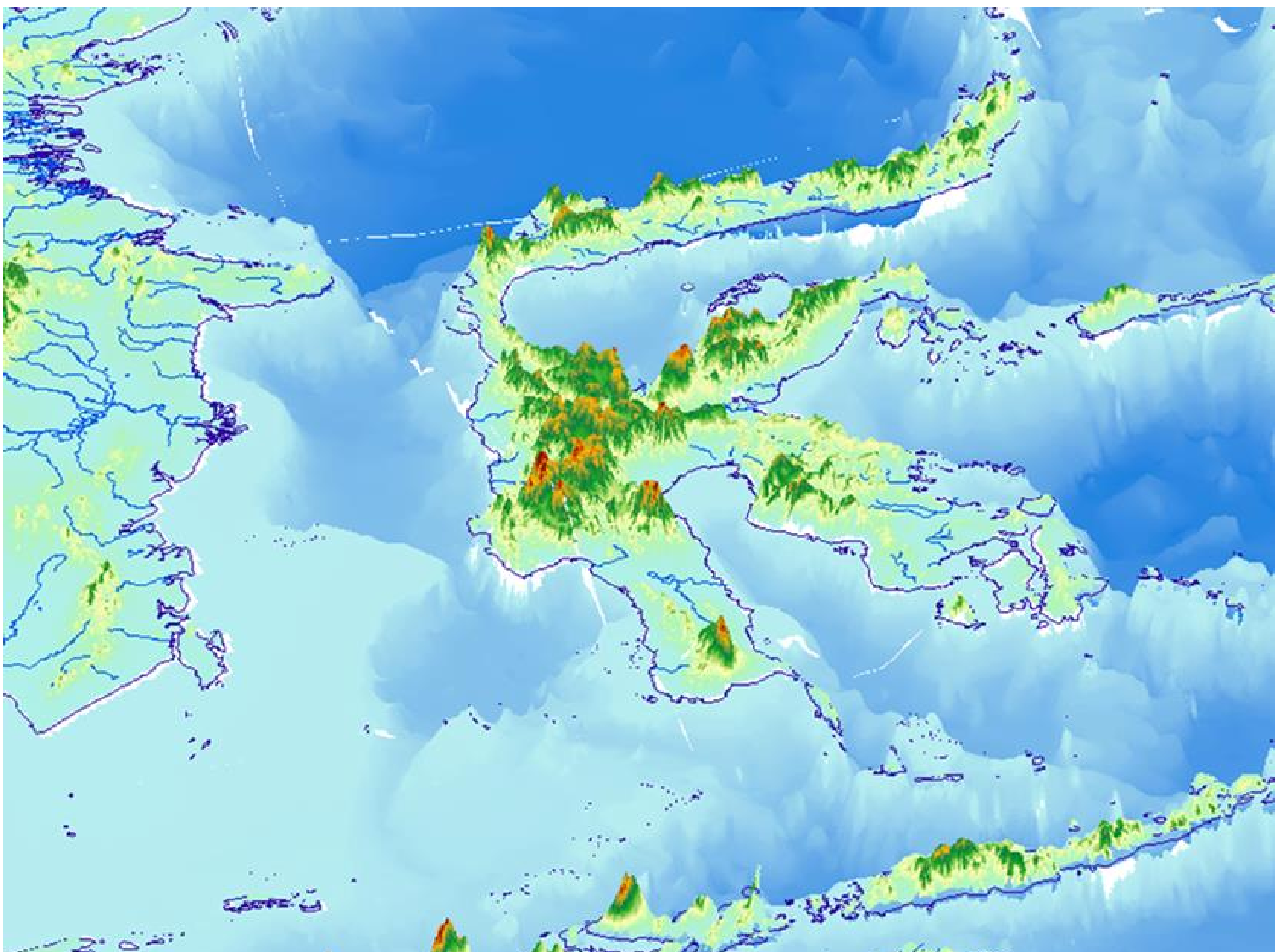
Bibliography of Indonesian Geology

BIBLIOGRAPHY OF THE GEOLOGY OF INDONESIA AND SURROUNDING AREAS

Edition 7.0, July 2018

J.T. VAN GORSEL

V. SULAWESI - BUTON



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This chapter V of Bibliography 7.0 contains 140 pages with 970 titles on the Sulawesi region, subdivided in two sub-chapters, Sulawesi and Buton.

For discussions and papers on surrounding areas see also:
- Makassar Straits: in Chapter IV (Borneo);
- Celebes Sea: in Chapter IXa (Circum-Indonesia/ Asia);
- Banggai-Sula islands: in Chapter VII (North Moluccas).

V.1. Sulawesi

Sub-chapter V.1 contains 893 papers on the geology of the Sulawesi region.

Today Sulawesi is a triple junction of three major tectonic plates, Eurasia to the west, Pacific to the NE and Australia- New Guinea- Indian Ocean to the South and East. Its peculiar K-shape reflects a Cretaceous-Recent history with multiple episodes of subduction, collision and dismemberment of the active margin by hyperextension.

Despite widespread volcanism on Sulawesi during most of Cenozoic time, there is little or no volcanic activity today (except Una Una volcano in Tomini Bay and volcanoes near Manado on the eastern tip of the North Arm, which are part of the Sangihe Arc).

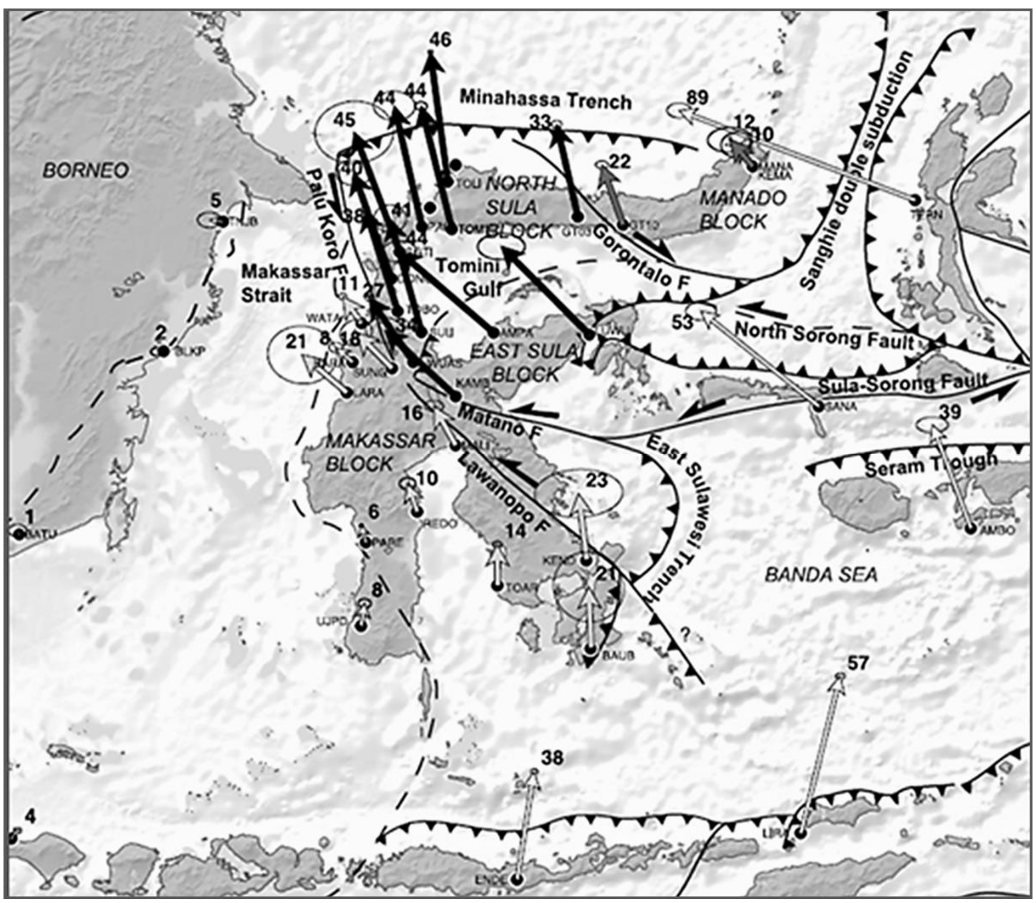

Figure V.1.1. Present-day GPS movements in the Sulawesi region, with arrows showing directions and rates of convergence (mm/year) relative to the Eurasian Plate (Borneo/Sundaland) (Socquet et al. 2006).

Active strike-slip tectonics and block rotations

After the Middle Miocene collision of the Bangai-Sula microcontinent with East Sulawesi, the present-day West-ward convergence of the Pacific Plate relative to the Eurasian Plate (Sundaland) is accommodated in Sulawesi by:

1. movements along major active sinistral strike-slip fault zones the NW-SE trending Palu Koro, Matano, Lawanopo major strike slip faults (causing clockwise rotation of 'Sula Block') (Magetsari et al. 1987, etc.) (Figure V.1.1);
2. multiple thrust belts: off the North Arm of Sulawesi, West Sulawesi (onshore and Makassar Straits) and offshore SE Sulawesi (see below).

The major left-lateral Palu-Koro Fault zone has been known for a long time (Katili 1969, 1970, Tjia 1978).

One significant effects of the ongoing strike-slip faulting is significant rotation of parts of Sulawesi relative to Sundaland: clockwise rotation of the North, NW and East Arms of 2.5-3.0°/ Myr, and counterclockwise rotation of SW Sulawesi and parts of the SE Arm by 1.5°/ Myr (Figure V.1.1; Socquet et al. 2006). The cumulative effect of these rotations, as estimated from paleomagnetic data, is 60° counterclockwise rotation of the SW arm of Sulawesi and 90° clockwise rotation of the North arm (e.g. Panjaitan and Mubroto, 1994).

The active Pacific- Eurasia convergence in the Sulawesi region created young fold-and-thrust belts/ accretionary prisms at:

1. the North side of the North Arm, between North Sulawesi and the Minahassa Trench, reflecting subduction of several 100's kilometers of Celebes Sea oceanic crust;
2. the Majene-Kalosi foldbelt at the west side of Sulawesi and its offshore continuation in East Makassar Straits basin, with age of thrusting and uplift latest Miocene and younger (see below and Figure V.1.11), with underthrusting (subduction?) of a large part of the North Makassar Straits basin floor below West Sulawesi (Pubellier et al. 2005);
3. the East Sulawesi/ Tolo trench/foldbelt East of SE Sulawesi.

Significant young uplift of various parts of Sulawesi is clear from various observations, including the outcrops of Late Miocene- Pliocene granites that formed at depths of ~4-12 km, and are now exposed at altitudes of 3000m (Maulana et al. 2016).

The 'arms' of Sulawesi represents three fundamentally different geologic provinces (Figure V.1.2):

1. The SW and NW arms represent a Cenozoic volcanic arc complex that was built on Lower Cretaceous accretionary-collisional basement terrane. This basement formed part of the SE Sunda/ East Borneo active margin prior to Middle- Late Eocene rifting of Makassar Strait. It outcrops at several metamorphic basement complexes (Palu, Bantimala, Barru, etc.);
2. The North arm is mainly a (composite?) intra-oceanic volcanic arc terrane, built on Eocene oceanic crust. At its western end it contains the Paleozoic? Malino metamorphic complex; its eastern end it merges with the active, N-S trending Sangihe volcanic arc;
3. Central Sulawesi (including the western parts of the SE Arm) contains widespread metamorphic rocks, signifying both mid-Cretaceous 'normal' regional metamorphism, locally overprinted by Late Oligocene High P- Low T 'blueschist-facies' metamorphism (Parkinson 1991);
4. East and SE Arms of Sulawesi are dominated by outcrops of the Late Mesozoic East Sulawesi Ophiolite, one of the world's largest ophiolite complexes, which 'obducted' onto the Central Sulawesi metamorphic belt (around Oligocene time?).
5. At the East side of Sulawesi is the Banggai-Sula block, clearly derived from New Guinea, and collided with East Sulwesi in Late Miocene- Early Pliocene time. A Buton- Tukang Besi block at the SEside of Sulawesi is often proposed as a microcontinental block similar to Banggai-Sula, bit its history and origin are less obvious.

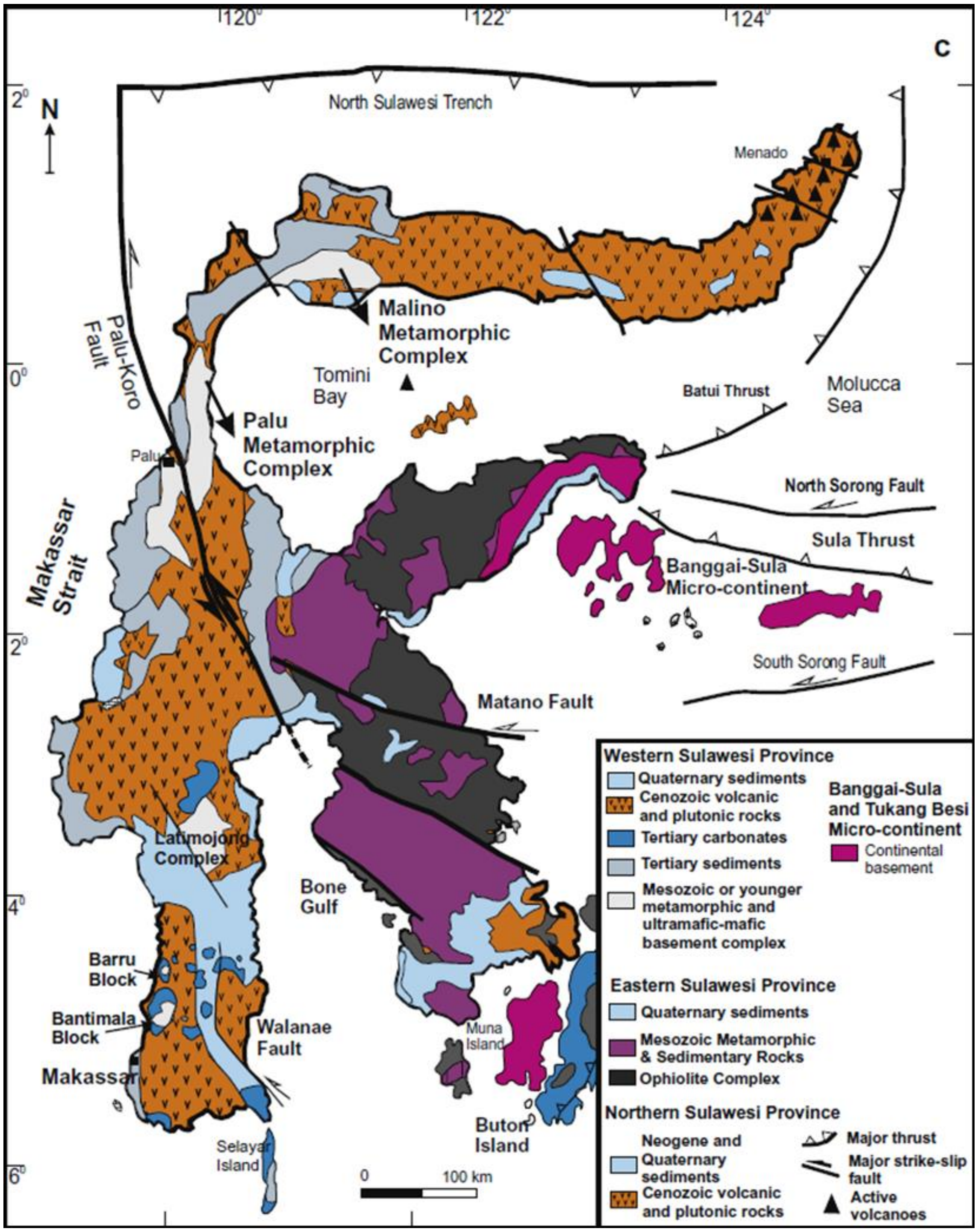

Figure V.1.2. Regional geologic map of Sulawesi Island (Maulana et al. 2016).

Sulawesi North Arm

The North arm of Sulawesi is a volcanic arc terrane built on oceanic crust (Kavalieris et al. 1992, Van Leeuwen and Muhardjo 2005). It is probably a composite of Paleogene and Neogene volcanic arc complexes:

1. Young arc volcanism is from active, South-dipping subduction of Eocene-age oceanic crust of the Celebes Sea, which has subducted to depths up to >400 km (tomography). Most radiometric ages are between 10- 4 Ma;
2. The oldest rocks are Middle-Late Eocene Labunaki basalts and Middle Eocene- Oligocene deep water Papayato island arc volcanics (Van Leeuwen 2011), possibly tied to (present-day) North-dipping subduction?

At its western end it contains the Paleozoic? Malino metamorphic complex (exhumed in Miocene and later time; Van Leeuwen et al. 2007, Advokaat et al. 2017).

SW - West Sulawesi

SW and West Sulawesi outcrops contain volcanic and plutonic rocks of successive Cenozoic magmatic arcs, built on pre-Late Cretaceous accretionary complexes of metamorphic- ophiolitic rocks. These basement terranes may be a continuation of the Cretaceous accretionary complexes of the Meratus in SE Kalimantan and Luk-Ulo in Central Java, etc. (Wakita et al. 1996).

In several areas mid-Cretaceous accretionary basement complexes are overlain by locally thick (>2000m) Late Cretaceous 'flysch' of the Latimojong/ Balangbaru Formations. Current directions from the West and presence of the 'Tethyan' mid-Cretaceous larger foram *Orbitolina* suggest a Sundaland source, while common andesitic detritus suggests a forearc setting (Sukamto 1986, Hasan 1991, Hasibuan and Limbong 2009).

Cretaceous flysch is overlain unconformably by less-deformed clastics in Middle Eocene and younger rift basins. Early rift sediments contain coal beds that were surveyed in detail in the early 1900's, but were never deemed commercial. These are overlain by widespread Late Eocene- Middle Miocene post-rift platform carbonates (Tonasa Limestone; Wilson 1996 and others), and capped by thick Miocene and younger Camba Fm volcanics.

There is relatively little or no present-day volcanic activity in the western half of Sulawesi, but volcanic- plutonic activity was widespread here through much of the Tertiary. Multiple periods of arc volcanism and granitoid intrusions were identified between Late Cretaceous to Pliocene, presumably above West-dipping subduction zones (see papers by Priadi, Polve, Elburg, Soeria-Atmadja, Van Leeuwen, etc.). The main peaks of activity reportedly are (Priadi et al. 1994, Elburg et al. 2002, 2003):
- Late Cretaceous (common arc volcanic detritus in Balangbaru Fm flysch)
- Middle Eocene- Early Oligocene (~50-30 Ma; arc volcanics and/or back-arc basin basalts)
- Middle-Late Miocene (mainly 10-12 Ma; high-K volcanics;)
- Late Miocene- Pliocene (~7-2 Ma; felsic calk-alkaline).

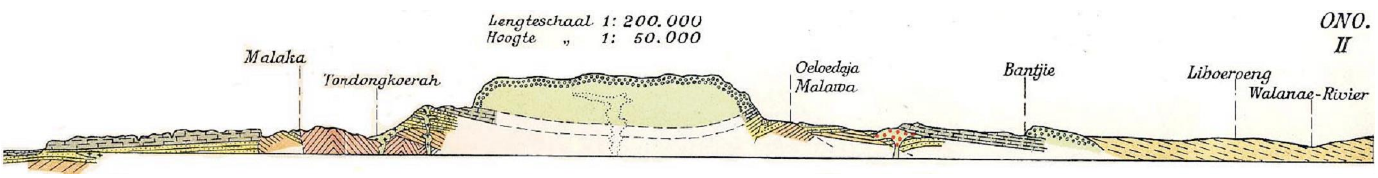

Figure V.1.3. Historic W-E cross-section through SW Sulawesi, showing folded Cretaceous sediments, overlain by Eocene clastics with coal and Late Eocene Nummulites limestone, capped by volcanics ('T Hoen and Ziegler, 1915)

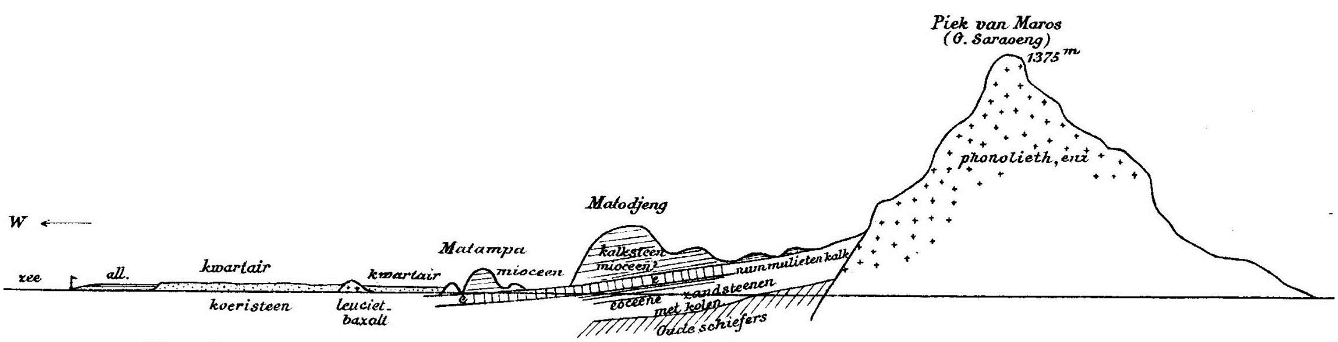

Fig. 45. Schematische doorsnede door de vlakte Makasser - Maros - Pangkadjéne en het aangrenzend gebergte, van W. naar O.

Figure V.1.4. Historic W-E cross-section through SW Sulawesi, showing rel. thick Eocene sandstones with coal on 'Old slates', grading upward into limestone and intruded by large, young Maros granitoid (Verbeek, 1908).

West Sulawesi Cretaceous metamorphic complexes

Basement of West Sulawesi outcrops in a number of Early Cretaceous metamorphic complexes. They are associated with ultramafic rocks and probably represent Early Cretaceous subduction complexes that supposedly became inactive after an Aptian collision with a Gondwanan continental microfragment (Wakita et al. 1996, Parkinson 1998).

From South to North they include Bantimala, Barru, Latimojong, Karossa and Palu. Many of these have well-documented ~mid-Cretaceous (~Aptian) radiometric ages (Wakita et al 1994, 2000) (Palu may be younger?).

The Bantimala Complex contains ENE-dipping thrust slices with high-P glaucophane schists and eclogites with K-Ar ages of 113-132 Ma and with ultramafic rocks in the NE. The complex is overlain by Late Albian- early Cenomanian (~100 Ma) radiolarian cherts (Haile 1974, Wakita et al. 1994, 1996, 2000, Maulana et al. 2008, 2013, 2015), followed by Turonian- Maastrichtian Balangbaru Formation flysch (Hasan 1991).

Munasri (2013) reported older (Valanginian-Barremian) radiolaria from manganese carbonate nodules in dark reddish shale of the Barru melange complex.

The Latimojong complex, viewed as an accretionary complex of metamorphic rocks tectonically mixed with cherts and ophiolitic rocks, contains cherts with Aptian-Albian radiolaria (White et al. 2017).

West and North Sulawesi Neogene granitoids

Widespread young granitoids are known from the West and NW arms of Sulawesi (Figure V.1.5).

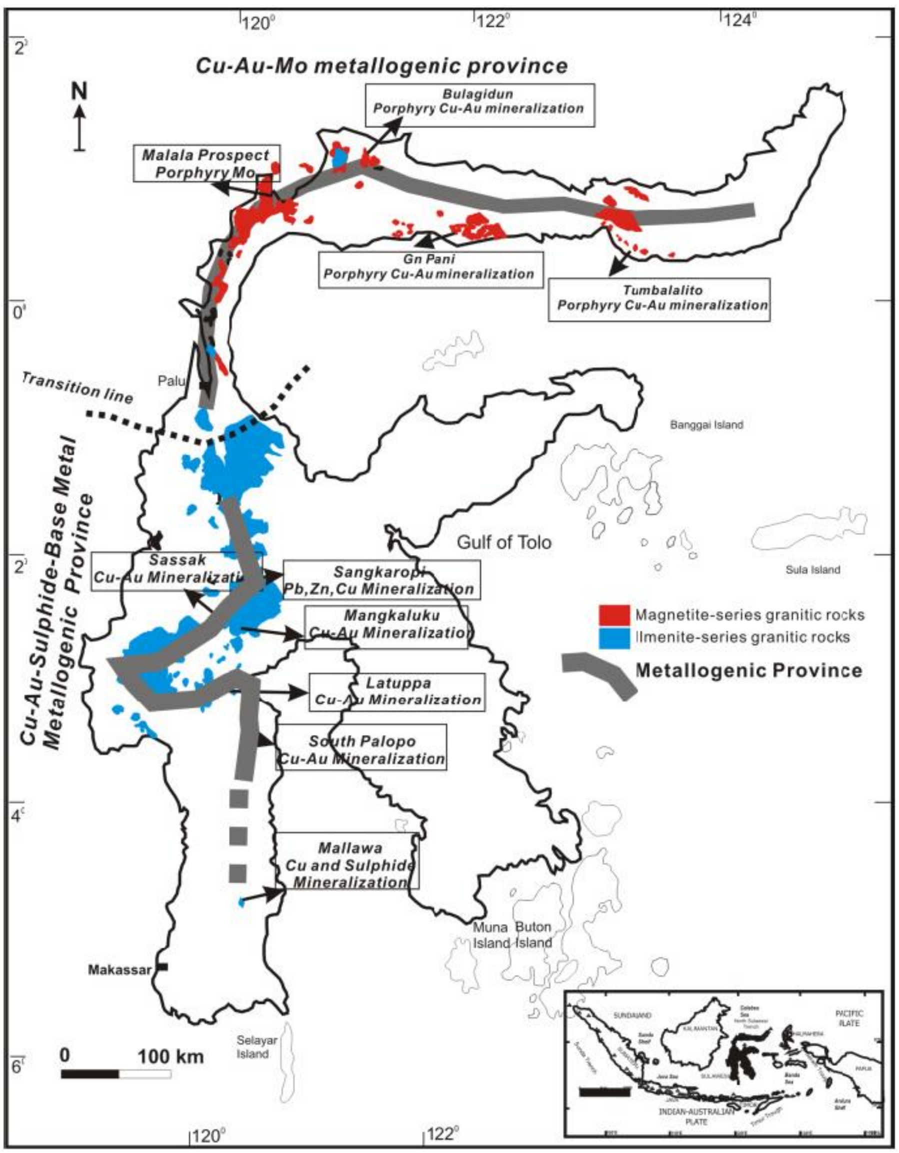

Figure V.1.5. Two groups of Cenozoic granitic rocks, with associated mineral deposits (Maulana et al. 2013). In W Sulawesi mainly Ilmenite I-type granitoids, in North Magnetite-series granitoids.

Central Sulawesi Metamorphic Belt- Neogene metamorphic complexes

The areas of Central Sulawesi and the western part of the SE Arm of Sulawesi are home to outcrops of large metamorphic complexes (Pompangeo and Tokorondo Mountains around Lake Poso, also the Malino Metamorphic Complex in the west part of North arm?). They are probably mainly Paleozoic? metasediments from a continental margin setting.

Detailed petrographic studies by Egeler (1947, 1949) and De Roever (1947, 1950) recognized at least two phases of metamorphism, an older high-grade epidote-amphibolite regional metamorphism, overprinted by younger metamorphic events: (1) in West contact metamorphism around granitoid intrusives, and (2) in East high-P blueschist metamorphism.

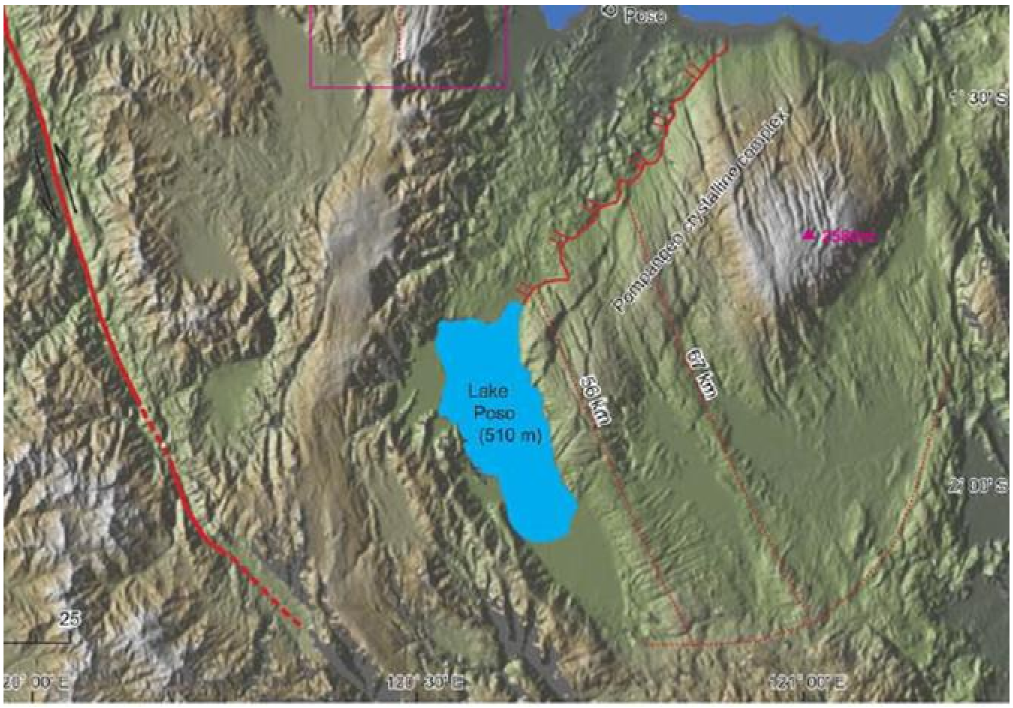

Figure V.1.6. Pompangeo massif, NE of Lake Poso, Central Sulawesi. Interpreted as domed metamorphic core complex, with corrugated surface of NNW-SSE-trending grooves, representing the direction of displacement on the overlying low-angle normal detachment fault plane (Spencer 2010).

Parts of the Central Sulawesi metamorphic complexes are large domes with characteristic corrugated surface with large grooves, interpreted to represent large low-angle extensional detachment faults on top of a metamorphic core complex, exhumed during a period of hyperextension (Figure V.1.6; Spencer 2011). The core complexes probably represent exhumed lower continental crust

East Sulawesi Ophiolite

East Sulawesi is characterized by one of the world's largest ophiolite complexes (Figure V.1.7). A composite section suggests an >15 km thick, relatively complete ophiolite sequence from mantle peridotite at the base to oceanic crust gabbros, overlain by a sheeted dike complex and pillow basalts at the surface. However, in much of East Sulawesi it appears to be a relatively thin and incomplete, but widespread sheet that covers a continental terrane (Surono and Sukarna 1995).

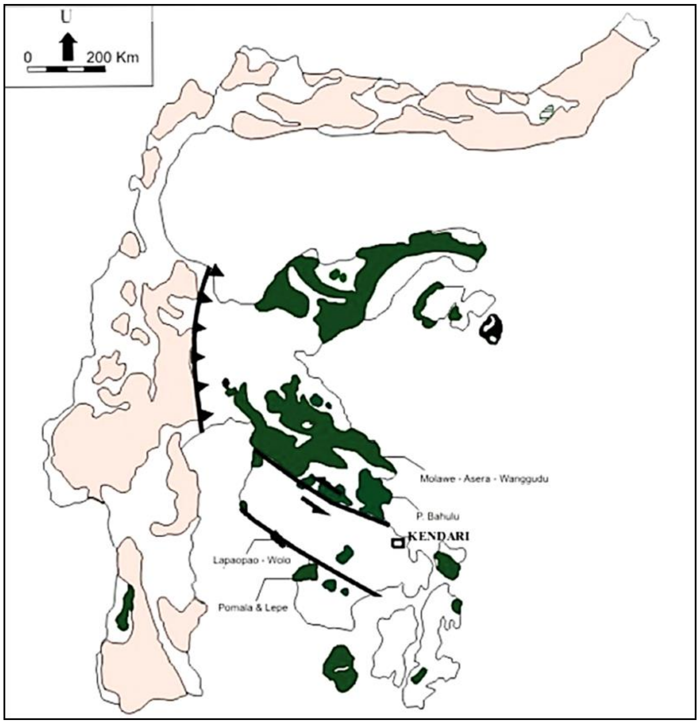

Figure V.1.7. Sulawesi Island, with widespread ophiolites in the East and SE arms (dark green), widespread volcanics in the SW and North Arms (pink) (Dirk 2010).

East Sulawesi ophiolites have yielded Cretaceous- Paleogene radiometric ages (e.g. Kadarusman et al. 2004), but they are overlain by (Upper) Cretaceous pelagic calcilutite of the Matano Formation with radiolaria and *Globotruncana* pelagic foraminifera (Koolhoven 1932, Simandjuntak 1993, 1994). The post-Cretaceous radiometric ages therefore can not reflect the original crystallization age of East Sulawesi ophiolitic mantle rocks.

Geochemistry of the ophiolite rocks were interpreted as suggesting an origin as an Asian marginal oceanic basin (Monnier et al. 1995). Kadarusman et al. (2002, 2004) argued for an origin from a SW Pacific Ocean, mantle plume-influenced setting.

The ophiolite complex is a relatively flat-lying slab that appears to be thrusted over a high-pressure metamorphic sole (Pompangeo glaucophane schist) in the western parts of the East and SE Arms. In the Kolonodale area of the eastern part East Sulawesi it overlies imbricated Late Triassic- Paleogene marine passive margin sediments, without much thermal alteration, which may reflect younger (~Middle Miocene) underthrusting by the colliding southern part of the Banggai-Sula block.

A more or less complete ophiolite sequence can be seen in the East Arm of Sulawesi, with progressively higher units exposed in easterly direction (Figure V.1.8).

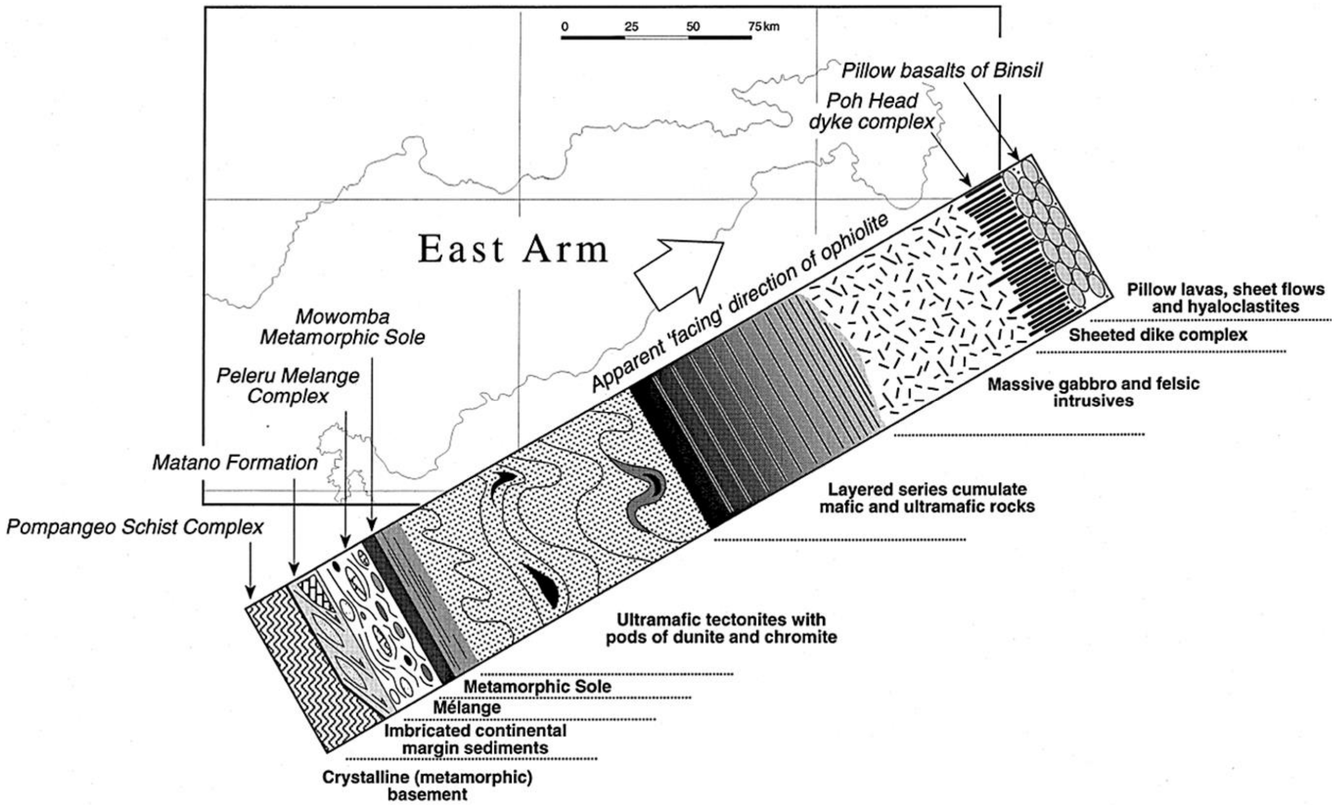

Figure V.1.8. Sequence of lithologies in idealized ophiolite sequence (upper mantle + oceanic crust). In the East Arm of Sulawesi the lowest parts of the ophiolites are exposed in the West, the highest parts in the East, probably reflecting gentle easterly dip of the ophiolite sheet (Parkinson 1998).

Age of East Sulawesi ophiolite uplift

The age of ophiolite obduction onto the East Sulawesi margin is generally believed to be around Late Oligocene time (cooling age of 'East Pompangeo' metamorphic sole ~26-30 Ma; Helmers et al. 1990, Parkinson 1998, Surono 2012).

Further evidence that the East Sulawesi ophiolite complex was uplifted and being eroded by earliest Miocene time was provided conglomeratic limestones from NE part of the SE arm (Bahumpombini/ Bungku area), with larger foraminifera of Early Miocene zone Te5 (*Miogypsina, Spiroclypeus, Lepidocyclina (Eulepidina)*), but also with reworked clasts of Upper Cretaceous *Globobotruncana* pelagic limestone, radiolarian chert and serpentine (Van der Vlerk and Dozy,1934).

Ophiolitic detritus is also very common in the 'Sulawesi Molasse" of Middle(?) Miocene and younger ages in East Sulawesi and Buton.

The ophiolite terrane in the East Arm of Sulawesi has undergone very recent uplift, as demonstrated by uplifted Late Quaternary coral reef terraces to elevation of 410m in the last ~230,000 years (Sumususastro et al. 1989, Fig. V.1.8.)

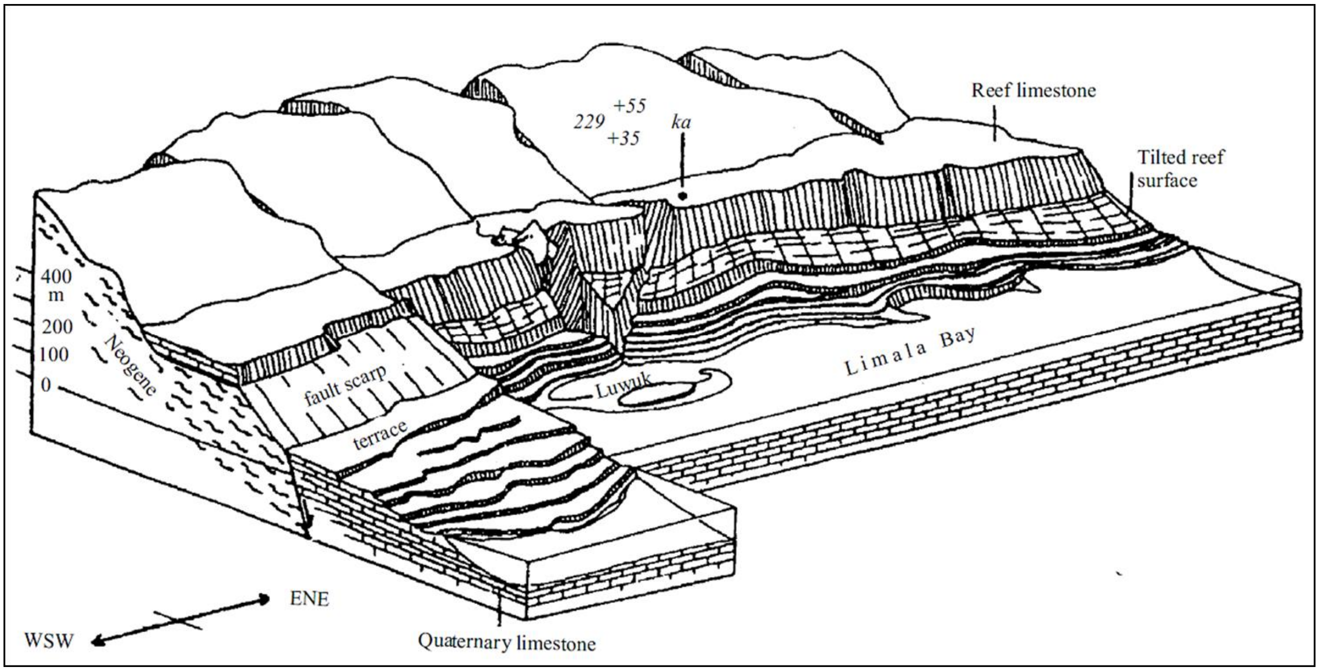

Figure V.1.8. Uplifted Late Quaternary reef terraces at Luwuk, South coast of East Arm of Sulawesi (Sumususastro et al. 1989).

Banggai-Sula Block collision with East Arm of Sulawesi

The Middle Miocene- Pliocene Tomori Basin, at the south side of the East arm of Sulawesi is a classic foreland basin, which formed by thrust loading during the collision between the underthusted continental Banggai-Sula microplate in the south and the overthrusted ophiolite/ arc system of the East arm (Figures V.1.9, V.1.10).

A backstepping Middle-Late Miocene carbonate platform developed in the Tomori basin, on the downgoing plate, which contains several buildups with oil- gas fields (Senoro, Matindok; Luthfi et al. 2002, Hasanusi et al. 2004, etc.) (Figure V.1.9).

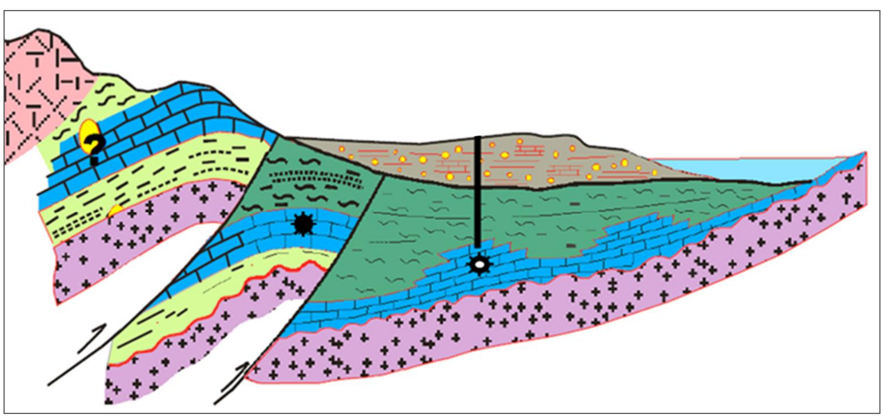

Figure V.1.9. NW-SE cross-section of Late Miocene- Early Pliocene foreland basin of Tomori Basin, East Sulawesi, formed by collision of the downgoing Banggai-Sula continental block and the overriding East Arm of Sulawesi (Luthfi et al. 2002).

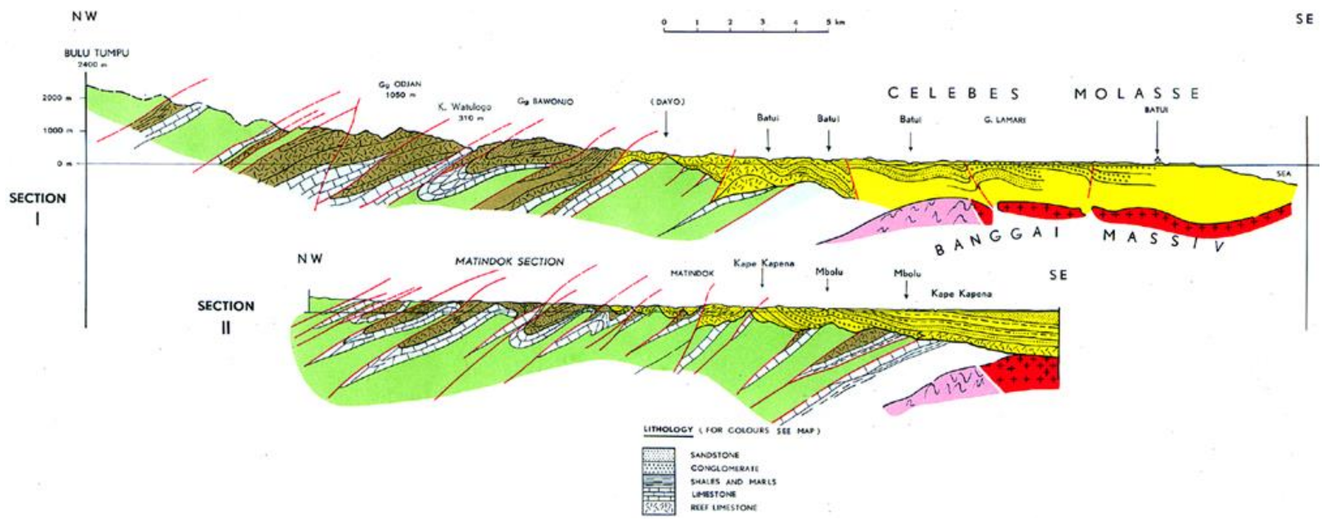

Figure V.1.10. NW-SE sections across southern part of the East Arm of Sulawesi, showing up to 2 km thick, post-orogenic 'Sulawesi Molasse' (yellow), unconformably over imbricated-to-SE collision zone with Banggai-Sula terrane. Green = ophiolite (Kundig 1956).

West Sulawesi foldbelt

A significant feature of West Sulawesi is the Majene- Kalosi foldbelt and its offshore continuation in East Makassar Straits basin (Figures V.1.11, V.1.12, V.1.13). Age of thrusting and uplift is probably latest Miocene (5-10 Ma; Coffield et al. 1993, Fraser et al. 1993, Bergman et al. 1996) or mid- Pliocene (Calvert and Hall 2007), and may or may not be be related to the collision of the Banggai-Sula terrane at the Eastern margin of Sulawesi.

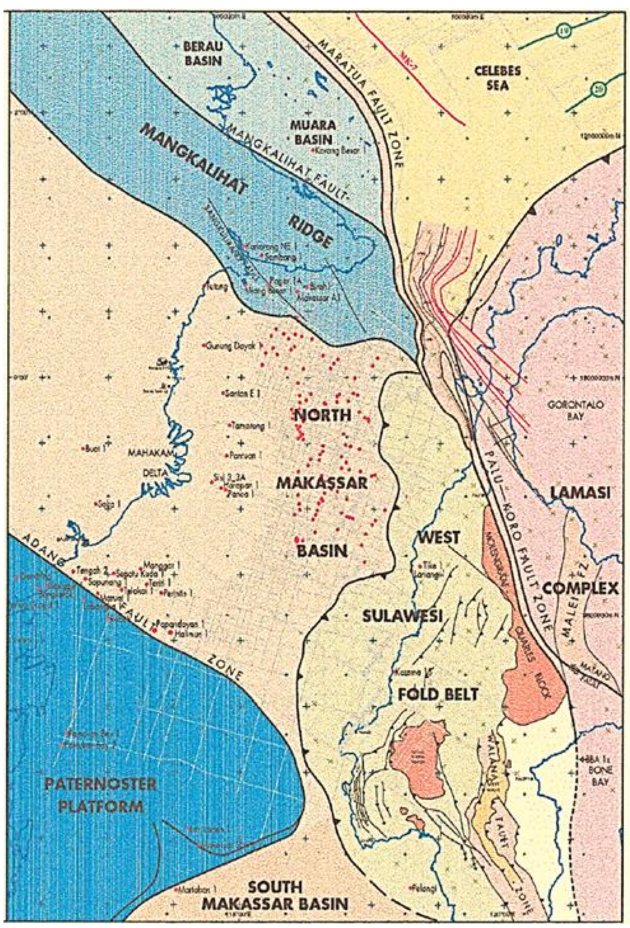

Figure V.1.11. West Sulawesi foldbelt: WNW-directed thrusting (Fraser et al. 1993).

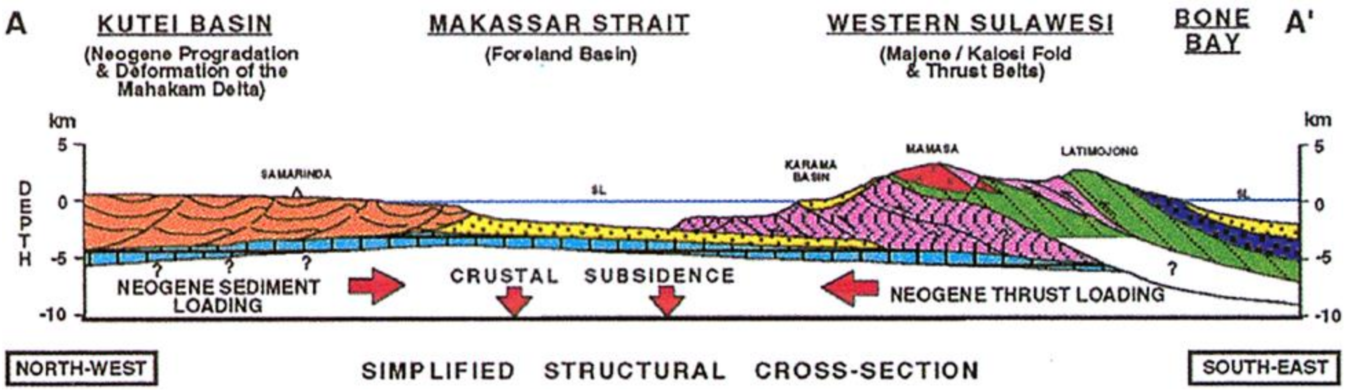

Figure V.1.12. West Sulawesi shown here as a >150 km wide belt of Late Neogene WNW-directed thrusting (onshore Majene-Kalosi foldbelt with offshore continuation along the east margin of North Makassar Straits (Bergman et al. 1996).

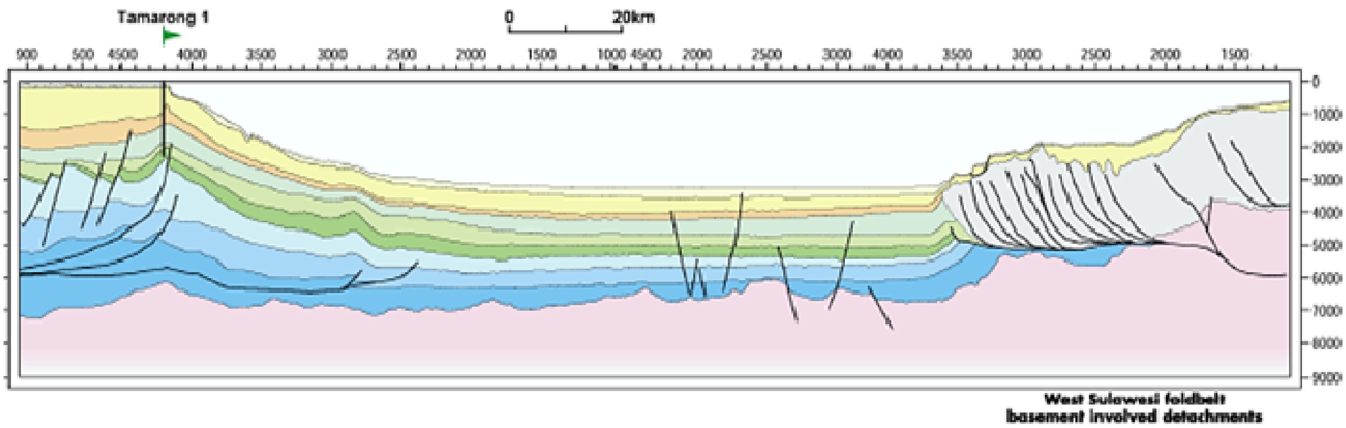

Figure V.1.13. Cross-section across North Makassar Strait basin, with on right side the frontal thrusts of the West Sulawesi foldbelt (Fraser et al. 1993, 2003)

The thrust system continues offshore into Makassar Straits (Figure V.1.13), where much of the North Makassar Straits basin floor was obviously underthrusted below West Sulawesi (e.g. Pubellier et al. 2005).

Brief tectonic evolution of Sulawesi

Milsom et al. (2000) noted that the tectonostratigraphic successions of East Sulawesi, Buton, Buru, Seram and the Banda Terrane' of Timor were remarkably similar, suggesting these were all part of one or several related microcontinents that had separated from the NW Australian margin in Latest Triassic- Early Jurassic time and collided with the Eurasian margin/ West Sulawesi to form the Sulawesi orogen in Oligocene time. Subsequent studies by French authors supported similar scenarios (Villeneuve et al. 2002).

In very broad terms the Cenozoic geodynamic evolution of Sulawesi may be described as (e.g. Villeneuve et al. 2001, 2002 and many others):

1. Early Cretaceous subduction and accretion along the eastern Sundaland margin, forming the future basement of West Sulawesi (although thrust slices in Bantimala complex are NE/E- dipping, indicating East-dipping subduction?)
2. An ~Aptian-age collision event with ophiolite obduction terminates subduction; this is probably followed by renewed subduction in Late Cretaceous and possibly Early Paleogene (still along the Sundaland margin).
3. Middle Eocene onset of rifting of Makassar Straits, separating West Sulawesi from the Sundaland margin;
4. Late Oligocene collision of a 'Gondwanan' microcontinental block with the Asian volcanic arc of West Sulawesi, presumably closing a West-dipping subduction system. This block has been called 'Banda Block' or Kolonodale Block' by French workers. It outcrops in the East and SE arms of Sulawesi and its Triassic-

Paleogene marine stratigraphic succession is very similar to that of Buru-Seram, the Sinta Ridge and parts of Timor, with which they were probably united before the opening of the Banda Seas.

4a. The Kolonodale block was overridden by the large East Sulawesi ophiolite, whose origin (marginal basin or Pacific Ocean), and timing (Early Oligocene?) and place of obduction are still debated;

5. Late Miocene collision ('underthrusting') of Banggai-Sula continental block, another Gondwanan block rifted from the New Guinea (Birds Head?) region (Figure V.1.9). In East Sulawesi this led to major uplift of the East Sulawesi ophiolite complex, and onset of deposition of ?Late Miocene- Pliocene 'Celebes Molasse', which contains erosional products of the ophiolite. In West Sulawesi a significant WNW directed fold-thrust belt system formed, starting in latest Miocene;

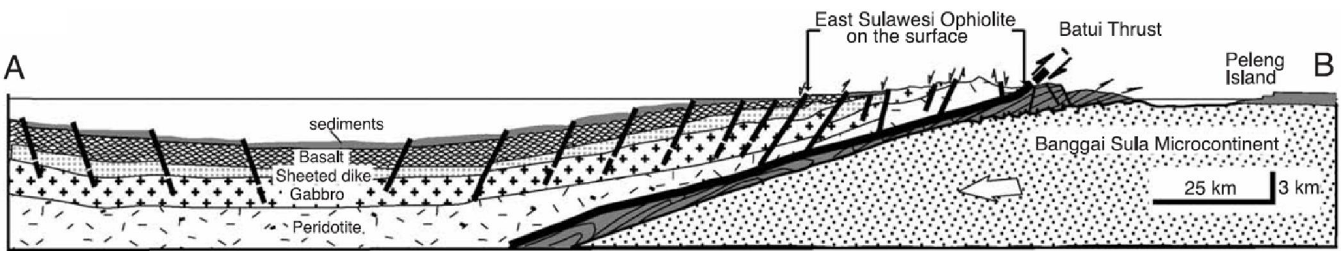

Figure V.1.7. NW-SE cross-section showing Banggai-Sula microcontinent thrust under East Sulawesi Ophiolite (Kadarusman et al. 2004).

6. Fragmentation of the East Sulawesi orogenic belt by Late Miocene and younger post-orogenic extension: (1) rifting in the Bone and Gorontalo/ Tomini Basins, separating West and Borth Sulawesi from East and SE Sulawesi, and (2) margin breakup by rifting/ spreading of the young oceanic North and South Banda Sea basins, which removed multiple Sulawesi margin terranes like Sumba, the Banda Terrane of Timor, Buru-Seram, etc. (e.g. Figure V.1.8.; Milsom et al. 2000, 2001). This was probably driven by slab rollback of the subducting Indian Ocean Plate (Spakman and Hall 2010, Pownall et al. 2016).

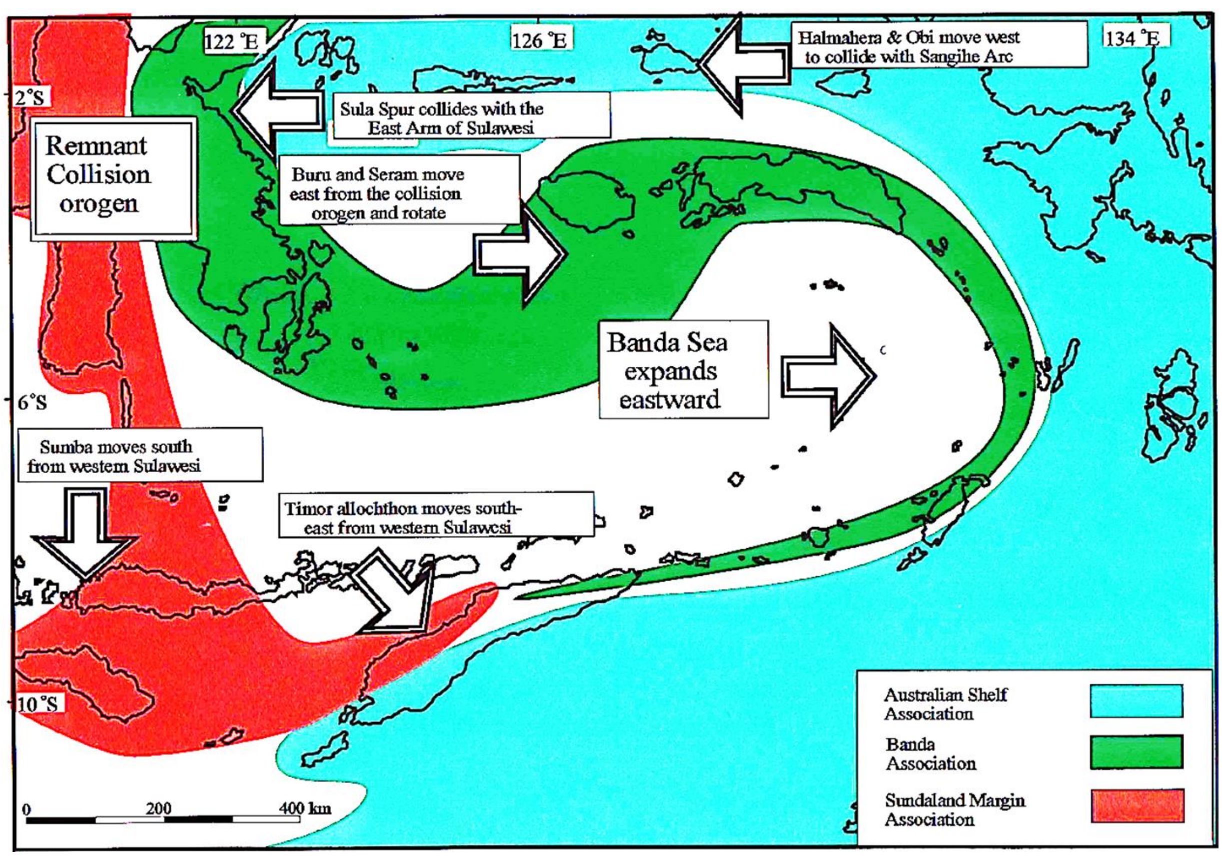

Figure V.1.8. Disperrsal of terranes from the East and SE Sulawesi collisional belt during Late Miocene- Early Pliocene Banda Sea opening (Sumba, Timor allochthon, Buru-Seram, etc.; Milsom et al. 2000).

7. Present-day strike-slip faulting and block rotations/ strike-slip faulting, due to continued convergence between the Eurasian and Pacific plates Figure V.1.1).

Some suggested reading- Sulawesi *(not a complete listing of all relevant papers)*

General, Tectonics	*Abendanon 1916, Audley-Charles 1974, Sukamto 1978, Van Leeuwen 1981, Panjaitan & Mubroto 1993, Magetsari et al. 1987, Coffield et al. 1993, Fraser et al. 1993, Bergman et al. 1996, Parkinson 1998, Villeneuve et al. 2000, 2002, Van Leeuwen and Muhardjo 2005, Van Leeuwen et al. 2007, 2010, Surono 2012, Surono & Hartono 2013, Advokaat et al. 2017*
Active faulting, plate motions	*Tjia 1973, Magetsari 1984, Walpersdorf et al. 1998abc, Stevens et al. 1998, Vigny et al. 2002, Bellier et al. 2001, 2006, Socquet et al. 2006, Watkinson 2010, Watkinson and Hall 2011, Natawidjaja, and Daryono 2015, Sarsito et al. 2017*
C Sulawesi metamorphics (Pompangeo, Malino, etc.)	*De Roever 1947, 1950, 1953, 1956, Egeler 1947, 1949, Helmers 1991, Parkinson 1998, Kadarusman & Parkinson 2000, Van Leeuwen et al. 2007, 2016, Permana 2013*
SW Sulawesi mid-Cretaceous metamorphic-accretionary complexes	*Zulkarnain et al. 1993, 1995, 1999, Miyazaki et al. 1996, Wakita et al 1996, Parkinson et al. 1998, Soesilo & Sopaheluwakan 1998, Syafri 2004, Maulana et al. 2010, 2013, Setiawan et al. 2013, 2016, Jaya et al. 2015, 2017, Hennig et al. 2017, White et al. 2017.*
West Sulawesi volcanics, granites	*Coffield et al. 1993, Priadi et al. 1994, Bergman et al. 1996, Polve et al. 1997, 2001, Elburg and Foden 1998, 1999, Soeria-Atmadja et al. 1999, Elburg et al. 2002, 2003, Priadi 2013, Maulana 2013, Maulana et al. 2016, Shaban et al. 2016,*
SW Sulawesi stratigraphy:	*Hasan 1991, Wilson and Bosence 1996, Wilson et al. 2000, Van Leeuwen et al. 1981, 2005, 2010, Calvert 2000, Calvert and Hall 2003, 2007*
Cenozoic paleogeography	*Nugraha 2016, Nugraha and Hall 2018*
East Sulawesi/ ophiolites:	*Koolhoven 1930, 1932, Kundig 1956, Monnier et al. 1994, 1995, Surono and Sukarna 1995 Surono 2012, Kadarusman et al. 2004, Dirk 2010, Permana and Surono 2013, Irzon and Baharuddin 2016*
East/ SE Sulawesi Mesozoic:	*Cornee et al. 1994, 1995, 1999, Martini et al. 1997, Milsom et al. 2000, Surono 1994, 1996, Surono and Bachri 2002*
North Sulawesi volcanic arc:	*Koperberg 1929, Carlile et al. 1990, Bellon and Rangin 1991, Kavalieris et al. 1992, Van Leeuwen et al. 1994, Van Leeuwen and Muhardjo 2005.*
Sulawesi Mineral deposits:	*Van Leeuwen and Pieters 2011, 2013, Robinson et al. 2013, Hakim et al. 2018.*

V.2. Buton, Tukang Besi Islands

Sub-chapter V.2 contains 76 papers on the geology of the Buton and Tukang Besi islands.

Buton and the adjacent Tukang-Besi islands are located SE of the SE arm of Sulawesi and are frequently viewed as one or even two small microcontinental plates that collided with SE Sulawesi in Miocene time. However, Buton and SE Sulawesi have a similar imbricated Late Triassic- Paleogene complex that is overlain by remnants of an obducted ophiolite sheet, and it seems more reasonable to view the geology of Buton as a continuation of SE Sulawesi (Kolonodale Block of Villeneuve et al. 2010; see also papers by Cornee, Martini, Surono, etc.).

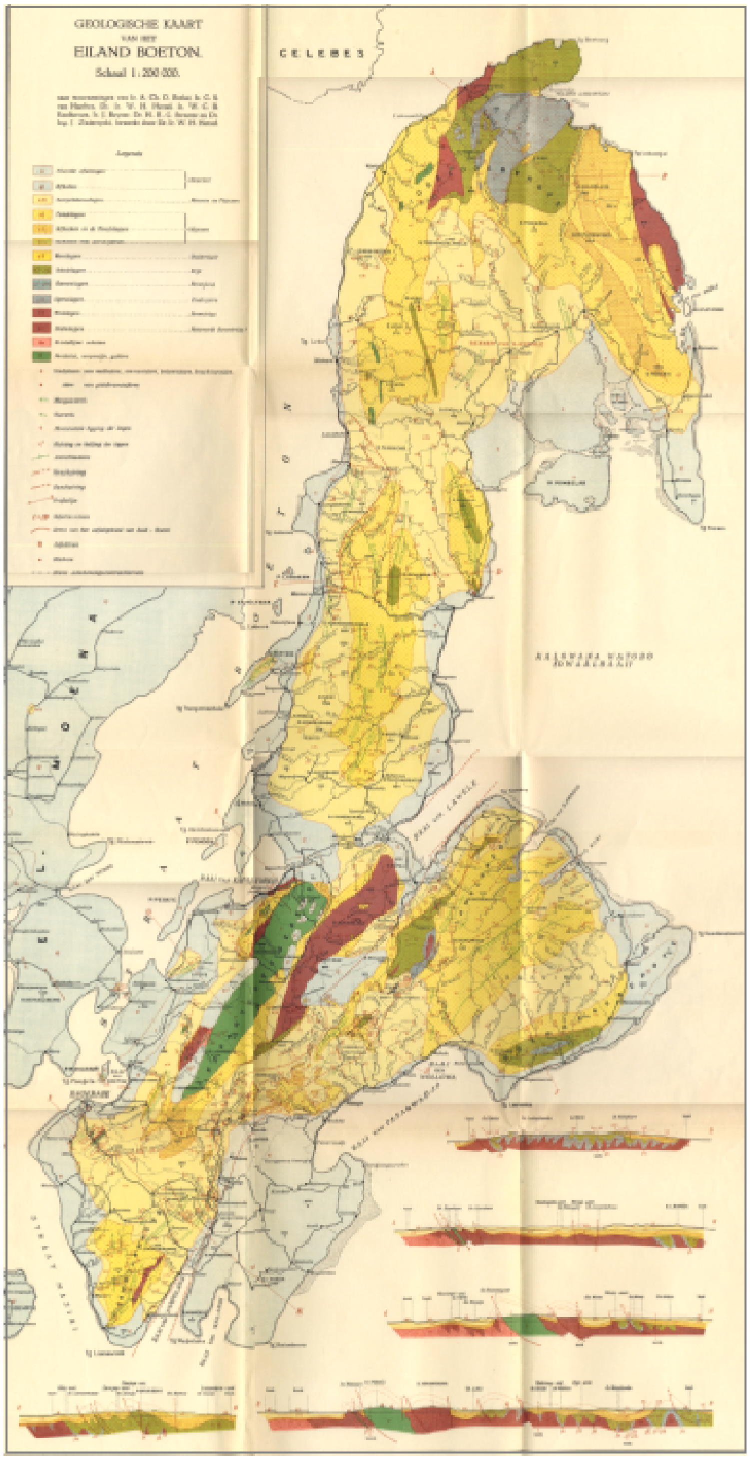

Figure V.2.1. Vintage geologic map of Buton (Hetzel, 1936).

Besides SE Sulawesi, there are also numerous similarities between the tectonostratigraphy of Buton and those of Timor, Seram and Buru ('Banda Association of Milsom et al. 2001). suggesting these may all have been part of a larger plate with similar history with:
- Late Triassic rifting,
- Late Triassic or Early Jurasic breakup (presumably from North Gondwana)
- Jurassic- Middle Eocene drift in an oceanic environment,
- collision with West Sulawesi or the East Sulawesi ophiolite around Oligocene time (Villeneuve et al. 2013)
- partial breakup and dispersal during Late Miocene Banda Sea opening.

Like SE Sulawesi, ophiolitic rocks are present on Buton, but these have no deep roots, and are believed to be relatively thin, isolated overthrust sheets that do not mark any terrane suture (Milsom et al. 1999). Ophiolites and associated metamorphic are imbricated with Triassic and younger pelagic sediments, or overlie them.

The main folding event in Buton is probably around Oligocene time, as also suggested by Villeneuve et al. (2013), based on:
- the youngest folded deep marine deposits are of Middle Eocene age (with planktonic foram *Hantkenina*, and early Middle Eocene radiolaria (Ling and Smith 1995);
- conglomeratic Late Eocene- Oligocene 'Wani Beds' are folded with the underlying Late Triassic- Eocene pelagic limestones (Hetzel 1936) (see also below);
- the oldest post-deformational deposits are the relatively little-deformed basal Tondo Formation conglomerates. A latest Oligocene or earliest Miocene age is shown by larger foraminifera *Spiroclypeus* and *Miogypsinoides* (Hetzel 1936) (not Middle Miocene as suggested by Wiryosujono and Hainim, 1978). The post-deformational earliest Miocene Tondo Fm basal conglomerates contain ophiolitic clasts, and thus post-date ophiolite uplift.

The cross-section of Figure V.2.2. illustrates the deformational style of Buton, and brackets the age of main folding between Middle Eocene and earliest Miocene: intensely folded Late Triassic- Middle Eocene marine pelagic sediments, unconformably overlain by relatively little deformed (latest Oligocene?-) Miocene and younger marine sediments.

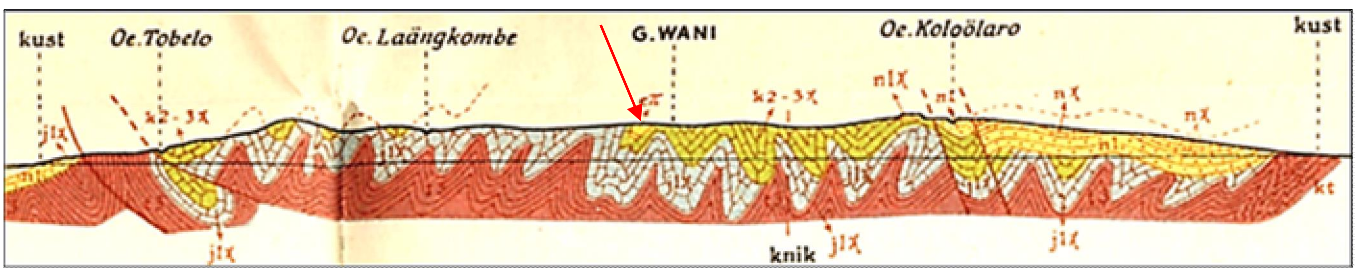

Figure V.2.2. W-E cross-section through Tobelo Mts of North Buton, showing west-dipping, isoclinally folded, Late Triassic-Eocene series, unconformably overlain by Miocene- Pliocene Tondo Fm clastics (light red: Triassic Winto clastics and carbonates; blue-grey Jurassic; Ogena and Rumu Fms; light green: Cretaceous-Middle Eocene pelagic carbonates of Tobelo Fm; yellow: Miocene- younger Tondo Fm marls and clastics). Red arrow points to Eocene Wani Beds (Hetzel, 1936).

'Wani Beds' of Hetzel (1936)

The Late Eocene Wani Beds on Buton (Hetzel 1936; red arrow on Fig. V.2.2) are sandstones and polymict conglomerates that are only known from a few small outcrops in the Tobelo Mountains of North Buton, but they appear to be contain critical information on the Paleogene deformational history of Buton. If the observations below (from Hetzel) are correct they signify a Late Eocene uplift/ erosion event that terminated >170 million years of pelagic sedimentation on the Buton terrane, but underwent a second intense folding episode in the Oligocene:
1. they contain a shallow marine Late Eocene larger foraminifera assemblage (Tb; *Nummulites, Asterocyclina, Lepidocyclina boetonensis, Biplanispira*; identified by Van der Vlerk in 1928 and later also by Tan Sin Hok 1936, 1937);
2. they contain reworked clasts of Upper Cretaceous *Globotruncana* limestone and serpentinite, suggesting uplift and erosion of older pelagic sediments and ophiolites;.
3. the Wani Beds also appear to tightly folded with the Mesozoic beds, and therefore appear to predede the main fold-thrust event of Buton (as marked by the unconformity at the base of the post-folding Tondo Beds,

which have basal conglomerates and limestone with *Spiroclypeus* and *Miogypsinoides* (Hetzel 1936), demonstrating a latest Oligocene- earliest Miocene (Te4?) age for the oldest post-collisional beds.

Late Miocene subsidence and Plio-Pleistocene uplift uplift

Miocene and younger deformation on Buton is mainly extensional (Milsom et al. 1999). Fortuin et al. (1990) recorded rapid Late Miocene- Early Pliocene subsidence (bathyal Sampolakosa Fm marls; reflecting Banda Sea extension?), followed by onset of uplift in Late Pliocene (3.5 Ma).

The ongoing young uplift of Buton is demonstrated by multiple uplifted Quaternary reefal limestones up to 700m elevation (e.g. Verbeek 1908, Verstappen 1957; Figure V.2.3).

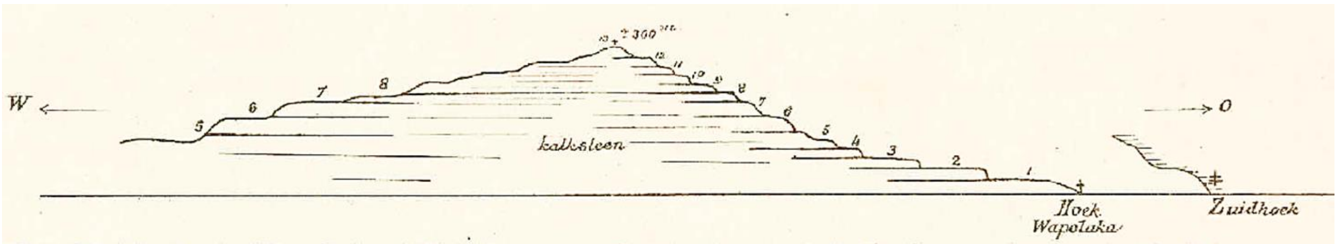

Fig. 25. De hoek Wapolaka (Zuidkust van Boeton) van het Zuiden gezien, met 13 kalkterrassen

Figure V.2.3. View of Wapaloka from sea along South coast of Buton, with 13 Quaternary reefal limestone terraces up to 360m elevation (Verbeek 1908).

Buton asphalt

Buton has been known for its Late Triassic oil shales (Winto Formation marine source rocks) and migrated, biodegraded oil in Miocene tar sands, which was sourced from the Triassic. These asphaltic deposits have been mined intermittently since the 1920's. The most detailed description of the geology of the Buton asphalt deposits is by Hetzel (1936).

The Late Triassic Winto Formation has TOC's up to 16% (Mujito et al. 1998) and is obviously a good oil source rock. However, the five oil exploration wells drilled on and around Buton between 1976 and 2012 were unsuccessful.

Tukang Besi islands

The Tukang Besi islands SE of Buton are often viewed as part of a tectonic terrane that collided with Buton in Pliocene time (e.g. Mubroto and Ali 1998). However, the geological knowledge of these low-lying islands (elevations up to 275m) appears to be limited to observations of an uplifted core of late Neogene *Globigerina* limestones, surrounded by raised coral reef terraces (Hetzel 1930).

The geologic nature and older history of these islands therefore remains mostly unknown, and does not support or contradict any tectonic model.

Some suggested reading- Buton *(not a complete listing of all relevant papers)*

Buton General	*Hetzel 1936, Sartono et al. 1990, Davidson 1991, Smith and Silver 1991, Sikumbang et al. 1995, Milsom et al. 1999, Milsom 2000.*
Neogene history	*Wiryosujono and Hainim 1978, Smith 1983, Fortuin et al. 1990*
Buton asphalt	*Bothe 1928, Hetzel 1936, Tobing 2005, Triono 2005, Hadiwisastra 2009, Hadiyanto et al. 2009, Satyana 2011, Satyana et al. 2013*
Paleontology	*Martin 1935, 1937, Beets 1943, 1952, Keijzer 1945, 1953, Reinhold 1952, Ling and Smith 1995, Soeka 1991, Jansen 1999.*
Tukang Besi islands	*Escher 1920, Kuenen 1928, Hetzel 1930, Umbgrove 1943, Koswara & Sukarna 1994.*

V. SULAWESI- BUTON

V.1. Sulawesi

Abendanon, E.C. (1911)- De tektoniek van Midden Celebes. Handelingen XIII Nederlandsch Natuur-Geneeskundig Congres, Groningen 1911, Kleynenberg, Haarlem, p. 389-406.
(online read only at: http://babel.hathitrust.org/cgi/pt?id=uc1.b3093404;view=1up;seq=999)
('The tectonics of Central Sulawesi'. First summary of geology and tectonics of C Sulawesi after initial reconnaissance survey of Sarasin cousins. C Sulawesi mainly volcanics and metamorphic rocks. Presence of major faults)

Abendanon, E.C. (1912)- Zur Umrissform der insel Celebes. Zeitschrift Deutschen Geol. Gesellschaft, Berlin, 64, Monatsberichte 5, p. 266-277.
(online at: https://www.biodiversitylibrary.org/item/150869#page/1036/mode/1up)
('On the outline of Sulawesi'. Early interpretation of tectonic zones and fault patterns of Sulawesi)

Abendanon, E.C. (1912)- Eine Nachschrift "Zur Umrissform von Celebes". Zeitschrift Deutschen Geol. Gesellschaft 64, Monatsberichte 11, p. 512-516.
(online at: https://www.biodiversitylibrary.org/item/150869#page/1288/mode/1up)
(Follow-up of Abendanon (1912) paper on outline of Sulawesi. No figures)

Abendanon, E.C. (1915)- Celebes uit, of in de Tethys? Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 32, p. 358-365.
(online at: https://babel.hathitrust.org/cgi/pt?id=mdp.39015078113514;view=1up;seq=398)
(Scathing critique of observations and conclusions of Waterschoot van der Gracht 1915 paper on C Sulawesi)

Abendanon, E.C. (1915)- Midden Celebes Expeditie- Geologische en geographische doorkruisingen van Midden-Celebes (1909-1910). E.J. Brill, Leiden, vol. I, p. 1-451.
('Geologic and geographic traverses of Central Sulawesi (1909-1910)'. First of 4 volumes + Atlas of classic first geological reconnaissance traverses of C Sulawesi, sponsored by Royal Dutch Geographical Society. With 7 maps and 22 cross-sections in Atlas volume. Vol. I with reports of rock observations on 1909 traverses of Latimojong Mts, Saadang, Masupu and Mamasa Rivers, and Rante Pao- Palopo. Metamorphic rocks, M Eocene Nummulites limestones volcanics, etc.))

Abendanon, E.C. (1915)- Midden Celebes Expeditie- Geologische en geographische doorkruisingen van Midden-Celebes (1909-1910). E.J. Brill, Leiden, vol. II, p. 453-944.
(Continuation of 1909- 1910 fieldwork report, with traverses of Malili River, Matana Lake, Kolonodale (areas with widespread 'peridotite plate', ~1000m thick, overlying Mesozoic?, also gabbro, some radiolarite, etc.). Also Poso Depression (metamorphics, incl. glaucophane schist), Koro to Lariang (common metamorphics, volcanics), Sarasin graben, Pare Pare, Donggala, etc. Folded schist in C Sulawesi commonly steeply dipping and strike in E-W direction. p. 823: Post-Eocene folding followed by Oligocene peneplanisation, followed by Neogene folding and uplift up to 2000m. With 6 maps and 21 cross-sections in Atlas volume)

Abendanon, E.C. (1917)- Midden Celebes Expeditie- Geologische en geographische doorkruisingen van Midden-Celebes (1909-1910). E.J. Brill, Leiden, vol. III, p. 953-1381.
(Volume with reports on palaeontology:(1) brief note by G.J. Hinde on radiolaria poorly preserved; ('reminescent of radiolarian cherts from U Kapuas region of N Kalimantan'; 'probably not older than Jurassic') and small foraminifera, (2) G.F. Dollfus on identifications of Cretaceous - Tertiary fossils (incl. M Eocene larger foraminifera Nummulites, Alveolina, Orthophragmina (= Discocyclina), Pellatispira and molluscs). Also extensive report on petrography of igneous and metamorphic rocks by W.F. Gisolf)

Abendanon, E.C. (1917)- Midden Celebes Expeditie- Geologische en geographische doorkruisingen van Midden-Celebes (1909-1910). E.J. Brill, Leiden, vol. IV, p. 1383-1902.
('Synthesis volume' on rock types and stratigraphy (incl. gneiss, thick series of ?Precambrian schists, >1000m thick ?Triassic peridotites with 'shell' of associated basic igneous gabbro, diabase, tuffsand deep marine red

radiolarite, U Cretaceous claystones, granite laccoliths, M Eocene clastics with coal and Nummulites limestone, E Tertiary tuffs, E Miocene reefal limestones, Mio-Pliocene volcanics, etc.), and tectonics of Sulawesi. Final chapters on Recent freshwater molluscs and fishes, economic geology and historic maps)

Abendanon, E.C. (1916-18)- Voyages geologiques et geographiques a travers la Celebes centrale. Brill, Leiden. 3 vols. + Atlas, p. 1-1549.
('Geologic and geographic travels across Central Sulawesi'. French translation of above Dutch text)

Abendanon, E.C. (1916)- De oude beddingen der Beneden-Saadang River. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 33, 3, p. 429-449.
('The old courses of the Lower Sadang River'. Sadang River in SW Sulawesi now drains W into Makassar Straits, but river shifted 25 km N from old Sadang delta at Jampua 50 years ago. Diversion appears to point to ~5m of uplift in last 50 years)

Abendanon, E.C. (1916)- Schetskaart van Midden-Celebes. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 33, 2p.
('Overview map of Central Sulawesi'. Reprint of map IX in Abendanon 1915-1917))

Abendanon, E.C. (1916)- De geomorphologische beteekenis der basische stollingsgesteenten in het middendeel van den Ned.- Ind Archipel. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 33, 5, p. 742-749.
('The geomorphologic meaning of the basic igneous rocks in the central part of the Netherlands Indies archipelago')

Abendanon, E.C. (1916)- Een palaeogeographische gevolgtrekking in verband tot de kristallijne schisten-formatie van Midden Celebes. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 3 (Molengraaff volume), p. 171-190.
(online at: https://ia601908.us.archive.org/30/items/verhandelingenva3191geol/verhandelingenva3191geol.pdf)
('A paleogeographic conclusion from the crystalline schist formation of Central Sulawesi'. C Sulawesi belt of metamorphic rocks between Bone Gulf and Tomini Bay interpreted as part of larger Precambrian Asian-Australian continent, with proposed name of 'Aequinoctia'. Started to break up in Permo-Carboniferous)

Abendanon, E.C. (1917)- Historische geologie van Midden-Celebes. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 34, p. 440-456 and p. 547-564.
('Historical geology of Central Sulawesi')

Abendanon, E.C. (1918)- Ontdekking van belangrijke delfstoffen-afzettingen in Nederl.-Indie (Midden-Celebes) op grond van een geologischen verkenningstocht. De Ingenieur, Delft, 1918, 7, p. 1-14.
('Discovery of important mineral deposits in Netherlands Indies (Central Sulawesi) based on a geological reconnaissance trip'. First to report presence of lateritic of iron, nickel and chrome deposits associated with peridotites in the 'Verbeek Mountains' near Matano and Towuti lakes)

Abendanon, E.C. (1919)- Midden-Celebes, een antikritiek. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 36, p. 49-97.
('Central Sulawesi, a reply'. Reply to critical discussion of Abendanon 1916-1918 Sulawesi volumes by Wing Easton, 1918, 'Rustig of dansend Celebes')

Abendanon, E.C. (1920)- Een jong-paleozoisch en een devonisch fossiel van Celebes? De Ingenieur, 31 Januari 1920, p. and 29 Januari 1921, p.
('A Late Paleozoic and a Devonian fossil from Sulawesi? Questions Sulawesi origin of Permian ammonite and Devonian brachiopod reported by Brouwer (1919) from Kalosi region of C Sulawesi)

Abimanyu, R. (1990)- The stratigraphy of the Sulawesi Group in the Tomori PSC, East Arm of Sulawesi. Proc. 19th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung 1990, 1, p. 99-118.

(Union Texas overview of stratigraphy of (Latest Miocene?-) Pliocene -Pleistocene clastics-dominated, post-orogenic Kintam Fm in Tomori Basin. Documents latest Miocene or basal Pliocene (N17 or N18- N19/20) bathyal flysch-type fine clastics sedimentation reflecting deepening/flexural loading as result of collision between E Sulawesi ophiolite and Banggai Sula block. Followed by Biak Fm coarse clastics in latest E Pliocene (N20-?N21), reflecting post-orogenic uplift/ erosion in E Pliocene ('Sulawesi Molasse'))

Adam, J.W.H. (1922)- Over de resultaten eener proefontginning van nikkelertsafzetingen nabij Soroako (Celebes). Jaarboek Mijnwezen Nederlandsch Oost-Indie 49 (1920), Verhandelingen 1, p. 201-249.
(Results of test exploitation of nickel ore deposits near Soroako on S side of Matano lake, central East Sulawesi. Nickel ore on weathered surface of large peridotite body (mainly dunite). Concentrations of nickel ore typically 3-4% Ni, some over 7%, not as high as New Caledonia)

Adhitiya, R., S.S. Angkasa, V. Oryzavica, A.R. Parinduri, D. Wirasatia & R. Adiarsa (2010)- Re-appraisal, tectonic and sedimentary control of Bone Basin and implication to Cenozoic multi hydrocarbon play. Proc. 39th Ann. Conv. Indon. Assoc. Geol. (IAGI), Lombok, PIT-IAGI-2010-088, 12p. *(In Indonesian)*
(Literature summary of S Sulawesi Bone Basin, borrowing heavily from Yulihanto 2004)

Advokaat, E.L. (2015)- Neogene extension and exhumation in NW Sulawesi. Ph.D. Thesis Royal Holloway London University. p. *(Unpublished)*

Advokaat, E., R. Hall, L. White, R.A. Armstrong, B.P. Kohn & M. BouDagher-Fadel (2014)- Neogene extension and exhumation in NW Sulawesi. American Geophys. Union (AGU), Fall Mtg., San Francisco, T43A-4701, 1p. *(Poster Abstract)*
(Crustal extension important in Neogene development of Sulawesi. North Arm with Eocene- Lower Miocene basalts intercalated with radiolarian chert and volcaniclastics, intruded by granitoids with zircon ages from~9.4- 8.2 Ma. Beneath these rocks is Malino Metamorphic core complex quartzo-feldspathic schist-gneiss with zircon rim ages of ~15.4 Ma, surrounded by discontinuous greenschist carapace, intruded by granitoids with ages of 4.85- 3.78 Ma. Late stage exhumation by high angle oblique normal faults between ~3.3- 1.4 Ma. E Pliocene- E Pleistocene sediments crosscut by normal faults. Two phases of extension in N Sulawesi, M Miocene and Late Pliocene-Pleistocene)

Advokaat, E., R. Hall, L. White, I.M. Watkinson, A. Rudyawan & M.K. BouDagher-Fadel (2017)- Miocene to recent extension in NW Sulawesi, Indonesia. J. Asian Earth Sci. 147, p. 378-401.
(online at: http://searg.rhul.ac.uk/pubs/advokaat_etal_2017%20Extension%20North%20Sulawesi.pdf)
(Malino Metamorphic Complex (MMC) in W part of N Arm of Sulawesi previously thought to be metamorphic complex exhumed in E-M Miocene. New data suggest MMC metamorphic core complex underwent E-M Miocene extension, but no exhumation at this time: (1) Pliocene undeformed granitoids intrude MMC indicating complex still at depth and (2) Pliocene- Pleistocene cover sequences do not contain metamorphic detritus. Second phase of extensional uplift with brittle faulting from Late Miocene-Pliocene onwards, with MMC exhumation (synchronous exhumation of adjacent Palu Metamorphic Complex in W Sulawesi, and rapid offshore subsidence in Gorontalo Bay). Linked to N-ward slab rollback of S-subducting Celebes Sea since Pliocene, and ongoing at present day)

Agard, P., P. Yamato, L. Jolivet & E. Burov (2009)- Exhumation of oceanic blueschists and eclogites in subduction zones: timing and mechanisms. Earth-Science Reviews 92, p. 53-79.
(Review of buoyancy-driven exhumation of continental rocks that converted to blueschist-eclogite in subduction zone exhumation. With brief discussion of Sulawesi Cretaceous Bantimala Complex, which represents exhumed wedge of Cretaceous subduction and is mainly made of mafic bodies and volcanoclastics, with eclogite blocks embedded in serpentinites. Ultramafic units occupy internal position)

Ahlburg, J. (1910)- Uber den geologischen Aufbau von Nordcelebes. Zeitschrift Deutschen Geol. Gesellschaft, Berlin, 62, Monatsberichte 3, p. 191-202.
(online at: https://archive.org/details/zeitschriftderd621910deut)
('On the geological structure of North Sulawesi')

Ahlburg, J. (1913)- Versuch einer geologischen Darstellung der Insel Celebes. Geol. Palaeont. Abhandlungen, Neue Folge 12, 1, p. 3-172.
(online at: http://archive.org/details/geologischeundpa12jena)
('Attempt of a geological description of Sulawesi island'. Early overview of Sulawesi geology, partly based on observations on North arm along Tomini Bay in 1909, partly compilation of published data. (S Sulawesi part criticized by Van Waterschoot van der Gracht 1915))

Ahmad, W. (1978)- Geology along the Matano Fault Zone, East Sulawesi. In: S. Wiryosujono & A. Sudradjat (eds.) Proc. Regional Conf. Geology and Mineral Resources of Southeast Asia (GEOSEA), Jakarta 1975, Indon. Assoc. Geol. (IAGI), p. 143-150.
(170km long, WNW-ESE trending Matano Fault Zone in N part of SE Arm of Sulawesi. Lake Matano graben-like structure between overstepping fault segments. Observed left-lateral offsets of old geologic contacts ~20km; several young stream offsets of 200-600m)

Andi Mangga, S. (2004)- Tinjauan lingkungan tektonik batupasir Formasi Kalumpang di daerah Kalumpang, Kabupaten Mamuju, Sulawesi Selatan. J. Sumber Daya Geologi 14, 2 (146), p. 26-36.
('Observations on tectonic setting of the Kalumpang Fm sandstone in the Kalumpang area, Mamuju District, S Sulawesi'. Eocene Kalumpang Fm clastics at Karama River, W Sulawesi, quartz sandstone and claystone with minor coal and limestone, with clasts derived from metamorphic, igeous and sedimentary terranes ('quartzose recycled orogen'))

Andi Mangga, S., Moh. Heri H.Z. & T. Sihombing (2005)- Tinjauan geologi dan potensi batubara daerah Sulawesi Selatan. J. Sumber Daya Geologi 15, 1 (148), p. 124-142.
('Observations on the geology and coal potential of the South Sulawesi area'. Tertiary basins of S Sulawesi Makassar Straits, Lariang, Karama Makasar and Bone Basins. Formed due to rifting between E Eocene and E Miocene. Coal deposits in M-L Eocene of Mamuju (NW) and Enrekang (NE) and E-M Miocene in Barru-Bone Block (S))

Andreason, M.W., A.F. Chatfield, J.A. Curiale, M.V. Filewicz, E.D. Lumadyo et al. (2000)- Exploration in the gravity collapse rifts of the Salayar Basin, Indonesia. AAPG 2000 Ann. Mtg *(Abstract only)*
(Salayar Basin offshore SW Sulawesi (S end Makassar Straits) gravity collapse rift formed in M Cretaceous along SE Sunda shield margin. Salayar and SE Sunda margin basins differ from typical Indonesian back-arc basins due to Cretaceous main rift event and crustal thickening prior to Paleocene-Eocene source deposition. Sequence of events: (1) E Cretaceous accretion, thrusting, granite intrusion, low-angle subduction; (2) Mid-Cretaceous collapse due to Australian plate roll-back, deposition of deepwater flysch; (3) Late Cretaceous isostatic adjustment of rift blocks; (4) Paleocene-M Eocene rifting, deposition in alluvial, lacustrine, and fluvio-deltaic environments; (5) Late Eocene- Late Oligocene post-rift quiescence, carbonate platform development on basin margins, deepwater marls- shales in basin center; (6) Late Oligocene- M Miocene inversion; (7) M Miocene- present relative tectonic quiescence, sediment starved conditions, infill of lows)

Anggayana, K., T. Darijanto & S. Widodo (2003)- Studi mineral pirit sebagai salah satu sumber sulfur pada batubara: kasus batubara dari Kabupaten Barru Sulawesi Selatan. Jurnal Teknologi Mineral (ITB) X, 1, p. 3-14.
('Study of pyrite minerals as main source of sulfur in coal: case from the Barru regency, South Sulawesi')

Anonymous (1920)- Uitkomsten van mijnbouwkundige onderzoekingen in een gedeelte van Midden-Celebes (Sasak). Verslagen Meded Indische Delfstoffen en hare Toepassingen, Dienst Mijnwezen Nederlandsch Oost-Indie, 12, p. 1-64.
('Results of mining investigations in a part of Central Sulawesi (Sasak)'. Report on survey of copper and iron deposits in C Sulawesi between 1911-1917 by Mines department ingenieurs Van der Kloes, Reijzer, Macke and Wolvekamp. Surveys of terrains Sasak, Masupu and Bobokan in Toraja region did not lead to proving commercial deposits)

Apandi, T. (1977)- Geologic map of the Kotamobagu quadrangle, North Sulawesi, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(See 2nd edition 1993, below)

Apandi, T. & S. Bachri (1993)- Geologic map of the Kotamobagu quadrangle, North Sulawesi, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 2n Ed.
(Geologic map in eastern half of Sulawesi North Arm. Part of volcanic arc, above double subduction zone: Celebes Sea subduction from North (active since E Tertiary) and E Sangihe subduction zone to E (active since E Quaternary). Oldest rock Eocene (and older?) Tinombo Fm deep marine clastics, chert and red limestone with pillow basalts (50 Ma radiometric age reported in Villeneuve et al. 1990). Overlain by Miocene and younger clastics and volcanics and E-M Miocene limestones. Widespread Late Miocene Bone diorite/ granite intrusions. With E-W trending normal faults and NNW-SSE (right lateral) and NNE-SSW (left-lateral) strike slip faults. More than one compressional tectonic episodes: older isoclinal folding and younger open folding)

Ardiansyah R., I. Kusuma, H. Kamaruddin, R.R. Wibawa & M.R. Kamil (2015)- Geological prospect, resource and ore reserve estimation in Pomalaa, Kolaka, Southeast Sulawesi, Indonesia. In: N.I. Basuki (ed.) Proc. Indonesian Soc. Econ. Geol. (MGEI) 7th Ann. Conv., Balikpapan, p. 67-76.
(Pomalaa nickel mine in SE Sulawesi in nickel laterite derived from ultramafic rocks (harzburgite, dunite, etc.) of E Sulawesi ophiolite. Slopes between 3°-15° produce ~2- 7 m thick nickel saprolite zone, with Ni grade of 1.8-2.2%)

Aridianto & N. Azman R. (1990)- Kajian geologi daerah Sulawesi tenggara dalam kaitannya dengan prospek hidrokarbon. Proc. 19th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 136-148.
('Study of the geology of the Southeast Sulawesi region in relation to hydrocarbons prospectivity'. Tertiary section above metamorphics-ophiolite starts with 'Langkawala Fm' Eocene conglomeratic sandstones?. Not much detail)

Armandita, C., N. Pudyo, S.E. Saputra & Sumaryana (2011)- Exploration challenges and opportunities in deep water Makassar Strait Basins, Indonesia: review of carbonate play based on sequence stratigraphy and seismic characterization. Proc. SEG Ann. Meeting, San Antonio 2011, p. 1-5. *(Extended Abstract)*
(Evaluation of deepwater of Makassar Strait after 6 recent unsuccessful exploration wells. Geological factors of unsuccessful results include misinterpretation of age of carbonate reservoirs from seismic, inadequate evaluation of petroleum system, etc.)

Arosi, H.A. & M.E.J. Wilson (2015)- Diagenesis and fracturing of a large-scale, syntectonic carbonate platform. Sedimentary Geology 326, p. 109-134.
(Tonasa Limestone Fm of SW Sulawesi developed in extensional regime, with block faulting, tilt-block rotation, differential uplift and subsidence throughout Eocene- E Miocene history. Carbonate alteration in shallow to deeper burial depths by fluids with predominantly marine precursor origins)

Aryani, S.C. & R.Sinaga (2010)- Potential prospect of Au- base metal mineralization in Esang, Mamasa, West Sulawesi, Indonesia. Proc. 39th Ann. Conv. Indon. Assoc. Geol. (IAGI), Lombok, 7p.
(Esang gold and base metal mineralization in W Sulawesi hosted in Cretaceous Latimojong Fm metasediments and Miocene- Pliocene andesites of Talaya Fm)

Ascaria, N.A. (1997)- Carbonate facies development and sediment evolution of the Miocene Tacipi Formation, South Sulawesi, Indonesia. Ph.D. Thesis, University of London, p. 1-397. *(Unpublished)*
(Tacipi Fm 300m thick Middle-Late Miocene reefal limestones, outcrops over 1500 km2 in eastern S Sulawesi. Tectonic activity controlled facies development in M-L Miocene)

Ascaria, N.A. (1999)- Control on carbonate sedimentation of Tacipi Formation, South Sulawesi, Indonesia. Berita Sedimentologi 10, p. 16-17.
(M Miocene- E Pliocene Tacipi Fm limestones of SW Sulawesi deposited in intra-arc or forearc setting. 300-700m thick, outcrops in area of 1500 km2, also in Sengkang basin subsurface (economic gas reservoir).

Outcrops in N isolated knoll reefs with deeper water M Miocene shallowing upward into Late Miocene reef complexes. In S Bone region M Miocene shallow marine carbonates. Tectonic control on facies distribution)

Ascaria, N.A. & N.A. Harbury (1997)- Tacipi Limestone facies distribution and sequence development, Mio-Pliocene, South Sulawesi, Indonesia. Berita Sedimentologi 5, p.

Ascaria, N.A., N.A. Harbury & M.E.J. Wilson (1997)- Hydrocarbon potential and development of Miocene knoll-reefs, South Sulawesi. In: J.V.C. Howes & R.A. Noble (eds.) Proc. Conf. Petroleum Systems of SE Asia and Australasia, Indon. Petroleum Assoc. (IPA), p. 569-584.
(Tacipi Fm M Miocene (Tf2-3)- E Pliocene (Tg) intra-arc or forearc carbonates. Thickness 300-700m. Subcrops in Sengkang Basin form economic gas reservoirs. Dominant lithologies reef facies, packstones and wackestones. Northern outcrops (N Bone Region) isolated knoll-reefs, displaying N-S trend, surrounded by deeper-water facies. Buildups composed of deeper-water M Miocene facies at base and shallow upwards into Late Miocene reef complexes. Differential subsidence resulted in variations in time of drowning of reefs. Fine grained clastics and volcaniclastics cover reefs and act as seals)

Ashton, P.R. (1976)- Miocene algal reef mounds, Sengkang province, Sulawesi. Proc. Carbonate Seminar, Jakarta 1976, Indon Petrol. Assoc. (IPA), p. 122. *(Abstract only)*
(S edge of Sengkang Basin, S Sulawesi, well exposed outcrops of algal reef limestone. Numerous discrete biocherms, rooted in U Miocene limestone platform and covered by U Miocene- Pliocene pelagic calcareous mudstones. Bioherms mainly of calcareous algae; corals significant only at base)

Asmariyadi, R. Langkoke, A. Maulana, I. Nur & W. Astaman (2012)- Ore characteristics and fluid inclusion of the base metal vein deposit in Moncong Bincanai Area, Gowa, South Sulawesi, Indonesia. J. Geologi Indonesia 7, 4, p. 189-197.
(online at: http://jgi.bgl.esdm.go.id/index.php/JGI/article/view/43/32)
(Moncong Bincanai mineralization veins in basalt, consisting of galena, sphalerite, chalcopyrite, and pyrite, with Pb 47.9%, Cu 1.3%, Zn 1.0%, and Fe 9.5%. Fluid inclusion microthermometry indicate formation T of ~250°C. Categorized as low-sulfidation epithermal deposits, formed at 410-440m below paleosurface)

Asyiah, S., M.R. Suwondo & R. Waren (2010)- Eocene- Miocene plate tectonic habitats and structural style of Gorontalo Basin, Sulawesi. Proc. 39th Ann. Conv. Indon. Assoc. Geol. (IAGI), Lombok, PIT-IAGI-2010-006, 13p. *(in Indonesian)*

Audley-Charles, M.G. (1974)- Sulawesi. In: Mesozoic-Cainozoic orogenic belts. Geol. Soc. London, Spec. Publ. 4, p. 365-378.
(Elegant, somewhat dated overview of Sulawesi geology)

Aziz, F. (1993)- Fosil fauna Sulawesi dan Batas Wallace. J. Geologi Sumberdaya Mineral 3, 21, p. 2-9.
('Fossil faunas of Sulawesi and the Wallace Line'. Makassar Straits believed to be major faunal boundary between Asian and Australian faunas, but presence of Asian elements like Celebochoerus, Elephas, Stegodon and Geochelone in Late Pliocene- Pleistocene Walanae Fm of SW Sulawesi shows some animals were able to cross Wallace Line)

Aziz, F. (1994)- Vertebrate faunal evolution of Sulawesi during the Late Neogene. In: R. Tsuchi (ed.) Pacific Neogene Events in Time and Space. Contributions to the West Pacific, IGCP-246, Shizuoka University, Japan, p. 79-85.

Aziz, F., G.D. van den Bergh et al. (1995)- The geology and stratigraphy of the vertebrate-bearing deposits in the Sengkang Basin: the terrestrial faunal evolution of South Sulawesi during the Late Pliocene and Quaternary. Geol. Res. Dev. Centre, Spec. Publ. 18, p. 1-112.
(At least three immigrations of large-sized terrestrial mammals into S Sulawesi in Late Pliocene-Quaternary. Vetebrate fauna localities in Walanae Depression/rift. East Walanae fault initiated as late M-early Late Miocene normal fault, but in Late Pliocene- Early Pleistocene compressional or left lateral strike slip faulting)

Aziz, M.C.A. & K.A.M. Syihab (1993)- Arah pengendapan batuan Tersier, daerah Silea, Kecamatan Sampara, Kabupaten Kendari, Sulawesi Selatan. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 1141-1150.
('Aspects of the deposition of Tertiary rocks in the Silea area, Sampara, Kendari district, S Sulawesi')

Bachri, S. (2006)- Stratigrafi lajur vulkano-plutonik daerah Gorontalo, Sulawesi. J. Sumber Daya Geologi 16, 2 (152), p. 94-106.
('Stratigraphy of the volcanic-plutonic belt of the Gorontalo area', N Sulawesi. N Sulawesi mainly Eocene-Pliocene volcanics and Neogene plutonics. Oldest unit Eocene-E Miocene Tinombo Fm, in volcanic and sedimentary facies. Overlain by M Miocene-E Pliocene marine volcanics and sediments, intruded by Bone Diorite. M Pliocene acid- intermediate volcanic rocks. Late Pliocene-E Pliocene molasse with tuffs and acidc-intermediate Pinogu Volcanics with Bumbulan Granodiorite. Plio-Pleistocene reef limestone in S coast area)

Bachri, S. (2011)- Structural pattern and stress system evolution during Neogene- Pleistocene times in the central part of the North Arm of Sulawesi. J. Sumber Daya Geologi 21, 3, p. 127-135.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/140/137)
(Five main trends of lineaments and faults, reflecting changes in stress system evolution during Neogene-Pleistocene, related to S-ward subduction of N Sulawesi Sea, which in Pleistocene weakened as Sangihe subduction in Molucca Sea to E commenced, resulting in change of stress field orientation)

Bachri, S. & Baharuddin (2001)- Geological map of the Majene-Malunda Quadrangle, Sulawesi, scale 1: 100,000. Geol. Res. Dev. Centre (GRDC), Bandung.

Bachri, S. & Sidarto & (2013)- Tektonik Sulawesi. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 303-324.
('Tectonics of Sulawesi'. Chapter 13 in Geology of Sulawesi book. Brief review of regional tectonics of Sulawesi. No plate reconstruction)

Bachri, S., Sukido & N. Ratman (1994)- Geological map of the Tilamuta Quadrangle, Sulawesi, 1: 250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Geologic map in western half of North Arm of Sulawesi. Oldest rocks Eocene- E Oligocene Tinambo Fm and gabbro, intruded by Miocene Bone Diorite/ granites. Overlain by Miocene and younger clastics and volcanics)

Baese, R. (2013)- Fluid-rock interaction processes during subduction and exhumation of oceanic crust: constraints from jadeitites in serpentinites, eclogite veins in blueschists and tectonic breccias formed during uplift. Doct. Thesis Christian-Albrechts University, Kiel, p. 1-129.
(online at: http://macau.uni-kiel.de/receive/dissertation_diss_00010505)
(Including chapters on eclogitisation, geochemistry and petrologyof eclogite veins and blueschists and repeated brecciation during exhumation of subducted oceanic crust at Bantimala Complex, SW Sulawesi. Eclogite protoliths mainly Mid-Ocean Ridge Basalts (N-MORB, some Oceanic Island Basalts and formed at depths of >90 km. Blueschists protoliths also similar to N-MORB. Exhumation/ uplift process led to dismembering of subducted crust. High-pressure rocks from slices of dismembered slab incorporated into accretionary wedge sediments during upward motion of continental fragment, resulting in alternating sequence of metamorphic and sedimentary rocks in Bantimala Complex. Brecciation at different levels during exhumation, between 10-80km))

Baese, R. & V. Schenk (2013)- Brittle deformation during exhumation of eclogites and blueschist of the Bantimala Complex, Sulawesi: evidence for intra-slab shearing. In: Symposium on tectonics, structural geology and geology of crystalline rocks, Kiel?, p. 23. *(Abstract only)*
(online at: http://oceanrep.geomar.de/14846/1/Baese.pdf)

Baharuddin & B.H. Harahap (2000)- Tinjauan kembali kerangka stratigrafi dan tektonik daerah Palopo, Sulawesi Selatan. J. Geologi Sumberdaya Mineral 10 (110), p. 24-38.

('Review of the stratigraphic and tectonic framework of the Palopo area, S Sulawesi'. Palopo area in NE part of S arm of Sulawesi underlain by Latimojong phyllite (>4500m; originated from Cretaceous flysch, overlain by fluvio-deltaic Eocene Toraja Fm (>1500m), U Oligocene- M Miocene Makale Fm carbonates (>1500m) and U Miocene- Pliocene Sekala Fm clastics (1800m). Lamasi Volcanic Complex probably represents oceanic ophiolitic sequence of gabbro, dikes and pillow lavas and emplaced in M Miocene. Mio-Pliocene non-orogenic volcanism)

Baharuddin & B.H. Harahap (2003)- Lava Tersier dari Bonto Sarong Palopo, Sulawesi: ciri geokimia dan kaitannya dengan evolusi dan tektonika. In: Pros. Forum Penelitian dan Pengembangan Energi dan Sumberdaya Mineral, Badan Litbang Energi Sumberdaya Mineral, p. 377-388.
('Tertiary lavas from Bonto Sarong Palopo, Sulawesi; geochemical characteristics and relationships between its evolution and tectonics')

Baillie, P., H. Darman & T.H. Fraser (2004)- Deformation of Cenozoic basins of Borneo and Sulawesi. In: R.A. Noble et al. (eds.) Proc. Deepwater and Frontier Exploration in Asia and Australasia Symposium, Jakarta, Indon. Petroleum Assoc. (IPA), p. 443-461.

Barber, A.J. (1996)- Multiple collisions on the southeastern margin of Sundaland: the tectonic evolution of Sulawesi. Warta Geologi (Newsl. Geol. Soc. Malaysia) 22, 4, p. 300-301. *(Abstract only)*
(online at: https://gsmpubl.files.wordpress.com/2014/09/ngsm1996004.pdf)
(Sundaland constructed since Late Paleozoic by collisions of continental fragments. In E Cretaceous SE margin of Sundaland lay in Borneo; subduction and accretion added oceanic and micro continental material to this margin. In W Sulawesi oldest basement rocks are ocean floor materials in accretionary complex, with components carried down deep in subduction zone (eclogites, gneisses and glaucophane schists with cooling ages of 132-113 Ma (E Cretaceous). After uplift and erosion, Late Cretaceous subsidence and development of forearc basin over accretionary complex, with deposition of cherts and turbidites. In Eocene area stabilised as part of Sundaland continental margin, with development of rifts. C Sulawesi composed of rocks of oceanic and continental origin now metamorphosed in amphibolite, greenschist and glaucophane schist facies, overlain by melange, then by major ophiolite complex of East Arm. Amphibolite and greenschist facies rocks formed by W-ward subduction of microcontinental fragment and metamorphosed in E Cretaceous, at same time as basement in W Sulawesi. Glaucophane schist metamorphism affects earlier metamorphic rocks and melange, which is overlain to E by high-T metamorphic sole beneath E Sulawesi Ophiolite. Melange formation and metamorphism due to mid-oceanic subduction towards E. Subduction ceased at 28 Ma (Oligocene), when Sundaland ran into subduction zone and ophiolite obducted onto continental margin. W-ward subduction then commenced beneath E margin of ophiolite, terminating in M Miocene when Banggai-Sula microcontinent ran into subduction zone. Banggai-Sula originated as fragment of Australia, separated in Jurassic, carried W along Sorong Fault Zone. Collision zone in E Arm is marked by imbrication of Banggai-Sula continental margin sediments with slices of ophiolite. Metamorphic rocks of C Sulawesi were thrust across W Sulawesi, and uplifted blocks of basement were thrust W-wards across Eocene-M Miocene carbonate platform. Downgoing continental rocks subducted beneath W Sulawesi gave rise to volcanic arc with volcanic rocks geochemical signature of Australian origin)

Barmi, O., F. Urip & E. Purnomo (2003)- The Donggi gas field discovery- a challenge for Pertamina for finding and developing new hydrocarbon reserves in the future. Proc. 29th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA03-B-074, 16p.
(2001 Donggi discovery on Tomori/ Matindok Block, East arm of Sulawesi, may exceed 2.7 TCF gas. Reservoir Late Miocene carbonates of Mentawa Mb of Minahaki Fm, with 13-34% porosity. Oligo-Miocene Tomori Fm carbonates directly on 'Australian' granitic basement)

Bartstra, G.J. (1977)- Walanae Formation and the Walanae terraces in the stratigraphy of South Sulawesi (Celebes, Indonesia). Quartar 27, p. 21-30.
(online at: www.quartaer.eu/pdfs/1977/1977_02_bartstra.pdf)
(On Pliocene-Quaternary vertebrate-bearing clastics formation of SW Sulawesi)

Beaudouin, T. (1998)- Tectonique active et sismotectonique du systeme des failles decrochantes de Sulawesi central. Doct. Thesis, Universite Paris-Sud, p. 1-343. *(Unpublished)*
('Active tectonics and seismotectonics of C Sulawesi fault zones')

Beaudouin, T., O. Bellier & M. Sebrier (2003)- Champs de contrainte et de deformation actuels de la region de Sulawesi (Indonesie): implications geodynamiques. Bull. Soc. Geologique France 174, 3, p. 305-317.
(online at: http://documents.irevues.inist.fr/handle/2042/263)
('Present-day stress and deformation field in the Sulawesi region; geodynamic implications'. High seismicity along N Sulawesi trench and Molucca Sea subduction zone, lower activity in C and S Sulawesi. Represents activity of NE, SW and SE arms thrusts and left-lateral C Sulawesi Fault System (Palu-Koro and Matano faults). System connects N Sulawesi subduction zone to Sorong fault through S Sula fault and Tolo thrust in N Banda Sea. Clockwise rotation of Sula block. C Sulawesi fault system fast slipping with low seismicity. Extensional stress in S part Tomini Gulf (9 mm/yr in N36°E direction), possibly back-arc spreading related to N Sulawesi subduction. Batui zone E-M Pliocene collision between NE arm and Banggai-Sula block, remains active, but mainly affected by strike-slip deformation. Tolo thrust off SE arm E coast absorbs N Banda Sea convergence to W. This allows to distinguish a N Banda block in SE Sulawesi. Tolo thrust and Hamilton fault move W at lower rate than Sula block. SW arm of Sulawesi compressional stress regime (Majene-Kalosi thrusts activity) and may represent W- most accommodation of Philippine/Sunda plates motion)

Beets, C. (1950)- On Lower Tertiary Mollusca from SW and Central Celebes. Leidsche Geol. Mededelingen 15, p. 282-290.
(online at: www.repository.naturalis.nl/document/549324)
(Sulawesi mollusc meterial collected by Sax (BPM) in 1931, comparable to material described by Dollfus (1915) from same area. Incl. Turritella krooni of probable Eocene age from SW Central Sulawesi and collection of shells from anticline W of Batoekoe-coalfield W of Ujung Lamuru, SW Sulawesi, where 250m thick marl- limestone series contains Nummulites and molluscs with similarities to Nanggulan fauna of C Java, incl. Volutilithes and Cardita)

Bellier, O., T. Beaudoin, M. Sebrier, M. Villeneuve, I. Bahar et al. (1998)- Active faulting in central Sulawesi (eastern Indonesia). In: P. Wilson & G.W. Mitchell (eds.) The geodynamics of S and SE Asia (GEODYSSEA project). Geoforschungszentrum, Potsdam, Germany, p. 276-312.

Bellier, O., M. Sebrier, T. Beaudouin, M. Villeneuve, R. Braucher, D. Bourles, L. Siame, E. Putranto & I. Pratomo (2001)- High slip rate for a low seismicity along the Palu-Koro active fault in central Sulawesi (Indonesia). Terra Nova 13, 6, p. 463-470.
(C Sulawesi with complex left-lateral strike-slip fault zones in triple junction between Pacific, Indo-Australian and Eurasian plates. Low-magnitude shallow earthquakes related to NNW-trending Palu-Koro and WNW-trending Matano fault zones. N-ward increasing complexity of Palo-Kuro fault segmentation. Left-lateral displacements of streams. Slip rate 32±45 mm/yr. PKF is fast slipping fault with relatively low seismicity)

Bellier, O., M. Sebrier, D. Seward, T. Beaudouin, M. Villeneuve & E. Putranto (2006)- Fission track and fault kinematics analyses for new insight into the Late Cenozoic tectonic regime changes in West-Central Sulawesi (Indonesia). Tectonophysics 413, 3-4, p. 201-220.
(Left-lateral C Sulawesi Fault System composed of NNW Palu-Koro and ESE Matano faults in triple junction of Pacific, Indo-Australian and Eurasian plates. C Sulawesi three tectonic regimes: (1) Late Miocene- E Pliocene (5 Ma) WNW-trending transpression along PKF and compression in Poso area, resulting from collision of Banggai-Sula block with Sulawesi; (2) Pliocene collapse tectonics associated with W-trending extension, with coeval regional cooling and exhumation; (3) Quaternary transtension from C Sulawesi block N motion, and back-arc spreading behind N Sulawesi subduction (Tomini Gulf))

Bellon, H. & C. Rangin (1991)- Geochemistry and isotopic dating of Cenozoic volcanic arc sequences around the Celebes and Sulu Seas. Proc. Ocean Drilling Program (ODP), Scient. Results, 124, College Station, p. 321-338.
(online at: www-odp.tamu.edu/publications/124_SR/VOLUME/CHAPTERS/sr124_23.pdf)

(K-Ar ages for>50 igneous rocks from onshore Philippines, N Borneo (Sabah) and N Sulawesi. Ages range from 32 Ma to near 0 Ma. Generally calc-alkaline affinity with some shoshonitic high-K basalts. Two types of island arcs (1) related to progressive closing of Celebes and Sulu marginal basins and (2) arcs of Philippine Sea Plate. Includes radiometric dates of Sabah Dent- Semporna Peninsula (9- 13 Ma), Sulu Sea/ Cagayan Ridge (ODP Sites 769/771: ~14-21 Ma), Kinabalu Intrusives (6.4- 6.8 Ma), N Sulawesi (Gorontalo area volcanics: 4.1- 8.9 Ma and 18.2- 22.3 Ma)

Bergman, S.C., D.Q. Coffield, J.P. Talbot & R.A. Garrard (1996)- Tertiary tectonic and magmatic evolution of western Sulawesi and the Makassar Strait, Indonesia: evidence for a Miocene continent-continent collision. In: R. Hall & D.J. Blundell (eds.) Tectonic evolution of Southeast Asia, Geol. Soc., London, Spec. Publ. 106, p. 391-429.
(W Sulawesi three Neogene N-S domains, from W to E: (1) active foldbelt with Pliocene- Miocene volcanogenic rocks in W-vergent thrusts, extending into Makassar Strait; (2) deformed submarine Miocene (av. age 8 Ma) arc, built on Oligocene-Eocene clastics and carbonate platform with Mesozoic basement thrust over E margin; (3) accreted pre-Eocene age ophiolite between Latimojong basement block and Bone Bay, obducted in Late Oligocene- Miocene. M Miocene- Pliocene (3-18 Ma) volcano-plutonic complex, with melts sourced from Late Proterozoic- E Paleozoic, tied to continent-continent collision of W-vergent Australian-New Guinea plate subducting under E-most Sundaland. Makassar Strait is foreland basin flanked by Neogene thrust belts, not Paleogene rift. E Sulawesi ophiolite extends into W Sulawesi, suggesting Bone Bay resulted from collapse of over-thickened Miocene orogen)

Berry, R.F. & A.E. Grady (1987)- Mesoscopic structures produced by Plio-Pleistocene wrench faulting in South Sulawesi, Indonesia. J. Structural Geol. 9, p. 563-571.
(Bantimala and Barru metamorphic complexes of S Sulawesi bounded in W by E-dipping thrust faults. Composed of glaucophane schists, serpentinites, etc., overlain by >750m of Cretaceous clastics. Area dominated by Plio-Pleistocene NNW-striking sinistral wrench faults, result of N-ward movement of Banda Sea microplate with respect to W Indonesia)

Bothe, A.C.D. (1927)- Voorlopige mededeeling betreffende de geologie van Zuid-Oost Celebes. De Mijningenieur 8, 6, p. 97-103.
('Preliminary note on the geology of SE Sulawesi'. Smaller islands Kabaena and Wawoni very similar to E Sulawesi. Larger islands Buton and Moena very different)

Bothe, A.C.D. & W.H. Hetzel (1932)- De geologie van Laiwoei, Poleang, Roembia en Kolaka (ZO Celebes). Verslag Archief Dienst van den Mijnbouw, Bandung, p. 1-36. *(Unpublished)*
('The geology of Laiwui, Poleang, Rumbia and Kolaka islands (SE Sulawesi)'. Unpublished Bandung geological survey report)

Boudagher-Fadel, M.K. (2002)- The stratigraphical relationship between planktonic and larger benthic foraminifera in Middle Miocene to Lower Pliocene carbonate facies of Sulawesi, Indonesia. Micropaleontology 48, 2, p. 153-176.
(M Miocene- E Pliocene Tacipi Fm of Bone region of SW Sulawesi up to 300m thick, deposited in large area of shallow marine carbonates, with deeper water sediments deposited to N. Co-occurrences of planktonic and larger foraminifera : (1) M Miocene N11-N12, and Tf2 with Katacycloclypeus, Lepidocyclina (N); (2) Late Miocene N16-N17 and Tg with Planorbulinella) (samples from A.N. Ascaria))

Bromfield, K. & W. Renema (2011)- Comparison of 87Sr/86Sr isotope and biostratigraphic ages of uplifted fossil reefs in the Indo-Pacific: Indonesia, Papua New Guinea and Fiji. Australian J. Earth Sci. 58, p. 61-73.
(Dating of limestones from seven Neogene sites from Indo-Pacific, using foraminifera and 87Sr/86Sr isotopes: Salayar Lst on Salayar Island, S Sulawesi (Late Miocene-Pliocene/Pleistocene), Yalam Lst in E New Britain, PNG (M Miocene) and Tokelau Lst Gp on Vanua Balevu in Lau Group, Fiji (M-L Miocene). Salayar Lst 50-100m thick, contains Quasirotalia sp. and Calcarina spengleri and has Sr ages 5.8-3.4 Ma)

Brooks, R.R., E.D. Wither & L.Y.T. Westra (1978)- Biogeochemical copper anomalies on Salajar Island, Indonesia. J. Geochemical Expl. 10, 2, p. 181-188.
(20 species of plants from Salajar island, SW Sulawesi, have copper values >80 pg/g (max. 600pg/g) in their dried leaves. These values greatly exceed highest values found in other parts of SE Asia outside of Salajar)

Brouwer, H.A. (1919)- Fossielhoudende Palaeozoische afzettingen op Celebes. De Ingenieur, 8 Nov. 1919, p. 832-833.
('Fossiliferous Paleozoic beds on Sulawesi'. Permian ammonite Popanoceras timorense in collection of Colonel G.J. Verstege, reportedly from 'the Sadang and Mato Allo river basins and the mountains in-between, partly found by myself, partly presented by the chiefs of Enrekang, Doeri and Maiwa in 1907 and 1910' (Kalosi region). This suggests presence of Late Paleozoic marine sediments in S-C Sulawesi, but localities never independently verified. Occurrences questioned by Abendanon (1920) and Von Koenigswald (1933), who believed they probably came from Timor, via a Chinese pharmacy (But cannot be dismissed completely?: Permian brachiopods also reported from E Sulawesi by others (Von Loczy 1934, Kutassy 1934); JTvG)

Brouwer, H.A. (1919)- Devonische afzettingen in den Oost-Indischen archipel. De Ingenieur, 1921, 48, 29 Nov. 1919, 2p.
('Devonian deposits in the East Indies Archipelago'. In addition to Permian ammonite in collection of Colonel G.J. Verstege from Kalosi region, C Sulawesi, also a grey limestone with Upper Devonian brachiopod Spirifer verneuili (NB: Spirifer also known from Permian of Timor; JTvG))

Brouwer, H.A. (1921)- Een jong-Paleozoisch en een Devonisch fossiel van Celebes? De Ingenieur, 1921, p. 138-
('A Late Paleozoic and a Devonian fossil from Sulawesi?'. Additional report of Upper Devonian brachiopod Spirifer verneuilli from collection of Colonel G.J. Verstege)

Brouwer, H.A. (1924)- Geologische beschrijving der omgeving van de Tertiaire fossielrijke lagen nabij Patoenoeang Asoe (Zuid-Celebes). Jaarboek Mijnwezen Nederlandsch Oost-Indie 52 (1923), Verhandelingen, p. 151-165.
('Geological description in the area of Tertiary fossil-rich beds near Patunuang Asu (S Sulawesi)'. Localities of thin-bedded marine fish-bearing lagoonal limestone in Miocene reefal limestone complex, SW Sulawesi. Eocene- Miocene limestones intruded by basalt-diabase sills (Foraminifera from this locality described by Rutten 1924, crab fossil by Van Straelen 1924, fish fossils by De Beaufort 1926))

Brouwer, H.A. (1930)- The major tectonic features of Celebes. Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 33, 4, p. 338-343.
(online at: www.dwc.knaw.nl/DL/publications/PU00015894.pdf)
(Brief overview of Sulawesi geology, after 1929 expedition. C Sulawesi three zones: (1) eastern zone with abundant imbricated basic-ultrabasic igneous rocks, radiolarian cherts and Mesozoic limestones; (2) central zone dominated by crystalline schists, deformation strike mainly N-S; (3) western zone with abundant granitic rocks and with Mesozoic sediments of different facies from zone 1)

Brouwer, H.A. (1934)- Geologisch onderzoekingen op het eiland Celebes. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 10, p. 39-218.
(Report on 1929 geological traverses in Central Sulawesi. With appendices on Mesozoic belemnites by Stolley, molluscs by Broili and Tertiary foraminifera by Van der Vlerk & Dozy. Occurrence of E-M Cretaceous limestone with coral and Orbitolina in isoclinally folded shales-sandstone-radiolarian?chert near Latimojong Mts, SW Sulawesi. At E coast of the norther SE Arm of Sulawesi Early Miocene (Te5) conglomeratic limestone with clasts of underlying, mainly W-SW dipping imbricated series with serpentinite and Cretaceous pelagic limestone with Globotruncana, etc.))

Brouwer, H.A. (1941)- Tektonik und Magma in der Insel Celebes und der indonesische Gebergstypus. Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam 44, 3, p. 253-261.
(online at: www.dwc.knaw.nl/DL/publications/PU00017559.pdf)

('Tectonics and magma of Sulawesi and the Indonesian mountain type'. C Sulawesi 3 N-S trending belts: (1) Eastern belt of ultrabasic rocks overlain by Mesozoic limestones and radiolarites; (2) central belt of regional metamorphic schists, age of which is debatable, and with decreasing metamorphism to East; (3) Western belt with common granodiorite, biotite-rich schist and Cretaceous-Tertiary sediments. No active volcanism in C Sulawesi today, but stopped only in Quaternary)

Brouwer, H.A. (1947)- Geological explorations in Celebes- summary of the results. In: H.A. Brouwer (ed.) Geological Explorations of the Island of Celebes, North Holland Publ. Co., p. 1-64.
(Summary of geology of C Sulawesi, mainly based on work of the 1929 Bandung Geological Survey expedition, results of which were first reported by Brouwer 1934). This summary also incorporates results of petrographic work by Willems (1937), Egeler (1947) and De Roever (1947))

Brouwer, H.A. (1949)- Sur un massif granodioritique et ses phenomenes de contact a l'ouest de Palopo (Celebes). Proc. Kon. Nederl. Akademie Wetenschappen 52, 6, p. 610-613.
(online at: www.dwc.knaw.nl/DL/publications/PU00018675.pdf)
('On a granodioritic massif and its contact phenomena W of Palopo, S part of Central Sulawesi'. Graniodiorite massif and contact aureole sampled along road Rante Pao and Palopo, 17-28 km E of Rante Pao)

Brouwer, H.A. & L.F. de Beaufort (1922)- Tertiaire afzettingen met fossiele visschen van Z-Celebes. Verslagen Kon. Akademie Wetenschappen, Amsterdam, Afd. Wis- en Natuurk., 32, p. 33-40.
('Tertiary deposits with fish fossils in S Sulawesi'; same as paper below)

Brouwer, H.A. & L.F. de Beaufort (1923)- On Tertiary marine deposits with fossil fishes from South Celebes. Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 26, 3-4, p. 159-166.
(online at: www.dwc.knaw.nl/DL/publications/PU00014925.pdf)
(English version of paper above. Two fish fossils of probable Miocene age in fine-grained 'lithographic' limestone block from roadcut near Patoenoeang Asoe E, Maros district. Rocks probably lagoonal deposit in Eocene-Miocene reefal limestone complex. Fish identified as Clupea (Sardinella) brouweri n.sp. and Lutjanus)

Bucking, H. (1904)- Beitrage zur Geologie von Celebes. Sammlungen Geol. Reichs-Museums Leiden, ser. 1, 7, p. 29-205.
(online at: www.repository.naturalis.nl/document/552426)
('Contributions to the geology of Sulawesi', in 6 chapters. Early descriptions of SW Sulawesi igneous, metamorphic, sedimentary rocks. First description of (Bantimala) Cretaceous metamorphic complex in Pangkajene River area:mica-schist, glaucophane schist, etc. associated with serpentinites, and overlain by radiolarian cherts, Eocene coal-bearing clastics and Nummulites limestones and Miocene limestones)

Budiman, B., I. Hardjana & Hermadi (2011)- The geology and Au-mineralization system in the Totopo West Prospect, Gorontalo, Indonesia. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado, MGEI/IAGI, p. 189-200.
(see Budiman et al. 2012)

Budiman, B., I. Hardjana & Hermadi (2012)- The geology and Au-mineralization system in the Totopo West Prospect, Gorontalo, Indonesia. Majalah Geologi Indonesia 23, 3, p. 159-170.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/732)
(Same paper as Budiman et al. 2011). Totopo West gold prospect, W of Gorontalo, probable Miocene andesitic volcanics unconformably overlain by Pliocene-Pleistocene dacitic volcanics, all intruded by are intruded by contemporaneous diorite and dacite porphyry dykes. Additional exploration required)

Buskamal, M.T. Djunaedi & Nur Hasjim (1999)- Biostratigraphic study of Toraja Formation, Kalosi, South Sulawesi. Proc. 28th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 3, p. 21-34.
(In Indonesian. Summary of biostratigraphy of marine Eocene Toraja Fm in area S and SW of Kalosi, in NE part of S Arm of Sulawesi. Planktonic foram zones P12-P16, nannofossil zones NP14-NP20. Rantepao

limestone member with Late Eocene (Tb) larger forams Discocyclina, Nummulites, Pellatispira. Palynomorphs Proxapertitus cursus zone)

Caldwell, .G. & M. Lillie (2004)- Manuel Pinto's inland sea: using palaeoenvironmental techniques to assess historicalevidence from Southwest Sulawesi. In: S.G. Keates & J. Pasveer (eds.) Quaternary Research in Indonesia, Chapter 13, Modern Quaternary Research in Southeast Asia 18, Balkema, Leiden, p. 259-272.
(Discussion of historical Bugis accounts (La Galigo) suggesting expansion of Tempe, Sidenreng and Buaya lakes in SW Sulawesi and possible seaway across SW Arm of Sulawesi)

Calvert, S.J. (2000)- The Cenozoic geology of the Lariang and Karama regions, Western Sulawesi, Indonesia. Ph.D. Thesis, University of London, p. 1-353. *(Unpublished)*

Calvert, S.J. (2000)- The Cenozoic evolution of the Lariang and Karama basins, Sulawesi. Proc. 27th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 505-511.
(W Sulawesi influenced by development of Makassar Straits to W and collision of continental, ophiolitic and island arc fragments to E (E Sulawesi ophiolite and Buton, Tukang-Besi and Banggai-Sula microcontinents). Ages attributed to collision events Early to Late Miocene. Collisions caused uplift, erosion and deposition of 'Celebes Molasse'. Lariang and Karama basins in central W Sulawesi ~10,000 km2)

Calvert, S.J. & R. Hall (2003)- The Cenozoic geology of the Lariang and Karama regions, Western Sulawesi: new insight into the evolution of the Makassar Straits region. Proc. 29th Ann. Conv. Indon. Petr. Assoc. (IPA), Jakarta, p. 501-517.
(W Sulawesi Lariang and Karama regions oldest sediments ?Paleocene non-marine coals, sandstones, mudstones. Rifting M- Late Eocene. Eocene sediments in graben/half graben in marine and marginal marine environments. Eocene Makassar Straits rift asymmetrical: Kalimantan margin twice width of Sulawesi margin. Start thermal subsidence in Late Eocene. By end-Oligocene most of W Sulawesi shelf carbonate and mudstone deposition. Carbonates- mudstones deposited throughout E Miocene and in places until M or Late Miocene. Little or no evidence of Miocene collisions in W Sulawesi. First evidence of orogenic deformation is Pliocene uplift and erosion, followed by deposition of coarse clastics from orogenic belt to E of study area)

Calvert, S.J. & R. Hall (2006)- The Cenozoic evolution of the Lariang and Karama regions, North Makassar Basin, Western Sulawesi: Indonesia. Proc. Jakarta 2006 Int. Geosc. Conf. Exhib., AAPG/ Indon. Petr. Assoc. (IPA), Jakarta06-PG-31, 5p.

Calvert, S.J. & R. Hall (2007)- Cenozoic evolution of the Lariang and Karama regions, North Makassar Basin, western Sulawesi, Indonesia. Petroleum Geoscience 13, p. 353-358.
(Similar to papers above. Main contractional deformation in W Sulawesi is mid-Pliocene, whereas in E Kalimantan it dates from E Miocene)

Camplin, D.J. & R. Hall (2013)- Insights into the structural and stratigraphic development of Bone Gulf, Sulawesi. Proc. 37th Ann. Conv. Indon. Petroleum Assoc., IPA13-G-079, p. 1-24.
(Bone Bay seismic stratigraphic study. Gulf can be divided into several transtensional sub-basins and highs, which are important strike-slip fault zones trending roughly WNW-ESE. Extension occurred since M Miocene, although may have started in E Miocene)

Camplin, D.J. & R. Hall (2014)- Neogene history of Bone Gulf, Sulawesi, Indonesia. Marine Petroleum Geol. 57, p. 88-108.
(Bone Gulf probably underlain by pre-Neogene volcanogenic, sedimentary, metamorphic and ultramafic rocks. Basin initiation probably in Miocene, by extension associated with strike-slip deformation. Main basin trend N-S, divided into several sub-basins. Carbonate deposits formed at margins while deeper marine sediments were deposited in axial parts. Early Pliocene unconformity marks major uplift of Sulawesi and subsidence of Bone Gulf, causing major influx of clastics from the north. Hydrocarbons indicated by seeps)

Carlile, J.C., S. Digdowirogo & K. Darius (1990)- Geological setting, characteristics and regional exploration for gold in the volcanic arcs of North Sulawesi, Indonesia. J. Geochemical Exploration 35, p. 105-140.
(N Sulawesi significant gold province in series of spatially overlapping Tertiary volcanic arcs. In W rhyodacitic volcanics overlie quartzo-feldspathic metamorphic basement. Oldest rocks in W part (Marisa region, same age as Palu granodiorite, ~31 Ma). In C and E areas submarine basaltic basement overlain by andesitic volcanics, centres of which migrated progressively E from E Miocene to present day. Four categories of gold mineralization: porphyry Cu-Au, gold and base metal breccia and high- and low sulpidation epithermal)

Carlile, J.C. & A.G. Kirkegaard (1985)- Porphyry copper-gold deposits of the Tombulilato district, North Sulawesi, Indonesia: an extension of the Philippine porphyry copper-gold province. In: M.P. Jones (ed.) Proc. Asian Mining ô85 Conf., Manila, Inst. Mining Metallurgy, London, p. 351-363.

Carthaus, E. (1900)- Beobachtungen auf Celebes und Sumatra. Sammlungen Geol. Reichs-Museums Leiden, ser. 1, 6, p. 246-249.
(online at: www.repository.naturalis.nl/record/509505)
('Observations on Sulawesi and Sumatra'. Brief report with geological observations made during a trip to W Sulawesi, incl. leucite-bearing volcanics along coast S of Mamuju, etc.. No maps, figures)

C & C Reservoirs (1997)- Kampung Baru Field, East Sengkang Basin, Indonesia. Digital Analogs, Reservoir Evaluation Report, Far East, 15p.
(Late Miocene Tacipi Fm gas-bearing (350 GCF) reefal buildup on carbonate platform, encased in deep water shales in SW Sulawesi. Moldic porosity from fresh-water leaching)

Chaerul, M., L.O. Ngkoimani & S. Sadri (2017)- Limestone facies and diagenesis on Tondo Formation at Kaisabu Village Bau-Bau City Southeast Sulawesi Province. J. Geoscience Engin. Environment Techn. 2, 1, p. 9-13.

Charlton, T.R. (1996)- Correlation of the Salawati and Tomori basins, eastern Indonesia: a constraint on left-lateral displacements of the Sorong fault zone. In: R. Hall & D. Blundell (eds.) Tectonic evolution of Southeast Asia, Geol. Soc., London, Spec. Publ. 106, p. 465-481.
(Salawati Basin of W New Guinea and Tomori Basin of E Sulawesi may have formed single sedimentary basin before displacement on Sorong Fault system, implying left-lateral displacement of ~900 km, probably largely in latest Miocene-Quaternary, contemporaneous with deposition of clastic sediments)

Cipta, A., R. Robiana, J.D. Griffin, N. Horspool, S. Hidayati & P. Cummins (2016)- A probabilistic seismic hazard assessment for Sulawesi, Indonesia. In: P.R. Cummins & I. Meilno (eds.) Geohazards in Indonesia; Earth science for disaster risk reduction, Geol. Soc. London, Spec. Publ. 441, 20p.
(High seismic activity rates, both along fast-slipping crustal faults(Palu-Koro-Matano Fault) and in regions of distributed deformation, contribute moderate-high earthquake hazard over all but the SW part of Sulawesi)

Cita, A., H. Moechtar, U.M. Lumbanbatu, Subiyanto & S. Poedjoprajitno (eds.) (2014)- Geodinamika Kuarter daerah Sulawesi Utara. Pusat Survei Geologi (Badan Geologi), Bandung, Spec. Publ., p. 1-275.
('Quaternary geodynamics of the Sulawesi region'. Collection of papers on Quaternary of Sulawesi)

Coffield, D.Q., S.C. Bergman, R.A. Garrard, N. Guritno, N.M. Robinson & J. Talbot (1993)- Tectonic and stratigraphic evolution of the Kalosi PSC area and associated development of a Tertiary petroleum system, South Sulawesi, Indonesia. Proc. 22nd. Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 679-706.
(S Sulawesi basement imbricated, metamorphic Mesozoic sediments and ophiolites (SE Sundaland Cretaceous accretionary complex). Unconformably overlain by Paleo-Eocene volcanics and Eocene fluvial- lacustrine rocks, associated with extensional faulting. U Eocene- M Miocene Tonasa Fm platform carbonates reflect quiescence. Thick M Miocene- Pliocene N-S trending bimodal volcano- plutonic belt reflects E-M Miocene subduction beneath S Sulawesi and obduction of oceanic crust onto E Sulawesi micro-continent(s), followed by M-L Miocene collision. These are unconformably overlain by latest Miocene- earliest Pliocene Tacipi reef carbonates and Pliocene and younger synorogenic clastics. Continued Pliocene convergence formed W-vergent

orogen in S Sulawesi, with thin-skinned thrusting in W and basement-involved thrusting in E. Oils from seeps typed to mature Eocene source rocks)

Coffield, D.Q., N. Guritno, M.E.J. Wilson & N.A. Ascaria (1997)- Petroleum systems of South Sulawesi, Indonesia (fieldtrip summary). In: J.V.C. Howes & R.A. Noble (eds.) Proc. Int. Conf. Petroleum systems of SE Asia and Australasia, Indon. Petroleum Assoc. (IPA), Jakarta, p. 1001-1010.
(S Sulawesi dominated by W-verging Late Miocene- Pliocene foldbelt. Source rocks in deltaic coals of early transgressive sequences. Late Tertiary magmatism and subsequent Pliocene orogenesis resulted in formation of multiple kitchen areas. Potential reservoirs throughout Late Tertiary section, although only Late Miocene-Pliocene (post-magmatic/ pre-orogenic) carbonates proven productive to date in S Sulawesi)

Coffield, D., N. Guritno, M. Wilson & A. Ascaria (1997)- Petroleum systems of South Sulawesi, Indonesia. Indon. Petroleum Assoc. Fieldtrip Guidebook, p. 1-81.

Collins J.S.H. & A.J. Barber (1998)- A new middle Eocene crab, *Lobocarcinus pentanodosus* sp. nov. (Crustacea, Decapoda) from Doi Doi, Barru, South Sulawesi, Indonesia. Bull. Mizunami Fossil Museum, Japan, 25, p. 97-101.
(New cancroid crab fossils from M Eocene of S Sulawesi. This is first record of genus from W Pacific)

Cornee, J.J., R. Martini, M. Villeneuve, L. Zaninetti, E. Mattioli, R. Rettori, F. Atrops & W. Gunawan (1997)- Jurassic pelagic deposits of East Sulawesi (Kolonodale Area, Indonesia): new biostratigraphic data based on calcareous nannofossils. In: Geoitalia, 1 Forum FIST, 2, p. 97-98 *(Abstract)*
(online at: http://archive-ouverte.unige.ch/unige:4764)
(E-M Jurassic (Toarcian- Bathonian) calcareous nannoplankton above Late Triassic limestones in dismembered succession in Kolonodale-Beteleme area of W margin of E Sulawesi Zone)

Cornee, J.J., R. Martini, M. Villeneuve, L. Zaninetti, E. Mattioli, R. Rettori, F. Atrops & W. Gunawan (1999)- Mise en evidence du Jurassique inferieur et moyen dans la ceinture ophiolitique de Sulawesi (Indonesie). Consequences geodynamiques. Geobios 32, 3, p. 385-394.
('Evidence of Lower and Middle Jurassic in the Sulawesi ophiolite belt: geodynamic consequences'. ~350m E-M Jurassic deep marine clays and carbonates over Latest Triassic reefal carbonates in E Sulawesi Kolonodale area, indicating major subsidence after Triassic carbonate deposition. Thin E Jurassic limestones with Involutina liassica. On W bank of Lambolo Gulf in thin Toarcian shale one ammonite of Hammatoceras moluccanum group. Ophiolite overrides rel. thin Late Cretaceous- Paleogene pelagic limestones. Prior to Neogene tectonics, which strongly dismembered E Indonesia, ophiolitic tectonic zone of E Sulawesi probably part of wide paleogeographic block which included some of Banda Sea continental fragments (Buru, Seram, Buton, Sinta Ridge))

Cornee, J.J., G. Tronchetti, M. Villeneuve, B. Lathuiliere, M.C. Janin, P. Saint-Marc, W. Gunawan & H. Samodra (1995)- Cretaceous of eastern and southeastern Sulawesi (Indonesia): new micropaleontological and biostratigraphical data. J. Southeast Asian Earth Sci. 12, p. 41-52.
(New outcrops of pelagic carbonates of Albian and Campanian-Maastrichtian age in strongly tectonized areas in E and SE Sulawesi. Species indicate no major difference in facies of E and SE arms of Sulawesi. Similar facies also in numerous places in E Indonesia and in distal Australian shelf during Late Cretaceous)

Cornee, J.J., M. Villeneuve, R. Martini, L. Zaninetti, D. Vachard, B. Vrielynck. W. Gunawan, H. Samodra & L. Sarmili (1994)- Une plate-forme carbonatee dôage rhetien au centre-est de Sulawesi (region de Kolonodale, Celebes, Indonesie). Comptes Rendus Academie Sciences, Paris 318, Ser. II, p. 809-814.
(online at: https://archive-ouverte.unige.ch/unige:4767)
('A carbonate platform of Rhaetian age in Central-East Sulawesi (Kolonodale region'. Widespread outcrops of ~150m of white latest Triassic reefal carbonates S and SW of Kolonodale (below E Sulawesi ophiolite terrane?). Limestones range from boundstone to grainstone. Non-skeletal grains mainly peloids and some ooids and intraclasts. Skeletal grains molluscs, green algae (including dasycladaceans), echinoderms and benthic

foraminifera (Aulotortus spp., Auloconus, Triasina hantkeni) and locally also brachiopods, coral clusters. Limestones can be correlated with U Triassic limestones of Tokala Mts of Sulawesi East Arm)

Costa, K.M., J.M. Russell, H. Vogel & S. Bijaksana (2015)- Hydrological connectivity and mixing of Lake Towuti, Indonesia in response to paleoclimatic changes over the last 60,000 years. Palaeogeogr. Palaeoclim. Palaeoecology 417, p. 467-475.
(Sediment geochemistry of cores from Lake Towuti in C Sulawesi records paleoclimate changes over last 60 ka. During Last Glacial Maximum no changes in sediment provenance, despite drier climate, but trace elements suggest decrease in weathering intensity, likely in response to decreased precipitation and temperature)

Cottam, M.A., R. Hall, M. Forster & M. Boudagher Fadel (2011)- Basement character and basin formation in Gorontalo Bay, Sulawesi, Indonesia: new observations from the Togian Islands. In: R. Hall, M.A. Cottam & M.E.J. Wilson (eds.) The SE Asian gateway: history and tectonics of Australia-Asia collision, Geol. Soc. London, Spec. Publ. 355, p. 177-202.
(Togian islands stratigraphy includes Walea Fm pillow basalts and volcanic breccias of unknown age, overlain by late Middle Miocene Peladan Fm limestone, overlain by Late Miocene- E Pliocene Bongka Fm/ Celebes Molasse and uplifted ?Pleistocene reef terraces. Field relationships indicate latest Miocene- Pliocene age for inception of Gorontalo Bay basin. Young medium-K to shoshonitic volcanism in Togian Islands not due to subduction but reflects crustal thinning and extension in Pliocene- Pleistocene. Extension continuing today. Extension and subsidence driven by rollback of subduction hinge at N Sulawesi Trench.)

Crotty, K.J. & D.W. Engelhardt (1993)- Larger foraminifera and palynomorphs of the upper Malawa and lower Tonasa Formations, southwestern Sulawesi Island, Indonesia. In: T. Thanasuthipitak (ed.) Int. Symposium Biostratigraphy of mainland Southeast Asia: facies and paleontology (BIOSEA), Chiang Mai 1993, p. 71-82.
(SW Sulawesi M Eocene coal-bearing Malawa Fm clastics with pollen Retitribrevicolporites matamanadhensis and dinoflagellates Muratodinium fimbriatum and Homotryblium floripes. Overlying clastics/ limestones Late Eocene with Verrucatosporites usmensis, Nummulites javanus (Ta3?) and Pellatispira- Biplanispira (Tb), Discocyclina and Asterocyclina. Overlain by ~120' thick basal dolomitic member of E Oligococene Tonasa Lst with Coskinolina, Praerhapidionina, arenaceous foraminifera and miliolids, overlain by thin Tc with Nummulites fichteli and Td with same + Eulepidina, Austrotrillina striata. Near top of Tonasa quarry Late Oligocene/ Te1-4 with Nephrolepidina, Spiroclypeus and Heterostegina borneensis. No miogypsinids seen)

Cucci, M.A., R.A. Garrard & M. Golborne (1994)- The Early Tertiary rift basins of offshore South Sulawesi, Indonesia. AAPG Ann. Mtg., Denver *(Abstract)*
(Offshore S Sulawesi Paleogene rift system activated and failed twice. Initial rifting Late Paleocene-E Eocene, with N-S oriented sags on Cretaceous platform with Langi Fm volcanics. By M Eocene rifting failed and uplift/ erosion formed major unconformity. Second rift event M Eocene, close to earlier 'sags'. N-S orientation, from off S Sulawesi to near Sabalana Island at intersection with E-W trending Kangean-Lombok rift system. M Eocene terrestrial-lacustrine Malawa/Toraja Fms overlain by fluvio-deltaic deposits. In Late Eocene rifting ceased, leaving extensive shelfal areas isolated from Sulawesi sediment supply. Transgression initiated vast Tonasa/ Makali Fm carbonate platform with localized reefal buildups. Late Miocene carbonates gave way to siliciclastics (Camba Fm), derived from establishment of major magmatic belt. Late Tertiary compressional tectonics inverted many Paleogene rifts to form classic 'Sunda- type' folds)

Dam, R.A.C., J. Fluin, P. Suparan & S. van der Kaars (2001)- Paleoenvironmental developments in the Lake Tondano area (N-Sulawesi, Indonesia) since 33,000 yr B.P.. Palaeogeogr. Palaeoclim. Palaeoecology 171, p. 147-183.
(Lake Tondano at 680m above SL. Lake levels rose and fell. Late Pleistocene phase with lower precipitation and lower temperatures. Progressive deforestation of Tondano upland)

Darman, H. (2011)- Seismic expression of North Sulawesi subduction zone. Berita Sedimentologi 22, p. 5-8.
(online at: www.iagi.or.id/fosi/files/2011/10/...)
(Seismic lines/ cross sections of recent subduction complex of Sulawesi Sea plate under Sulawesi North Arm)

Davies, I.C. (1990)- Geological and exploration review of Tomori PSC, eastern Indonesia. Proc. 19th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 41-67.
(Tomori PSC, E Sulawesi, two tectonostratigraphic units: (1) Banggai-Sula microcontinent and (2) 'trapped' E Sulawesi Ophiolite Belt, thrust over Banggai-Sula microcontinental block in E Pliocene. Structural styles developed, firstly as Banggai- Sula moved W to present position, and secondly as it entered collision zone with E Sulawesi Ophiolite Belt. N area characterized by normal and wrench faults, S area by imbricate thrusts. Pre-collision Miocene sequence two carbonate reservoir units: (1) E Miocene platform limestones, with Tiaka oil field in complex thrust zone in S part of PSC; (2) Late Miocene mixed platform- reefal carbonate with Minahaki and Matindok gas fields. Source rocks for hydrocarbons in Miocene. Generation and migration in Pliocene/ Pleistocene, as prior to this, insufficient overburden to create mature source)

De Beaufort, L.F. (1926)- On a collection of marine fishes from the Miocene of South Celebes. Jaarboek Mijnwezen Nederlandsch-Indie 54 (1925), Verhandelingen 1, p. 115-148.
(Fish fossils collected by Brouwer in 1923 from lithographic (lagoonal?) platy limestone mear Patanuang Asi, Maros district, S Sulawesi Fifteen coastal marine fish species, including herring-like Sardinella brouweri and Lutjanus. Associated foraminifera identified by Rutten as Early Miocene age. No location or stratigraphy info)

De Beaufort, L.F. (1934)- On a fossil fish from Gimpoe (Central Celebes). Verhandelingen Kon. Nederl. Geologisch Mijnbouwkundig Genootschap (KNGMG) 10, 2, p. 180-181.
(Brief description of fish fossils, probably fresh-water and of Neogene age, collected at Gimpoe basin, C Sulawesi, by Brouwer 1929 expedition)

De Klerk, L.G. (1983)- Zeespiegels, riffen en kustvlakten in Zuidwest-Sulawesi, Indonesia: een morfogenetisch- bodemkundige studie. Ph.D. Thesis University of Utrecht, p. 1-174.
('Sea levels, reefs and coastal plains of Southwest Sulawesi, Indonesia: a morphogenetic-pedological study'. On the Holocene evolution of the Spermonde Archipelago coral reefs and adjacent SW Sulawesi coastal region)

De Koning Knijff, J. (1914)- Geologische gegevens omtrent gedeelten der afdelingen Loewoe, Pare Pare en Boni van het Gouvernement Celebes en onderhoorigheden. Jaarboek Mijnwezen Nederlandsch Oost-Indie 41 (1912), Verhandelingen 1, p. 277-312.
(Report on 1909 reconnaissance surveys in Luwu, Pare Pare and Bone districts (S and C Sulawesi), compiled by Brouwer. Not overly useful)

Delisle, G., H. Beiersdorf, S. Neben & D. Steinmann (1998)- The geothermal field of the North Sulawesi accretionary wedge and a model on BSR migration in unstable depositional environments. In: J.P. Henriet et al. (eds.) Gas hydrates: relevance to world margin stability and climate change, Geol. Soc., London, Spec. Publ. 137, p. 267-274.
(Distribution of heat flow in N Sulawesi accretionary wedge derived from depths of bottom simulating reflector (BSR) and nine in situ heat flow measurements. High heat flow of ~70-100mWm 2 near deformation front and systematic decrease to 30mWm -2 landwards)

De Man, J.G. (1904)- Beschreibung einiger brachyurer Krebse aus post-Tertiaren schichten der Minahassa, Celebes. Sammlungen Geol. Reichs-Museums Leiden, E.J. Brill, ser. 1, 7, 1, p. 254-278.
(online at: www.repository.naturalis.nl/document/552414)
(Description of Quaternary brachyurid crab fossils from marls near Kajoe ragi, along road from Menado to Kema, N Sulawesi, collected by Fennema. Incl. new species Metopoxantho martini and Macrophthalmus granulosus. Associated molluscs described by Schepman 1907)

De Roever, W.P. (1947)- Igneous and metamorphic rocks in Eastern Central Celebes. In: H.A. Brouwer (ed.) Geological explorations of the island of Celebes, North Holland Publ. Co., p. 67-173.
(Two main metamorphic facies in eastern C Sulawesi: older epidote-amphibolite facies and younger lawsonite-glaucophane blueschist facies. Many rocks polymetamorphic, affected by both facies. Epidote-amphibole facies over whole region, glaucophane facies in western half of eastern C Sulawesi only (Lake Poso, etc.))

De Roever, W.P. (1950)- Preliminary notes on glaucophane-bearing and other crystalline schists from Southeast Celebes, and on the origin of glaucophane-bearing rocks. Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 53, 9, p. 1455-1465.
(online at: www.dwc.knaw.nl/DL/publications/PU00018892.pdf)
(Petrographic study of 170 crystalline schist samples from SE Sulawesi, collected by Bothe, Hetzel, etc. Two metamorphics groups, similar to Kabaena island (De Roever 1953): (1) Rumbia and Mendoke Mts mainly glaucophane-lawsonite schist facies (metamorphism of 'alpine orogene'; original material of Mesozoic age) and (2) lower La Solo River mainly amphibolite and greenschist-dynamometamorphic facies (probably Paleozoic or older original rock and pre-alpine age metamorphism). 'Paired metamorphic belt' of lawsonite-glaucophane schists and ultrabasites in East, andalusite-cordierite metamorphics and granites on W side of Sulawesi)

De Roever, W.P. (1951)- Ferrocarpholite, the hitherto unknown ferrous analogue of carpholite. Indonesia. American Mineralogist 36, p. 736-745.
(Ferrocarpholite new dark green prismatic mineral from cobble of metamorphic vein-quartz collected by Hetzel, W of Tomata, eastern Central Sulawesi (= part of high P/ low T blueschist metamorphic facies; JTvG))

De Roever, W.P. (1953)- Tectonic conclusions from the distribution of the metamorphic facies in the island of Kabaena near SE Celebes. Proc. 7th Pacific Science Congress, New Zealand 1949, 2, p. 71-81.
(Metamorphic facies map of Kabaena Island off SE arm of Sulawesi and W of Buton. Peridotites-serpentinites are uppermost tectonic unit. Separated by overthrust fault from underlying metamorphic schists of amphibolite and epidote-amphibolite facies. Below this another overthrust plane. Lowermost tectonic unit ?Mesozoic schists in glaucophane-lawsonite facies, thrusted 10's of km, Movements directed approximately to N)

De Roever, W.P. (1955)- Genesis of jadeite by low-grade metamorphism (Celebes). American J. Science 253, 5, p. 283-298.
(Jadeite-rich pyroxene occurs as zoned crystals in metamorphic quartzite of Salimoeroe and Koesek River regions, Sulawesi (petrographic descriptions in De Roever 1947). Formed by conversion of albite in psammitic sediments as extreme variety of low-grade metamorphism in glaucophane schist facies)

De Roever, W.P. (1956)- Some additional data on the crystalline schists of the Rumbia and Mendoke Mountains (SE Celebes). Verhandelingen Kon. Nederl. Geologisch Mijnbouwkundig Genootschap, Geol. Serie 16 (Brouwer volume), p. 385-394.
(Rumbia and Mendoke Mts in SE Sulawesi up to 1000m high and composed of metamorphic rocks. Two phases of metamorphism: (1) main phase of rel. deep garnet-lawsonite glaucophane schists, (2) younger 'Alpine' lower grade metamorphism, probably accompanied by large scale overthrusting)

De Roever, W.P. & C. Kieft (1971)- Additional data on ferrocarpholite from Sulawesi (Celebes), Indonesia. American Mineralogist 56, p. 1976-1982.
(Ferrocarpholite from N part of C Sulawesi, resembling actinolite. Most likely a product of metamorphism in glaucophane-schist and lawsonite-albite facies)

Dieckmann, W. (1919)- Nikkelhoudende lateritische ijzerertsen op Celebes. De Ingenieur 43, p. 782-787.
(Nickel-bearing lateritic iron ores on Sulawesi')

Dieckmann, W. & M.W. Julius (1925)- Algemeene geologie en ertsafzettingen van Zuidoost Celebes. Jaarboek Mijnwezen Nederlandsch-Indie 53 (1924), Verhandelingen, p. 11-65.
('General geology and ore deposits of SE Sulawesi'. Mainly valuation of iron, nickel, chromium deposits. With brief appendix on fossils by Van der Vlerk, reporting three groups of pelagic rocks: red radiolarian chert, red shales with 'Globigerina linneana (= Late Cretaceous Globotruncana; JTvG) and grey shale with Globigerina bulloides (Tertiary? JTvG). Followed by petrographic descriptions by Gisolf)

Dill, H.G., A. Fricke, K.H. Henning & H. Gebert (1995)- An APS mineralization in the kaolin deposit Desa Toraget from northern Sulawesi, Indonesia. J. Southeast Asian Earth Sci. 11, 4, p. 289-293.

(Two types of APS (Aluminium-phosphate-sulphate) minerals in Desa Toraget kaolin deposit on Pliocene Tondano Tuff at NE end of N Arm of Sulawesi. Genetic link between epithermal Au mineralization and high sulphidation kaolinitic alteration elsewhere, suggests area may be potential target for Au exploration)

Dirk, M.H.J. (2001)- Petrologi ofiolit lengan tenggara Sulawesi dan potensi sumber daya mineral yang berasosiasi. Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 28, p. 11-26.
('Petrology of ophiolite of the SE arm of Sulawesi and potential of associated minerals')

Dirk, M.H.J. (2010)- Ofiolit di jalur Sulawesi Timur, Warta Geologi 5, 3, p. 40-43.
(online at: http://www.bgl.esdm.go.id/images/stories/warta_geologi/pdf/warta201003.pdf)
('Ophiolite in the East Arm of Sulawesi'. Brief review)

Djajadihardja, Y.S., A. Taira, H. Tokuyama, K. Aoike, C. Reichert, M. Block, H.U. Schluter & S. Neben (2004)- Evolution of an accretionary complex along the North arm of the island of Sulawesi, Indonesia. Island Arc 13, 1, p. 1-17.
(Well-developed accretionary prism at S side N Sulawesi Trench, formed as result of clockwise rotation and N ward movement of N Sulawesi arm after M Miocene Bangai-Sula collision in E. Greatest convergence and widest accretionary wedge in W part of trench/wedge. Growth of accretionary prism started at ~5 Ma)

Djuri, M., Sudjatmiko, S. Bachri & Sukido (1998)- Geologic map of the Majene and western part of the Palopo sheets, Sulawesi, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, p.
(Second edition of 1974 W Sulawesi geologic map between 3-4°S (adjacent to Mandar block). Oldest rocks low-metamorphic Upper Cretaceous clastics, overlain by Eocene limestones-clastics, Oligocene and younger clastics, limestones and volcanics, Miocene- Pliocene granitic intrusives. M Miocene- Pliocene molasse unconformable over older sediments)

Dollfus, G.F. (1917)- Paleontologie du voyage a lõile de Celebes de M.E.C. Abendanon. In: E.C Abendanon, E.C. (1917) Geologische en geographische doorkruisingen van Midden-Celebes (1909-1910), E.J. Brill, Leiden, 3, p. 959-1016.
('Paleontology of the voyage to Sulawesi by Abendanon'. Brief descriptions of 'Jurassic' red radiolarian cherts, Upper Cretaceous marls with molluscs (Turritella, Thracia abendanoni, Cytherea verbeeki), hard, dark Eocene Nummulites- Discocyclina- Pellatispira limestone and Oligocene- Pliocene marine sediments with molluscs)

Dollfus, G.F. (1919)- L'Oligocene de l'ile de Celebes. Compte Rendu sommaire Seances Soc. Geologique France 1919, p. 13-15.
(online at: https://babel.hathitrust.org/cgi/pt?id=mdp.39015035493991;view=1up;seq=23)
('The Oligocene of Sulawesi island'. Disagrees with Martin (1917) critique of Dollfus (1917), suggesting Dollfus' Oligocene molluscs from Sulawesi should be Neogene. Occurrence of Tympanotonus (Vicarya) verneuili)

Dzakirin, D.F., P.Y. Pratama, W.B. Raharjo, S. Hartanto, R. Armanda, Jaenudin et al. (2017)- Development and controlling factors of Miocene carbonate buildups: an example from the Senoro gas field, Central Sulawesi. Proc. Joint Conv. HAGI-IAGI-IAFMI-IATMI (JCM 2017), Malang, 3p.
(Senoro gas field in E Sulawesi divided into two carbonate reservoir areas: (1) N Senoro with Mentawa carbonate buildup facies, and (2) S Senoro with Minahaki platform carbonate facies)

Effendi, A.C. (1976)- Geologic map of the Manado quadrangle, North Sulawesi. Geol. Res. Dev. Centre (GRDC), Bandung.
(see also Effendi & Bawono, 1997; 2nd Edition)

Effendi, A.C. & S.S. Bawono (1997)- Geologic map of the Manado quadrangle, North Sulawesi, 2nd Ed.. Geol. Res. Dev. Centre (GRDC), Bandung.

(Geologic map of NE tip of North Arm of Sulawesi. Common E Miocene- Recent volcanics and volcanoclastics and associated limestones. Volcanic arc formed as response to subduction from N Sulawesi subduction zone and East (E Sangihe subduction zone))

Egeler, C.G. (1947)- Contribution to the petrology of the metamorphic rocks of Western Celebes. In: H.A. Brouwer (ed.) Geological Explorations of the Island of Celebes, North Holland Publishing Co., p. 177-346.
(Also Thesis University of Amsterdam, 1946, p. 1-165. Descriptions of metamorphic and igneous rocks from N Part of western Central Sulawesi and S part of Sulawesi 'neck', collected by Brouwer in 1929. Widespread young 'alpine' granodioritic intrusions of W Sulawesi caused intense plutonic contact metamorphism, which was superimposed over older regional metamorphism)

Egeler, C.G. (1949)- On amphibolitic and related rocks from western Celebes and the southern Sierra Nevada, California. Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 51, 1, p. 100-105.
(On similarities between metamorphic rocks of Sulawesi and Sierra Nevada, California)

Egeler, C.G. (1949)- On metamorphic rocks from the island of Kabaena in the East-Indian Archipelago. Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 52, 5, p. 551-562.
(online at: www.dwc.knaw.nl/DL/publications/PU00018668.pdf)
(Petrographic descriptions of metamorphic rocks collected by Brouwer in 1929: hornfels, mica-schists, gneiss, amphibolite, amphibolite schist and crystalline limestones. Kabaena high-grade regional metamorphic schists considered to be older than ophiolitic rocks, similar to SE Sulawesi, but not affected by younger glaucophanitic metamorphism as seen in E Sulawesi (but De Roever (1953) did report glaucophane schist from Kabaena; JTvG). No locality maps or geologic context)

Elburg, M. & J. Foden (1998)- Temporal changes in arc magma geochemistry, Northern Sulawesi, Indonesia. Earth Planetary Sci. Letters 163, p. 381-398.
(N Sulawesi Sangihe Arc Late Miocene- Recent volcanics geochemical change through time. Oldest suites mantle source with previous event of melt extraction. Modern lavas, especially volcanic centres far from trench indicate subduction zone component dominated by melt of sedimentary origin. Change from fluid-dominated to melt-dominated subduction zone component may be related to collision between Halmahera and Sangihe arcs. These changes appear superimposed on variable parent magma composition)

Elburg, M. & J. Foden (1999)- Sources for magmatism in Central Sulawesi: geochemical and Sr-Nd-Pb isotopic constraints. Chemical Geology 156, p. 67-93.
(M Miocene- Quaternary magmatism in C West Sulawesi distinct subduction signature. Isotopic signature of lamprophyres interpreted as mixed mantle source with contribution from old sub-continental lithospheric source, from sliver of Australian continent thrust under C Sulawesi. Felsic magmatism likely reflects high degrees of crustal contamination or intracrustal melting)

Elburg, M.A. & J. Foden (1999)- Geochemical response to varying tectonic settings: an example from Southern Sulawesi (Indonesia). Geochimica Cosmochimica Acta 63, p. 1155-1172.
(S arm Sulawesi active continental margin from ~60 to 10 Ma, when it collided with Buton microcontinent. Pre-collisional geochemical signature typical of arc volcanics. Syn-collisional samples more enriched isotopic signatures and K-rich, interpreted to reflect larger contribution from subducted sediments, added to mantle wedge as silicic melt. Magmatism that postdates 10 Ma collision reflects melting of subduction-modified mantle with significant contribution from subcontinental lithospheric mantle)

Elburg, M.A., V.S. Kamenetsky, I. Nikogosian, J. Foden & A.V. Sobolev (2006)- Co-existing high- and low-calcium melts identified by mineral and melt inclusion studies of a subduction-influenced syncollisional magma from South Sulawesi, Indonesia. J. Petrology 47, 12, p. 2433-2462.
(online at: https://academic.oup.com/petrology/article/47/12/2433/1564500)
(Mineral and melt inclusions in olivines from Late Miocene (6-9 Ma) mafic silica-undersaturated ultra-potassic volcanic rocks with 'continental' Sr isotopic characteristics from southern W Sulawesi Volcanic Province

indicate that two distinct melts contributed to its petrogenesis. High-CaO melt typical for subduction-related volcanic rocks, low-CaO melt does not have any obvious rock equivalent)

Elburg, M.A., T. Van Leeuwen, J. Foden & Muhardjo (2002)- Origin of geochemical variability by arc-continent collision in the Biru Area, Southern Sulawesi (Indonesia). J. Petrology 43, 4, p. 581-606.
(online at: https://academic.oup.com/petrology/article/43/4/581/1473969)
(Two main Tertiary volcanic episodes in SW Sulawesi: (1) M-L Eocene (~50 Ma) calc-alkaline Langi volcanics, (2) late Early Miocene calc-alkaline and M-L Miocene (15-6.3 Ma) potassic arc volcanics, both presumably related to W-dipping subduction. Also 1.8 Ma volcano farther S, not related to subduction? Miocene volcanics more heterogeneous after Buton microcontinent collision at ~15 Ma. Isotopic ratios more 'continental' 4 My after collision)

Elburg, M., T. van Leeuwen, J. Foden & Muhardjo (2003)- Spatial and temporal isotopic domains of contrasting igneous suites in western and Northern Sulawesi, Indonesia. Chemical Geology 199, p. 243-276.
(Paleocene- Pliocene magmatism in NW Sulawesi progression from Older Series with calc-alkaline/ tholeiitic signatures (51-17 Ma) to Younger Series of mafic-intermediate high-K magmas (~14-5 Ma) and felsic K-rich calc-alkaline magmas (9-2 Ma). Younger felsic magmatism reflects melting of Australian origin continental crust. Geochemical progression similar to C Sulawesi and explained by oceanic plate subduction followed by melting of underthrust sliver of Australian microcontinent, the size of which can be estimated from extent of low-Nd-isotope magma (~4°S to 1°N). Underthrusting must have happened prior to 14 Ma, indicating it cannot be equated to Sulawesi- Sula platform collision at 5 Ma. While subduction beneath W Sulawesi ceased prior to onset of potassic magmatism, it continued in N Sulawesi producing calc-alkaline suites)

Erlinghagen K.P. (1991)- Petrogenese und geodynamische Entwicklung der Subduktions-Metamorphite von Zentral-Sulawesi, Indonesien. Goettinger Arbeiten Geol. Pal. 52, 103p.
('Petrogenesis and geodynamic development of subduction metamorphics of Central Sulawesi'. Analyses of metamorphic rocks and minerals from NE of Lake Poso and W-NW of Poso town. High-pressure metamorphic rocks of C Sulawesi formed as result of oblique subduction in WNW-dipping subduction zone. Metamorphic grade increasing P and T from E to W: lawsonite-blueschist facies of Taripa belt grade W-ward into epidote-blueschist and eclogite facies of Tineba belt. Max. P-T conditions ~11 kbar/ 400-450°C (Taripa) and ~13 kbar/500-570°C (~45km depth; Tineba). Age of peak metamorphism ~60-65 Ma (Paleocene), followed by rapid cooling in Eocene. K-Ar cooling ages of phengite in garnet-mica schist 38.8 Ma (Late Eocene), silicate marble 50.2 Ma (E Eocene). Late metamorphic overprint of lawsonite-blueschist zone suggested by K-Ar ages around 19 Ma, tied to age of intrusives in W and onset of Banggai-Sula collision)

Endharto, Mac (2000)- Studi stratigrafi kaitannya dengan perkembangan struktur geologi di Kawasan Latimojong, lengan Barat Sulawesi. J. Geologi Sumberdaya Mineral 10, 107, p. 14-45.
('Study of stratigraphy and relation to development of geological structures in the Latimojong District, W arm of Sulawesi'.)

Endharto, M. & Surono (1991)- Preliminary study of Meluhu Complex related to terrane fomation in Sulawesi. Proc. 20th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 340-353.
(Meluhu complex (microcontinent) of SE Sulawesi is NW-SE trending ~25km wide strip in SE Sulawesi, with Late Triassic-Jurassic fluvial clastics and marine limestone and black shale, separated from neighboring terranes by slivers of ophiolite melange. Review of Sulawesi tectonics and reconstructions of M-L Miocene collisions of Tukang Besi Platform and Banggai Sula with E Sulawesi. Meluhu Complex is. (Discussed in more detail in subsequent Surono papers; JTvG))

Ernowo, F.M. Meyer, A. Idrus, H. Widyanarko & N.L. Endrasari (2016)- An update of key characteristics of Awak Mas mesothermal gold deposit, Sulawesi Island, Indonesia. Proc. 8th Ann. Conv. Indonesian Soc. Economic Geol. (MGEI), Bandung, p. 72-75.
(Awak Mas gold deposit in metamorphic belt of Sulawesi. Hosted by low-metamorphic Cretaceous Latimojong Fm flysch sequence locally intruded by diorite dykes. Believed to have formed by hydrothermal fluids sourced from metamorphic dewatering reactions of marine sediments (mesothermal orogenic gold deposit))

Evans, M.J. (1991)- Geological field survey of onshore PSC and adjacent areas, Sulawesi, Indonesia, with specific reference to Eocene reservoir quality and distribution. BP Petroleum Indonesia Report, p.
(Unpublished, but commonly used geological survey report of W Sulawesi basins)

Fadhlurrohman, I., A.F. Parma & C. Fitriani (2017)- Geological observation on Kabaena Island, Southeast Sulawesi: an implication of hydrocarbon occurrence in frontier area based on outcrop study. Proc. 41st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA17-190-SG, 11p.
(Kabaena island off SE Sulawesi contains ultramafic rocks (peridotite), Pompangeo Complex low-medium grade metamorphics (amphibilite, schist) and metamorphosed, fractured Matano Fm limestone and some black shale. Ultramafic rocks thrusted over microcontinental rocks. Gas seepage in limestone unit tied to strike slip fault. Not much new)

Fahrudin, R.S. Wicaksono, J. Wahyudiono & W. Gunawan (2012)- Deformasi cekungan Banggai pada zaman Tersier di Kabupaten Banggai, Sulawesi Tengah. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-GD-26, p.
('Deformation of the Banggai Basin in Tertiary time, Banggai District, C Sulawesi')

Farida, M., F. Arifin, R. Husain & I. Alimuddin (2013)- Paleoseanografi Formasi Tonasa berdasarkan Kandungan Foraminifera Daerah Barru, Sulawesi Selatan. In: Proc. 6th Seminar Nasional Kebumian, Teknik Geologi Universitas Gadjah Mada, Yogyakarta 2013, 12p.
('Paleoceanography of the Tonasa Formation based on foraminifera content in Barru area, South Sulawesi'. Outcrop section with M-L Eocene open marine calcareous shales and thin limestones with planktonic foraminifera (P9-P16), smaller benthics and larger forams)

Farida, M., A. Imran & F. Arifin (2014)- Lingkungan pengendapan purba satuan napal Formasi Tonasa berdasarkan kandungan foraminifera bentonik, studi kasus: Sungai Camming dan Sungai Palakka Kabupaten Barru, Provinsi Sulawesi Selatan. J. Penelitian Geosains (Hasanuddin University) 10, 2, p. 50-57.
(online at: http://repository.unhas.ac.id/bitstream/handle/123456789/15298/)
('Depositional environment of the marl unit of the Tonasa Formation based on benthic foraminifera, case studies: Camming River and River Palakka Barru, S Sulawesi Province'. Mainly middle-outer neritic facies ('30.48- 182.88m'), concluded from nodosarids-dominated benthic foram assemblages in Early-Late Eocene of Tonasa Marls in two outcrop sections)

Farida, M., Pratiwi & R. Husain (2014)- Paleotemperature of Middle Eocene Tonasa Limestone based on foraminifera at Palakka Area South Sulawesi. Int. J. Engineering and Science Applications (UNHAS) 1, 1, p. 77-84.
(online at: http://pasca.unhas.ac.id/ojs/index.php/ijesca/article/view/137/93)
(Interbedded marl/limstone at Palakka section, Barru area (presumably basal Tonasa Lst) with lower M Eocene (P11) planktonic foraminifera and middle? neritic small benthic forams ('warm water= 0-27°C'))

Fauzia, R., R. Sari, A. Mulawardhani, M.I. Novian & T. Sihombing (2012)- Dinamika pengendapan batupasir Formasi Lamusa, Desa Salodik, Kecamatan Luwuk, Kabupaten Banggai, Propinsi Sulawesi Tengah. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-GD-36, 4p. *(Extended Abstract; no figures)*
('Dynamics of Lamusa Formation sandstone deposition, Salodik Village, Banggai District, C Sulawesi'. E Arm of Sulawesi with U Cretaceous calcareous sst near Salodik village, probably middle-outer neritic facies. Facies A with U Cretaceous planktonic foraminifera (Coniacian- Santonian with Marginotruncana spp. Pseudotextularia, Dicarinella concavata, D. asymetrica); Facies B turbiditic Turonian-Santonian with Marginotruncana spp., Heterohelix, etc. Also Late Eocene- Oligocene P18/19 pelagic facies E-M Eocene Facies F with P11-P14 planktonics)

Ferdian, F. (2017)- Eastern Sulawesi basement: revelation from zircon data. Proc. Joint Conv. HAGI-IAGI-IAFMI-IATMI (JCM 2017), Malang, 3p. *(Extended Abstract)*

(Zircon ages from Banggai-Sula and E Sulawesi. Granites from Banggai-Sula region with mainly Permo-Triassic age zircons. Also one Banggai-Sula granitoid with 23-26 Ma zircons. Banggai and Taliabu metamorphics mainly Proterozoic zircon ages. Sulabesi metasediments with Permo-Triassic zircons. SE Sulawesi Mekongga Fm metamorphics with Mesozoic-Paleozoic and Meso-Paleoproterozoic zircons, but youngest zircon ~170 Ma (M Jurassic) (similar distribution in Triassic-Jurassic Meluhu clastics))

Frantz, L.A., F.A. Rudzinski, A.M.S. Nugraha, A. Evin, J. Burton, A. Hulme-Beaman et al. (2018)- Synchronous diversification of Sulawesiôs iconic artiodactyls driven by recent geological events. Proc. Royal Society (London) B 285, 20172566, p. 1-8.
(online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5904307/pdf/rspb20172566.pdf)
(Paleogeographical reconstructions with genetic and morphometric datasets from Sulawesi's three largest mammals (babirusa, anoa, Sulawesi warty pig) indicate these likely colonized Sulawesi at different times (14 Ma to 2-3 Ma), and experienced near-synchronous expansion from central part of island at ~1-2 Ma. Endemic fauna of Sulawesi driven by geological events over last few million years)

Frenzel, A. (1881)- Mineralogisches aus dem Ostindischen Archipel, 8. Celebes. Zeitschrift Kristall., Min. Petrogr. 3, 4, p. 289-300.
('Mineralogic data from the East Indies Archipelago- 8. Celebes'. Mainly on petrography of volcanic rocks from Sulawesi. Incl. first(?) description of Eocene Nummulites limestone from S Sulawesi)

Fornasiero, M. (2001)- Eocene molluscs species known from Nanggulan (Java) newly found in Malawa (Sulawesi). Memorie Scienze Geol., Padova, 53, p. 57-60.
(Eight mollusc species in Malawa, NE of Makassar, SW Sulawesi, also occur in M Eocene of Nanggulan, C Java and are all Tethyan species not known from Australian Plate. Outcrops believed to be M Miocene chaotic deposits with large olistoliths of M Eocene marls, possibly part of accretionary prism)

Fu, W., M. Yang, X. Huang & Y. Zhang (2014)- Garnierite in a laterite-Ni deposit from Kolonodale area, Sulawesi, Indonesia: a preliminary study on mineralogy. Acta Geologica Sinica 88, Suppl. 2, p. 1451. *(Abstract)*

Fu, W., J. Yang, M. Yang, B. Pang, X. Liu, H. Niu & X. Huang (2014)- Mineralogical and geochemical characteristics of a serpentinite-derived laterite profile from East Sulawesi, Indonesia: implications for the lateritization process and Ni supergene enrichment in the tropical rainforest. J. Asian Earth Sci. 93, p. 74-88.
(Ni-laterite profile over weathered serpentinite in Kolonodale area of E Sulawesi three lithostratigraphic horizons, from bottom to top: saprolite horizon, limonite horizon and ferruginous cap. Highest concentration of Ni (up to 11.5% NiO) in saprolite horizon)

Fu, W., Y. Zhang, C. Pang, X. Zeng, X. Huang, M. Yang, Ya Shao & H. Lin (2018)- Garnierite mineralization from a serpentinite-derived lateritic regolith, Sulawesi Island, Indonesia: mineralogy, geochemistry and link to hydrologic flow regime. J. Geochemical Exploration 188, p. 240-256.
(On genesis of garnierite nickel ore, mainly in veins in lower saprolite of serpentinite-derived regolith. Ni preferentially enriched in talc-like phases rather than serpentine-like phases)

Fu, W., Y. Zhou, Y. Chen, Y. Hu, N. Chen, H. Niu et al. (2010)- Geological and geochemical characteristics of laterite nickel deposit and ore genesis; a case study of Kolonodale deposit in Indonesia Sulawesi, Southeast Asia. Earth Science Frontiers (China University of Geosciences, Beijing) 17, 2, p. 127-139.

Gani, M.U.A. (1997)- Karakteristik batu marmer di daerah Bulupanampu Kabupaten Maros, Sulawesi Selatan. Proc. 26th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 899-912.
('Characteristics of marble rock in the area of Bulupanampu, Maros District, S Sulawesi')

Gani, M.U.A. & H. Soetjito (1999)- Coal ash characteristization of Tondongkurah coal, Pangkajene, South Sulawesi. Proc. 28th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 2, p. 293-300.

Gani, M.U.A., H. Soetjijo & S. Indro (1996)- Karakterisasi dan kualitas pemanfaatan batubara Tondongkurah, Pangkajene Sulawesi Selatan. Proc. 25th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 313-324.
('Characterization and quality of Tondongkurah coal, Pangkajene, S Sulawesi')

Garrard, R.A., D. Silalahi, D. Schiller & P. Mahodim (1989)- Sengkang Basin, South Sulawesi. Indon. Petroleum Assoc., Post Convention Field Trip Guidebook, Jakarta, p. 1-46.
(SW Sulawesi fieldtrip guide book)

Garrard, R.A., G. Nusatriyo & D.Q. Coffield (1992)- The prospectivity of Early Tertiary rift sequences in the Neogene foldbelts of South Sulawesi. In: Eastern Indonesian Exploration Symposium, Jakarta, April 1992, Pertamina and Simon Petroleum Technology, 12p.

Garwin, S.L., D. Hendri & P.F. Lauricella (1995)- The geology of the Mesel sediment-hosted gold deposit, North Sulawesi, Indonesia. In: J.L. Mauk & J.D. St George (eds.) Exploring the Rim, Proc. PACRIM 1995 Congress, Auckland, Australasian Inst. of Mining and Metallurgy (AusIMM), Parkville, Publ. Ser. 9/95, p. 221-226.
('Carlin-type' sediment-hosted Au-Ag deposit in extensional M Miocene basin in N Sulawesi volcanic arc (only one of this type in Indonesia?). Discovered in 1988. Gold in finely disseminated pyrite adjacent to andesite intrusive)

Girardeau, J., C. Monnier, R. Maury, M. Villeneuve, D. Soetisma & H. Samodra (1995)- Origin of the East Sulawesi ophiolite. Abstracts, Eighth Regional Conf. Geology Minerals and Energy Resources of SE Asia (GEOSEA 95), 8, p. 51-52.

Gisolf, W.F. (1917)- Beschrijving van een microscopisch onderzoek van gabbro's en amfibolieten, herkomstig van Midden-Celebes. Thesis University of Delft, p. 1-141. *(Unpublished)*
('Description of microscopic investigations of gabbros and amphibolites from C Sulawesi'. Incl. rocks from Latimojong Complex. Presumably same as Gisolf (1917) in Abendanon (1917))

Gisolf, W.F. (1917)- Petrografie van Midden-Celebes. Microscopisch onderzoek van de gesteenten der Midden-Celebes verzameling van E.C. Abendanon. In: E.C Abendanon, E.C. (1917) Geologische en geographische doorkruisingen van Midden-Celebes (1909-1910), E.J. Brill, Leiden, vol. 3, p. 1017-1381.
(Petrography of rocks from C Sulawesi collected by Abendanon. Mainly igneous (granites, gabbros, peridotites, trachytes, andesites, etc.) and metamorphic (gneiss, eclogite, amphibolite, jadeite, quartzite, etc.) rocks)

Gisolf, W.F. (1920)- Lawsonite en epidoot in de schisten van het Latimojong gebergte, Celebes. Handelingen 17th Nederlandsch Natuur- Geneeskundig Congres, Leiden 1919, p. 422-424.
(Online read only at: http://babel.hathitrust.org/cgi/pt?id=uc1.b3093406;view=1up;seq=476)
('Lawsonite and epidote in the schists of the Latimojong Mountains, Sulawesi'. Lawsonite observed in epidote-chlorite schists collected by Abendanon near Bulu Palaka in Latimojong Mts, C Sulawesi)

Gisolf, W.F. (1923)- On the occurrence of diamond as an accessory mineral in olivine and anorthite bearing bombs, occurring in basaltic lava, ejected by the volcano Gunung Ruang (Sangir-Archipelago north of Celebes). Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 26, 7-8, p. 510-512.
(online at: www.dwc.knaw.nl/DL/publications/PU00014971.pdf)
(Accessory diamonds in volcanic bomb from Gunung Ruang volcano in Sangir Archipelago, N Sulawesi)

Gisolf, W.F. (1924)- Mikroskopisch onderzoek van gesteenten uit Zuidoost Selebes. Jaarboek Mijnwezen Nederl.-Oost Indie 53, Verhandelingen, p. 66-113.
('Microscopic investigations of rocks from SE Sulawesi'. Brief descriptions of igneous (granites peroditites, serpentinites, volcanics), metamorphic (mica-schists, phyllites, gneiss, amphibolite, glaucophane schist, eclogite, quartzite) and sedimentary (sandstone, limestone, shales, radiolarian chert) rocks collected by Julius and other geologists. Localities poorly described, no locality maps)

Golightly, J.P. (1979)- Geology of Soroako nickeliferous laterite deposits. In: D.J.I. Evans et al. (eds.) International Laterite Symposium, New Orleans 1979, Soc. Mining Eng. American Inst. Min. Metall. Petrol. Eng. (AIMM & PE), New York, p. 38-56.
(Nickel mined by PT INCO from laterite overlying E Sulawesi ophiolite. In situ weathering of 20-50 thick column of ophiolite in last 10 My believed to have formed 5-30cm thick laterite)

Gomez, J.M., R. Madariaga, A. Walpersdorf & E. Chalard (2000)- The 1996 earthquakes in Sulawesi, Indonesia. Bull. Seismological Soc. America 90, 3, p. 739-751.
(1996 earthquakes in relay zone between N Sulawesi trench and Palu-Koro transcurrent fault. Slip vectors NNW orientation parallel to direction of convergence between N Sulawesi arm and Celebes Sea)

Graha, D.S. (1998)- Zonasi umur pada batuan granitik Polewali, Sulawesi Selatan. J. Geologi Sumberdaya Mineral 8, 78, p. 9-19.
('Age zonation in granitic rocks of Polewali, S Sulawesi'. K-Ar ages of biotite in Polewali granite 3.1- 14.0 Ma suggest age zonation of ~3.1-3.5 Ma at outside, 6.1-9.8 Ma in middle and 14.0 Ma in center. Ages from hornblende and biotite from Riso syenite 4.5- 6.75 Ma)

Grainge, A.M. & K.G. Davies (1983)- Reef exploration in the East Sengkang Basin, Sulawesi. Proc. 12th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 207-227.
(East Sengkang Basin Late Miocene reefs in outcrop and as shallow gas-bearing Late Miocene reefs in N part of basin. Four accumulations with ~0.75 TCF of dry gas in place at average depth 700m. Kampung Baru is largest field and contains over half the total. Reservoir quality excellent. Gas probably generated in W Sengkang Basin and sub-sequently migrated into E Sengkang Basin)

Grainge, A.M. & K.G. Davies (1985)- Reef exploration in the East Sengkang Basin, Sulawesi, Indonesia. Marine Petroleum Geol. 2, p. 142-155.
(Shallow, gas-bearing Upper Miocene reefs in N part Sengkang basin, with Kampung Baru as largest field. Lower Miocene mudstones and limestones unconformable over Eocene volcanics acoustic basement. Two M Miocene periods of deformation and erosion. Late Miocene widespread carbonate deposition with platform limestones and pinnacle reef complexes. Reef growth ceased at end Miocene and clastic sedimentation covered irregular limestone surface. Walanae sinistral strike-slip fault zone separates E and W Sengkang Basins)

Gremmen, W.H.E. (1989)- Palynological investigations in the Danau Tempe Depression, Southwest Sulawesi (Celebes), Indonesia. Modern Quaternary Research in Southeast Asia, Balkema, Rotterdam, 11, p. 123-134.
(online at: http://www.oxis.org/articles-c-j/gremmen-1990.pdf)
(Tempe Lake Depression in SW Sulawesi with three lakes and swamp areas probably remnant shallow marine seaway between Makassar Straits and Bone Bay until recently. In tidal mangrove zone between 7000- 2600 BP)

Gunawan, W. (1999)- Structure, stratigraphie et evolution de la partie centrale de Sulawesi (Indonesie orientale). Doct. Thesis Universite de Aix-Marseille, p. 1-283. *(Unpublished)*
(Sulawesi is area of collision between Eurasian and Gondwanan blocks. Three main events: (1) collision of Asia- Banda Blocks (= E Sulawesi) in Late Oligocene, (2) collision of Banda- Lucipara blocks in M Miocene and (3) collision of Banggai-Sula and Sulawesi in M Pliocene. C Sulawesi marks collision between Asia and Banda blocks, with obduction of ophiolite nappe of Asian origin over E Sulawesi block. E Sulawesi block sedimentary cover starts with Triassic reefal/ platform carbonates followed by Early Jurassic platform interior carbonates, Lower Cretaceous radiolarites and Upper Cretaceous-Oligocene pelagic limestones. High P- low T metamorphism during W-directed subduction in Early Oligocene. Western active margin has substrate metamorphosed in Aptian- Albian, overlain by Upper Cretaceous- Pliocene volcano-sedimentary formations, and deforemed by thrusting during Oligocene collision, possibly followed by a Middle Miocene event also known from Buton island)

Guntoro, A. (1996)- Seismic interpretation and gravity models of Bone Bay in relation to its evolution. Proc. 25th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 3, p. 349-369.

Guntoro, A. (1997)- Stratigrafi dan evolusi tektonik Pulau Tanahjampea dan sekitarnya, Kabupaten Selayar, Sulawesi Selatan. Berita Sedimentologi 4, p. 9-17.
('Stratigraphy and tectonic evolution of Tanahjampea Island and surroundings, Selayar District, S Sulawesi'. Oldest rocks Eocene volcanic breccia (part of Langi volcanics of S Sulawesi?), overlain by E Miocene limestone with Lepicyclina (part of Tonasa Lst of Sulawesi?), Pleistocene volcanic breccia)

Guntoro, A. (1997)- Preliminary study of the geology and tectonics of the Flores Sea islands, South Sulawesi. Proc. 26th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 291-313.
(Islands S of SW Sulawesi/ Flores Sea (Selayar, Bonerate and Kalaotoa groups) poorly known. Similar stratigraphy to SW Sulawesi. Extensive volcanic and tectonic activity since Eocene. Tanahjampea and Tanahmalala islands mainly SW Sulawesi-like granite, also Eocene and M-U Miocene calc-alkaline volcanics, possibly overlain by Batu Fm limestone with large Lepidocyclina. Suggesting W-dipping subduction zone E of W Sulawesi in E Tertiary continued to E of these islands. Kalao island uplifted coral reefs on andesite. Bonarate, Kalaotoa islands also with uplifted Quaternary reefal limestones)

Guntoro, A. (1999)- The effect of collision of the Banggai-Sula microcontinent to the tectonic development in Central Indonesian region. In: G.H. Teh (ed.) Proc. 9th Reg. Congress Geology, Mineral and Energy Resources of SE Asia (GEOSEA ô98), Kuala Lumpur 1998, Bull. Geol. Soc. Malaysia 43, p. 103-111.
(online at: www.gsm.org.my/products/702001-100829-PDF.pdf)
(Seismic interpretation shows presence of major faults indicating extensional, compressional and inversion tectonics in Makassar Strait, Sulawesi and Bone Bay. Gravity models indicate presence of oceanic crust in middle of Makassar Strait and Bone Bay and remnant subduction to S of Bone Bay. Origin of oceanic crust in Makassar Straits and Bone Bay due to rifting, with E-ward driving mechanism subduction roll-back of Pacific Plate eastward since E Tertiary. Bone Bay openings due to M Miocene collision of Banggai-Sula with Sulawesi, causing displacement and rotation of two Walanae and Palu-Koro faults. Banggai-Sula collisionalso caused inversion structures at E and W sides of N Makassar Basin by inverting Eocene extensional basin)

Guntoro, A. (2004)- The relationship between tectonic development of Central Indonesian region and collision of Banggai-Sula microcontinent to the east Sulawesi. Jurnal Teknologi Mineral (ITB) 11, 1, p.
(Central Indonesia with major faults indicating extension, compression and inversion. Gravity data indicate presence of oceanic crust in middle of Makassar Straits and Bone Bay, related to rifting. Driving mechanism of rifting in Makassar Strait is subduction roll-back of Pacific Plate E-ward since early Tertiary. Rifting in Bone Bay due to collision of Banggai-Sula Microcontinent against Sulawesi causing displacement and rotation of two major faults, Walanae and Palu-Koro)

Guritno, N., D.Q. Coffield & R.A. Cook (1996)- Structural development of central South Sulawesi, Indonesia. Proc. 25th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 253-266.
(S Sulawesi stratigraphy: pre-Tertiary basement, Eocene synrift, Oligo-Miocene post-rift, M Miocene syn-magmatic, and Late Miocene-Pliocene synorogenic sedimentary packages. E part hinterland of exposed Cretaceous basement in W-vergent thrust system. W of basement outcrops is basement-involved, W-vergent Kalosi fold-thrust, with exposed Paleogene sediments. Further W shortening thin-skinned Majene foreland fold-thrust belt. S Sulawesi is W-vergent orogen superimposed on M Miocene magmatic arc. Bone Bay is continent-continent suture recently disrupted by transtensional wrenching and collapse of orogen's eastern extremity. SE Sulawesi E-vergent portion of orogen with allochthonous ophiolite nappes from continent-continent suture. Leading edge of orogen along Banda Sea W margin)

Hadiwijoyo, S., D. Sukarna & K. Sutisna (1993)- Geology of the Pasangkayu Quadrangle, Sulawesi. (Quad. 2014), 1: 250,000, Geol. Res. Dev. Centre (GRDC), Bandung, 19p.
(W Sulawesi map between 1-2°S. Oldest rocks ?Triassic metamorphics (no data to support age), unconformably overlain by low-metamorphic Upper Cretaceous clastics. Overlain by Oligocene and E Miocene Lamasi andesitic-dacitic volcanics. Unconformably overlain by M-L Miocene Talaya andesitic-basaltic series and Late Miocene- Pliocene molasse. Oil seep at Doda. Unlike areas to S, no Eocene rocks present)

Haile, N.S. (1974)- An unusual unconformity of radiolarian chert on schist and gneiss west of Pangkajene, SW arm, Sulawesi (Celebes). Geol. Soc. Malaysia Newsletter 52, p. 21-22.
(Brief note on mid-Cretaceous unconformity in Sungai Dera (tributary.of Sg Paring) ~22 km E of Pangkajene, SW Sulawesi. Brecciated gneiss and micaschists of Bantimala Complex are overlain, with horizontal unconformity, by slightly folded ~7m thick red chert sequence. Near base of chert are up to 30cm thick beds of m quartz-mica sandstone with up to 35% lithics of micaschists and altered ultrabasic rocks. (Age of radiolaria in chert Late Albian- E Cenomanian; Wakita 2000))

Haile, N.S. (1978)- Reconnaissance palaeomagnetic results from Sulawesi, Indonesia, and their bearing on palaeogeographic reconstruction. Tectonophysics 46, p. 77-85.
(SW Sulawesi Jurassic radiolarian chert rotated ~35° CCW since Late Mesozoic. E Cretaceous radiolarian chert formed at ~3° and may have formed single plate with Kalimantan and Malay Peninsula, which rotated ~35-50° CCW since Cretaceous. Jurassic cherts from SE Sulawesi formed at high latitude (61°S))

Haile, N.S., A.J. Barber & D.J. Carter (1979)- Mesozoic cherts on crystalline schists in Sulawesi and Timor. J. Geol. Soc. London 136, p. 65-70.
(Non-metamorphosed Jurassic or Early Cretaceous pelagic radiolarian chert deposited unconformably on brecciated gneiss of Bantimala Complex in Pangkajene valley, SW Sulawesi. Cherts associated with turbiditic lithic sandstones, with grains of mica schist, muscovite, altered ultramafic rock, rare garnet and tourmaline. Radiolaria deemed to be of Jurassic or E Cretaceous age by Ling (no details). Very similar rock succession on Timor (Miomaffo) suggest Sulawesi and Timor probably part of continuous terrain during deposition of radiolarian cherts (see also Harahap 2000))

Hakim, A.Y.A. (2017)- Genesis of orogenic gold in the Latimojong district, South Sulawesi, Indonesia. Dissertation Montanuniversitat Leoben, Germany, p. 1-355.
(online at: https://pure.unileoben.ac.at/portal/files/2214320/AC14527918n01.pdf)
(Awak Mas and Salu Bullo gold deposits in Latimojong Metamorphic Complex, S Sulawesi. Latimojong MC part of Late Cretaceous accretionary complex with high-P metamorphics, W of obducted Lamasi Complex (= E Sulawesi Ophiolite?). Gold hosted in quartz veins in pumpellyite- to greenschist-facies metasedimentary and metavolcanic rocks. Metamorphic reactions in metasedimentary rocks during retrogression stage considered main source of ascending fluids forming Au-mineralization)

Hakim, A.Y.A., F. Melcher, W. Prochaska, R. Bakker & G. Rantitsch (2018)- Formation of epizonal gold mineralization within the Latimojong Metamorphic Complex, Sulawesi, Indonesia: evidence from mineralogy, fluid inclusions and Raman spectroscopy. Ore Geology Reviews 97, p. 88-108.
(Gold deposits in Latimojong Metamorphic Complex, S Sulawesi (Awak Mas, Salu Bulo), in pumpellyite-greenschist facies metasedimentary and metavolcanic rocks. Gold in quartz veins in N-S normal faults and extensional fractures. Minerals dominated by pyrite, chalcopyrite, galena, minor tetrahedrite and sphalerite; gold is electrum with low silver content. Gold bearing fluids trapped in quartz at ~180-250 °C at depths <5 km. Isothermal decompression during retrogression stage mobilized large volumes of fluids, leading to significant gold mineralization)

Halim, A. & D. Heru (2003)- Successful extreme underbalance perforation in exploration well Donggi Gas Field, Sulawesi. In: SPE Asia Pacific Oil and Gas Conf. Jakarta 2003, 5p.

Handiwiria, Y.E. (1990)- The stratigraphy and hydrocarbon occurrences of the Salodik Group, Tomori PSC area, East Arm of Sulawesi. Proc. 19th Ann. Conv. Indon. Assoc. Geol. (IAGI), 1, p. 69-98.
(Rel. comprehensive overview by Union Texas of Late Eocene- Miocene carbonate-rich Salodik Group on Banggai-Sula Plate (Late Eocene- E Miocene Tomori Fm, M Miocene clastic Matindok Fm, M-L Miocene Minahaki Fm carbonates, still with Lepidocyclina). Eocene Tomori Fm in Tiaka wells with Lacazinella. Late Eocene- E Oligocene missing in northern area (Mantawa-Minahaki-Matindok). Latest Miocene- E Pliocene basin deepening and Kintom Fm flysch deposition. Basement penetrations metamorphic rocks. Tiaka 2 well TD in granite and schist, with K-Ar date of 224 ± 9 Ma = ~E Norian)

Harahap, B.H. (1995)- Petrology of the Neogene subvolcanic rocks from the western part of South Sulawesi. Bull. Geol. Res. Dev. Centre (GRDC), Bandung 18, p. 68-85.
(Neogene K-rich volcanics in SW Sulawesi)

Harahap, B.H. (1999)- Asal lava bantal Salu Latupa, Latimojong, Sulawesi Selatan. Majalah Geologi Indonesia 15, 1-2, p. 25-38.
('Genesis of Salu Latupa pillow lava, Latimojong, S Sulawesi')

Harahap, B.H. (2000)- Petrologi lava basaltik dari jalan raya antara Palopo dan Rantepao, Sulawesi selatan. J. Geologi Sumberdaya Mineral 10, 101, p. 2-9.
('Petrology of basaltic lava from the main road between Palopo and Rantepao, S Sulawesi'. Basalts outcropping at km 376-379 intrude Eocene Toraja Fm equivalent rocks. Age unclear? Geochemistry suggest subduction-related lavas, probably from before M Miocene Banggai-Sula collision with Sulawesi)

Harahap, B.H. (2000)- Kejadian rijang di Sungai Paring Sulawesi Selatan. J. Geologi Sumberdaya Mineral 10, 105, p. 2-11.
('Genesis of chert in the Paring River of South Sulawesi'. Red, thin-bedded deep marine radiolarian chert Fm in Paring River near Bantimala, 22km E of Pangkajen. Unconformably overlies Bantimala melange complex, composed of schist, ultramafic rocks, clastic sediments, etc.. With slump structures; associated with sandstones and breccias with fragments of schist. Chert contains radiolaria indicative of U Albian- Lower Cenomanian age (~100 Ma; Wakita 1996; 7m of radiolarian cherts with some turbiditic sandstones on brecciated gneiss from same area also described by Haile et al. 1978))

Harahap, B.H. (2000)- Petrologi lava dan korok basalt dari Walenrang, Sulawesi. Proc. 29th Ann. Conv. Indonesian Assoc. Geol. (IAGI), Bandung, 4, p. 179-189.
('Petrology of lava and basalt of Walenrang, Sulawesi'. C Sulawesi Pliocene Lamasi volcanics chemistry comparable to Mid-Ocean Ridge Basalts)

Harahap, B.H. (2002)- Ofiolit di Pegunungan Latimojong Sulawesi bagian selatan dan implikasi geodinamika dalam tatanan tektonik dan stratigrafi regional Sulawesi. Buletin Geologi (ITB) 34, 1. p. 1-20.
('Ophiolite of the Latimojong Mts, S Sulawesi and geodynamic implications for the regional tectonic and stratigraphic history of Sulawesi')

Harahap, B.H. (2004)- Plio-Pleistocene volcanic rocks from Tanatoraja South Sulawesi. Majalah Geologi Indonesia (IAGI) 19, 2, p. 81-90.

Hardjadinata, K. (1992)- Beberapa aspek lapangan batuan vulkanik daerah Gorontalo, Sulawesi Utara. J. Geologi Sumberdaya Mineral 2, 6, p. 4-8.
('Some aspects of the volcanic rocks of the Gorontalo area, northern Sulawesi')

Hardjana, I. (2011)- The discovery, geology and exploration of the high sulphidation Au-mineralization system in the Bakan District, North Sulawesi. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado, MGEI/IAGI, p. 161-188.
(also in Majalah Geologi Indonesia 27, 3, p. 143-157)
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/731)
(Gold mineralization in Bakan, N Sulawesi, hosted by dacitic tuffs of Plio-Pleistocene Bakan Fm, which unconformably overlie Miocene basement units of andesitic lavas, feldspathic sandstones and diorite porphyry)

Harjanto, Ernowo (2017)- Hydrothermal alteration and gold mineralization of the Awak Mas gold deposit, Sulawesi Island, Indonesia. Ph.D. Thesis RWTH Aachen University, Germany, p. 1-177.
(Awak Mas metasedimentary-hosted gold deposit in Cretaceous metamorphic Latimojong Fm, S Sulawesi. Hosted by phyllites-schists representing metamorphosed shales derived from acidic arc volcanic rocks in continental island arc setting, and metamorphosed under low P-T conditions (greenschist-facies). Obduction and thrusting of Lamasi Ophiolite Complex onto Latimojong Metamorphic Complex in Miocene led to ductile

deformation, followed by crustal thickening that caused melting at base of crust and granitic magmatism at 5-8.1 Ma. Granodiorites of calc-alkaline magmatic affinity emplaced in transition between volcanic-arc and syn-collisional granite tectonic setting. Extensional collapse caused brittle deformation (normal faulting/ fracturing) and formation of veins controlled gold mineralization. Awak Mas epigenetic, orogenic gold deposit)

Harjanto, E., F.M. Meyer & A. Idrus (2015)- Geology and mineralization of Awak Mas gold deposit and challenges for new exploration targeting in the metamorphic rock terrain of eastern Indonesia. Proc. 13th Biennial Mtg Soc. Geology Applied to Mineral Deposits (SGA), Nancy, p. 103-106.
(Awak Mas metamorphic-rock hosted gold deposits in C Sulawesi Cretaceous Latimojong metamorphic belt. Dominant lithologies slate, phyllite and mica schist. Mineral assemblage reflects high P/ low T environment or greenschist facies metamorphic rocks. Extensional faults, shears and fractures control gold mineralization)

Harjanto, Ernowo, F.M. Meyer, A. Idrus, H. Widyanarko & N.L. Endrasari (2016)- An update of key characteristics of Awak Mas mesothermal gold deposit, Sulawesi Island, Indonesia. Proc. 8th Ann. Conv. Indonesian Soc. Economic Geol. (MGEI), Bandung, p. 72-75.
(Awak Mas gold deposit in metamorphic belt of Sulawesi. Hosted by low-metamorphic Cretaceous Latimojong Fm flysch sequence locally intruded by diorite dykes. Believed to have formed by hydrothermal fluids sourced from metamorphic dewatering reactions of marine sediments (mesothermal orogenic gold deposit))

Harju, H.O. (1979)- Exploration of P.T. INCO's nickel laterite deposits in Sulawesi, Indonesia. In: D.J.I. Evans et al. (eds.) Int. Laterite symposium, American Inst. Mining Metall. Petroleum Eng., New York, p. 292-299.

Haryono, A. Susilo, E. Purnomo & Tasiat (2002)- Donggi gas discovery of Matindok in Banggai Basin Sulawesi: a success story by using a new G & G approach. In: F.H. Sidi & A. Setiawan (eds.) Proc. Giant Field and New exploration concepts seminar, Indon. Assoc. Geol. (IAGI), Jakarta 2002, p. 6-18.
(On 2001 Donggi-1 gas discovery in Miocene carbonate buildup in Matindok Block, Banggai Basin, E Sulawesi. Net gas column 134m)

Hasan, K. (1990)- The Upper Cretaceous flysch succession of the Balangbaru Formation, Southwest Sulawesi, Indonesia. Ph.D. Thesis, University of London, p. 1-336. *(Unpublished)*
(Upper Cretaceous (Turonian-Maastrichtian) Balangbaru Fm ~3300m of deep marine flysch, unconformably over accretionary complex. Not internally deformed, only slight E tilt. Paleocurrent of gravity flows mainly from NW to SE and W to E. Provenance in lower part mainly metamorphic lithics and chert from accretionary complex, upper part influenced by magmatic arc provenance. Tectonic setting small fore-arc basin on trench slope. Basement complex uplifted from significant depth prior to deposition of Balangbaru Fm, thus preventing transport of volcaniclastics into basin)

Hasan, K. (1991)- The Upper Cretaceous flysch succession of the Balangbaru Formation, Southwest Sulawesi. Proc. 20th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 183-208.
(Summary paper of above thesis on *Upper Cretaceous (Turonian-Maastrichtian) Balangbaru Fm 'flysch')*

Hasan, K., R. Garrard & P. Mahodim (1991)- SW Sulawesi, Post-convention field trip guidebook. Indonesian Petroleum Association (IPA), p. 1-61.
(Balangbaru area of SW Sulawesi Albian (111, 115 Ma) age metamorphics. Late Cretaceous (Turonian-Maastrichtian) Balangbaru flysch 3300m thick, unconformably over fractured ultrabasic rocks. Uplift/ erosion event followed by Eocene fluvio-deltaics and Nummulites limestones, overlain by up to 500m Late Eocene- E Miocene Tonasa Limestone)

Hasanusi, D., R. Abimayu, E. Artono & A. Baasir (2004)- Prominent Senoro gas field discovery in Central Sulawesi. In: R.A. Noble et al. (eds.) Proc. Deepwater and Frontier Exploration in Asia & Australia Symposium, Jakarta, Indon. Petroleum Assoc. (IPA), p. 177-197.
(Senoro gas field 1999 discovery in S part of E arm of Sulawesi. Reserves of 3.7 TCF gas and 65 MB condensate. Three play types in Tomori area: Miocene carbonate buildups, wrench-fault anticlines and thrust-sheet anticlinal structures. Two potential hydrocarbon sources: Jurassic and Miocene marine shales and coals.

Geochemical analyses indicate seeps and oils and gas from wells relate to E-M Miocene rocks. Hydrocarbon generation commenced in E-M Pliocene due to Pliocene sedimentation and loading by thrust sheets. Some remigration of hydrocarbons due to regional basin tilting caused by uplifting of fold belt in Pleistocene)

Hasanusi, D., E. Adhitiawan, A. Baasir, L. Lisapaly & R. van Eykenhof (2007)- Seismic inversion as an exciting tool to delineate facies distribution in Tiaka carbonate reservoirs, Sulawesi- Indonesia. Proc. 31st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA07-G-008, 13p.
(Tiaka field produces oil from E Miocene Tomori limestone, while limited gas bearing zones can be found in M-L Miocene Minahaki limestone. Six oil wells and one dry well drilled. Seismic inversion confirmed dry well was drilled in tight limestone area, while oil wells were drilled in porous limestone area)

Hasanusi, D., D. Kurniawan, R.M. Iman Argakoesoemah & W. Darmawan (2012)- Fractured carbonate reservoir of Tiaka Field, Eastern Sulawesi, Indonesia (T-3 Carbonate Cores). In: AAPG Geoscience Technology Workshop (GTW) on reservoir quality of a fractured limestone reservoirs, Bali 2012, Search and Discovery Art. 20145, p. 1-23. *(Abstract + Presentation)*
(online at: www.searchanddiscovery.com/documents/2012/20145hasanusi/ndx_hasanusi.pdf)

Hasanusi, D. & M. Petricola (2006)- A surprise discovery using cased hole logs in the Tiaka Field. Proc. Jakarta 2006 Int. Geosc. Conf. Exhib., Indon. Petroleum Assoc. (IPA), Jakarta, 06-VSL-05, 8p.
(Discovery of new gas sand behind casing in M-L Miocene Minahaki Fm ?Limestone in Tiaka Field)

Hasanusi, D. & A. Priyantoro (2011)- Diagenetic events as the controlling improvement reservoir quality of the carbonate reservoirs in the Senoro field and surrounding areas, Banggai-Sula basin, Central Sulawesi. Proc. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-028, 20p.
(On reservoir quality and diagenesis of M-U Miocene Mentawa Mb reefal build-ups (common recrystallization and dissolution, creating good porosity- permeability) and Minahaki Fm 'platform carbonate' (composed of deeper water globigerinid limestones; good porosity but low permeability))

Hasanusi, D., J. Sumarianto, R. Wijaya & D. Hendrian (2015)- The Tiaka-Tiara fault bend fold structures and its implication to control hydrocarbon entrapment within fracture carbonate reservoir in the Eastern Arm of Sulawesi, Indonesia. AAPG/SEG Int. Conf. Exhibition, Melbourne, p. 1-11. *(Extended Abstract)*
(online at: www.searchanddiscovery.com/documents/2015/51213hasanusi/ndx_hasanusi.pdf)
(Tiaka-Tiara fault bend fold structures in tectonically complex area of Banggai Basin, offshore E arm of Sulawesi, formed by Late Miocene- Pliocene collision between Banggai Sula microcontinent and E Sulawesi ophiolite belt. SW-NE oriented major fault and series of SSE-NNW oblique minor fault bend folds, affectingMiocene Minahaki and Tomori fractured carbonate reservoirs)

Hasibuan, F. (2001)- *Ostrea (Turkostrea) doidoiensis* n.sp. from the Middle Eocene of Malawa Formation, South Sulawesi. Proc. 30th Ann. Conv. Indon. Assoc. Geol. (IAGI) and 10th GEOSEA Reg. Congress, Yogyakarta, p. 191-194.
(New oyster species from M Eocene Malawa Fm that unconformably overlie Late Cretaceous Balangbary flysch in Doidoi village, S of Ralla, S Sulawesi. O. (T.) doidoiensis) is from basal marine beds above the two coal beds of Malawa Fm and is associated with gastropods, solitary corals ond other bivalves)

Hasibuan, F. (2009)- Lingkungan pengendapan Formasi Malawa, Sulawesi Selatan berdasarkan kandungan makro fosil. J. Sumber Daya Geologi 19, 2, p. 95-106.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/196/188)
('Environment of deposition of the Malawa Fm, S Sulawesi based on macrofssils'. Malawa Fm with E-M Eocene palynomorphs and overlain by Tonasa Lst with Eocene Nummulites javanus. Four M Eocene stratigraphic units with molluscs, incl. Ostrea doidoiensis and Septifer. Environments mangrove swamp, fluvial, lagoon- sandbars and deltaic)

Hasibuan, F. & A. Kusworo (2008)- Umur Formasi Nambo di Sulawesi Tengah dengan acuan khusus fosil Moluska. J. Sumber Daya Geologi 18, 1, p. 43-54.

(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/226/216)
('Age of the Nambo Fm in C Sulawesi based on fossil molluscs'. Nambo Fm along Kali Nambo near Luwuk in E Arm of Sulawesi 50m thick calcareous shale of latest Jurassic (Tithonian) age with molluscs (Retroceramus haasti, Malayomaorica malayomaorica) and belemnites (Belemnopsis mangolensis, B. stolleyi, B. aucklandica simitis, B. moluccana, B. galoi). Similar to upper part of Buya Fm of Sula islands)

Hasibuan, F. & A. Limbong (2009)- Geologi dan paleontologi Formasi Balangbaru dan Formasi Marada berumur Kapur, Sulawesi Selatan. J. Sumber Daya Geologi 19, 6, p. 365-376.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/220/210)
('Geology and paleontology of the Cretaceous Balangbaru and Marada formations, S Sulawesi'. Balangbaru Fm Albian- Maastrichtian turbiditic series with macrofossils including echinoids, bivalve Inoceramus sp. and ammonite Grossouvreites sp.. Marada Fm partly distal equivalent of Balangbaru Fm, with Spirorhaphe trace fossil and Turonian- Late Maastrichtian nannofossil assemblages)

Hasibuan, F., Sudijono, A. Limbong, Suyoko & E.H. Nugroho (1996)- Data baru umur Formasi Nambo, Sulawesi Tengah. Proc. 25th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 52-70.
('New data on the age of the Nambo Fm, E Sulawesi'. Late Jurassic deposits)

Hasria, A. Idrus & I.W. Warmada (2017)- The metamorphic rocks-hosted gold mineralization at Rumbia Mountains prospect area in the Southeastern Arm of Sulawesi Island, Indonesia. J. Geoscience Engineering Environm. Technol. (JGEET) 2, 3, p. 217-223.
(online at: http://journal.uir.ac.id/index.php/JGEET/article/view/434/376)
(On 'orogenic gold' in gold-bearing quartz veins in Pompangeo Metamorphic Complex of Permo-Carboniferous metasediments and mica schists at Rumbia Mountains, SE Sulawesi. Veins sheared/deformed and brecciated, 1- 15.7 cm thick. Associated with pyrite, chalcopyrite, hematite, cinnabar, stibnite and goethite. Gold also in derived placer deposits)

Helmers, H. (1991)- Sulawesi blueschists and subduction along the Sunda continent, an alternative view. In: Proc. Silver Jubilee Symposium on the dynamics of subduction and its products, Yogyakarta 1991, Indon. lnst. Science, Res. Dev. Centre for Geotechnology (LIPI), p. 220-223.
(Alternative scenario for development of 600 km long belt of blueschist (= high P- low T metamorphic continental rocks) in E Sulawesi. Blueschist metamorphism age ~28 Ma, cooling ages 22.5-16 Ma, and older than Banggai-Sula and Tukang Besi collisions. Tied to obduction related to Oligocene rotation of Borneo. Early Miocene extension enabled rise of blueschist and created Gulf of Bone- Lake Poso depressions)

Helmers, H., E.H. Hebeda & W.J. Lustenhouwer (1990)- The enigmatic relationship between subduction-caused metamorphism, ophiolite emplacement and collision in eastern Sulawesi, Indonesia. In: Orogenesis in Action: Tectonics and processes at the West equatorial Pacific margin, Geological Society, London, p. 30. *(Abstract only)*

Helmers, H., P. Maaskant & T.H.D. Hartel (1990)- Garnet peridotite and associated high-grade rocks from Sulawesi, Indonesia. Lithos 25, p. 171-188.
(Garnet peridotite and associated granulite-facies contact rocks from along Palu-Koro strike-slip fault (uplifted lower crustal rocks))

Helmers, H., J. Sopaheluwakan, E. Surya Nila & S. Tjokrosapoetro (1989)- Blueschist evolution in southeast Sulawesi, Indonesia. In: J.E. van Hinte et al. (eds.) Proc. Snellius II Symposium, Jakarta 1987, Netherlands J. Sea Research 24, p. 373-381.
(SE Sulawesi blueschists graphite-mica schists and metabasites of MORB-affinity, latter increasing to S and part of 600 km N-S belt of blueschists. After fast burial during subduction rocks recrystallized at high P (10.5 kbar)- low T ~400°C). Exhumation started immediately; rocks moved to 400°C/ 2-3 kbar on normal thermal gradient in few million years. Lack of radiometric age determinations prevents geotectonic modeling)

Hendrawan, D. (2015)- Exploration history and mineral inventory of Tombulilato Block, Gorontalo, Indonesia. In: N.I. Basuki (ed.) Proc. Indonesian Soc. Econ. Geol. (MGEI) 7th Ann. Conv., Balikpapan, p. 27-33.
(*Gold-copper-silver belt of N Sulawesi Arm, an extension of Phillipine porphyry Cu-Au belt, has long exploration history since era of Dutch colonialism. Tombulilato Block I with discoveries in 3 complexes: Sungai Mak, Cabang Kiri and Pombolo. Three types of mineralization: porphyry Cu-Au, high sulphidation epithermal Cu-Au-Ag and low sulphidation epithermal Au-Ag)*

Hendrawan, D. & G.N. Putranto (2013)- The Tombulilato copper gold project in Sulawesi, Indonesia ôFacing the challenges and opportunitiesö. Proc. Symposium East Asia Geology, exploration technologies and mines, Bali, Australian Inst. Geoscientists p. 32-33. *(Extended Abstract)*
(Tombulilato district in N Sulawesi characterized by >3400m thick Late Miocene(?)- Pleistocene island arc-type volcano-sedimentary pile. Main compressional deformation event in Pliocene. Uplift and erosion removed ~2 km of rock in last 3 My and progressive unroofing of hydrothermal system. Intrusive bodies postdate folding/ thrusting. Three mineralization types in district: (1) porphyry Cu-Au (Cabang Kiri, Sungai Mak, Kayubulan Ridge, Cabang Kanan); (2) high-sulfidation epithermal Au-Cu-Ag (Motomboto, Mohutango, Ridho);(3) low-sulfidation epithermal Au-Ag (Kaidundu, Mamungaa, Pombolo, Hulapa, Ombulo, etc.))

Hendri, D. & M.C. Farmer (1997)- The discovery of the Mesel sediment hosted gold deposit, North Sulawesi, Indonesia. In: Proc. Conf. New Generation Gold Mines '99, case histories of discovery, Perth 1997, AMF, Adelaide, p. 5.1-5.13.
(Example of sediment-hosted, disseminated gold deposit in Mesel in Late Miocene limestone in N Sulawesi)

Hendri, D. & M.C. Farmer (1997)- The discovery of the Mesel sediment hosted gold deposit, North Sulawesi, Indonesia. Proc. 26th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 119-131.
(Same as Hendri & Farmer (1997) above. Mesel sediment-hosted, disseminated gold deposit discovered by Newmont in 1988 in Ratatotok District, 70km S of Manado, N Sulawesi. Close to early 1900's Dutch alluvial gold mining operation (Mt. Totok). Gold mineralization in M Miocene limestone, intruded by porphyritic andesite, near-contemporaneous with sedimentation)

Hennig, J. (2015)- Age, origin and exhumation history of magmatic and metamorphic rocks of NW Sulawesi, Indonesia. Ph.D. Thesis, Royal Holloway, University of London, p. 1-589. *(Unpublished)*

Hennig, J., E. Advokaat, A. Rudyawan & R. Hall (2014)- Large sediment accumulations and major subsidence offshore; rapid uplift on land: consequences of extension of Gorontalo Bay and northern Sulawesi. Proc. 38th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA14-G-304, 16p.
(Pliocene rollback of N Sulawesi subduction zone caused subsidence of Gorontalo Bay to water depths of up to 2 km and uplift of Neck and parts of C Sulawesi to 3 km. Late Miocene-Pliocene granitic and volcanic rocks in N Arm and in C Sulawesi all underwent rapid Pliocene exhumation. Neogene metamorphic core complexes in N Arm (Malino) and S of Gorontalo Bay in Tokorondo and Pompangeo Mts and suggest extensional setting. W part of Gorontalo Bay underlain by Australian continental crust added to Sundaland margin in Cretaceous. Metapelite schist and paragneiss from Palu Metamorphic Complex in S Neck of Sulawesi with Cretaceous and Eocene/Oligocene protolith ages and do not represent old Australian basement rocks. Age of deposition of Celebes Molasse at W side of Neck is Pleistocene)

Hennig, J., R. Hall & R.A. Armstrong (2016)- U-Pb zircon geochronology of rocks from west Central Sulawesi, Indonesia: extension-related metamorphism and magmatism during the early stages of mountain building. Gondwana Research 32, p. 41-63.
(online at: http://searg.rhul.ac.uk/pubs/hennig_etal_2016%20Sulawesi%20U-Pb%20zircons.pdf)
(Metamorphic and granitoid rocks from Palu Metamorphic Complex of W C Sulawesi with inherited Proterozoic-Paleogene zircons. Mesoproterozoic and Triassic inherited populations similar to New Guinea Birds Head region (and different from E Java). Some metamorphic rocks with Late Eocene zircons indicating metamorphism not older than Late Eocene, and metamorphosed in Neogene after Sula Spur collision and subsequent extension. Some metapelites of PMC with Cretaceous zircons, possibly from Sundaland (Schwaner intrusions in Kalimantan). Widespread M Miocene- Pliocene magmatism in W C Sulawesi: (1) M Miocene-

Late Miocene (~14-10 Ma?) K-rich shoshonitic suite; (2) Late Miocene-Pliocene shoshonitic to high-K calc-alkaline rocks with intermediate I-type granitoids mainly ~8.5- 5 Ma, felsic S-types ~5- 2.5 Ma. Many rims of metamorphic zircons ~3.8- 3.0 Ma (M Pliocene). Eocene zircons in some metamorphic rocks shows metamorphism of PMC metapelites younger than previously inferred; not Mesozoic or older Australian basement rocks. Co-occurrence of magmatism and metamorphism in M Pliocene during extensional phase)

Hennig, J., R. Hall, M.A. Forster, B.P. Kohn & G.S. Lister (2017)- Rapid cooling and exhumation as a consequence of extension and crustal thinning: implications from the Late Miocene to Pliocene Palu Metamorphic Complex, Sulawesi, Indonesia. Tectonophysics 712-713, p. 600-622.
(online at: http://searg.rhul.ac.uk/pubs/hennig_etal_2017%20Rapid%20cooling%20Palu%20Sulawesi.pdf)
(Metamorphic complexes form 1.5- 2km high mountains in W Sulawesi, and younger than previously thought. Some have Eocene sedimentary protoliths. Palu Metamorphic Complex strongly deformed and partially melted to migmatites. 40Ar/39Ar dating shows cooling in E Pliocene (~5.3-4.8 Ma) in N, and Late Pliocene (~3.1-2.7 Ma) in S. Intruded S-type granites similar Pliocene ages. Fast cooling and rapid exhumation in very young orogenic belt. Contemporaneous magmatism and deformation interpreted as consequence of decompressional melting due to extension. I-type magmatic rocks, separated from PMC by Palu-Koro Fault exhumed from upper crustal levels at moderate rates)

Hennig, J., R. Hall, I. Watkinson & M. Forster (2012)- Timing and mechanisms of exhumation in West Central Sulawesi, Indonesia. AGU Fall Meeting, San Francisco, T43E-2713, 1p. *(Abstract only)*
(online at: http://fallmeeting.agu.org/2012/eposters/eposter/t43e-2713/)
(Basement and intrusive rocks from NW Sulawesi record Neogene deformation, younger than expected, with rapid exhumation. C Sulawesi granitic orthogneiss with zircons with Proterozoic inherited cores and Devonian, Permo-Triassic and Jurassic zircon populations, suggesting Australian-derived terrane. Palu Metamorphic Complex basement rocks complex history of metamorphism. Pre-kinematic cordierite, etc., indicate regional high T-low P metamorphic event. Pliocene cooling age. Granites from Sulawesi Neck and mountain range W of Palu-Koro Fault mainly Late Miocene crystallisation ages (7.2 Ma, 6.4 Ma). Late-stage exhumation started in Neck in Pliocene (2.9 Ma). Magmatism, core complex exhumation and subsidence of Gorontalo Bay all related to crustal thinning due to extension driven by subduction rollback)

Hermanto, B. (2014)- Perkembangan kerangka tektonik Laut Maluku, Kepulauan Banggai-Sula dan lajur ofiolit Sulawesi Timur. J. Geologi Sumberdaya Mineral 15, 2, p. 69-74.
('Tectonic framework development of the Molucca Sea, Banggai-Sula islands and ophiolite belt in Eastern Sulawesi'. Brief review; not much new?)

Hermanto, B. (2015)- Usulan baru titik bor eksplorasi minyak dan gas bumi di lapangan Tiaka dan Senoro, cekungan Luwuk- Banggai. J. Geologi Sumberdaya Mineral 16, 1, p. 45-53.
('Proposed new oil and gas exploration drillings in Tiaka and Senoro fields, Luwuk-Banggai Basin'.)

Hermiyanto, M.H., S. Andi Mangga & Koesnama (2010)- Lingkungan pengendapan batubara Formasi Kalumpang di daerah Mamuju. J. Sumber Daya Geologi 20, 4, p. 179-187.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/171/167)
('Depositional environment of coal in the Kalumpang Formation, Mamuju area', SW Sulawesi. Kalumpang (Toraja) Fm syn-rift sediments of M-L Eocene age, with quartz sst, conglomerate, shale, claystone with alternations of coal and limestone. Coal caloric value 2480-7440 kal/gr, moisture 1.3- 6.7%, volatile matter 14.7 - 45%, sulphur 0.8-7.7%. Petrography shows vitrinite 91.6- 100%. Vitrinite reflectance (Rv-max) 0.32-0.62%. High vitrinite suggests Kalumpang coal derived from plants in humic condition (wet forest swamp))

Hetzel, W.H. (1927)- The geology of Kabaena island, Indonesia. Geol. Survey, Bandung, 24p.
(Unpublished geological survey report on island S of SE Arm of Sulawesi)

Hetzel, W.H. (1930)- Over de geologie der eilanden in de Flores-Zee. De Mijningenieur 11, 3, p. 53-56.
('On the geology of the islands in the Flores Sea'. On islands S of SW arm of Sulawesi. Jampea oldest rocks alkaline and calc-alkaline rocks, partly covered by limestone, etc.)

Hetzel, W.H. (1932)- De geologie van het eiland Wowoni. Geological Survey Bandung, p.
(Unpublished report)
('The geology of Wowoni Island'. Unpublished survey report on island off SE Arm of Sulawesi, N of Buton)

Hetzel, W.H. (1935)- Enkele kritische aantekeningen bij een recente publicatie over de geologie van den Oost arm van Celebes. De Ingenieur in Nederlandsch-Indie (IV), 4, p. 29-31.
(Brief critique of Von Loczy (1934) paper on E Sulawesi, noticing inconsistencies and unjustified conclusions)

Hinde, G. (1917)- Notes on specimens of organic rocks from Central Celebes collected by Mr. E.C. Abendanon. In: E.C. Abendanon (1917) Geologische en geographische doorkruisingen van Midden-Celebes (1909-1910), E.J. Brill, Leiden, 3, p. 953-958.
(Poorly preserved radiolaria from C Sulawesi, collected by Abendanon, interpreted as of Late Jurassic age)

Hirschi, H. (1911)- Lagerstatte von kristallisiertem Gold in einem Kalkmassiv zu Totok. Zeitschrift Praktische Geologie 29, p. 213-214.
('Deposits of crystallized gold in a limestone massif at Totok', N Sulawesi)

Hirschi, H. (1913)- Geologische Beobachtungen in Ost-Celebes. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 30, p. 611-618.
('Geological observations in E Sulawesi'. Summary of 1909 reconnaissance of part of Tomini Bay coastal area and traverse NW from Tomori Bay. Between Bongka Koi and Podi folded 'Celebes Molasse' with coral limestone breccias with well-preserved Lepidocyclina (suggests Celebes Molasse partly as old as Miocene, if not reworked?; JTvG). Molasse overlies serpentinized volcanics and diabase, with clasts including gabbro, serpentinite, etc.)

Hofstra, A.H. & O.D. Christensen (2002)- Comparison of Carlin-type Au deposits in the United States, China, and Indonesia: implications for genetic models and exploration. In: S.G. Peters (ed.) Geology, geochemistry and geophysics of sedimentary rock-hosted Au deposits in P.R. China, U.S. Geol. Survey (USGS) Open-File Report 02-131, Chapter 2, p. 62-94.
(online at: http://pubs.usgs.gov/of/2002/of02-131/chapters/OF02-131_chapter2.pdf)
(Includes data on Mesel Au deposit in N Sulawesi island arc setting, a 'Carlin-type' disseminated gold mineralization in M Miocene Ratatotok Limestone)

Hojnos, R. (1934)- Verslag over een micropalaeontologisch onderzoek van sedimentaire gesteenten uit Celebes. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 10, p. 291-294.
('Report on a micropaleontologic investigation of sedimentary rocks from Sulawesi'. Chapter in Von Loczy 1934 paper on thin sections DD21-DD33. White and reddish deep marine limestones from Tokala Mts/ N Boengkoe Mts in E arm of Sulawesi (called 'Boeroe Lst- Tokala Lst by Von Loczy; highly deformed, surrounding ophiolite massifs, with canaliculate belemnites in lower parts, and radiolaria of Late Jurassic and Early Cretaceous ages (NB: age interpretations questioned by Tan Sin Hok (1935), but species identified by Hojnos are indeed diagnostic of Late Jurassic- Early Cretaceous age; JTvG; (Sanfilippo and Riedel 1985, p. 576 suggest Cretaceous age (Neocomian and Senonian) only))

Hopper, R.H. (1941)- A geology reconnaissance in the east arm of Celebes and Island Peleng. Nederlandsche Pacific Petroleum Maatschappij (NNPM), p. *(Unpublished Report; 1947?)*.
(Cornee et al. 1999: Record of E Jurassic ammonite Harpoceras cf. toarcense in E Arm of Sulawesi)

Hornaday, W.T., R.A. de Boer, J.N. Grant, N. Nastiti & P. Astono (1996)- Sengkang Basin (SW Sulawesi). In: Pertamina/BPPKA (eds.) Petroleum geology of Indonesian basins, VII, Jakarta, p. 1-34.
(Overview of the mainly Neogene Sengkang Basin of SW Sulawesi. With series of Eocene- Pliocene paleogeographic maps of SW Sulawesi)

Hotz, W. (1913)- Vorlaufige Mitteilung uber geologische Beobachtungen in Ost-Celebes. Zeitschrift Deutschen Geol. Gesellschaft, Berlin, 65, Monatsberichte 6, p. 329-334.
(online at: https://www.biodiversitylibrary.org/item/37576#page/337/mode/1up)
('Preliminary note on geological observations in E Sulawesi'. Summary of 1912 survey at southern coastal area of East arm of Sulawesi. First report of Mesozoic rocks in East arm of Sulawesi: probably Jurassic-age blue-grey marls with common belemnites near Lontio village, probably in core of anticline in area dominated by Tertiary beds. Upper Bongka River near drainage divide red cherty limestones and Nummulites limestones. Age of gabbro and peridotitic rocks relatively young?)

Hovig, P. (1918)- Contactmetamorfe ijzerertsen aan de Salo Talimbangan en de Salo Pebatoean (Centraal Celebes). Jaarboek Mijnwezen Nederlandsch Oost-Indie 45 (1916), Verhandelingen 2, p. 25-38.
('Contactmetamorphic iron ores along Talambingan and Pebatoean rivers (C Sulawesi)'. Granodioritic intrusive into probably Eocene age interbedded shale-limestone, with magnetite-hematite mineralization in limestones of contact zone, 12 km from Rante Pao)

Hufenbach, C. (1992)- Petrogenetische und Tektonische Entwicklung des Ophiolith-Komplexes von Ost-Sulawesi, ein Beispiel fur die Obduktion ozeanischer Kruste. Doct. Thesis Georg-August University, Gottingen, Germany, p. 1-120. *(Unpublished)*
('Petrogenetic and tectonic development of the ophiolite complex of East Sulawesi; an example of obduction of oceanic crust')

Husein, S., M.I. Novian & D.H. Barianto (2014)- Geological structures and tectonic reconstruction of Luwuk, East Sulawesi. Proc. 38th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA14-G-137, 16p.
(Luwuk area at E end of East Arm of Sulawesi, where E Sulawesi Ophiolite Complex thrusted S-ward over Banggai-Sula microcontinent in Neogene. C part of E Sulawesi Arm is compressional, Pliocene, thin-skinned NW-verging fold- thrust belt with common Eocene-M Miocene carbonates. In ophiolite complex at N side (facing Tomini Gulf) extensional, block-faulting tectonic regime (Plio-Pleistocene relaxation of earlier compressive phase) (NB: suggested NW vergence of thrust belt is opposite of suggested by all previous workers; No documentation for age control of stratigraphy and tectonic events; No mention of Kundig (1956) work in same area; JTvG))

Hutubessy, S. (2003)- Pola cekungan dan struktur bawah permukaan di Sulawesi dan sekitarnya berdasarkan analisis data gayaberat. J. Geologi Sumberdaya Mineral 13, 135, p. 24-39.
('Basin patterns and deep structure of Sulawesi and surroundings based on analysis of gravity data'. Gravity patterns interpretation of E Sulawesi.)

Iddings, J.P. & E.W. Morley (1915)- Contributions to the petrography of Java and Celebes. J. Geology 23, p. 231-245.
(Brief petrographic and geochemical analyses of lavas and crystalline rocks of Bulu Saraung (Maros Peak), SW Sulawesi and Pleistocene Muria volcano NE Java)

Iddings, J.P. & E.W. Morley (1917)- A contribution to the petrography of Southern Celebes. Proc. National Academy Sciences USA 3, 10, p. 592-597.
(Additional brief descriptions and chemical analyses of igneous rocks from SW Sulawesi)

Idrus, A., Fadlin, S. Prihatmoko, I.W. Warmada, I. Nur & F.M. Meyer (2012)- The metamorphic-rock hosted gold mineralization at Bombana, Southeast Sulawesi: a new exploration target in Indonesia. J. Sumber Daya Geologi 22, 1, p. 35-48.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/105/97)
(Placer gold discovered in Bombana, SE Sulawesi not associated with volcanic rocks, but possibly derived from quartz veins hosted by Mesozoic Pompangeo Metamorphic Complex of N Rumbia Mts mica schists, etc.. Three generations of veins identified. Gold mainly as 'free gold' among silicate minerals. May be called 'orogenic gold', and may have formed at 5km depth)

Idrus, I., A. Imai, A. Makkawaru, Kamrullah, I.W. Warmada, I. Nur & R. Langkoke (2009)- Preliminary study on orogenic deposit type as a source of placer gold at Bombana, Southeast Sulawesi, Indonesia. Proc. Int. Symp. on Earth Science and Technology, Fukuoka 2009, p. 569-572.
(Gold deposits in Indonesia generally in volcanic-related hydrothermal deposits, but recent SE Sulawesi placer gold discoveries tied to gold-bearing quartz veins in metamorphic rocks. Such veins recognized in metamorphic rocks at Wumbubangka Mt (N flank Rumbia Mts) and in Mendoke Mts. (N of Langkowala). These gold deposits classified as 'orogenic gold type')

Idrus, A., S. Mansur, Ahmad, Rahmayuddin & Abdul (2016)- Occurrences and characteristics of gold mineralization in Rampi Block prospect, North Luwu Regency, South Sulawesi Province, Indonesia. J. Applied Geology (UGM) 1, 2, p. 63-70.
(online at: https://journal.ugm.ac.id/jag/article/view/26962)
(Quartz ± gold veins in Rampi block prospect mainly hosted by metamorphic and metasedimentary rocks of Latimojong Fm and Pompangeo metamorphic complex. Orientation and distribution of veins controlled by NW-SE and NE-SW trending structures. Orogenic/mesothermal gold type, with similarities to Awak Mas mesothermal prospect in Luwu district)

Idrus, A., I. Nur, I.W. Warmada & Fadlin (2011)- Metamorphic rock-hosted orogenic gold deposit type as a source of Langkowala placer gold, Bombana, Southeast Sulawesi. J. Geologi Indonesia 6, 1, p. 43-49.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/301)
(Same paper as Idrus, Warmada et al. 2010)

Idrus, A. & S. Prihatmoko (2011)- The metamorphic-hosted gold mineralization at Bombana, Southeast Sulawesi: a new exploration target in Indonesia. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado, MGEI/IAGI, p. 243-258.
(Bombana area 'orogenic' gold deposits, hosted in mica schists of Carboniferous-Permian Pompangeo Metamorphic Complex)

Idrus, A., S. Prihatmoko, E. Harjanto, F.M. Meyer, I. Nur, W. Widodo & L.N. Agung (2016)- The metamorphic rock-hosted gold mineralization at Bombana (Southeast Sulawesi) and Buru Island (Maluku): their key features and significances for gold exploration in Eastern Indonesia. Proc. 8th Ann. Conv. Indonesian Soc. Economic Geol. (MGEI), Bandung, p. 80-87.
(Examples of metamorphic rock-hosted 'orogenic' gold mineralization in Bombana (Rumbia Mts, SE Sulawesi; gold-bearing quartz veins in Pompangeo metamorphics) and NE Buru Island (quartz veins in Permo-Carboniferous Wahlua mica schists))

Idrus, A., S. Prihatmoko, E. Harjanto, F.M. Meyer, I. Nur, W. Widodo & L.N. Agung (2017)- The metamorphic rock-hosted gold deposit style at Bombana (Southeast Sulawesi) and Buru Island (Maluku): their key features and significances for gold exploration in Eastern Indonesia. J. Geoscience Engineering Environm. Technol. (JGEET) 2, 2, p. 124-132.
(online at: http://journal.uir.ac.id/index.php/JGEET/article/view/291/130)
(same as Idrus et al. 2016)

Idrus, A., Sufriadin & I. Nur (2011)- Hydrothermal ore mineralization in Sulawesi: a view point of tectonic setting and metallogenesis. Proc. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-298, 12p.
(Review of the potential and metallogenesis of hydrothermal-related ore deposits, particularly along Neogene magmatic arc of W Sulawesi and Paleozoic metamorphics-hosted arm of SE-Central Sulawesi. W Sulawesi 3 magmatic provinces, each with different magmatic and mineralization characteristics: (1) S Sulawesi with K-alkaline shoshonitic affinity and mainly Pb-Zn-Cu base metal in epithermal veins; (2) C Sulawesi with high-K calc-alkaline affinity and porphyry Mo mineralization; (3) N Sulawesi-Sangihe island arc with low-K-normal calc-alkaline affinity and porphyry Cu-Au and other Au deposits)

Idrus, A., I.W. Warmada, I. Nur, Sufriadin, A. Imai, S. Widasaputra, S.I. Marlia, Fadlin & Kamrullah (2010)- Metamorphic rock-hosted gold deposit type as a source of Langkowala placer gold, Bombana, Southeast Sulawesi, Indonesia. Proc. 39th Ann. Conv. Indon. Assoc. Geol. (IAGI), Lombok, PIT-IAGI-2010-068, 7p.
(Placer gold discovered in 2008 in Langkowala area, SE Sulawesi, interpreted derived from 'orogenic gold': sheared gold-bearing quartz veins, hosted by metamorphic rocks (mica schist, metasediment of Pompangeo Complex in Wumbubangk- Rumbia Mts to S). At least two generations of veins. Similar quartz veins probably in Mendoke Mts at N side of Langkowala area)

Ilhami, A.S. (2012)- Provenance and sedimentology study of Mesozoic clastic sandstone of Meluhu Formation, Southeast Arm of Sulawesi, Eastern Indonesia. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-SS-20, 5p.
(Late Triassic fluvial-deltaic Mehulu Sst of SE Sulawesi underlain by metamorphic rocks and unconformably overlain by Paleogene Tampakura Fm carbonates. Petrography shows litharenite, sublitharenite and quartz arenite with average composition of 65% monocrystalline quartz (some with metamorphic undulose extinction, but also likely volcanic provenance), 12% polycrystalline quartz, 16% rock fragments, 1.5% feldspar, some muscovite and heavy minerals (tourmaline, zircon). Lithics dominated by metamorphic rock fragments, indicating source area dominated by metamorphic basement)

Ilyas, A., K. Kashiwaya & K. Koike (2016)- Ni grade distribution in laterite characterized from geostatistics, topography and the paleo-ground water system in Sorowako, Indonesia. J. Geochemical Exploration 165, p. 174-188.
(Modeling of N-content suggests that highest grade zones are concentrated below slopes in 5-19° range)

Ilyas, A. & K. Koike (2012)- Geostatistical modeling of ore grade distribution from geomorphic characterization in a laterite nickel deposit. Natural Resources Res. 21, 2, p. 177-191.
(Modeling of Ni grade in laterite Ni deposit in Sorowako, East C Sulawesi. Maximum Ni grade in saprolite zone in areas of slight slope. Ni accumulation probably originates from deep weathering by groundwater infiltrating through rock fractures)

Imran, A.M. (2000)- Microfacies and diagenesis of the Tertiary Selayar Limestone (Walanae Formation), South Sulawesi, Indonesia. Doct. Thesis, University of Erlangen-Nurnberg, p. 1-187. *(Unpublished)*

Imran, A.M., M. Farida, M.F. Arifin & R. Husain, (2015)- Pleistocene coral reef facies in Bira, South Sulawesi. Int. J. Engineering and Science Applications (UNHAS) 2, 2, p. 183-189.
(online at: http://pasca.unhas.ac.id/ojs/index.php/ijesca/article/view/163/118)
(Pleistocene raised reef terrace with reef front, reef core and back reef facies in Bira area at SE tip of S Arm Sulawesi. Part of complex of four seaward-young narrow terraces of U Miocene-Pleistocene 'Selayar Limestone', reflecting uplift of area (Bone Bay rift shoulder?; JTvG))

Imran, A.M., Kaharuddin M.S., D.A. Suriamihardja & H. Sirajuddin (2013)- Geology of Spermonde Platform. Proc. 7th Int. Conf. on Asian and Pacific Coasts (APAC 2013), Bali 2013, p. 1062-1067.
(online at: http://repository.unhas.ac.id/bitstream/handle/123456789/11699/171.CR%2003.pdf?sequence=1)
(Mainly review of setting for development of Quaternary reef complexes on Spermonde Platform along Makassar Straits, off SW Sulawesi since sea level rise of ~7000 years ago (mainly based on De Klerk 1982))

Imran, A.M. & R. Koch (2006)- Microfacies development of the Selayar Limestone, South Sulawesi. Proc. 35th Conv. Indon. Assoc. Geol. (IAGI), Pekanbaru 2006, PITIAGI2006-028, 8p.
(Four stages of development in Late Miocene- Pliocene Selayar Limestone in SE Bulukumba area of SW Sulawesi, ~200 km SE of Makassar. Oldest unit B1 is Late Miocene Amphistegina- Cycloclypeus foram limestone that forms knoll reefs. Three younger units (Pliocene- Pleistocene) form terraces, reflecting Plio-Pleistocene uplift, composed of coral reef and Halimeda algal grainstone facies)

Imran, A.M. & R. Koch (2008)- Marine diagenetic history of the Selayar Limestone, South Sulawesi. Jurnal Inform. Tekn. 14, 2, p. 109-117.

(Common marine radial fibrous calcite cement in Late Miocene- Pleistocene Selayar Limestone)

International Nickel Indonesia (1972)- Laterite deposits in the south-east arm of Sulawesi. Bull. Nat. Inst. Geology and Mining (NIGM), Bandung 4, 1, p. 37-57.
(PT INCO review of principal occurrences of nickeliferous laterite in E Sulawesi, which coincide with two NW trending belts of ultrabasic rocks and derived sediments: (1) SW belt from Sua-Sua through Pomalaa and Torobulu to Wowoni Island and (2) NE belt from Malili and Kolonodale at N end of E Arrm to Lasolo on E Coast. Nickeliferous laterite on undulating, somewhat dissected plateaus of low relief; rugged areas have little or no laterite cover)

Irfan, U.R., M.S. Kaharuddin, Budiman & H. Umar (2014)- Analisis litofasies batuan vulkanik Pare-Pare di daerah Lumpue Sulawesi Selatan. Proc. 43st IAGI Ann. Conv. Exhib., Jakarta, 5p.
('Lithofacies analysis of Pare-Pare volcanic rocks in the Lumpue area of South Sulawesi'. Rock types of latest Miocene- earliest Pliocene (~4-7 Ma) Pare-Pare volcanic deposits)

Irzon, R. (2017)- Pengayaan logam berat Mn, Co, dan Cr pada laterit nikel di Kabupaten Konawe Utara, Provinsi Sulawesi Tenggara. Bul. Sumber Daya Geologi 12, 2, p. 71-86.
(online at: http://buletinsdg.geologi.esdm.go.id/index.php/bsdg/issue/archive)
('Heavy metal enrichment of Mn, Co, and Cr in nickel laterite in North Konawe Regency, SE Sulawesi'. Weathering of ultramafic rock causes Mn, Co and Cr enrichment mostly in laterite, whilst Ni concentrated in transitional bedrock. Highest REE concentrations in lateritic horizon)

Irzon, R. & Baharuddin (2016)- Geochemistry of ophiolite complex in North Konawe, Southeast Sulawesi. Eksplorium 37, 2, p. 101-114.
(online at: http://jurnal.batan.go.id/index.php/eksplorium/article/view/2868/pdf)
(Geochemistry of N Konawe ultramafic rocks suggest origin in arc tholeiitic tectonic environment setting. SiO2 38.5- 41%, etc. Emplaced in E Cretaceous, unconformably overlain by Late Cretaceous Matano Fm)

Jablonski, D., P. Priyono, S. Westlake & O.A. Larsen (2007)- Geology and exploration potential of the Gorontalo Basin, Central Indonesia- Eastern extension of the North Makassar basin? Proc. 31st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, G-083, p. 197-223.
(Seismic in Gorontalo basin S of N arm of Sulawesi suggests basin underlain by Eocene rift grabens. Active petroleum system suggested by E-W depocentres, locally >10 km thick, mostly S-ward focused hydrocarbon migration, onshore oil seeps along S edge of basin and AVO anomalies. Potential plays: (1) Older blocks associated with Australian plate rifting and Cretaceous collision with Borneo; (2) Eocene rift fault-blocks; (3) Oligocene-M Miocene platform carbonates; (4) Late Miocene-Pliocene build-ups; (5) Late Miocene- Recent lowstand deltas and turbidites; (6) Late Miocene-Recent compressional folds associated with collision of Sundaland with Australian plate)

Jaya, A. (2001)- Sequence stratigraphy of the Tonasa Limestone, Ralla Section, South Sulawesi. J. Penelitian Enjiniring (JPE), Hasanuddin University, 8, 1, p. 59-68.

Jaya, A. (2006)- Facies and sedimentary environment of Camba Formation, Dutungan area, South Sulawesi. J. Penelitian Geosains (Hasanuddin University, Makassar) 2, 3, p. 243-256.

Jaya, A. (2014)- Tectonic evolution of South Sulawesi, Indonesia: reconstructed by analysis of deformation structures. Doct. Engin. Thesis, Dept. Engineering and Resource Science, Akita University, Japan, p. 1-148.
(online at: air.lib.akita-u.ac.jp/dspace/bitstream/10295/2714/1/kouhakuotsu634.pdf)
(Biru Metamorphic Complex E of Makassar, S Sulawesi mainly epidote-amphibolite and amphibolite facies metamorphics from mid-oceanic ridge and calc-alkali basalts and island-arc tholeiite protoliths. E Cretaceous K-Ar age (109 ± 2.4 Ma) indicates metamorphism of Biru Complex coeval with Bantimala Complex and Barru Block. NE-SW striking/ S/SE-dipping schistosities also similar to Barru Block, despite different lithologic associations. Emplacement of Biru granodiorite in E-M Miocene. E Walanae Fault stress generated by collision of Sulawesi with Australian fragments since Late Miocene, continuing to present-day)

Jaya, A. & O. Nishikawa (2011)- Deformation microstructures of metamorphic rocks in the Biru area South Sulawesi. Proc. Joint 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-175, 10p.
(Biru metamorphic rocks in Biru area, S Sulawesi adjacent to W Walanae Fault (WWF). Rocks mainly metabasite, adjacent to Cretaceous Marada Fm sediments. Higher greenschist-amphibolite metamorphic grade. Multiple deformation phases. Schistosity dips 15-52° to SE. Two groups of fold structures: SSW trending tight fold (F1) and ENE-WSW trending gentle-open fold (F2)).

Jaya, A. & O. Nishikawa (2013)- Paleostress reconstruction from calcite twin and faulteslip data using the multiple inverse method in the East Walanae fault zone: implications for the Neogene contraction in South Sulawesi, Indonesia. J. Structural Geol. 55, p. 34-49.
(Stress states caused by collision of SE margin of Sundaland with Australian microcontinents during Pliocene detected from combination of calcite-twin data and fault-slip data. Pliocene NE-SW to-E-W directed compression activated E Walanae fault zone in S. Sulawesi as reverse fault, with dextral component of slip with pervasive development of secondary structures in zone between Bone Mts and Walanae Depression)

Jaya, A., O. Nishikawa & Y. Hayasaka (2017)- LA-ICP-MS zircon U-Pb and muscovite K-Ar ages of basement rocks from the south arm of Sulawesi, Indonesia. Lithos 292-293, p. 96-110.
(Ages of detrital zircons in Bantimala Complex and muscovite K-Ar of amphibolite in Biru Complex 109-115 Ma. Youngest detrital zircon in schist from Barru Complex Triassic (243-247 Ma). Age data indicate protoliths of S Sulawesi basement complexes involved in subduction system and metamorphosed in late E Cretaceous. Felsic igneous intrusive rocks Late Cretaceous and Eocene ages, similar to Meratus Complex of S Kalimantan. Detrital zircon age distributions of basement rocks supporting W Sulawesi block origin from circum Birds Head-Australia (Inner Banda block). Absence of Jurassic zircon age population in S Arm of Sulawesi. W Sulawesi composed of several blocks separated from Inner Banda block with different histories)

Jaya, A. & D.R. Salamba (2014)- Studi struktur makro (mesoscale structure) batuan metamorf daerah Barru Provinsi Sulawesi Selatan. Pros. 2014 Seminar Penelitian Teknologi Terapan 2014 (8), Hasanuddin University, Makassar, p. TG3-1- TG3-8.
(online at: http://repository.unhas.ac.id/handle/123456789/16802)
(' Study of the macrostructure (mesoscale structure) of metamorphic rocks in the Barru region, S Sulawesi'. Barru metamorphic block composed of low- moderate grade metamorphic rocks, with foliation generally NE-trending and tilting to SE. Two main stretching directions i.e., SE-NW-trending and NE-SW-trending, both plunging to W. Fault low angle dip-slip or thrust and horizontal movement or strike-slip. Locally high angle dip-slip faults. Folds formed earlier than faults)

Jaya, A., A.I.S. Simalango & A. Maulana (2015)- Struktur dan deformasi batuan metamorf daerah Paboya Provinsi Sulawesi Tengah. J. Penelitian Geosains (Hasanuddin University) 11, 1, p. 35-41.
(online at: http://repository.unhas.ac.id/handle/123456789/16801)
('Structure and deformation of metamorphic rocks in the Poboya region of Central Sulawesi province'. Poboya/ E Palu District in 'neck' of Sulawesi with outcrops of molasse sediments, gneiss and biotite schist. Folding and post-Tertiary horizontal faulting.Quartz crystal orientations and porphyroblasts in amphibolite-greenschist facies indicate formation at low-medium T (300-700°C) and P <1 Gpa, during syn-tectonic sinistral shear, related to Palu-Koro regional fault)

Jaya, A., Sufriadin & I. Nur (2011)- A short note on sedimentary rocks of the Barru Area, South Sulawesi. Berita Sedimentologi 22, p. 9-14.
(online at: www.iagi.or.id/fosi/files/2011/10/...)
(On Late Cretaceous-Tertiary stratigraphy of Barru area, SW Sulawesi, ~120km N of Makassar. Three measured sections at SE side of Barru basement complex, with M Eocene Malawa Fm fluvio-deltaic clastics, M-Late Eocene Tonasa Fm mixed clastics and redeposited carbonates, Mio-Pliocene Camba Fm deeper marine volcanoclastics)

Jezek, P.A., D.J. Whitford & J.B. Gill (1981)- Geochemistry of recent lavas from the Sangihe- Sulawesi arc. In: A.J. Barber & S. Wiryosujono (eds.) The geology and tectonics of Eastern Indonesia, Proc. CCOP-IOC SEATAR Working Group Mtg., Bandung 1979, Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 2, p. 383-389.
(Sangihe Arc stretches from NE of Sulawesi to N, at W side Molucca Sea. 130-180 km above W dipping Benioff zone that extends to 650 km depth. S sector mainly olivine basalts and pyroxene andesite, N part more hornblende andesites. No evidence of involvement of sediments in lavas)

Jugovics, L. (1940)- Der granodiorit von Gorontalo auf Nordcelebes. Foldtani Kozlony 70, p. 163-176 and p. 222-231.
('The granodiorite of Gorontalo on North Sulawesi')

Jugovics, L. (1950)- Beitrage zur Kenntnis der Gesteine von Ost-Celebes. Geologica Hungarica, Ser. Geol. 8, p. 1-112.
('Contributions to the knowledge of rocks from East Sulawesi'. Descriptions of igneous rocks collected by Loczy 1928. Mainly ophiolitic igneous rocks (gabbro, hartzburgite, serpentinite), some metamophics and volcanics)

Jurkovic, I. & I.B. Zalokar (1990)- The copper deposit of Batu Marupa in Central Sulawesi, Indonesia. Rudarsko Geol. Naftni Zbornik 2, Zagreb, p. 29-33.
(Brief description of small abandoned copper mines, exploited by Japanese in WWII in central West Sulawesi)

Kadar, A.P. & Sudijono (1993)- Biostratigrafi fosil nanno Tersier Tengah Formasi Tonasa (Penampang Rala), Sulawesi Selatan. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 1100-1113.
('Biostratigraphy of Middle Tertiary nannofossils in the Tonasa Formation (Rala Section), South Sulawesi'. Nannofossils from lower Tonasa Fm show Late Eocene (NP18-NP20)- Early Oligocene (NP21-NP23) ages. Calciturbidites in Late Eocene (NP20) with larger foraminifera Discocyclina, Pellatispira, etc.. In E Ologocene zone NP23 olistostrome bed with reworked Eocene larger forams)

Kadarusman, A. (2011)- Basement rocks of Sulawesi and their contribution to the metallogenic formation. In: N.I. Basuki (ed.) Proc. Sulawesi Minerals Resources, Manado 2011, Indon. Soc. Econ. Geol. (MGEI) - IAGI, p. 121-130.
(Sulawesi five basement types (1) accretionary-collision complex (Bantimala and Barru Complex in SW arm), (2) metamorphic rocks with continental margin parentage (metamorphic complexes in W, NW, C and SE Sulawesi), (3) ophiolitic rock and oceanic crust (E and N arm, respectively), (4) melange or broken formation (C part), (5) continental granitic basement (Banggai-Sula and Tukang Besi). All basements Mesozoic in age; some metamorphic rocks have Paleozoic protoliths)

Kadarusman, A., H.K. Brueckner, H. Yurimoto, C.D. Parkinson & S. Maruyama (2001)- Geochemistry and Sm-Nd dating of garnet peridotites from Central Sulawesi, and its implication to the Neogene collision complex in Eastern Indonesia. American Geophys. Union (AGU), Fall Meeting 2001, T52D-08, 1p. *(Abstract only)*
(Small garnet-bearing peridotites on Sulawesi in two regions in strike-slip fault zones: Palu-Koro fault zone and right-lateral Ampana fault in Bongka river valley juxtaposed against E Sulawesi ophiolite. P-T time plot suggests prograde subduction zone peridotite. Sm-Nd ages 27-20 Ma. 27 Ma probably peak metamorphism and 20 Ma cooling age. Ultramafic rocks most likely metamorphosed to garnet- assemblages during Late Oligocene- E Miocene continent-continent collision in C Sulawesi. Due to buoyancy peridotites uplifted within Neogene metamorphic complex)

Kadarusman, A., S. Miyashita, S. Maruyama & A. Ishikawa (2002)- The East Sulawesi Ophiolite: the accreted Cretaceous huge ophiolite massif formed by Southwest Pacific superplume. Abstract Superplume Workshop, Tokyo, 4p.
(online at: http://192.129.24.144/licensed_materials/10069/free/conferen/superplu/..)
(Ophiolite complexes of W and C Indonesia (i.e. Java, Kalimantan) of Tethyan provenance, those in E Indonesia probably parts of Circum-Pacific ophiolite belt. E Sulawesi Ophiolite tectonically dismembered, >15 km thick ophiolite sequence from mantle peridotite to mafic cumulate, gabbro, sheeted dolerites and basaltic

volcanics. Geochemistry suggests oceanic plateau origin, may have originated in SW Pacific Superplume. Ages Paleogene (60-32 Ma; termination of generation of oceanic lithosphere?) and Cretaceous (79-137 Ma; first generation of oceanic lithosphere?). Obduction onto Sundaland ~30 Ma (age of metamorphic sole))

Kadarusman, A., S. Miyashita, S. Maruyama, C.D. Parkinson & A. Ishikawa (2004)- Petrology, geochemistry and paleogeographic reconstruction of the East Sulawesi ophiolite, Indonesia. Tectonophysics 392, p. 55-83.
(E Sulawesi Ophiolite (ESO) tectonically dismembered and widely distributed in C and E Sulawesi. Comprises, from base: mantle peridotite, gabbro, sheeted dolerites and basaltic volcanic rocks. Possible oceanic plateau origin (15 km thick). Possible Cretaceous origin of oceanic plateau component indicated on basis of calculated paleopositions using plate trajectory analyses together with published paleolatitude data)

Kadarusman, A. & C.D. Parkinson (2000)- Petrology and P-T evolution of garnet peridotites from Central Sulawesi, Indonesia. J. Metamorphic Geol. 18, 2, p. 193-209.
(Alpine-type garnet-bearing peridotites associated with E Cretaceous (140-115 Ma) quartzo-feldspathic gneisses of in two areas of Sulawesi (Palu-Koro fault and outcrops juxtaposed against gabbros and peridotites of E Sulawesi ophiolite in right-lateral Ampana fault). Final exhumation from upper crustal levels facilitated by entrainment in Neogene granitic plutons, and/or Oligocene transtension in deep-seated strike–slip fault zones)

Kadarusman, A., T. van Leeuwen & R. Soeria-Atmadja (2005)- Discovery of eclogite in the Palu region of Central Sulawesi and its implication for the tectonic evolution of Sulawesi. Majalah Geologi Indonesia 20, 2, Spec. Ed., p. 80-89.
(Eclogite and other high-grade metamorphic rocks in float in Palu-Koro fault valley. Proposed history: (1) Early Tertiary conversion of oceanic lithosphere into eclogite after subduction to ~60km below Sundaland; (2) Late Oligocene- Early Miocene collision between microcontinent and Sundaland margin incorporated eclogite fragments into upper plate; (3) latest Miocene- Pliocene rapid uplift after Banggai-Sula collision)

Kadarusman, A., T. van Leeuwen & J. Sopaheluwakan (2011)- Eclogite, peridotite, granulite and associated high-grade rocks from the Palu region, Central Sulawesi, Indonesia: an example of mantle and crust interaction in a young orogenic belt. Proc. Joint 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-379, 10p.
(Palu region of C Sulawesi part of collision zone with peridotites and high-grade metamorphic rocks (eclogite, granulite). Formed at great depth during collision event between Sundaland and underthrusted Australian continental fragment sometime in Late Eocene- E Miocene. Radiometric ages of Palu Metamorphic Complex two groups: Mesozoic (144-73 Ma) and Late Miocene-Pliocene (6-2 Ma). Younger ages probably overprint of widespread young granite magmatism)

Kaharuddin, M. (2010)- Perkembangan tektonik dan stratigrafi Kompleks Bantimala, Sulawesi Selatan. Pros. Hasil Penelitian Fakultas Teknik Unhas 4, p. TG 5-1-TG5-9.
('Tectonic and stratigraphic development of the Bantimala Complex, South Sulawesi')

Kaharuddin M.S., A. Jaya & H. Sirajuddin (2015)- Olistostrome dan batu mulia kompleks tektonik Bantimala, Kabupaten Pangkajene dan kepulauan, Provinsi Sulawesi Selatan. Proc. 24th TPT and 9th Congress Assoc. Indonesian Mning Professionals (PERHAPI), Jakarta 2015, p. 65-76.
(online at: http://repository.unhas.ac.id/bitstream/ ....)
('Olistostrome and precious stones in the Bantimala tectonic complex, Pangkajene District, S. Sulawesi'. Bantimala Complex composed of metamorphic rocks such as glaucophane schist, hornblende mica schist, eclogite, granulite, phyllite and metaquartzite of Triassic age. Olistostrome components schist, quartzite, metachert, jadeite, Jurassic-Cretaceous metaperidotite and Cretaceous sediments (flysch, shale, sandstone, mudstone and radiolarian chert). Basement contains precious stones like agate, jade, turquoise, etc.)

Kaharuddin M.S., A. Tonggiroh & H. Sirajuddin (2014)- Olistostrome dan obduksi ofiolit Lasitae, Kabupaten Barru, Provinsi Sulawesi Selatan. Proc. 43rd Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, PIT IAGI 2014-075, 8p.
('Olistostrome and ophiolite obduction, Lasitae, Barru, S Sulawesi Province'. Polymict and limestone breccia olistostrome sediments exposed along Barru River (± 3 km), N of (and overthrust by?) schist-ophiolite complex.

Composed of blocks of dacite, peridotite, Malawa sst, coal and silicified Eo-Oligocene Tonasa Lst with Nummulites. Four members in olistostrome, with tuffaceous marls in upper part. Formation of olistostrome most likely in Late Oligocene, at edge of shallow sea basin, and tied to obduction of Lasitae ophiolite)

Katili, J.A. (1970)- Additional evidence of transcurrent faulting in Sumatra and Sulawesi. Bull. Nat. Inst. Geology and Mining (NIGM), Bandung, 3, 3, p. 15-28.

Katili, J.A. (1977)- Past and present geotectonic position of Sulawesi, Indonesia. Proc. 6th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 317-332.
(Early plate tectonic model for Sulawesi, proposing Sulawesi- Kalimantan collision in Early Pliocene, followed by post-Pliocene Makassar Straits extension. Timing of various events described no longer current; JTvG)

Katili, J.A. (1978)- Past and present geotectonic position of Sulawesi, Indonesia. Tectonophysics 45, p. 289-322.
(Outdated overview of events shaping Sulawesi geology: Banda Sea= trapped old Indian Ocean crust, Sulawesi Sea= old trapped Pacific crust, opening of Makassar Straits in Quaternary, etc.)

Katili, J.A., L. Kartaadiputra & Surio (1963)- Magma type and tectonic position of the Una-Una Island, Indonesia. Bull. Volcanology 26, 1, p. 431-454.
(Una-Una rocks differ from other volcanoes in Indonesia: K-rich, medium alkaline, transitional between trachytes and andesites. Volcano lies outside orogenic belt, probably at intersection of two basement fissures of NE-SW and SE-NW directions. Extinct volcanism in Togean ridge. Known eruption in 1898, earthquake in 1960 (and major eruption in 1983; Katili & Sudradjat 1984))

Kavalieris, I. (1984)- The geology and geochemistry of the Gunung Pani gold prospect, North Sulawesi. M.Sc. Thesis, Australian National University (ANU), Canberra, p. 1-450. *(Unpublished)*
(Study of Gunung Pani gold prospect near Marisa village, N Sulawesi, initially surveyed in 1920's. Gold mineralization low grade, large tonnage gold resource, hosted in intrusive porphyritic rhyodacites and pyroclastics of Pliocene- Pleistocene Pani Volcanic Complex. Geochemically Pani Volcanics best compared to rocks from continental margin tectonic settings)

Kavalieris, I., T.M. van Leeuwen & M. Wilson (1992)- Geological setting and styles of mineralisation, North arm of Sulawesi, Indonesia. J. Southeast Asian Earth Sci. 7, p. 113-129.
(Sulawesi N arm Neogene island arc on Paleogene volcanic-sedimentary basement, underlain by oceanic crust. Sulawesi neck metamorphic rocks and felsic granitoids belong to Sundaland continental margin. N Sulawesi Arc two stages, separated by gap 13- 9.5 Ma, reflecting collision of N arm with Sula Platform microcontinent in M Miocene. E Miocene calc-alkaline arc due to W-directed subduction. Arc-continent collision resulted in back-arc thrusting, clockwise rotation of N arm, and inception of subduction along N Sulawesi Trench. Post-collisional magmatism in N Sulawesi Arc produced felsic-mafic volcanic suites related to rifting of former arc rather than subduction. Sulawesi Neck Dondo suite potassic granites of continental affinity. N arm rel. well mineralized. Porphyry Cu-Au mineralization at ~2-4 Ma in oceanic terrane following collision-related arc reversal and Mo mineralization in continental terrane that underwent lower crustal melting during extension following same collision. Cogenetic granites exposed over 5000 km2 and intruded in arcuate belt, more than 400 km long, parallel to Sula Platform collision zone)

Kavalieris, I., J.L. Walshe, S. Halley & B.P. Harrold (1990)- Dome-related gold mineralization in the Pani Volcanic complex, North Sulawesi, Indonesia: a study of geologic relations, fluid inclusions and chloritic compositions. Economic Geology 85, p. 1208-1225.
(Gold mineralization at Gunung Pani prospect near Marisa, N Sulawesi. related to Miocene or younger rhyodacitic volcanic center, which overlies and partly intrudes hornblende-biotite granodiorite and Eocene(?) basaltic volcanics)

King, J., A.E. Williams-Jones, V. van Hinsberg & G. Williams-Jones (2014)- High-sulfidation epithermal pyrite-hosted Au (Ag-Cu) ore formation by condensed magmatic vapors on Sangihe Island, Indonesia. Economic Geology 109, p. 1705-1733.
(online at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.855.9057&rep=rep1&type=pdf)
(Related Bawone and Binebase high-sulfidation epithermal Au (Cu-Ag) deposits on S Sangihe volcanic island hosted by altered andesitic rocks. Mineralization multiple generations of gold-bearing pyrite)

Koesnama (2014)- Pensesaran mendatar dan zona tunjaman aktif di Sulawesi: hubungganya dengan kegempaan. J. Geologi Sumberdaya Mineral 15, 2, p. 75-79.
('Strike-slip faults and active subduction in the Sulawesi area and their relationships with seismicity'. On Pulau-Koro, Walanae, Matano, Lawanopo and Gorontalo faults, mainly large strike-slip faults)

Koolhoven, W.C.B. (1930)- Verslag over een verkenningstocht in de Oostarm van Celebes en den Banggai Archipel. Jaarboek Mijnwezen Nederlandsch-Indie 58 (1929), Verhandelingen, p. 187-225.
('Reconnaissance survey of Sulawesi E arm and Banggai Archipelago'. E Sulawesi isoclinally folded (N-dipping) Eocene limestones-sst and E Miocene limestones-marls (Oligocene absent), overthrusted by ophiolites, both unconformably overlain by Pliocene 'Celebes molasse'. No crystalline basement. Small outcrops of underlying Jurassic? with belemnites (Cenomanian; Silver et al. 1983). In North ophiolites overlain by ?Miocene diabase, tuff, andesite. Several oil seeps in Pliocene Celebes Molasse, some with non-flammable H2S-bearing gas, and also in gabbro in S. Babason. Eocene Nummulites limestone with Lacazina and Alveolina wichmanni (p. 202 'known only from New Guinea and E Celebes'). Quaternary limestones along S coast of E arm up to 500m uplift, little or none along N coast)

Koolhoven, W.C.B. (1932)- De geologie van het Malili terrein (Midden Celebes). Jaarboek Mijnwezen Nederlandsch-Indie 59 (1930), Verhandelingen 3, p. 127-153.
(Description of part of E Sulawesi ophiolite belt and pelagic cover in C Sulawesi Malili area. Peridotites (= pre-Cretaceous oceanic crust?), with top zone of 10's of m thick dynamometamorphic serpentinites with some metamorphic blocks (amphibolite, piemontite-quartzite, etc.). Overlain by Matano series of ?Late Jurassic- E Cretaceous? red deep sea clay with radiolarian cherts and Late Cretaceous Discorbina (=Globotruncana) pelagic limestones, interpreted to be deep sea deposits deposited directly on peridotite. No Tertiary sediments)

Koomans, C. (1935)- Die Trachyten und Andesiten der Togianinseln und Oena-Oena (Niederlandisch Ost-Indien). Leidsche Geol. Mededelingen 6, p. 119-122.
(online at: www.repository.naturalis.nl/document/549748)
('The trachytes and andesites volcanics of the Togian Islands and Una-Una', Tomini Bay E Sulawesi'. Brief petrographic descriptions of volcanic rocks collected by Molengraaff and Umbgrove. No ages or locality maps)

Koperberg, M. (1900)- Verslag van het geologisch en mijnbouwkundig onderzoek in de residentie Menado over het jaar 1899. Jaarboek Mijnwezen Nederlandsch-Indie 29 (1900), p. 30-50.
('Report on geological-mining investigations in the Menado Residency for the year 1899')

Koperberg, M. (1901)- Verslag van het geologisch en mijnbouwkundig onderzoek in de residentie Menado over het jaar 1900. Jaarboek Mijnwezen Nederlandsch-Indie 30 (1901), p. 115-121.
('Report on geological-mining investigations in the Menado Residency for the year 1900')

Koperberg, M. (1902)- Geologisch en mijnbouwkundig onderzoekingen in de residentie Menado gedurende het jaar 1901. Jaarboek Mijnwezen Nederlandsch-Indie 31 (1902), p. 147-161.
('Geological-mining investigations in the Menado Residency during the year 1901')

Koperberg, M. (1903)- Geologisch en mijnbouwkundig onderzoekingen in de residentie Menado gedurende het jaar 1902. Jaarboek Mijnwezen Nederlandsch-Indie 32 (1903), p. 170-178.
('Geological-mining investigations in the Menado Residency during the year 1902')

Koperberg, M. (1925)- Opmerkingen over de geologie van de residentie Menado. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 8 (Verbeek volume), p. 312-328.
(‘Remarks on the geology of the Menado Residency’, N Sulawesi’)

Koperberg, M. (1929)- Bouwstoffen voor de geologie van de Residentie Manado. Jaarboek Mijnwezen Nederlandsch-Indie 75 (1928), Verhandelingen 1, p. 1-397.
('Elements of the geology of the Manado Residency'. Part I of major compilation of geology of N and N Central Sulawesi: Minahasa, Bolaang, E Gorontalo, etc.)

Koperberg, M. (1929)- Bouwstoffen voor de geologie van de Residentie Manado. Jaarboek Mijnwezen Nederlandsch-Indie 75 (1928), Verhandelingen 2, p. 1-446.
('Elements of the geology of the Manado Residency'. Parts II (W Gorontalo, Bwool, Pageat, Maoeton, Una-Una) and III (Poso, Todjo areas) of major compilation of N and N Central Sulawesi region geology; incl. Una-Una volcano. With separate Atlas volume)

Koswara, A. & D.Z. Hayat (2002)- Batuan plutonik kaitannya dengan daerah mineralisasi Pulau Tanahjampea, Sulawesi Selatan. J. Geologi Sumberdaya Mineral 12, 2002, p. 19-27.
('Plutonic rocks and their relation to mineralized areas Tanahjampea Island, South Sulawesi'. Tanahjampea Island S of Selayar/ S Sulawesi in East Java Sea. Intrusive rocks Eocene-Oligocene granite and monzonite and M Miocene diorite, andesite, basalt, etc. of calc-alkaline affinity. Sediments Late Oligocene- E Miocene Batu Fm limestone, interfingering with Late Oligocene- E Miocene Kayuadi Fm 400m of volcanic breccias. M Miocene- Pliocene Kalao and Selayar Fms marine marls and limestones)

Koswara, A., H. Panggabean, Baharuddin & D. Sukarna (1994)- Geologic map of the Bonerate sheet, S Sulawesi. Geol. Res. Dev. Centre (GRDC), Bandung.
(Geologic map of islands off S Sulawesi (Tambolongan, Kayuadi, Kalao, Bonerate, Madu, etc. Oldest rocks Cretaceous(?) ultramafics (pyroxenite, gabbro, basalt), Eocene- Oligocene granite. Overlain by E-M Miocene Kayuadi Fm andesitic volcanics and Batu Fm limestones, M Miocene- E Pliocene Kalao / Selayar/ Walanai Fms sst, marls, lst)

Kundig, E. (1932)- Versuch einer petrographischen Characteristik des kristallinen Grundgebirges von Celebes. Schweizerische Mineralogische Petrographische Mitteilungen 12, 2, p. 450-507.
(online at: https://www.e-periodica.ch/digbib/view?pid=smp-001:1932:12#486)
(‘Attempt at petrographic characterization of the crystalline basement of Sulawesi’. Early paper on metamorphic rocks in various basement complexes of S, C and SE Sulawesi (gneiss, phyllite, glaucophane schist (mainly at Rumbia), etc. With map of Pajangkene Massif (= Bantimala?; metamorphics). Large parts of E and SE arm of Sulawesi viewed as alpine thrust belt. With one map)

Kundig, E. (1932)-Morphologie und Hydrographie der Toili-Ebene (Ostcelebes). Mitteilungen Geographisch-Ethnograph. Gesellschaft Zurich 32, 2, p. 105-134.
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('Morphology and hydrography of the Toili plain (East Sulawesi). Geographic description of East Arm of Sulawesi. With 1: 200,000 topographic map of SE coast of East Arm)

Kundig, E. (1956)- Geology and ophiolite problems of East-Celebes. Verhandelingen Kon. Geologisch Mijnbouwkundig Genootschap, Geol. Serie 16 (Memorial volume/Gedenkboek H.A. Brouwer), p. 210-235.
(Paper and map of Sulawesi E arm- Togian Islands, summarizing BPM work. Nice cross-sections of SE-directed imbricates of ophiolitic rocks and pelagic Upper Cretaceous limestones. Age of main orogenic phase is M Miocene (ophiolite debris in Upper Miocene ‘Celebes Molasse’). Map shows ophiolite on Togian Islands where GRDC map shows young volcanoclastics)

Kurniawan, A.P., G.P. Adi, M. Arifin, A.S. Arifin, K. Sani, S. Pamungkas, A.D. Guntara & T. Suroso (2017)- Imaging Miocene duplex carbonate play beneath ophiolite belt zone using seismic synthetic modeling approach. Proc. 41st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA17-60-G, 8p.

(Seismic suggestive of carbonate duplex structure under ophiolite in Banggai-Sula foreland basin imbricate thrust zone (Batui Thrust belt), E Sulawesi)

Kurniawan, A.P., G.P. Adi, M. Arifin, A.S. Ningrum & A.S. Arifin (2017)- Pliocene deep water carbonate turbidites play evaluation in the Banggai-Sula foreland basin. Proc. 41st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA17-59-G, 14p.
(Banggai-Sula Foreland Basin in Matindok Block, E Sulawesi, is product of Late Miocene- E Pliocene collision between Banggai Sula microcontinent and E Sulawesi Ophiolite-magmatic arc of Sundaland. Onshore wells Matindok-7 and Penyu-1, and discovered gas-condensate in M-52 carbonate layer of Plio-Pleistocene Celebes Molasse. M-52 turbiditic carbonate 3 layers, with (reworked?) Miocene Lepidocyclina, poosity 10-20%)

Kurniawan, A.P., C.D. Ardianto, M.J. Panguriseng, M. Arifin, I. Firman & G.P. Adi (2016)- Possible Mesozoic graben system in the offshore Matindok Block: a new evaluation of prospective kitchen using 2D PSDM dataset. Proc. 40th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA16-41-G, 7p.
(2D seismic dataset in Matindok Block, E Sulawesi, suggests possibility of NNE-SSW trending Mesozoic graben system in Tolo foredeep of Banggai-Sula foreland beneath Miocene platform carbonate. Several Mesozoic half-graben inversions. This may have consequences for distribution of Jurassic mature source rock (but crude oils tested so far with Tertiary biomarkers, probably tied to E-M Miocene Tomori Fm))

Kurniawan, A.P., M. Arifin, I. Firman & H. Budiarso (2015)- Regional vitrinite reflectance (Ro) trend for predicting kitchen area beneath Batui Thrust in the onshore area of Matindok Block, Eastern Sulawesi-Indonesia. Proc. 39th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA15-G-140, 4p.
(Vitrinite Reflectance modelling used to predict kitchen area beneath Batui Thrust, onshore E Sulawesi)

Kurniawan, A.P., M. Arifin, W.T. Sundari, Sardjito, N. Budi & H. Nurudin (2016)- Interval velocity modeling of Celebes Molasse as post collision in Banggai-Sula foreland basin, Eastern Sulawesi, Indonesia. Proc. 40th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA16-44-G, 7p.
(Banggai-Sula Foreland Basin product of Late Miocene- E Pliocene collision between Banggai-Sula microcontinent and E Sulawesi ophiolite-magmatic arc of Sundaland. Post-collisional Celebes Molasse deposited E-ward into basin in Plio-Pleistocene, with thickness 1500-2700m. Interval velocity modeling of molasse to improve interpretation of underlying Top Miocene carbonate surface)

Kurniawan, A.P., M. Arifin, R.A. Wibawa, H. Budiarso, N. Budi & H. Nurudin (2015)- Understanding imbricate thrust sequences of Miocene carbonate platform in the southwest offshore area of Mmatindok Block, Eastern Sulawesi- Indonesia. Proc. Joint Conv. HAGI-IAGI-IAFMI-IATMI, Balikpapan, JCB2015-346, 4p.
(Imbricate thrust zone in SW offshore area of Matindok Block area, Tolo Bay, E Sulawesi, product of Late Miocene- E Pliocene collision between Banggai-Sula microcontinent and E Sulawesi Ophiolite/magmatic arc. Unconformably overlain by Pliocene Celebes Molasse. Oilfield in Tiaka thrust, but dry holes in Kalomba-1 and Tolo-1 thrust prospects. NW-SE regional seismic line shows 6 thrust slices (38% shortening), in front of upthrust ophiolite (penetrated by Dengkala 1 well). Older imbricate thrust sequences lower porosity)

Kurniawan, A.P., I. Firman, E. Nurjadi, A. Prasetyo & I.G. Widyoseno (2018)- Unlocking potential plays of unexplored back-bulge in the Banggai-Sula foreland basin. Proc. 42nd Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA41G, 17p.

Kurniawan, D., F.F. Baskaraputra, Sugiyanto, A. Baasir & D.H. Febrianto (2011)- Integrated reservoir modeling and characterization of 'SNR' Field. Proc. Joint 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-346, 15p.
(Reservoir model of SNR (= Senoro) gas field, discovered in 1999 in Late Miocene Mantawa Mb carbonate buildup, Senoro-Toili Block, E Sulawesi)

Kusnama & S. Andi Mangga (2007)- Hubungan lingkunan pengendapan Formasi Malawa dan keterdapatan batubara di daerah Soppeng, Sulawesi Selatan. J. Sumber Daya Geologi 17, 4, p. 218-232.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/291/262)

('Relationship of Malawa Fm depositional environment and coal beds in the Soppeng area, S Sulawesi' M Eocene (- Oligocene?) fluvial Malawa Fm m-c grained quartz sst, shale and claystone in lower part; mudstone and carbonaceous fine- grained sst in upper part. Thickness in Gatareng area ~100m. Detailed descriptions of several 50-120 cm thick sub-bituminous coal intercalations)

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(online at: www.bgl.esdm.go.id/dmdocuments/jurnal20080404.pdf)
(Tomini/ Gorontalo Basin seismic interpretation)

Kusnida, D., Subarsyah & B. Nirwana (2009)- Basement configuration of the Tomini Basin deduced from marine magnetic interpretation. J. Geologi Indonesia 4, 4, p. 269-274.
(online at: www.bgl.esdm.go.id/dmdocuments/jurnal20090404.pdf)
(Magnetic survey in Tomini Basin (= Gorontalo Basin), E Sulawesi, shows elevated magnetic susceptibility values in centre of basin. Oceanic-like crust with nearly NE-SW symmetric lateral lineation of susceptibility values. At centre E-W trending basin axis, suggests rift-related graben)

Kusuma, R.A.I., H. Kamaruddin, R.R. Wibawa & M.R. Kamil (2015)- Geological prospect, resource and ore reserve estimation in Pomalaa Kolaka, Southeast Sulawesi, Indonesia. In: N.I. Basuki (ed.) Proc. Indonesian Soc. Econ. Geol. (MGEI) 7th Ann. Conv., Balikpapan, p. 67-76.
(Pomalaa nickel mine/prospect in SE Arm of Sulawesi, 30km S of Kolaka, in N-Co laterite on East Sulawesi Ophiolite. Typical laterite profile: weathered, serpentinized ultramafic bedrock overlain by 2-7m thick saprolite layer with average 1.7-2.3% nickel (mainly garnierite), overlain by 3-7m thick yellow and red limonite zone with 0.4-1.2% nickel)

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(On Poboya low sulphidation epithermal gold-silver deposit in 'neck' of N Sulawesi, E of Palu-Koro fault system. Discovered by Rio Tinto in 1993. Three mineralization zones)

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(same as Surono 1998?)

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('The Paleozoic and Triassic of East Sulawesi'. Chapter in Von Loczy 1934 paper. Oldest rocks known from SE Sulawesi are deformed and partly metamorphosed Triassic-Jurassic Kendari Beds and Toeli Lst with Jurassic belemnites. Material collected by Von Loczy also contains dark grey marly bituminous limestone with probable Permian bivalve Oxytoma and brachiopods Productus and Streptorhynchus. Triassic Tokala Lst and sandstones with macrofossils include locally common Misolia spp., also known from Timor, Buru, Seram and Misool)

Kutassy, A. (1934)- Jong Tertiaire koralen en mollusken uit de molasse-afzettingen in Oost-Celebes. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 10, p. 306-317.
('Young Tertiary corals and molluscs from E Sulawesi molasse deposits'. Chapter in Von Loczy 1934 paper)

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(Miocene Minahaka Fm carbonate platform reservoir characterization study at Senoro gas field, C Sulawesi)

Kwong Hiu Jing (2011)- Paleomagnetic investigation of the Balangbaru Formation, SW Sulawesi, Indonesia. Masters Thesis, University of Hongkong, p. 1-121. *(Unpublished)*

(online at: http://hub.hku.hk/handle/10722/134043)
(Paleomagnetic study of 6 localities of Balangbaru Fm, an Upper Cretaceous (Turonian- Maastrichtian and older?) volcanoclastic marine turbiditic series of SW Sulawesi. No rock samples carry reversed polarity. Declination values show CCW rotation of ~15-20°, reflecting tectonic motion of Sunda Block since Late Cretaceous (similar to Sasajima et al. (1980) results on Marada Fm). Calculated paleolatitude for tilt-corrected inclination is 8.3° S (present-day latitude is ~4°45' S, indicating possible 3.5- 4° N-ward shift; JTvG)

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('Study on a fossil plant from marine Tertiary deposits of S Sulawesi'. Plant fossils associated with fish fauna in Early Miocene lithographic limestone at Patanuang Asu, NE of Makassar, collected by Brouwer. Mainly shallow marine seaweed Cymodocea micheloti)

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('Active tectonics of NE Sulawesi and structural control on the Tondano caldera'. NE tip Sulawesi field study and SPOT image analyses show distributed active ENE-WSW sinistral strike-slip fault zone. Faulting accommodates N-S movement of Celebes Sea plate and represents transfer fault zone between E end of Celebes Sea subduction and Moluccas Sea subduction zone)

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(online at: www.koreascience.or.kr/)
(Olo-Olohonickel laterite prospect in SE Sulawesi. Nickel ore derived from weathered, fractured ultrabasic rocks of U Mesozoic age, which overlies Carboniferous (?) schist)

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Lowder, G.G. & J.A.S. Dow (1978)- Geology and exploration of porphyry copper deposits in North Sulawesi, Indonesia. Economic Geology 37, p. 628-644.
(N Sulawesi porphyry copper discoveries in two districts, with several centers of mineralization. Tombuililato district high-level quartz diorite porphyry stocks intrude Eocene- E Miocene island-arc sequence (Tinombo-Bilungala Fms), consisting mainly of andesite and rhyolite. Mineralization and alteration may have occurred at relatively low temperatures (350-400°C). Tapada district mineralization in M-U Miocene dioritic plutons, root zones of high-level stocks whose eroded parts were like deposits exposed at Tombuililato)

Lubis, H., S. Prihatmoko & L.P. James (1994)- Bulagidun prospect: a copper, gold and tourmaline bearing porphyry and breccia system in northern Sulawesi, Indonesia. J. Geochemical Exploration 50, p. 257-278.
(Bulagidun prospect in N Sulawesi characteristic of island-arc porphyry Cu-Au mineralization, although abundant tourmaline is unusual in SW Pacific. Mineralization tied to intrusions into widespread andesitic volcanic rocks (~9.4 Ma))

Lubis, H., S. Prihatmoko & F.E. Nugroho (2011)- Cu-Au porphyry mineralization at Bahumbung, North Sulawesi, Indonesia. J. Sumber Daya Geologi 21, 6, p. 307-320.
(Bahumbung is porphyry Cu-Au prospect in N Arm of Sulawesi. Miocene andesitic volcanics intruded by multiple diorites and post mineral dykes of aplite. Bahumbung system experienced deep level of erosion. Currently considered sub-economic)

Lubis, H., S. Prihatmoko & F.E. Nugroho (2011)- Cu-Au porphyry mineralization at Bahumbung, North Sulawesi, Indonesia. In: N.I. Basuki (ed.) Proc. Sulawesi Minerals Resources 2011, Manado, MGEI/IAGI, p. 145-160.
(Same paper as above)

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(In 1998-2001 Pertamina drilled three wildcat wells in Banggai Basin, onshore E Arm of Sulawesi. Two wells hit gas-bearing zones in Miocene carbonates, with net pay of reservoir 140-207m)

Magetsari, N.A. (1984)- L'ile de Celebes, Indonesie orientale: analyse structurale par teledetection des grands lineaments, un exemple de collision. Thesis 3me Cycle, Universite de Chambery, p. 1-134. *(Unpublished)*
('Sulawesi island: structural analysis by remote sensing of large lineaments, an example of collision'. Several major lineaments from W to E: (1) Palu-Koro, 300km, sinistral strike slip zone; (2) Matano and Malili-Kendari, also sinistral; (3) Batui in NE, corresponding partly with ophiolite obduction over Sula islands, continuing offshore as 'Batui thrust'. Small Plio-Pleistocene pull-apart basins over large fault zones. Tectonics linked to NW-SE compression due to convergence of Australian plate and its split-off Sula fragment. Main collision in M Miocene, with obduction of peridotites and continental underthrusting of W side of Sula microcontinent. After that convergence accommodated along major fault zones and absorbed by accretionary prism of N Celebes Trough and Tolo zone at Banda Sea margin. At same time N arm of Sulawesi underwent 90° CW rotation)

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Marhum, F.A. & R.H.L. Djamaluddin (2012)- Rekonstruksi fasies dan lingkungan pengendapan berdasarkan analisis maseral pada batubara daerah Pasenrengpulu, Kecamatan Lamuru, Kabupaten Bone, Provinsi Sulawesi Selatan. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-E-28, 7p.
('Reconstruction of facies and depositional environment based on analysis of coal macerals in the Pasenrengpulu area, Bone District, S Sulawesi'. Petrographic analysis of Eocene Malawa Fm coals. Coal composition: vitrinite (48.6% -83.8%), inertinite (2.4-16.2%) and liptinite (0-9%), clay minerals (2.0-38.4%) and pyrite (1.4-11.8%))

Marrama, G., S. Klug, J. De Vos & J. Kriwet (2018)- Anatomy, relationships and palaeobiogeographic implications of the first Neogene holomorphic stingray (Myliobatiformes: Dasyatidae) from the early Miocene of Sulawesi, Indonesia, SE Asia. Zoological J. Linnean Society 20, p. 1-27.
(Redescription of Trygon vorstmani De Beaufort 1926, an E Miocene stingray from fish-bearing limestones of Tonasa Fm near Patoenoeang Asoe E in Maros District of SW Sulawesi. Assigned to new genus Protohimantura. First holomorphic stingray specimen from Neogene)

Martin, K. (1890)- Notiz uber das Pliozan von Gorontalo. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap (2), 7, p. 275-277.

('Note on the Pliocene of Gorontalo', N Sulawesi. Brief note on some presumedly Pliocene gastropods from sandstones exposed between Gorontalo and Limbotto, collected by Van Schelle. No maps, no figures)

Martin, K. (1891)- Zur Geologie von Celebes, nach Anlass des Wichmann'schen Reiseberichtes. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap (2), 8, p.
('On the geology of Sulawesi, referring to Wichmann's travel reports')

Martin, K. (1917)- Bemerkungen uber sogenannt Oligocane und andere Versteinerungen von Celebes. Sammlungen Geol. Reichs-Museums Leiden, N.F., II, 7, p. 299-308.
(online at: www.repository.naturalis.nl/document/552463)
('Remarks on so-called Oligocene and other fossils from Sulawesi'. Critical review of Tertiary molluscs from Sulawesi identified by Dollfuss (in Abendanon 1915))

Martin, K. (1918)- On some fossils from Celebes believed to belong to the Oligocene. Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 20, p. 793-799.
(online at: www.dwc.knaw.nl/DL/publications/PU00012269.pdf)
(Fish fossils found by Abendanon near Enrekang along lower Saadang River, believed to be of Oligocene age by Dollfus, based on presence of Vicarya. However, this is misidentified and mollusc fauna more likely of Neogene age)

Martini, R., D. Vachard & L. Zaninetti (1995)- *Pilammina sulawesiana* n.sp. (Ammodiscidae, Pilammininae, n. subfam.), a new foraminifer from Upper Triassic reefal facies in E. Sulawesi (Kolonodale area, Indonesia). Revue Paleobiologie, Geneve, 14, 2, p. 455-460.
(online at: http://archive-ouverte.unige.ch/unige:35376)
(New small, complex agglutinated ammodiscid foraminifera species Pilammina sulawesiana from Norian-Rhaetian limestones of Kolonodale area, E Sulawesi, typical of Late Triassic reefal carbonates. Association with Triasina hantkeni and conodont Miskella posthernsteini suggests U Rhaetian age (species subsequently also found in Asinepe Lst of Seram, Sambosan accretionary complex in Japan, N Italy, Karakorum, Turkey, Cyprus, etc.))

Martini, R., D. Vachard, L. Zaninetti, S. Cirilli, J.J. Cornee, B. Lathuiliere & M.Villeneuve (1996)- Upper Triassic reefal facies in E Sulawesi, Indonesia. In: Sediment '96, 11th Meeting of Sedimentologists, Universitat Wien, Vienna 1996, p. 109. *(Abstract only)*
(online at: https://archive-ouverte.unige.ch/unige:4766)
(Widely outcropping Late Triassic reefal carbonate platform between Kolonodale and Tomata on W margin of Ophiolitic Zone of E and SE arms of Sulawesi. Late Norian-Rhaetian age based on rich benthic foraminifera, and also on youngest Mesozoic conodont Misikella posthemsteini. Two foraminiferal associations, lagoonal (Triasina hantkeni and other Aulotortidae) and reefal (porcelaneous foraminifers incl. Galeanella). Main framebuilders: branching coral Retiophyllia seranica, chaetetid sponge Blastochaetetes intabulata and solenoporacean algae (see also Cornee et al. 1994, Martini et al. 1997))

Martini, R., D. Vachard, L. Zaninetti, S. Cirilli, J.J. Cornee, B. Lathuiliere & M.Villeneuve (1997)- Sedimentology, stratigraphy, and micropaleontology of the Upper Triassic reefal series in Eastern Sulawesi (Indonesia). Palaeogeogr. Palaeoclim. Palaeoecology 128, p. 157-174.
(E Sulawesi Late Norian- Rhaetian 150m thick reefal carbonates are part of larger, dismembered carbonate platform. Shallowing-upward series: lower 100m micritic limestone, upper 150m massive 'reefal' limestones, dominated by foram packstones-grainstones, but also sponge-algal-coral boundstones and oolitic wackestones/ grainstones. Foram assemblages closest affinity to S Tethyan Seram and Wombat Plateau carbonates)

Martono, U.M. (1999)- Structural diversity of the layered rocks in the metamorphic complex of the western arc of Central Sulawesi. J. Geologi Sumberdaya Mineral 9, 92, p. 2-12.
(On layering in metamorphic rocks. Little regional geology info)

Maryanto, S. (1999)- Proses diagenesis batugamping Eosen di lintasan S. Nanggala, Tana Toraja, Sulawesi Selatan. J. Geologi Sumberdaya Mineral 9, 94, p. 2-16.
('Diagenetic process in the Eocene limestone of the Nanggala River section, Tana Toraja, S Sulawesi'. Eocene-E Miocene Toraja Fm limestone of S Sulawesi 1000m thick or more. At Nanggala River section NE of Rantepao M-U Eocene bioclastic limestone ~80m thick, with larger foraminifera Nummulites javanus, Pellatispira, Discocyclina, Asterocyclina, Fasciolites and Heterostegina saipanensis. Descriptions of diagenetic features. Eocene limestone not feasible as hydrocarbon reservoir)

Maryanto, S. (2002)- Stratigrafi Tersier daerah Torajah, Sulawesi Selatan. Proc. 31st Ann. Conv. Indon. Assoc. Geol. (IAGI), Surabaya, 2, p. 734-768.
('Tertiary stratigraphy of the Toraja area, S Sulawesi'. General review of M Eocene- Pliocene stratigraphy. M-L Eocene Toraja Fm mixed clastics- carbonate facies, conformably overlain by latest Eocene- M Miocene Makale Fm platform carbonates. Overlain by M Miocene- E Pliocene Sekata Fm volcanoclastic turbidites)

Maryanto, S. (2002)- Lingkungan pengendapan Formasi Toraja di daerah Sekitat Rantepao, Sulawesi Selatan. Bull. Geol. Res. Dev. Centre 22, p. 63-84.
(Sedimentology of Eocene Toraja Fm in Rantepao area, NE part of Sulawesi SW arm. Mixture of fluvial, lacustrine, intertidal and shallow marine facies)

Maryanto, S. & T. Sihombing (2004)- Stratigrafi dan sedimentologi batuan Paleogen di lintasan Sungai Ana, Kalumpang, Sulawesi Selatan. Geol. Res. Dev. Centre, Spec. Publ. 31, p. 269-282.
('Stratigraphy and sedimentology of Paleogene rocks in the Ana River section, Kalumpang, South Sulawesi')

Maryanto, S., E.E. Susanto & Sudijono (2004)- Sedimentologi Formasi Salokalupang di daerah Bone, Sulawesi Selatan. J. Geologi Sumberdaya Mineral 14, 1 (145), p. 69-83.
('Sedimentology of the Salokupang Fm in the Bone area, S Sulawesi'. Salokalupang Fm deposited in Late Eocene- M Miocene SW-NE trending deepwater basin, deepening to NE. To W is Tonasa Fm carbonate platform, to S Eocene volcanics. No marked boundary to E, probably connected with open sea. Paleogeography of basin in Salokalupang Fm time shows alluvial plain in SW, whereas turbidity and deepwater depositional systems developed in NE)

Matasak, T. (2011)- Coal deposits in Sulawesi. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources, Manado 2011, MGEI/IAGI, p. 319- .

Maulana, A. (2009)- Petrology, geochemistry and metamorphic evolution of the South Sulawesi basement rock complexes, Indonesia. M. Phil. Thesis, Australian National University, Canberra, p. 1-188. *(Unpublished)*
(Two pre-Upper Cretaceous basement complexes in SW Sulawesi: (1) Bantimala block: ENE-dipping tectonic slices of metamorphic rocks (eclogites, blueschists, greenschist, some seafloor sediments and volcanics), overlain by ultramafic unit, emplaced from E (records subduction of cold ocean floor and exhumation of deeply subducted material, prior to collision with microcontinents to E and obduction of ultramafics); (2) Barru Block: smaller, 30 km to N, weakly metamorphosed sediments and volcanics, without high-P blueschist and eclogite. Metamorphism at higher geothermal gradients (quartzo-feldspathic gneisses, metabasic amphibolite) at sole of obducted ultramafics. Barru tectonic slices dip to NNW. Barru interpreted as roots of old island arc, subduction of some ocean floor with seamounts, and obduction of different ocean floor material from N. Barru intrusives indicate second arc formed on top of ultramafics as result of renewed subduction)

Maulana, A. (2013)- A petrochemical study of granitic rocks from Sulawesi Island, Indonesia. Doct. Engineering Thesis, Kyushu University, Fukuoka, p. 1-167.
(online at: http://repository.unhas.ac.id/handle/123456789/7116)
(Study of granitic rocks from 11 areas in W and N Sulawesi. Plutons classified as (1) high-K /shoshonitic (HK), mainly in S and CW part of W Sulawesi; (2) high-K calc-alkaline (CAK) in C and NW part of province; (3) low K- tholeiitic, dominant in N Sulawesi. Most granitoids metaluminous I-type granitic rocks. HK and CAK granitic rocks derived from partial melting of lower crustal sources with arc signature; low-K /tholeiitic granites from oceanic crust. Crystallization depths ~4-12 km. Rapid exhumations of granites in W Sulawesi

triggered by Late Miocene- Pliocene collision of Banggai- Sula microcontinent with E Sulawesi (Ar-Ar cooling ages 9.5.1 Ma. Exhumation of granites in N Sulawesi attributed to Celebes Sea subduction)

Maulana, A. (2013)- Mineral chemistry of chromite from ultramafic rock in South Sulawesi, Indonesia. J. Penelitian Geosains (Hasanuddin University) 9, 2, p. 83-87.
(online at: http://repository.unhas.ac.id/handle/123456789/15016)
(Chromite occurs in chromitite as podiform lenses or layers 10-40 cm thick in depleted lherzolite and dunite from Bantimala and Barru blocks, S Sulawesi. Also other differences in mineral chemistry, suggesting chromitites originated in different settings, Bantimala from parental melt in island arc environment, Barru from boninitic lava)

Maulana, A. (2014)- Iron ore occurrence in Balanalu area Limbong District North Luwu South Sulawesi. J. Penelitian Geosains (Hasanuddin University) 10, 1, p. 38-49.
(online at: at: http://repository.unhas.ac.id/)
(C Sulawesi magnetite and hematite mineralization in weathered and brecciated andesitic-dacitic tuff)

Maulana, A., A.G. Christy & D.J. Ellis (2008)- The petrology of eclogites from Bantimala Complex, South Sulawesi, Indonesia. Proc. 37th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 367-398.
(Eclogites tectonic block in E Cretaceous high-Pressure- low T blueschist facies rock of Bantimala basement complex, which consists mainly of high-P Triassic-Jurassic metamorphic rocks and late Albian- Cenomanian and younger sediments and ultramafics. Eclogites range of origins and formed at ~540-615 °C and 18-24 kbar)

Maulana, A., A.G. Christy & D.J. Ellis (2015)- Petrology, geochemistry and tectonic significance of serpentinized ultramafic rocks from the South Arm of Sulawesi, Indonesia. Chemie der Erde 75, 1, p. 73-87.
(Serpentinized ultramafic rocks of S Sulawesi in (1) Bantimala (harzburgite, dunite and clinopyroxenite, with lenses of podiform chromitite) and (2) Barru Block (harzburgite and podiform chromitite). Both derived from supra-subduction zone environment and obducted during closure of small back-arc basins. If no rotation of blocks, Bantimala ultramafics emplaced from ENE, Barru ultramafics from WNW. Ultramafic suites from juxtaposed with metamorphic assemblages and later intruded by younger volcanics. Different metamorphic histories and different directions of obduction, suggest ultramafics of two blocks emplaced in separate events)

Maulana, A., A.G. Christy, D.J. Ellis, A. Imai & K. Watanabe (2011)- The characteristic of serpentinised ultramafic rocks from South Sulawesi Indonesia: constraint from petrology and geochemistry data. Proc. Int. Symp. on Earth Science and Technology, Fukuoka 2010, p. 301-306.
(online at: http://repository.unhas.ac.id/.)
(Serpentinised ultramafic rocks with different characteristics in two basement complexes in S Sulawesi, Bantimala and Barru blocks)

Maulana, A., A.G. Christy, D.J. Ellis, A. Imai & K. Watanabe (2013)- Geochemistry of eclogite- and blueschist-facies rocks from the Bantimala Complex, South Sulawesi, Indonesia: protolith origin and tectonic setting. Island Arc 22, 4, p. 427-452.
(Bantimala Complex, SW Sulawesi., eclogites both glaucophane-rich and glaucophane-free; blueschists are albite-epidote glaucophanite and quartz-glaucophane schists. Eclogite protoliths include enriched and normal mid-oceanic ridge basalt (E-MORB and N-MORB) and gabbroic cumulates. Blueschists protolithsh include N-MORB, Oceanic Island Basalt (OIB) and Island Arc Basalt (IAB). All protoliths subducted, metamorphosed to blueschist/eclogite-facies and subsequently exhumed. Samples deduced to have come from thicker-crust environments (OIB, IAB) were subducted to shallower depths (blueschist facies) than MORB-derived samples, which reached eclogite-facies conditions.Geochemical data demonstrate variety of ocean floor types subducted under SE margin of Sundaland in Late Jurassic)

Maulana, A., A.G. Christy, D.J. Ellis, Kaharuddin M. & A. Tonggiroh (2009)- Petrology, geochemistry and tectonic significance of the South Sulawesi ultramafic, Indonesia. Proc. 38th Ann. Conv. Indon. Assoc. Geol. (IAGI), Semarang, PITIAGI2009-205, 26p.

(Ultramafic rocks in S Sulawesi Bantimala and Barru basement complexes of different origins. Barru lherzolite derived from supra-subduction zone environment, with no High-P metamorphics. Bantimala ultramafics are cumulates associated with High-P metamorphics (eclogite and blueschist). Stratigraphic position suggests Bantimala ultramafic emplaced onto Bantimala block from spreading of oceanic crust at E-NE part of block. At same time, those from Barru block obducted from back arc basin setting at W-NW part of blocks). Serpentinised ultramafic rocks suggest different origins of two basement complexes in SW Sulawesi (Bantimala, Barru). Absence of gabbro, pillow basalt, sheeted dykes, etc., suggest incomplete ultramafic suites (dismembered ophiolite sequences). Barru ultramafics emplaced from N, Bantimala from E, suggesting obduction events not caused by W-ward thrust of Australian microcontinent or Pacific oceanic plate on Eurasian margin. Both complexes geochemical differences from ultramafic rocks of East Sulawesi Ophiolite)

Maulana, A., D.J. Ellis & A.G. Christy (2010)- Petrology, geochemistry and tectonic evolution of the South Sulawesi basement rocks, Indonesia. Proc. 34th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA1-G-192, 26p.
(SW Sulawesi two Cretaceous basement outcrop complexes, with different ultramafic rocks and metamorphic histories. Bantimala block (in S) protoliths mainly oceanic basalts. Barru block (in N) quartzo-feldspathic gneisses more felsic and of arc affinity. Bantimala block records subduction of cold ocean floor and exhumation of deeply subducted material. Barru preserve roots of old island arc, subduction of some ocean floor, obduction of different ocean floor material from N, and too warm to preserve blueschist or eclogites. Two blocks derived from different sources and tectonic setting)

Maulana, A., D.J. Ellis & A.G. Christy (2013)- Geodynamic significance of the South Sulawesi Basement rocks, Indonesia: a petrochemical constraint. Pros. 6th Seminar Nas. Kebumian, Universitas Gajah Mada, Yogyakarta 2013, p.

Maulana, A., D.J. Ellis, A.G. Christy, K. Watanabe, A. Imai & Purwanto (2011)- Rare earth element in greenschist facies rock from Bantimala Complex, South Sulawesi, Indonesia. Proc. 36th HAGI and 40th IAGI Ann. Conv., Makassar, p. 1-7.
(online at: http://repository.unhas.ac.id/..)
(also in Majalah Geologi Indonesia 26, 2, p. 73-82. Moderate irregular Rare Earth Element pattern in E Cretaceous greenschist facies rock of Bantimala Complex, S Sulawesi. Greenschist facies rock (with epidote, albite, chlorite) derived from mid oceanic ridge basalt to upper continental crust rocks)

Maulana, A., A. Imai, T. Van Leeuwen, K. Watanabe, K. Yonezu, T. Nakano, A. Boyce, L. Page & A. Schersten (2016)- Origin and geodynamic setting of Late Cenozoic granitoids in Sulawesi, Indonesia. J. Asian Earth Sci. 124, p. 102-125.
(Late Cenozoic granitoids in 160 km belt in W and N Sulawesi. Three series: shoshonitic (HK; ~14- 4 Ma), high-K felsic calc-alkaline (CAK (~5-2 Ma), and normal calc-alkaline to tholeiitic (CA-TH). All granitoids I-type and metaluminous- peraluminous. Two K-rich series restricted to W Sulawesi, formed in extensional, post-subduction setting. Two parental magma sources (1) enriched mantle or lower crustal equivalent for HK magmas, and (2) Triassic igneous rocks in Gondwana-derived fragment thrust beneath C and N parts of W Sulawesi for CAK magmas. CA-TH granitoids mostly in N Sulawesi, formed in active subduction environment)

Maulana, A., A. Jaya & A. Imai (2018)- Study on gold and base metal occurrence in Uluwai prospect, Western Latimojong Mountain, South Sulawesi. Int. Conf. Nuclear Technologies and Sciences (ICoNETS 2017), Makassar, IOP Conf. Series, Journal of Physics Conf. Series 962, 9p.
(online at: http://iopscience.iop.org/article/10.1088/1742-6596/962/1/012011/pdf)
(Uluwai Cu-Au prospect in N part of South Arm of Sulawesi, along E part of Kalosi Fold Belt and Latimojong Mountain. Mineralization rel. simple sulphide ore mineral assemblage (pyrite, sphalerite, chalcopyrite) in metasediments and greenschist)

Maulana, A., A. Jaya & K. Sitha (2017)- Field characteristic of metamorphic-hosted gold deposit in Sulawesi, Indonesia: an insight into Awak Mas prospect, South Sulawesi. Int. J. Engineering and Science Applications (UNHAS) 4, 2, p. 105-111.

(online at: http://pasca.unhas.ac.id/ojs/index.php/ijesca/article/view/1385/351)
(Metamorphic-hosted gold deposit in Awak Mas, S Sulawesi with two main styles of quartz vein mineralization. Gold mineralization considered as mesothermal deposit . Gold mainly hosted within Latimojong flysch sequence, also in basement schist associated with shear zones in Lamas ophiolitic sequences)

Maulana, A. & K. Sanematsu (2015)- Study on the critical metal and Rare Earth Element occurrences in Sulawesi. Int. J. Engineering and Science Applications (UNHAS) 2, 1, p. 41-46.
(online at: http://pasca.unhas.ac.id/ojs/index.php/ijesca/article/view/145/101)
(Scandium-bearing laterite Ni deposits in Sulawesi could be dominant source of Sc resources in future)

Maulana, A. & K. Sanematsu (2015)- An overview on the possibility of scandium and REE occurrence in Sulawesi, Indonesia. In: ICG 2015, 2nd Int. Conf. and 1st Joint Conf. Faculty of Geology Universitas Padjaran and University of Malaysia Sabah, p. 151-156.
(online at: http://seminar.ftgeologi.unpad.ac.id/wp-content/uploads/2016/02/An-overview-on-the-possibility-of-scandium-and-REE-occurrence-in.pdf)
(Lateritic soil of ultramafic rocks of Sulawesi may be potential source of scandium, while weathered I-type granitic rocks could be potential source of rare earth elements (but no actual data to support this?))

Maulana, A., K. Sanematsu & M. Sakakibara (2016)- An overview on the possibility of Scandium and REE occurrence in Sulawesi, Indonesia. Indonesian J. Geoscience 3, 2, p. 139-147.
(online at: https://ijog.geologi.esdm.go.id/index.php/IJOG/article/view/283/211)
(Similar to Maulana & Sanematsu 2015. Sc concentrated in lateritic limonite layers in Soroaka ultramafic complex)

Maulana, A., K. Watanabe, A. Imai & K. Yonezu (2011)- Enrichment Rare Earth Elements (REE) contents in granitic rock from South Sulawesi, Indonesia. Proc. Int. Workshop and Conference on Earth Resources Technology 2011, p. 33-39.

Maulana, A., K. Watanabe, A. Imai & K. Yonezu (2011)- Geochemical composition variety of granitoid rocks from Sulawesi Island, Indonesia. Proc. Int. Symposium on Earth Science and Technology, Fukuoka 2011, p. 379-388.
(Geochemistry of 55 Tertiary granitoids from 9 areas in Sulawesi)

Maulana, A., K. Watanabe, A. Imai & K. Yonezu (2011)- Magnetic susceptibility of Sulawesi granitic rocks, Indonesia: implication for regional metallogenic genesis. Proc. 1st Asia Africa Mineral Resources Conference, Fukuoka 2011, P-06, p.

Maulana, A., K. Watanabe, A. Imai & K. Yonezu (2012)- Petrology and geochemistry of granitic rocks in South Sulawesi, Indonesia: implication for origin of magma and geodynamic setting. Int. J. Environm. Earth Sci. Engineering 6, 1, p. 1-6.
(online at: www.waset.org/journals/ijcee/v6/v6-1.pdf)
(Mio-Pliocene granitic rocks from Polewali, Masamba areas, SW Sulawesi dominated by granodiorite and granite. Calc-alkaline field with metaluminous affinity and typical of I-type granitic rock, produced from melting of upper continental crust in arc-related subduction environment, with later evidence of continent-continent between Australia-derived microcontinent and Sundaland to form continental arc)

Maulana, A., K. Watanabe, A. Imai & K. Yonezu (2013)- Origin of magnetite- and ilmenite-series granitic rocks in Sulawesi, Indonesia: magma genesis and regional metallogenic constraint. Procedia Earth Planetary Sci. 6, p. 50-57.
(Sulawesi granitic rocks dominated by ilmenite series granites, but ratio of ilmenite/ magnetite series granites decreases from S to N. Occurrence of ilmenite-series with I-type characteristic granitic rocks on Sulawesi may be explained by assimilation between magma and crustal material with reduced C- and S-bearing sediments)

Maulana, A., K. Watanabe, A. Imai & K. Yonezu (2013)- Petrochemical characteristic and geothermobarometry study of the granitic rocks from Sulawesi, Indonesia: Implication on exhumation and tectonomagmatic process J. Earth System Science, p. *(in press?)*
(online at: www.ias.ac.in/jess/forthcoming/JESS-D-12-00334.pdf)
(Analyses from 5 granite complexes in S and N Sulawesi suggests granitic rocks calc-alkaline character and I-type granite characteristics. Exhumation of granitic rocks in W Sulawesi Province commonly attributed to collision of Banggai-Sula microcontinent with E Sulawesi in Late Miocene- Pliocene)

Maulana, A., K. Watanabe and K. Yonezu (2016)- Petrology and geochemistry of granitoid from South Sulawesi, Indonesia: implication for Rare Earth Element (REE) occurrences. Int. J. Engineering and Science Applications (UNHAS) 3, 1, p. 79-86.
(online at: http://pasca.unhas.ac.id/ojs/index.php/ijesca/article/view/280/164)
(Late Miocene- Pliocene calk-alkaline I-type granitoids at Polewali and Masamba, 300-400 km N of Makassar, W Sulawesi, with average REE content 249 and 194 ppm. REE-bearing minerals zircon, monazite and apatite)

Maulana, A., K. Watanabe, K. Yonezu, G. Zhang & T. van Leeuwen (2016)- Exhumation and tectono-magmatic process of granitic rock from Sulawesi. Proc. GEOSEA XIV and 45th Ann. Conv. Indon. Assoc. Geologists (IAGI) (GIC 2016), Bandung, p. 362-364.
(In C and N parts of W Sulawesi Late Miocene- Pliocene granite plutons rise to 3000m altitude. P-T data suggest increasing depth of emplacement of plutons from CW to NW Sulawesi (~2.1 to ~11km) and more rapid exhumation (0.37- 2.7 mm/year. Most rapid uplift tied to Palu-Koro fault activity)

Maulana, A., K. Yonezu & K. Watanabe (2014)- Geochemistry of rare earth elements (REE) in the weathered crusts from the granitic rocks in Sulawesi Island, Indonesia. J. Earth Science (China) 25, 3, p. 460-472.
(online at: http://en.earth-science.net/PDF/20140603042501.pdf)
(First study of geochemistry of rare earth elements in weathered crusts of I-type and calc-alkaline to high-K (shoshonitic) granites at Mamasa and Palu region, NW Sulawesi)

Maulana, J.P. (2011)- Source indication of oil seep from Paniki River, Kalukku, Mamuju, West Sulawesi based on geochemical characterization. Proc. Joint. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-030, 10p.
(Paniki River oil seep near Amberaro Village, 40km NE of Mamuju, SW Sulawesi, with oil that underwent heavy biodegradation. Common presence of bicadinane, oleanoids, oleanane, and taraxastane show oil probably derived from terrestrial higher plant source, probably from Eocene coals or carbonaceous clays)

Mawaleda, M., E. Suparka, C.I. Abdullah, N.I. Basuki, M. Forster, Jamal & Kaharuddin (2017)- Hydrothermal alteration and timing of gold mineralisation in the Rumbia Complex, Southeast Arm of Sulawesi, Indonesia. In: 2nd Int. Conf. Transdisciplinary research on environmental problems in Southeast Asia (TREPSEA), Bandung 2016, IOP Conf. Series, Earth Environm. Science, 71, 012030, p. 1-15.
(online at: http://iopscience.iop.org/article/10.1088/1755-1315/71/1/012030/pdf)
(Rumbia WNW-ESE trending high P-low T metamorphic schist complex of SE Sulawesi (mainly mica schist, some blueschist) with gold mineralization in two phases: (1) initial phase related to deformation and exhumation of HP metamorphic rocks (gold, silver, stibnite, chalcopyrite, galena, etc.; syn-tectonic, ~23 Ma; mainly in N and NW parts of Rumbia Complex); (2) hydrothermal mineralization associated with extensional phase at between ~15-7 Ma. Two possible tectonic scenarios(see also Musri et al. 2016)

Mayall, M.J. & M. Cox (1988)- Deposition and diagenesis of Miocene limestones, Sengkang Basin, Sulawesi, Indonesia. Sedimentary Geology 59, p. 77-92.
(Porosity evolution of Late Miocene knoll-reef carbonates of Kampung Baru gas field, SW Sulawesi)

McCaffrey, R., E.A. Silver & R.W. Raitt (1981)- Seismic refraction studies in the East Arm, Sulawesi- Banggai Islands region of Eastern Indonesia. In: A.J. Barber & S. Wiryosujono (eds.) The geology and tectonics of Eastern Indonesia, Proc. CCOP-IOC SEATAR Working Group Mtg., Bandung 1979, Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 2, p. 321-325.

(online at: http://web.pdx.edu/~mccaf/pubs/mccaffrey_sulawesi_grdc_1981.pdf)
(Two seismic refraction lines in E Gorontalo basin and E of E arm of Sulawesi (lines not shown). Show block faulted basement stepping down in Gorontalo Basin oceanic lithosphere)

McCaffrey, R. & R. Sutardjo (1982)- Reconnaissance microearthquake survey of Sulawesi, Indonesia. Geophysical Research Letters 9, 8, p. 793-796.
(Zone of microearthquakes dipping to N from Batui Thrust zone suggests leading edge of Banggai Island block was subducted to at least 100 km depth. E Gorontalo Basin earthquake zone may connect with deep seismic zone under Celebes Sea Basin. Beneath W Gorontalo Basin narrow zone of earthquakes dips S, probably within lithosphere of Celebes Sea Basin subducted at N Sulawesi Trench. Shallow earthquakes near Lake Matano in C Sulawesi, possibly on Matano Fault, suggest E-W extension)

McCaffrey, R., R. Sutardjo, R. Susanto, R. Buyung, B. Sukarman et al. (1983)- Micro-earthquake survey of the Molucca Sea and Sulawesi, Indonesia. Bull. Geol. Res. Dev. Centre 7, p. 13-23.
(Several hundred, mostly shallow, microearthquakes recorded below Molucca Sea and Tomini Gulf/Gorontalo)

McDonald, R.C. (1976)- Limestone morphology in South Sulawesi, Indonesia. Zeitschrift Geomorphologie 26, Karst processes, p. 79-91.

Meeren, J. (2009)- A geothermobarometric study on garnet peridotite and granulite from the Palu region, Central Sulawesi, Indonesia. M.Sc. Thesis, University of Utrecht, p. 1-101. *(Unpublished)*

Meeren, J. & H.L.M. van Roermund (2009)- A two stage exhumation model for HP rocks from the Palu Region, Central Sulawesi, Indonesia- a geothermobarometric study. In: 8th Int. Eclogite Conference (IEC), Xining, China 2008, 2p. *(Abstract only)*
(Garnet peridotite and granulite thin tectonic slices (< 10m) in Palu-Koro Fault zone, crosscutting Cretaceous Palu Metamorphic Complex. Palu garnet peridotite peak metamorphic conditions of ~1030°C/18 kbar and ~855 °C/ 10 2 kbar for retrograde assemblage. Palu granulite peak metamorphic conditions of ~655 °C/ 19 kbar. Palu granulite (microcontinental fragment) subducted in Cretaceous subduction system at Sundaland margin. After exhumation from 65 km to lower crustal levels, granulite stored in lower crust until Miocene upwelling asthenosphere invaded subcontinental lithosphere and caused heating in lower crust under C Sulawesi. Palu garnet peridotite started ascent to lower crustal levels from ~65 km in E Miocene. Final exhumation of Palu HP rock facilitated by transpression along Palu-Koro fault. Occurrence of HP rock in C Indonesia cannot be explained by simple collision event in subduction system of Cretaceous age)

Mesdag, F.T. (1914)- De goudmijn "Totok" te Totok, Noord-Celebes. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Mijnbouwkundig Ser. 1, p. 191-203.
('The gold-mine 'Totok' at Totok, N Sulawesi'. Review of operations of Totok mine, active since 1900, after long history of small-scale local diggings. Gold-bearing quartz veins in foram-coral limestone in area dominated by andesitic volcanics)

Michaux, B. (1996)- The origin of Southwest Sulawesi and other Indonesian terranes: a biological view. Palaeogeogr. Palaeoclim. Palaeoecology 122, p. 167-183.
(Present-day distribution of birds and moths used for reconstruction of tectonic histories of Indonesian islands. Sulawesi highest endemism and appears to have been isolated from all other areas)

Milsom, J., Sardjono & A. Susilo (2001)- Short-wavelength, high-amplitude gravity anomalies around the Banda Sea, and the collapse of the Sulawesi Orogen. Tectonophysics 333, p. 61-74.
(Ophiolitic rocks around Banda Sea commonly associated with strong gravity anomalies and steep gradients, but relationships not always straightforward. Bouguer gravity levels and gradients over extensive E Sulawesi ophiolite generally low. Gravity variations and ophiolite distribution around Banda Sea compatible with extension in Sulawesi region following Oligo-Miocene collision with Australian-derived microcontinent)

Milsom, J., J. Thurow & D. Roques (2000)- Sulawesi dispersal and the evolution of the northern Banda Arc. Proc. 27th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 495-504.
(Bituminous U Triassic and Lw Jurassic in Buton, Buru, Seram and E Sulawesi suggest these were parts of single microcontinent separated from Australia in Jurassic and collided with Eurasian margin to form Sulawesi orogen in Oligocene or E Miocene. Collision was followed by extension and dispersion, creating Banda Sea. Parts of former microcontinent became involved in new collision zones of Outer Banda arc)

Miyazaki, K., I. Zulkarnain, J. Sopaheluwakan & K. Wakita (1996)- Pressure-temperature conditions and retrograde paths of eclogites, garnet-glaucophane rocks and schists from South Sulawesi, Indonesia. J. Metamorphic Geol. 14, p. 549-563.
(High-P metamorphic rocks in Bantimala area 40 km NE of Ujung Pandang formed as Cretaceous subduction complex with fault-bounded slices of melange, chert, basalt, turbidite, shallow marine sedimentary rocks and ultrabasic rocks. Eclogites, garnet-glaucophane rocks and schists of Bantimala complex have estimated peak T of 580-630 °C and P=18-24 kbar, suggesting subduction to ~65-85 km and T gradient ~8°C/km)

Molengraaff, G.A.F (1902)- Ueber die Geologie der Umgegend von Sumalatta auf Nord-Celebes und uber die dort vorkommenden goldfuhrenden Erzgange. Zeitschrift Praktische Geologie 10, p. 249-257.
(online at: https://babel.hathitrust.org/cgi/pt?id=uc1.31822032651069;view=1up;seq=265)
('On the geology of the Sumalatta area on North Sulawesi and on the gold-bearing ore veins there'. On gold-bearing in Sumalatta coastal mountains of N Sulawesi. Highest parts of area mainly granites, intruded into steeply dipping, bedded metamorphosed greywacke-like rocks (Dolokapa series crystalline schists). Metalliferous veins associated with rel. young andesitic magmas (Wubudu volcanic breccia, etc.))

Monnier, C. (1996)- Mecanisme d'accretion des domaines oceaniques arriere-arc et geodynamique de l'Asie du sud-est. Petrologie et geochimie des ophiolites d'Indonesie (Sulawesi, Haute-Chaine Centrale, Cyclops, Seram et Meratus). Ph.D. Thesis, Universite de Bretagne Occidentale, Brest, p. 1-605. *(Unpublished)*
('Mechanism of accretion of oceanic forearc domains and geodynamics of SE Asia', Petrology and geochemistry of Indonesian ophiolites (Sulawesi, Central Range, Cyclops, Seram and Meratus)'. Indonesian ophiolites formed in back-arc setting, based on petrology and geochemistry. Most are dismembered but show normal succession from peridotites and gabbros to pillow basalts)

Monnier, C., H. Bellon & J. Girardeau (1994)- Datation K40-Ar40 de l'ophiolite de l'ile de Sulawesi. Comptes Rendus Academie Sciences, Paris 319, Ser. II, p. 349-356.
('K-Ar dating of the Sulawesi ophiolite'. Remnants of giant ophiolite nappe in Central E Sulawesi formed in M Eocene (44 ± 4 Ma). K/Ar ages for amphiboles in sample from SE Arm 47.4 and 41.2 Ma)

Monnier, C., J. Girardeau, R.C. Maury & J. Cotten (1995)- Back-arc origin for the East Sulawesi ophiolite (Indonesia). Geology 23, 9, p. 851-854.
(Ophiolites probably formed in Eocene Paleo-Celebes Sea backarc basin and emplaced by N to S obduction of Eurasia/ Celebes Sea over 'Australian' Eastern Sulawesi basement)

Moss, S.J. & M.E.J. Wilson (1998)- Biogeographic implications of the Tertiary palaeogeographic evolution of Sulawesi and Borneo. In: R. Hall & J.D. Holloway (eds.) Biogeography and geological evolution of SE Asia, Backhuys, Leiden, p. 133-163.
(Series of paleogeographic maps of Borneo- Sulawesi region, from 50- 4 Ma. W Sulawesi accreted onto Borneo by Late Cretaceous, then separated in M-Late Eocene. E Sulawesi collided with W Sulawesi in M-L Oligocene. Late Miocene accretion of Australia-derived microcontinents onto E Sulawesi (Buton, also Sula Spur ?))

Moyle, A.J., B.A. Wake, S.H. Tuckey & J. Ariti (1997)- The Toka Tindung Gold Project, northern Sulawesi, Indonesia. Proc. World Gold 1997 Conference, Singapore, 2, p. 27-34.
(On discovery of Toka Tindung, Pajajaran, Blambagan and Araren low-sulphidation quartz-adularia vein and stockwork gold-silver deposits on N Minahasa Peninsula, N Sulawesi. Mineralized veins in Late Pliocene basaltic andesite volcaniclastics and flows, part of E Miocene- Pleistocene Sulawesi-East Mindanao Arc)

Mubroto, B. (1988)- A palaeomagnetic study of the East and Southwest arms of Sulawesi, Indonesia. Ph.D. Thesis, University of Oxford, p. 1-253. *(Unpublished)*
(Including paleomagnetic work on E Sulawesi Ophiolite, suggesting formation in Late Cretaceous at 17-24°S and rotated CW about 60°)

Mubroto, B. (1994)- Palaeomagnetism of ophiolites of eastern Sulawesi; evidence for northward translation. In: J.L. Rau (ed.) Proc. 30th Sess. Committee Co ord Joint Prospecting Mineral Res Asian Offshore Areas (CCOP), Bangkok, 2, p. 179-189.
(Indo-Australian, Eurasian and Pacific plates all interact in Sulawesi region. Paleomagnetic analysis of Cretaceous basalts from E Sulawesi Ophiolite Complex at Batusamping and Binsil, suggests ophiolite was derived from N part of Indo-Australian oceanic plate, formed at spreading ridge at 17° ±4°S paleolatitude)

Mubroto, B., J.C. Briden, E. McClelland & R. Hall (1994)- Palaeomagnetism of the Balantak ophiolite, Sulawesi. Earth Planetary Sci. Letters 125, p. 193-209.
(Paleomag from Cretaceous-Paleogene lavas in Balantak Ophiolite on E tip of E Sulawesi indicates formation at 17±4° S and ~60° of CW rotation. Supporting evidence for paleolatitude and N-ward movement of E arm from other lavas and Boba Cherts. Contrast between these results and subequatorial origin of contemporary rocks on Halmahera consistent with subduction of Indian Ocean lithosphere beneath Sunda margin in Late Mesozoic- Early Tertiary. Large differences in declination in E Sulawesi rocks indicate large clockwise and anticlockwise rotations of tectonic blocks only tens of km across)

Muin, M.R., S. Pramumijoyo, I.W. Warmada & W. Suryanto (2017)- Neogene tectonics and paleomagnetism of the western and eastern of Palu Bay, Central Sulawesi, Indonesia. In: Southeast Asian Conference on Geophysics, Bali 2016, IOP Conf. Series, Earth Environm. Science 62, 012003, 6p.
(online at: http://iopscience.iop.org/article/10.1088/1755-1315/62/1/012003/pdf)
(Paleomagnetic work on 8 Neogene granites suggests similar rotation of both sides of Palu Bay during Neogene)

Muller, H.W., G. Riedmuller & B. Schwaighofer (1984)- Weathering products of andesitic rocks from Sulawesi, Indonesia. Clay Minerals 19, 1, p. 21-28.
(online at: http://www.minersoc.org/pages/Archive-CM/Volume_19/19-1-21.pdf)
(Weathered andesitic and overburden along Tondano river, N Sulawesi, indicate different weathering conditions. Andesite altered to 7A halloysite and allophane with some hematite, reflecting paleoclimate with more pronounced dry season and lower annual rainfall than today. Transported latosols of overburden with 10A- and 7A-halloysites, weathered under recent tropical climate)

Multan, R.A., B. Rochmanto & R. Langkoke (1999)- Analysis of sedimentary environment of chromite ore in Sawugi, Bengkulu Barat, Poso, Central Sulawesi. Proc. 28th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 2, p. 313-320.

Munasri (1995)- Cretaceous radiolarian biostratigraphy in the Bantimala and Barru areas, South Sulawesi, Indonesia. M.S. Thesis, University of Tsukuba, Japan, p. *(Unpublished)*

Munasri (2013)- Early Cretaceous radiolarians in manganese carbonate nodule from the Barru area, South Sulawesi, Indonesia. J. Riset Geologi Pertambangan (LIPI) 23, 2, p. 79-88.
(online at: www.geotek.lipi.go.id/riset/index.php/jurnal/article/view/92/52)
(E Cretaceous (Valanginian-Barremian) radiolaria from manganese carbonate nodule in dark reddish shale of Barru melange, 15 km SE of Barru. Assemblage with Pantanellium squinaboli, Cecrops septemporatus, Eucyrtidium parviporum, E. brouweri, Theocapsa laevis, Stichocapsa pseudodecora, Pseudodictyomitra lilyae, P. carpatica, Gongylothorax verbeeki, etc. Rocks accreted at subduction trench in M Cretaceous (Aptian). Albian- E Cenomanian assemblages in chert-siliceous shale of Bantimala Complex by Wakita et al. (1994). Barru and Bantimala Complexes may not be parts of single accretionary complex, as previously suggested)

Musri, M., E. Suparka, C.I. Abdullah, N.I. Basuki & M.A. Forster (2016)- $^{40}Ar/^{39}Ar$ geochronology of Rumbia schist complex: new implications for timing and hydrothermal activity in the Southeast Sulawesi gold prospect, Indonesia. Int. J. Engineering and Science Applications (UNHAS) 3, 2, p. 145-152.
(online at: pasca.unhas.ac.id/ojs/index.php/ijesca/article/download/1086/234)
(Rumbia Mountains with E-W oriented high-P/low-T, and medium-P/low-T metamorphic rocks (mica schist, glaucophane schist, greenschist). Host of gold deposits. Two periods of gold mineralization: (1) associated with tectonic deformation and metamorphic rocks exhumation (Ar/Ar age ~23 Ma); (2) related to post-tectonic hydrothermal activity (overprinting at ~6.8 Ma))

Musri, E. Suparka & B. Tambun (2011)- Geology model of alteration and hydrothermal mineralization Latuppa area, Palopo, South Sulawesi. Proc. 36th HAGI and 40th IAGI Ann. Conv., Makassar, 8p.

Nainggolan, D.A. (2006)- Perkembangan struktur geologi bawah permukaan berdasarkan hasil analisis data gaya berat di utara Kendari, Sulawesi Tenggara; implikasinya terhadap kemungkinan terdapatnya sumber daya geologi. J. Sumber Daya Geologi 16, 5 (155), p. 270-284.
('The development of subsurface geological structure based on gravity data analysis in the north of Kendari, Southeast Sulawesi; implications for the possibility of the presence of geological resources'. Study area in SE Sulawesi mainly covered by ophiolite. Structure mainly NW-SE (also SW-NE?))

Nainggolan, D.A. & B.S. Widijono (2003)- Struktur kerak dan geodinamika daerah Luwuk dan sekitarnya Sulawesi Tengah berdasarkan analisis data gaya berat. J. Geologi Sumberdaya Mineral 13, 140, p. 18-29.
('Crustal structure and geodynamics of the Luwuk area, C Sulawesi, based on analysis of gravity data'. Gravity analysis of N part of E Arm of Sulawesi and S Tomini Bay. Gravity high over Togian Islands. Gravity low over Luwuk and adjacent areas, interpreted as Mesozoic sediments overlan by ophiolite sheets)

Natawidjaja, D.H. & M.R. Daryono (2015)- The Lawanopo Fault, central Sulawesi, East Indonesia. Proc.4th Int. Symposium on earthquake and disaster mitigation, Bandung 2014, AIP Conference Proc. 1658, 030001, p. 1-23.
(NW-SE trending Lawanopo fault of SE Sulawesi considered as active left-lateral strike-slip fault. Exposures of fault are clear, and it serves as tectonic boundary between different rock assemblages. Young fault, but no evidence of recent activity, consistent with lack of seismicity on fault)

Ndoasa, R.P., M.A. Amir, H.D. Asmuruf & Rudianto (1994)- Penempatan ofiolit Barru dan pembentukan Selat Makasar. Proc. 23rd Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 1, p. 291-299.
('Emplacement of the Barru ophiolite and the formation of Makassar Straits')

Neben, S., K. Hinz & H. Beiersdorf (1998)- Reflection characteristics, depth and geographic distribution of bottom simulating reflectors within the accretionary wedge of Sulawesi. In: J.P. Henriet & J. Meinert (eds.) Gas hydrate: relevance to world margin stability and climate change, Geol. Soc., London, Spec. Publ. 137, p. 225-265.
(Seismic profiles across subduction zone N of Sulawesi bottom simulating reflectors (BSRs) across accretionary wedge. BSR correlated with heat flow data and indicate that where heat flow is high and BSR interrupted, active venting of methane may occur at sea floor. BSRs limited to central part of N Sulawesi subduction zone (between 121°30'E and 123°30'E In W part of area only short BSR segments found, which may be result of slope instability and slumping of sediments. On E-most profile, no bottom simulating reflectors found at all)

Ngakan, A.A., B. Priadi, K. Hasan, Surono & T.O. Simanjuntak (2000)- Sulawesi. In H. Darman & F.H. Sidi (eds.) An outline of the geology of Indonesia, Chapter 8, Indon. Assoc. Geol. (IAGI), Spec. Publ., p. 101-120.

Niermeyer, J.F. (1909)- De onderzeese vorm van Celebes. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 26, p. 612-621.
('The undersea shape of Sulawesi'. Early bathymetric map around Sulawesi. No landmass on earth is surrounded by seas and cut by and embayments that are this deep and steep, except perhaps Halmahera. With 1:2.5m scale color bathymetry map)

Nishimura, S., T. Yokohama & Herry (1980)- Gravity measurements at South Sulawesi. In: Physical geology of Indonesian island arcs, Kyoto University, p. 35-41.

Noack, O. (1926)- Vergleichende petrographische Studien an Gesteinen der Minahassa in Nord-Celebes. Thesis Hohen Naturw. Fakultat Vereinigten Friedrichs Universitat, Halle, p. 1-41. *(Unpublished)*
('Comparative petrographic studies of rocks of the Minahasa in N Sulawesi'. Petrographic descriptions and chemical analyses of young volcanic rocks collected by Rinne in 1900. No illustrations)

Noble, R.A., D.M. Jessup, D. Burt & Djumlati (2000)- Petroleum system of the Senoro-1 discovery, East Sulawesi, Indonesia. AAPG Int Conf. Exhibition, Bali 2000, American Assoc. Petrol. Geol. (AAPG) Bull. 84; 9, p. 1470. (*Abstract only)*
Senoro-1 1999 gas oil discovery in N Tomori petroleum system: U Miocene reefs, charged by E-M Miocene calcareous marine source rocks after burial by Pliocene synorogenic deposits of Tomori collision zone. Porous reefal facies of Mantawa Fm with gross gas-oil columns of 656' and 33'. Gas mixed thermogenic and biogenic; 89% methane, 2% CO2, ~1% H2S and wet hydrocarbon gases C2+)

Norvick, M.S. & R.L. Pile (1976)- Field report on the Lariang and Karama geological survey West Sulawesi. BP Petroleum Indonesia, Report JKT/EXP/0071, p. 1-72.
(Unpublished, but commonly used comprehensive field survey report of W Sulawesi basins for Gulf/ BP)

Novian, M.I., D.H. Barianto, V.D. Mardiana N. & T. Sihombing (2012)- Paleogeografi Miosen daerah Luwuk, Sulawesi Tengah berdasarkan keberadaan konglomerat batu gamping dari Formasi Kintom dan Formasi Bongka. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-GD-29, p. 12. *(Abstract only)*
('Miocene paleogeography of the Luwuk area, C Sulawesi, based on presence of limestone conglomerates from the Kintom and Bongka Formations'. 'East Sulawesi Molasse' in N arm of Sulawesi with 65m thick conglomerate with mainly limestone clasts (sourced from Salodik Fm) and 5% ultramafic rocks. Age of conglomerate M-Late Miocene)

Novian, M.I., B.S. Astuti & D.H. Barianto (2012)- Stratigrafi formasi Poh pada jalur Sungai Bun, Desa Bondat, Pagiman, Sulawesi Tengah. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-SS-35, 1p. *(Abstract only)*
('Stratigraphy of the Poh Formation in Bun River section, Bondat Village, Central Sulawesi'. ~140m thick setion of coarsening upward calcareous claystone-sandstone section of 'Poh Formation'. Sedimentary structures parallel lamination, some flute casts and ripples, trough cross bedding and hummocky cross stratification. Lithics consists of fragments of ultramafic rocks, limestone and molluscs shells. Foraminifera suggest M Oligocene- Pliocene age)

Nugraha, A.M.S. (2016)- Late Cenozoic history of Sulawesi, Indonesia: the Celebes Molasse. Ph.D. Thesis Royal Holloway London University, p. 1-.
(Celebes Molasse in SE Sulawesi unconformable over pre-Miocene rocks, post dating E Miocene Sula Spur collision. Three units: (1) serpentine-rich clastic unit (pre-Latest Miocene), (2) limestone unit (Latest Miocene-Holocene) and (3) quartz-rich clastic unit (Late Miocene-Pliocene).

Nugraha, A.M.S. & R. Hall (2017)- Late Cenozoic palaeogeography of Sulawesi, Indonesia. Palaeogeogr. Palaeoclim. Palaeoecology 490, p. 191-209.
(New paleogeographic maps from E Miocene-Pleistocene (20-1 Ma), after Sula Spur- N Sulawesi volcanic arc collision. For most of Neogene Sulawesi shallow marine area with small islands surrounded by deeper marine areas. Onset of extension at ~15 Ma. Deep inter-arm bays began to form in Late Miocene and islands became larger. Pliocene increase in land area and elevation accompanied by major subsidence of inter-arm bays. Separate islands coalesced in Pleistocene to form distinctive K-shaped island known today)

Nugraha, A.M.S. & R. Hall (2017)- Light and heavy mineral constraints on the provenance of unconformity-bounded formations: an example from SE Sulawesi, Indonesia. American Geophys. Union (AGU) Fall Meeting, New Orleans, EP24B-06, 1p. *(Abstract only)*
(online at: https://agu.confex.com/agu/fm17/meetingapp.cgi/Paper/219367)
(Neogene sediments of Celebes Molasse in SE Arm of Sulawesi show unroofing series: (1) U Miocene Pandua Fm dominated by serpentinite and chrome spinel, less polycrystalline quartz and metamorphic, etc. lithics (mainly sourced from ultramafic rocks) and (2) latest Miocene-earliest Pleistocene Langkowala Fms poor in serpentinite and increasing metamorphic detritus including glaucophane/lawsonite (from exhumation of HP-LT metamorphic complexes). Two formations separated by angular unconformity)

Nugraha, A.M.S. & R. Hall (2018)- Late Cenozoic history of Sulawesi. Proc. 42nd Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA18-27-G, 22p.
(Neogene stratigraphy of Sulawesi with five regional unconformities: (1) E Miocene (~23 Ma), (2) M Miocene (~15 Ma), (3) latest Miocene- earliest Pliocene (~ 6-5.3 Ma), (4) E Pleistocene (~1.8 Ma), and (5) M Pleistocene (~1 Ma). E Miocene collision between promontory of Sula Spur and N Sulawesi volcanic arc, causing ophiolite emplacement in E Sulawesi. M Pliocene unconformity in some areas of N Sulawesi. With 10 paleogeographic maps)

Nugroho, S., I. Hardjana, A.D. Susanto & C.C. Bautista (2005)- Notes on the discovery of the Riska deposit, North Sulawesi- Indonesia. In: S. Prihatmoko et al. (eds.) Indonesian mineral and coal discoveries, IAGI Special Issues 2005, p. 31-44.
(On Riska high-sulphidation epithermal gold deposit 20 km SE of Kotamobagu, discovered by Newmont in 1998. Hosted by Plio-Pleistocene andesitic pyroclastics)

Nur, I., A. Idrus, S. Pramumijoyo, A. Harijoko & A. Imai (2011)- Mineral paragenesis and fluid inclusions of the Bincanai epithermal silver- base metal vein at Baturappe area, South Sulawesi, Indonesia. J. Southeast Asian Applied Geol. (UGM) 3, 1, p. 34-44.
(online at: http://geologic-risk.ft.ugm.ac.id/fresh/jsaag/vol-3/no-1/jsaag-v3n1p034.pdf)
(Baturappe prospect in S part of Sulawesi island, is hydrothermal mineralization district of >20 epithermal silver-base metal deposits, hosted in late M Miocene Baturappe Fm basaltic-andesitic volcanic rocks)

Nur, I., A. Idrus, S. Pramumijoyo, A. Harijoko, Y. Juyanagi & A. Imai (2009)- Characteristics of epithermal quartz veins at Baturappe area, Gowa, South Sulawesi: implication to base metal exploration. In: Proc. Int. Seminar on Geology of the Southern Mountains of Java, Yogyakarta 2009, 1, p. 179-186.

Nur, I., A. Idrus, S. Pramumijoyo, A. Harijoko, Sufriadin, A.H.S. Jaya & U.R. Irfan (2009)- Geologi endapan urat logam dasar Pb daerah Baturappe Kabupaten Gowa, Sulawesi Selatan. Proc. 38th Ann. Conv. Indon. Assoc. Geol. (IAGI), Semarang, p. 629-637.
('Geology of the Baturappe area Pb deposits, Gowa Regency, S Sulawesi'. Quartz-Pb veins in M Miocene basaltic-andesitic volcanic- intrusion complex. Oldest rock unit in outcrop late Middle-Miocene basalt lava (K-Ar ages ~12.4-12.8 Ma))

Nur, I., A. Idrus, S. Pramumijoyo, A. Harijoko, K. Watanabe & A. Imai (2011)- Hydrothermal alteration zoning around the Baturappe epithermal silver-base metal deposit, South Sulawesi, Indonesia. Proc. Int. Symposium on Earth Science and Technology, Fukuoka 2011, p. 305-312.

Nur, I., A. Idrus, S. Pramumijoyo, A. Harijoko, K. Watanabe, A. Imai, Sufriadin, A. Jaya & U.R. Irfan (2012)- Elemental Mass Balance of the hydrothermal alteration associated with the Baturappe epithermal silver-base metal prospect, South Sulawesi, Indonesia. Jurnal Penelitian Enjinering, p.
(online at: http://repository.unhas.ac.id/handle/123456789/6138)

Nur, I., Y. Jayanagi, A. Idrus, S. Pramumijoyo, A. Harijoko & A. Imai (2010)- Mineralogy and microthermometry of the epithermal base metal veins at Baturappe area, South Sulawesi, Indonesia. Proc. 39th Ann. Conv. Indon. Assoc. Geol. (IAGI), Lombok, 7p.

(Baturappe area, S Sulawesi, hydrothermal quartz-Pb veins in basalt and porphyritic basalt host rocks. Microthermometric study of fluid inclusions in quartz indicates temperature formation of veins betweeen ~230°-280°C. Minimum formation depth about 300- 550m)

Oostingh, C.H. (1935)- Enige opmerkingen over A. von Kutassyôs beschrijving van jong-Tertiaire mollusken uit Oost-Celebes. De Ingenieur in Nederlandsch-Indie 1935, IV, 4, p. 30-31.
(Questions validity and notes inconsistencies of Mio-Pliocene age determinations based on molluscs from E Sulawesi sediments by Kutassy in Von Loczy (1934)

Osimo, G. (1908)- Di alcuni foraminiferai dell' Eocene di Celebes. Rivista Italiana Paleont. 14, 1-2, p. 28-54.
('On some foraminifera from the Eocene of Celebes'. Larger forams from marl near Dongala, N Sulawesi, collected by Bonarelli. With Miogypsinoides complanata, Spriroclypeus and Baculogypsina looks more like Late Oligocene assemblage?)

Otofuji, Y., F. Hehuwat, S. Sasajima, S. Nishimura & A. Dharma (1981)- Paleomagnetic evidence for clockwise rotation of the Northern arm of Sulawesi, Indonesia. Earth Planetary Sci. Letters 54, p. 272-280.
(North arm of Sulawesi clockwise rotation of >90°. Rotational motion began no later than M Miocene and probably terminated before initiation of Plio-Pleistocene volcanic activity)

Paju, J.A., Y.S. Purnama, B.Nugroho, A. Bachtiar & F. Peera (2006)- Sedimentology of Mallawa clastics and its implication to hydrocarbon occurrences in western part of West arm Sulawesi. Proc. 35th Ann. Conv. Indon. Assoc. Geol. (IAGI), Pekanbaru 2006, PITIAGI2006-012, p. 1-18.
(Eo-Oligocene Mallawa Fm (should be Malawa Fm of Sukamto 1982; JTvG) clastics with coal in S part of West Arm of Sulawesi up to 400m thick. Unconformably overlies flysch deposits of Balangbaru and Marada Fm and unconformably overlain by Tonasa Limestone and thick Camba Fm volcanics. Malawa Fm interfingers with volcanic sequence of Langi Fm to E. Mainly fluvial- tidal deposits. Probably equivalent of fluvio-deltaic Lower Toraja Fm in N of Sulawesi West Arm)

Panggabean, H. & Surono (2011)- Tektono-stratigrafi bagian Timur Sulawesi. J. Sumber Daya Geologi 21, 5, p. 239-281.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/150/146)
('Tectonostratigraphy of East Sulawesi'. Sulawesi four geological provinces: (1) W Sulawesi volcanic, (2) C Sulawesi metamorphic, formed since Cretaceous subduction; (3) E Sulawesi ophiolite, result of extension in Pacific Ocean in Cretaceous- Eocene and (4) fragments of microcontinents in E Sulawesi, which separated from N Australia margin. E and SE Sulawesi areas of latest Oligocene- M Miocene collision between continental and ophiolitic basement blocks)

Panjaitan, S. (2009)- Penelitian paleomagnetik dan gaya berat kaitannya dengan pembentukan formasi batuan di Sulawesi selatan serta hubungannya dengan selat Makasar dan Kalimantan. J. Sumber Daya Geologi 19, 5, p. 297-212.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/214/204)
('Paleomagnetic and gravity investigations tied to rock formations in S Sulawesi and its relations to Makassar Straits and Kalimantan'. Paleomagnetism and GPS analysis indicate CCW rotation and N-ward drift of S Sulawesi since Triassic: (1) Triassic Ultramafics (92° CCW rotation, paleolatitude -26.5°S); (2) Cretaceous melange complexes (30° CCW rotation, paleolatitude -16.1°S); (3) Eocene- M Miocene- Tonasa Limestone Fm (CCW rotation 80°, paleo latitude -14.8°S); (4) M-L Miocene Camba Fm (81° CCW rotation, paleolatitude -12.5°S; (5) M Miocene Tacipi Limestone (80° CCW rotation, paleo latitude 4.5°S); (6) Pleistocene Walanae Fm sandstone (0°- 2° CCW rotation, paleo latitude -3.5°S). Kalimantan derived from Asia in Triassic)

Panjaitan, S. & S. Hutubessy (2002)- Sifat fisik batuan di daerah Palopo dan Makale, Sulawesi Selatan. J. Sumber Daya Geologi 7, 124, p. 2-10.
(Physical properties of Pretertiary rocks in area of Palopo and Makale, NE part of SW Arm of Sulawesi)

Panjaitan S. & B. Mubroto (1993)- Indikasi tektonik berdasarkan data paleomagnetik di daerah Soppeng, Sulawesi selatan. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 83-91.
('Tectonic indications from paleomagnetic data in the Soppeng area, S Sulawesi'. Miocene- Pliocene paleomagnetic data from Camba and Walanae formations in SW Sulawesi suggest N-ward movement of SW Sulawesi from 12.5° S to 3.3° S and ~60° CW rotation between M Miocene- Pleistocene)

Panjaitan, S. & J. Nasution (2004)- Potensi minyak bumi dan gas alam lepas pantai cekungan Sengkang, Sulawesi Selatan, tinjauan analisis gayaberat. J. Sumber Daya Geologi 14, 1 (145), p. 3-12.
('Oil and gas potential of the Sengkang basin S Sulawesi, from gravity analysis'. Gravity anomalies interpreted as anticlines and Tacipi limestone buildups)

Pardiana, D., M. Harayanto, D. Ramdani, F. Ginting, D. Setyandhaka et al. (2015)- Bakan gold mine and 2014 exploration results update. In: N.I. Basuki (ed.) Proc. Indonesian Soc. Econ. Geol. (MGEI) 7th Ann. Conv., Balikpapan, p. 101-119.
(Bakan gold mine 200km SW of Manado in N Arm of Sulawesi operational since 2013. Cluster of epithermal high-sulphidation gold occurrences hosted by Plio-Pleistocene dacitic tuffs that are unconformable over Mioccene andesitic lavas and sandstones. Mineralization similar to North Lanut mine)

Parkinson, C.D. (1991)- The petrology, structure and geologic history of the metamorphic rocks of Central Sulawesi, Indonesia. Ph.D. Thesis, University of London, p. 1-337. *(Unpublished)*
(Includes description of metamorphic sole below obducted E Sulawesi ophiolite in C Sulawesi)

Parkinson, C.D. (1991)- Counterclockwise P-T-t paths from Sulawesi meta-basites: implications for subduction zone metamorphism. In: Proc. Symposium on the dynamics of subduction and its products, Res. Dev. Centre Geotechnology, Indonesian Inst. Science (LIPI), p. 225-226.

Parkinson, C.D. (1996)- The origin and significance of metamorphosed tectonic blocks in melanges: evidence from Sulawesi, Indonesia. Terra Nova 8, p. 312-323.
(Block-bearing melange ('knockers' in sheared mudstone) of C Sulawesi Peleru Melange Complex overlain by E Sulawesi ophiolite nappe, with Mowomba metamorphic sole sequence at base (formed at E-dipping subduction zone). Most blocks are ophiolite, also blueschist, etc. Matrix serpentinite and red phyllite. Direct genetic relationship between high-grade tectonic blocks in melange and amphibolites in metamorphic sole. High-grade tectonic blocks originated in thin, thermally zoned metamorphic sheet welded to oceanic hanging wall plate at inception of subduction. Break-up at depth by tectonic erosion led to dispersal of fragments into newly developed serpentinite melange wedge)

Parkinson C. (1998)- An outline of the petrology, structure and age of the Pompangeo Schist Complex of Central Sulawesi, Indonesia. The Island Arc 7, 1-2, p. 231-245.
(C Sulawesi Pompangeo Schist is metamorphosed accretionary complex, with phyllitic marble, phyllite, schist and quartzite, all of terrigenous- marine origin. Along E margin schists interthrust with unmetamorphosed Early Jurassic sandstone (may be Cretaceous?; JTvG), which may be parent material. Schists unconformably overlain by Albian-Cenomanian pelagic sediment. Synmetamorphic NNW-SSE striking and W dipping isoclinal folding. E-W metamorphic gradient, representing rel. low T gradient of 15°C/ km. K-Ar ages ~108-114 Ma. Correlative metamorphic rocks may underlie W Sulawesi Neogene magmatic province. Pompangeo and Bantimala schists probably generated in same subduction system responsible for C Kalimantan Mesozoic arc)

Parkinson, C.D. (1998)- Emplacement of the East Sulawesi ophiolite: evidence from sub-ophiolite metamorphic rocks. J. Southeast Asian Earth Sci. 16, 1, p. 13-28.
(Metamorphic sole at base E Sulawesi ophiolite composed of thin garnet and epidote amphibolite and basal greenschist metaclastics, with K/Ar ages ~30 Ma (= cooling age?). E-dipping tectonite fabrics in amphibolite and underlying basement mica schist and overlying peridotite indicate orthogonal E to W emplacement of ophiolite in C Sulawesi. Followed by W Sulawesi arc volcanism in E Miocene and collision of Banggai-Sula Platform in Late Miocene)

Parkinson, C.D. & T. Dooley (1996)- Basin formation and strain partitioning along strike-slip fault zones. Bull. Geol. Survey Japan 47, 8, p. 427-436.
(online at: https://www.gsj.jp/data/bull-gsj/47-08_02.pdf)
(On strike-slip fault zones, with example of Sulawesi: series of curvilinear sinistral strike-slip fault zones (Palo-Kuro, Poso, Matano and Lawanopo), formed after Late Miocene collision of Sula Platform and E Sulawesi Ophiolite)

Parkinson, C.D. & I. Katayama (1999)- Present-day ultrahigh-pressure conditions of coesite inclusions in zircon and garnet: evidence from laser Raman microspectroscopy. Geology 27, p. 979-982.
(Coesite is high-pressure polymorph of quartz and occurs as inclusions in deeply subducted, metamorphosed crustal rocks in several Eurasian collisional orogens, including in zircons in eclogites from Bantimala Complex, S Sulawesi. It is primary indicator mineral of ultrahigh-pressure metamorphism)

Parkinson, C.D. & I. Katayama (1999)- Metamorphic microdiamond and coesite from Sulawesi, Indonesia; evidence of deep subduction at the SE Sundaland margin. American Geoph. Union (AGU), 1999 Fall Mtg., EOS Transactions 80, 46, Suppl., p. 1181. *(Abstract only)*
(In situ diamond grains identified by laser Raman spectroscopy within quartz pseudomorphs after coesite in E Cretaceous (130-120 Ma) garnet in jadeite quartzite of Bantimala complex, C Sulawesi. Indicate ultrahigh-pressure conditions (>4 GPa) and subduction of continental crust to depths within diamond stability field, followed by rapid exhumation)

Parkinson, C.D., K. Miyazaki, K. Wakita, A.J. Barber & D.A. Carswell (1998)- An overview and tectonic synthesis of the Pre-Tertiary very-high pressure metamorphic and associated rocks of Java, Sulawesi and Kalimantan, Indonesia. Island Arc 7, p. 184-200.
(High-P metamorphics common in Cretaceous accretionary complexes of Java, Sulawesi, SE Kalimantan. Many occur as imbricate slices of carbonate, quartzose and pelitic schists, interthrust with subordinate basic schists and serpentinite. They are mainly low-intermediate metamorphic grade, with K-Ar ages of 110-120 Ma. Metamorphic rocks from depths >60 km sporadically exposed, usually as tectonic blocks. Many metamorphics probably recrystallized in N-dipping subduction zone at Sundaland craton margin in E Cretaceous. Exhumation possibly facilitated by collision of Gondwanan continental fragment with Sundaland margin at ~120-115 Ma)

Patria, A., A.H. Dewangga, R.S. Putranto & B. Priadi (2012)- Geochemistry of igneous rocks from Bintauna area, North Sulawesi: tectonic implication. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-GD-11, 4p.
(Tinombo Fm, Wobudu Breccias and Dolokapa Fm outcrop in Bintauna-Labuanaki areas, N coast of Sulawesi N Arm. Samples ages ranging of 41.8- 13.9 Ma. Geochemistry indicates volcanics are Low-K volcanic arc basalts, related to Late Eocene- M Miocene subduction. No maps)

Pearson, D.F. & N.M. Caira (1999)- The geology and metallogeny of central North Sulawesi. In: G. Weber (ed.) Proc. PACRIM ô99 Congress, Australasian Inst. of Mining and Metallurgy (AusIMM), Parkville, 4/99, p. 311-326.
(N Arm Sulawesi gold and base metal mineralisation styles: porphyry Cu-Au; porphyry-related gold and base metal veins; high-sulphidation Cu-Au-As; low-sulphidation epithermal Au; hydrothermal breccias; and sediment-hosted Au mineralisation. Different Miocene and Pliocene porphyry systems recognised whilst most remaining epithermal mineralisation Pliocene or later. Central N Arm of Sulawesi Miocene magmatic island arc on E Tertiary oceanic basaltic basement, overprinted by Pliocene arc. Structural fabric dominated by SSE arc-normal and ESE arc-parallel faults, established during Miocene under dextral wrench regime. Intersections of major fault sets favoured sites for Miocene porphyry Cu-Au)

Perdana, M.J. & H. Amijaya (2010)- Identification of geochemical degradation of oil seep from Paniki River, Kalukku, Mamuju, West Sulawesi. Proc. 34th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA10-SG-036, 10p.
(Oil seeps in Paniki River, Kalukku, 40 km NE of Mamuju, W. Sulawesi, considered to have originated from Eocene coals or carbonaceous clays of Toraja Fm. GCMS work suggests severe biodegradation)

Perdana, M.J. & H. Amijaya (2011)- Source indication of oil seep from Paniki River, Kalukku, Mamuju, West Sulawesi, based on geochemical characterization. Proc. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-030, 10p.
(Many oil and gas seeps in W Sulawesi area. Paniki River seep oil biodegraded. Common bicadinane, oleanoids, oleanane, and taraxastane show oil probably derived from higher land plants. No gammaceranes)

Perello, J.A. (1994)- Geology, porphyry Cu-Au, and epithermal Cu-Au-Ag mineralization of the Tombulilato district, North Sulawesi, Indonesia. J. Geochemical Exploration 50, p. 221-256.
(N Sulawesi Tombulilato district island arc-type volcano-sedimentary pile with >3400m of Late Miocene(?) - Pleistocene volcanics, interbedded with marine and continental sediments. Sequence intruded by high-level stocks and dikes, cut by Late Pliocene- Pleistocene diatreme breccias, some associated with Cu mineralization. Main compressive deformation event in Pliocene. Mineralization between 2.9 - 0.9 Ma as part of district-scale hydrothermal system. Uplift and erosion removed ~2 km of rock in last 3 Myr)

Permana, H. (2013)- Kompleks batuan malihan. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 127-152.
('Metamorphic rock complexes'. Chapter 7 in Geology of Sulawesi book. Brief review of metamorphic rocks of Sulawesi. Nine main metamorphic complexes (Malino, Pompangeo, Mengkoka, Mendoke-Rumbia-Kabaena, Palu-Koro, Latimojong-Karossa, Matano, Bantimala-Barru and Buton), mainly of Cretaceous age, and associated with Triassic-age ultramafic rocks)

Permana, H., T. McConachy, B. Priadi, J. Parr, N.D. Hananto, S. Burhanuddin, M. Pirlo, I.S. Brodjonegoro & Sultan (2008)- Gunungapi dan kegiatan hidrotermal bawah laut di perairan Sulawesi Utara: mineralisasi dan implikasi tektonik. J.Geologi Kelautan 6, 2, p. 69-79.
(online at: http://ejournal.mgi.esdm.go.id/index.php/jgk/article/view/151/141)
(Volcanoes and subsea hydrothermal activities in North Sulawesi waters: mineralization and tectonic implications'. IASSHA 2003 expedition in Sangihe islands waters identified the submarine volcano of Kawio Barat and observed hydrothermal activities at Roa, Naung and Banua Wuhu. At Kawio Barat volcano polychaete 'tube worms' colony growth on rock at methane gas seep)

Permana, H. & Surono (2013)- Kompleks ofiolit. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 213-224.
('Ophiolite complexes'. Chapter 9 in Geology of Sulawesi book. Brief review of major ophiolite complexes of East and SE Arms of Sulawesi and peridotites in Palu-Koro zone and Bantimalu- Barru melanges. E Sulawesi ophiolite overlain by E Cretaceous radiolarian cherts (Valanginian- Cenomanian)

Permanadewi, S. & Baharuddin (2012)- Cooling of granitic rocks in the Palu region, Middle Sulawesi: zircon and apatite fission track constraints. J. Sumberdaya Geologi 22, 3, p. 131-136.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/112/104)
(Zircon and apatite FT data suggest two cooling episodes of Oligocene granitic rocks in Palu region, C Sulawesi: (1) in S cooling around 30 Ma, (2) in N ('neck' area) rapid cooling due to local uplift, possibly in response to overthrust at ~6 Ma (Late Miocene))

Permanadewi, S. & H. Utoyo (1994)- Perbandingan umur hasil pentarikhan kalium-argon batuan granitik, daerah Bora, Sulawesi tengah dengan horenblenda dan biotit sebagai mineral penentu. J. Geologi Sumberdaya Mineral 4, 36, p. 16-20.
('Results of K- Ar dating of granitic rocks in Bora area, C Sulawesi, comparing hornblende and biotite data'. K-Ar dates of granitic rocks from Bora area, S of Palu, using biotite ~16.2-16.4 Ma, hornblende ~16.5-16.9 Ma (near E-M Miocene boundary))

Pertamina/BPPKA (eds.) (1996)- Banggai Basin (E Sulawesi). In: Petroleum Geology of Indonesian basins, VI, Jakarta, p. 1-24.

Pezzati, G. (2016)- Basin development in Gorontalo Bay, Sulawesi. Ph.D. Thesis, Royal Holloway London University, p. *(Unpublished)*

Pezzati, G., R. Hall, P. Burgess & M. Perez-Gussinye (2014)- The Poso Basin in Gorontalo Bay, Sulawesi: extension related to core complex formation on land. Proc. 38th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA14-G-297, 12p.
(Seismic analysis and literature research suggest possible E Miocene origin for Gorontalo Bay, following Sula Spur collision. In W part of Gorontalo Bay two subbasins, northern Tomini Basin and southern Poso Basin. Poso Basin much younger than Tomini Basin; its development may be related to extension associated with development of metamorphic core complexes onshore)

Pholbud, P., R. Hall, E. Advokaat, P. Burgess & A. Rudyawan (2012)- A new interpretation of Gorontalo Bay, Sulawesi. Proc. 36th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA12-G-029, p. 1-23.
(online at: http://searg.rhul.ac.uk/pubs/pholbud_etal_2012%20Gorontalo%20Sulawesi.pdf)
(Interpretation of ages of seismic horizons of Gorontalo Bay difficult due to absence of wells. Two age scenarios for rifting-subsidence timing: Eocene- Recent or Miocene-Recent. Most of subsidence young and tied to slab rollback of N Sulawesi subduction zone)

Piccoli, G., E. Robba & S. Sartono (1994)- Mixed fossil molluscs from Tana Toraja (South Sulawesi, Indonesia). In: Studies on ecology and palaeoecology of benthic communities, Proc. 5th Paleobenthos Symposium, Rome 1992, Boll. Soc. Paleontologica Italiana, Modena, Spec. Vol. 2, p. 221-226.

PND- Patra Nusa Data (2009)- Opportunities (I), Bone Basin. Inameta J. 8, Sept. 2009, p. 23-27.
(online at: www.patranusa.com)
(Overview of Bone Basin, S Sulawesi, in conjunction with tender round)

Poedjoprajitno S. (2012)- Morphostructure control towards the development of Mahawu Volcanic Complex, North Sulawesi. J. Geologi Indonesia 7, 1, p. 39-54.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/365)
(Development pattern of N Sulawesi Mahawu, Linau, Tompusu and Kasurutan volcanic cones irregular, except Mahawu Volcano Complex showing linear pattern interpreted as NW-SE fault controlling rise of magma)

Polve, M., R.C. Maury, H. Bellon, C. Rangin et al. (1997)- Magmatic evolution of Sulawesi (Indonesia): constraints on the Cenozoic geodynamic history of the Sundaland active margin. Tectonophysics 272, p. 69-92.
(Paleocene magmatic activity limited to Ujung Pandang area (61-59 Ma). Major Eocene (50-40 Ma) event with tholeitic pillow lavas and basaltic dikes of back-arc basin affinity in all areas, possibly equivalent to Celebes Sea basaltic basement. Oligocene- Miocene island-arc tholeiites and calc-alkaline series (mainly 30-15 Ma) Widespread K-rich magmatic event between 13-10 Ma. Calc-alkaline activity resumed only in N Arm in Late Miocene (9 Ma) and still active in Manado region. K-rich activity continued in S until Pleistocene (0.77 Ma). Most recent event in C Sulawesi 6.5- 0.6 Ma granites and acid tuffs, probably strong continental imprint)

Polve, M., R.C. Maury, P. Vidal, B. Priadi, H. Bellon, R. Soeria-Atmadja, J.L. Joron & J. Cotten (2001)- Melting of lower continental crust in a young post-collision setting: a geochemical study of Plio-Quaternary acidic magmatism from central Sulawesi (Indonesia). Bull. Soc. Geologique France 174, p. 305-317.
(Acid, potassic, calc-alkaline magmas in C part of Sulawesi West arm from 6.5-0.6 Ma (dacites, rhyolites, granites. Chemical signatures consistent with Australian granulites and Indian Ocean sediments suggest magmas derived from anatexis of lower crust of Australian origin (Banggai-Sula) after M Miocene collision with W Sulawesi Sundaland margin and possibly breakoff of subducted Molucca Sea slab)

Pouyet, S. & G. Braga (1993)- *Thalamoporella sulawesiensis* n. sp. (Bryozoa, Cheilostomata) from the Eocene of Sulawesi. Neues Jahrbuch Mineral. Geol. Palaont., Monatshefte 1993, 2, p. 88-96.

Prasetyo, H. (1994)- Marine geoscientific survey of the West-East Indonesia back arc transition zone, Southeast Sulawesi margin. In: J.L. Rau (ed.) Proc. 29th Sess. Comm. Co-ord. Joint Prospecting Mineral Resources in Asian Offshore Areas (CCOP), Hanoi 1992, Bangkok, 2, p. 127-146.
(Overview of backarc region between SE Sunda Shelf-SW Sulawesi- N Bali- N Flores. Four main tectonic phases: (1) Paleocene rifting; (2) Miocene inversion of rifts to create 'Sunda folds', tied to collision of Buton with Sulawesi Arc; (3) flexure of SE Sunda shield to S, under volcanic ridge and (4) post-Neogene formation of back-arc fold and thrust zone, associated with Australia- Banda Arc collision)

Prasetyo, H., Y.R. Sumantri, B. Situmorang & S. Wirasantosa (1995)- The ôDoang Borderland Systemô in Southwest Sulawesi margin: implications for hydrocarbon prospect in the Eastern Indonesian frontier region. Int. Seminar on the sea and its environments, Ujung Pandang 1995, p.

Priadi, B. (1993)- Geochimie du magmatisme de lôOuest et du Nord de Sulawesi: tracages des sources et implications geodynamiques. Doct. Thesis, Universite Paul Sabatier, Toulouse III, p. 1-293. *(Unpublished)*
('Geochemistry and magmatism of W and N Sulawesi'. Study of petrology and geochemistry of magmatic rocks of SW, C and N Sulawesi. S Sulawesi different history from rest of island, with Jurassic tholeitic magmatism. Calc-alkaline magmatism rel. rare, tholeitic and potassic magmatism more common. Old cycle in S only (55-60 Ma), calc-alkaline magmatism in S and C at 30 -17 Ma. In S-most sector highly potassic magmatism between 11-3 Ma and in C part acid calc-alkaline magmatism at 6-0.5 Ma. In N Sulawesi calc-alkaline magmatism continuation of Philippine Arc (incl. 22 Ma date) with ~15 Ma change from subduction to collision regime)

Priadi, B. (1996)- Kompleks granitoid Neogen di Sulawesi Tengah: tinjauan geokimia. Buletin Geologi (ITB) 26, 2-3, p.
('Neogene granitoid complex in C Sulawesi'. Neogene granitoid (5.5-3.2 Ma) along C Sulawesi Palu-Koro Fault associated with Late Miocene-Recent potassic calc alkaline (KCA) magmatism. Correlated with collision of Banggai-Sula micro-continent with Sulawesi in M Miocene, but details about genesis still limited)

Priadi, B. (2011)- Sulawesi magmatic arcs. In: N.I. Basuki (ed.) Proc. Seminar Sulawesi Mineral Resources 2011, Manado, MGEI/IAGI, p. 111-120.
(Magmatic arc products in Sulawesi mostly in W and N Arms. Oldest magmatism exposed in S part indicates Late Jurassic age (Lamasi Volcanics at E side of S arm; 159-137 Ma), with characteristics of back arc or marginal-basin magmatism (possibly part of dismembered E Sulawesi ophiolite). Paleogene- M Miocene mostly subduction-related magmatism, but W and N arms not connected until Eocene. Local Paleocene non subduction-related magmatism in N Arm may represent S-ward obducted parts of Sulawesi Sea. M Miocene-Recent magmatism different magmatic affinities, correlated with E-M Miocene collision of Banggai-Sula microcontinent, affecting melting of lower continental crust, producing magma with potassic calc-alkaline affinity in Palu-Tolitoli areas. Collision also halted subduction in S, with M Miocene- Recent alkaline/ shoshonitic post-subduction magmatism in Makassar-Toraja area)

Priadi, B (2013)- Magmatisme Sulawesi. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 113-126.
('Magmatism of Sulawesi'. Chapter 6 in Geology of Sulawesi book. Review of Sulawesi magmatism in Pre-Tertiary, Paleogene, Neogene and Quaternary)

Priadi, B., H. Bellon, R.C. Maury, M. Polve, R. Soeria-Atmadja & J.C. Philippet (1994)- Magmatic evolution in Sulawesi in the light of new 40K-40Ar age data. Proc. 23rd Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 1, p. 355-369.
(W Sulawesi volcanic episodes: Jurassic (~150 Ma) back arc basin magmatism, Paleocene subduction-related magmatism (~60 Ma), Oligocene- M Miocene (40-~15 Ma; well-developed in N Sulawesi; also in W and C Sulawesi) subduction-related magmatism and Miocene-Recent (~13-0 Ma) collision-related magmatism)

Priadi, B., R.C. Maury, R. Soeria-Atmadja M. Polve & H. Bellon (1991)- Tertiary and Quaternary magmatism in Central Sulawesi: chronological and petrological constraints. In: Proc. Silver Jubilee Convention Dynamics of subduction and its products, Yogyakarta 1991, LIPI, p. 171-194.

(same title as Priadi et al. 1994)

Priadi, B., M. Polve, R.C. Maury, R. Soeria-Atmadja & H. Bellon (1993)- Geodynamic implications of Neogene potassic calc-alkaline magmatism in Central of Sulawesi: geochemical and isotopic constraints. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 59-81.
(Potassic calc-alkaline magmatism of C Sulawesi mostly acidic, ranging in age fom 6.5 Ma- Recent. Isotopic character similar to Australian blocks, suggesting result of collision between two 'Australian' blocks, Banggai Sula in E and western block that is either microcontinent of Australian origin or ancient volcanic arc that incorporated large volume of sediment)

Priadi, B., M. Polve, R.C. Maury, H. Bellon, R. Soeria-Atmadja, J.L. Joron & J. Cotten (1994)- Tertiary and Quaternary magmatism in Central Sulawesi: chronological and petrological constraints. J. Southeast Asian Earth Sci. 9, p. 81-93.
(Four main magmatic events in C Sulawesi: (1) Late Eocene and Oligocene island arc tholeiites and calc-alkaline intrusions. (2) Lamasi Volcanics: 33-15 My K-Ar ages, but may not be magmatic ages. MORB-type affinity and anomalies indicative of BABB affinity. Origin still enigmatic. (3) Important shoshonitic affinity event at 10.1-11.9 Ma, probably post-subduction associations emplaced in S Sulawesi in Late Miocene and might derive from melting of mantle material after mantle metasomatised during former episode of subduction. (4) Last event 6.5- 0.6 Ma granitic rocks, rhyolites and widely distributed rhyolitic Barupu tuff pyroclastics (0.6 Ma). All magmatic rocks K-rich calc-alkaline composition, lacking basaltic and intermediate magmas (SiO2 >60%) and high enrichments in incompatible elements and radiogenic Sr isotopic signature. This is consistent with strong crustal imprint by melting of underthrusted continental crust in collisional context)

Priadi, B., R. Soeria-Atmadja, R. Maury, H. Bellon & M. Polve (1997)- The occurrence of back-arc magmatism in Sulawesi: geochemical constraints on geodynamic reconstruction. Proc. 26th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 390-403.
(Two volcanic units along E edge of S arm of Sulawesi: (1) Kalamiseng Fm pillow lava-breccia, with Miocene (~17-22 Ma K-Ar ages), but may be older; (2) Lamasi Volcanics in NE part of S Sulawesi K-Ar ages suggest 3 episodes of activity, including oldest ages of Sulawesi volcanics: (1) 'Palopo ophiolite' 'back-arc' micro-gabbro cut by dikes; Late Jurassic-earliest Cretaceous (~159-137 Ma) and subduction-related (2) Oligocene Lamasi-Songka volcanics (~33-28 Ma) and (3) M Miocene Lamasi- Pohi Volcanics (~15.4 Ma) volcanics. In N part of W Sulawesi and N Sulawesi mainly Eocene (~34-50 Ma) Tinombo Fm mostly back arc basin chemistry and Paleogene K-Ar ages. Younger volcanics less common and subduction related)

Priadi, B, I.G.B.E. Sucipta & J. Sopaheluwakan (2009)- Post-collisional granitoids in Central Sulawesi, Indonesia. In: 11th Reg. Congress Geology, Mineral and Energy Resources of Southeast Asia (GEOSEA 2009), Kuala Lumpur, p. 45. *(Abstract only)*
(Neogene potassic calc-alkaline granitoids and dacitic-rhyolitic volcanics along Palu-Koro FZ of C Sulawesi)

Priadi, B., I.G.B.E. Sucipta, H. Utoyo, J. Sopaheluwakan & W. Sudarsono (1996)- Kompleks granitoid Neogen di Sulawesi Tengah, tinjauan geokimia. Buletin Geologi (ITB) 26, p. 129-141.
('Geochemistry of Neogene granitoid complexes in Central Sulawesi')

Priadi, B., I.G.B.E. Sucipta, H. Utoyo, J. Sopaheluwakan & Sudarsono (1999)- Distribution of Neogene granitoid along the Palu-Koro fault zone, Central Sulawesi. In: H. Darman & F.H. Sidi (eds.) Tectonics and sedimentation of Indonesia, FOSI-IAGI-ITB Regional Seminar to commemorate 50th anniversary of Van Bemmelen's Geology of Indonesia, Bandung 1999, p. 72-74.
(Late Miocene- Recent potassic calk-alkaline magmatism along left-lateral Palu-Koro fault zone, possibly tied to collision of Banggai-Sula collision. Three groups of granitoids aged between ~8.4- 1.7 Ma, with possible contributions of continental material (SiO2 >60%). Also gneissic granitoid of Cretaceous (96.4 Ma age))

Priadi, B., H. Utoyo, Sudarsono, Widiasmoro, J. Sopaheluwakan, A. Kadarusman & D. Sukarna (1995)- Petro-geochemical variations of granitoids along Palu-Koro Fault Zone, Central Sulawesi. Proc. 6th Int. Congress Pacific Neogene Stratigraphy and IGCP-355, PUSPITEK-Serpong, p. 34-36.

Pribadi, A. & N. Azman (1990)- Kajian geologi daerah Sulawesi Tenggara dalam kaitannya dengan prospek hidrokarbon. Proc. 19th Ann. Conv. Indon. Assoc. Geol. (IAGI), 1, p. 136-148.
('Study of the SE Sulawesi area and its relations with hydrocarbon prospectivity')

Prihatmoko, S. & H. Lubis (1992)- Porfiri Au-Cu pada tubuh breksi di prospek Bulagidun, Lengan Utara, Sulawesi. Proc. 21st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta,1, p. 233-240.
(Au-Cu porphyry at breccia bodies in the Bulagidun prospect, North Arm Sulawesi')

Priyadi, A. & Sudijono (1993)- Biostratigrafi fosil nanno Tersier tengah formasi Tonasa (Penampang Rala), Sulawesi Selatan. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 1100-1113.
('Mid-Tertiary nannofossil biostratigraphy of the Tonasa Fm, S Sulawesi')

Priyanto, B. & M.R. Fitriannur (2008)- Neogene tectonic and sedimentary control to hydrocarbon generation in Banggai Basin, Eastern Sulawesi. Proc. 37th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 54-65.
(Literature review of Banggai Basin, formed as result of Miocene collision of Banggai-Sula microplate and E Sulawesi. Basin stratigraphy two distinct periods: (1) continental margin rift to collision, and (2) latest Miocene-Pliocene foreland basin molasse sequence. Numerous oil and gas seeps in NW Taliabu, wet gas seeps near Falabisahaya in Mangole, oil and gas from Dongkala-1, gas from Minahaki-1 and Matindok-1. Source, reservoir and seal rocks all within Miocene sequence. No new data)

Purawiardi, R. (2008)- Karakteristik bijih kromit Barru, Sulawesi Selatan. J. Riset Geologi Pertambangan (LIPI) 18, 1, p. 1-13.
(online at: http://id.portalgaruda.org/)
('Characteristics of Barru chromite ore, S Sulawesi'. Barru District asymmetric structural axes N-S and NW-SE trending. Chromite as podiform deposits in Triassic(?) serpentinitized ultrabasic rock, mostly at fault zones and around contact zone with dacitic rock)

Purnamaningsih, D. Sukarna & H. Panggabean (1995)- The geology, mineral and energy resources of northern West Sulawesi. In: J. Ringis (ed.) Proc. 31st Sess. Comm. Co-ord. Joint Prospecting Mineral Resources in Asian Offshore Areas (CCOP), Kuala Lumpur 1994, 2, p. 20-35.
(N part of W Sulawesi recently re-mapped. Covers Lariang and Karama sub-basins. Basement of unnamed M Cretaceous or older high-grade metamorphics, possibly part of accretionary complex along Eurasian continent, overlain by thick flysch-type, low-metamorphic, Upper Cretaceous Latimojong Fm. Unconformably overlain by M-Lt Eocene clastics and Nummulites limestones and Oligocene- M Miocene Tonasa Lst carbonate platform, up to 2500m thick, in S of area. Late Oligocene- E Miocene (29-22 Ma) Lamasi island arc volcanics, etc. Plio-Pleistocene thin-skinned W-directed thrusting= Majene foldbelt. With 3 simple, hard-to-understand paleogeographic maps)

Purnomo, E., S.P. Tony & A. Luthfi (1999)- Relative age indicator of Sulawesi collision zone, eastern arm of Sulawesi. In: H. Darman & F.H. Sidi (eds.) Tectonics and sedimentation of Indonesia, FOSI-IAGI-ITB Regional Seminar to commemorate 50th anniversary of Van Bemmelen's Geology of Indonesia, Bandung 1999, p. 76-78. *(Extended Abstract)*
(Batui collision zone between S part of East Arm of Sulawesi and Banggai Sula microcontinent. Syn-collisional bathyal Poh Fm marls (between pre-rift Salodik Fm carbonates-clastics and post-rift Celebes molasse) with planktonic foraminifera of E Pliocene age)

Puspita, D., R. Hall & C.F. Elders (2005)- Structural styles of the offshore West Sulawesi fold belt, North Makassar Straits, Indonesia. Proc. 30th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 519-542.
(Offshore W Sulawesi Fold Belt (WSFB) three structural provinces, S, C and N, controlled by basement structures and differing in amount and character of Cenozoic sediment. Central High (with onlap of sediments from Kalimantan, little sediment from W Sulawesi, and fold-thrust belt extending short distance offshore) separates S and N provinces, which extend W into deep water and display different deformation styles, sediment thickness and sediment types. Palu-Lariang region likely source of sediments in N; Karama-Kalosi region

probable source for S. Deformation propagating W from onshore Sulawesi and began in Pliocene. N Makassar Straits underlain by thinned continental crust)

Querubin, C.D. & S. Walters (2011)- Geology and mineralization of Awak Mas: a sedimentary hosted gold deposit, South Sulawesi, Indonesia. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado 2011, MGEI/IAGI, p. 211-229.
(See also updated version Querubin & Walters 2012)

Querubin, C.D. & S. Walters (2012)- Geology and mineralization of Awak Mas: a sedimentary hosted gold deposit, South Sulawesi, Indonesia. Majalah Geologi Indonesia (IAGI) 27, 2, p. 69-85.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/736)
(Awak Mas gold project in S part of C Sulawesi Metamorphic Belt, SSW of Palopo, explored since 1987. Hosted in intensely folded (WSW to SW-directed thrusting?, generally 15-50°N-dipping) Late Cretaceous Latimojong Fm flysch-type phyllites, slates, volcanics, limestones and schists, overlying basement metamorphic rocks and intruded by late diorite-monzonite plugs and stocks. T-P regime suggests either subduction or massive thrusting environment. ~N-S trending oblique normal faults and extensional fractures local controls to mineralization)

Radja, V.T. (1970)- Geothermal energy prospects in South Sulawesi, Indonesia. Geothermics 2, 1, p. 136-149.
(Indonesia geothermal potential large and genetically linked to volcanism. Preliminary appraisal of S Sulawesi suggests potential for 9 geothermal fields)

Rafianto, R.I. (2011)- Developing Indonesian nickel deposits: challenges and opportunities. Proc. 36th HAGI and 40th IAGI Ann. Conv, Makassar, p.

Rafianto, R., F. Attong, A. Matano & M.E. Syam Noor (2011)- The serpentine-related nickel sulfide occurrences from Latao, SE Sulawesi: a new frontier of nickel exploration in Indonesia. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Mineral Resources 2011, Manado, MGEI/IAGI, p. 267-288.

Rafianto, R., F. Attong, A. Matano & M.E. Syam Noor (2012)- Kehadiran sulfida nikel yang berkaitan dengan serpentin di Latao, Sulawesi Tenggara: suatu frontier baru eksplorasi nikel di Indonesia. Majalah Geologi Indonesia 27, 2, p. 87-107.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/768)
(The presence of nickel sulfide related to serpentine in Latao, SW Sulawesi: a new frontier of nickel exploration in Indonesia'. Same as Rafianto et al. 2011)

Rafianto, R. & G.H. Tutuko (2010)- 40 years PT INCO exploration: evolution in method and understanding nickel mineralization in Sulawesi. Proc. 39th Ann. Conv. Indon. Assoc. Geol. (IAGI), Lombok, PIT-IAGI-2010-095, 15p.
(History of Inco exploration and mining of nickel laterites since 1969 in East Sulawesi ultramafic ophiolite complex. Largest deposits highest nickel grades in Sorowako area in central part of E Sulawesi. Best nickel laterite deposits on crests and flanks of hills over ultramafic bedrocks)

Rahardiawan, R. & L. Arifin (2013)- Struktur geologi Teluk Bone- Sulawesi Selatan. J. Geologi Kelautan 11, 3, p. 141-147.
(online at: http://ejournal.mgi.esdm.go.id/index.php/jgk/article/view/238/228)
('Geologic structure of Bone Bay, South Sulawesi'. Bone Bay water depth 50-2000m. Seafloor morphology strongly influenced by active faults, incl. flower structures)

Rahardiawan, R., T. Naibaho & L. Arifin (2011)- Struktur dan stratigrafi Cekungan Spermonde, Sulawesi Selatan: studi pendahuluan seismik 2D. Majalah Geologi Indonesia 26, 2, p. 83-91.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/765))
('Structure and stratigraphy of the Spermonde Basin, offshore SW Sulawesi: preliminary study of 2D seismic'. Five seismic stratigraphic sequences assumed to be of Eocene- Pliocene age)

Raharjo, S., R. Seago, E.W. Jatmiko, F.B. Hakim & L.D. Meckel (2012)- Basin evolution and hydrocarbon geochemistry of the Lariang-Karama basin: implications for petroleum system in onshore West Sulawesi. Proc. 36th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA12-G-135, p. 1-22.
(Lariang-Karama basins onshore W Sulawesi M Eocene extensional half-grabens. Mild basin inversion in M Miocene at ~12 Ma, but extension continuing until Plio-Pleistocene inversion/ uplift at ~2 Ma. Fine siliciclastic turbidites in M Miocene in Tike-1 well thought to be distal equivalents to sediments of Kutei in Kalimantan. Most shortening taken up by NW-SE oriented strike-slip faults, compartmentalizing series of folds and thrusts. Oil-gas seeps over major fold structures and along faulted, E margin of coastal Karama basin, generated from M-L Eocene fluvio-deltaic coals and carbonaceous shale. Oils paraffinic, low sulfur, moderately low wax to waxy. Source of two oil seeps from Lariang Basin dominated by terrestrial higher plant material with minor algal input; seeps from Karama Basin mixed algal-terrestrial, probably open marine/deep lacustrine source)

Rangin C., R.C. Maury, M. Polve, H. Bellon, B. Priadi, R. Soeria-Atmadja et al. (1997)- Eocene to Miocene back arc basin basalts and associated island arc tholeiites from Northern Sulawesi (Indonesia): implications for the geodynamic evolution of the Celebes basin. Bull. Soc. Geologique France 168, 5, p. 627-635.
(Most of N arm of Sulawesi is on Eocene oceanic crust (back arc basin basalts), intruded by younger arc volcanics; N arm rotated clockwise 25°)

Ratman, N. (1976)- Geologic map of Tolitoli Quadrangle, North Sulawesi 2016-2116-2117, scale 1: 250, 000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Geologic map of westernmost part of North Arm of Sulawesi. Oldest rocks ?Mesozoic Malino Metamorphic Complex, overlain by ?Eocene- E Oligocene Tinambo Fm clastics and volcanics, overlain by Miocene and younger clastics and volcanics. Several undated granitoid complexes)

Ratman, N. & S. Atmawinata (1993)- Geology of the Mamuju Quadrangle, Sulawesi. Scale 1: 250, 000. Geol. Res. Dev. Centre (GRDC), Bandung, 2n Ed., 25p.
(SW Sulawesi map between 2-3°S. Metamorphic basement overlain by low-metamorphic Upper Cretaceous clastics. Eocene clastics and limestone, Late Oligocene- Early Miocene andesitic volcanics, Mio-Pliocene volcanoclastics. Large Late Miocene- E Pliocene granitic intrusive)

Reminton, C.H. (1995)- The challenge of petroleum exploration in the Gorontalo frontier basin, North Sulawesi- Indonesia. American Assoc. Petrol. Geol. (AAPG) Bull. 79, p. 81 *(Abstract only)*
(Gorontalo Basin untested frontier basin. Airborne Laser Fluorescence survey showed fluors on water surface in Tomini Bay. Oil and gas seeps onshore and offshore of Tomini Bay suggest mature Paleogene source rocks)

Reijzer, J. (1920)- Geologische aanteekeningen betreffende de Zuidelijke Toraja-landen, verzameld uit de verslagen der mijnbouwkundige onderzoekingen in Midden-Celebes. Jaarboek Mijnwezen Nederlandsch Oost-Indie 47 (1918), Verhandelingen 1, p. 154-209.
('Geologic notes on the southern Toraja lands, compiled from reports of mining investigations in Central Sulawesi'. Three areas with oil indications. Small Eocene coal-bearing basins)

Rinne, F. (1900)- Skizzen zur Geologie der Minahassa in Nord-Celebes. Zeitschrift Deutschen Geol. Gesellschaft, Berlin, 52, 2, p. 327-347.
(online at: https://www.biodiversitylibrary.org/item/148377#page/371/mode/1up)
('Notes on the geology of the Minahasa, North Sulawesi'. Early description of volcanics-dominated NE tip of Sulawesi)

Rinne, F. (1900)- Beitrag zur Petrographie der Minahassa, Nord-Celebes. Sitzungsberichte Preussischen Akademie Wissenschaften, Berlin, 1900, 1, p. 474-503.
('Contribution to the petrography of the Minahassa, North Sulawesi'. Petrographic description of volcanics and plutonic rocks of NE Sulawesi: diorite, diabase, dacites, andesites, basalt. Also granite near Gorontalo)

Rivai, T.A., K. Yonezu, K. Watanabe, Syafrizal, K. Sanematsu & D. Kusumanto (2017)- Characteristics of a Se-rich low-intermediate sulphidation epithermal deposit in the River Reef, the Poboya prospect, Central Sulawesi, Indonesia. 14th Biennial Meeting Soc. Geology Applied to Mineral Deposits (SGA), Quebec, 5p.
(Se-bearing Au-Ag low-intermediate sulphidation epithermal mineralisation in River Reef Zone of Poboya prospect, 12 km NE of Palu, C Sulawesi. Hosted in metamorphic and igneous rocks)

Robinson, G.P., B.T. Setiabudi, D.N. Sunuhadi, J.M. Hammarstrom, S. Ludington, A.A. Bookstrom, S.A. Yenie & M.L. Zientek (2013)- Porphyry copper assessment for Tract 142pCu7026, West Sulawesi, Indonesia. In: J.M. Hammarstrom et al., Porphyry copper assessment of Southeast Asia and Melanesia, U.S. Geol. Survey, Scient. Invest. Rep. 2010-5090-D, Appendix G, p. 126-136.
(online at: http://pubs.usgs.gov/sir/2010/5090/d/sir2010-5090d_text.pdf)
(W Sulawesi magmatic arc part of 1200-km-long Sulawesi- Sangihe magmatic arc, active since M Miocene-Pliocene. W-dipping subduction zone. Displacement of W Sulawesi arc system over Makassar Straits/ Celebes Sea in response to Banggai-Sula microcontinent collision, resulting in Pliocene-Pleistocene uplift of composite arc system. No known porphyry copper deposits, but Malala porphyry molybdenum (4.14 Ma) in N)

Robinson, G.P., B.T. Setiabudi, D.N. Sunuhadi, J.M. Hammarstrom, S. Ludington, A.A. Bookstrom, S.A. Yenie & M.L. Zientek (2013)- Porphyry copper assessment for Tract 142pCu7027, North Sulawesi-Sangihe-Indonesia. In: J.M. Hammarstrom et al., Porphyry copper assessment of Southeast Asia and Melanesia, U.S. Geol. Survey, Scient. Invest. Rept. 2010-5090-D, Appendix H, p. 137-148.
(online at: http://pubs.usgs.gov/sir/2010/5090/d/sir2010-5090d_text.pdf)
(Two known porphyry copper-gold deposits in S-C part of N Sulawesi tract: Tapadaa (3.75 Ma) and Tombulilato (3.0 Ma))

Rudyawan, A. (2015)- Neogene stratigraphy, structure and magmatism of the Central North Arm of Sulawesi, Indonesia. Ph.D. Thesis. Royal Holloway University of London, p. 1-484. *(Unpublished)*

Rudyawan, A., R. Hall & L. White (2014)- Neogene extension of the Central North Arm of Sulawesi, Indonesia. American Geophys. Union (AGU), Fall Meeting 2014, San Francisco, Abstract T43A-4681, 1p. *(Abstract + Poster)*
(Sulawesi North Arm more than simple oceanic arc. Paleogene granites suggest basement evolved arc crust or continental crust, but few inherited zircon ages. Neogene granites with Paleozoic and Proterozoic inherited zircon cores, suggesting melting of Australian continental crust. Two periods of sedimentation: M Miocene and Late Miocene-Pliocene. Two major fault trends: E–W Neogene basin-bounding faults and young NW-SE strike-slip faults. Record indicates arc-continent collision and underthrusting of Australian crust in E Miocene (~22 Ma), with later extensional episodes. Metamorphic core complex formed on land in M Miocene (~15 Ma), and later extension linked to initiation of S-ward subduction of Celebes Sea in latest Miocene- E Pliocene (~5 Ma))

Rusmana, E., A. Koswara & T.O. Simandjuntak (1993)- Geology of the Luwuk Quadrangle, Sulawesi. Map 1:250,000 scale, Geol. Res. Dev. Centre (GRDC), Bandung, 17p.
(NE part E arm of Sulawesi and Togian islands. Prior to Late Miocene- Pliocene overlap assemblage two distinct terranes (1) Banggai-Sula (Triassic-Jurassic clastics overlain by Eocene-M Miocene carbonates and clastics (reportedly with Nummulites, Lacazinella, Fasciolites; Strat. lexicon Indonesia) and (2) E Sulawesi (along N coast of E arm: S-directed thust imbricates of metamorphics, ultramafic rocks (supposedly Cretaceous oceanic crust), Late Cretaceous Matano Fm pelagic sediments). Oldest rocks on Togian Islands are supposedly Cretaceous-Paleocene Lamusa Fm brownish-red limestones)

Rusmana, E. & D. Sukarna (1984)- Tinjauan stratigrafi lengan tenggara Sulawesi dibandingkan dengan daerah sekitarnya. Proc. 14th Ann. Conv. Indon. Assoc. Geol. (IAGI), p. 61-70.
('Review of stratigraphy of SE arm of Sulawesi and comparison with surrounding areas'. First paper to propose SE arm of Sulawesi is continental block of 'Australian' origin; Surono 1998)

Rusmana, E., Sukido, D. Sukarna, E. Haryanto & T.O. Simandjuntak (1993)- Geology of the Lasusua-Kendari Quadrangle, Sulawesi (2112-2212), 1:250 000, Geol. Res. Dev. Centre (GRDC), Bandung, 16p.

(E Sulawesi map between 3-4° S, E side Bone Bay. Two geologic provinces, separated by Lasalo fault. Tinondo Province in SW has ?Carboniferous metamorphics and intrusives, overlain by Triassic- Jurassic Meluku/ Tokala Fms sediments, unconformably overlain by Eocene- M Miocene calcilutes? Remnants of ophiolites along Bone Bay shoreline. Hialu oceanic province in NE is widespread ?Cretaceous ophiolite, overlain by Late Cretaceous Matano Fm pelagic deposits, unconformably overlain by Late Miocene- Pliocene Celebes Molasse)

Rustiadi (1985)- Unsur perak (Ag) di dalam beberapa mineral sulfida dai endapan jenis Kuroko di daerah Sangkaropi, Sulawesi. J. Riset Geologi Pertambangan (LIPI) 6, 1, p. 32-41.
(Sangkaropi sulphide ores in SW Sulawesi NE of Rantepao resemble Kuroko ore deposits of Japan (submarine volcanogenic massive sulphides). Sphalerite, galena, pyrite and chalcopyrite most common)

Rutten, L. (1914)- Studien uber Foraminiferen aus Ost-Asien, 5. Einige Foraminiferen aus dem Ostarm von Celebes. Sammlungen Geol. Reichs-Museums Leiden (1), 9, p. 307-320.
(online at: www.repository.naturalis.nl/document/552393)
('Studies on foraminifera from East Asia, 5. Some foraminifera from the East Arm of Sulawesi'. Including Eocene Alveolina limestones at Biak Poh and Toeny and Lengketeng with Alveolina wichmanni and Nummulites bagelensis. Footnote: 'it is remarkable that the Eocene fauna of Celebes is more similar to samples from New Guinea than Java and Borneo'. Lower part of Celebes Molasse includes marls with poor Globigerina and limestones without Lepidocyclina, Miogypsina, etc, suggesting Late Miocene or younger age)

Rutten, L. (1924)- Over de foraminiferenfauna en den ouderdom van kalksteenen uit Zuid-Celebes afkomstig uit de groep der vischresten-bevattende gesteenten. Jaarboek Mijnwezen Nederlandsch-Indie 52 (1923), Verhandelingen, p. 173-183.
(Larger forams from limestones associated with fish fossils in S Sulawesi (Brouwer 1924). Fish-bearing limestones with non-diagnostic Heterostegina only. Spiroclypeus and Lepidocyclina (N.) brouweri n.sp. in nearby samples suggest E Miocene age)

Rutten, L.M.R. (1927)- Chapters 33-39 on the geology of Celebes (Sulawesi). In: L.M.R. Rutten (1927) Voordrachten over de geologie van Nederlandsch Indie, Wolters, Groningen, p. 520-635.
(Old review of geology of Sulawesi in Rutten's classic book of lectures)

Rutten, L. (1934)- Tertiaire foraminiferen van Oost Celebes. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 10, p. 286-289.
('Tertiary foraminifera from E Sulawesi'. Part of Von Loczy (1934) E Sulawesi mapping report)

Ryacudu, R., S. Tossin & E. Purnomo (1998)- Ampana strike-slip fault and its significance for hydrocarbon entrapment in the eastern arm of Sulawesi, Indonesia. In: J.L. Rau (ed.) Proc. 34th Sess. Sess. Co-ordCoord. Comm. Coastal Offshore Geosc. ProgramsGeoscience Programmes E and SE Asia (CCOP), Taejon, Korea 1997, 2, Techn. Reports, p. 1-21.
(Ampana strike-slip fault is NW-SE trending fault, cutting across E arm of Sulawesi, probably linked to S Sorong fault)

Ryacudu, R., T. Wibodo & Y.E. Handiwiria (1993)- Exploration for carbonate reservoirs in the Banggai Sula microcontinent, eastern Indonesia. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 679-692.
(Widespread Miocene pre-collisional Salodik carbonate platform on Banggai-Sula Block. End-Miocene collision between Banggai-Sula block and E Sulawesi terminated carbonate deposition, changing to Plio-Pleistocene Celebes Molasse (with Tiaka oilfield))

Saefudin, I. (1994)- Umur apatit dan zirkon batuan granitik daerah Palu dan sekitarnya, Sulawesi Tengah. J. Geologi Sumberdaya Mineral 4, 36, p. 9-15.
('Ages of apatite and zircon in granitic rocks of the Palu area and surroundings, C Sulawesi'. Apatite and zircon age analyses from 5 granitic rocks in neck of Sulawesi area. Granodiorite near Palu town E Oligocene age from both zircon and apatite methods (~29.5 Ma). Granites in 'neck' further N gave different results for

apatite and zircon methods: apatite ages ~6.2- 8.3 Ma (Late Miocene) zircon ages from same rock ~9.5- 11.8 Ma (late M Miocene). Differences in ages caused by annealing process of apatite)

Sahabuddin, A.M. Imran & M.F. Arifin (2012)- Biostratigrafi foraminifera planktonik satuan batupasir Formasi Pasangkayu, Kecamatan Pasangkayu, Kabupaten Mamuju Utaru, Sulawesi Barat. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-SS-28, p.
('Planktonic foraminifera biostratigraphy of the sand member of the Pasangkayu Formation, Pasangkayu, W Sulawesi'. Study of N Lariang basin upper M Miocene- E Pliocene, consisting of three zones)

Sahabuddin, A.M. Imran, F. Arifin & A. Jaya (2013)- Biostratigrafi foraminifera planktonik satuan batupasir Formasi Pasangkayu Cekungan Lariang Sulawesi Barat. J. Penelitian Geosains (Hasanuddin University) 9, 2, p. 111-120.
(online at: http://repository.unhas.ac.id/handle/123456789/16805)
('Planktonic foraminifera biostratigraphy of the sandstone unit of the Pasangkayu Formation, Lariang Basin, West Sulawesi'. Pasangkayu Fm in W Sulawesi Pasangkayu area with upper M Miocene- E Pliocene planktonic foraminifera (N14-N19; G. nepenthes-Gr siakensis to Gr tumida- Sphaeroidinellopsis subdehiscens zones))

Santy, L.D. (2016)- The Mesozoic source rock identification in Tomori Basin, East Arm of Sulawesi and its implication for petroleum play. Proc. IPA 2016 Technical Symposium, Indonesia exploration: where from- where to, Indon. Petroleum Assoc. (IPA), Jakarta, 28-TS-16, p. 1-19.
(Tomori Basin at S side of East arm of Sulawesi is Miocene foreland basin in collision zone between Sundaland/ E Sulawesi Ophiolite and Banggai-Sula microcontinent. Source rock analysis of onshore E Sulawesi Mesozoic Tokala, Nanaka and Tetambahu shales show hydrocarbon source potential: TOC 0.32- 3.46% and mainly type III kerogen. Rock-eval Tmax measurements suggests immature to marginally mature (428- 432°C), but vitrinite reflectance Ro 0.56- 0.76%) and TAI data (2-2.5) suggest sediments early mature to peak mature)

Santos, F.R., P. Sulistiono & N.E.W. Litaay (1999)- Totopo West, a low sulphidation epithermal system in North Sulawesi. Proc. 28th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 2, p. 203-215.
(Totopo West 55km W of Gorontalo, with gold in epithermal vein system at NW margin of Pliocene rhyodacitic caldera, along regional NE-trending faults. Associated dacite porphyry K/Ar ages (2.1-2.4 Ma and 2.8-3.3 Ma))

Santoso, B. & Subagio (2016)- Pendugaan mineral kromit menggunakan metode Induced Polarization (Ip) di daerah Kabaena Utara, Bombana Sulawesi Tenggara. J. Geologi Sumberdaya Mineral 17, 3, p. 179-192.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/17/11)
('Prediction of chromite minerals using Induced Polarization (Ip) method in the area of North Kabaena, Bombana, SE Sulawesi'. In N Kabaena island chromite present in Cretaceous ultramafic peridotites and as alluvial deposits. Electric methods used to predict distribution)

Sapiie, B., M.A. Nugraha, R. K. Wardana & A. Rifiyanto (2017)- Fracture characteristics of melange complex basement in Bantimala Area, South Sulawesi, Indonesia. Indonesian J. Geoscience 4, 3, p. 121-141.
(online at: https://ijog.geologi.esdm.go.id/index.php/IJOG/article/view/405/242)
(Analysis of fractures in Pre-Tertiary melange complex of Bantimala area South Sulawesi, Indonesia. Common fracture orientations NW-SE, W-E, NNE-SSW and ENE-WSW, different in each lithology. Fracture intensity in schists higher than other lithologies)

Saputro, S.P. & B. Priadi (2016)- Penyebab serta sumber high-K pada batuan volkanik dan plutonik di Tana Toraja, Sulawesi Selatan bagian utara: terkait kerak, evolusi magma, dan rezim tektonik. In: R. Hidayat et al. (eds.) Proc. 9th Seminar Nasional Kebumian, Dept. Teknik Geologi, Gadjah Mada University, Yogyakarta, p. 412-420.
(online at: https://repository.ugm.ac.id/273523/)
('Causes and sources of high-K in volcanic and plutonic rocks in Tana Toraja, N part of South Sulawesi: associated crust, magma evolution and tectonic regime'. Mio-Pliocene high-K volcanics and plutonics in Tana Toraja area, S Sulawesi, formed in post-subduction tectonic regime, with magma interacting with crust, creating 'continental affinity')

Sarasin, P. & F. Sarasin (1898)- Materialien zur Naturgeschichte der Insel Celebes. C.W. Kreidel's Verlag, Wiesbaden, vol. 1. Die Susswasser-Mollusken von Celebes, p. 1-102.
(online at: www.archive.org/details/materialienzurna01sara)
('Materials for the natural history of the island of Sulawesi, 1. The fresh-water molluscs of Celebes island'. Volume 1 of 5 of classic work on late 1800's geographic- geological travels in Sulawesi by cousins P. and F. Sarasin)

Sarasin, P. & F. Sarasin (1899)- Materialien zur Naturgeschichte der Insel Celebes. C.W. Kreidel's Verlag, Wiesbaden, 2. Die Land-Mollusken von Celebes, p. 1-244.
(online at: www.archive.org/details/materialienzurna02sara)
(Volume 2 of Sarasin work: 'The land molluscs of Celebes island')

Sarasin, P. & F. Sarasin (1901)- Materialien zur Naturgeschichte der Insel Celebes. C.W. Kreidel's Verlag, Wiesbaden, 3. Ueber die geologische Geschichte der Insel Celebes auf Grund der Thierverbreitung, p. 1-169.
(online at: www.archive.org/details/materialienzurna03sara)
(Volume 3 of Sarasin work: 'On the geological history of Celebes island based on the animal distribution')

Sarasin, P. & F. Sarasin (1901)- Materialien zur Naturgeschichte der Insel Celebes. C.W. Kreidel's Verlag, Wiesbaden, 4. Entwurf einer geographisch-geologischen Beschreibung der Insel Celebes, p. 1-344.
(online at: www.archive.org/details/materialienzurna04sara)
(Volume 4 of Sarasin work: 'Geographic- geologic description of Celebes island'. With appendix of rock descriptions by C. Schmidt)

Sarasin, P. & F. Sarasin (1905)- Reisen in Celebes ausgefuhrt in den Jahren 1893- 1896 und 1902- 1903. C.W. Kreidel Wiesbaden, p. 1-390.
(Read online at: http://archive.org/stream/reisenincelebes00saragoogpage/n10/mode/2up)
('Travels in Sulawesi in the years 1893-1896 and 1902-1903'. Mainly geographic travel account across S Sulawesi with geological observations by Sarasin cousins)

Sarasin, P. (1912)- Zur Tektonik von Celebes. Zeitschrift Deutschen Geol. Gesellschaft, Berlin, 64, Monatsberichte, p. 226-245.
(online at: www.biodiversitylibrary.org/item/150869#page/996/mode/1up)
('On the tectonics of Sulawesi'. No figures. See also critical discussion in Abendanon 1915)

Sardjono (2013)- Gayaberat. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 259-276.
('Gravity'. Chapter 11 in Geology of Sulawesi book)

Sardjono & E. Mirnanda (2007)- Gravity field and structure of the crust beneath the East Arm of Sulawesi and the Banggai Archipelago. Proc. 31st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA07-G-024, 11p.
(Gravity modeling suggests Banggai- Sula Archipelago composed of blocks of severely attenuated continental crust. East arm of Sulawesi is predominantly continental, with thick Neogene sediment cover and thickened continental crustal block in middle part. Only E tip (Poh Head) may have deep-rooted ultramafic rocks)

Sarmili, L. (1998)- Formation of the Tolo accretionary prism in relation to reactivation of the Palukoro Fault, Sulawesi. In: J.L. Rau (ed.) Proc. 33rd Ann. Sess. Coord. Comm. Coastal and Offshore Geoscience Progr. East and Southeast Asia (CCOP), Shanghai 1996, 2, p. 104-113.
(New bathymetric map of N Banda Sea between Buru and SE Sulawesi. General NW-SE directions, e.g. Tampomas Ridge and Hamilton slope. To W of N Banda Sea, N-S trending, 150 km long Tolo prism, well developed in N and centre, possibly due to large amount of sediment from Sulawesi island (i.e. Celebes molasse). To S, width of prism decreases and disappears in Buton Trough. Recent sediments deformed, and upper and lower thrust units appear faulted. As consequence of convergence, prism seems oriented NW-SE parallel to Hamilton fracture zone which continues to join Lawanopo and Palu-Koro strike-slip faults on-land)

Sarmili, L. (2015)- Opening structure of the Bone Basin on South Sulawesi in relation to process of sedimentation. Bull. Marine Geol. 30, 2, p. 97-107.
(online at: http://ejournal.mgi.esdm.go.id/index.php/bomg/article/view/79/80)
(Seismic profiles show Bone basin bordered on both sides by uplifted basement highs and in middle by flat-lying young sediments, indicating opening of basin)

Sarmili, L., D. Indriati & T. Stiawan (2016)- Proses sedimentasi Cekungan Bone berdasarkan penafsiran seismik refleksi di perairan Teluk Bone, Sulawesi Selatan. J. Geologi Kelautan 14, 1, p. 37-52.
(online at: http://ejournal.mgi.esdm.go.id/index.php/jgk/article/view/338/267)
('Sedimentation processes in Bone Basin, based on interpretation of seismic reflection in waters of Bone Bay, South Sulawesi'. Deep marine Bone Basin between S and SE arms of Sulawesi formed in Paleogene-Neogene. Initial Bone Basin formed by Cretaceous subduction, then developed as intra-montane basin. May be underlain by oceanic crust in Paleogene. Quaternary deposits influenced by reactivation of Walanae Fault. Six main seismic sequences A-F. Unit B Oligocene limestone, Unit C Late Oligocene- E Miocene volcanics, etc.)

Sarsito, D.A., Susilo, W.J.F. Simons, H.Z. Abidin, B.Sapiie, W. Triyoso & H. Andreas (2017)- Newly velocity field of Sulawesi island from GPS observation. Proc. Int. 6th Symposium on Earth hazard and disaster mitigation (ISEDM) 2016, AIP Conf. Proc. 1857, 1, 040005, p. 1-6.
(New GPS velocity observations in agreement with previous results : CW rotation of North Arm, Tomini Gulf opening and left-lateral strike slip of Palu-Koro fault. SW Sulawesi moves as part of Eurasian-Sunda Block with some compression at Makassar Straits (6.25mm/yr to W). Palu-Koro Fault rapid strike slip faulting)

Sarsito, D.A., Susilo, W.J.F. Simons, H.Z. Abidin, B.Sapiie, W. Triyoso & H. Andreas (2017)- Rotation and strain rate of Sulawesi from geometrical velocity field. Proc. Int. 6th Symposium on Earth hazard and disaster mitigation (ISEDM) 2016, AIP Conf. Proc. 1857, 1, 040006, p. 1-6.
(Sulawesi characterized by rapid rotation in several different domains and compression-strain pattern varies depending on type and boundary conditions of microplate)

Sartono, S., K.A.S. Astadiredja & H. Murwanto (1991)- East Arm Sulawesi: Banggai microplate- Sunda subduction zone collision. Proc. 20th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 376-395.
(Review of E Sulawesi stratigraphy and early tectonic scenario for Sulawesi. Accepts presence of Permo-Carboniferous rocks in E Sulawesi. Pretertiary rocks in E Sulawesi (with ophiolite) and Banggai Sula (with pink granites) similar age range, but seem to be of different origin. Several tectonic melange complexes (incl. Cretaceous) and olistostromes)

Sartono, S., I. Hendrobusono, B. Suprapto & H. Murwanto (1989)- Sedimen lengseran gravitasi Eosen-Miosen bawah di Tana Toraja, Sulawesi Selatan (Indonesia). Proc. 18th Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, p.
('Eocene- Lower Miocene gravity sedimentation in Tana Toraja, South Sulawesi (Indonesia)')

Sasajima, S., S. Nishimura, K. Hirooka, Y. Otofuji, T. Van Leeuwen & F. Hehuwat (1978)- Paleomagnetic results and fission track ages obtained from the Western and Northern Sulawesi, East Indonesia. In: M. Kono (ed.) Rock magnetism and paleogeophysics, Tokyo, 5, p. 73-80.
(online at:
http://peach.center.ous.ac.jp/rprep/Rock%20Magnetism%20and%20Paleogeophysics%20vol5%201978.pdf)
(Reconnaissance paleomagnetic work combined with fission track age dating of U Cretaceous- Pliocene rocks mainly from Biru area, E of Makassar, SW Sulawesi. M Miocene and younger rocks similar position as present-day. Probable 45° CCW rotation beween 63-13 Ma (authors suggest probably between 19-13 Ma, but no explanation why; JTvG), possibly in tandem with Malay Peninsula and W Borneo from which Haile (1978) reported similar 35-50° CCW rotations)

Sasajima, S., S. Nishimura, K. Hirooka, Y. Otofuji, T. Van Leeuwen & F. Hehuwat (1980)- Paleomagnetic reconnaissance from Northern arm of Sulawesi, Indonesia. In: S. Nishimura (ed.) Physical geology of Indonesian Island arcs, Kyoto University, p. 23-34.

Sasajima, S., S. Nishimura, K. Hirooka & Y Otofuji (1981)- Paleomagnetic studies combined with fission-track datings on the western arc of Sulawesi, east Indonesia. In: A.J. Barber & S. Wiryosujono (eds.)The geology and tectonics of Eastern Indonesia, Proc. CCOP-IOC SEATAR Working Group Mtg., Bandung 1979, Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 2, p. 305-311.
(Same as Sasajima et al. (1980). SW arm of Sulawesi 40° CCW rotation since Paleocene- E Miocene)

Sasajima, S., T. Van Leeuwen, F. Hehuwat, S. Nishimura, K. Hirooka & Y. Otofuji (1980)- Paleomagnetic studies combined with fission-track datings on the Western Arm of Sulawesi, East Indonesia. Tectonophysics 64, p. 163-172.
(Paleogene- E Miocene paleomagnetic pole for SW Sulawesi very different from that in M Miocene- Recent. This suggests possibly 19-13 Ma major tectonic event caused ~40-45° of CCW rotation. Postulated collision followed by welding of E and W Sulawesi in Pliocene (Katili, 1978) may be cause. Our data does not support hypothesis that W Sulawesi derived from dispersal of Gondwanaland)

Satyana, A.H. (2006)- Docking and post-docking tectonic escapes of Eastern Sulawesi: collisional convergence and their implications to petroleum habitat. Proc. Jakarta 2006 Int. Geosc. Conf., Indon. Petroleum Assoc. (IPA), PG-16, 4p. *(Extended Abstract only)*
(Summary of Sulawesi tectonic history of docking of microcontinents (Buton at 11 Ma, Sula at 5 Ma), followed by escape towards free edges, creating arc-polarity reversal, large strike slip faults, local extension, etc.)

Satyana, A.H. (2011)- Sulawesi: where two worlds collided- geologic controls on biogeographic Wallace's Line. Proc. Joint 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-065, 16p.
(On Cenozoic geological history controlling present-day Wallace's Line, which separates Asian and Australian fauna and flora. Sulawesi island shows mixture of Oriental and Australasian faunas)

Satyana, A.H., S. Damayanti & C. Armandita (2012)- Tectonics, stratigraphy and geochemistry of the Makassar Straits: recent updates of exploring West Sulawesi offshore, opportunities and risks, Proc. 36th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA12-G-156, p. 1-21.
(W part of Makassar Straits prolific petroleum province, sourced and reservoired by Miocene-Pliocene Mahakam deltaic sediments. E part of Makassar Straits very different. Makassar Straits extension began in M Eocene and formed graben/ half-graben above which is important unconformity of probable Late Eocene age, marking top of synrift sequence. Nature of basement still debated in areas. Onshore W Sulawesi seeps and offshore microseeps suggest terrestrial M-L Eocene coals and coaly shales are main source rocks)

Satyana, A.H., T. Faulin & S.N. Mulyati (2011)- Tectonic evolution of Sulawesi area: implications for proven and prospective petroleum plays. Proc. Joint 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-064, 30p.
(Substantial review of Cenozoic tectonic evolution, basins and hydrocarbons of Sulawesi)

Satyana, A.H. & M.E.M. Purwaningsih (2011)- Collision of microcontinents with Eastern Sulawesi: records from uplifted reef terraces and proven-potential petroleum plays. Proc. 35th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA11-G-219, 25p.
(Sulawesi is assemblage of collided terranes. Buton-Tukang Besi micro-continent collided with SE Sulawesi/ Muna Block from E Miocene- Late Miocene. Collision overthrusted Kapantoreh ophiolitic suture (here interpreted as oceanic crust originally located between Muna and Buton), shortened and uplifted Buton. Tukang Besi single microcontinent with Buton, and separated from Buton as response to post-collisional tectonics. Banggai-Sula microcontinent collided with Sulawesi E Arm in M Miocene- E Pliocene. Post-collisional uplifts exhumed micro-continents in Buton, Wakatobi (Tukang Besi), and Luwuk (Banggai) areas and uplift of Quaternary reef terraces)

Satyana, A.H. & S. Zaitun (2016)- Origin of oils and gases at Banggai-Sula microcontinent, Eastern Sulawesi-North Moluccas: constraints from biomarkers and isotope geochemistry- implications for further exploration of Cenozoic and Pre-Cenozoic objectives. Proc. 40th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA16-575-G, 27p.
(Oils in Banggai Basin oil-gas fields (Tiaka, Senoro, Minahaki, etc.) and onshore seeps (Kolo, Dayuk, Toikli, etc.) with common oleanane and relatively high sulfur sourced from marine E Miocene Tomori Fm carbonates-shaly carbonates (type A oils) and M Miocene Matindok shales- calcareous shales (type B oils). No evidence of petroleum contribution from Jurassic- Cretaceous rocks in Banggai Basin, although gas seeps on Sula islands tied to Pre-Cenozoic source rocks in graben areas of offshore Taliabu-Mangole Shelf)

Schepmann, M.M. (1907)- Mollusken aus posttertiaren Schichten von Celebes. Sammlungen Geol. Reichs-Museums Leiden, Ser. 1, 8, E.J. Brill, p. 153-203.
(online at: http://repository.naturalis.nl/document/552420)
('Molluscs from the post-Tertiary beds of Sulawesi'. Descriptions of molluscs from Kajoe ragi, Manado area, N Sulawesi, collected by Fennema. Mainly gastropods (15 species of Conus, 7 species of Pleurotoma, 10 species of Drillia, 6 species of Mitra, 19 species of Turricula, 11 species of Nassa, 13 speies of Cypraea, etc. spp.) and some pelecypods (Venus, Spondylus, Chlamys, etc.)

Schlaich, E.P. & J.R.J. Ten Berge (1941)- Rapport over het geologisch onderzoek van het Jong Tertiare Pompanoea bekken (ZW Celebes). BPM- Balikpapan Geological Report *(unpublished)*
(Report on geological survey and shallow core hole drilling in Young Tertiary of Pompanoea (= Sengkang) Basin, SW Sulawesi)

Schreuder, S. (1854)- Onderzoekingen naar steenkool in de afdeeling Maros of Noorderdistrikten van het gouvernement Celebes en onderhoorigheden. Natuurkundig Tijdschrift Nederlandsch-Indie 7, p. 388-395.
('Investigations of coal in the Maros district, (SW) Sulawesi'. Generally poor quality coal, associated with common limestone and volcanic rocks. Not much detail; no maps)

Schubert, R.J. (1913)- Beitrag zur fossilen Foraminiferenfauna von Celebes. Jahrbuch Kon. kaiserl. Geol. Reichanstalt 62 (1912), 4, p. 127-150.
(online at: www.landesmuseum.at/pdf_frei_remote/JbGeolReichsanst_063_0127-0150.pdf)
('Contribution to the fossil foraminiferal fauna of Sulawesi'. Foraminifera from North Arm and N part of East arm of Sulawesi, collected by Koperberg. Mainly young Miocene- Pliocene. Some E-M Miocene carbonates with Miogypsina, Lepidocyclina)

Sendjaja, P. (2013)- Petrologi dan geokimia batuan volkanik di Kepulauan Togean, Teluk Tomini, Propinsi Sulawesi Tengah: implikasinya terhadap tatanan tektonik Pulau Sulawesi. Ph.D. Thesis, Inst. Teknologi Bandung (ITB), p. 1- . *(Unpublished)*
('Petrology and geochemistry of volcanic rocks in Togean Islands, Tomini Bay, Central Sulawesi: implications for the tectonic structure of Sulawesi'. Volcanic rocks from Togean Islands 3 types:(1) Una-Una (adakitic subduction volcanics from partial melting of Celebes Sea slab at 70-85 km depth), (2) Togean (both adakites, basaltic-trachyandesite and result of partial melting of Sulawesi Sea slab in amphibole-eclogite zone) and (3) Walea (tholeitic basaltic-andesite and tholeite basalt, interpreted as upper part of ophiolite, formed around 6 Ma from seafloor spreading due to rollback of oceanic crust of Banggai-Sula microcontinent)

Sendjaja, P. & I.G.B.E. Sucipta (2008)- Adakite rock From Una-Una island, Central Sulawesi. Proc. 37th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 212-228.
(Pyroclastics and lavas from Una-Una Island in Tomini Gulf adakitic geochemical signature: SiO_2 >60%, MgO <3%, low Y and HREE relative to normal island arc volcanics, high Sr and Nb enrichment. Tectonically, adakites formed by partial melting of young oceanic crust. Crust presently subducted at nearby trench may be <25 Ma old)

Sendjaja, P., E. Suparka, C.I. Abdullah, E. Sucipta & T. Hasenaka (2011)- A petrology and geochemistry of the volcanic rocks from the Togean Islands, Central Sulawesi, Indonesia: estimation of subduction component at a complex tectonic regime. Proc. Joint. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-166, 13p.
(Togean Island in Tomini Gulf. Nearby Una-Una volcano typical adakitic rocks. Mio-Pliocene volcanics of Togean islands further toE quite different. Volcanic rocks from Walea Kodi and Walea Bahi Islands lower SiO2 and low Sr content than Una-Una. Compositions seems similar to volcanic rocks from Sangihe Region)

Setiawan, I., S. Indarto, A.F. Ismayanto & Sudarsono (2012)- Karakter dan tipe mineralisasi hidrotermal di wilayah Bombana berdasarkan studi mineralogi dan geokimia. J. Sumber Daya Geologi 22, 3, p. 155-168.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/115/107)
('Character and the type of hydrothermal mineralization in the Bombana area based on a study of mineralogy and geochemistry'. Bombana gold mineralization in metamorphic rocks of Rumbia Mts, with no obvious connection with magmatism. Area with metamorphic and ultramafic rocks (garnet- glaukophane- amphibole schist, peridotite, serpentinite, metasediments, etc.). Gold mineralization of epithermal-mesothermal type, resulting from hydrothermal processes, formed after metamorphism. Ore minerals gold, pyrite, chalcopyrite, goethite, lepidocrocite and cinnabar, commonly associated with quartz veins/ K-Ar age of plagioclase of meta-andesite 85± 2 Ma)

Setiawan, N.I., Y. Osanai, N. Nakano & T. Adachi (2014)- Metamorphic evolution of garnet-biotite-muscovite schist from Barru Complex in South Sulawesi, Indonesia. J. Southeast Asian Applied Geol. (UGM) 6, 2, p. 68-78.
(online at: http://jurnal.ugm.ac.id/jag/article/download/7219/5658)
(Mid-Cretaceous garnet-biotite-muscovite schist from Dengedenge River in Barru Complex, 30 km N of Bantimala, SW Sulawesi. Bordered in N by ultramafic rocks and in S by Late Cretaceous turbidites. Foliation of schist varies from N80°E to N30°E, dipping 30-60° to E (SE). Garnet, biotite, muscovite, quartz, rutile and plagioclase represent peak P-T condition of this rock, estimated at T= 501-562ºC and P= 0.89-0.97 GPa. Within geothermal gradient P-T path of eclogite from Bantimala Complex. Wakita 1994 K-Ar age ~106 Ma)

Setiawan, N.I., Y. Osanai, N. Nakano & T. Adachi (2013)- Jadeite jade from South Sulawesi in Indonesia and its geological significance. In: N.I. Setiawan et al. (eds.) Proc. Int. Conf. Geological Engineering, Gadjah Mada University, Yogyakarta 2013, ER05, p. 40-56.
(online at: http://lib.ugm.ac.id/digitasi/upload/4244_jhon-mu.140108-nugroho.pdf)
(Jadeite abundant in high-P garnet-jadeite-quartz metamorphic rock in E Cretaceous Bantimala subduction compex of S Sulawesi. Rock mainly jadeite, garnet, quartz, phengite, epidote, with minor glaucophane and rutile. Rock experienced peak P-T condition at 2.2-2.5 GPa and 500-540 ºC and subsequently retrogressed)

Setiawan, N.I., Y. Osanai, N. Nakano, T. Adachi, K. Yonemura, A. Yoshimoto (2016)- Prograde and retrograde evolution of eclogites from the Bantimala Complex in South Sulawesi, Indonesia. J. Mineralogical Petrological Sci. 111, 3, p. 211-225.
(online at: https://www.jstage.jst.go.jp/article/jmps/111/3/111_150907/_pdf)
(Evolution of high-P metamorphic rocks from Bantimala Complex, S Sulawesi))

Setiawan, N.I., Y. Osanai, N. Nakano, T. Adachi, K. Yonemura, A. Yoshimoto, L.D. Setiadji, K. Mamma & J. Wahyudiono (2013)- Geochemical characteristics of metamorphic rocks from South Sulawesi, Central Java, and South and West Kalimantan in Indonesia. Proc. 5th AUNS/SEED-Net Regional Conf. Geological Engineering, p. 263-280.
(online at: www.seed-net.org/download/GeoE013_revised_060513.pdf)
(Metamorphic rocks in Cretaceous metamorphic complexes of C Java, S Kalimantan and S Sulawesi are mainly HP metamorphics. Protoliths are metabasics (basalts, andesite) and meta-sediments. Eclogites and blueschists from S Sulawesi with MORB and within-plate basalt signatures. Eclogites and blueschists from C Java mostly within-plate basalt signatures, amphibolites and garnet amphibolites are MORB. Metatonalites from Nangapinoh, Schwaner Mts of W Kalimantan are calc-alkaline rocks from volcanic-arc environment, some adakitic in nature, one sample of 233± 3Ma age (Late Triassic) (non-metamorphosed granites Cretaceous, 77-157 Ma))

Setiawan, N.I., Y. Osanai, N. Nakano, T. Adachi, K. Yonemura, A. Yoshimoto, L.D. Setiadji, K. Mamma & J. Wahyudiono (2013)- Geochemical characteristics of metamorphic rocks from South Sulawesi, Central Java, and South and West Kalimantan in Indonesia. Asean Engineering J. C, 3, 1, p. 107-127.
(online at: www.seed-net.org/wp-content/uploads/2015/12/GEOCHEMICAL-CHARACTERISTIC...)
(same paper as Setiawan et al. 2013)

Setyanta, B. & Subagio (2013)- Sinyal geomagnetik di Cekungan Sengkang implikasi terhadap pola struktur dan konfigurasi batuan alas cekungan. J. Sumber Daya Geologi 23, 2, p. 69-79.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/91/85)
'Geomagnetic signals in the Sengkang Basin and its implications for structural and basement configuration'. Intensity of magnetic anomalies at Sengkang Basin from -750- 400 nT. Sengkang Basin underlain by high magnetic ultrabasic rocks (especially E flank?). Geologic structures NE-SW fold, cut by NW-SE fault)

Setyoko, J., S. Hadipandoyo & S. Oemar (2000)- Hydrocarbon resources assessment of the Late Miocene Tacipi Formation in the Bone Basin, South Sulawesi, Indonesia. Proc. 36th Sess. Coord. Comm. Coastal and Offshore Programmes E and SE Asia (CCOP), Hanoi 1999, p. 35-49.
(Late Miocene Tacipi Fm reefal limestone gas producing in Kampung Baru Field, E Sengkang sub-basin of Bone Basin. Porosity generally 20-30% (moldic, vugular and fracture). Source rocks Eocene and Oligocene carbonaceous sediments. Unproven potential plays in Eocene Toraja Fm sst, Oligocene Toraja Fm carbonate and Pliocene Walanae Fm sst. Undiscovered resources in Tacipi play in Bone basin assessed as maximum 22.5 Gm3 and 5.3 million Tons of oil)

Shaban, G., F. Fadlin & B. Priadi (2016)- Geochemical signatures of potassic to sodic Adang Volcanics, Western Sulawesi: implications for their tectonic setting and origin. Indonesian J. Geoscience 3, 3, p. 197-216.
(online at: https://ijog.geologi.esdm.go.id/index.php/IJOG/article/view/344/226)
(Adang Volcanics ~400m thick series of (ultra-) potassic- sodic lavas and tuffs of mainly trachytic composition, part of widespread Late Cenozoic (latest Miocene- E Pliocene) high-K volcanics in W Sulawesi. Tectonic setting and origin debated. Major rock forming minerals leucite, diopside/aegirine and high T phlogopite. Geochemistry suggests formation in post-subduction, continental rift tectonic setting)

Siagian, H.P. & Widijono (2009)- The possibility of hydrocarbon trap and its potential in the North Bone Basin, based on geological and geophysical data. Jurnal Sumber Daya Geologi 19, 1, p. 63-76.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/194/186)
(Bone basin believed to have formed since Early Tertiary, as fore-arc basin, underlain by pre-Tertiary metamorphics, volcanics and metasediments (Latimojong and Pompangeo Complexes). Hydrocarbon presence demonstrated by gas seeps in Pongko and Malangke villages. Coarse clastic and limestone deposits such as fluvio-deltaic Toraja and Lamasi Fms may be potential reservoirs; shales in Lamasi and Toraja Fms potential petroleum source rocks. Gulf Oil 1972 BBA 1X well in N part of Bone Bay TD at 10,521' in M Miocene)

Siahaan, E.E., S. Ciptadi, D. Budihartanto & C.A.E. Pelmelay (1994)- Sistem panasbumi pada tektonik sesar Palu, di daerah Bora, Sulawesi Tengah. Proc. 23rd Ann. Conv. Indon. Assoc. Geol. (IAGI), p. 1001-1009.
('The geothermal system at the Palu fault, Bora area, C Sulawesi'. Granite in Palu area 15-16 Ma K/Ar ages)

Sidarto (2008)- Sesar barat laut- tenggara di daerah Mamuju dan sekitarnya dan hubungannya dengan pembentukan Cekungan Karama. J. Sumber Daya Geologi 18, 2, p. 89-105.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/241/220)
('NW-SE in the Mamuju area and surroundings and its relationship to the formation of the Karama Basin'. In SW Sulawesi four parallel NW-SE trending faults: Budong-budong, Talondo, Keang and Adang. Dextral faults in E Tertiary, but sinistral in Miocene-Pliocene. Karama Basin between Budong-budong and Talondo faults contains Eocene trangressive sedimentary rocks and probably step over basin of in E Tertiary)

Sidarto & S. Bachri (2013)- Struktur Geologi. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 277-302.

('Structural geology'. Chapter 12 in Geology of Sulawesi book. Brief reviews of major faults (Palu-Koro, Walanae, Matano, Balantak, etc.), Tertiary rifts (Makassar, Bone) and subduction zones)

Sidarto & U. Hartono (2009)- Identifikasi gunung api purba di daerah Sapaya, Sulawesi Selatan pada data inderaan jauh. J. Sumber Daya Geologi 19, 6, p. 351-363.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/219/209)
('Identification of ancient volcanoes in Sapaya, South Sulawesi, from remote sensing data '. S Arm of Sulawesi Island is Tertiary volcanic arc, represented by Camba Fm. Satellite imagery interpretation reveals two ancient volcanoes in Sapaya area and surroundings: (1) M Miocene- Pliocene Sapaya volcano eroded cone and (2) Pliocene Bantoloe volcano eroded cone. Sapaya Volcano may be controlled by Tethyan type subduction/ collision between Australian micro continental and Eurasian continent plates)

Sidarto & Wahyono (2001)- Kaitan antara struktur geologi dan endapan batubara di cekungan Karama, Sulawesi. Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 26, p. 15-28.
('Link between structural geology and coal deposits in Karama basin, W Sulawesi'. Toraja Fm Late Eocene coal seams folded and thrusted in Late Miocene- Early Pliocene. Coal rank locally increases along fault zones. Above coal Late Eocene limestone with Discocyclina and Pellatispira)

Sidarto & Wahyono (2002)- Pemodelan geologi cekungan batubara di daerah Baraka, Enrekang, Sulawesi Selatan. J. Geologi Sumberdaya Mineral 12, 130, p. 2-18.
('Geologic model of the coal basin in the Baraka area, Enrekang, S Sulawesi'. Eocene coals of Toraja Fm rift section in Toraja Basin, N part of S Sulawesi. Overlie U Cretaceous Latimojong Fm and overlain by Late Eocene limestone. Three seams, Titok, Sangbuah and Batunoni-Lapin. Exposure of coal after Late Miocene-Pliocene folding event (see also Wahyono and Sidarto 2002))

Silver, E.A. (1981)- A new tectonic map of the Molucca Sea and East Sulawesi, Indonesia, with implications for hydrocarbon potential and metallogenesis. In: A.J. Barber & S. Wiryosujono (eds.) The geology and tectonics of Eastern Indonesia, Proc. CCOP-IOC SEATAR Working Group Mtg., Bandung 1979, Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 2, p. 343-347.
(New fault zones discovered during Scripps 1976-1979 cruises and land expeditions: (1) Sula Thrust at N side Banggai- Sula Platform, (2) W continuation of Sorong FZ and (3) E extension of Batui Thrust which bounds upthrusted E Sulawesi ophiolite (which also forms Gorontalo basin basement, and emplacement was complete in Pliocene or earlier). Also mapped recently active Tolo Thrust E of Sulawesi and Buton)

Silver, E.A., Y. Joyodiwiryo & R. McCaffrey (1978)- Gravity results and emplacement geometry of the Sulawesi ultramafic belt, Indonesia. Geology 6, p. 527-531. *(also in Geol. Res. Dev. Centre, Spec. Publ. 2, p. 313-319)*
(SE arm Sulawesi gravity highs at schist ultramafic contacts indicate thick ultramafic rocks there, possibly dipping under schist. Gravity effect of ultramafics decreases E away from schist)

Silver, E.A., R. McCaffrey, Y. Joyodiwiryo & S. Stevens (1983)- Ophiolite emplacement by collision between the Sula Platform and the Sulawesi arc, Indonesia. J. Geophysical Research 88, p. 9419-9435.
(Large ophiolite belt from Miocene collision of Sulawesi island arc and continental Sula Platform. Batui thrust separates ophiolite from deformed sedimentary rocks along edge of Sula Platform and continues E from Sulawesi along S margin of Gorontalo basin. Sulawesi ophiolite traced offshore to oceanic crust basement of Gorontalo basin. Ophiolite melange underlies harzburgites on SE Arm beneath low-angle thrusts. Melange several 100m thick thrust packets of serpentine and red shale matrix and N to NE dipping foliation, consistent with significant N-ward component of lower plate movement, probably Sula platform margin. Ophiolite emplaced by oblique convergence of Sula platform along S edge of Gorontalo basin. Gorontalo basin probably forearc basin with ophiolite basement. Presence of dunite in Colo volcanic products in Tomini Bay indicate magma went through through oceanic material, possibly part of E Sulawesi Ophiolite)

Silver, E.A., R. McCaffrey & R.B. Smith (1983)- Collision, rotation, and the initiation of subduction in the evolution of Sulawesi, Indonesia. J. Geophysical Research 88, p. 9407-9418.

(Sulawesi shaped as result of collision with Sula platform, resulting in rotation of N volcanic arm and accretionary wedge of N Sulawesi trench. N Sulawesi trench changes laterally from no active deformation in E to a wide accretionary wedge in W. Early thrusting produced steep frontal slope (8°-16°), indicative of high basal shear stress, more advanced (W) zone of thrusting produces gentle slope (2°). Paleomagnetic data suggest post-Late Eocene counter-clockwise rotation of N Arm. Convergence between N Banda Basin and SW Sulawesi documented by Tolo thrust. S end of thrust projects toward Buton, but structural relations not clear)

Simandjuntak, T.O. (1980)- Wasuponda melange. Proc. 8th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, p.
(First description of C Sulawesi Wasuponda melange. Contains eclogite)

Simandjuntak, T.O. (1981)- Some sedimentological aspects of Mesozoic rocks in eastern Sulawesi, Indonesia. Proc. 9th Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, p.

Simandjuntak, T.O. (1986)- Sedimentology and tectonics of the collision complex of the East arm of Sulawesi, Indonesia. Ph.D. Thesis, Royal Holloway and Bedford New College, University of London, p. 1-374. *(Unpublished)*
(Stratigraphic- tectonic study of Sulawesi East. M Miocene collision complex separates E Sulawesi Ophiolite belt from Banggai-Sula continental block slices of sediment cover. Pelagic cover of E Sulawesi ophiolite Cretaceous- E Tertiary age: E Cretaceous radiolarian chert with Thanarla conica (= T. brouweri Tan), Zipondium, Archaeodictyomitra apiaria, Pseudodictyomitra cosmoconica, Acanthoricus, Cryptocephalic, etc.)

Simandjuntak, T.O. (1986)- Struktur duplek (dwiunsur), sesar sungkup dan sesar jurus mendatar di lengan timur Sulawesi. Proc. 15th Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, p.
('Duplex structures, thrust faults and wrench faults in the East arm of Sulawesi')

Simandjuntak, T.O. (1986)- New data on the age of ophiolitic rocks in Eastern Sulawesi. Proc. 15th Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, p.

Simandjuntak, T.O. (1990)- Sedimentology and tectonics of the collision complex in the East Arm of Sulawesi, Indonesia. Geologi Indonesia 13, 1, p. 1-35.
(In E Arm of Sulawesi imbricated Mesozoic-Paleogene continental margin sediments of Banggai-Sula Platform juxtaposed with E Sulawesi Ophiolite Belt along Batui- Balantak Fault system. Three distinct sequences in E Arm: (1) Triassic- Paleogene continental margin; (2) Cretaceous pelagic chert and radiolaria-rich calcilutite (= upper part of ophiolite suite) and (3) overlap assemblage of Neogene post- orogenic clastics ('Sulawesi Molasse'), with clasts of (1) and (2). Collision zone marked by Kolokolo Melange with M Miocene calcareous mudstone matrix, locally with oil seeps. At least 3 raised coral reef terraces on S coast of East Arm show ongoing uplift)

Simandjuntak, T.O. (1992)- New data on the age of the ophiolite in Eastern Sulawesi. Geol. Res. Dev. Centre (GRDC), Bandung, Bull. 15, p. 38-44.
(K/Ar dating of gabbro from E Sulawesi ophiolite gave ages of 93-48 Ma (Late Cretaceous- E Eocene); pillow basalts ~53-38 Ma (Eocene). Peridotites could not be dated due to very low K content. Oldest cherts with manganese nodules above pillow basalts of ophiolite complex in Boba beds from E Arm of Sulawesi contain E Cretaceous (Valanginian- E Cenomanian) radiolaria, overlain by U Cretaceous calcilutites with Globotruncana. (K/Ar ages too young?))

Simandjuntak, T.O. (1992)- Sedimen Mesozoikum dan prospek hidrokarbon di Indonesia Timur (studi kasus penelitian geologi di lengan Timur Sulawesi). J. Geologi Sumberdaya Mineral 2, 7, p. 10-20.
('Mesozoic sediments and hydrocarbon prospects in E Indonesia, special study of E arm of Sulawesi'. Oil and gas seeps, probably sourced from Jurassic marls, in many places between Banggai-Sula microcontinent and E Sulawesi ophiolite belt. Tectonism before, during and after continent collision may stimulate oil migration)

Simandjuntak, T.O. (1993)- Neogene plate tectonic convergence in eastern Sulawesi. J. Geologi Sumberdaya Mineral 3, 25, p. 2-10.
(In M Miocene NW-ward moving microcontinental blocks incl. Banggai-Sula Platform, Tukang Besi- Buton Platform and Mekongga Platform, collided ('underplated') with E Sulawesi Ophiolite Belt, in 'Tethyan-type' convergence. Followed by deposition of Late Miocene- Pliocene post-orogenic 'molasse' of non-marine and shallow marine sediments. E Sulawesi Ophiolite overlain by U Cretaceous pelagic calcilutite with radiolaria (Matano= Boba Fm). C Sulawesi Metamorphic Belt formed in W-dipping Benioff zone in Cretaceous-Paleogene. Imbricated sedimentary cover of Banggai-Sula Plate with U Triassic (Tokala Lst Fm)- Jurassic (Nanaka quartz sst, Sinsidik Lst with belemnites) and U Cretaceous- Paleogene sediments)

Simandjuntak, T.O. (1993)- Struktur rangkap (duplex), sesar sungkup dan sesar jurus mendatar di Lengan Timur Sulawesi. Geol. Res. Dev. Centre (GRDC), Bandung, Bull. 16, p. 27-44.
('Duplex structure overthrusting and displacement in the eastern arm of Sulawesi'. Batui Thrust is M Miocene suture between Banggai-Sula Platform and E Sulawesi Ophiolite Belt. Consists of several thrusts, all dipping NW. NE portion subjected to dextral strike-slip with 150 km of displacement in Plio-Pleistocene (Balantak fault). Melanges related to tectonic diapyrism developed along Batui Thrust zone. Several duplex structures developed in sediments of Banggai-Sula Plate)

Simandjuntak, T.O. & M. Mubroto (1991)- Neogene Tethyan type convergence in eastern Sulawesi. In: Proc. Silver Jubilee Symp. Dynamics of subduction and its products, Yogyakarta 1991, Indonesian Inst. Sciences (LIPI), p. 274-277.

Simandjuntak, T.O., E. Rusmana, J.B. Supandjono & A. Koswara (1993)- Geology of the Bungku Quadrangle, Sulawesi. Quad. 2213, Map 1:250,000, Geol. Res. Dev. Centre (GRDC), Bandung, p. 1-13.
(E Central Sulawesi map sheet, mapped in 1980. Two terranes: (1) E Sulawesi ophiolite of Cretaceous ultramafics, overlain by Upper Cretaceous pelagic sediments (Matano Fm) and Late Miocene-Pliocene tuffaceous clastics and (2) 'Banggai-Sula terrane' of Triassic (-E Jurassic?) Tokala Fm limestones and clastics, Jurassic Nanaka Fm clastics with conglomerates with volcanics, red granite and metamorphic clast, J-K pelagic limestones and U Eocene- Lower Miocene Salofik Fm limestones. Various episodes of folding; last tectonic event in Pleistocene)

Simandjuntak, T.O., E. Rusmana, Surono & J.B. Supandjono (1991)- Geology of the Malili Quadrangle, Sulawesi. Quad 2113, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 35p.
(C Sulawesi map between 2-3°S, N end Bone Bay. Comprises W and E Sulawesi provinces, separated by Palu-Koro fault. W Sulawesi with Late Cretaceous flysch, Eocene- Miocene clastics, Oligocene- M Miocene volcanic arcs and Neogene granitic rocks, unconformably overlain by Late Miocene- Pliocene turbidites, followed by Plio-Pleistocene- Recent andesitic volcanics. C Sulawesi Pompangeo metamorphic belt, E Sulawesi ophiolite overlain by Cretaceous pelagic Matano Fm with common radiolarian cherts near base. Late Miocene- Pliocene post-orogenic molasse)

Simandjuntak, T.O., Surono & Sukido (1994)- Geology of the Kolaka Sheet, Sulawesi (Quadrangles 2111, 2210, 2211), 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 18p.
(SE Sulawesi map sheet between 4-5°S, mapped in 1983. Two juxtaposed terrains: (1) E Sulawesi ophiolite (E Cretaceous ultramafics overlain by Late Cretaceous pelagic limestone) and 'Pompangeo metamorphic complex' (incl. eclogites and glaucophane-bearing rocks) and (2) Buton- Tukang Besi continental terrane with ?Permo-Carboniferous? metamorphics and low-metamorphic Triassic Meluhu Fm clastics and Tokala Fm carbonates. Both overlain by M Miocene- Pliocene 'Sulawesi molasse'. Strong Paleogene deformation, M Miocene upthrust of E Sulawesi terrane onto Tukang Besi- Buton block and Plio-Pleistocene block faulting. (Panggabean & Surono 2011: Matano Fm (pelagic rock overlying E Sulawesi ophiolite?) contains E Cretaceous radiolaria Thanaria conica, Archaeodictyomitra apiaria, Pseudodictyomitra cosmoconica (= E Cretaceous), etc.)

Simandjuntak, T.O., Surono & J.B. Supandjono (1991)- Geologic map of the Poso Quadrangle, Sulawesi. Map 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, p.
(C Sulawesi map between 1-2°S, S end Tomini Bay. Two terrains: W Sulawesi, E Sulawesi)

Socquet, A., W. Simons, C. Vigny, R. McCaffrey, C. Subarya, D. Sarsito, B. Ambrosius & W. Spakman (2006)- Microblock rotations and fault coupling in SE Asia triple junction (Sulawesi, Indonesia) from GPS and earthquake slip vector data. J. Geophysical Research 111, B08409, 3, p. 1-15.
(online at: http://onlinelibrary.wiley.com/doi/10.1029/2005JB003963/epdf)
(Current Sulawesi deformation described by small number of rapidly rotating blocks. SW Sulawesi (Makassar Block) rotates CCW at ~1.4°/Myr. NE Sulawesi (Bangai-Sula) 3 blocks: central N Sula Block moves NNW and rotates CW at ~2.5°/Myr, NE Manado Block rotates CW at ~3°/My; E Sulawesi pinched between N Sula and Makassar blocks. Along Makassar Block- Sunda Plate boundary, trench accommodates ~15 mm/yr of slip in Makassar Strait. N Sula-Manado blocks boundary is Gorontalo Fault, moving right laterally at ~11 mm/yr. 42 mm/yr relative motion between N Sula and Makassar blocks accommodated on Palu-Koro left-lateral fault zone. Data also indicate pull-apart structure in Palu area. Sulawesi example of collision accommodated by block rotation instead of mountain building)

Soehaimi, A & D. Muslim (2013)- Seismotectonics of the Palu-Kuro active fault and analysis of the disappearance of megalith cultures from central Sulawesi island. In: Proc. 49th Annual Session Coord. Comm. Geoscience Programmes E and SE Asia (CCOP), Sendai, p. 75-81.
(online at: www.ccop.or.th/download/as/52as2.pdf)

Soemarno, S. (1979)- Beberapa hasil penerapan cara terpadu pada batuan yang mengandung bijih khromit di daerah Lasitae (Barru), Sulawesi Selatan. J. Riset Geologi Pertambangan (LIPI) 2, 1, p. 32-44.
(online at: http://pustaka.geotek.lipi.go.id/wp-content/uploads/2016/02/Riset-Vol.2-No.1-2-2-.pdf)
('Some of the results of integrated study of rocks with chromite ore in the Lasitae (Barru) area, South Sulawesi'. Lasitae area mountains SE of Barru with ultramafic zones with two WSW-ENE belts of chromite ore deposits)

Soeria-Atmadja, R., J.P. Golightly & B.N. Wahju (1974)- Mafic and ultramafic rock associations in the East Arc of Sulawesi. Proc. Inst. Technology Bandung 8, 2, p. 67-85. *(also in 1972 Proc. Regional Conf. Geol. SE Asia)*
(E and SE arms of Sulawesi largely occupied by discontinous belts of ultramafic complexes, mainly hartzburgite, lherzolite with some dunite and pyroxenite. Presumably of Late Mesozoic- Early Tertiary age. Associated with gabbroic rocks. Contacts with surrounding rocks generally faults/ thrusts)

Soeria-Atmadja, R., B. Priadi, T.M. van Leeuwen & I. Kavalieris (1999)- Tectonic setting of porphyry Cu-Au, Mo and related mineralization associated with contrasted Neogene magmatism in the Western Sulawesi arc. Island Arc 8, 1, p. 47-55.
(Neogene W Sulawesi Arc three magmatic provinces: (1) South: K alkaline-shoshonitic, with leucite-bearing rocks, 13-2 Ma (2) Central: high-K calc-alkaline and (3) North low-K, normal calc-alkaline arc volcanics, mainly 22-13 Ma, also 9.5 Ma-present. Origin of magmatism in terms of subduction and collision processes contentious. Four widely spaced Cu-Au porphyry and one Mo porphyry district(s) along W Sulawesi Arc, with N Sulawesi province most mineralized. Porphyry Mo systems require involvement of continental crust in magma source, while Au-rich porphyry systems are derived from mantle source)

Soesilo, J. (1998)- Metamorfosa pada komplek Latimojong, Sulawesi Selatan dan makna tektonikya. Masters Thesis, Inst. Teknologi Bandung (ITB), p. 1-85. *(Unpublished)*
('Metamorphism in the Latimojong Complex, S Sulawesi and tectonic significance'. Metamorphic rocks of Latimojong Mts low- medium grade rocks derived from alternating siliciclastic, calcareous and volcanic rocks, intruded by basaltic-acidic, high K, calc alkaline and tholeiite rocks. W-ward imbrication dominant structure and involves metamorphic rocks, serpentinites, chert and island arc metabasites of accretionary complex. At least three deformational phases, including metamorphism at glaucophane greenschist facies. Supports formation of primitive island arc prior to its collision with Sundaland margin)

Soesilo, J. & J. Sopaheluwakan (1998)- Petrologi dan geokimia meta-batuan beku Pegunungan Latimojong, Sulawesi Selatan. Proc. 27th Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 3 (Geodin., Magmat. Volkanologi), p. 94-107.

('Petrology and geochemistry of metamorphics of Latimojong Mts, S Sulawesi'. Geochemistry of 10 metamorphosed igneous rock samples in Latimojong metamorphic complex: metabasites (former island arc basalt), meta-gabbros, dolerites, andesites and granite, presumably formed in active subduction environment)

Soesilo, J., E. Suparka, C.I. Abdullah & V. Schenk (2010)- Pemetaan inklusi di dalam garnet tekanan tinggi pada kompleks melange Bantimala, Sulawesi Selatan. Majalah Geologi Indonesia 25, 3, p. 143-159.
(On inclusions in garnet in Bantimala melange complex, S Sulawesi)

Sohma, K. (1973)- *Florschuetzia*, a fossil sonneratioid pollen genus, from Sulawesi, Indonesia. Sci. Rept. Tohoku Univ, 4th Ser. (Biology), 36, 4, p. 261-266.

Sopaheluwakan, J. (1979)- The evolution of Franciscan type melange in South Sulawesi, with special reference to the Barru area. J. Riset Geologi Pertambangan (LIPI) 2, 1, p. 45-55.
(online at: http://pustaka.geotek.lipi.go.id/wp-content/uploads/2016/02/Riset-Vol.2-No.1-2-2-.pdf)
(Early study of Barru- Bantimala melange/ metamorphic complexes of SW Sulawesi, and similarities with SE Kalimantan and C Java. Metamorphics include glaucophane schists, eclogites, amphibilite, marble, etc., unconformably overlain by E Cretaceous? deep-sea sediments, followed by U Cretaceous flysch. Associated with fault-bounded, chromite-bearing ultramafics with shear zones (but no pillow lavas))

Sopaheluwakan, J. (1994)- Do Karangsambung (Central Java) and Bantimala (SW Sulawesi) form a single subduction process? a provocative view. Proc. 30th Anniversary Symposium, Res. Dev. Centre for Geotechnology (LIPI), Bandung, 2, p. 7-8.
(Cretaceous subduction complexes of Ciletuh (W Java), Karangsambung and Bayat (C Java), Meratus (S Kalimantan), and Bantimala and Barru (S Sulawesi) may belong to same orogenic belt. Bantimala and Barru complexes may form single and intact Mesozoic basement, linked to Meratus Range prior to Makassar Strait opening.)

Sopaheluwakan, J. (1995)- The deep crustal processes of West Arm of Sulawesi and the evolution of Makassar Strait: evidences from Bantimala, Meratus Mountain and Palu Koro Fault Zone. In: Y. Kumoro et al. (eds.) Proc. Seminar Sehari Geoteknologi dalam indistrialisasi, Hasil-hasil Penelitian Puslitbang Geoteknologi LIPI, p. 216-217. *(Abstract)*.
(West Arm of Sulawesi was eastern margin of Sunda craton, now separated from mainland of Kailmantan by thinned continental crust of Makassar Straits. East Sunda crust exposed near Palu (Toboli complex schists and slates). Sunda continent rimmed by Late Mesozoic subduction/accretionary complex, exposed as tectonic windows in Bantimala and Barru areas, extending N to Palu and to SW in Karangsambung. Late Cretaceous accretion ended subduction. Long-standing subduction had enriched mantle wedge under continental margin; its buoyancy led to continental crustal stretching and opening of Makassar Straits in E Tertiary)

Sopaheluwakan, J., A. Kadarusman, B. Priyadi & H. Utoyo (1995)- The nature of basement rocks in the Palu Region, Central Sulawesi. The newly found ecoglite and its regional implications. Proc. 6th Int. Congress Pacific Neogene Stratigraphy and IGCP 335, Neogene evolution of Pacific: biotic, climatic, oceanographic and tectonic development, Puspitek Serpong 1995, Kyoto, p. 77-83.

Sopaheluwakan, J., K. Miyazaki, I. Zulkarnain & K. Wakita (1993)- Early Cretaceous Eastern Sunda subduction metamorphism and its tectonic implication: record of Karangsambung and Bantimala eclogites. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, p.

Sopaheluwakan, J, K. Wakita & K. Myazaki (1993)- The origin of the Bantimala eclogite: a preliminary view. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 147-158.

Spencer, J.E. (2010)- Structural analysis of three extensional detachment faults with data from the 2000 Space-Shuttle Radar Topography Mission. GSA Today 20, 8, p. 4-10
(Large grooved surfaces on Space Shuttle Radar Topography images interpreted as exhumed footwalls of recently active extensional detachment faults. Examples include N Tokorondo Mts NW of Lake Poso and

Pompangeo Mts E of Lake Poso in C Sulawesi. Linear landforms interpreted by Hamilton, etc., as thrust imbrication with thrusts striking parallel to ridges here interpreted as stretching lineations of exhumed footwall of detachment fault. Length of lineaments suggests 60-70 km of extension above Pompangeo complex)

Spencer, J.E. (2011)- Gently dipping normal faults identified with Space Shuttle radar topography data in Central Sulawesi, Indonesia, and some implications for fault mechanics. Earth Planetary Sci. Letters 308, p. 267-276.
(Topography data from C Sulawesi show two corrugated, domal landforms, covering 100s to 1000s of km2, bounded to N by abrupt transition to hilly to mountainous topography. Interpreted as metamorphic core complexes. N-ward transition interpreted as traces of extensional detachment faults, dipping 4°- 18°)

Stelbrink, B., C. Albrecht, R. Hall & T. von Rintelen (2012)- The biogeography of Sulawesi revisited: is there evidence for a vicariant origin of taxa on Wallaceôs ôanomalous islandö? Evolution 66, p. 2252-2271.
(Divergence time estimates for split of Sulawesi lineages from sister groups postdate relevant tectonic vicariant events, suggesting island predominantly colonized by dispersal. Speciation on Sulawesi not before Miocene, consistent with geological evidence for more land on island from that time)

Stevens, C., R. McCaffrey, Y. Bock, J. Genrich, Endang, C. Subarya, S.S.O. Puntodewo, Fauzi & C. Vigny (1999)- Rapid rotations about a vertical axis in a collisional setting revealed by the Palu fault, Sulawesi, Indonesia. Geophysical Research Letters 26, 17, p. 2677-2680.
(online at: http://onlinelibrary.wiley.com/doi/10.1029/1999GL008344/epdf)
(GPS measurements indicate left-lateral Palu fault in C Sulawesi slips at ~38 mm/yr. Palu and nearby faults accomodate rapid CW rotation of nearly 4°/Ma of E Sulawesi relative to E Sunda. Rotation of E Sulawesi transfers E-W shortening between Pacific- Eurasian plates to N-S subduction of Celebes basin under Sulawesi)

Stolley, E. (1943)- Uber Mesozoische Belemniten-fuhrenden Schichten von Celebes. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 10, p. 172-175.
('On Mesozoic belemnite-bearing beds from Sulawesi'. Appendix in Brouwer (1934), describing material collected in 1929 from Central Sulawesi. Upper Jurassic (Oxfordian?) belemnites, mainly Belemnopsis gerardi group (= Tithonian B. galoi- B. stolleyi of Challinor, 1990), from limestone with chert at Bahoempombini on Gulf of Tolo))

Subagio & B.S. Widijono (2012)- Interpretasi pola anomali gaya berat regional kaitannya terhadap potensi sumber daya geologi di lengan selatan Sulawesi. J. Sumber Daya Geologi 22, 1, p. 49-64.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/106/98)
('Interpretation of the regional gravity anomaly patterns related to the potential geological resources in the South arm of Sulawesi'. Geologic cross sections interpretation W-directed fold-thrusting)

Subandrio, A.S. (2006)- Diagenetic alteration in Late Miocene carbonate of Tacipi area, South Celebes. Proc. 35th Ann. Conv. Indon. Assoc. Geol. (IAGI), Pekanbaru 2006, 10p.
(Tacipi reefal carbonate platform in Sengkang Basin, S Sulawesi mainy homogenous boundstones at top and packstones with local grainstones, and wackestones at bottom. Four reef facies identified: patch reef, barrier reef, fore reef and lagoon. Extensive freshwater leaching created biomoldic and vug pores)

Subandrio, A.S. & E. Usman (2011)- Diagenetic features of paleo lagoonal reef of Tacipi Area, South Celebes. Bull. Marine Geol. 26, 2, p. 95-104.
(online at: http://ejournal.mgi.esdm.go.id/index.php/bomg/article/view/37/38)
Late M Miocene- E Pliocene Tacipi Lst exposed in Tacipi area, Sengkang Basin, in lagoonal facies. Limestones mainly homogenous boundstones on top and packstones with local grainstones, and wackestones at base. Extensive freshwater leaching of fossil fragments and calcareous cement created moldic and vug porosity)

Subarsyah & Sahudin (2010)- Identifikasi sub-cekungan di cekungan Tomini bagian Selatan, berdasarkan penampang seismik 2D dan anomali gaya berat. J. Geologi Kelautan 8, 2, p. 95-104.
(online at: http://ejournal.mgi.esdm.go.id/index.php/jgk/article/view/190/180)

('Identification of sub-basins in the southern part of the Tomini basin, based on 2D seismic lines and gravity anomalies')

Subroto, E.A., B.Y. Afriatno & P. Sumintadireja (2007)- Prediction of the biogenic gas occurrences in Indonesia based on studies in East Java and Tomori (Central Sulawesi). Jurnal Teknologi Mineral (ITB), 14, 3, p. 115-124.
(online at: www.fttm.itb.ac.id/galeri/prediction.pdf)
(Biogenic gas dry (>99% methane), light carbon-isotopes (-61 to -67‰) and bacterial in origin. One of fields producing biogenic gas in E Java Basin. Sediments most likely producing biogenic gas from Plio-Pleistocene, characterized by high sedimentation rates, low geothermal gradients and high organic matter content)

Subroto, E.A., B. Priadi & B. Yulian (2004)- Study on gas samples collected from Tanjung Api and Tomori area, Sulawesi: abiogenic, biogenic, or thermogenic? Buletin Geologi (ITB) 36, 3, p. 117-124.
(Analysis of 3 gas samples from E Sulawesi. Two are from Donggi 1 well and are biogenic. Tanjung Api surface seep sample 53% hydrocarbon gas (98.2% methane, 1.5% ethane) and unusually heavy d13C isotopes. Origin is dubious: possibly abiogenic or post-mature or biodegraded)

Sudarmono (1999)- Tectonic and stratigraphic evolution of the Bone Basin, Indonesia: insights to the Sulawesi collision complex. Proc. 27th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 531-534.
(Bone Basin is subduction complex/ suture between Sundaland and Gondwana-derived micro-continent that evolved into submerged intra-montane basin. Paleogene- E Miocene forearc stage with W-dipping subduction complex. M-L Miocene W-ward convergence of microcontinents toward subduction complex changed deposition and basin configuration. M Miocene collision with accretionary complex, followed by collision with W Sulawesi. Collision led to E-ward rotation of SE Sulawesi, with rifting and submergence of S part of basin. Compression from collision caused major back-thrust systems of W-verging Kalosi and Majene fold belts in W Sulawesi. Colliding plates began to lock in Pliocene, and continued plate convergence was accommodated by strike-slip along Walanae, Palu Koro and other faults. Bone Basin submerged into intra-montane basin setting. Clastic sediments from surrounding mountains to E, N and W prograded S to depocenter. Strike-slip still active)

Sudijono (2005)- Biostratigraphy and the depositional environment of the Toraja Limestone at the Nanggala river section, Toraja, South Sulawesi. J. Sumber Daya Geologi 15, 1 (148), p. 57-74.
(80m thick Toraja Fm limestone member at Nanggala River, 10km NE of Rantepao. Lower part Middle Miocene (Ta3) age, with Alveolina and Nummulites javanus. Upper ~10m Late Eocene (Tb) with Pellatispira madaraszi and abundant Discocyclina/ Asterocyclina. Overlying volcanic sst-claystone facies (Lamasi Volcanics?) with abundant Late Eocene (P15) planktonic foraminifera (Hantkenina, Gr. cerroazulensis, Pseudohastigerina micra). Toraja Fm underlain unconformably be Cretaceous Latimojong Fm metasediments)

Sudijono (2005)- On the age of the Makale Formation of the Makale-Totumbang Road section, Tana Toraja, South Sulawesi. J. Sumber Daya Geologi 15, 2 (149), p. 3-23.
(Makale Fm ~500-1000m thick marl-limestone formation, well exposed between Makale and Totumbang, in NE part of South Arm. Affected by N-S trending, West directed thrusting. Sampled part mainly zone Tf1, possibly also Te5 near base and Tf2 at top. Presence of Austrotrillina howchini, Cycloclypeus (Katacycloclypeus) annulatus, Flosculinella bontangensis, Miogypsina antillea, etc. Age late E Miocene- early M Miocene)

Sudradjat, A. (1982)- Geologi Lembah Palu Sulawesi Tengah dengan menggunakan teknik penginderaan jauh. Masters Thesis Inst. Teknologi Bandung (ITB), p. *(Unpublished)*
('Geology of the Palu valley, Central Sulawesi, using remote sensing techniques'. Palu-Koro Valley 250 km long, is reflection of sinistral Palu-Koro strike slip fault, with active movement estimated at 2-3.5mm to 14-17 mm/ year, totaling 3.25 km. Palu-Koro fault separates two different terranes)

Sufriadin (2008)- Comparative petrography of Paleogene and Neogene coal deposits from Southern Arm Sulawesi. Proc. 37th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 672-681.
(Petrography of 18 coal samples from SW Sulawesi. Toraja Fm Paleogene coals higher vitrinite and liptinite than Neogene Fm coal, which have more inertinite and higher mineral matter (clay, iron sulfides, minor

carbonate). Vitrinite reflectance wide range in Paleogene (0.35- 0.86%). Neogene coals narrower range (0.44-0.60%; lignite to HV Bituminous A coal). Maturity of some coals affected by igneous intrusions)

Sufriadin, K. Angayana & A. Sudarsono (2002)- Karakteristik mineralogi batubara daerah Tondongkurah, Kabupaten Pangkep, Sulawesi Selatan. In: Proc. 31st Ann. Conv. Indon. Assoc. Geol. (IAGI), Surabaya, p. 185-192.
('Characteristics of coal mineralogy in the Tondongkurah area, Pangkep District, S Sulawesi')

Sufriadin, A. Idrus, S. Pramuwijoyo, I.W. Warmada & A. Imai (2011)- Study on mineralogy and chemistry of the saprolitic nickel ores from Soroaka, Sulawesi, Indonesia: implication for the lateritic ore processing. J. Southeast Asian Applied Geol. (UGM) 3, 1, p. 23-33.
(online at: https://journal.ugm.ac.id/jag/article/viewFile/7178/5618)

Sufriadin, A. Idrus, S. Pramuwijoyo, I.W. Warmada, A. Imai & Y. Yamauchi (2012)- Chromian spinel in peridotite of the Soroako ultramafic complex, Sulawesi, and its petrogenetic significance. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-M-03, 8p.
(Cr-spinels in Soroako peridotites of E Sulawesi (ultramafic complex with affinity to alpine-type peridotite, bounded in W by W-dipping thrust fault that separates it from Mesozoic limestone and red shales) occur as inclusions in olivine and orthopyroxene. Likely derived from upper mantle of suprasubduction zone or fore-arc setting and formed by high partial melting with low oxygen fugacity)

Sufriadin, A. Idrus, S. Pramuwijoyo, I.W. Warmada, I. Nur, A. Imai, A.M. Imran & Kaharuddin (2012)- Thermal and infrared studies of garnierite from the Soroako nickeliferous laterite deposit, Sulawesi, Indonesia. J. Geologi Indonesia 7, 2, p. 77-85.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/401)
(Mineralogical study of garnierite, a green material with high nickel content, from Soroako nickel laterite deposit of C Sulawesi)

Sufriadin, A. Jaya H.S. & A.M. Imran (2007)- Characteristic and the occurrence of coal deposits in Neogene Mandar Formation of West Sulawesi Province. Proc. Joint Conv. 32nd HAGI, 36th IAGI and 29th IATMI, Bali 2007, p. 387-394.
(Very thin layers (up to 15cm thick) and lenses of Late Miocene coals in Mandar Fm in Polaman Regency, westernmost Sulawesi. Mainly vitrinite (93.4-98.6 %), followed by inertinite (1.2- 3.0 %). Vitrinite refectance Rmax 0.56-0.60%, indicating high volatile bituminous coal rank)

Sufriadin, S. Ueno, A. Imai, A. Idrus, S. Pramumijoyo & I.W. Warmada (2010)- Characteristics and the occurrence of garnierite from the Soroako nickeliferous laterite deposits, Sulawesi. Proc. 39th Ann. Conv. Indon. Assoc. Geol. (IAGI), Lombok, p.

Suherman, D., M.A. Isnandar, S. Damuar, A. Sukutjo & S. Soemardan (2008)- Reservoir characteristics of Donggi Field, Central Sulawesi, using inversion and AVO analysis methods. Proc. 32nd Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA08-G-077, 12p.
(Donggi gas field in Matindok Block, C Sulawesi, reservoired in Miocene carbonate build-up, with satisfactory porosity at almost all intervals)

Sukadana, I.G., A. Harijoko & L.D. Setijadji (2015)- Tataan tektonika batuan gunung api di Komplek Adang, Kabupaten Mamuju, Provinsi Sulawesi Barat. Eksplorium 36, 1, p. 31-44.
(online at: http://jurnal.batan.go.id/index.php/eksplorium/article/view/2769/pdf)
('Tectonic setting of Adang Volcanic Complex in Mamuju Region, West Sulawesi Province '. Adang volcanic complex in W Sulawesi subdivided into seven complexes. K-Ar ages ~5.4 (sanidine)- 2.4 Ma (biotite). Basic-intermediate alkaline volcanics with high radioactivity. Volcanic center and several lava domes, composed of phonolite to dacite rock, with ultrapotassic affinity, formed in active continental margin and influenced by SW Sulawesi micro-continental crust (see also Shaban et al. 2016, suggesting rift volcanism))

Sukadana, I.G. & F.D. Indrastomo (2016)- Radioactive mineral occurrences on submarine alkaline volcanic rocks in West Tapalang, Mamuju, West Sulawesi, Indonesia. Proc. GEOSEA XIV and 45th Ann. Conv. Indon. Assoc. Geologists (IAGI) (GIC 2016), Bandung, p. 260-262.
(High concentrations of radiometric U and Th in Mamuju area, W Sulawesi, in ultrapotassic, leucite-bearing (Pliocene?) basaltic- intermediate Adang Volcanics. Three volcanic domes, probably submarine volcanism; submarine flanks of volcano dominated by erosive-depositional and mass-wasting features)

Sukamto, R. (1975)- Geological map of Indonesia, VIII, Ujung Pandang sheet, 1:1, 000, 000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Reprinted in 1989/1990. 1:1 million map covering most of Sulawesi and Banggai-Sula (not incl. North Arm))

Sukamto, R. (1975)- Perkembangan tektonik di Sulawesi dan daerah sekitarnya; suatu sintesis perkembangan berdasarkan tektonik lempeng. Geologi Indonesia (IAGI) 2, 1, p. 1-13.
('Tectonic development of Sulawesi and surrounding regions; a synthesis of the evolution of plate tectonics')

Sukamto, R. (1978)- The structure of Sulawesi in the light of plate tectonics. In: S. Wiryosujono & A. Sudradjat (eds.) Proc. Regional Conf. Geology and Mineral Resources of Southeast Asia (GEOSEA), Jakarta 1975, 2, Indon. Assoc. Geol. (IAGI), p. 121-142.
(Review of Sulawesi geology and interpretation in terms of plate tectonics. Glaucophane schists associated with ultrabasic rocks found along W part of the E Sulawesi province post-Cretaceous in age, but before intra-Miocene orogenetic phase. Glaucophane schist in SW Sulawesi older than mid-Cretaceous. M Miocene ntense folding, followed by overthrusting in E Arm and C part of W Sulawesi. E Sulawesi ophiolite emplacement pre-Triassic (?). In S Sulawesi E Tertiary W-dipping subduction zone which became inactive in M Miocene, then flipped to W side of Sulawesi, in Makassar Straits)

Sukamto, R. (1981)- Geological map of the Danau Tempe Sheet South Sulawesi,1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Probably same as Pangkajene- Watampone Quad map (Danau Tempe in N of this map sheet))

Sukamto, R. (1982)- The geology of the Pangkajene and Western part of Watampone Quadrangles, South Sulawesi, scale 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, p. 1-27.
(SW Sulawesi map between 4-5°S. With Bantimala basement complex of ultrabasics, metamorphics with NE-dipping foliation and 111 Ma K/Ar age and melange. Overlain by >2000m of Late Cretaceous Balangbaru Fm flysch. Paleocene volcanics, 3000m of Eocene- M Miocene Tonasa carbonates, E-M Miocene and Late Miocene- E Pliocene volcanoclastics. No sedimentation or volcanic activity after Late Pliocene)

Sukamto, R. (1986)- Tektonik Sulawesi Selatan dengan acuan khusus ciri-ciri himpunan batuan daerah Bantimala. Ph.D. Thesis, Inst. Teknologi Bandung (ITB), p. 1-364. *(Unpublished)*
('Tectonics of S Sulawesi, with special emphasis on rock associations in the Bantimala area'. Bantimala Melange includes tectonically mixed and imbricated Triassic- E Cretaceous rocks, including Kayubiti ultramafics, Bontorio metamorphics, Paremba sandstone (thought to have E Jurassic ammonites, but may be Late Cretaceous?; Grant-Mackie in Sukamto & Westermann 1992), Dengengdengeng basalt, schist breccia and Paring chert (Late Jurassic-E Cretaceous). Unconformably overlain by Late Cretaceous Balangbaru Fm forearc flysch, Alla Fm Paleocene arc volcanics, Eocene Malawa Fm terrestrial clastics, Late Eocene-E Miocene Tonasa Fm carbonates and M-Late Miocene arc volcanics)

Sukamto, R. & N. Ratman (2013)- Batuan Pratersier. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 13-36.
('Pretertiary rocks'. Chapter 2 in Geology of Sulawesi book. Triassic or older rocks in Sulawesi mainly metamorphics. In S Sulawesi E-M Jurassic Paremba Sst, and Late Jurassic- E Cretaceous 'Paring Chert'. Mid-Cretaceous Bantimala melange overlain by Upper Cretaceous volcanics and Balangbaru Fm flysch, etc.)

Sukamto, R. & N. Ratman (2013)- Batuan Paleogen. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 37-63.

('Paleogene rocks'. Chapter 3 in Geology of Sulawesi book. M-L Eocene-Oligocene volcanics and clastics and Late Eocene- Oligocene limestones, widespread in W and N Sulawesi)

Sukamto, R. & N. Ratman (2013)- Batuan Neogen. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 65-92.
('Neogene rocks'. Chapter 4 in Geology of Sulawesi book. Miocene- Pliocene volcanics, clastics and limestones, widespread in W and N Sulawesi)

Sukamto, R. & N. Ratman (2013)- Batuan Kuarter. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 93-112.
(' Quaternary rocks'. Chapter 5 in Geology of Sulawesi book)

Sukamto, R. & T.O. Simandjuntak (1983)- Tectonic relationship between the geologic provinces of Western Sulawesi, Eastern Sulawesi, and Banggai-Sula in the light of sedimentological aspects. Bull. Geol. Res. Dev. Centre (GRDC), Bandung, 7, p. 1-12. *(also in Proc. 4th Regional Conf. Geology and Mineral Resources of SE Asia, GEOSEA IV, Manila 1981)*
(Three tectonic domains in Sulawesi: (1) W Sulawesi Late Cretaceous- Eocene flysch-type forearc sediments derived from volcanic arcs; (2) E Sulawesi oceanic environment of ophiolites overlain by Jurassic and Cretaceous pelagic sediments; (3) Banggai-Sula microcontinent with basement of Carboniferous metamorphics and Permo-Triassic plutonic rocks, overlain by Triassic-Cretaceous continent-derived shelfal sediments)

Sukamto, R. & S. Supriatna (1982)- The geology of the Ujung Pandang, Benteng dan Sinjai Quadrangles, Sulawesi, scale 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, p. 1-20.
(SW Sulawesi map. Oldest rocks U Cretaceous flysch over older metamorphics. Thick, folded Eocene marine clastics with Pellatispira and Nummulites in NE corner of map (Salokalupang Fm). Eocene- M Miocene Tonasa Fm carbonate platform 1750m thick or more. Early Miocene and Plio-Pleistocene volcanic activity)

Sukapti, W.S. (2001)- Palynological study of the Burecing member, Walanae formation, South Sulawesi. Jurnal Teknologi Mineral (ITB) 8, 1, p. 29-36.

Sukarna, D. (1998)- Tertiary geology of the West Arm Sulawesi and Southeastern Kalimantan. J. Geologi Sumberdaya Mineral 8, 78, p. 2-8.
(Stratigraphic successions in SE Kalimantan and SW Sulawesi suggest these were united in Late Cretaceous- E Tertiary, located in fore-arc/ accretionary complex of W-dipping Cretaceous subduction system. M Eocene- early M Miocene extension led to separation of W arm of Sulawesi. In W arm Sulawesi M Eocene clastics deposition changed to carbonate platform in Late Eocene- M Miocene, followed by inversion movements in late M Miocene due to collision of Banggai-Sula microcontinent)

Sukarna, D., Sudarsono, S. Indarto, H. Utoyo, J. Sopaheluwakan, B. Priadi & S. Pramumijoyo (2000)- Peridotit bergarnet dan batuan malihan berderajat menengah daerah Winatu-Wana, Kulawi, Sulawesi Tengah. J. Geologi Sumberdaya Mineral 10, 111, p. 2-16.
('Garnet peridotites and intermediate metamorphic rocks in the Winatu-Wana area, Kulawi, C Sulawesi'. Palu area of NW Sulawesi with garnet-bearing peridotite (xenoliths in Palu granite), Toboli Complex epidote-amphibolite greenschist metamorphics (118.4 Ma) and U Cretaceous Latimojong Fm metasediments (parts of Sundaland margin basement) and acid-intermediate Plio-Pleistocene Palu granitoid. Palu Valley part of paleo-subduction complex from C Java to Bantimala-Barru))

Sukido, D. Sukarna & K. Sutisna (1993)- Geological map of the Pasangkayu Quadrangle, Sulawesi, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung.

Sukmono, S., A. Baasir, R. Abimanyu & N. Pudyo (2005)- Tiaka Field, Sulawesi: a recognized potential thrusted anticline play type in Sulawesi- Indonesia. In: Proc. 66th EAGE Conf. Exhib., Paris, B043, 4p.

(Extended Abstract. Tiaka Field in Miocene carbonate in thrust anticline in E Sulawesi. NE-SW structure with Tiaka primary thrust faults at E side and Kalomba thrust faults in W. Porosity of Tomori carbonate 5-23%, Minahaki carbonate 10-29% and Matindok clastics 18-39%)

Suliantara & T. Susantoro (2015)- Hydrocarbon potential of Tolo Bay Morowali Regency: qualitative analysis. Scientific Contr. Oil and Gas, Lemigas, Jakarta, 38, 1, p. 13-24.
(online at: www.lemigas.esdm.go.id/publikasi/read/scientific/1/)
(Tolo Bay E of East Sulawesi, with water depth of up to 3500m. Part of Banggai Basin and within Late Cretaceous- M Miocene collision zone between Banggai-Sula Microcontinent and E Sulawesi. Drift phase sediment at front of Banggai-Sula Microcontinent is potential source and reservoir rock. Hydrocarbon exploration very risky)

Sumadirdja, H., T. Suptandar, S. Harjoprawiro & D. Sudana (1973)- Reconnaissance geological map of the Palu Quadrangle, Sulawesi, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(NW Sulawesi map between 0-1°S, 'neck' between Makassar Straits and Tomini Bay, incl. onshore adjacent to Suramana Block. Oldest rocks are metamorphics, overlain by Eocene Tinombo Fm and Celebes Molasse. Probably different ages granitic intrusions)

Sumartono, Sabtanto J.S. & Y.R. Ramli (2001)- Review on systematic geochemical mapping in Sulawesi-Indonesia. In: Proc. CCOP 37th Ann. Sess. Bangkok 2000, 2, Techn. Repts., p. 43-59.
(Results of systematic geochemical mapping of SW and SE arms of Sulawesi. Three provinces distinguished: (1) West: magmatic arc granitoid intrusives associated with epithermal gold, porphyry copper-gold, volcanogenic massive sulphide, manganese and iron mineralisations (2) Central: metamorphic rocks and melange with rare metallic mineral occurrences and (3) East: ophiolite nappe with nickel, chrome and iron mineralisations)

Suminto (1987)- Sedimentologi endapan molasa di daerah Taweli, Kabupaten Donggala. In: Kolokium hasil pemetaan dan penelitian Puslitbang Geologi 1992/1993, Geol. Res. Development Center, Bandung, Spec. Publ. 15, p. 1-16.
('Sedimentology of molasse deposits in the area of Tawaeli, Donggala District'. In: Colloquium results of mapping and research GRDC 1992/1993)

Suminto (1994)- Sedimentologi Formasi Tinombo di daerah Kecamatan Tinombo, Kabupaten Donggala, Sulawesi Tengah. J. Geologi Sumberdaya Mineral 4, 38, p. 2-8.
('Sedimentology of the Tinombo Formation in the Kecamatan Tinombo, Donggala area, C Sulawesi'. On Tinombo Fm Late Eocene- E Oligocene marine clastics and limestones (with Nummulites), incl. 'flysch-facies', in Tomini Bay side of NW 'neck' of Sulawesi. ~3900m thick measured section NW of Tinombo, in steeply NW dipping sediments, with two diorite intrusion ~30 and 100m thick. Deepening-upward succession (formation also contains Pellatispira according to Harahap et al. 2003; JTvG))

Suminto (1995)- Lingkungan pengendapan fasies sedimen klastika Formasi Walanae di daerah Lappariaja, Bone, Sulawesi Selatan. J. Geologi Sumberdaya Mineral 5, 44, p. 8-11.
('Outline of clastic sediment facies of the Walanae Formation in the Lappariaja area, Bone, S Sulawesi'. Late Miocene- Pliocene Walanae Fm in E side of SW arm of Sulawesi. In Sungei Bengo section ~600m thick shallow marine clastics above limestone deposits and with terrestrial facies at top)

Sumosusastro, P.A., H.D. Tjia, A.R. Fortuin & J. Van der Plicht (1989)- Quaternary reef record of differential uplift at Luwuk, Sulawesi east arm, Indonesia. In: J.E. van Hinte et al. (eds.) Proc. Snellius II Symposium, Jakarta 1987, Netherlands J. Sea Research 24, 2-3, p. 277-285.
(Luwuk area near E tip of Sulawesi E arm dominated by raised coral reef terraces, elevations of >400m. Lower group of 6- 10 terraces up to 30-100m. Middle group up to 250m, 18°- 22° seaward sloping surface bordered by coast-parallel faults. Upper group of terraces >400m above sea level. U/Th ages of four reef terraces at 410m, 62m, 19m and 6.6m range from 350 ka- 67 ka. Uplift rate of highest terrace 184 cm/ka)

Sunartadirdja, M.A. (1959)- Beitrage zur Geomorphologie von Sudwest Sulawesi. Doct. Thesis Johann Wolfgang Goethe Universitat, Frankfurt, p. 1-98. *(Unpublished)*
('Contributions to the geomorphology of SW Sulawesi')

Sunartadirdja, M.A. & H. Lehmann (1960)- Der tropische Karst von Maros und Nord-Bone in SW-Celebes (Sulawesi). Zeitschrift Geomorphologie, p. 49-65.
('The tropical karst of Maros and North Bone in SW Sulawesi'. Two types of karst on SW Sulawesi, steep-walled and rounded. Suggested explanations include differences in limestone type (Nummulites limestone versus coral limestone), age, and tectonic history, but thickness of limestone above valley floor is controlling factor)

Sunarya, Y., K. Judawinata & D.Z. Herman (1980)- Penelitian stratigrafi dan geokimia bijih tipe Kuruoka di daerah Sangkaropi, Kecamatan Sescan, Tana Toraja, Sulawesi. Proc. 15th Ann. Meeting Indon. Assoc. Geol. (IAGI), Yogyakarta, p.
('Study of the stratigraphy and geochemistry of ore of Kuruoka type in the area of Sangkaropi, District Sescan, Tana Toraja, Sulawesi')

Sunarya, Y., T. Yoshida, K. Yudawinata, R. Rinawan, Hartono & B. Sutopo (2011)- The Sangkaropi massive sulphide deposit district, South Sulawesi: its implications for genesis and exploration for Kuroko-type deposits. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado, MGEI/IAGI, p. 230-242.

Sunarya, Y., T. Yoshida, K. Yudawinata, R. Rinawan, Hartono & B. Sutopo (2012)- The Sangkaropi massive sulphide deposit district, South Sulawesi: its implications for genesis and exploration for Kuroko-type deposits. Majalah Geologi Indonesia 27, 2, p. 109-119.
(online at: bgl.esdm.go.id/publication/index.php/dir/article_download/769)
(Same paper as Sunarya et al. 2011. Sangkaropi massive sulphide deposits in near Rantepao in C part of SW Sulawesi. Deposits closely associated with Miocene submarine volcanism of W Sulawesi arc ('Green Tuff Fm/ Old Andesite Fm, and composed of 'Kuroko-type' stratiform and stockwork ore bodies, mostly covered with thin layer of barite. Sulfide minerals include sphalerite, galena, chalcopyrite, pyrite, tetrahedrite, bornite, etc. Temperatures of fluid inclusions in sphalerite and quartz 160- 346°C)

Supandjono, J.B. & E. Haryono (1993)- Geology of the Banggai Sheet, Sulawesi-Maluku. Map at scale 1:250,000, with brochure, Geol. Res. Dev. Centre (GRDC), Bandung.
(Geology of Banggai Islands, SE of East Arm of Sulawesi. Oldest rock Carboniferous? metamorphics (schist, gneiss, amphibolite, quartzite). (Permian-?) Triassic Banggai Granite and co-magmatic Mangole Fm volcanics (rhyolite, ignimbrite, etc.) (K-Ar ages of Banggai Granite ~224-240 Ma; Harahap et al. 2003). Unconformably overlain by Late Jurassic Bobong Fm conglomerate, sandstones with coal and Buya Fms shales and quartz sandstones, Cretaceous Tanamu Fm marls, Eocene- Miocene Salodik Fm limestones-marls)

Supardi, N., A.M. Imran & M. Farida (2014)- Lingkungan pengendapan batuan karbonat Formasi Tonasa pada daerah Karama Kecamatan Bangkala Kabupaten Jeneponto, Provinsi Sulawesi Selatan. J. Penelitian Geosains (Hasanuddin University) 10, 2, p. 58-67.
(online at: http://repository.unhas.ac.id/bitstream/handle/123456789/15298/)
('Depositional environment of Tonasa carbonate rock formations in the Karama area, District of Bangkala, Jeneponto, South Sulawesi Province'. Outcrop of M Eocene Tonasa Fm marl dominated section with limestone interbeds at S-most tip of S Sulawesi deemed to be deposited in middle shelf environment)

Suparka (1977)- Hubungan antara khromit dan batuan ultramafik: dengan daerah Balambano-Karebe, Sulawesi Selatan; sebagai suatu tinjauan. J. Riset Geologi Pertambangan (LIPI) 1, 1, p. 17-33.
(online at: http://pustaka.geotek.lipi.go.id/wp-content/uploads/2016/02/Riset-Vol.1-No.1-22-.pdf)
('The relationship between chromite and ultramafic rocks: with Balambano-Karebbe area, S Sulawesi; a review')

Suratman (2000)- Geologi dan endapan Ni-laterit Soroako Sulawesi Selatan. Proc. 29th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 37-44.

('Geology and Ni-laterite deposits at Saroako, S Sulawesi'. Review of nickel laterites with saprolite ore in weathering zone of East Sulawesi ophiolite, in E and W Soroakao blocks)

Suratman (2000)- Geology and nickel-laterite weathering deposit in the southeast arm of Sulawesi. Berita Sedimentologi 14, p. 12-15.
(Nickel laterite in E Sulawesi derived from chemical weathering of ultrabasic rocks)

Surjono, S.S. & P.N. Pamurty (2011)- Dynamic sedimentation of Mapi Formation in Majene area, West Sulawesi. Proc. Joint. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-169, 10p.
(Description of depositional environments in 3 traverses of M Miocene- Pliocene Mapi Fm (N16-N20) in SW Sulawesi controlled by tectonics of Sulawesi and volcanism. Overall shallowing-upward succession. Volcanism generated by subduction in both S and N arms of Sulawesi)

Surmont, J., C. Laj, C. Kissel, H. Rangin, H. Bellon & B. Priadi (1994)- New paleomagnetic constraints on the Cenozoic tectonic evolution of the North Arm of Sulawesi. Earth Planetary Sci. Letters 121, p. 629-638.
(Paleomagnetism of Sulawesi N arm between 120- 122°E suggests post-Miocene CW rotation of ~20-25° of W part, probably during N-ward drift of N Arm along Palu-Matano sinistral transcurrent fault. Oligocene- E Miocene CW rotation of same amplitude documented by Sasajima et al. (1979). Between 122.5- 124°E CW and CCW rotations from ±6° to 85°, likely corresponding to microblock rotation and consistent with complex fault system of Gorontalo/ Kotamobagu shear zones)

Surono (1989)- Molasa di lengan Timur Sulawesi. Bull. Geol. Res. Dev. Centre (GRDC), Bandung 13, p. 39-45.
('The molasse in the East Arm of Sulawesi'. Widespread molasse deposits in E Sulawesi of M Miocene-Pliocene age, rich in ophiolite fragments. Also as 1981 IAGI Conference paper)

Surono (1989)- Hubungan stratigrafi antara Kepulauan Banggai-Sula dan lengan Timur Sulawesi. Bull. Geol. Res. Dev. Centre (GRDC), Bandung 13, p. 46-60.
('Stratigraphic relationship between the Banggai-Sula Islands and Sulawesi's East arm'. Differerent types of basement and overlying rocks, but both overlapped by similar Late Miocene-Pliocene Celebes Molasse)

Surono (1994)- A sedimentologic investigation of the Southeast Arm of Sulawesi with special reference to the Kendari area. Ph.D. Thesis, University of Wollongong, Australia, p. 1-211 + Appendices, figures, tables.
(online at: http://ro.uow.edu.au/theses/1393/)
(Collision complex in SE Arm of Sulawesi consists of SE Sulawesi continental terrane, overthrust by ophiolite E Sulawesi Ophiolite Belt in Oligocene- M Miocene and overlain by synorogenic E Miocene Sulawesi Molasse. SE Sulawesi continental terrane consists of metamorphic basement unconformably overlain by clastics-dominated Late Triassic Meluhu Fm (basal part fluvial, grading upward into deltaic and marine facies) and carbonate-dominated Eocene- E Oligocene Tampakura Fm (incl. oolites). Paleolatitude of basin at time of Triassic Meluhu Fm deposition ~20°S. Basal Sulawesi Molasse unconformably over Paleogene, with Matarape conglomerate with ophiolite clasts, overlain by E Miocene limestone with Te5 larger forams (Miogypsinoides, Spiroclypeus, Lepidocyclina) (Sample 6A; identified by Chaproniere 1993) and NN3 nannofora)

Surono (1994)- Stratigraphy of the Southeast Sulawesi continental terrane, eastern Indonesia. J. Geologi Sumberdaya Mineral 31, 4, p. 4-11. *(also reprinted in Surono 2008)*
(SE Arm of Sulawesi continental terrane composed of Mesozoic metamorphic rocks, intruded by granites. Unconformably overlain by Late Triassic Meluhu Fm fluvial clastics (Carnian- Norian?; with Falcisporites), and U Jurassic- Lw Cretaceous marine deposits of Tetambahu Fm (with Tithonian- Hauterivian radiolaria incl. Archaeodictyomitra and Thanarla). Unconformably overlain by Paleogene Tampakura Fm oolitic- dolomitic carbonates with Nummulites. SE Sulawesi and Bangai-Sula block stratigraphy similar to central PNG. Paleomagnetic analysis suggest SE Arm part of continental terrane, deposited 20°S of present location in Late Triassic, at N Australian (PNG) continental margin. Emplacement of poorly-dated E Sulawesi Ophiolite complex over SE Sulawesi continental block margin in latest Oligocene (= collision of SE Sulawesi- Buton?).

Post-collisional Sulawesi Molasse unconformable over molasse and older formations, with Pandua Lst interbeds with E Miocene larger foraminifera)

Surono (1995)- A petrographic study of an oolitic limestone succession of the Eocene-Oligocene Tampakura Formation, South-East Sulawesi, Indonesia. J. Geologi Sumberdaya Mineral 5, 50, p. 2-11. *(also reprinted in Surono 2008, p. 103-118)*
(?Eocene Tampakura Fm limestone unconformable between underlying Late Triassic Meluhu Fm and overlying Mio-Pliocene Sulawesi Molasse. Oolites dominant, minor lime mudstone locally rich in globigerinid planktonic foraminifera, some dolomite)

Surono (1995)- Sedimentology of the Tolitoli Conglomerate Member of the Langkowala Formation, Southeast Sulawesi, Indonesia. J. Geologi Sumberdaya Mineral 5, 46, p. 1-7.
(also reprinted in Surono 2008, p. 161-173. E-M Miocene Tolitoli conglomerates of SE Sulawesi unconformable on Triassic clastics and Paleogene limestone. Deposited in braided river/ alluvial fan environment, with general paleocurrent direction to West. Conglomerate clast mainly derived from Late Triassic Meluhu Fm sandstones, with minor contribution from Tampakura Fm. No fossils, but age derived from position unconformably over Oligocene and under Late Miocene-Pliocene Boepinang Fm)

Surono (1996)- A regional stratigraphic review of the South East Arm of Sulawesi, Indonesia. Proc. 25th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 169-189.

Surono (1997)- A preliminary study on the origin of dolomite in the Tampakura Formation, Southeast Sulawesi, Eastern Indonesia. Bull. Geol. Res. Dev. Center, Bandung 21, p. 151-161.
(Dolomite in Eocene- E Oligocene oolitic Tampakura Fm in SE Sulawesi formed in intertidal- supratidal zones)

Surono (1997)- A petrographic study on sandstones from the Meluhu Formation, Southeast Sulawesi, Eastern Indonesia. Bull. Geol. Soc. Malaysia 40, p. 215-231.
(online at: www.gsm.org.my/products/702001-100878-PDF.pdf)
(Late Triassic Meluhu Fm sandstone 39-95% quartz (av. 68%). Polycrystalline quartz av. 12.7%. Undulose extinction common in monocrystalline quartz. Source area mainly metamorphic rocks, probably with thin cover of sedimentary and volcanic rocks. Thick cyclic channel deposits S of Tinobu with coarse clasts, probably deposited close to source area of high relief, forming alluvial fans along basin margin)

Surono (1997)- A provenance study of sandstones from the Meluhu Formation, Southeast Sulawesi, Eastern Indonesia. J. Geologi Sumberdaya Mineral 7, 73, p. 2-16.
(Same as Surono (1997) above. Also reprinted in Surono (2008). Late Triassic Meluhu Fm sandstones dominated by quartz (mainly monocrystalline, also common polycrystalline) and lithics (sedimentary and metamorphic; very minor volcanics). Most likely source low-grade metasediments at SW margin of block)

Surono (1997)- Geology and origin of the Southeast Sulawesi continental terrane, Indonesia. Proc. 26th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 961-974.
(On SE Sulawesi Continental Terrane(s) in SE Arm of Sulawesi, overridden by E Sulawesi Ophiolite. Oldest unit pre-Carboniferous low-grade metamorphics, intruded by Permo-Triassic aplite and associated volcanics. Unconformably overlain by Late Triassic Meluhu Fm Triassic clastics, unconformably overlain by Eocene Tamborasi and 400m of Tampakura Fm Eocene-Early Oligocene carbonates. Similarities in stratigraphy suggest same origin as Banggai-Sula terrane; also similar to Kubor Anticline, PNG. Before collision with E Sulawesi Ophiolite Belt in latest Oligocene (E Miocene age of basal Sulawesi molasse in SE Sulawesi), joined with Banggai-Sula Terrane. Three pre-collision tectonic events: Permian-Late Triassic pre-rift (pre-breakup), Jurassic breakup and Late Jurassic-Oligocene rift-drift)

Surono (1998)- A sedimentological study of the oolitic limestone succession of the Paleogene Tampakura Formation in Southeastern Sulawesi, Indonesia. In: J.L. Rau (ed.) Proc. 33rd Sess. Co-ord. Comm. Coastal Offshore Geoscience Programmes E and SE Asia (CCOP), Shanghai 1996, 2, p. 10-41. *(also in Surono 2008, p. 133-160)*

(Late Eocene- E Oligocene Tampakura Fm consists of oolite, lime mudstone, wackestone, packstone and framestone, and widely distributed in N part of SE Sulawesi. Underlain by U Triassic Meluhu Fm clastics and unconformably overlain by Miocene Sulawesi Molasse. Tampakura Fm deposited in tidal environment. Basin configuration was rimmed shelf)

Surono (1998)- Geology and origin of the Southeast Sulawesi continental terrane, Indonesia. Media Teknik (UGM) 20, 3, p. 33-42.
(Same paper as Surono 1997)

Surono (1999)- An organic petrology study on coal and carbonaceous rocks from the Triassic Meluhu Formation, Southeast arm of Sulawesi, Eastern Indonesia. Majalah Geologi Indonesia 15, 1-2, p. *(also reprinted in Surono 2008)*
(Two coal seams, 0.7 and 0.9m thick, in basal part of Triassic Meluhu Fm of SE Sulawesi. Vitrinite is dominant maceral. Average vitrinite reflectance Rv 0.69%)

Surono (2008)- Geology of the Southeast arm of Sulawesi. Geological Survey, Bandung, Spec. Publ. 35, p. 1-213.
(Reprint collection of 12 previously published papers on SE Sulawesi)

Surono (2011)- Tektono-stratigrafi bagian Timur Sulawesi. Proc. Joint. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-054, 5p.
('Tectonostratigraphy of East Sulawesi'. Brief review; no figures)

Surono M. (2012)- Tectonostratigraphy of the eastern part of Sulawesi, Indonesia, in relation terrane origins. J. Sumber Daya Geologi 22, 4, p. 199-207.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/119/113)
(E Sulawesi mainly formed by two terranes, both unconformably covered by post-collisional Sulawesi molasse: (1) ophiolite complex and E Cretaceous Matano Fm pelagic sediment cover and (2) Banggai Sula and SE Sulawesi continental terranes (metamorphic basement, Late Triassic- Paleogene sediment cover), both overlain by E Miocene- Pliocene Sulawesi Molasse. Ophiolite and pelagic cover thrusted over continental terranes in Oligocene (~33-26 Ma). Ophiolite K-Ar ages 93.4- 26 Ma (all too young?; JTvG), formed in mid-ocean ridge within Pacific Plate. Continental terranes originated from N margin of Australian Continent)

Surono (2013)- Geologi lengan Tenggara Sulawesi. Geological Survey (Badan Geologi), Bandung, Spec. Publ., p. 1-169.
(Review of the geology of SE Arm of Sulawesi)

Surono (2013)- Kepingan Benua. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 153-211.
('Continental fragments'. Chapter 8 in Geology of Sulawesi book. Brief review of continental blocks of Sulawesi: Banggai-Sula, Siombok, Tambayoli, Bungku, Mattarombeo, SE Sulawesi, Buton and Tukangbesi)

Surono (2013)- Batuan sedimen Neogen dan Kuarter. In: Surono & U. Hartono (eds.) Geologi Sulawesi, LIPI Press, Bandung, p. 225-257.
('Neogene and Quaternary sedimentary rocks'. Chapter 10 in Geologi Sulawesi book. E Sulawesi Molasse members suggest E Miocene- Pliocene age range)

Surono & S. Bachri (2002)- Stratigraphy, sedimentation and palaeogeographic significance of the Triassic Meluhu Formation, Southeast arm of Sulawesi, Eastern Indonesia. J. Asian Earth Sci. 20, p. 177-192.
(SE Sulawesi M-L Triassic Meluhu Fm fluvio-deltaic clastics unconformable on metamorphic basement and unconformably overlain by Paleogene carbonates. Source area rugged and composed of metamorphic rocks, overlain by sandstone and volcanic rocks. Meluhu Fm deposited in humid tropical region. Paleomagnetic study shows~25° clockwise rotation and paleolatitude of 20° S. Meluhu Fm early rift stage sediment on NW

Australian continent. Continental fragment, including Meluhu Graben, separated from Australia to become allochthonous terrane before colliding with Sulawesi)

Surono, M. Endharto, A. Azis & D.M. Ali (1992)- Sedimentology of the Meluhu Formation, Southeast Arm of Sulawesi, Indonesia. Proc. 21st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2, p. 833-852.
(Late Triassic- Jurassic Meluhu Fm widespread in SE Sulawesi. Underlain by metamorphic basement, overlain by Laonto Fm. Three members: (1) Lower part Toronipa Mb sand-rich fluvial deposits (max. 800m thick); (2) middle part Watuteluboto Mb tide-influenced deltaic deposits (max. thickness 200m); (3) upper part Tuetue Mb estuarine- shallow marine clastics with thin(Juassic?) limestone beds near top (110m, thickening to NW). With Halobia and Daonella molluscs. Paleocurrents generally to ESE. Provenance from volcanic, metamorphic and sedimentary rocks)

Surono & U. Hartono (eds.) (2013)- Geologi Sulawesi, 2nd Ed.. LIPI Press, Bandung, p. 1-348.
('The geology of Sulawesi'. Comprehensive overview in Indonesian of geology and stratigraphy of Sulawesi by Geological Survey personnel. 13 chapters)

Surono, T.O. Simandjuntak & E. Rusmana (1997)- Collision mechanism between the oceanic and continental terranes in the Southeast private arm of Sulawesi, Eastern Indonesia. Bull. Geol. Res. Dev. Center, Bandung, 21, p. 109-125. *(reprinted in Surono 2008, p. 193-213)*
(Banggai-Sula terrane originated from PNG and collided with W Sulawesi volcanic arc in Oligocene. Collision caused anticlockwise rotation of S arm and clockwise rotation of N arm. SE Sulawesi-Buton also allochthonous continental terrane now juxtaposed with E Sulawesi Ophiolite Belt. In SE Sulawesi highly deformed Eocene- E Oligocene carbonates unconformably overlain by gently deformed E Miocene Celebes molasse, suggesting major deformation near Late Oligocene)

Surono, T.O. Simandjuntak, R.L. Situmorang & Sukido (1994)- Geology of the Batui Quadrangle, Sulawesi. Quad 2114, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 38p.
(E Sulawesi map between 1 and 2°S, NW side of Tolo Bay, mapped in 1981. Two terranes: (1 Banggai-Sula Platform with Carboniferous metamorphics and Permo-Triassic granites and (2) E Sulawesi ophiolite belt, composed of E Cretaceous ultrabasics overlain by U Cretaceous Matano Fm deep marine pelagic cherts and calcilutites. Terranes collided in M Miocene, creating Late Miocene- Pliocene molasse. Quaternary uplift. Oil seeps in several places along Batui thrust, the collision zone between ES ophiolite and BS Platform. Miocene Kolokolo melange near Batui Thrust))

Surono & D. Sukarna (1993)- Geology of the Sanana Sheet, Maluku, scale 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Geology of eastern Banggai-Sula Islands, SE of E Sulawesi (E Taliabu, Mangole, Sanana). Oldest formation ?Carboniferous metamorphics and ?Permo-Triassic Banggai granite intrusives with >400m thick co-magmatic Mangole Fm volcanic breccias and tuffs. Small occurrence of ~50-100m thick Triassic? Nofanini Fm coral-mollusc limestone off S coast of Mangole. Unconformably overlain by thick M-L Jurassic Bobong and Buya Fms with common ammonites, and Late Cretaceous Tanamu Fm Globotruncana marl-limestone)

Surono & D. Sukarna (1995)- The Eastern Sulawesi Ophiolite Belt, Eastern Indonesia. A review of its origin with special reference to the Kendari area. J. Geologi Sumberdaya Mineral 5, 46, p. 8-16.
(Also in Ofiolit di Sulawesi, Halmahera, dan Kalimantan, Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 28 (2001), p. 1-10 and reprinted in Surono 2008). Mafic-ultramafic rocks widespread in SE arm of Sulawesi. Peridotite dunite, etc. with gabbro and basalt characterize mid-oceanic ridge type ophiolite complex. Ophiolite probably was thin widespread layer covering continental terrane. Late Cretaceous- Late Oligocene age (does not fit with reported E Cretaceous radiolaria in overlying sediments?; JTvG). Paleomagnetic results suggest formation at 17-24°S in Late Cretaceous and rotated CW about 60° (Mubroto). Ophiolite debris abundant in M Miocene and younger Sulawesi Molasse. SE arm ophiolite probably thrust over SE Sulawesi continental terrane in M-Late Oligocene, while in E arm it occurred in E Miocene)

Surono & D. Sukarna (1996)- Sedimentology of the Sulawesi molasse in relation to Neogene tectonics, Kendari area, Eastern Indonesia. Proc. 6th Int. Congress Pacific Neogene Stratigraphy, IGCP355, Serpong 1995, p. 57-72.
(Reprinted in Surono 2008, p. 175-192)
(Miocene- Pliocene Sulawesi Molasse post-collisional deposits, with E Miocene forams (Spiroclypeus) and nannofossils (NN3) in limestones in upper part of basal Matarape Fm conglomerates. Ophiolite-derived fragments dominant in lower molasse, decreasing in size upsection, and more detritus from SE Sulawesi continental terrane, suggesting ophiolite formed thin cover over SE Sulawesi terrane)

Surono & H.A. Tang (2009)- Batuan pembawa emas primer dari endapan emas sekunder di Kabupaten Bombana, Sulawesi Tenggara berdasarkan interpretasi inderaan jauh. Proc. 38th Ann. Conv. Indon. Assoc. Geol. (IAGI), Semarang 2009, 11p.
(SE Sulawesi secondary gold deposits in streams and in Miocene Langkowala Fm sandstones. Rivers draining from Mendoke and Rumbia Mts, formed by metamorphic and meta sediments, but igneous intrusion identified in W end of Mendoke Mountains)

Surono & H.A. Tang (2009)- Kemungkinan keterdapatan endapan emas primer di Kabupaten Bombana, Sulawesi Tenggara. J. Teknologi Mineral Batubara 5, 4, p. 163-170.
('Possible occurrences of primary gold deposits in Bombana District, SE Sulawesi')

Sutadiwiria, Y., Yeftamikha, A.H. Hamdani, Y. Andriana, I. Haryanto & E. Sunardi (2017)- Origin of oil seeps in West Sulawesi onshore, Indonesia: geochemical constraints and paleogeographic reconstruction of the source facies. J. Geol. Sciences Applied Geology (UNPAD) 2, 1, p. 10-15.
(online at: http://jurnal.unpad.ac.id/gsag/article/view/13420/7373)
(Numerous oil- gas seeps onshore W and S Sulawesi, but no discoveries so far in area. Biomarkers indicate coals and/or coaly shales as source, with some marine input in Karama region to S. Best candidate for source of oil seeps is Eocene Toraja or Kalumpang Fm. Maturities at generation equivalent with Ro 0.8-1.0 %)

Sutjipto, M. (1999)- The geology and development of the Limpoga epithermal sediment-hosted deposit, Ratatotok Districk, North Sulawesi. Proc. 28th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 2, p. 235-252.
(Limpoga gold deposit sediment-hosted epithermal deposit 70km S of Manado, 3km E of Mesel Mine)

Suyono & Kusnama (2010)- Stratigraphy and tectonics of the Sengkang Basin, South Sulawesi. J. Geologi Indonesia 5, 1, p. 1-11.
(online at: www.bgl.esdm.go.id/dmdocuments/jgi20100101.pdf)
(Neogene stratigraphy and tectonic evolution of Sengkang Basin, onshore SW Sulawesi. Formed by NNW-SSE trending Walanae Fault system, followed by formation of Pliocene-Pleistocene foreland basin with W-prograding syn-orogenic Walanae Fm deposits. Fault system separated E and W parts of S Sulawesi and influenced Late Miocene- Quaternary deposition. Lower part of unit with small Late Miocene Tacipi Mb carbonate reefs in E Sengkang Basin. Lamasi Ophiolite in W Sulawesi and analogous E Sulawesi ophiolite separated by deep Bone Bay, suggesting orogenic collapse may have occurred here)

Swamidharma, Y.C.A. (2011)- Nickel laterite contents and grades in Sulawesi. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado, Indonesian Soc. Econ. Geol. (MGEI)/IAGI, p. 289-298.

Swift, L.R. & M. Alwan (1990)- The discovery of gold-silver mineralization at Binebase, Sangihe Island, Indonesia. Proc. Pacific Rim Congress 90, 2, Australasian Inst. of Mining and Metallurgy (AusIMM), Parkville, p. 533-539.

Syaefuddin (1997)- Preliminary study of the geology and tectonics of the Flores Sea islands, South Sulawesi. Proc. 26th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 291-313.

Syafri, I. (2000)- Etude petrologique et geochimique des peridotites a grenat, eclogites et roches associees des parties Ouest et Centrale de lõile de Sulawesi, Indonesie. Ph.D. Thesis Universite de Paris 6, p. 1-455.

(Unpublished) ('Petrological and geochemical study of the garnet peridotites, eclogites and associated rocks in W and C parts of Sulawesi island'. Study of high-grade metamorphic rocks in Bantimala tectonic complex (E Cretaceous eclogites derived from Tethys ocean crust basalts in W-dipping subduction zone), Palu fault zone (granulites derived from arc volcanics; garnet peridotites exhumed from ~70km depth) and Wassupang melange (eclogites from oceanic gabbro subducted under W Sulawesi in Late Eocene- Early Oligocene)

Syafri, I. (2002)- The eclogites and associated rocks from Wassupang melange in the eastern part of the Central Sulawesi metamorphic belt, Indonesia: P-T history and geodynamic implications. Proc. 31st Ann. Conv. Indon. Assoc. Geol. (IAGI), Surabaya, 19p.

Syafri, I. (2004)- Komposisi kimia eklogit dan batuan bergarnet- berglaukofan dari kompleks Bantimala Sulawesi Selatan, Indonesia serta kemungkinan jenis- jenis batuan asalnya. Bull. Scientific Contr. (UNPAD) 2, 2, p. 50-60.
('The chemical composition of eclogite and garnet-glaucophane rocks of the Bantimala complex, S Sulawesi, Indonesia and their possible origin')

Syafri, I. (2014)- Ekoglit terubah dan batuan asosiasinya sebagai indikator subduksi purba selama Eosen Atas hingga Oligosen Bawah di sabuk metamorfik Sulawesi Tengah Bagian Timur- Indonesia. Bull. Scientific Contr. (UNPAD) 12, 3, p. 131-146.
(online at: http://jurnal.unpad.ac.id/bsc/article/view/8374/3890)
('Eclogite and associated rocks as an indicator of ancient subduction during the Upper Eocene to Lower Oligocene in the east part of the C Sulawesi metamorphic belt, East Indonesia'. Eclogites in several areas in Sulawesi: Bantimala, Palu valley, Bongka River and in Wasuponda melange complex. Wasuponda eclogites different from Bantimala or Palu and formed at different times. P-T conditions of ~21 kbar and 500°C of both Wasuponda and Bantimala eclogites indicate formation at 61-80 km depth. Eclogite from Wasuponda Melange underwent retrograde metamorphism to amphibolite/greenschist and originated from gabbroic oceanic crust. Bantimala eclogite formed during Cretaceous subduction, collision and microcontinent accretion; Wasuponda eclogite in NE dipping melange, formed during Eocene-Oligocene (intra-oceanic?) subduction and obduction)

Syafri, I., J.R. Kienast & J. Girardeau (1995)- New data on high-pressure rocks from Barru Complex, South-West Sulawesi, Indonesia: P-T history and geodynamic implications. Proc. 8th Regional Conf. Geology Mineral Energy resources of SE Asia (GEOSEA), Manila 1995, p.

Syafri, I., J.R. Kienast & R. Soeria-Atmadja (2005)- High-pressure granulite from Palu Valley, Central Sulawesi, Indonesia; P-T history and geodynamic implications. Majalah Geologi Indonesia 20, 2, Spec. Ed., p. 68-79.
(P-T conditions calculated from HP granulite at Palu suggest formed at ~65 km in upper mantle, while normally these form at 35-40 km depth. It may be derived from foreign (Australian?) material carried into subduction zone mantle wedge below continental crust of Sulawesi)

Syafrizal, K. Anggayana & D. Guntoro (2011)- Karakterisasi mineralogi endapan nikel laterit di daerah Tinanggea, Kabupaten Konawe Selatan, Sulawesi Tenggara. J. Teknologi Mineral 18, 4, p. 211-220.
('Characterization of mineralogy of a lateritic nickel deposit in the Tinanggea area, South Konawe Regency, Southeast Sulawesi'. Lateritic nickel from advanced weathering of Ni-silicate bearing ultramafic rock)

Syafrizal, T.A. Rivai, K. Yonezu, D. Kusumanto, K. Watanabe & A.N.H. Hede (2017)- Characteristics of a low-sulfidation epithermal deposit in the River Reef Zone and the Watuputih Hill, the Poboya gold prospect, Central Sulawesi, Indonesia: host rocks and hydrothermal alteration. Minerals 7, 124, p. 1-16.
(online at: www.mdpi.com/2075-163X/7/7/124/pdf-vor)
(Gold mineralization hosted in granite, biotite gneiss and biotite schist of Palu Metamorphic Complex)

Szentpeteri, K., G. Albert & Z. Ungvari (2015)- Plate tectonic and stress-field modelling of the North Arm of Sulawesi (NAoS), Indonesia, to better understand the distribution of mineral deposit styles. In: Proc. SEG 2015 Conf. World class ore deposits: discovery to recovery, Hobart. *(Abstract and Poster)*

(N Arm of Sulawesi with 4 active gold mines. Three oceanic plates subducting under N Arm. Molluca and Celebes plates dip opposite to each other, Sangihe plate at right angles to other two. Variations in subducting plates marked by breaks in morphology and earthquake intensity, corresponding to arc-transform structures in upper plate. N Arm and Tomini and Gorontalo Bays in extensional regime (incl. uplifts of metamorphic core complexes), possibly tied to slab detachment and/or rollback of Sulawesi Trench. Young (5-1 Ma) Au-Cu mineralized districts in N Arm related to extensional features and intersections with transtensional arc normal faults (which may extend as tear faults on lower, opening window to mantle))

Tan Sin Hok (1935)- Over ouderdomsbepalingen op grond van radiolarien van Oost-Celebes. De Ingenieur in Nederlandsch-Indie 1935, IV, 4, p. 31-33.
('On age determinations based on radiolarians of E Sulawesi'. The validity of Late Jurassic- Early Cretaceous age determinations of 12 E Sulawesi radiolarian-bearing samples by Hojnos in Von Loczy (1934) is questioned, but no suggestions for alternative ages are proposed (N.B. Hojnos' conclusions probably mostly correct; all species recorded are Late Jurassic- E Cretaceous forms (O'Dogherty 2009); Tan's skepticism derives from his not recognizing the E Cretaceous age of his radiolarian-rich samples from Roti (Tan 1927); JTvG))

Tatsumi, Y., M. Murasaki, E.M. Arsadi & S. Nohda (1991)- Geochemistry of Quaternary lavas from NE Sulawesi: transfer of subduction components into the mantle wedge. Contrib. Mineralogy Petrology 107, p. 137-149.
(Geochemistry of Quaternary Sangihe arc volcanics. Formed in intra-oceanic tectonic setting, not associated with backarc basin. All incompatible elements, except Pb, increase away from volcanic front)

Tatsumi, Y., M. Murasaki, E.M. Arsadi & S. Nohda (1991)- Geochemistry of Quaternary lavas from NE Sulawesi: transfer of subduction components into the mantle wedge. In: Proc. Silver Jubilee Symposium on Dynamics of subduction and its products, Yogyakarta 1991, LIPI, p. 144-170.
(same paper as above)

õT Hoen, C.W.A.P. & K.G.J. Ziegler (1917)- Verslag over de resultaten van geologisch-mijnbouwkundige verkenningen en opsporingen in Zuidwest Celebes. Jaarboek Mijnwezen Nederlandsch-Indie 44 (1915), Verhandelingen 2, p. 235-363.
('Results of geological-mining reconnaissance and investigations in SW Celebes'. First extensive SW Sulawesi survey, with focus on Eocene coal occurrences. Brief discussion of gas seeps; no oil seeps encountered. With 1:200,000 scale geologic map and 1:20,000 maps of coal fields Tondong Koerah, Podo, Batoekoe and Malawa)

Tjia, H.D. (1973)- Palu-Koro fault zone, Sulawesi. Berita Direktorat Geologi, Geosurvey Newsl. 5, p. 1-3.
(Suggests 750km of sinistral displacement along NNW trending Palu-Koro fault zone of C Sulawesi (subsequent authors estimates closer to 200-250km; JTvG))

Tjia, H.D. & P. Sumosusastro (1986)- Radiocarbon age of a 410-metre reef flat at Luwuk, Sulawesi. Warta Geologi (Newsl. Geol. Soc. Malaysia) 12, 3, p. 127-129.
(online at: https://gsmpubl.files.wordpress.com/2014/09/ngsm1986003.pdf)
(Quaternary raised reef terraces at Luwuk Peninsula, E Sulawesi. Highest terrace at 410m asl, with radiocarbon age of Luwuk-6 sample of 35,000± 400 yr B.P. (at which time sea level was ~50m below present-day datum). More detail see Sumosusastro et al. 1989)

Tjia, H.D. & T.H. Zakaria (1974)- Palu-Koro strike slip fault zone, Central Sulawesi. Sains Malaysiana (Univ. Kebangsaan Malaysia), 3, p. 67-88.

Trail, D.S., T.U. John, M.C. Bird, R.C. Obial, B.A. Pertzel, D.B. Abiog & S. Parwoto (1974)- The general geological survey of Block 2, Sulawesi Utara, Indonesia. PT Tropic Endeavour Indonesia, Report, 68p.
(Unpublished, but apparently widely circulated report that forms basis of much of knowledge of N Sulawesi Cenozoic arc-volcanic dominated geology)

Tsujimori, T., V.B. Sisson, J.G. Liou, G.E. Harlow & S.S. Sorensen (2006)- Very-low-temperature record of the subduction process: a review of worldwide lawsonite eclogites. Lithos 92, p. 609-624.
(Formation and preservation of lawsonite eclogites requires cold subduction to mantle depths and rapid exhumation. Glaucophane-bearing lawsonite eclogites together with serpentinite and garnet-quartz micaschists in Albian-age (106 Ma) accretionary complex in Barru complex, W Sulawesi. Mineralogy suggests peak conditions of P=~2.1 GPa and T=520°C)

Tuckey, S.H., N.M. Silvio & S.D. Potter (1998)- Geological modeling and resource estimation of the Toka Tindung epithermal gold deposit, North Sulawesi, Indonesia. In: S. Shedden (ed.) Seminar papers Gold & nickel ore reserve estimation practice seminar, Australasian Inst. of Mining and Metallurgy (AusIMM), Carlton, 10, p. 76-92.

Turner, S.J., P.A. Flindell, D. Hendri, I. Hardjana, P.F. Lauricella et al (1994)- Sediment-hosted gold mineralization in the Ratatotok District, North Sulawesi, Indonesia. J. Geochemical Exploration 50, p. 317-336.
(Gold mined in Ratatotok district in Minahasa Regency since at least 1850s. Newmont exploration delineated sediment-hosted replacement-style deposit at Mesel, in Late Miocene limestone in island arc environment. Later uplift resulted in karst development in limestone and erosion of adjacent volcanic arc with deposition of thick epiclastic unit, followed by shallow level andesite intrusion into sequence. Mineralisation synchronous with late-stage reactivation of strike-slip faults. Elsewhere in district mineralisation in permeable zones along limestone-andesite contacts, quartz-calcite veins and stockworks)

Turner, S.J., S.A. Garwin & A.H. Hofstra (2002)- Mesel SRHDG deposit and low-sulfidation gold veins in the Ratatotok District, North Sulawesi, Indonesia. Geol. Soc. America, 2002 Ann. Mtg., 1p. *(Abstract only)*
(N Arm of Sulawesi classic oceanic island arc with porphyry Cu and volcanic-hosted epithermal Au-Ag deposits. Ratatotok/ Mesel deposits hosted in Miocene carbonates deposited in NE-trending graben. Carbonate sequence deposited on and later covered by andesitic volcanics and volcaniclastics. Carbonates gently folded along E-W axes. Porphyritic andesite intrusions dated at 4.3 to 3.4 Ma)

Umbgrove, J.H.F. (1930)- Een tocht naar Tandjong Api, Oost Celebes. Onze Aarde 3, p. 282-286.
('A trip to Tanjung Api, East Sulawesi'. At N coast of E arm of Sulawesi serpentinitic rocks (lherzolite) from which self-igniting gases flow)

Umbgrove, J.H.F. (1939)- De atollen en barriere-riffen der Togian eilanden. Leidsche Geol. Mededelingen 11, 1, p. 139-187.
(online at: www.repository.naturalis.nl/document/549574)
('The atolls and barrier reefs of the Togian Islands'. Study of modern atolls and reefs in Tomini Gulf, N Sulawesi, with reconnaissance geology observations on Togian Islands. Oldest rocks are sediments, intruded by young volcanics (but no recent activity). Togian peak and nearby areas composed of andesite/ trachyte volcanic rocks. Raised reef terraces younger than Tf/ Miocene)

Umbgrove, J.H.F. (1942)- A revision of fossil corals from Celebes described by Dollfus. Geologie en Mijnbouw (N.S.) 5, p. 14-16.
(online at: https://drive.google.com/file/d/1gjHuDZR314U_cYFZxqglAkhjY4LtefVP/view)
(Brief note on identifications by Dollfus (1915) of fossil corals from Sulawesi, collected by Abendanon. Disagrees with most identifications of material from Saadang and Donggala. No figures)

Untung, M., J. Taruno, M. Ali, P. Kridoharto & S.S. Sukardi (1985)- Explanatory note on preliminary aeromagnetic map of the Makassar Strait. Proc. CCOP 20st Sess., Kuala Lumpur 1983, II, p. 199-209.
(Much of N Makassar Strait interpreted as probable oceanic crust)

Usman, E. & Panuju (2013)- Study of gas potency based on gravity anomaly modeling and seismic profile analysis at Banggai-Sula Basin. Bull. Marine Geol. 28, 2, p. 51-60.
(online at: http://ejournal.mgi.esdm.go.id/index.php/bomg/article/download/55/56)

Utama, H.W., W. Gheovani, N. Supardi & W. Mukhtar (2016)- Determination of facies depositional environment based on outcrop of carbonate rock and micro-forams of Tonasa Formation at Karama, South Sulawesi. Proc. 40th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA16-285-SG, 6p.
(18m section in calcareous claystone in Tonasa Lst at Karama with M Eocene planktonic foraminifera (Globigerina senni, Globigerapsis kugleri, etc.), and open marine small benthics)

Utoyo, H., B. Priadi, A. Kadarusman & Sudarsono (1997)- K-Ar age of granitoids from Palu-Koro fault zone, Central Sulawesi. J. Geologi Sumberdaya Mineral 7, 71, p. 17-20.
(Granitic rocks in Palu-Koro fault zone with K/Ar ages between 8.4- 1.0 Ma. Categories: biotite-poor granite (2-5 Ma), mylonitized granite (5-7 Ma), biotite granite (6-8 Ma). Toboli gneissic granite 96 Ma (M Cretaceous))

Utoyo, H. (1998)- K/Ar dan Ar/Ar batuan granitik daerah Kulawi, Sulawesi Tengah. Proc. 27th Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 3, p. I 72-I 76.
('Radiometric ages of granitic rocks in the Kulawi area, C Sulawesi'. Kulawi area in Palu-Koro fault zone area. Ar/Ar dates of biotite from granitic rocks dated between 3.1- 3.5 Ma, hornblende 6.4 Ma. K/Ar ages from biotite generally higher: 3.8- 10.1 Ma, hornblende 5.5 Ma)

Utoyo, H. (2008)- Bijih besi di daerah Bonocani Kabupaten Bone, Sulawesi Selatan. J. Sumber Daya Geologi 18, 5, p. 309-317.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/251/231)
('Iron ore in Bontocani area, Bone district, South Sulawesi'. Iron ore in boulders; magnetite and hematite mineralization associated with granitoid intrusions)

Utoyo, H. & Subiyanto (2001)- Ofiolit Pegunungan Batui, Luwuk, Sulawesi Tengah. Geol. Res. Dev. Centre (GRDC), Bandung (GRDC), Spec. Publ. 28, p. 27-46.
('Ophiolite of the Batui Mountains, Luwuk, Central Sulawesi'. Batui Mts ophiolite incomplete upper part of ophiolite sequence, with gabbro-basalt in N, dominantly serpentinite in S. Eocene and Miocene K/Ar ages (too young?-JTvG). No evidence of mineralization)

Van Bemmelen, R.W. (1949)- Celebes. In: The geology of Indonesia, Government Printing Office, Nijhoff, The Hague, 1, p. 389-441.

Van den Bergh, G.D., U.M. Lumbanbalu, P.L. de Boer & F. Aziz (1995)- Lithostratigraphy of the West Sengkang Basin. In: The geology and stratigraphy of the vertebrate-bearing deposits in the Sengkang Basin: the terrestrial faunal evolution of South Sulawesi during the Late Pliocene and Quaternary. Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 18, p. 14-27.

Van den Bergh, G.D., U.M. Lumbanbalu, P.L. de Boer & F. Aziz (1995)- Lithostratigraphy of the East Sengkang Basin. In: The geology and stratigraphy of the vertebrate-bearing deposits in the Sengkang Basin: the terrestrial faunal evolution of South Sulawesi during the Late Pliocene and Quaternary. Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 18, p. 28-31.

Van der Vlerk, I.M. & J.J. Dozy (1934)- The Tertiary rocks of the Celebes-expedition- 1929. Verhandelingen Kon. Nederl. Geologisch Mijnbouwkundig Genootschap, Geol. Serie 10, p. 183-218.
(Appendix in Brouwer, 1934. Documentation of Eocene limestones with Pellatispira and Miocene limestones in different parts of Sulawesi. Several conglomeratic limestones from NE part of SE arm (Bahumpombini/ Bungku area) contain E Miocene larger foraminifera (Te5; Miogypsina, Spiroclypeus and Lepidocyclina (Eulepidina)), but also reworked clasts of U Cretaceous Globobotruncana pelagic limestone, radiolarian chert and serpentine (suggesting E Miocene or older uplift of E Sulawesi ophiolite terrane; JTvG))

Van Leeuwen, T. (1981)- The geology of southwest Sulawesi with special reference to the Biru area. In: A.J. Barber & S. Wiryosayono (eds.) The geology and tectonics of Eastern Indonesia. Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 2, p. 277-304.

(SW Sulawesi Biru area E of Ujung Pandang (Makassar) almost complete U Cretaceous- U Miocene record. Basement is Bantimala Complex metamorphics (K/Ar age 111 Ma), ultrabasic rocks and tectonic melange with NE-dipping radiolarian cherts, clastics and igneous rocks. Metamorphics unconformably overlain by latest Jurassic-E Cretaceous sands, shale and radiolarian cherts. Sands near base with metamorphic and ultramafic clasts. Flysch-type U Cretaceous folded and uplifted before deposition of thick Langi Fm andesitic volcanics (Paleocene K/Ar age near base; upper part with Late Eocene coals and limestones with Pellatispira). Conformably overlain by ~400m U Eocene- M Miocene Tonasa Limestone (Tb- Lower Tf, but mid-Oligocene unconformity). Unconformably overlain by >1000m thick M and U Miocene Sopo-Walanae-Lemo Fm volcanics (~17- ~5 Ma?). Mid-M Miocene folding and uplift event, associated with 40° CCW rotation of area. Also unconformity at base of U Miocene Lemo andesitic volcanics and Plio-Pleistocene folding-uplift event)

Van Leeuwen, T., C.M. Allen, M. Elburg, H.J. Massonne, J.M. Palin & J. Hennig (2016)- The Palu Metamorphic Complex, NW Sulawesi, Indonesia: origin and evolution of a young metamorphic terrane with links to Gondwana and Sundaland. J. Asian Earth Sci. 115, p. 133-152.
(Young metamorphic core complexes of Palu (PMC) and Karossa, mainly in 'neck' of NW Sulawesi. N part mainly amphibolite (oceanic parentage?), S part mainly biotite schists (meta-sediments) with some gneiss (meta-granite). Local peridotite. Rocks resided at depths of 60-120 km during part of their histories. S part overlain by U Cretaceous Latimojong Fm clastics and volcanics (but parts of PMC also metamorphosed Latimojong Fm). Zircon ages of metamorphics suggest metamorphism event at 3-4 Ma of older protoliths (210-230 Ma/ Late Triassic and ~80-120 Ma/M Cretaceous). Rapid cooling exhumation in latest Miocene- M Pliocene (Ar/Ar cooling ages 6.0- 3.6 Ma). Composite terrane with (1) gneiss unit of Gondwana origin (but presence of Late Triassic meta-granitoids and recycled Proterozoic zircons suggest W Sulawesi Block origin in New Guinea region, not NW Australian margin, as suggested in recent reconstructions?), (2) schist unit composed of low-metamorphic turbidites deposited in Late Cretaceous- E Tertiary along SE Sundaland margin, and (3) slivers of amphibolite with oceanic crust characteristics)

Van Leeuwen, T., C.M. Allen, A. Kadarusman, M. Elburg, J.M. Palin, Muhardjo & Suwijanto (2007)- Petrologic, isotopic, and radiometric age constraints on the origin and tectonic history of the Malino metamorphic complex, NW Sulawesi, Indonesia. J. Asian Earth Sci. 29, p. 751-777.
(Malino Metamorphic Complex (MMC) at W end of Sulawesi N arm mica schists and gneisses from proximal turbidite and granitoid protoliths, with intercalations of greenschist, amphibolite, marble and quartzite. Devonian- Early Carboniferous age, Archean-Proterozoic inherited zircons, and isotopic signatures indicate terrane derived from New Guinea-Australian margin. Similarities with Birds Head basement suggests common origin. Greenschists around MMC from adjacent autochthonous Paleogene. Barrovian progression from greenschist through epidote-amphibolite to amphibolite. P-T estimations suggest 27-30 km burial. Cooling ages 23-11 Ma, and 7 Ma age for unconformably overlying volcanic rocks, indicate Miocene exhumation. Two tectonic scenarios: (1) continental fragment docked with Sulawesi in Mesozoic and exhumed as metamorphic core complex in Miocene; (2) subducted beneath N arm in Late Oligocene, then rapidly returned to surface)

Van Leeuwen, T.M. & Muhardjo (2005)- Stratigraphy and tectonic setting of the Cretaceous and Paleogene volcanic-sedimentary successions in Northwest Sulawesi, Indonesia: implications for the Cenozoic evolution of Western and Northern Sulawesi. J. Asian Earth Sci. 25, p. 481-511.
(W Sulawesi is rifted continental margin of E Sundaland. Metamorphic basement, partly of Australian origin, overlain by Late Cretaceous Latimojong Fm fore-arc turbidites. M Eocene- earliest Miocene transgressive cycle: syn-rift siliciclastics, nummulitic limestone and associated shelf sediments to deeper marine mudstones and turbidites (Budungbudung and Tinombo Fms). At same time N Sulawesi oceanic island arc, with bimodal Papayato volcanism on oceanic crust. Cretaceous- Paleogene volcanic and sedimentary suites contrasting tectonic setting of two provinces. Relationship between two domains not clear: probably formed continuous belt through Cenozoic, definitely connected by E Miocene. Paleogene deformation in N part of NW Sulawesi and unconformable relationship with overlying formations may be result of collision of N arm with Australian-derived continental fragment in E Miocene, or M Miocene formation of extensional metamorphic core complex. Second major tectonic event Pliocene-ongoing, affects entire region)

Van Leeuwen, T.M. & P.E. Pieters (2011)- Mineral deposits of Sulawesi. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado, MGEI/IAGI, p. 1-109.
(Major review of Sulawesi mineral deposits. Same as Van Leeuwen & Pieters (2013))

Van Leeuwen, T.M. & P.E. Pieters (2013)- Mineral deposits of Sulawesi. Geological Agency, Ministry of Energy and Mineral Resources, Bandung, p. 1-127.
(Extensive overview of mineral deposits of N, W and E Sulawesi Provinces, set in historic and geologic contexts. Sulawesi has complex geology with wide variety of mineralization styles, including porphyry Cu-Au, porphyry Mo, epithermal, metamorphic and sedimentary Au, lateritic nickel and Fe, etc.. Gold mining started in 1896, nickel in 1938. By world standards Sulawesi is underexplored)

Van Leeuwen, T.M., E.S. Susanto, S. Maryanto, S. Hadiwisastra, Sudijono, Muhardjo & Prihardjo (2010)- Tectonostratigraphic evolution of Cenozoic marginal basin and continental margin successions in the Bone Mountains, Southwest Sulawesi, Indonesia. J. Asian Earth Sci. 38, 6, p. 233-254.
(Bone Mts in SW Sulawesi composed of Oligocene- Lower Miocene transtensional marginal basin Bone Gp (MORB-like volcanics and interbedded hemipelagic mudstones), juxtaposed against Eocene- Miocene continental margin Salokalupang Gp. Latter: (1) M- U Eocene volcaniclastics with limestone intercalations in upper part, reflecting arc volcanism and carbonate development along Sundaland margin; (2) Oligocene calc-arenites, deposited on passive margin, and (3) Lower- M Miocene clastics- volcanics, formed in extensional regime without subduction. At ~14-13 Ma start of widespread extension in SW Sulawesi, with potassic volcanism (Camba Fm), reaching peak 1 Ma year later with juxtaposition of Bone Gp against Salokalupang Gp along Walanae strike-slip fault. Potassic volcanism continued to end Pliocene, locally to Quaternary)

Van Leeuwen, T.M., R. Taylor, A. Coote & F.J. Longstaffe (1994)- Porphyry molybdenum mineralization in a continental collision setting at Malala, Northwest Sulawesi, Indonesia. J. Geochemical Exploration 50, p. 279-315.
(Malala deposit in NW Sulawesi only known porphyry Molybdenum in Indonesia, associated with mainly granitic intrusives (Malala porphyries) as late differentiates in roof zone of Dondo batholith. Intrusives part of 600 km belt of granites and granodiorites, emplaced in continental margin ('W Sulawesi') in Late Miocene-Pliocene, during and following collisions between several microcontinents and Sulawesi western magmatic arc/eastern subduction complex. Granitoids from partial melting of lower crust (possibly underthrusted Precambrian- Paleozoic continental crust) due to lithospheric thickening in continental collision regime)

Van Schelle, C.J. (1889)- Opmerkingen over de geologie van een gedeelte der afdeeling Gorontalo, Res. Menado. Jaarboek Mijnwezen Nederlandsch Oost-Indie 1889, Wetenschappelijk Gedeelte 2, p. 115-158.
('Remarks on the geology of a part of the district Gorontalo, Residency Manado')

Van Schelle, C.J. (1889)- Verslag van een onderzoek naar de waarde van bekende goudvindplaatsen in de afdeeling Gorontalo (Res. Menado). Jaarboek Mijnwezen Nederlandsch Oost-Indie 1889, Technisch Admin. Ged., p. 39-55.
('Report of investigation of the value of known gold occurrences in the district Gorontalo, Residency Manado')

Van Straelen, V. (1924)- *Portunus brouweri*. Portunien nouveau du Tertiaire de l'Ile Celebes. Jaarboek Mijnwezen Nederlandsch Oost-Indie (1923), Verhandelingen p. 169-170.
('Portunus brouweri, a new portunid from the Tertiary of Sulawesi'. New species of crab fossil from probably Miocene-age lithographic limestones with fish fossils at Patunuang Asu, S Sulawesi (see also Brouwer 1924))

Van Vuuren, L. (1920)- Het gouvernement Celebes: proeve eener monographie. Encyclopedisch-Bureau, Weltevreden, 535p. + Atlas with 25 maps.
(Early geographic description of Sulawesi. Includes geology chapter, influenced by Wegener's continental drift theory)

Vigny, C., H. Perfettini, A. Walpersdorf, A. Lemoine, W. Simons, D. van Loon, B. Ambrosius, C. Stevens, R. McCaffrey et al. (2002)- Migration of seismicity and earthquake interactions monitored by GPS in SE Asia triple junction: Sulawesi, Indonesia. J. Geophysical Research 107, B10, 2231, p. 7/1-7/11.
(online at: http://onlinelibrary.wiley.com/doi/10.1029/2001JB000377/epdf)
(GPS- detected coseismic and transient post-seismic deformation related to January 1996 earthquake on N Sulawesi (Minahassa) trench)

Villeneuve M., J.J. Cornee, W. Gunawan, J. Girardeau, C. Monnier, J.P. Rehault, J. Malod, S. Burhanuddin et al. (1995)- Role of the Miocene extensional tectonic event in the blueschist exhumation and the molassic basin origin in the Sulawesi island (Indonesia). EUG 8, Terra Nova, Suppl., p. 119. *(Abstract only)*

Villeneuve, M., J.J. Cornee, W. Gunawan, M.C. Janin, J. Butterlin, P. Saint-Marc & H. Samodra (2000)- Continental block collision in the eastern arm of Sulawesi (Indonesia); structure and geodynamic interpretation. Comptes Rendus Academie Sciences, Paris, IIA, Earth Planetary Sci. 330, 5, p. 371-378.
(E arm of Sulawesi result of collision between two continental blocks: Tokala in W and Banggai-Sula in E. Tokala block results from Oligocene obduction of ophiolitic Asiatic basin onto passive margin of Gondwanan block (Banda block), with collision with Asiatic active margin (W arm of Sulawesi) near end Oligocene or beginning of Miocene. Tokala Block then collided by Banggai-Sula block in E-M Pliocene or later)

Villeneuve, M., J.J. Cornee, W. Gunawan, R. Martini, G. Tronchetti. M.C. Janin, P. Saint-Marc & L. Zaninetti (2001)- La succession lithostratigraphique du bloc de Banda dans la region de Kolonodale (Sulawesi central, Indonesie). Bull. Soc. Geologique France 172, 1, p. 59-68.
(online at: https://archive-ouverte.unige.ch/unige:9820)
('Lithostratigraphy of the Banda Block in the Kolonodale area, C Sulawesi'. E and SE Sulawesi composed of two major continental blocks: (1) 'Banda block' (in later papers called Kolonodale Block; JTvG) including also Buru, Seram and Sinta Ridge, collided with Asian volcanic arc of W Sulawesi in Oligocene, then was dismembered during Late Neogene Banda Sea opening, and (2) Banggai-Sula block which drifted from Irian Jaya and collided with Banda block in Mid-Late Pliocene. Fragment of Banda block is in E Sulawesi, corresponding to the ophiolitic zone, where, in Kolonodale area, it is possible to reconstruct sedimentary succession under ophiolite, despite intensive deformations. Good overview of Late Triassic carbonates)

Villeneuve, M., W. Gunawan, O. Bellier, H. Bellon, J.J. Cornee, R. Martini & J.P. Rehault (2013)- Multiple collisions in Sulawesi Island and relationships with the geodynamical evolution of eastern Indonesia. In: 2nd Southeast Asian Gateway evolution Meeting (SAGE 2013), Berlin, p. 177. *(Abstract only)*
(Three small NE Gondwanan blocks from E or SE collided with W and N Arms of Sulawesi, at W-dipping subduction zone(s): (1) Late Oligocene- E Miocene 'Kolonodale Block', tectonically capped by large ophiolite; (2) M Miocene 'Lucipara Block' collision with Kolonodale Block; (3) M Pliocene 'Banggai-Sula Block'. Kolonodale Block strikingly similar to Timor; Lucipara and Banggai-Sula blocks similar to Birds Head)

Villeneuve, M., W. Gunawan, J.J. Cornee & O. Vidal (2002)- Geology of the Central Sulawesi belt (eastern Indonesia): constraints for geodynamic models. Int. J. Earth. Sci. (Geol. Rundschau) 91, 3, p. 524-537.
(Sulawesi four major tectonic events: (1) Mid-Cretaceous in W arm; (2) Oligocene Eastward ophiolite obduction and collision of 'Kolonodale Block' of Gondwana origin, producing metamorphic belt in C Sulawesi; (3) Middle Miocene collision of Banda Block and Tukang-Besi Platform and (4) Middle Pliocene collision between Kolonodale and Banggai-Sula blocks)

Von Koenigswald, R. (1933)- Over het zogenaamde voorkomen van *Spirifer verneuili* Murch. op Celebes. De Mijningenieur 1933, 1, p. 14-16.
('On the alleged occurrence of Paleozoic brachiopod Spirifer verneuili on Sulawesi'. Paleozoic brachiopod reported from Sulawesi by Brouwer is almost certainly from Chinese pharmacy, not from Sulawesi. Brachiopods like Spirifer Cyrthua and Orthis rel common in Chinese pharmacies across Java and outer areas and were presumably all imported from China)

Von Loczy, L. (1934)- Geologie van Noord Boengkoe en het Bongka-gebied tusschen de Golf van Tomini en de Golf van Tolo in Oost-Celebes. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 10, p. 219-322.
(Report on BPM fieldwork in Bongka River region, Sulawesi E arm. 70% of area covered by ophiolites (peridotite, serpentinite gabbro), thrust over Triassic- U Cretaceous sediments (local contact-metamorphism), incl. 300-500m dense yellow U Triassic (Norian) limestone rich in Misolia. Deep marine Late Jurassic belemnite limestone and white and red radiolarian-bearing Jurassic- Cretaceous limestones. Highly folded Late Eocene limestones with Discocyclina- Pellatispira. Celebes molasse 1200m thick, with Miocene Lepidocyclina limestone near base. Separate chapters on radiolaria (Hojnos; U Jurassic- Lw Cretaceous) and foraminifera (Van der Vlerk), Mesozoic macrofossils (Kutassy). Some of Von Loczy's conclusions debated by Hetzel (1935), Oostingh (1935), Tan Sin Hok (1935))

Von Staff, H. (1911)- Zum Problem der Entstehung der Umrissform von Celebes. Zeitschrift Deutschen Geol. Gesellschaft, Berlin, 63, Monatsberichte, p. 180-186.
('On the problem of the origin of the outline shape of Sulawesi'. Followed by reply by Ahlburg, 1911, p. 399-405. Also discussed by Abendanon 1912 and Sarasin 1912))

Von Steiger, H. (1915)- Petrografische beschrijving van eenige gesteenten uit de onderafdeeling Pangkadjene en het landschap Tanette van het gouvenement Celebes en onderhoorigheden. Jaarboek Mijnwezen Nederlandsch Oost-Indie 42 (1913), Verhandelingen, p. 171-227.
('Petrographic description of rocks from sub-district Pajangkane and Tanette region, SW Sulawesi'. Mainly igneous rocks, also glaucophane schist. With 1:150,000 scale geological map of departments Makassar and Bone by 'T Hoen)

Wahyono & Sidarto (2002)- Karakteristik kimia dan fisika serta pematangan batubari di daerah Baraka, Enrekang, Sulawesi Selatan. J. Geologi Sumberdaya Mineral 12, 132, p. 20-37.
('Chemical and physical characteristics and maturation of coal in the Baraka area, Enrekang, S Sulawesi'. Eocene Baraka coals NE of Enrekang high sulfur and ash, brown coal to medium volatile bituminous. Two groups: (1) Titok crushed and sheared with Rvmax 0.19-1.48% and Batunoni-Lapin with Rvmax 0.32-0.64%)

Wajdi, M.F., B. Santoso, D. Kusumanto & S. Digdowirogo (2011)- Metamorphic hosted low sulphidation epithermal gold system at Poboya, Central Sulawesi: a general descriptive review. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado 2011, MGEI/IAGI, p. 201-210.
(See also Wajdi et al. 2012)

Wajdi, M.F., B. Santoso, D. Kusumanto & S. Digdowirogo (2011)- Sistem emas epitermal sulfidasi rendah dalam batuan metamorf di Poboya, Sulawesi Tengah: tinjauan deskriptif umum. Majalah Geologi Indonesia 27, 2, p. 131-141.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/771)
('Low sulfidation epithermal gold systems in metamorphic rocks in Poboya, C Sulawesi: general descriptive review'. Same as Wajdi et al. 2010. On Poboya epithermal gold prospect 12 km NE of Palu, C Sulawesi, on E margin of pull-apart basin related to Palu Koro sinistral strike slip fault system)

Wake, B., N. Silvio, A. Lattore, A.S. Iswahyudi & A. Purwanto (1996)- Geology of the Toka Tindung epithermal gold deposit, North Sulawesi, Indonesia. In: Proc. Conf. Porphyry related copper and gold deposits of the Asia Pacific Region, Cairns 1996, Australian Mineral Found., Adelaide, p. 9.1-9.8.
(On Toka Tindung low sulphidation epithermal gold deposit on N tip of Sulawesi, 35km NE of Manado. Two vein systems in Pliocene andesitic volcaniclastics)

Wake, B.A., A.S. Iswahyudi, & M. Dadi Kuswandi (1997)- Epithermal gold-silver mineralization in a fossil hot spring system, Toka Tindung, North Sulawesi. Seminar Nasional Sumber Daya Geologi, Fakultas Teknologi Mineral, UPN 'Veteran' Yogyakarta, p.

Wakita, K. (2002)- Mystery man and mysterious unconformity in South Sulawesi, Indonesia. Chishitsu News 573, p. 48-68. *(in Japanese)*
(online at: www.gsj.jp/Pub/News/pdf/2002/05/02_05_05.pdf)

Wakita, K., Munasri, J. Sopaheluwakan, I. Zulkarnain & K. Miyazaki (1994)- Early Cretaceous tectonic events implied in the time-lag between the age of radiolarian chert and its metamorphic basement in Bantimala area, South Sulawesi, Indonesia. The Island Arc 3, p. 90-102.
(Bantimala Complex of S Sulawesi mainly melange, chert, basalt, ultramafic rocks and high-P metamorphics. Radiolarian assemblage from unconformably overlying chert Mid-Cretaceous (late Albian-early Cenomanian), while K-Ar ages from schist range from 132-114 Ma. This suggests brief tectonic event followed by quick waning tectonism during Albian-Cenomanian transgression)

Wakita, K., J. Sopaheluwakan, K. Miyazaki, I. Zulkarnain & Munasri (1996)- Tectonic evolution of the Bantimala Complex, South Sulawesi, Indonesia. In: R. Hall & D. Blundell (eds.) Tectonic evolution of Southeast Asia, Geol. Soc., London, Spec. Publ. 106, p. 353-364.
(Bantimala Complex NE-dipping tectonically stacked slices, composed mainly of high-P metamorphics and radiolarian chert, but also E-M Jurassic sandstones and overlain by mid-Cretaceous radiolarites and Late Cretaceous turbiditic series. Ages of metamorphics suggest oceanic plate subduction in Late Jurassic- earliest Cretaceous. Subduction ceased in Albian. High-P schists exhumed due to collision of Gondwana-derived microcontinents)

Walpersdorf, A., C. Rangin & C. Vigny (1998)- GPS compared to long-term geologic motion of the North arm of Sulawesi. Earth Planetary Sci. Letters 159, p. 47-55.
(Paleomagnetic data from N arm of Sulawesi indicate ~20-25° rotation since 5 Ma, suggesting 200-250 km of left-lateral displacement along Palu-Koro fault. Similar Palu fault displacement derived from magnetic anomalies of Celebes seafloor, which implies 200- 250 km of oceanic crust subducted at N Sulawesi trench. Another marker for rotation derived from opening of Gulf of Tomini and NW migration of calc-alkaline subduction-related volcanism. GPS observation of 4 cm/year of left-lateral strike-slip across Palu fault fit well with N arm motion of 4-5 cm/year. Current rates from GPS approximate long-term rates)

Walpersdorf, A., C. Vigny, P. Manurun, C. Subarya & S. Sutisna (1999)- GPS observation of the Triple Junction, Indonesia. In: The GEODYnamics of S and SE Asia (GEODYSSEA) Project, GeoForschungs Zentrum, Potzdam, STR 98/14, p. 226-238.

Walpersdorf, A., C. Vigny, C. Subarya & P. Manurung (1998)- Monitoring of the Palu-Koro Fault (Sulawesi) by GPS. Geophysical Research Letters 25, 13, p. 2313-2316.
(online at: http://onlinelibrary.wiley.com/doi/10.1029/98GL01799/epdf)
(5 years of GPS monitoring shows ~3.4 cm/yr left-lateral strike slip on Palu Fault)

Wanner, J. (1910)- Beitrage zur Geologie des Ostarms der Insel Celebes. Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 29, p. 739-778.
('Contributions to the geology of the East Arm of Sulawesi Island'. Results of 2-month geological reconnaissance in 1905, mainly in SE side of E Arm, along Peleng Straits, near Toeli, Nambo, etc. In around Central Mountains describes (1) ultrabasic rocks, (2) rel. widespread Eocene limestones with Alveolina, Discocyclina and Nummulites, reminescent of Alveolina Limestone of Misool; (3) E Miocene shallow water carbonates with Lepidocyclina and Miogypsina; (4) Celebes molasse conglomerates 1200m thick or more (sandy marls and limestone near base with Pliocene planktonic and larger foraminifera, incl. Globorotalia tumida, no lepidocyclinids; JTvG), (5) Quaternary raised coral reef terraces up to 400m above s.l. Near Toeli also probably Jurassic-age 'Toeli Limestone', reminescent of Buru Limestone. Along N coast (Tomini Bay) common gabbro and peridotite, with oil seep in Babason creek, a tributary of Lobu River. Gabbro appear to be intrusives in U Oligocene- E Miocene limestone with Spiroclypeus, Lepidocyclina)

Wanner, J. (1914)- Eine Reise durch Ost-Celebes. Petermanns Geogr. Mitteilungen 60, 1, p. 78-81 and p. 133-136.

('A voyage through East Sulawesi'. Summary of 1905 traverse of East Sulawesi for Royal Dutch Petroleum Co. from Kintom. Mainly travel report with little geology (more in Wanner, 1910). In Babason creek near Dolong oil seep from fractures in gabbro, suggesting these overlie Tertiary sediments. With 1 map)

Wanner, J. (1919)- Die Geologie von Mittel-Celebes nach den neueren Forschungen E.C. Abendanons und anderer. Geol. Rundschau 10, 1, p. 45-62.
(online at: https://www.digizeitschriften.de/dms/img/?PID=GDZPPN000455245)
('The geology of Central Sulawesi after new investigations of E.C. Abendanon and others'. Review of Central Sulawesi investigations. No figures)

Wanner, J. (1923)- Die Geologie von Celebes, speciell vom okonomischen Gesichtspunkte. Vierde Koloniale Vacantiecursus voor Geografen, Comite voor Indische Lezingen en Leergangen, Amsterdam, p. 3-10.
('The geology of Sulawesi, especially from an economic point of view'. Brief summary of lecture on Sulawesi geology and indications of oil, coal and metals. No figures)

Wanner, J. & E. Jaworski (1931)- Liasammoniten von Jamdena und Celebes. Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 66, B, p. 199-210.
('Liassic ammonites from Yamdena and Sulawesi'. Sulawesi ammonites from poorly known central part of East arm, collected by BPM geologist Weber. First records of E Jurassic ammonites from E Sulawesi (Arnioceras cf. seilaeve from dark grey sandy limestone as float in upper Balingara River, 20km SE of river mouth). Yamdena ammonites from Tasik Selwasa and Botenjahu mud volcano deposits include Echioceras wichmanni, Asteroceras sparsicostatum n.sp. and Arnioceras cf. arnouldi. Fauna and lithology very similar to 'grey cephalopod nodule marl' of Roti and Timor, described by Krumbeck (1922))

Waterschoot van der Gracht, W.A.J.M. van (1915)- Voorloopige mededeeling in zake de geologie van Centraal-Celebes. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 32, p. 188-204.
('Preliminary communication on the geology of Central Sulawesi'. Summary of 1913 fieldwork in Toraja lands, mainly to investigate stratigraphy. Widespread, thick, folded red Globigerina marls with thin limestone intercalations of E-M Eocene age, not Cretaceous as previously suggested. Overlain by several km thick volcanic series, probably Late Eocene- Miocene age. Mid-Tertiary granite intrusions. "Sulawesi more likely part of Tethys geosyncline than of Asian mainland'. Heavily criticized by Abendanon 1915 for proposing sweeping regional conclusions based on only 11 days of fieldwork in small part of C Sulawesi)

Waterschoot van der Gracht, W.A.J.M. van (1915)- Bijdrage tot de geologie van Centraal-Celebes. Jaarboek Mijnwezen Nederlandsch Oost-Indie 43 (1914), Verhandelingen 2, p. 16-73.
('Contribution to the geology of Central Sulawesi'. Report on 2-week journey into C Sulawesi Toraja lands from Palopo at N end of Bone Bay. One of first to demonstrate that widespread red claystones are of E-M Eocene age (with interbeds of limestone with Nummulites, Assilina). Different from earlier interpretations of De Sarasin and Ahlburg (Abendanon books had not been published yet))

Watkinson, I.M. (2011)- Ductile flow in the metamorphic rocks of Central Sulawesi. In: R. Hall, M.A. Cottam & M.E.J. Wilson (eds.) The SE Asian gateway: history and tectonics of Australia-Asia collision, Geol. Soc. London, Spec. Publ. 355, p. 157-176.
(Gneisses, amphibolites and schists exposed along Palu-Koro Fault of W-C Sulawesi are part of regionally metamorphosed Mesozoic-Precambrian basement. In Palu and Neck regions of Sulawesi, ductile shear fabrics record low-angle W-ward extension. Further south in Palu valley, extension directed towards SW. Cross-cutting granitic dykes show foliation in neck region of Sulawesi occurred before ~44-33.7 Ma. In Palu valley it occurred before 5-3.5 Ma, precluding origin as result of Palu-Koro Fault activity. Ductile flow during either Eocene-Miocene mid-crustal extension above metamorphic core complex, Cretaceous subduction-related deformation in over-riding plate, or intracontinental deformation within Gondwana)

Watkinson, I.M. & R. Hall (2011)- The Palu-Koro and Matano faults, Sulawesi, Indonesia: evolution of an active strike-slip fault system. Geophysical Research Abstracts 13, EGU2011-8270, EGU Gen. Assembly 2011.
(Abstract only. Palu-Koro and Matano faults of Sulawesi important active strike-slip faults. Palu-Koro fault slip

rate 32-45 mm/yr and left-lateral displacement about 200 km. Shorter Matano fault SE continuation and now in process of coalescing with Palu-Koro fault. Faults probably did not initiate before ~5 Ma)

Werdmuller, J.O. (1926)- Petrographische Untersuchung von Eruptivgesteinen des Pik von Maros in Sud-West-Celebes. Schweizerische Mineralogische Petrographische Mitteilungen. 6, 2, p. 205-254.
(online at: https://www.e-periodica.ch/digbib/view?pid=smp-001:1926:6#232)
('Petrographic investigation of volcanic rocks of the peak of Maros in SW Sulawesi'. Descriptions of rocks from volcanic Maros Peak (phonolite; 1375m high) and associated igneous rocks (incl. marosite, named after Maros Peak; also shonkinite, trachyte, etc.). Rocks collected between 1895-1902 by Sarasin cousins and in 1904 by Schmidt. With photomicrographs of thin sections)

White, L.T., R. Hall & R.A. Armstrong (2014)- The age of undeformed dacite intrusions within the Kolaka Fault zone, SE Sulawesi, Indonesia. J. Asian Earth Sci. 94, p. 105-112.
(Dacite intrusions in strand of Kolaka Fault that crosses SE Arm of Sulawesi and N Bone Bay. Kolaka Dacite undeformed, with zircon ages between ~4.4 and 7 Ma. Rare inherited zircons, with ages between 8- 1854 Ma, show SE arm of Sulawesi is underlain by Proterozoic or younger material)

White, L.T., R. Hall & R.A. Armstrong, A.J. Barber, M.K. BouDagher-Fadel, A. Baxter, K. Wakita, C. Manning & J. Soesilo (2017)- The geological history of the Latimojong region of western Sulawesi. J. Asian Earth Sci. 138, p. 72-91.
(Latimojong Metamorphic Complex in C-W Sulawesi is accretionary complex of metamorphic rocks tectonically mixed with cherts and ophiolitic rocks, overlain(?) by unmetamorphosed U Cretaceous Latimojong Fm distal turbidites (accretionary complex). Aptian-Albian radiolaria in chert float sample in Latimojong Metamorphic Complex. Foraminifera ages from Toraja Group (56-23 Ma), Makale Fm (20.5-11.5 Ma) and Enrekang Volcanic Series (8.0-3.6 Ma). Magmatic zircons record ~38, ~25 and 8.0-3.6 Ma phases of volcanism. Late Miocene- E Pliocene high-K Enrekang Volcanics (~ 3.9-7.5 Ma) and Palopo Granite (6.6-4.9 Ma) may be tied to crustal extension/ slab rollback. Miocene-Proterozoic inherited zircons in Pliocene igneous rocks support Proterozoic-Phanerozoic (193, 38-34 Ma) basement or sediments derived from these. Little evidence for Oligocene-Pliocene thrusting in Latimojong region)

Whitten, A.J., M. Mustafa & G.S. Henderson (1988)- The ecology of Sulawesi. Gadjah Mada University Press, Yogyakarta, p. 1-777. *(Reprinted 2002, Periplus Edition, 727p.)*

Wibowo, S., M.F. Rosana & A.D. Haryanto (2017)- Implication of fracture density on unserpentinized ultramafic rocks toward characteristics of saprolite zone in Sorowako, South Sulawesi. Bull. Scientific Contr. (UNPAD) 15, 2, p. 101-110.
(online at: http://jurnal.unpad.ac.id/bsc/article/view/13375/pdf)
(Nickel grades reach maximum in saprolite zones. Fracture density in ultramafic bedrocks played important roles during laterisation. In Sorowako ultramafic complex of East Sulawesi Ophiolite Complex high-medium fractured types of bedrock tied to thick saprolite zone)

Wichmann, A. (1893)- Uber Glaukophan-Epidot-Glimmerschiefer von Celebes. Neues Jahrbuch Mineral. Geol. Palaont. 1893, 2, p. 176-178.
('On glaucophane-epidote-mica schists from Sulawesi'. Brief paper, first description of common glaucophane schist from SW Sulawesi in float of Pajangkene River)

Wichmann, A. (1893)- Petrographische Studien uber den Indischen Archipel. I. Leucitgesteine von der Insel Celebes. Natuurkundig Tijdschrift Nederlandsch-Indie 53, 2, p. 315-331.
(online at: http://62.41.28.253/cgi-bin/...)
('Leucite-bearing rocks from Sulawesi island'. First description of Neogene leucite-bearing volcanic rocks, which are widespread across SW Sulawesi (Parang-Lowe near Makassar, Pajangkene, Tempe, Walanae, etc.). Previously known only from N Java and Bawean island)

Wichmann, A. (1895)- Petrographische Studien uber den Indischen Archipel. II. Zur Geologie der Insel Saleijer. Natuurkundig Tijdschrift Nederlandsch-Indie 54, p. 236-268.
(online at: www21.us.archive.org/details/mobot31753002489778)
('Petrographic studies on the Indies Archipelago, II. On the geology of Salayar Island', Mainly petrographic descriptions of rocks from Salayer, S of SW arm of Sulawesi, collected by M. Weber in 1889. In East mainly young volcanic rocks (mica trachyte, andesites and tuffs, basalt). In West quartz sandstone without andesitic detritus, white marl (with Late Miocene-Pliocene planktonic forams; reminiscent of E Java Kendeng zone and Timor) and Neogene coral limestone)

Wichmann, A. (1896)- Bemerkungen zur Geologie des Posso-Gebietes. Petermanns Geogr. Mitteilungen 42, p. 160-165.
('Remarks on the geology of the Poso area'. Rel. common serpentinized peridotitic rocks. In NE of Poso area, at Tanjung Api along Tomini Bay, serpentinized ultramafic rocks (with burning gas seep))

Wichmann, A. (1902)- Der Vulkan der Insel Una Una (Nanguna) im Busen von Tomini, Celebes. Zeitschrift Deutschen Geol. Gesellschaft, Berlin, 54, p. 144-158.
(online at: https://www.biodiversitylibrary.org/item/150077#page/178/mode/1up)
('The volcano of Una-Una island in Tomini Bay, Sulawesi'. Erupted in 1898, with ash reaching W into E Kalimantan)

Widiasmoro, B. Priadi & R. Soeria-Atmadja (1997)- Granitoid Neogene tipe tumbukan di zona sesar Palu-Koro, Sulawesi Tengah. Proc. 26th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 371-389.
('Neogene collision-type granitoids in the Palu-Koro fault zone, Central Sulawesi')

Widijono, B.S. & B. Setyanta (2000)- Model kerak dan implikasi geodinamika lajur sesar Palu-Koro sajian analisis data gayaberat, kegempaan dan kinematika. Geol. Res. Dev. Centre (GRDC), Geophys. Ser. 1, p. 21-34.
(Crustal model of area of Palu-Kuro fault zone from gravity-magnetic data)

Widodo, S., Sufriadin, A. Imai & K. Anggayana (2016)- Characterization of some coal deposits quality by use of proximate and sulfur analysis in the Southern Arm Sulawesi, Indonesia. Int. J. Engineering and Science Applications (UNHAS) 3, 2, p. 137-143.
(online at: http://pasca.unhas.ac.id/ojs/index.php/ijesca/article/view/1085/233)
(SW Sulawesi coal deposits at Paluda, Padanglampe, Lamuru and Tondongkura. Lower moisture of Paluda coal might be affected by igneous intrusion. Coal samples generally high ash (29%) and sulfur(3.74.%). No vertical distribution trend for ash and sulfur)

Wijaya, P.H., Subarsyah, J. Widodo, N.A. Kristanto, Susilohadi & L.Arifin (2007)- Seismic stratigraphy and tectonic of Gorontalo Basin and its implication for hydrocarbon trap potential. Proc. Joint Conv. 32nd HAGI, 36th IAGI and 29th IATMI, Bali 2007, p. 963-969.
(Same as Wijaya et al. 2007, below)

Wijaya, P.H., J. Widodo, N.A. Kristanto, Subarsyah, Susilohadi & L. Arifin (2007)- Data baru Cekungan Gorontalo perairan Teluk Tomini, Sulawesi: integrasi data seismik dan magnetik untuk mengidentifikasi potensi hidrokarbon. Mineral dan Energi 5, 1, p. 42-49.
('New data from the Gorontalo Basin, Tomini Bay, Sulawesi: integration of seismic and magnetics for identification of hydrocarbon potential')

Wijbrans, J.R., H. Helmers & J. Sopaheluwakan (1994)- The age and thermal evolution of blueschists from South-East Sulawesi, Indonesia: the case of slowly cooled phengites. Mineralogical Magazine 58A (Goldschmidt Conf. 1994), p. 975-976.
(Abstract only. SE Sulawesi blueschist belt graphite-mica schists and metabasites of MORB affinity. Ar/Ar dates 20.8- 27.5 Ma)

Willems, H.W.V. (1937)- Contribution to the petrology of the crystalline schists of western Central Celebes (Netherlands East Indies). Doct. Thesis University of Amsterdam, p. 1-147. *(Unpublished)*
(Descriptions of metamorphic rocks along two traverses collected by 1929 Celebes expedition (Brouwer, 1934). All are epi- to mesometamorphic grade, with general increase in metamorphism from E to W. Calcareous rocks more numerous in southern traverse)

Williamson, A. (2011)- Discovery and development of Toka Tindung low sulphidation epithermal gold project. In: N.I. Basuki (ed.) Proc. Conf. Sulawesi Minerals Resources 2011, Manado, MGEI/IAGI, p. 259-266.

Wilson, M.E.J. (1995)- The Tonasa Limestone Formation, Sulawesi, Indonesia: development of a Tertiary carbonate platform. Ph.D. Thesis University of London, p. 1-520. *(Unpublished)*

Wilson, M.E.J. (1996)- Evolution and hydrocarbon potential of the Tertiary Tonasa Limestone Formation, Sulawesi, Indonesia. Proc. 25th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 227-240.
(Eocene- M Miocene Tonasa Lst of S Sulawesi started as transgressive sequence. By Late Eocene 100 km long Tonasa carbonate platform. Shallow-water sedimentation continuous until M Miocene on parts of platform, but active normal faulting caused basinal graben formation and subaerial exposure in other areas. Platform top mainly large benthic foraminifera facies. Facies belts trend E-W and relatively static through time. Tertiary exposure of shallow-water facies affected by block faulting. In grabens basinal marls interbedded with coarse redeposited carbonates. Lack of abundant aragonitic bioclasts and localized subaerial exposure result in little porosity development in platform top. Redeposited facies porous and permeable, and most likely to form hydrocarbon reservoirs)

Wilson, M.E.J. (1999)- Prerift and synrift sedimentation during early fault segmentation of a Tertiary carbonate platform, Indonesia. Marine Petroleum Geol. 16, 8, p. 825-848.
(Eocene- M Miocene Tonasa Fm carbonate platform in SW Sulawesi reflects Late Eocene- E Miocene rifting)

Wilson, M.E.J. (2000)- Tectonic and volcanic influences on the development and diachronous termination of a Tertiary tropical carbonate platform. J. Sedimentary Res. 70, p. 310-324.
(Sulawesi Eocene- M Miocene syntectonic Tonasa carbonate platform developed W of volcanic arc and overlain by M-U Miocene volcanics. Greatest extent Late Eocene. Tectonics and volcanism influenced evolution and diachronous termination in 4 ways: (1) Paleogene volcanic activity limited E-ward extent of platform but had little effect in W S Sulawesi. (2) Late Eocene faulting resulted in platform segmentation, localized drowning in hanging wall areas and subaerial exposure on footwall highs. (3) E-M Miocene faulting around early stages of volcanism in W S Sulawesi resulted in localized tilting of fault blocks, formation of new graben, and exposure of footwall highs. (4) M Miocene volcaniclastics influx buried remaining areas of shallow-water carbonates. Carbonate production contemporaneous with volcanism in areas shielded from volcaniclastic input)

Wilson, M.E.J. & A. Ascaria (2000)- The Cenozoic carbonates and petroleum systems of South Sulawesi. IPA Field Excursion, October 2003, 55p.

Wilson, M.E.J., N.A. Ascaria, D.Q. Coffield & N. Guritno (1997)- The petroleum systems of South Sulawesi, Indonesia. In: J.V.C. Howes & R.A. Noble (eds.) Proc. Conf. Petroleum Systems of SE Asia and Australasia, Indon. Petroleum Assoc. (IPA), Jakarta, p. 561-567.
(S Sulawesi early Tertiary transgressive sequences marginal marine clastics passing upwards into carbonates overlain by deeper marine sediments. In S Sulawesi, late Tertiary magmatism and subsequent Pliocene orogenesis resulted in the formation of multiple kitchen areas)

Wilson, M.E.J. & D.W.J. Bosence (1996)- The Tertiary evolution of South Sulawesi: a record in redeposited carbonates of the Tonasa Limestone Formation. In: R. Hall & D.J. Blundell (eds.) Tectonic evolution of Southeast Asia, Geol. Soc., London, Spec. Publ. 106, p. 365-389.
(Redeposited carbonate facies of Eocene- M Miocene Tonasa Limestone Fm reliable indicators of tectonic activity. Immaturity and provenance of clasts indicate redeposited facies derived from faulted N margin of

Tonasa Carbonate platform. Three main faulting phases indicated by redeposited facies: Late Eocene- E Oligocene, M Oligocene and E-M Miocene)

Wilson, M.E.J. & D.W.J. Bosence (1997)- Platform-top and ramp deposits of the Tonasa carbonate platform, Sulawesi, Indonesia. In: A.J. Fraser, S.J. Matthews & R.W. Murphy (eds.) Petroleum geology of Southeast Asia. Geol. Soc. London, Spec. Publ. 126, p. 247-279.
(Facies analysis of shallow-water platform and ramp deposits of SW Sulawesi Late Eocene- M Miocene Tonasa carbonate platform. Platform dominated by foraminifera and had ramp-type S margin. Facies belts on platform trend E-W, remaining remarkably stable through time indicating aggradation of platform-top. Outer ramp deposits prograded S at intervals into basinal marls. Moderate- to high-energy platform top or redeposited carbonate facies may form hydrocarbon reservoirs)

Wilson, M.E.J., D.W.J. Bosence & A. Limbong (2000)- Tertiary syntectonic carbonate platform development in Indonesia. Sedimentology 47, p. 395-419.
(Evolution of syntectonic Eocene- M Miocene Tonasa Fm, SW Sulawesi. Deposited initially as part of transgressive sequence in backarc setting. By late Eocene shallow-water carbonates deposited over much of S Sulawesi forming 100-km long platform. Shallow-water sedimentation continued in parts of platform until M Miocene. Elsewhere, normal faulting created fault-block platforms, with local subaerial exposure of footwalls and formation of graben. Platform-top facies aggradational and dominated by larger foraminifera. Faults periodically active and formed steep escarpment margins. Regional subsidence and extension low on margins of backarc basin. Shallow-water accumulation rates for this foraminifera-dominated carbonate platform order of magnitude lower than those for modern warm-water platforms dominated by corals or ooids)

Wilson, M.E.J. & S.J. Moss (1999)- Cenozoic palaeogeographic evolution of Sulawesi and Borneo. Palaeogeogr. Palaeoclim. Palaeoecology 145, p. 303-337.
(Early Eocene- Pliocene paleogeographic maps on plate tectonic reconstructions illustrate evolution of Borneo and Sulawesi in Tertiary. Progressive accretion of continental and oceanic material from E onto E margin of Sundaland, with resultant development of volcanic arcs. Large tracts of W Sulawesi, E Borneo, E Java Sea and Makassar Straits formed extensive basinal area through much of Tertiary)

Wing Easton, N. (1918)- Rustig of dansend Celebes? Beschouwingen, studien en kritieken naar aanleiding van E.C. Abendanon's "Geologische en geografische doorkruisingen van Midden-Celebes". Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 35, p. 606-677.
('Quiet or dancing Sulawesi?' Lengthy, critical review of Abendanon 1915 classic books on Sulawesi fieldwork)

Witkamp, H. (1940)- Langs de Lariang rivier (West Celebes). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 47, p. 581-600.
('Along the Lariang River, W Sulawesi'. Report of travel up river, with some minor geological observations)

Wunderlin, W. (1913)- Beitrage zur Kenntnis der Gesteine von Sudost-Celebes. Sammlungen Geol. Reichs-Museums Leiden, Ser. 1, 9, p. 244-280.
(online at: www.repository.naturalis.nl/document/552396)
('Contributions to the knowledge of rocks from SE Sulawesi'. Descriptions of rocks from SE Sulawesi and nearby islands Buton, Kabaena and Rumbia, collected by Elbert in 1909. Includes ultramafic rocks (hartzburgite, serpentinite, gabbro) from Buton, Rumbia and Kabaena, metamorphics (amphibolite, glaucophane schist) from Rumbia island and Mendoke Mts on SE Sulawesi. Six types of glaucophane-bearing rocks)

Yadi, V. (2011)- Successful geostatistical approach for a nickel ore deposit; a case study for nickel laterite deposit in central I pit, Kabaena nickel mine, Kabaena Island, southeast Sulawesi, Indonesia. In: Proc. 8th Int. Mining Geology conference, Australasian Inst. of Mining and Metallurgy (AusIMM), Melbourne, 8, p. 463-468.

Yamamoto, M., A. Maulana, K. Yonezu, K. Watanabe & A. Subehan (2015)- Geochemistry and mineralization characteristic of Sungai Mak deposit in Gorontalo, Northern Sulawesi, Indonesia. Int. J. Engineering and Science Applications (UNHAS) 2, 2, p. 99-105.
(online at: http://pasca.unhas.ac.id/ojs/index.php/ijesca/article/view/154/109)
(Gold-copper mineralization associated with granodiorite of Sungei Mak in Gorontalo similar to other porphyry copper deposit(s) in Tombolilato District (>3400m thick Late Miocene- Pleistocene island arc-type volcano-sedimentary pile)

Yoshida, T., C. Hashullah & T. Ohtagaki (1982)- Kuroko-type deposits in Sangkaropi area, Sulawesi, Indonesia. Mining Geology 32, 175, p. 369-377.
(online at: www.journalarchive.jst.go.jp/...)
('Kuroko-type' deposits in Miocene (more likely Late Eocene- E Oligocene?; JTvG) rhyolitic pyroclastic arc volcanics in central part of W Sulawesi. Ore deposits in Sangkaropi area associated with submarine volcanism. Some deposits stratiform, covered with thin barite layer. Ore minerals include sphalerite, galena, chalcopyrite, pyrite, tetrahedrite, bornite, etc.)

Yulianto, I. (2003)- Neogene magmatic arc in the Minahasa Region, North Sulawesi, Indonesia. In: B. Ratanasthien et al. (eds.) Pacific Neogene paleoenvironments and their evolution, 8th Int. Congress on Pacific Neogene Stratigraphy, Chiang Mai, 2003, p.

Yulihanto, B. (2004)- Hydrocarbon play analysis of the Bone Basin, South Sulawesi. In: R.A. Noble et al. (eds.) Proc. Deepwater and frontier exploration in Asia & Australasia Symposium, Jakarta, Indon. Petroleum Assoc. (IPA), p. 333-348.
(Bone Basin of S Sulawesi between SW volcanic arc and SE collision complex. Rimmed by N-S faults. Tertiary sedimentation M-Late Eocene or older syn-rift deltaic-shallow marine sediments (Toraja/ Malawa Fm), followed by Oligo-Miocene marine carbonates and clastics (Tonasa/ Makale Fm). M Miocene- Pliocene clastic/volcanoclastic deposits with carbonates in parts of basin. Late Miocene shallow marine carbonates (Camba Fm, Tacipi Fm), laterally changing to deep marine sediments, followed by Late Miocene-Pliocene progradational sediments (Walanae Fm). M-Late Eocene deltaic-shallow marine syn-rift sediment potential source rock that reached maturity in M-Late Miocene. With facies maps for 5 time slices)

Yuwono, Y.S. (1987)- Contribution a l'etude du volcanisme potassique de l'Indonesie. Exemples du Sud-Ouest de Sulawesi et du volcan Muria (Java). Doct. Sci. Thesis, Universite de Bretagne Occidentale, Brest, vol. 1, p. 1-285, vol. 2, p. 1-166. *(Unpublished)*
('Contribution to the study of potassic volcanism of Indonesia; examples from SW Sulawesi and the Muria volcano (Java)')

Yuwono, Y.S. (1988)- G. Lompobotang, Sulawesi Selatan, petrologi dan mineralogi. Proc. 17th Ann. Conv. Indon. Assoc. Geol. (IAGI), p.
('Lompobotang Mountain, S Sulawesi, petrology and mineralogy')

Yuwono, Y.S. (1989)- Petrologi dan mineralogi Gunung Lompobattang, Sulawesi Selatan. Geologi Indonesia (IAGI), 12, 1, p. 483-509.
('Petrology and mineralogy of Lompobattang Mountain, S Sulawesi'. Volcano in SE part of S Arm)

Yuwono, Y.S. (1990)- Produk volkanik Pare-Pare (Sulawesi Selatan): contoh deret shoshonitik di Indonesia. Proc. 19th Ann. Conv. Indon. Assoc. Geol. (IAGI), 2, p. 68-90.
('Volcanic products of Pare-Pare (S. Sulawesi): an example of a shoshonitic sequence in Indonesia')

Yuwono, Y.S., H. Bellon, R. Soeria-Atmadja & R.C. Maury (1985)- Neogene and Pleistocene volcanism in South Sulawesi. Proc. 14th Ann. Conv. Indon. Geol. (IAGI), Jakarta 1985, p. 169-179.
(S-most Sulawesi volcanics late M Miocene (12 Ma)- Pleistocene (1.2 Ma), not typical calc-alkaline subduction volcanics. Most rocks silica-undersaturated. Paleocene subduction responsible for arc volcanics. Second W-dipping subduction phase in E Miocene, terminating with collision of W and E arms and obduction of oceanic

fragments. From end M Miocene- Pleistocene high K volcanism not linked to subduction, but developed in extensional intraplate context)

Yuwono, Y.S., S. Digdowirogo, J. Cotton, H. Bellon & B. Priadi (1995)- Petrology of some magmatic rocks from North Sulawesi, Indonesia. Jurnal Teknologi Mineral (ITB) 2, 3, p. 21-32.
(Fourteen magmatic rock samples from N Sulawesi, collected in 1989-1990. Four samples selected for K/Ar dating. Subduction-type magmatism with orogenic tholeiitic and calc alkaline affinities from Oligocene(?)- M Miocene. Post-M Miocene magmatic activity of shoshonitic affinity believed to be post subduction. Evolution of N Sulawesi similar to C portions of magmatic arc of W Sulawesi, with subduction ending in M Miocene, coinciding with start of collision between E and W Arms of Sulawesi)

Yuwono, Y.S., R.C. Maury, R. Soeria-Atmadja & H. Bellon (1988)- Tertiary and Quaternary geodynamic evolution of South Sulawesi: constraints from the study of volcanic units. Geologi Indonesia 13, 1, p. 32-48.
(S Sulawesi M Miocene and older volcanic rocks are of 'orogenic origin'. Volcanics younger than M Miocene not related to subduction)

Zaccarini, F., A. Idrus & G. Garuti (2016)- Chromite composition and accessory minerals in chromitites from Sulawesi, Indonesia: their genetic significance. Minerals 6, 46, p. 1-23.
(online at: www.mdpi.com/2075-163X/6/2/46/pdf)
(Chromite from S and SE Arms of Sulawesi varies from Cr-rich to Al-rich. Small platinum-group minerals (PGM) in chromitites mainly laurite. Accumulation of Cr-rich chromitites probably at deep mantle level, Al-rich chromitites close or above Moho-transition zone. All laurites considered to be magmatic in origin)

Zaitun, S., D.H. Amijaya, J. Setyowiyoto & A.H. Satyana (2016)- Oil classification and genetic type of gas in Tiaka, Matindok, Donggi, Senoro fields and surrounding area in Banggai Basin, Central Sulawesi. Proc. GEOSEA XIV and 45th Ann. Conv. Indon. Assoc. Geologists (IAGI) (GIC 2016), Bandung, p. 509-523.
(Tiaka offshore oil field and Matindok, Minahaki, Donggi and Senoro onshore gas fields Banggai Basin, E Sulawesi, sourced from Tertiary (high oleanane). Two oil types, A and B, generated from marine carbonate and shale source rocks. Senoro gas thermogenic, formed from secondary cracking. Matindok gas thermogenic, generated from mixed gas source and the most mature gas)

Zakaria, Z. & Sidarto (2015)- Aktifitas tektonik di Sulawesi dan sekitarnya sejak Mesozoikum hingga kini sebagai akibat interaksi aktifitas tektonik lempeng tektonik utama di sekitarnya. J. Geologi Sumberdaya Mineral 16, 3, p. 115-127.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/36/37)
('Tectonic activity in Sulawesi and surrounding areas since the Mesozoic to Recent as a result of the interaction of tectonic activity of the surrounding main tectonic plates'. Review of tectonic development of Sulawesi region)

Zhu, Z., C. Zhao & Z. Yang (2008)- Distribution and geochemical characteristics of adakites and adakite-like rocks in Sulawesi, Indonesia. J. Jilin University (Earth Science Ed.), 39, p. 80-88.
(In Chinese with English summary. Published information suggests 25 mid-acidic rock samples that may be considered as normal or adakite-like rocks in S, C, NW and N Sulawesi, forming Cenozoic adakite belt at Sundaland margin. Sulawesi adakites belong to tholeiitic, calc-alkaline and high K calc-alkaline series, characterized by low Y and Yb of heavy REE elements and high Sr. Two types: (1) oceanic island arc and/or continental margin arc and high K calc-alkaline series related to continental adakites)

Zulkarnain, I. (1994)- Lingkungan tektonik komplek Bantimala: implikasinya terhadap kualitas mineral garnet sebagai batu mulia. Proc. 30th Anniv. Symp., Res. Dev. Centre for Geotechnology (LIPI), p.
('Tectonic environment of the Bantimala complex: implications for quality of garnet minerals as gemstones')

Zulkarnain, I. (1999)- Cretaceous tectonic events of the Bantimala Area, South Sulawesi, Indonesia; evidence from rock chemistry. Jurnal Teknologi Mineral (ITB) 6, 2, p. 65-77.
(Bantimala Complex melange, Albian-Cenomanian chert, basalt, ultramafics and various grade metamorphic rocks, dated as 132-114 Ma. Wide SiO2 range (44-86%) in 36 metamorphic rocks precursor rocks vary from

basaltic to granitic to sedimentary rock. Glaucophane indicates origin in subduction system, exhumed from different levels of Benioff zone. High-P metamorphic rocks granitic and sedimentary character indicating derivation from micro continent. Subduction system ceased when micro continent subducted in Mid-Cretaceous. Exhumation of metamorphic rocks just after metamorphism and before deposition of chert)

Zulkarnain, I. (2001)- Rock chemistry of Quarternary volcanics around Manado and Siau Island, North Sulawesi. Jurnal Teknologi Mineral (ITB) 8, 1, p. 37-52.
(Volcanic rocks around Manado two suites based on position in subduction zone: (1) trench-side (E of Manado; lower trace element content (Ba, Nb, Rb, Sr), and longer crystallization history, producing wide range in composition from basaltic to dacitic) and (2) backarc (N and W of Manado; more primitive with narrow range in composition (basaltic to andesitic) and higher content of trace elements). Volcanics from Siau classified as trench-side type)

Zulkarnain, I. (2002)- Geochemical signatures of volcanic rocks from Sangihe Island, North Sulawesi, Indonesia. Buletin Geologi (ITB) 34, p. 21-33.

Zulkarnain, I., J. Sopaheluwakan, K. Miyazaki & K. Wakita (1995)- Elements transfer during basalt metamorphism: the case of Bantimala eclogite. J. Riset Geologi Pertambangan (LIPI) 1, 1, p. 42-55.
(online at: http://pustaka.geotek.lipi.go.id/wp-content/uploads/2016/02/Riset-Vol.1-No.1-1995-.pdf)
(On transfer of elements during basalt metamorphism to greenschist, blueschist and eclogite in Triassic-Jurassic-age Bantimala Complex of SW Sulawesi (mainly introducing water, removing calcite))

Zulkarnain, I., J. Sopaheluwakan & E.T. Sumarnadi (1993)- Komplek Malihan Bontoria, daerah Mangilu, Kabupaten Pangkejene Kepulauan, Sulawesi Selatan. Seminar of Research results of R&D Centre for Geotechnology LIPI, p.
('Bontoria metamorphic complex, Mangilu area, Pangkajene Kepulauan District, S Sulawesi')

Zulkarnain, I., J. Sopaheluwakan, K. Wakita & K. Miyazaki (1993)- The origin of the Bantimala eclogite: a preliminary view. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 147-158.
(Bantimala complex 50km N of Makassar, SW Sulawesi, with Bontoria Fm high pressure metamorphics (glaucophane schist, eclogite) underlie Late Cretaceous Balangbaru Fm flysch. K/Ar date of muscovite in schist 132 Ma; exhumation probably several 10’s of Myrs later. Precursor rock is trench greywacke sandstone (most other blueschists from basalt or oceanic crust), probably subducted to 10’s of km to 350- 520°C, 8-18 kb)

V.2. Buton, Tukang Besi

Ali, J.R., J. Milsom, E.M. Finch & B. Mubroto (1996)- SE Sundaland accretion: palaeomagnetic evidence of large Plio-Pleistocene thin skin rotations in Buton. In: R. Hall & D. Blundell (eds.) Tectonic evolution of Southeast Asia, Geol. Soc. London, Spec. Publ. 106, p. 431-444.
(Tukang Besi Platform docked with Sundaland/East Buton in Pliocene. Wide array of paleomagnetic results of surface sediments suggest thin-skinned block rotations)

Alviyanda, G.M.L. Junursyah, I.S. Gumilar & U. Mardiana (2014)- Interpretation of subsurface structure in Tersier sediment based on magnetotelluric data, South Buton Area. Proc. 38th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA14-SG-0545, 13p.

Arifin, L. & T. Naibaho (2015)- Struktur geologi Pulau Buton Selatan. J. Geologi Kelautan 13, 3, p. 143-151.
(online at: http://ejournal.mgi.esdm.go.id/index.php/jgk/article/view/269/259)
('Geological structure south of Buton island'. Shallow reflection seismic lines in waters S of Buton and Muna)

Arisona, A., M. Nawawi, U.K. Nuraddeen & M. Hamzah (2016)- A preliminary mineralogical evaluation study of natural asphalt rock characterization, southeast Sulawesi, Indonesia. Arabian J. Geosciences 9, 272, 9p.
(Bitumen content of 'Asbuton' 10-40%. Geoelectrical resistivity survey and x-ray fluorescence shows Ca is dominant element in asphalt rock (40-90%), indicating limestone (surprise!))

Beets, C. (1943)- Beitrage zur Kenntnis der angeblich oberoligocanen Mollusken-Fauna der Insel Buton, Niederlandsch-Ostindien. Leidsche Geol. Mededelingen 13, p. 256-328.
('Contributions to the knowledge of the supposedly Oligocene-age mollusc fauna of Buton Island, Netherlands East Indies'. Description of molluscs from asphalt beds on Buton in collections in The Netherlands. Looks like diverse, but endemic faunas (51 new species and 11 species described by Martin 1933- 1935, 1937). Age of fauna uncertain, but possibly Late Oligocene as suggested by Martin (in Beets 1952 believed to be younger))

Beets, C. (1943)- On *Waisiuthyrina*, a new articulate brachiopod genus from the Upper Oligocene of Buton (S.E. Celebes), Dutch East Indies. Leidsche Geol. Mededelingen 13, p. 341-347.
(online at: www.repository.naturalis.nl/document/549268)
(Description of new species of terebratulid brachiopod Waisiuthyrina margineplicata from ?Miocene asphalt rocks of Buton. Brachiopods are generally very rare in Tertiary of Indonesia)

Beets, C. (1943)- Weitere Verwandtschaftsbeziehungen zwischen den Oberoligocaenen Mollusken von Buton (S.E. Celebes) und den Neogenfaunen des Ostindischen Archipels. Leidsche Geol. Mededelingen 13, p. 349-355.
(online at: www.repository.naturalis.nl/document/549308)
('Additional relationships between the Upper Oligocene molluscs from Buton (SE Sulawesi) and the Neogene faunas of the East Indies archipelago'. 'Oligocene' Buton mollusc faunas mostly endemic in character, but most similarities with Late Neogene of Ceram and Nias)

Beets, C. (1952)- Reconsideration of the so-called Oligocene fauna in the asphaltic deposits of Buton (Malay Archipelago). 1. Mio-Pliocene mollusca. Leidsche Geol. Mededelingen 17, 1, p. 237-258.
(online at: www.repository.naturalis.nl/document/549592)
(Molluscs from asphaltic marls of Buton previously considered Oligocene- lowermost Miocene in age, but here re-interpreted as Mio-Pliocene, partly based on associated diatoms (Reinhold) and foraminifera (Keijzer). The low % of Recent species because this is deep water fauna, of which Recent representatives were poorly known)

Bothe, A.C.D. (1928)- De asfaltgesteenten van het eiland Boeton, hun voorkomen en economische betekenis. De Ingenieur 19, Mijnbouw 4, p. 27-45.
('The asphalt rocks of Buton Island, distribution and economic significance')

Bothe, A.C.D. (1928)- Voorkomen en winning der asfaltgesteenten van Boeton. De Mijningenieur, 1928, p. 88.

Chamberlain, M.I., R.D. Seago, Soebardi & Sumitra (1990)- Hydrocarbon prospectivity of Buton Island, SE Sulawesi, Indonesia. Earth Resources Inst. (ESRI) Rept. EIB90-1, p. 1-232. *(Unpublished)*

Corne, C.P. & Soehartono (1989)- Utilization of Buton Island rock asphalt in road pavements. In: R.F. Meyer & E.J. Wiggins (eds.) Proc. 4th UNITAR/UNDP Int. Conf. on Heavy crude and tar sands, Edmonton 1988, 2, Alberta Oil Sands Technology and Research Authority, p. 397-412.

Davidson, J.W. (1991)- The geology and prospectivity of Buton island, southeast Sulawesi, Indonesia. Proc. 20th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 209-234.
(Stratigraphy-structure Buton different from SE Sulawesi-Muna; more similar to Timor, Seram, Buru. Sedimentation controlled by four tectonic events: (1) 'Pre-Rift'- Permian(?) metasediments, unconformably overlain by E Triassic turbidites derived from Australia- New Guinea continent; (2) 'Rift-Drift'- Late Triassic rifting (turbidites), M Jurassic breakup, and Late Jurassic- Oligocene NW drift (deep marine calcilutites) from Australia- New Guinea; (3-4) 'Syn and Post-Orogenic'- E-M Miocene coarse clastics, Late Miocene fine clastics, and Pliocene marls-claystones. Coarse clastics deposited in intra-thrust basins, generated by E-M Miocene collision of Buton microcontinent with Muna/ SE Sulawesi. Pliocene sedimentation coincided with regional subsidence of Buton following accretion of island to Sulawesi, and E shift of subduction zone)

Emmerton, S., A.R. Muxworthy, M.Sephto, M. Aldana, V. Costanzo-Alvarez, G. Bayona & W. Williams (2013)- Correlating biodegradation to magnetization in oil bearing sedimentary rocks. Geochimica Cosmochimica Acta 112, p. 146-165.
(Study on relationship between biodegraded tar sands and magnetization. Includes analyses on tar sands of Tondo Fm at Kabungka and Lawele on Buton island)

Escher, B.G. (1920)- Atollen in den Nederlandsch-Oost-Indischen Archipel. De riffen in de groep der Toekang Besi-eilanden. Meded. Encycl. Bureau, Batavia, 22, 18p.
('Atolls in the Netherlands East Indies Archipelago: the reefs in the Tukang Besi Group'. Some of modern Tukang Besi reefs off SE Sulawesi true atolls up to 48km long, some small barrier reefs around islands up to 274m in height. Reefs arranged in four NW-SE trending rows, possibly controlled by two anticlinal axes (with barrier reefs) and two synclinal axes (with atolls))

Fortuin, A.R., M.E.M. De Smet, S. Hadiwasastra, L.J. van Marle, S.R. Troelstra & S. Tjokrosapoetro (1990)- Late Cenozoic sedimentary and tectonic history of south Buton, Indonesia. J. Southeast Asian Earth Sci. 4, 2, p. 107-124.
(Late Cenozoic deposition started at 11 Ma after main pre-Neogene deformation, presumably related to collision of Buton microplate with SE Sulawesi. Rapid Late Miocene- E Pliocene subsidence, initially with coarse clastic Tondo Fm gravity flows, followed by later Late Miocene Sampolakosa Fm pelagic deposition. Late Pliocene (3.5 Ma) start of uplift, probably caused by collision between Buton and Tukang Besi Platform submerged microcontinent, and causing 60° clockwise rotation of S Buton)

Hadiwisastra, S. (2009)- Kondisi aspal dalam Cekungan Buton. J. Riset Geologi Pertambangan (LIPI) 19, 1, p. 49-57.
(online at: http://download.portalgaruda.org/)
('Condition of asphalt in the Buton Basin'. Buton heavy asphalt in outcrop in S Buton. Reservoired in Neogene Sampolakosa and Tondo units in SW-NE trending Lawele Graben)

Hadiyanto, S.M. Tobing & H. Fujiono (2009)- Oil shale prospect in the Buton Island, Southeast Sulawesi, Indonesia. In: 29th Oil Shale symposium, Colorado School of Mines, Golden 2009, 47p.
(Abstract and presentation online at: www.costar-mines.org/oss/29/presentations/PRES_12-3_Hadiyanto_Fujiono_-_Hendro.pdf)
(Two types of oil shale on Buton: primary oil shale in Late Triassic Winto Fm and secondary asphalt rock/ tar sand in Mio-Pliocene Sampolakosa and Tondo Fms. Hypothetical resource of primary shale is 158 mT oil, secondary 3.6 billion tons asphalt (=226 MB Oil))

Hetzel, W.H. (1930)- Over de geologie der Toekang Besi eilanden. De Mijningenieur 11, 3, p. 51-53.
('On the geology of the Tukang Besi islands'. Uplifted islands of Tomea, Wangiwangi and Kaledupa mainly composed of late Neogene Globigerina limestones. Strike of folded Tertiary beds at right angles to NW-SE trend of rows of raised islands and atolls, suggesting earlier phase of folding, followed by later block-faulting)

Hetzel, W.H. (1936)- Verslag van het onderzoek naar het voorkomen van asfaltgesteenten op het eiland Boeton. Verslagen en Mededeelingen betreffende Indies delfstofkunde en hare toepassingen, Dienst Mijnbouw Nederlandsch-Indie, Batavia, 21, p. 1-56.
('Report of an investigation of the occurrence of asphalt-bearing rocks on Buton Island'. Detailed descriptions of surface asphalt deposits, probably originated from Triassic oil. Bitumen impregnations in Miocene sandstones and Pliocene Globigerina marls, unconformably overlying complexly folded, deep marine Triassic-Cretaceous (-Eocene?) sediment series. With 1:200,000 scale geologic map of Buton and detail maps of asphalt terrains)

Hetzel, W.H. (1936)- Boetoniet, een bijzonder gesteente van het eiland Boeton (ZO Celebes). De Ing. In Nederl. Indie, Sect. IV, 5, 10, p. 151-155.
('Boetoniet, a peculiar rock type from Buton isand'. Dark, glassy rock found along margins of peridotite named 'Boetonite'. Mainly in S Buton, at W side of Kapantoreh Mountains. Commonly as veins in Triassic and Neogene. Contain chromite and marcasite. Possibly hydrothermal weathering product near ultrabasic rocks)

Horizon/ Robertson (2004)- Buton prospectivity screening study. Multi-client study, Jakarta, 118p. *(Unpublished)*

Janssen, A.W. (1999)- Euthecosomatous gastropods (Mollusca: Heterobranchia) from Buton (SE Sulawesi, Indonesia), with notes on species from Viti Levu, Fiji; systematics, biostratigraphy. Geologie en Mijnbouw 78, 2, p. 179-189.
(Revision of pteropoda from asphaltic deposits of Buton (Sampolakosa Beds?). Faunas first described by Martin (1935) and Beets (1943, 1950, 1953). Beets recognized this as deep marine fauna, of probable Mio-Pliocene age. With planktonic gastropods (pteropods), incl. Styliola subula, Cavolinia bituminata, C. mexicana. and Diacria mbaensis. Comparison with Fiji associations suggests Late Miocene age for Buton faunas (Tortonian- Messinian; fits with ages conluded from microfaunas by Fortuin et al. 1990; JTvG))

Kanehara, K. (1943)- Boeton Island (Dutch East Indies), its geology, asphalt and manganese ore. Chigaku Zasshi (= J. Geography, Tokyo) 55, 653, p. 237-264.
(Review of Hetzel (1936) original report on geology of Buton island)

Keijzer, F.G. (1945)- Upper Cretaceous smaller foraminifera from Buton (D.E.I.). Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 48, p. 338-339.
(online at: www.dwc.knaw.nl/DL/publications/PU00017937.pdf)
(Tertiary asphalt-bearing marls of Buton generally pure Globigerina-Globorotalia-marls, probably Neogene. One sample with angular white and grey pieces of limestone (resembling Cretaceous Globotruncana-limestones), grey and black pieces of chert, and common reworked Upper Cretaceous planktonic foraminifera, incl. Globotruncana arca, Gt. calcarata, Pseudotextularia varians, Planoglobulina acervulinoides, Bolivinoides seranensis, Globorotalia velascoensis (= Paleocene?; JTvG), etc.). Fauna very similar to U Cretaceous fauna from Seram, described by Van der Sluis (1949))

Keijzer, F.G. (1953)- Reconsideration of the so-called Oligocene fauna in the asphaltic deposits of Buton (Malay Archipelago). 2. Young-Neogene foraminifera and calcareous algae. Leidsche Geol. Mededelingen 17, p. 259-293.
(online at: www.repository.naturalis.nl/document/549557)
(Buton asphalt-bearing marls contain 333 species of deep marine benthic foraminifera, incl.many species of Bolivina, Cassidulina, Cristellaria, Dentalina, Lagena, Nodosaria, Planulina, Siphogenerina, Sphaeroidina, etc., Also planktonics, incl. Globorotalia tumida flexuosa and Gq. altispira, demonstrating Pliocene age, not Oligocene as previously postulated. Also: (1) breccia with reworked U Cretaceous clasts and Globotruncana

planktonic forams (indicative of mud volcanism?); (2) sample W-10 from Wariti asphalt field with M Miocene larger forams Katacycloclypeus, Miogypsina, Lep. (T.) rutteni; (3) Halimeda. With appendix on sample from Bawean with E-M Miocene larger forams Lepidocyclina (N) and Miogypsina primitiva. (Amphimorphinella butonensis Keijzer indicator of hydrocarbon seepage?; Hayward et al. 2011))

Koswara, A. & D. Sukarna (1994)- Geological map of the Tukang Besi sheet, Southeast Sulawesi. Geol. Res. Dev. Centre (GRDC), Bandung. 14p.
(Tukang Besi islands mainly Quaternary coral reef limestone, unconformably over core of latest Miocene-Pliocene Ambeuwa Fm Globigerina marls, dipping 15-30°?. Wowoni Island N of Buton has juxtaposed ?Triassic metamorphics, Cretaceous? ultramafics overlain by M-L Miocene Lampeapi Fm conglomerate, sandstones with coals, overlain by Late Miocene- Pliocene Lansilowo Fms marls, limestone and sandstones)

Kuenen, P.H. (1928)- Geologische problemen in verband met de Toekang-Besi eilanden. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, ser. 2, 45, 2, p. 236-247.
('Geological problems associated with the Tukang Besi islands'. Tukang Besi islands SE of Sulawesi four rows of atolls, possibly all associated with young NW-SE trending anticlinal structures)

Kuenen, P.H. (1933)- The formation of the atolls in the Toekang-Besi-group by subsidence. Proc. Kon. Akademie Wetenschappen, Amsterdam 36, 3, p. 331-336.
(online at: www.dwc.knaw.nl/DL/publications/PU00016412.pdf)
(As described by Escher (1920), Tukang Besi islands are atolls and raised islands arranged along NW-SE fault trends. Post-Pleistocene subsidence produced atolls where reef growth kept up with subsidence)

Ling, H.Y. & R.B. Smith (1995)- Role of Eocene and Cretaceous radiolarians from Buton Island in the Eastern Indonesian collision tectonics. In: Proc. Int. Symposium Geology of SE Asia and adjacent areas, J. Geology, Geol. Survey Vietnam, Hanoi, 5-6, p. 160-161. *(Abstract only)*
(Pre-Neogene Wolio collision complex of N Buton includes samples with early M Eocene radiolaria (U Tobelo Fm of Turumbia Bay) and well-preserved Cretaceous Aptian- Albian radiolaria (Tobelo Fm at Rumu River section of SE Buton))

Martin, K. (1933)- Eine neue Tertiare Molluskenfauna aus dem Indischen Archipel. Leidsche Geol. Mededelingen 6, 1, p. 7-32.
(online at: www.repository.naturalis.nl/document/549740)
('A new Tertiary mollusc fauna from the Indies Archipelago'. Mollusc assemblage of 26 new species from Buton asphalt-bearing marls/ limestones, which are unconformable over folded Mesozoic sediments. Assigned Late Oligocene or E Miocene age (Later interpretations favor Late Miocene-Pliocene ages (e.g. Beets 1952, Keyzer 1953, Fortuin et al. 1990, Janssen 1999))

Martin, K. (1935)- Oligocaene Gastropoden von Buton. Leidsche Geol. Mededelingen 7, 2, p. 111-118.
(online at: www.repository.naturalis.nl/document/549589)
('Oligocene gastropods from Buton'. Molluscs from asphalt-bearing limestones of Buton 35 species, all extinct, suggesting pre-Neogene (Oligocene) age. Nine new gastropod species described here (since then age corrected as Mio-Pliocene; JTvG))

Martin, K. (1937)- Die oligocaenen Mollusken von Buton als Auswurflinge eines Schlammsprudels betrachtet. Leidsche Geol. Mededelingen 8, p. 311-314.
(online at: www.repository.naturalis.nl/document/549248)
('The Oligocene molluscs from Buton, interpreted as clasts of a mud volcano'. Molluscs from Buton originally dated as Oligocene, but Sampolakosa Fm now regarded as Late Neogene age by Hetzel (1936). Older material may be explained as mud volcano ejecta (see also Beets 1952, who argues for Miocene-Pliocene age of Buton molluscs)

Milsom, J. (1992)- Structure and collision history of the Buton continental fragment, Eastern Indonesia. AAPG Int. Conf., Sydney 1992, Search and Discovery Art. 91015. *(Abstract only)*

(Fragment of Australian continental margin now exposed on Buton, SE of Sulawesi. Asphalt reserves support significant local industry. Buton Terrane underwent significant relative rotations and extends beneath adjacent island of Muna. Tukang Besi platform E of Buton may be distinct, unrelated, unit. Ophiolitic rocks exposed on Buton not attached to deep roots and are thin overthrust sheets not marking terrane boundary)

Milsom, J., J. Ali & Sudarwono (1999)- Structure and collision history of the Buton continental fragment, Eastern Indonesia. American Assoc. Petrol. Geol. (AAPG) Bull. 83, p. 1666-1689.
(Buton is Australian-derived continental terrane. Gravity defines present-day W limits of Buton terrane and suggests terrane includes Tukang Besi platform in E. Ophiolitic rocks on Buton no deep roots, but thin and isolated overthrust sheets, and do not mark terrane boundary. Buton separated from Australia in Jurassic or Late Triassic, and collided with Eurasian margin in SE Sulawesi in Oligocene or E Miocene. Extension dominated recent history of area, producing minor separation of Tukang Besi from Buton and dispersion of other fragments, some of which have been incorporated in collision zone in Outer Banda arc. Oil seeps and asphalt deposits of Buton show hydrocarbons can be sourced from these fragments)

Mubroto, B. & J. Ali (1998)- Tectonic rotations indicated by the late Cenozoic paleomagnetic rocks in Buton Island, Southeast Sulawesi, Indonesia. In: J.L. Rau (ed.) Proc. 33rd Sess. Coord. Comm. Coastal and Offshore Programmes E and SE Asia (CCOP), Shanghai 1996, 2, p. 246-258.
(Buton island continental fragment impacted, accreted and uplifted when Tukang-Besi platform began docking with SE Sulawesi in Pliocene (2-3 Ma). Two major structural orientations; N-S in N part, NE-SW in S part, suggesting 60° clockwise rotation of S Buton with respect to N Buton (Fortuin et al. 1989). Data from 41 paleomagnetic sites from Miocene-Pliocene Tondo and Sampolakosa Fms suggest N Buton rotations of ~30° CW and CCW, probably local, C Buton small rotations, and S Buton 30-60° CW rotation. Data imply thin-skinned sheets associated with collision)

Mujito, S. Hadipandoyo & T.H. Sunarsono (1998)- Hydrocarbon resource assessment of the micro continent Buton Basin, southeast Sulawesi, Indonesia. In: J.L. Rau (ed.) Proc. 33rd Sess. Coord. Comm. Coastal and Offshore Programmes E and SE Asia (CCOP), Shanghai 1996, 2, p. 1-9.
(Buton basin assessment of hydrocarbon potential. Primary source rock Late Triassic Winto Fm with up to 16% TOC. Main reservoir Miocene Tondo Fm sandstones. Oil potential max. 1.373 million tons, expected value 0.205 million tons. Gas potential max. 0.412 milliards m3, expected value 0.061 milliards of m3)

Nolan, S.C., M.E.M. de Smet, M. Chamberlain, S. Gafoer, S. Santosa & Soebardi (1989)- Hydrocarbon prospectivity of Buton Island, S.E. Sulawesi, Indonesia. Earth Resources Institute (ESRI) Report, p. 1-99.
(Unpublished)

Okhotnikova, E.S., Y.M. Ganeeva, E.E. Barskaya, G.V. Romanov, T.N. Yusupova et al. (2016)- Composition and physicochemical properties of natural bitumen from the Pasar Wajo deposit (Indonesia). Petroleum Chemistry 56, 8, p. 677-682.
(Bitumen from Pasar Wajo, Buton island classified as asphalt. Low concentrations of sulfur and trace elements and lack of normal-chain hydrocarbons)

Pedoja, K., L. Husson, A. Bezos, A.M. Pastier, A.M. Imran, C. Arias-Ruiz, A.C. Sarr, M. Elliot et al. (2018)- On the long-lasting sequences of coral reef terraces from SE Sulawesi (Indonesia): distribution, formation, and global significance. Quaternary Science Reviews 188, p. 37-57.
(Late Cenozoic coral reef terraces identified on 23 islands of Tukang Besi and Buton archipelagos. Reef terrace sequences from Wangi-Wangi (Buton) and islands of Ular, Siumpu and Kadatua with terraces from last interglacial maximum (MIS 5e; ~122 ka) at elevations <20m, at 34m on W Kadatua. On SE Buton reef terraces up to 650m, with >40 undated strandlines. On Sampolawa Peninsula 18 strandlines up to 430m, possibly as old as 3.8 ± 0.6 Ma)

PT Elnusa Geosains (2005)- Hydrocarbon potential of Buton Basin. Petromin 31, 6, p. 14-20.

PT Robertson Research Utama Indonesia (1989)- A geochemical evalution of field samples (of rock, asphalt, water and gas) from Buton Island, S.E. Sulawesi. Report 139, p. *(Unpublished)*
(Triassic Winto Shale good oil source rock, but presence of gammacerane in widespread asphalts appears to preclude Winto Shale as source)

PT Robertson Research Utama Indonesia (1989)- Results of petrographic analyses Buton Island outcrop samples. Report 140, p. *(Unpublished)*
(Triassic Winto sandstones almost entirely lithic, derived from sediments and metamorphic rocks, and locally common igneous material)

PT Robertson Research Utama Indonesia (1989)- A petroleum geochemical evaluation of four asphaltic stained shallow cores from Lawele Pit, Buton Island. Report 197, p. *(Unpublished)*
(Asphalt analyses suggest degraded oil is isotopically light and derived from terrestrial organic matter. Presence of gammacerane may indicate a hypersaline, marine carbonate or restricted lacustrine source)

Reinhold, T. (1952)- Reconsideration of the so-called Oligocene fauna in the asphaltic deposits of Buton (Malay Archipelago). 3. Report on diatoms. Leidsche Geol. Mededelingen 17, p. 294-297.
(online at: www.repository.naturalis.nl/document/549751)
(Diatoms from asphaltic marls of Buton with species related to Upper Miocene Globigerina marls of Java: Actinodiscus, Coscinodiscus, Hemidiscus, etc.)

Rochmanto, B. & L.M. Adam (2007)- Sedimentary environment of Sampolakosa Formation at Gonda Baru, subdistrict Sorawolio, Bau-Bau, Southeast Sulawesi. Proc. Joint Conv. 32nd HAGI, 36th IAGI, and 29th IATMI, Bali, JCB2007-251, 3p.
(Studied 61m of outcrop of middle part of Sampolakosa Fm at Gonda Baru, Buton. Lithology marine marl with thin limestones and diatomites in middle and lower part. Age Early Pliocene (N18), environment middle shelf-lower slope. Not much detail, no figures)

Rochmanto, B. & Darwin (2007)- Depositional environment of the Tondo Formation at Wakoko River Pasar Wajo Area, District of Buton, Southeast Sulawesi. Proc. 31st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA07-G-101, 6p.
(Student paper on 15m of late M Miocene (zone N14) Tondo Fm section at Wakoko River, S Buton. Coarsening-upward shale-sand packages, interpreted as deltaic depositional environment with tidal and fluvial dominance)

Sartono, S., I. Hendrobusono, H. Murwanto & B. Suprapto (1990)- Tektonik akresi di Buton: olistostrom dan melange diapir. Proc. 19th Ann. Conv. Indon. Assoc. Geol. (IAGI), 2, p. 1-26.
('Accretion tectonics of Buton: olistostrome and melange diapyr')

Satyana, A.H. (2011)- World-class asphalt deposits of Buton Island, SE Sulawesi, Indonesia: geology, geochemistry, mining status and problems. Proc. Sulawesi Mineral Resources Seminar, Manado 2011, Indonesian Soc. Economic Geology (MGEI), 15p.
(Review of asphalt deposits of Buton Island, which have been known since 1920s, and intermittently exploited since 1925. Reserves 100-132 MTonnes of asphalt. Asphalt sourced by Triassic Winto Fm marine shales. Originally medium gravity oils migrated into uplifted and thrusted carbonates of Pliocene Sampolakosa or sandstones of Miocene Tondo Fm, now biodegraded)

Satyana, A.H., C. Irawan & W. Kurniawan (2013)- Revisit geology and geochemistry of Buton asphalt deposits, SE Sulawesi: implications for petroleum exploration of Buton Area. Proc. 37th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA13-G-170, p. 1-18.
(Asphalt deposits of Buton Island, known since 1920's, contain 15-35% asphalt/bitumen, mainly impregnations in Pliocene Sampolakosa Fm carbonates and Miocene Tondo Fm sandstones, in uplifted and intensively thrusted anticlines. Asphalt deposits biodegraded crude oils derived from marine Type II kerogen, tied to Triassic calcareous shales and bituminous limestones of Winto Fm. Sulfur content generally high (2.5- 9.3%.).

Five exploration wells on Buton between 1976-2012, all dry, some with oil shows in Miocene. Nunu oil seep on W Buton contains oleanane, indicating Tertiary source)

Scheiber, R. (1932)- Der Boetonasphalt mit seine Foraminiferen. Asphalt und Teer, Strassenbautechnik 32, p. 659-661.
('The Buton asphalt with its foraminifera'. Obscure reference reporting presence of planktonic foraminifera Pulvinulina (=Globorotalia) menardii and Orbulina universa in asphalt-bearing rocks of Buton. This clearly suggests M Miocene or younger age, not Oligocene as originally suggested by Martin (1934), etc.)

Sikumbang, N., P. Sanyoto, R.J.B. Supandjono & S. Gafoer (1995)- Geologic map of the Buton Sheet, Southeast Sulawesi, 1:250, 000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Geologic map SE Sulawesi Buton/ Muna islands between 4.15 and 5.45° S. Oldest rocks pre-Triassic Mukito Fm metamorphics. Jurassic-Triassic low-metamorphic Doole Fm. Oldest sediments Triassic Winto Fm shale, ~750m thick sandstone and limestone, with bivalves Halobia, Daonella and Monotis salinaria, ammonite Juvavites ceramensis and radiolaria. Early Jurassic Ogena Limestone, pelagic, with ammonites Phylloceras, Psiloceras and Arietites and foraminifera Involutina liassica, Epistomina. Late Jurassic Rumu Fm ~150m red pelagic limestone-marl with manganese deposits and Belemnopsis gerardi, Malayomaorica, Stomiosphaera moluccana and Cadosina fusca. Cretaceous Tobelo Fm deep marine calcilutite with radiolaria, Globotruncana, Heterohelix, etc.. Unconformably overlain by 1300m Miocene Tondo Fm limestone and clastics with oil seeps-asphalt in S Buton (basal limestone latest Oligocene?; JTvG), Pliocene Sampolakosa Fm marls. Late Oligocene collision between Buton Block and SE Sulawesi caused folding-thrusting of Pre-Miocene rocks)

Smith, R.B. (1983)- Sedimentology and tectonics of a Miocene collision complex and overlying late orogenic clastic strata, Buton Island, Eastern Indonesia. Ph.D. Thesis University of California, Santa Cruz, p. 1-254. *(Unpublished) (Buton exposes M Miocene collision complex, overlain by clastics derived from erosion of uplifted complex. In Wolio Complex, lower part of ophiolite sequence juxtaposed with Triassic- Upper Eocene or Oligocene sediments in imbricate series of W-dipping thrust sheets with deep water limestones. Age of collision later in Sulawesi East Arm (Late Miocene) than in Buton (M Miocene). Buton- E Sulawesi collision zone evolved from W-dipping subduction zone. M- Late Miocene clastic strata (Tondo Fm) mostly bathyal marine sediments which accumulated in two separate basins. Lasalimu basin formed just E of uplifted ophiolite thrust front, which provided most of detritus to basin, forming coastal fan-deltas, slope and base-of-slope deposits. Langkalome basin turbidites accumulated W of uplifted ophiolite belt. (N.B.: post-orogenic Tondo Fm limestone member contains Spiroclypeus, signifying earliest Miocene age; thus suggesting collision older than E Miocene?; JTvG))*

Smith, R.B. (1987)- Diachronous Neogene microcontinent collision in Buton and Eastern Sulawesi, Indonesia. Geol. Soc. America (GSA) Ann. Mtg 1987 and Exposition, Abstracts with Programs 19, 7, p. 850. *(Abstract only)*

Smith, R.B. & E.A. Silver (1991)- Geology of a Miocene collision complex Buton, Eastern Indonesia. Geol. Soc. America (GSA) Bull. 103, p. 660-678.
(Buton part of Neogene collision zone along E margin of Sulawesi. Miocene collision of microcontinents with W-dipping subduction zone emplaced Tukang Besi Platform (TBP) against Buton. Buton Wolio collision complex imbricated W-dipping thrust sheets and overturned folds with later steep faults offsetting imbricate stack and controlling present map patterns. Consists of (1) Turumbia Fm mainly Late Triassic- Late Eocene or Oligocene deep-water limestone in E, interpreted as deep-water facies of W TBP margin; (2) Massive peridotite in W, with full ophiolite succession suggested by clasts in overlying conglomerates; (3) Mukito Fm metabasite and metachert remnants of metamorphic sole at base of ophiolite. Pelitic phyllite and quartzite in NE Buton probably slice of TBP continental basement: similar rocks dredged from NE margin of TBP and also form pre-Mesozoic basement of SP. M-U Miocene Tondo Fm clastics derived from uplift and erosion of Wolio Complex, placing M Miocene upper limit on age of TBP collision. Oblique convergence continued into Late Miocene)

Smit Sibinga, G.L. (1928)- De geologische ligging der Boven-Triadische olie- en asfaltafzettingen in de Molukken. Natuurkundig Tijdschrift Nederlandsch-Indie 58, p. 111-121.

('The geological setting of the Upper Triassic oil and asphalt deposits in the Moluccas'. Triassic oil and asphalt deposits in Moluccas (in similar facies on Timor, Ceram, Buru, Buton, SE Sulawesi) formed at edge of Mesozoic Sundaland craton. No figures/ maps)

Soeka, S. (1988)- Late Jurassic (Upper Tithonian) radiolaria from Buton Island, Indonesia. In: Workshop on Radiolaria 1988, University of Auckland, 25p.

Soeka, S. (1991)- Radiolarian faunas from the Tobelo Formation of the Island of Buton, Eastern Indonesia, Ph.D. Thesis, University of Wollongong, Australia, p. 1-399.
(online at: http://ro.uow.edu.au/theses/1401/)
(Tobelo Fm of Buton with low-latitude Tethyan radiolarian faunas, ranging from E Cretaceous- Oligocene. 128 species described, incl 3 new genera (Butonastrum, Discoconocaryomma, Paraxitus) and 29 new species (Butonastrum perkinsi, Triactiscus tumidus, Zanola deweveri, Z. riedeli, Praeconocaryomma sutrismani, Sphaerostylus lukmani, etc.). E Cretaceous (Valanginian)- Oligocene 5 interval zones, 1 range zone and 3 barren zones. Ten datum planes for local biostratigraphic correlations proposed. Paleolatitude interpretation of Buton E Cretaceous (Valanginian-Hauterivian; S Tethyan; 22-30°S) and E Jurassic (Pliensbachian-Toarcian Ogena Fm; S Austral >40°S). M Jurassic 'breakup unconformity between E Jurassic Ogena Fm and Late Jurassic Rumu Fm. Wani Fm with Late Eocene larger forams may be lateral equivalent of upper Tobelo Fm. E Miocene Basal Tondo Lst with peridotite debris unconformable over Late Oligocene? collision complex)

Soeka, S. & Mudjito (1992)- Early Cretaceous- Paleogene radiolarian biostratigraphy from the microcontinent of Buton, eastern Indonesia. Abstracts 29 Int. Geological Congress, Kyoto, p. 252. *(Abstract)*

Soeka, S., Mudjito & Sunarto (1991)- Jurassic-Paleogene paleolatitudes of Buton (Indonesia) as indicated by radiolaria. Proc. 20th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, p. 609. *(Abstract only)*
(Three different radiolarian assemblages in Jurassic- Paleogene of Buton: (1) South Austral assemblage in E Jurassic (Pliensbachian- Toarcian) Ogena Fm, indicating paleolatitude of >40°S; (2) South Tethyan assemblage in E Cretaceous Lower Tobelo Fm (20-30°S) and (3) Tropical assemblage in Tertiary. Support interpretation that Buton was part of Australian continent in Triassic- E Jurassic)

Soeka, S., O.S.R. Ongkosongo, M.N. Suhartati & Helfinalis (2008)- Biostratigrafi dan penelusuran evolusi posisi lintang Pulau Buton sejak Mesozoikum dengan radiolaria. In: S. Husein et al. (eds.) Prosiding Seminar Nasional Ilmu Kebumian 2008, Universitas Gadjah Mada, Yogyakarta, D11, p. 1-15.
('Biostratigraphy and investigation of the evolution of latitudinal position of Buton Island since the Mesozoic with radiolaria')

Sulistyani, L. & Surono (2006)- Facies analysis on the Limestone Member, the Tondo Formation, based on samples taken from Kaisapu Area, Buton, Southeast Sulawesi Province. Proc. Jakarta 2006 Int. Geosciences Conf. and Exhib., Indon. Petroleum Assoc. (IPA), Jakarta, 06-SPG-04, 5p.
(Extended abstract. With facies map of Early Miocene limestone member of Tondo Fm in area in S Buton. Limestone Mb underlain by ultramafic unit in N, interfingers with conglomerate of Tondo Fm Clastic Mb in W and with Sampolakosa Fm in E and S. At time of limestone deposition, land was situated to W, with open marine conditions E of study area. Four limestone facies: mudstone, boundstone, packstone and wackestone)

Tanjung, H., N. Sukarno, I.T. Mandiri & S.H. Sinaga (2009)- Understanding the genesis of Mukito metamorphics: sole metamorphism and geological consideration. Proc. 38th Ann. Conv. Indon. Assoc. Geol. (IAGI), Semarang, PITIAGI2009-085, 1p. *(Abstract only)*
(Mukito Fm metamorphics in Kapantoreh Mts in S Buton associated with Kapantoreh ophiolite. Metamorphics imbricated with Triassic Winto Fm to W and ophiolites to E. Predominance of amphibolite facies (hornblende schist, marble) towards ophiolite, rest is in green-schist facies (epidotic calcite chlorite schist). Petrochemistry suggest calc-alkaline basalts protolith. Interpreted as metamorphic sole, due to ophiolite obduction, formed from metamorphosed Cretaceous-Paleocene Tobelo Fm limestones and basalt dykes)

Tanjung, H., N. Sukarno, Y. Yuskar, H. Hermawan, A.D. Zeiza et al. (2008)- Field observation of Southern Buton: an overview of hydrocarbon manifestation and geological setting. IPA08-SG-074, 18p.
(Literature review of Buton geology, with some field observations and geochemical analyses of source rocks)

Tanjung, H., A.D. Zeiza & I.T. Mandiri (2007)- Trend of petroleum exploration in Buton: an insight from tectonic, stratigraphic and geochemical aspects. Proc. 31st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA07-SG-030, 13p.
(Literature review of Buton geology and hydrocarbon prospectivity. Buton is site of two collisions: (1) between Muna and Buton microcontinents in Miocene, (2) with Tukang Besi micro-continent from E in Plio-Pleistocene (this scenario not commonly accepted; JTvG)).

Thoenes, D. (1936)- Het ontstaan van asfalt-bitumen. Thesis Technical University Delft, p. 1-140. *(Unpublished) ('The origin of asphalt bitumen'. On chemistry and geology of bitumen and formation of natural asphalt, applied to Buton. Buton asphalt here thought to have formed directly from proto-bitumen, without crude oil as intermediate product)*

Tjia, H.D. (1968)- New evidence of Recent diastrophism in East Indonesia. Inst. Technology Bandung (ITB), Dept. Geol. Contr. 69, p. 71-76.
(Absence of two post-glacial sea levels in reef limestones of Tomea, Kaledupa and Wangi-wangi (Tukang Besi islands) interpreted to reflect warping of uplift after 3500-5000 BP)

Tobing, S.M. (2005)- Inventarisasi bitumen padat di daerah Sampolawa, Kabubaten Buton, propinsi Sulawesi Tenggara. Kolokium Hasil Lapangan DIM, 2005, p. 29/1- 29/10.
(http://psdg.bgl.esdm.go.id/kolokium/Batubara/29.%20Prosiding%20SAMPOLAWA%20Buton_N0.8.pdf)
(Survey of oil shale seams in Late Triassic Winto Fm in S Buton. Thickness of seams 0.05- 1.5 m, alternating with lime-siltstone and fine-grained lime-sandstone. Only four oil shale seams >1 m. All samples contain lamalginite (0.5 - 50%). Rocks seem immature (mean vitrinite Rv 0.2- 0.6%). Oil content in samples 5- 40 l/ton. Oil shale resources down to 100m depth in Winto Fm ~4.5 M ton, with 504k Barrels oil)

Triono, U. (2005)- The preliminary survey of solid bitumen accumulation of Kalisusu and surrounding area, Muna Regency, Southeast Sulawesi Province. Kolokium Hasil Lapangan, DIM, 2005, p. 31/1- 31/8.
(online at: http://psdg.bgl.esdm.go.id/kolokium/Batubara/31.%20Prosc%20Kalisusu_No.10.pdf)
(Brief evaluation paper on asphalt on North Buton. Bitumen contained in Late Triassic Winto Fm (resource estimates 2.8 MTons) and Miocene Tondo Fm (6.8 MTons). In Indonesian)

Ubaghs, J.G.H. & C.P.A. Zeylmans van Emmichoven (1947)- De genese der asfaltafzettingen op het eiland Boeton. Bull. Bureau Mines and Geol. Survey Indonesia 1, 1, p. 3-12.
('The genesis of the asphalt deposits on the island of Buton'. Authors dispute theory of impregnation of porous Tertiary strata by oil from Triassic, but believe formation of asphalt beds is due to lateral migration of Tertiary oil which accumulated in definite stratigraphic zone 500-800m above base Tertiary)

Umbgrove, J.H.F. (1943)- Corals from asphalt deposits of the Island Buton (East-Indies). Leidsche Geol. Mededelingen 13, 1, p. 29-37.
(online at: www.repository.naturalis.nl/document/549525)
(Pliocene corals from Buton asphalt deposits at Waisiu. 9 species, 8 of which still living species, incl. Caryophyllia, Stephanotrochus, Cyphastrea, Goniastrea, Favia, Coeloria, Platygyra and Porites Also illustration of fossil coconut)

Verstappen, H.Th. (1957)- Een en ander over het rifpantser van het eiland Muna (Z.O. Celebes). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 74, p. 441-449.
('On the reef cap of the island of Muna'. Reefal limestone over much of Muna island (W of Buton, SE Sulawesi), attributed to multiphase Quaternary uplift. Highest uplifted reefs on S sides of both Muna (445m) and Buton islands (700m); no elevated Quaternary reef cover in N. Muna island tilted WNW and cut by transverse faults

and faults subparallel to Buton straits. Tilting cannot be attributed to horizontal shifting of geanticline, as postulated in literature)

Walley, C.D. & D.T. Moffat (1988)- A review of the geology and hydrocarbon potential of Buton Island, Indonesia. Earth Res. Inst. Report EB88-1, 125p. *(Unpublished study)*

Warga Dalem, M.A. & S. Padmosubroto (1988)- The occurrence of heavy crude and tar sands in Indonesia. In: R.F. Meyer (ed.) Proc. Third UNITAR/UNDP Int. Conference on Heavy Crude and Tar Sands, Long Beach 1985, Alberta Oil Sands Technology and Research Authority, Edmonton, p. 171-183.

Wiryosujono, S. & J.A. Hainim (1978)- Cenozoic sedimentation in Buton Island. In: S. Wiryosujono & A. Sudradjat (eds.) Proc. Regional Conf. Geology and Mineral Resources of Southeast Asia (GEOSEA), Jakarta 1975, Indon. Assoc. Geol. (IAGI), p. 109-119.
(Exposed Cenozoic on Buton island starts with basal conglomerate of M-L Miocene Tondo Fm (with reworked Cretaceous, Eocene, Oligocene forams and clasts of peridotites and Mesozoic limestones), after Late Oligocene- E Miocene folding. Grades upward into flysch-type shale-silt, passing upward into >800m thick latest Miocene- Pliocene (N18-N21) bathyal Sampolakosa Fm marls. Tondo Fm deposited in tectonic trench. Both formations folded in latest Pliocene- E Pleistocene time. Quaternary reefal limestones uplifted to >700m in S Buton. Mesozoic on Buton starts with Late Triassic flysch. Absence of E Jurassic and Lower Cretaceous; U Cretaceous- Eocene (with Hantkenina) Tobelo bathyal pelagic limestones. Late Eocene- Oligocene conglomeratic 'Wani Beds' folded with Mesozoic?)

Zwierzycki, J. (1925)- Olie in de Trias op Boeton. De Mijningenieur 6, 1, p. 15.
('Oil in the Triassic on Buton'. Isoclinally folded Upper Triassic platy limestones, mica-bearing sandstones, and dark claystones-marls with Late Triassic molluscs Halobia, Daonella and Monotis in S part of Buton with some asphalt (similar oil shale on Buru and E Timor?; JTvG). Also Jurassic red sandstone and shales with caniculate belemnites and Jurassic or Cretaceous light colored limestones with foraminifera)