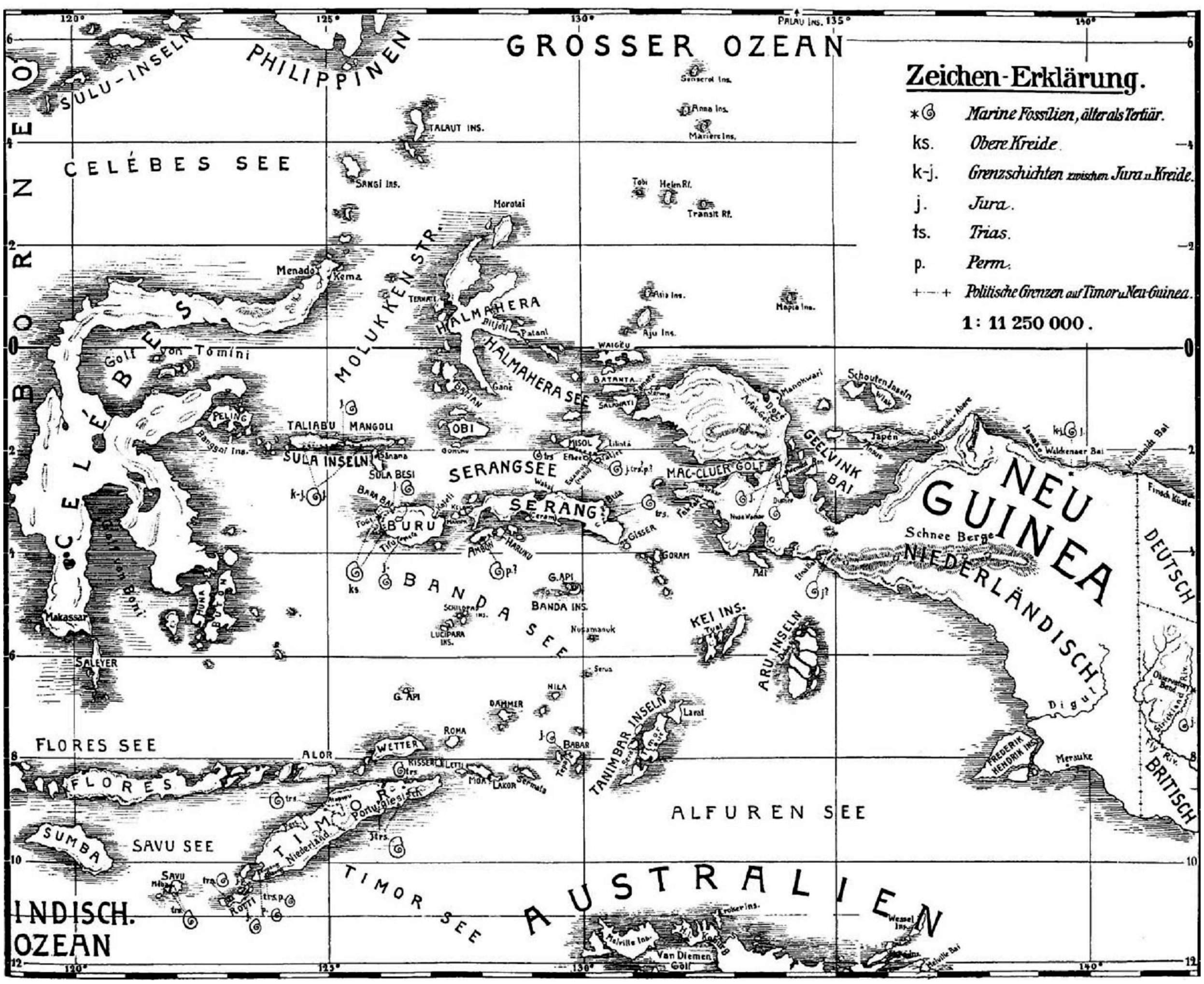
Bibliography of Indonesian Geology

BIBLIOGRAPHY OF THE GEOLOGY OF INDONESIA AND SURROUNDING AREAS

Edition 7.0, July 2018

J.T. VAN GORSEL

VI. NORTH MOLUCCAS (incl. Seram, Sula)



VI. NORTH MOLUCCAS

This chapter VI of Bibliography Ed. 7.0 deals with the northernmost part of the Indonesian Archipelago. It contains 67 pages, with 423 titles, and is divided into three sub-chapters.

The North Moluccas are a geologically complex region with a number of active volcanic arcs, non-volcanic 'outer arcs', fragments of remnant arcs, microcontinents, and deep basins floored by oceanic crust.

VI.1. Halmahera, Bacan, Waigeo, Yapen, Molucca Sea

Sub-chapter VI.1. contains 155 references on the geology of the Halmahera region.

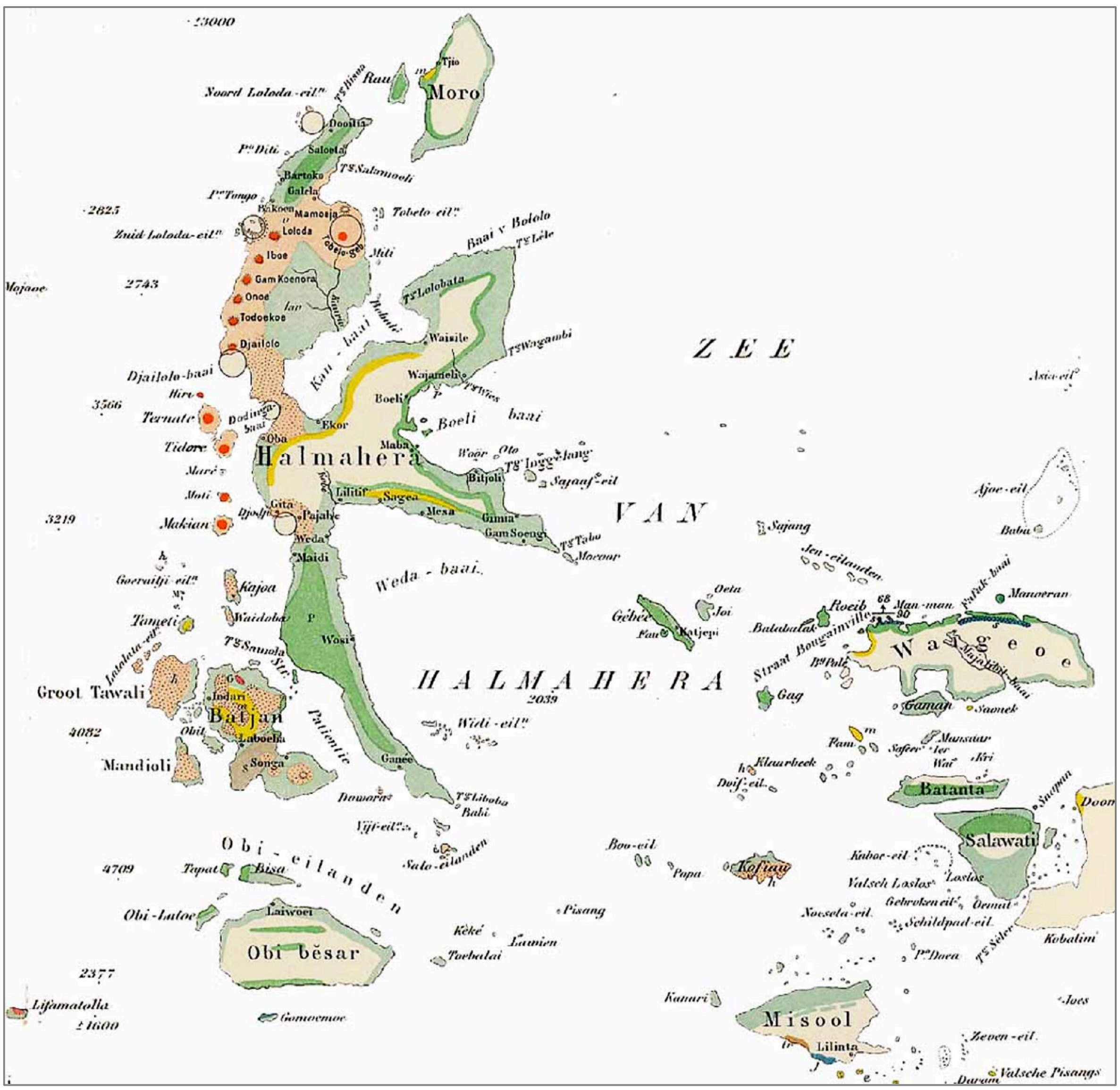


Figure VI.1.1. Early geologic map of Halmahera- Bacan- Waigeo (Verbeek 1908)

This area of N Indonesia is in the realm of the western Pacific Ocean (Philippine Sea Plate). The western part is the Molucca Sea complex, where Molucca Sea Plate oceanic crust is subducting in two directions, under Halmahera in the East and the Sangihe arc in the West. The S side is bordered by the Sorong Fault zone, a major strike slip zone separating the W-moving Pacific from a N-moving Australia- New Guinea plate.

Islands are composed of fragments of Late Cretaceous- M Eocene and younger island arc volcanics, intruded into and overlying collisional complexes with Jurassic or Cretaceous-age ophiolites. With the exception of parts of islands in the Sorong fault zone complex, no Pre-Tertiary sediments or continental crust material have been reported.

Halmahera

The K-shaped island of Halmahera may be viewed as a similar, smaller and younger edition of Sulawesi. In both islands the western arms represent a Neogene volcanic arc system, while the central region and eastern arms contain large ophiolite complexes and interlayered sediments, while the arms are separated by young extensional basins.

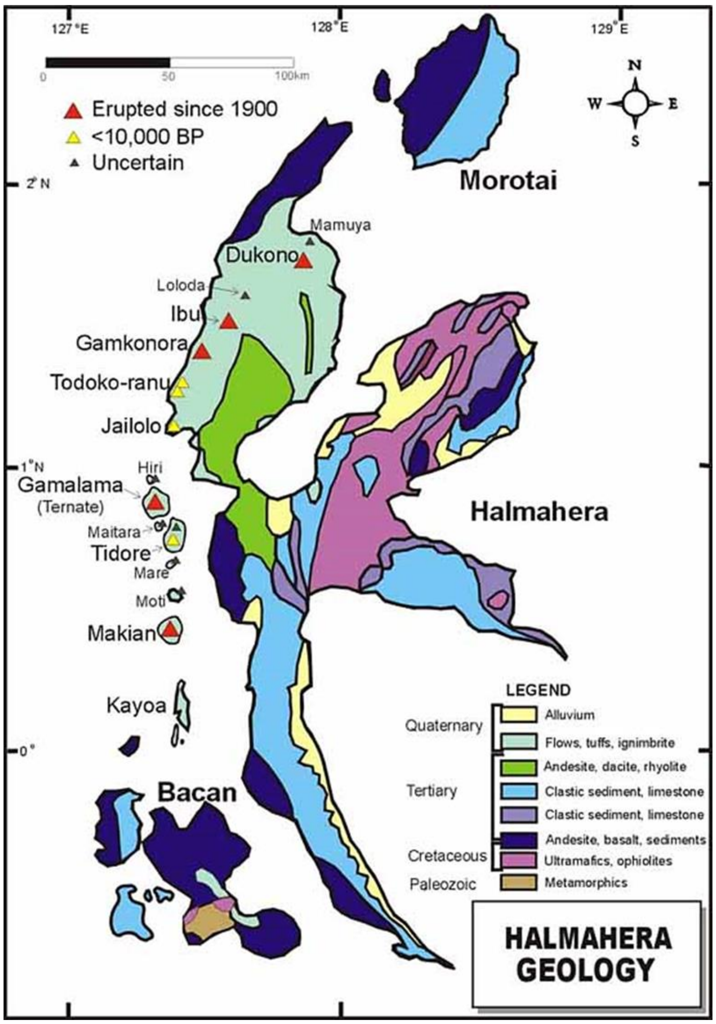


Figure VI.1.2. Simplified geologic map of Halmahera island, showing Tertiary- Quaternary volcanics-dominated west half, and widespread ultramafic rocks in the eastern half (purple).

The West Halmahera Arc is composed of Late Miocene- Quaternary andesites with subordinate basalts, and is a response to the East-ward subduction of the Molucca Sea Plate at the Halmahera Trench (Hakim and Hall 1991).

Molucca Sea

The Molucca Sea is a rare modern-day example of a 'double-dipping' oceanic plate, dipping westward under the Sangihe Trench/Arc in the West and eastward under the West Halmahera Trench/Arc in the East (Figures VI.1.3.and VI.1.4). Most of the Moluccas Sea oceanic crust has actually been consumed, and the Molucca Sea floor is an area of an arc-arc collision-in-progress (Silver and Moore 1978, 1981, Cardwell , Hamilton 1979, McCaffrey 1982, 1991).

The collision zone is composed of two accretionary complexes of opposing vergence, with slivers of ophiolites. The Talaud Islands represent an uplifted part of the accretionary/ melange complex of the collision zone (Atmadja, and R. Sukamto, 1979, Sukamto 1980).

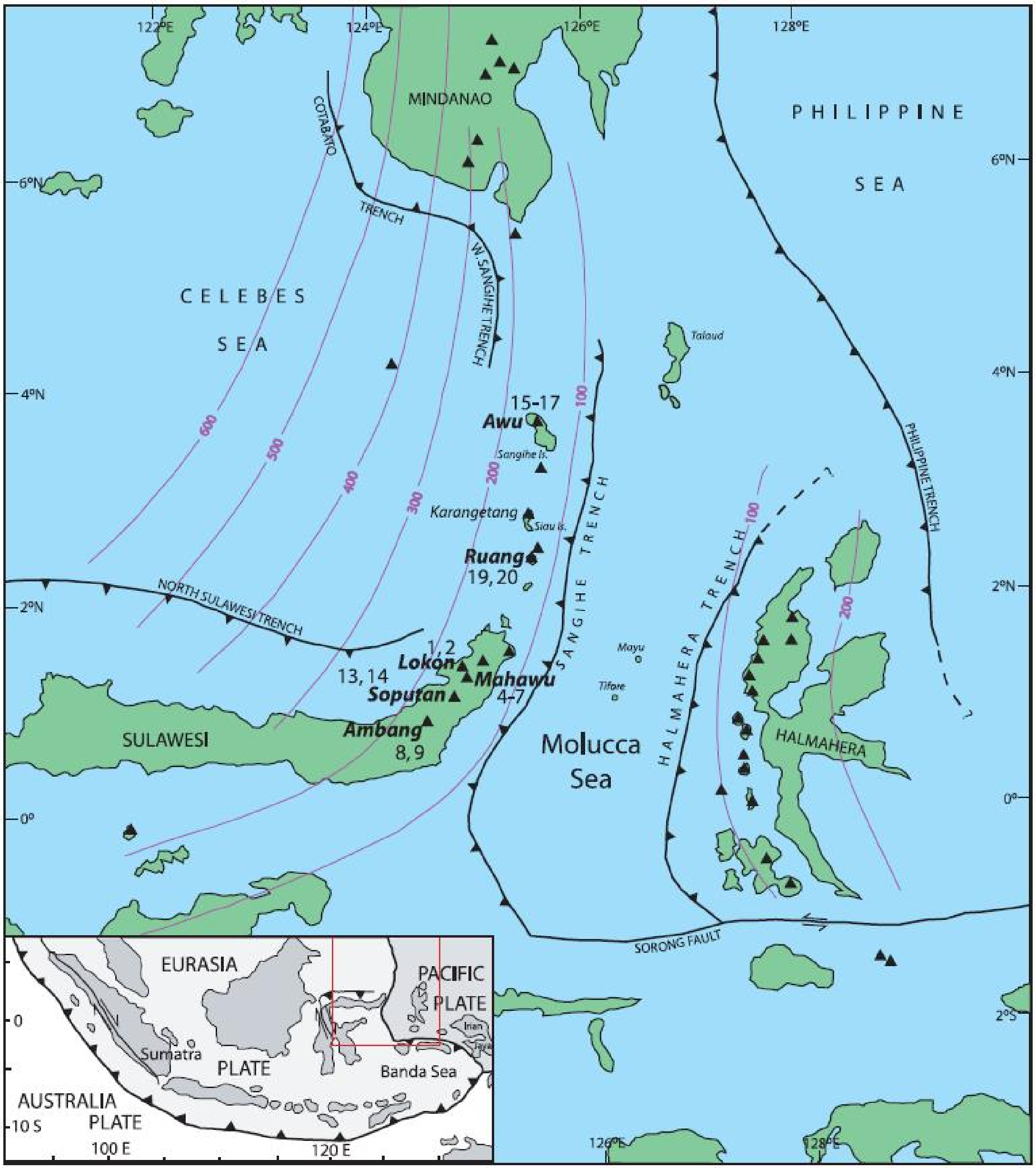


Figure VI.1.3. Map of Molucca Sea region, showing five active subduction trenches, Quaternary volcanoes of North Sulawesi- Sangihe and Halmahera Arcs (black triangles). Purple lines represent contours of subducting Molucca Sea slabs (Clor et al. 2005).

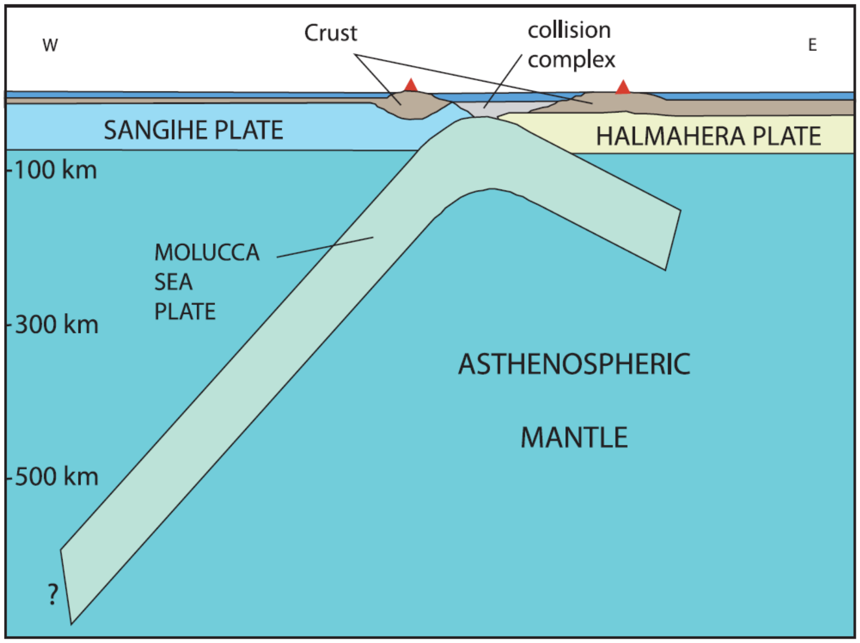


Figure VI.1.4. Schematic W-E cross section through the Sangihe Arc- southern Molucca Sea- Halmahera, showing subduction of the Molucca Sea plate beneath the Halmahera arc to the east and the Sangihe arc to the West.

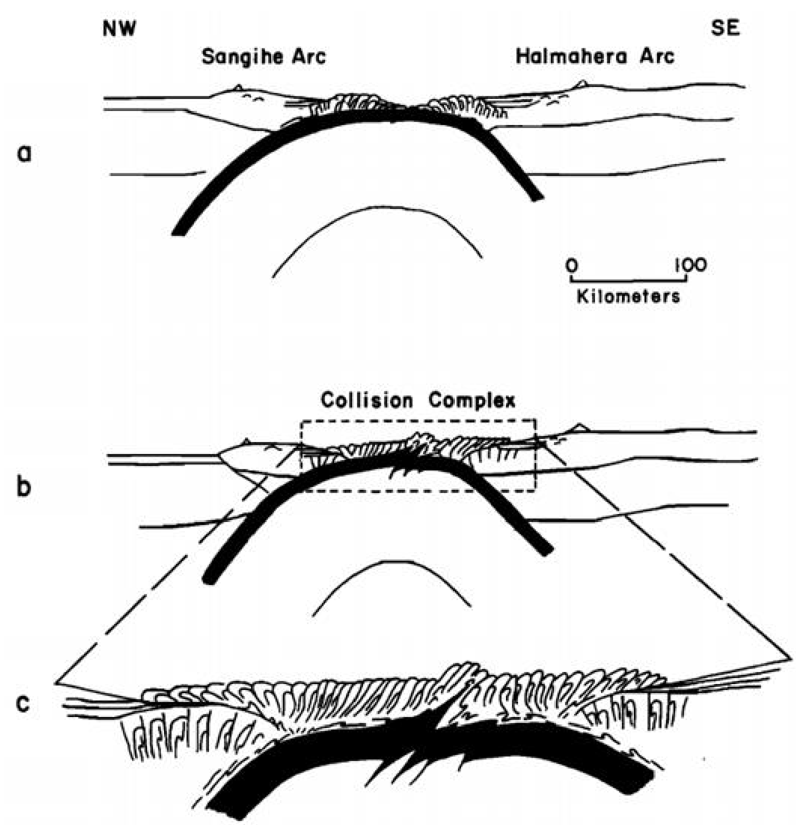


Figure VI.1.5. Interpretation of the structure of the Molucca Sea collision zone: (a) Reconstruction at time of initial collision of the opposing subduction complexes; (b) Present structure of the collision zone, with (c) Expanded view of collision complex (Silver and Moore 1978).

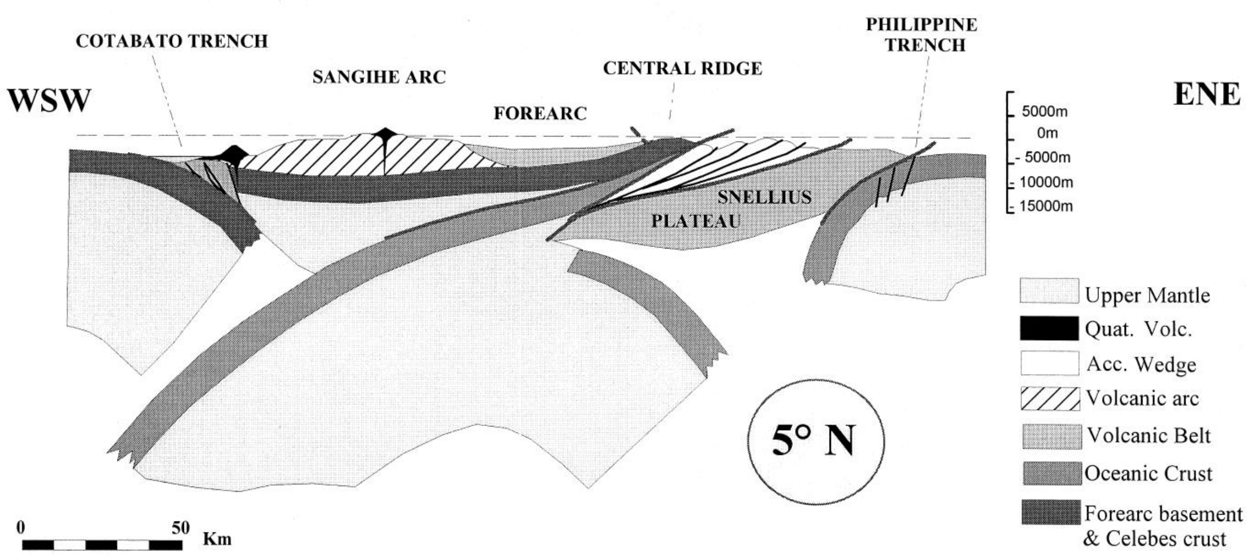


Figure VI.1.6. W-E cross-section farther North, from Celebes Sea- Sangihe Arc across northern Molucca Sea to Philippine Sea, showing multiple subduction zones (Pubellier et al. 1999).

The Talaud Islands are exposed parts of the N-S trending Central Ridge, which is entire composed of an imbricated accretionary prism/ melange complex, with ophiolitic blocks in a scaly clay matrix, (Soeria-Atmadja and Sukamto 1979, Moore et al. 1980, 1981).

Suggested reading- Halmahera area *(not a complete list of all relevant references)*

Halmahera General, Tectonics	*Verbeek 1908, Wanner 1913, Brouwer 1923, Soeria Atmadja 1981, Sukamto et al. 1981, Morris et al. 1983, Hall 1987, 1999, Hall et al. 1988, 1990, 1995, Hakim and Hall 1991, Sukamto 1989 Ali et al. 2001, Sodik et al. 1993.*
Molucca Sea	*Silver and Moore 1978, 1981, McCaffrey et al. 1980, 1982, 1991, Moore and Silver 1983, Widiyantoro 2003, Widiwijayanti et al. 2003, 2004*
Talaud islands	*Roothaan 1928, Sukamto and Suwarna 1976, 1979, Soeria-Atmadja and Sukamto 1979, Sukamto 1980, Moore et al. 1980, 1981, Bader and Pubellier, 2000*
Sangihe Arc	*Wichmann 1921, Morrice 1982, MacPherson et al. 2003.*

VI.2. Banggai, Sula, Taliabu, Obi

Sub-chapter VI.2. contains 79 references on the geology of the Banggai and Sula archipelagoes. This group of islands west of the Birds Head of West Papua is generally believed to represent one or more microcontinental plates, that sliced off the northern margin of New Guinea in Jurassic time.

Early geological investigations on the Sula islands included Boehm (1904, 1907, 1912) and Brouwer (1921). Early papers on the nearby Obi islands are by Brouwer (1924). The Obi islands appear to contain some Jurassic sediments overlying Triassic- Jurassic? ophiolites and matamorphics.

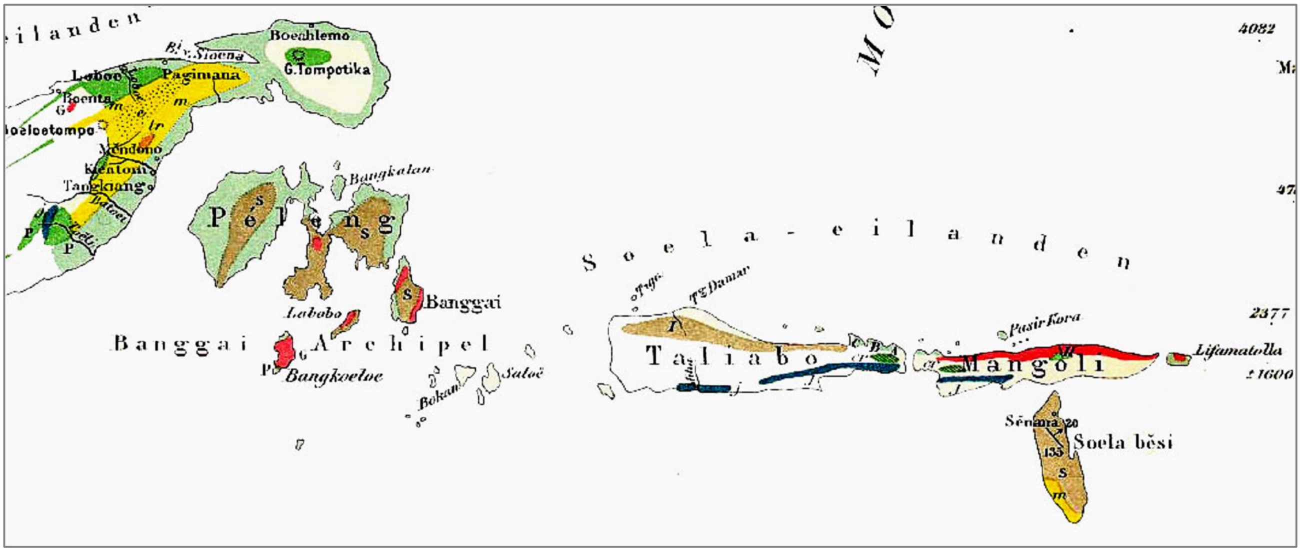


Figure VI.2.1. Early geologic map of Banggai- Sula islands (Verbeek 1908).

The Sula islands lent their name to the 'Sula Spur' of Klompe (1954, 1956), who viewed the Banggai, Sula and Obi islands region as the remnants of the western termination of the Australian-New Guinea Paleozoic ('Tasmanide') fold belt, and which acted as the leading edge of the Australia-New Guinea plate during during Tertiary colllisional movements. Structure of the main Sula islands (Taliabu, Mangoli) is rather simple (some block faulting, gentle N-ward dip).

Basement of the Banggai-Sula block consists of Paleozoic metamorphic rocks, overlain by Triassic arc volcanics (Mangole Fm) and intruded by co-magmatic granite batholiths (Banggai granite; K-Ar ages around 225 Ma). These Triassic intrusives and volcanics form part of a long Permo-Triassic arc system that continues East to New Guinea Birds Head (Netoni, Anggi granites), to terranes in northern Papua New Guinea (Idenburg, Kubor, Strickland granites; all ~220-240 Ma) and all along the East Australian active margin (Amiruddin 2000, 2009, Ding et al. 2011).

Gravity data suggest the Banggai- Sula Archipelago is is composed of blocks of severely attenuated continental crust (9-22 km thick; Sardjono 1999, Sardjono and Mirnanda 2007).

Outcrops of late Middle-Late Jurassic- Cretaceous marine sediments are relatively widespread, and the Sula Islands have long been famous for the richest Jurassic ammonite, belemnite and mollusc faunas in Indonesia (see also Garrard et al. 1988):
- the basal ('syn-rift'?) transgression is probably of Middle Jurassic age (Toarcian?; Bajocian; Panuju 2011), and consists of the non-marine Bobong Formation, which contains some thin coal beds (Kusnama et al. 2007, 2008, Septriandi et al. 2012);
- the (late-rift?) Middle Jurassic- Lower Cretaceous (Hauterivian?; Garrard et al. 1998) open marine Buya Formation is ~1200m thick and its suggested age include: Late Toarcian- Tithonian by Sato et al. (1978; macrofossils), Bathonian and younger (Westermann and Callomon 1988; ammonites). and Bathonian- Early Tithonian (Lelono and Nugrahaningsih 2012; dinoflagellates);
- the overlying Cretaceous bathyal pelagic carbonates of the Tanamu Formation appear to be restricted to Late Cretaceous age (Coniacian- Late Paleocene; Pigram et al. 1985, Garrard et al. 1998, Coniacian- Campanian?; Panuju et al. 2011).

Pigram et al. (1985) noted that the Mesozoic stratigraphy of the Sula Platform was closer to that of Central Papua New Guinea between 141°-145° than to West Papua, implying a westward displacement of >2500 km.

An apparent significant mid-Cretaceous between (>30-40 Myrs?) between clastic Buya Formation and the overlying Tanamu Fm pelagic carbonates was interpreted as a breakup unconformity by Garrard et al. (1998). This is significantly later event than the suggested Middle- Late Jurassic breakup event in Buru and Seram? (e.g. Pigram and Panggabean 1983).

Most of the Jurassic and Cretaceous was eroded in Early Paleogene time from the Banggai archipelago in the West. This event was followed by a likely Late Eocene trangression (with *Lacazinella* in Tiaka wells and at several localities in the Tomori area of East Sulawesi (Handiwiria 1990) that initiated widespread Late Eocene-Middle Miocene carbonate deposition of the pre-collisional Salodik Formation (Garrard et al. 1998).

Classic paleontological monographs on the Sula Jurassic macrofaunas include Boehm (1904-1912), Kruizinga (1921, 1926, belemnites, ammonites) and Challinor and Skwarko (1982; belemnites) and Westermann and Callomon 1988 (ammonites).

Banggai- Sula- East Sulawesi collision

The western edge of the Banggai-Sula plate collided with East Sulawesi, probably in Late Miocene time, by 'underthrusting' of the East Sulawesi ophiolite complex. Imbricated packages that were scraped off the downgoing Banggai Sula plate can be studied in outcrop in the Tomori area of the south side of the East Arm of Sulawesi.

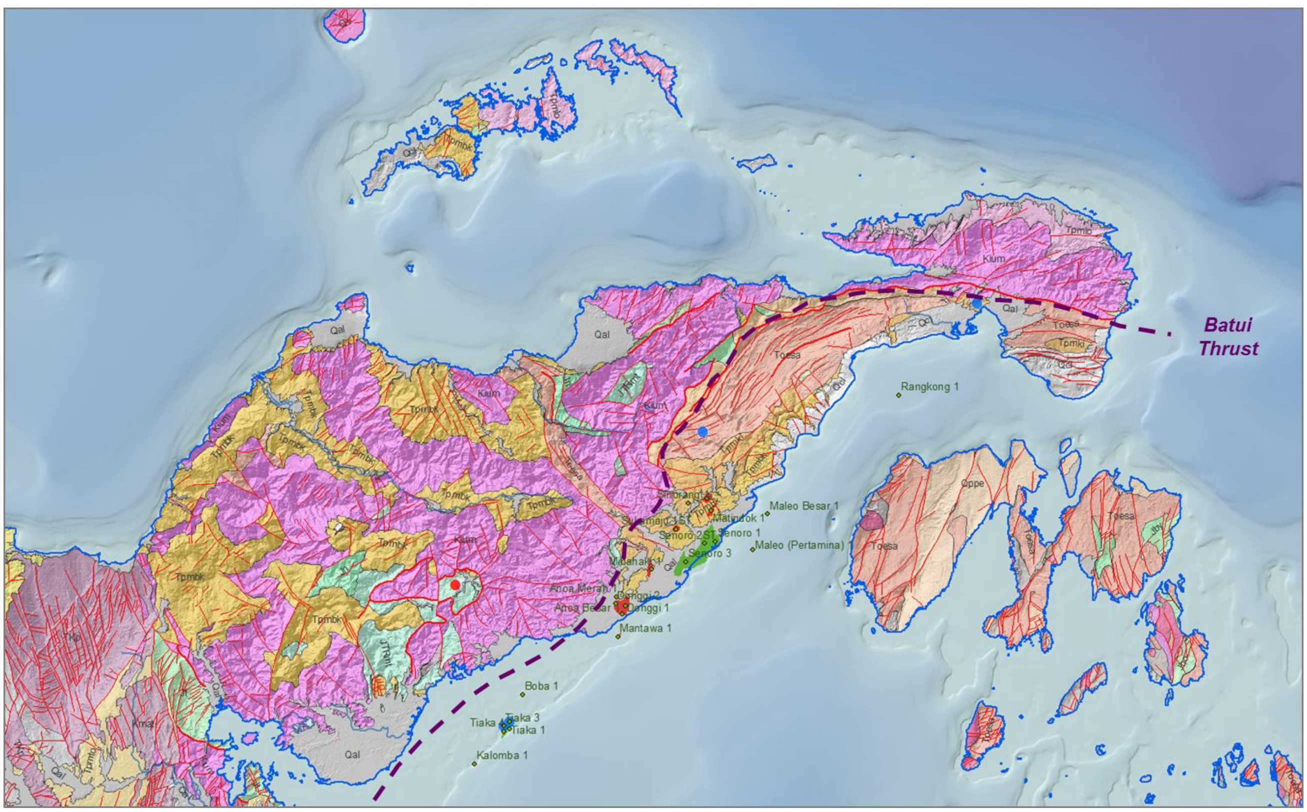


Figure VI.2.2. Late Miocene-Pliocene collision zone between western edge of Banggai-Sula plate and the East Arm of Sulawesi, which is mainly composed of ophiolite. Imbricated Cretaceous- Middle Miocene carbonate-rich series south of the Batui Thrust represent off-scraped distal sedimentary cover of Banggai-Sula plate.

The foredeep subsidence that preceded the collision set up favorable conditions for maturation and trapping of hydrocarbons. Initial subsidence created a backstepping series of Miocene carbonate platform and buildup facies. After burial by collisional and post-collisional 'Sulawesi molasse' these became the oil-bearing reservoirs of the Tiaka, Senoro fields in the Tomori Basin and adjacent onshore East Sulawesi (Figure VI.2.2).

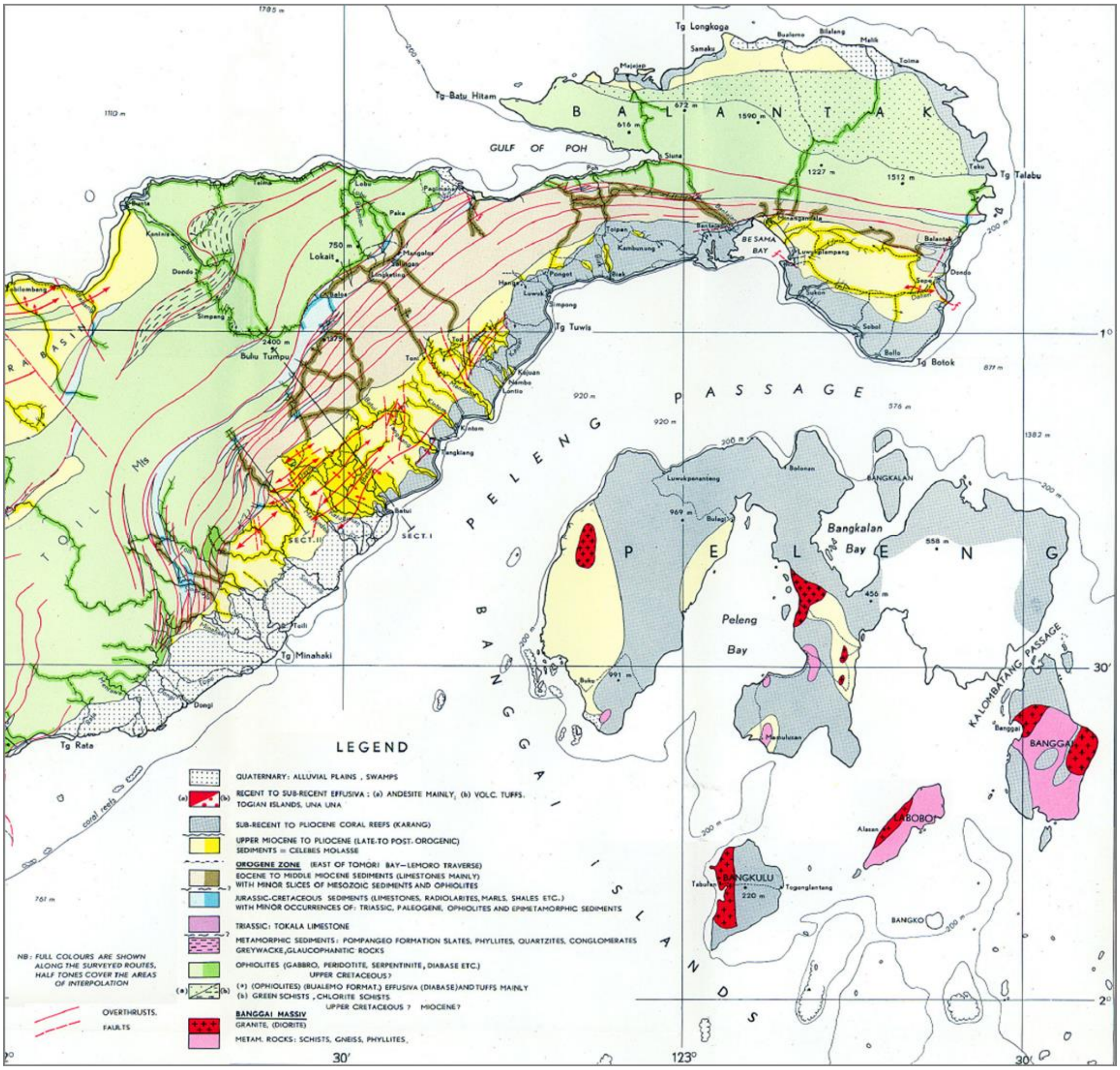


Figure VI.2.3. Late Miocene-Pliocene collision zone between western edge of Banggai-Sula plate and the East Arm of Sulawesi, same area as Figure VI.2.2 , but as surface geology map of Kundig (1956).

Suggested reading- Banggai-Sula area *(not a complete list of all relevant references)*

General, Tectonics	*Verbeek 1908, Wichmann 1914, Brouwer 1915, 1921, 1926, Koolhoven 1930, Klompe 1954, 1956, Sukamto 1975, Pigram et al. 1985, Ryacudu et al. 1993, Kadarusman et al. 1994, Natawidjaja, and Kadarusman 1994; Garrard et al. 1998, Walperdorf et al. 1998, Sardjono 1999, 2007, Amiruddin 2000, Nasution et al. 2008*
Jurassic stratigraphy/ paleontology	*Boehm 1904, 1907, 1912, Jaworski 1921, Kruizinga 1921, 1926, Sato et al. 1978, Westermann et al. 1978, Challinor and Skwarko 1982, Westermann and Callomon 1988, Sukamto and Westermann 1992, Francis and Westermann 1993, Oloriz, and. Westermann 1998, Pessagno and Meyerhoff Hull 2002, Kholiq et al. 2011, Panuju 2011 Lelono and Nugrahaningsih 2012, Septriandi et al. 2012*
Obi	*Martin 1904, Wanner 1913, Brouwer 1924, Kuenen 1942, Permana 1987, Soeria-Atmadja et al. 1988, Agustiyanto 1998, Dipatunggoro 2011, Khadafi et al. 2013, Rahmalia et al. 2017*

VI.3. Seram, Buru, Ambon

Sub-chapter VI.3. contains 189 references on the geology of Seram and nearby islands Buru and Ambon.

Seram

Seram and the chain of islands continuing in E/ SE direction all share a very complex fold-thrust belt geology, with N-directed thrusting and with fragments of continental blocks, metamorphic rocks and ophiolite complexes. Deformation is less intense West of Seram, on Buru island. Large ophiolite bodies and metamorphic complexes are present in SW Seram and Buru.

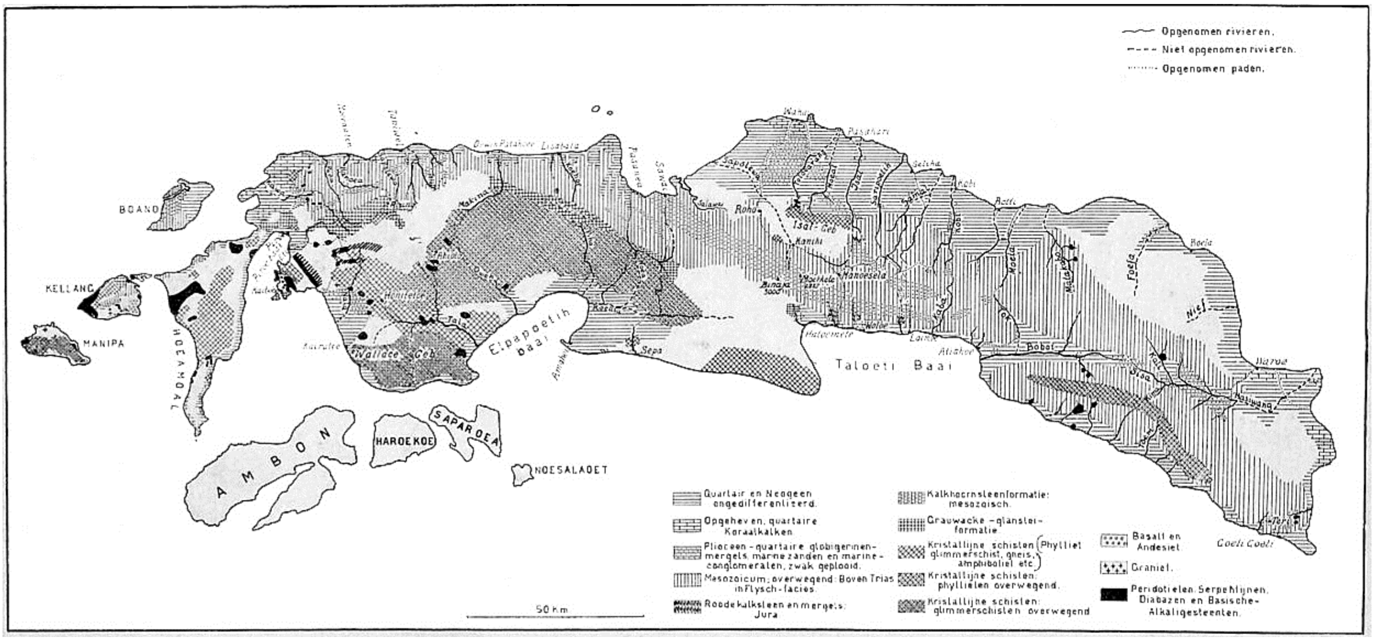


Figure VI.3.1. Early geologic map of Seram (Rutten 1929; from Rutten and Hotz, 1920)

Counterclockwise rotation of the Buru-Seram microplate has been suggested by paleomagnetic data (Haile 1978, 74° since Late Miocene) and structural analysis (Linthout et al. 1991; 45° since Early Pliocene).

Seram is home to three or four metamorphic complexes (Kobipoto, Saku, Tehoru, Taunusa; Sopaheluwakan et al. 1992). Interpretation of these has always been difficult, partly due to the wide range of radiometric ages, most of which are suspect (Davies and Tommasini, 2000). Some of the metamamorphics are presumably of pre-Late Triassic age, some have Miocene- Pliocene colling ages and were thought to have formed during Miocene ophiolite obduction (Helmers et al. 1989, Sopaheluwakan 1994). Recent re-interpretations by Pownall et al. (2013-2018) explain much of the metamorphic complexes as result of young hyper-extensional mantle exhumation during the opening of the Banda Sea and roll-back of the Banda Arc slab.

Paleozoic metamorphics are overlain by folded Late Triassic (Carnian-Norian) Kanikeh Fm flysch-type clastics, composed of micaceous sands and shales with plant fragments, *Monotos salinaria*, etc. This series has been interpreted as the basal part of a Late Triassic intra-cratonic rift sequence.

The clastics are capped by (partly interbedded with?) latest Triassic reefal and deepwater limestones of the Manusela and Saman Saman Formations (late Norian- Rhaetian; Al-Shaibani et al 1983). Reefal facies are rich in calcareous sponges corals and hydrozoans. The Late Triassic limestone of Seram is frequently reported as of Jurassic age, an idea started by Van der Sluis (1950) and Van Bemmelen (1949), although all paleontological evidence points to latest Triassic ages only (Wanner et al. 1952, Martini et al., 2004, Charlton and Van Gorsel 2014).

Above the Late Triassic the Early-Middle Jurassic is either highly condensed limestone (e.g. Wanner and Knipscheer 1951; 60 cm) or is missing completely and Late Jurassic marine Kola Shale directly overlies the Triassic. This hiatus/unconformity was suggested to represent a 'post-breakup unconformity' and signify onset of nearby oceanic spreading (Pigram and Panggabean 1984).

The latest Jurassic-Eocene interval is represented by reddish pelagic limestones (Nief Fm), devoid of any clastic material, and probably representing the oceanic drift or very distal passive margin stage of the Buru-Seram microplate. The basal radiolarian chert-rich limestones contain locally abundant latest Jurassic-earliest Cretaceous calpionellids (mainly *Stomiosphaera moluccana*; Wanner 1940), and are overlain by Upper Cretaceous limestones without chert and with *Globotruncana* and above this also Paleo-Eocene planktonics, including *Globorotalia velascoensis* and *Hantkenina* (Germeraad 1946).

Similarities in stratigraphy and structure between Seram and Timor have been noticed by many authors. There are also similarities with the Triassic stratigraphy of nearby Misool, but the Jurassic- Paleogene of Seram-Buru is in more distal facies, and lack the rich macrofossil faunas of Misool. There is also evidence of consumed oceanic crust between Misool and Seram, so the present-day proximity is not necessarily the same as the paleo-position(s).

Widespread folding and thrusting of Eocene and older rocks, with the formation of the 'Salas Block Clay' olistostrome or melange, suggests a major collisional event, but the exact age of this remains uncertain. It is probably related to ophiolite obduction at the S/SW side of Seram, which have a Late Miocene onset of exhumation age (around 8 Ma; Linthout et al. 1996).

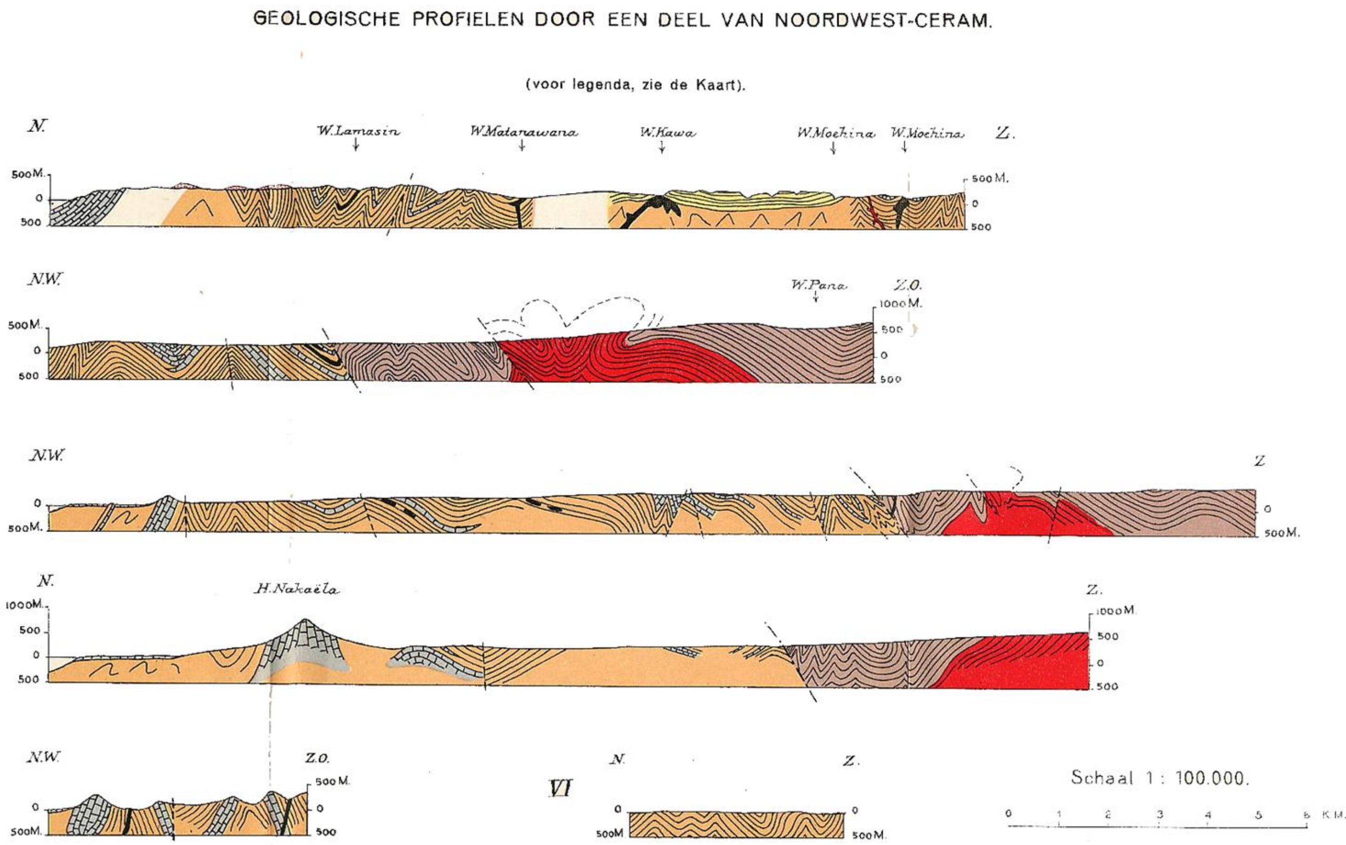


Figure VI.3.2. N-S cross-sections through NW Seram, showing N-directed folding and thrusting of metamorphics- granite (pink-red) complex over folded Mesozoic sediments (mainly Late Triassic; light brown 'flysch' and blue limestones) (Rutten and Hotz, 1919).

This Plio-Pleistocene North Seram fold-thrust belt outcrops on North Seram and continues offshore for up to ~100 km (e.g. Teas et al. 2009), where it looks like a continuation of the Banda Arc accretionary complex. This foldbelt is commonly described as merely a zone of young thrusting between Misool/ Birds Head and Seram Island (e.g. Pairault et al. 2003, Granath et al. 2011, Patria and Hall 2017). However, like the Timor Trough, it probably makes more sense to interpret the Seram Trough and the young North Seram imbricated complex as a subduction trench- accretionary prism complex, and a continuation of the (now mostly locked and extinct) eastern Banda Arc subduction zone (Figure VI.3.3; O'Sullivan et al. 1985, Jongsma et al. 1989, etc.):
- the width of the offshore imbricated belt implies 100's of kilometers of shortening;

- the imbricated complex can be tied to a South-dipping subducted slab below Seram that is clearly imaged by seismic tomography and deep earthquake distributions;
- remnants of a Late Pliocene-Pleistocene volcanic arc are present South of Seram (Ambon; Priem et al. 1978, Honthaas et al. 1999, Hammarstrom et al. 2013).

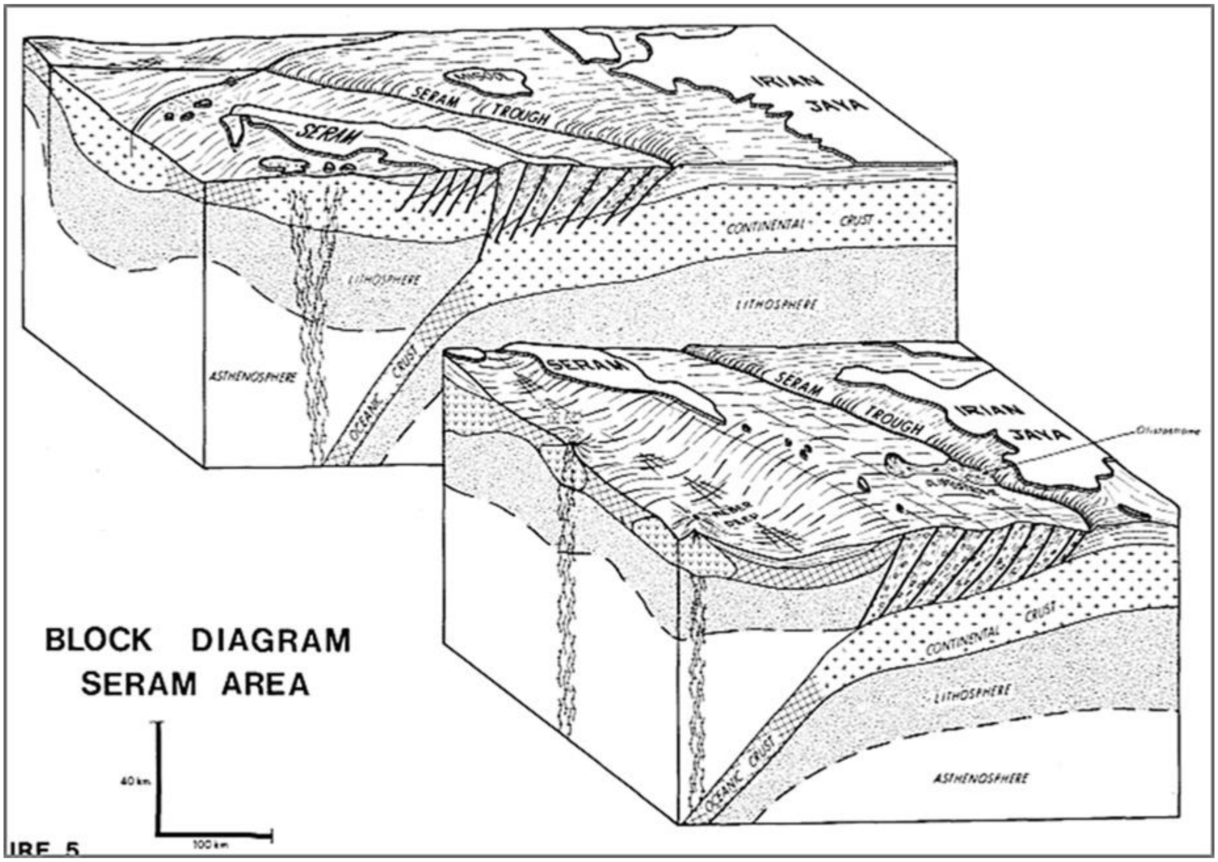


Figure VI.3.3. Block diagram with schematic regional S to N cross-sections, showing Seram as a separate plate from the subducting Birds Head plate (O'Sullivan et al. 1985).

Deep marine marls as young as Early Pleistocene outcrop on Seram island and suggest about 2 km of Pleistocene-Recent uplift in SW Seram (De Smet et al., 1989).

Oil has been produced from Plio-Pleistocene sands in NE Seram since 1897 (Bula Field), and is believed to be sourced from Late Triassic bituminous shale. Much later oil was also discovered in fractured Late Triassic limestones (Oseil field). Oils from surface seeps and the Oseil and Bula oil fields were sourced from Late Triassic basinal limestones- calcareous shales, derived from Type II marine algae (no terestrial organic material), deposited in anoxic conditions (Peters et al. 1999, Wahyudiono et al. 2018).

Buru

The geology of Buru Island shows very similar Triassic- Eocene stratigraphy to Seram but is in a less complex tectonic setting (Wanner 1907, Hummel 1923, Tjokrosapoetro and Budhitrisna 1982, 1983, etc.)

Of particular interest is the presence of Late Triassic 'asphalt shale' in outcrops near Bara-Bai, rich in ammonites and with 23% organic matter (Kossmat 1906, Von John 1906, Krumbeck 1913).

Suggested reading- Seram- Buru area *(not a complete list of all relevant references)*

Seram General, Tectonics	*Wanner 1907, 1923, Verbeek 1908, Brouwer 1919, Rutten and Hotz 1918-1920, De Jong 1923, Rutten 1927, Germeraad 1946, Valk 1945, Van der Sluis 1950, Audley-Charles and Carter 1977, Haile 1978, Audley-Charles et al. 1979,Tjokrosapoetro and Budhitrisna 1982, De Smet et al. 1989, Linthout et al. 1989, 1996, Kemp and Mogg 1992, Sopaheluwakan et al. 1992, 1994, Supandjono 1994, O'Sullivan et al. 1985, Hadiwisastra et al. 1996, Kemp et al. 1996, Monnier et al. 2003, Hill 2005, Bachri 2011, Hill 2012, Pownall et al. 2013, 2014, 2015,2017, 2018,*
North Seram fold-thrust belt	*Audley Charles and Carter 1977, Jongsma et al. 1989, Pairault et al. 2003, Teas et al. 2009, Riadini et al. 2010, Darman and Reemst 2012, Sapiie et al. 2012, 2013, Adlan et al. 2016, Patria and Hall 2017*
Paleontology,stratigraphy	*Boehm 1905, 1908, 1910, Wanner 1907, 1928, 1949, Gerth 1909, Deninger 1918, Fischer 1921, Krumbeck 1923, Welter 1923, Pia 1924, Koch 1925, Jaworski 1927, Wilckens 1937, Wanner and Knipscheer 1951, Al-Shaibani 1983, Pigram and Panggabean 1984,*
Triassic limestone	*Wilckens 1937, Wanner et al. 1952, Kemp 1992, Al-Shaibaini et al. 1983, 1984, Martini et al. 2004, Charlton and Van Gorsel 2014*
Oil field(s)	*Zillman and Paten 1975ab, Kemp 1992, Moyle et al. 2000, Nilandaroe et al. 2001, Lapulisa et al. 2012*
Source rocks, Oils	*Price et al. 1987, Peters et al. 1999, Adlan et al. 2018, Wahyudiono et al. 2018*
Buru	*Martin 1902, 1903, Kossmat 1906, Von John 1906, Wanner 1907, 1923, Gerth 1910, Krumbeck 1913ab, Henny 1922, Hummel 1923, Fortuin et al. 1988, Harahap 2002, Hakim and Harahap 2003, Harahap and Poedjoprajitno 2006*
Ambon	*Verbeek 1899, 1900, 1905, Boehm 1905, 1908, Brouwer 1925, 1927, Jaworski 1927, Kuenen 1949, Priem et al. 1978, Menzie et al. 1997, Honthaas et al. 1999, Hammarstrom et al. 2013.*

VI. NORTH MOLUCCAS

VI.1. Halmahera, Bacan, Waigeo, Molucca Sea

Anderson, C.D. (1999)- Cenozoic motion of the Philippine Sea Plate; new paleomagnetic data from eastern Indonesia. Masters Thesis, University of California at Santa Barbara, p. 1-164. *(Unpublished*
(Halmahera, Waigeo and other islands constitute largest land area of Philippine Sea Plate. New paleomagnetic results from 24 sites. Halmahera region motion three segments: 0-25 Ma moved N and rotated 40° CW; no rotation or latitude translation 25-40 Ma; 50° CW rotation and slight S-ward translation 40-50 Ma. Two Cretaceous sites indicate another 90° CW rotation between ~73-50 Ma, but interpretation speculative)

Anonymous (1981)- Gag Island nickel outlook not promising. Mining Magazine 144, 4, p. 287-289.
(Study by Pacific Nickel of weathered ultrabasic laterite of Gag Island in N Moluccas suggests 160 Million metric Tons of ore at 1.64% Nickel, 0.12% Cobalt, 37% Iron (BHP dropped Gag Island project in 2008))

Apandi, T. & D. Sudana (1980)- Geologic map of the Ternate Quadrangle, North Maluku, 1: 250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Geologic map of central part of Halmahera, 1:250,000 scale. Includes large Pretertiary Ultrabasic complex, overlain by Paleogene conglomerates with ultrabasic clasts, Paleogene limestone and younger Tertiary sediments (in NE Halmahera ophiolite also overlain(?) by Upper Cretaceous sediments with Globotruncana))

Bader, A.G. (1997)- Deformation de la croute oceanique lors de la fermeture d'un bassin marginal. Exemple de la Mer des Moluques (Philippines-Indonesie). Doct. Thesis Universite Pierre et Marie Curie, Paris VI, p.
(Unpublished) ('Deformation of oceanic crust during the closing of a marginal basin. Example of the Molucca Sea (Philippines-Indonesia).)

Bader, A.G. & M. Pubellier (2000)- Forearc deformation and tectonic significance of the ultramafic Molucca Central Ridge, Talaud islands (Indonesia). The Island Arc 9, 4, p. 653-663.
(Molucca Sea basin S of Mindanao underlain by N-S ophiolitic ridge, representing outer ridge of Sangihe subduction zone, and outcrops on Talaud Islands. Forearc sediments uncomformably on (1) dismembered ophiolitic series and (2) thick melanges. Two deformation events. Earlier direction (N20°E) is thrusting event affecting ophiolitic basement associated with edge of Celebes Sea. Incipient Sangihe subduction around 15 Ma uplifted deformed crust and buried melanges beneath forearc sediments. Recent E-W shortening during subduction of Snellius Plateau reactivated melanges within thrusts cutting forearc series)

Bader, A.G., M. Pubellier, C. Rangin, C. Deplus & R. Louat (1999)- Active slivering of oceanic crust along the Molucca Ridge (Indonesia-Philippine): implication for ophiolite incorporation in a subduction wedge. Tectonics 18, 4, p. 606-620.
(online at: http://onlinelibrary.wiley.com/doi/10.1029/1999TC900004/epdf)
(Marine geophysical survey in N Molucca Sea shows structure of classic active convergent margin, from W to E: Sangihe volcanic arc, Molucca Ridge forearc basin resting on outer ridge, accretionary wedge, and Snellius Ridge- Philippine Sea composite downgoing plate. Strong negative gravity anomaly above wedge suggests basement deepening and rupture of 700 km-long subducting lithosphere. S Snellius Ridge separated recently from S Philippine Basin by incipient Philippine Trench, deforming forearc region with backthrusting)

Baillie, M.C. & G.C. Cock (2001)- Weda Bay nickel/cobalt project- resource definition and the development of a project concept. Proc. Indonesia Mining Conf. Exhibition, Jakarta, p. 2B1-2B22.

Baker, S.J. (1997)- Isotopic dating and island arc development in the Halmahera region, Eastern Indonesia. Ph.D. Thesis University of London, p. 1-316. *(Unpublished)*
(Halmahera area in zone of complex tectonics at junction between Eurasian margin, Philippine Sea and Australian plates. Continental metamorphic rocks of probable Paleozoic age, derived from New Guinea, are found on Bacan and Obi. Ophiolitic rocks from Halmahera, Obi, Gag are of Philippine Sea plate origin, formed an intra-oceanic forearc-arc-backarc system of Jurassic age. Intrusives into ophiolitic rocks on Halmahera and Obi two phases of arc-related plutonic activity in Middle to Late Cretaceous

Baker, S. & J. Malaihollo (1996)- Dating of Neogene igneous rocks in the Halmahera region: arc initiation and development. In: R.Hall & D. Blundell (eds.) Tectonic evolution of Southeast Asia, Geol. Soc., London, Spec. Publ. 106, p. 499-509.
(K-Ar ages of igneous rocks from Halmahera show history of intra-oceanic arc development since late M Miocene, due to E-directed subduction of Molucca Sea plate under Philippine Sea plate. N-ward migration of volcanic activity in Late Miocene- E Pliocene. Arc volcanism began around 11 Ma on Obi, with subduction thought to have started around 15-17 Ma. No Neogene volcanism younger than 8 Ma in Obi area; on Bacan volcanism ceased at 2 Ma. Late Pliocene crustal deformation caused 30-40 km W-ward shift of volcanic front. Formation and propagation of Halmahera arc consequence of CW rotation of Philippine Sea plate)

Ballantyne, P. (1990)- The petrology of the ophiolitic basement rocks of eastern Halmahera, Indonesia. Ph.D. Thesis, University of London, p. 1-263. *(Unpublished)*

Ballantyne, P. (1991)- Petrological constraints upon the provenance and genesis of the East Halmahera ophiolite. J. Southeast Asian Earth Sci. 6, 3-4, p. 259-269.
(E Halmahera dismembered ophiolite petrology. Cumulus mineralogy comparable with cumulates of Papuan and Marum ophiolites of New Guinea. Ophiolitic rocks formed in supra-subduction zone environment. Volcanic rocks not abundant in E Halmahera, but distinct suites, of boninitic, island arc and oceanic island /seamount affinities)

Ballantyne, P. (1992)- Petrology and geochemistry of the plutonic rocks of the Halmahera ophiolite, eastern Indonesia; an analogue of modern oceanic forearcs. In: L.M. Parson, B.J. Murton & P. Browning (eds.) Ophiolites and their modern oceanic analogues, Geol. Soc., London, Spec. Publ. 60, p. 179-202.
(Halmahera ophiolite tectonically dismembered but all elements of complete ophiolite present, except sheeted dyke complex. Ophiolite formed in supra-subduction zone setting before Late Cretaceous and interpreted to represent forearc of Mesozoic arc whose remnants now found near margins of Philippine Sea Plate)

Ballantyne, P.D. & R. Hall (1990)- The petrology of the Halmahera Ophiolite, Indonesia; an early Tertiary forearc. In: J. Malpas et al. (eds.) Ophiolites; oceanic crustal analogues, Proc. Symposium 'Troodos 1987', Geol. Survey Cyprus, Nicosia, p. 461-475.

Bering, D. (1986)- The exploration of the Kaputusan copper-gold porphyry (Bacan Island, Northern Moluccas). Federal Inst. Geosciences Natural Resources (BGR), Hannover, Report 099386, p. 1-140.
(Kaputusan copper-gold porphyry mineralization discovered on Bacan during joint Indonesian-German (BGR) regional exploration program in late 1970's, with follow-up exploration work by BGR in 1983-1984. Hosted by Miocene tonalite porphyry stocks)

Bessho, B. (1944)- Geology of the Halmahera islands. J. of Geography, Tokyo, 56, 6, p. 195-203.
(online at: www.jstage.jst.go.jp/article/jgeography1889/56/6/56_6_195/_pdf)
(In Japanese. Brief review of Halmahera geology, with one geologic map and cross-section))

Brata, K. (1989)- Petrography and provenance of Neogene sandstones of South Halmahera, East Indonesia. M.Phil. Thesis, University of London, p. . *(Unpublished)*

Brouwer, H. (1921)- Geologische onderzoekingen op de Sangi-eilanden en op de eilanden Ternate en Pisang. Jaarboek Mijnwezen Nederlandsch Oost-Indie 49 (1920), Verhandelingen 2, p. 3-68.
('Geologic investigations on the Sangi islands and on the islands Ternate and Pisang'. Mainly descriptions of various active volcanoes of Sanghi islands (Ruang, Tagoelandang, Makalehi, Mahengetang), Ternate and Pisang (SE of Halmahera) islands)

Brouwer, H. (1923)- Geologische onderzoekingen op het eiland Halmaheira. Jaarboek Mijnwezen Nederlandsch Oost-Indie 50 (1921), Verhandelingen 2, p. 5-72.

('Geological investigations on Halmaheira Island'. Includes thin section photos of deep marine U Cretaceous Globotruncana limestones and shallow marine limestones of Eocene (Nummulites-Alveolina-Discocyclina) and Miocene (Lepidocyclina) ages (forams brief description by Douville 1923 in same volume))

Brouwer, H. (1923)- Bijdrage tot de geologie van het eiland Batjan. Jaarboek Mijnwezen Nederlandsch Oost-Indie, Verhandelingen 50 (1921), Verhandelingen 2, p. 73-106.
('Contribution to geology of the island of Bacan'. Bacan mostly schists and igneous rocks, including diorites, gabbros, peridotites and andesites. Also Miocene Lepidocyclina limestone, associated with coal fragments)

Burgath, K., M. Mohr & W. Simanjuntak (1983)- New discoveries of blueschist metamorphism and mineral occurrences in the Halmahera Gag ophiolite belt. Bull. Direct. Min. Res. Indonesia 13, 1, p. 1-19.

Carlile, J.C., G.R. Davey, I. Kadir, R.P. Langmead & W.J. Rafferty (1998)- Discovery and exploration of the Gosowong epithermal gold deposit, Halmahera, Indonesia. J. Geochemical Exploration 60, 3, p. 207-227.
(Gosowong epithermal gold deposit low-sulphidation epithermal quartz vein in Halmahera Neogene magmatic arc. Not much on geologic setting)

Chandra, J. & R. Hall (2016)- Tectono-stratigraphic evolution and hydrocarbon prospectivity of the South Halmahera Basin, Indonesia. Proc. 40th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA16-46-G, 19p.
(S Halmahera Basin influenced by Cretaceous- Oligocene and Pleistocene arc history, collision with Australian (New Guinea) continental margin in E Miocene from ~25 Ma, Neogene strike-slip faulting, etc. Rifting in Late Eocene formed W-E backarc basin with Late Eocene terrestrial-marginal marine clastic sediments, followed by limestone and deep marine turbidites. E Miocene arc-continent collision caused uplift and major unconformity above which widespread Miocene limestones were deposited. Two sub-basins formed in late Neogene, a response to formation of Halmahera volcanic arc to W and strike-slip movements along Sorong Fault Zone to S. Oil seep from Halmahera and similarities to productive Salawati Basin suggest petroleum potential)

Charlton, T.R., R. Hall & E. Partoyo (1991)- The geology and tectonic evolution of Waigeo Island, NE Indonesia. J. Southeast Asian Earth Sci. 6, 3-4, p. 289-297.
(Waigeo ophiolitic basement of possible Late Jurassic age, overlain by Paleogene forearc sediments. Basement and sedimentary cover deformed by Late Oligocene S-directed thrusting, probably collision of arc with continental block (New Guinea?))

Clark, L.V. (2012)- The geology and genesis of the Kencana epithermal Au-Ag deposit, Gosowong Goldfield, Halmahera Island, Indonesia. Ph.D. Thesis University of Tasmania, p. 1-260.
(online at: https://eprints.utas.edu.au/17493/2/Whole-Clark-_thesis.pdf)
(Kencana Au-Ag low-sulfidation epithermal deposit in Neogene magmatic arc of Halmahera is 2002 discovery in Gosowong goldfield on E side of NW arm of Halmahera, which is composed of four superimposed volcanic arcs (subduction of Molucca Sea plate beneath Halmahera since Paleogene). Epithermal mineralization hosted by U Miocene Gosowong Fm volcaniclastics andesitic flows and diorite intrusions. Andesite emplacement at 3.73 Ma followed by diorite intrusion at ~3.50 Ma. Epithermal mineralization with 40Ar/39Ar age of hydrothermal adularia of ~2.93 Ma)

Clark, L.V. & J.B. Gemmell (2018)- Vein stratigraphy, mineralogy, and metal zonation of the Kencana low-sulfidation epithermal Au-Ag deposit, Gosowong goldfield, Halmahera Island, Indonesia. Economic Geology 113, 1, p. 209-236.
(Kencana Au-Ag low-sulfidation epithermal deposit in Neogene magmatic arc of NW Arm of Halmahera, with resource of 4 Moz Au. Part of the Gosowong Goldfield, with Gosowong and Toguraci deposits. NW arm of Halmahera composed of four superimposed volcanic arcs. Epithermal mineralization in Pliocene Gosowong Fm of volcaniclastic rocks, ignimbrites, andesitic flows and diorite intrusions. Andesite emplacement at 3.73 Ma followed by diorite intrusion at ~3.50 Ma. Kencana epithermal mineralization at ~ 2.93 Ma)

Clor, L.E., T.P. Fischer, D.R. Hilton, Z.D. Sharp & U. Hartono (2005)- Volatile and N isotope chemistry of the Molucca Sea collision zone: tracing source components along the Sangihe Arc, Indonesia. Geochem. Geophys. Geosystems 6, 3, 20p.
(online at: https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2004GC000825)
(Volcanic gases from Sangihe Arc analyzed for trace chemistry and nitrogen isotope variations. Increased slab contribution in northernmost arc, possibly by slab melting as collision stalls progress of subducting plate)

Cock, G.C. & J.E. Lynch (1999)- Discovery and evaluation of the Weda Bay nickel/ cobalt deposits, central Halmahera, Indonesia. In: G. Weber (ed.) Proc. PACRIM '99 Congress, Australasian Inst. of Mining and Metallurgy (AusIMM), Parkville, 4-99, p. 197-206.
(Weda Bay nickel- cobalt laterite deposits on Halmahera first drilled in 1996. Laterites have developed by weathering over pre-Cretaceous serpentinised harzburgites and dunites)

Coupland, T., D. Sims, V. Singh, R. Benton, D. Wardiman & T. Carr (2009)- Understanding geological variability and quantifying resource risk at the Kencana underground gold mine, Indonesia. Seventh Int. Mining Geology Conference, Australasian Inst. Mining Metallurgy (AusAIMM), Melbourne, p. 169-186.
(Kencana underground gold mine on Halmahera with two large epithermal vein deposits. Rel. simple planar geometry, dipping 25 to 45° to East and extend 400-600 m along strike and down dip. True width 1-20m)

Davey, G.R., J.C. Carlile, D.J. Olberg & R P, Langmead (1997)- Discovery of the Gosowong epithermal quartz-adularia vein gold deposit, Halmahera, eastern Indonesia: In: Proc. New generation gold mines ô97 Conf., Perth, Australian Mineral Foundation, p. 3.1-3.15.
(see also Carlile et al. 1998)

Di Leo, J.F., J. Wookey, J.O. Hammond, J.M. Kendall, S. Kaneshima, H. Inoue, J.M. Yamashina & P. Harjadi (2012)- Deformation and mantle flow beneath the Sangihe subduction zone from seismic anisotropy. Physics Earth Planetary Interiors 194-195, p. 38-54.
(Sangihe subduction zone is where Molucca Sea microplate is subducting W beneath Eurasian plate. Anisotropic structure suggested by shear wave, probably caused by aligned cracks, possibly melt-filled beneath the volcanic arc, and fossil anisotropy in overriding plate. Three regions of anisotropy: (1) within overriding lithosphere, (2) along slab-wedge interface, (3) below subducting Molucca Sea slab)

Djaswadi, S., B. Tjahjono & T. Sudharto (1990)- Penjajagan mineral logam di Maluku Utara. Proc. 19th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 302-324.
('Metallic minerals exploration in the North Moluccas'. Rreview of deposits of copper (Obi, Bacan, Halmahera), nickel (E Halmahera), chromite (E Halmahera), etc.)

Douville, H. (1923)- Sur quelques foraminiferes des Moluques orientales et de la Nouvelle Guinee. Jaarboek Mijnwezen Nederlandsch-Indie 50 (1921), Verhandelingen 2, p. 107-116.
('On some foraminifera from the eastern Moluccas and from New Guinea'. Brief description of Eocene larger forams in samples collected by Brouwer in Halmahera (Nummulites, Discocyclina, Alveolina), Roti (large Nummulites, Discocyclina), Seram (E Miocene Lepidocyclina in breccia with reworked angular clasts of Upper Cretaceous pelagic limestone), New Guinea, Kai Besar (rounded fragments of Eocene Lacazina in quartz sandstone, etc. No location info)

Electricia, K.S., M.F. Rosana, E.T. Yuningsih, I. Syafri & S.N. Viqnoriva (2017)- Quartz vein infill structure mode in Kencana deposit, Gosowong goldfield, Indonesia. Bull. Scientific Contr. (UNPAD) 15, 1, p. 35-44.
(online at: http://jurnal.unpad.ac.id/bsc/article/view/11743/pdf)
(Gosowong gold-siver mine on Halmahera is low sulphidation epithermal veining system, hosted in Quaternary andesitic volcanics. Kencana epithermal vein system two main sub-parallel NW trending vein zones)

Evans, C.A., J.W. Hawkins & G.F. Moore (1983)- Petrology and geochemistry of ophiolitic and associated volcanic rocks of the Talaud Islands, Molucca Sea collision zone, northeast Indonesia. In: T.W.C. Hilde & S.

Uyeda (eds.) Geodynamics of the western Pacific-Indonesian region, American Geophys. Union (AGU), Geodynamic Series 11, p. 159-172.
(Much of Talaud islands tectonic melange with up to 5km wide blocks of ophiolite, preserving complete oceanic crustal sections. Pillow basalts associated with bedded chert and pelagic limestones with Eocene radiolaria. Miocene basaltic andesites not considered part of ophiolitic rocks.

Fiddin, T. & A. Hendratno (2012)- Karakteristik batuan ultrabasa di Pulau Halmahera, Provinsi Maluku Utara. J. Teknik Geologi (UGM), 1, 4, 5p.
(online at: http://lib.geologi.ugm.ac.id/ojs/index.php/geo/article/view/18)
('Characteristics of ultrabasic rocks on Halmahera, North Moluccas'.Ultramafic rocks of Halmahera island belong to dunite, harzburgite and serpentinite types. Chemically part of tholeiite series, low in K2O and high in MgO, and formed in mid-ocean ridge setting (N-MORB), in depleted mantle ~60-80 km above upper mantle)

Finch, E.M. & S.J. Roberts (1993)- An integrated Tertiary biozonation scheme for the Halmahera region, Eastern Indonesia. In: T. Thanasuthipitak (ed.) Int. Symposium Biostratigraphy of mainland Southeast Asia: facies and paleontology (BIOSEA), Chiang Mai 1993, p. 455. *(Abstract only)*
(Outcrop samples from Halmahera includes E-M Eocene volcanoclastics. Late M Eocene (45 Ma) regional unconformity, overlain by Late Eocene limestones and Oligocene volcanoclastics. Second regional unconformity at ~25 Ma, marking arc-Australian continent collision. Halmahera arc initiated in Late Miocene)

Fitzpatrick, N., A. Harris, F. MacCorquodale & D. Wardiman (2015)- The Gosowong goldfield- a world-class epithermal gold-silver district in Indonesia. In: Proc. PACRIM 2015 Congress, Hongkong, Australasian Inst. of Mining and Metallurgy (AusIMM), Melbourne, Publ. Ser. 2/2015, p. 235-242. *(Extended Abstract)*
(Gosowong epithermal Au-Ag deposits in NW arm of Halmahera discovered in 1994. With subsequent brownfields discoveries reserves of >6 Moz Au. Main deposits named Gosowong, Toguraci and Kencana. Epithermal mineralization in Pliocene andesitic-basaltic arc volcanics of Gosowong Fm (zircon ages 3.9-3.5 Ma) and Ar/Ar age for hydrothermal alteration of 2.9 Ma. Mineralisation in multistage veins, breccias and stockwork veins. Four major types of hypogene alteration)

Flett, D., R. Hall & N. Wagimin (2011)- The geology and hydrocarbon potential of the Weda Bay area, S.W. Halmahera, Eastern Indonesia. Proc. SE Asia Expl. Soc. (SEAPEX) Expl. Conf., Singapore 2011, Presentation 19, 31p.
(New seismic data over undrilled Weda Bay Basin, SE of Halmahera, indicates >7km of Tertiary sediment. Source rocks believed to be present, with potential to generate oil and gas. Hydrocarbon expulsion features on many lines. Basin flanks currently within oil and gas generative window. Potential play types both reefs and stacked clastics in compressional structures)

Forde, E.J. (1997)- The geochemistry of the Neogene Halmahera Arc, Eastern Indonesia. Ph.D. Thesis University of London, p. 1-268. *(Unpublished)*
(Halmahera arc is N-S intra-oceanic arc cutting across the islands of Halmahera and Bacan and is result of eastward subduction of Molucca Sea Plate. K/Ar dating revealed migration of volcanism along length of Halmahera arc. Oldest volcanics (~11 Ma) in S from Obi, where volcanism now extinct. To N in Bacan, ages from 7 Ma- Quaternary, in C Halmahera from 6- 2 Ma. Volcanic rocks from Obi, C Halmahera and N Bacan typical intra-oceanic arc lavas. Volcanic rocks from W and S Bacan suggest assimilation of continental component and supports hypothesis of overthrusting of Philippine Sea Plate ophiolitic and Australian plate continental material, due to collision in Early Miocene)

Gemmell, J.B. (2007)- Hydrothermal alteration associated with the Gosowong epithermal Au-Ag deposit, Halmahera, Indonesia; mineralogy, geochemistry, and exploration implications. Economic Geology 102, 5, p. 893-922.
(Gosowong epithermal Au-Ag deposit discovered in 1994 in NW arm Halmahera. Host rocks Miocene shallow marine, intermediate-basic volcanic and volcaniclastic rocks of Gosowong Fm. 40Ar/39Ar dating of adularia grains from vein zone yielded late Pliocene age (2.4-2.9 Ma))

Georgiades Bey, A. (1918)- Untersuchungen uber Eruptivgesteine der Insel Halmahera (Djilolo) im Archipel der Molukken. Inaugural Dissertation University of Zurich, p. 1-46. *(Unpublished)*
('Investigations of volcanic rocks of Halmahera Island (Djilolo) in the Moluccas Archipelago'. Petrographic study of basalts, diorites, trachydolerites, andesites, etc., collected by E. Gogarten in Halmahera. Little or no locality information. First geologic thesis by student from Turkey; Sengor 1988)

Gogarten, E. (1918)- Geologie van Noord-Halmahera; voorlopige mededeeling. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 2, p. 267-280.
('Geology of North Halmahera, preliminary communication'. Summary of 1911 geological reconnaissance along N coast of Halmahera. Not very useful, except for presence of belemnite in sandstone at SE Morotai island (but fossil lost in transport to Germany))

Gogarten, E. (1918)- Die Vulkane der nordlichen Molukken. Zeitschrift Vulkanologie 4, p. 211-305.
('The volcanoes of the northern Moluccas')

Hakim, A.S. (1989)- Tertiary volcanic rocks from the Halmahera Arc, Indonesia: petrology, geochemistry and low temperature alteration. M.Phil. Thesis, University of London, p. 1-292. *(Unpublished)*

Hakim, A.S. & R. Hall (1991)- Tertiary volcanic rocks from the Halmahera arc. J. Southeast Asian Earth Sci. 6, 3-4, p. 271-287.
(onine at: http://searg.rhul.ac.uk/pubs/hakim_hall_1991_halmahera.pdf)
(In W Halmahera Arc Quaternary and Late Neogene andesites and subordinate basalts. Probably no arc volcanic activity during most of Miocene: Neogene volcanic arc initiated at beginning of Late Miocene by E-ward subduction of Molucca Sea Plate at Halmahera Trench. Basalts of Oha Fm in SW belt older than Late Miocene (Late Cretaceous-Eocene suspecte) and probably products of Late Mesozoic or E Tertiary subduction within Pacific, evolved by olivine, plagioclase and clinopyroxene fractionation. With extensive sub-greenschist facies alteration reflecting deep burial and/or high heat flows, producing zeolites, chlorites, smectites etc.)

Hall, R. (1987)- Plate boundary evolution in the Halmahera Region, Indonesia. Tectonophysics 144, p. 337-352.
(online at: http://searg.rhul.ac.uk/pubs/hall_1987%20Plate%20boundaries%20Halmahera.pdf)
(Halmahera stratigraphy links to E Philippines and records history of Molucca Sea subduction. Halmahera- E Mindanao basement part of Late Cretaceous-E Tertiary arc and forearc and part of single plate since Late Eocene- E Oligocene. No evidence of Oligo-Miocene arc: Pliocene arc on E Tertiary arc basement. Arc volcanism ceased briefly in Pleistocene and shifted W after deformation episode. Present arc built on deformed Pliocene arc. Diachronous collision at W edge Philippine Sea Plate which began in Mindanao in Late Miocene impeded Philippine Sea Plate movement and further motion achieved by strike-slip along Philippine Fault, subduction at Philippine Trench and subduction of Molucca Sea lithosphere under Halmahera)

Hall, R. (1999)- Neogene history of collision in the Halmahera region, Indonesia. Proc. 27th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, G014, 8p.
(Molucca Sea Plate almost entirely subducted remnant of double subduction system, with Sangihe Arc in W, Halmahera Arc in E. In N Molucca Sea Halmahera Arc entirely overridden by Sangihe forearc, and in few million years time entire Halmahera arc may have disappeared)

Hall, R., J.R. Ali & C.D. Anderson (1995)- Cenozoic motion of the Philippine Sea plate: palaeomagnetic evidence from eastern Indonesia. Tectonics 14, p. 1117-1132.
(online at: http://searg.rhul.ac.uk/pubs/hall_etal_1995%20Philippine%20Sea%20Plate%20palaeomagnetism%20Tectonics.pdf)
(New paleomagnetic data N and S of Sorong Fault record S-ward movement in Eocene and N-ward movement in Neogene. All sites N of Sorong Fault (Halmahera- Kasiruta- Waigeo) clockwise declinations. Neogene rocks small deflections, Oligocene- M Eocene rocks clockwise declination deflections of ~40°. Declinations of lower Eocene rocks indicate ~90° of CW rotation. Sorong Fault originated after Australia- Philippine Sea plate collision at ~25 Ma. Area N of Sorong Fault always part of Philippine Sea Plate)

Hall, R., J.R. Ali, C.D. Anderson & S.J. Baker (1995)- Origin and motion history of the Philippine Sea Plate. Tectonophysics 251, p. 229-250.
(Halmahera-Waigeo good Mesozoic- Tertiary stratigraphic record indicating long arc history for S part of plate. Regional unconformities in Middle Eocene and base Miocene (~25 Ma))

Hall, R., M.G. Audley-Charles, F.T. Banner, S. Hidayat & S.L. Tobing (1988)- The basement rocks of the Halmahera region, eastern Indonesia: a Late Cretaceous-Early Tertiary arc and fore-arc. J. Geol. Soc. London 145, p. 65-84.
(W Halmahera active volcanic arc. E Halmahera basement dismembered ophiolites with slices of Mesozoic and Eocene sediments, unconformably overlain by M Oligocene and younger sediments and volcanics. Mesozoic-Eocene sediments similar to Marianas fore-arc. E Halmahera basement interpreted as pre-Oligocene fore-arc lacking accretionary complex. Mesozoic- Tertiary sediments imbricated with igneous and metamorphic rocks represent deeper parts of fore-arc during Late Eocene plate reorganization. S Bacan basement continental metamorphic rocks associated with deformed ophiolitic complex, different from E Halmahera. Metamorphic rocks interpreted to be part of N Australian continental margin basement, separated from Halmahera by splay of Sorong Fault system. Deformed ophiolite complex of Bacan may represent magmatism in fault zone)

Hall, R., M.G. Audley-Charles, F.T. Banner, S. Hidayat & S.L. Tobing (1988)- Late Palaeogene- Quaternary geology of Halmahera, Eastern Indonesia: initiation of a volcanic island arc. J. Geol. Soc. London 145, p. 577-590.
(Halmahera rel. complete M Oligocene- Recent sedimentary section unconformable on ophiolitic complex, part of Late Cretaceous- E Tertiary forearc. After volcanic arc activity ceased in Eocene, former fore-arc terrane uplifted and eroded in Late Paleogene. Clasts of Eocene reefal limestone with Discocyclina in ?Oligocene- E. Miocene Jawati conglomerate. Widespread Late Oligocene- Miocene carbonates. No evidence of arc volcanism in C Halmahera between Eocene and Pliocene. Oligo-Miocene volcanism in nearby regions interpreted as related to Sorong Fault system. Rapid subsidence in E Pliocene (tied to initiation of subduction of Molucca Sea) lead to basinal marls deposition, followed by siliciclastic turbidites with increasing amounts of calc-alkaline volcanic debris from W Halmahera Pliocene arc. Deformation in Pleistocene at junction of E and W Halmahera. Third Halmahera arc (Quaternary) active in N part of the islands since 1 Ma)

Hall, R., P.D. Ballantyne, A.S. Hakim & G.J. Nichols (1996)- Basement rocks of Halmahera, eastern Indonesia: implications for the early history of the Philippine Sea. In: G.P. & A.C. Salisbury (eds.) Trans. 5th Circum-Pacific Energy and Mineral Resources Conference, Honolulu 1990, Gulf Publishing, Houston, p. 301-317.
(Oldest rocks on Halmahera are 'supra-subduction zone' ophiolites, overlain by Late Cretaceous and Eocene arc volcanics and sediments. Late Cretaceous- Eocene age plutonic rocks intrude ophiolites. Shallow marine Eocene limestones unconformably overlain by Neogene sediments. Halmahera basement many similarities to submarine plateaus and ridges of Philippine Sea and E Philippines basement terranes, suggesting existence of extensive Late Cretaceous and Eocene volcanic arc(?) systems on Mesozoic ophiolitic basement)

Hall, R., M. Fuller, J.R. Ali & C.D. Anderson (1995)- The Philippine Sea plate: magnetism and reconstructions. In: B. Taylor & J.H. Natland (eds.) Active margins and marginal basins: a synthesis of Western Pacific drilling results, American Geophys. Union (AGU) Monogr. 88, p. 371-404.
(online at: http://searg.rhul.ac.uk/pubs/hall_etal_1995%20Philippine%20Sea%20plate%20palaeomagnetism%20AGU%20Monograph.pdf)
(Paleomagnetic results from ocean drilling and from land on Philippine Sea Plate indicate progressive N-ward translation of plate during Tertiary. ODP Leg 126 showed large CW declination shifts of up to -90° since E Oligocene. Similar large declination shifts at land sites at E margin of plate, similar changes in inclination as ocean drilling sites, and explained as result of entire plate rotation, marginal basin opening, and/or local tectonic deformation at plate edge. Propose plate rotated clockwise since E Tertiary by 5.5° between 0- 5 Ma, 34° between 5- 25 Ma, 50° between 40-50 Ma)

Hall, R. & G.J. Nichols (1990)- Terrane amalgamation in the Philippine Sea margin. Tectonophysics 181, p. 207-222.
(Philippine Sea plate includes plateaus of thickened crust, separated by thinner oceanic crust. Arrival of plateaus at subducting SW margin of Philippine Sea plate caused Philippine Trench to propagate S-ward in increments and caused transfer of terranes to Philippine margin. New data from the Halmahera region indicate plate boundaries strongly influenced by heterogeneous character of Philippine Sea plate. At present the Philippine Trench terminates at oceanic plateau which is structurally continuous with old forearc and ophiolite terrane on Halmahera. Position of this terrane caused Philippine Sea plate- Eurasia convergence to be transferred from subduction at Philippine Trench to Molucca Sea Collision Zone through NE-SW dextral transpressional zone across Halmahera)

Hall, R. & G. Nichols (1991)- Exploration in basins of the western Pacific margin: reducing the risk. In: J.W. Cosgrave & M.E. Jones (eds.) Neotectonics and resources, Belhaven Press, London, p. 243-256.
(Mainly on Halmahera geology)

Hall, R., G. Nichols, P. Ballantyne, T. Charlton & J. Ali (1991)- The character and significance of basement rocks of the southern Molucca Sea region. J. Southeast Asian Earth Sci. 6, p. 249-258.
(Pre-Neogene basement rocks in S Molucca Sea region include ophiolitic rocks, arc volcanics and continental rocks. Ophiolitic complexes, interpreted as oldest parts of Philippine Sea Plate, overlain by U Cretaceous and Eocene sediments and volcanics. Plutonic rocks of island arc origin intruding ophiolites yield Late Cretaceous radiometric ages; amphibolites with ophiolitic protoliths yield Eocene ages. Ophiolites speculated to have originated during mid-Cretaceous plate reorganization. Late Cretaceous-Paleogene arc volcanics in basement of Morotai, W Halmahera and Bacan overlain by shallow water Eocene limestones and Oligocene rift sequence with basaltic pillow lavas and volcaniclastic turbidites. Mid Eocene-Oligocene extension synchronous with opening of central W Philippine Basin)

Hammarstrom, J.M., B.T. Setiabudi, D.N. Sunuhadi, G.R. Robinson, C.L. Dicken, S. Ludington, A.A. Bookstrom & M.L. Zientek (2013)- Porphyry copper assessment for Tract 142pCu7202, Halmahera Arc, North Molucca Islands- 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 K, p. 175-185.
(online at: http://pubs.usgs.gov/sir/2010/5090/d/sir2010-5090d_text.pdf)
(Assessment of porphyry copper deposits in ~400 km long Neogene Halmahera island arc, along western parts of Morotai, Halmahera, Bacan, Obi, etc. With Kaputusan porphyry copper deposit on Bacan (with 77 Mt at 0.33% copper and 0.25 g/t gold; exact age unknown))

Handayani, L. (2004)- Seismic tomography constraints on reconstructing the Philippine Sea plate and its margin. Ph.D. Thesis Texas A&M University, College Station, p. 1-144.
(online at: http://txspace.tamu.edu/bitstream/1969.1/1497/1/etd-tamu-2004C-GEOP-Handaya.pdf)
(High velocity mantle anomalies coincident with Wadati-Benioff zones. N-ward movement of Philippine Sea Plate, WNW subduction of Pacific Plate since Eocene (~50 Ma), and N-ward subduction of Indian/ Australian Plate best explain subducted slab anomalies. E plate boundary originated as transform zone that evolved into subduction zone a few million years before Pacific Plate movement change. Initiation of this subduction zone may be one of triggers of Pacific Plate motion changes. 90° rotation of Philippine Sea Plate suggested in Hall (2002) reconstruction not supported by slab distribution beneath Philippine Sea region. Minimal rotation of Philippine Sea Plate assumed in reconstruction model)

Hanyu, T., J. Gill, Y. Tatsumi, J.I. Kimura, K. Sato, Q. Chang, R. Senda, T. Miyazaki, Y. Hirahara, T. Takahashi & I. Zulkarnain (2012)- Across- and along-arc geochemical variations of lava chemistry in the Sangihe arc: various fluid and melt slab fluxes in response to slab temperature. Geochem. Geophys. Geosystems 13, 10, Q10021, p. 1-27.
(online at: http://onlinelibrary.wiley.com/doi/10.1029/2012GC004346/epdf)
(Sangihe oceanic arc N of NE Sulawesi 500km long, with >25 Quaternary volcanoes. Is W half of active arc-arc collision. In S arc, volcanic front lavas enriched in fluid-mobile elements, while rear arc lavas more enriched in melt-mobile elements. Proportion of sediment versus altered oceanic crust in slab component only

~20% but larger than other arcs in W Pacific, suggesting more subduction of thick sediments in narrowing Molucca Sea. Lavas from dormant N Sangihe arc similar to Quaternary rear arc rather than Quaternary volcanic front lavas in S arc, possibly related to advanced collision in N arc that could have slowed subduction)

Hartadi, E.T., R. Mjos, S.I. Midtbo, P.T. Allo, G. Toxopeus, S. Hay, N. Pickard et al. (2013)- Early insights into the exploration of the Halmahera Basin, East Indonesia. Proc. 37th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA13-G-092, p. 1-6.
(Preliminary results of geologic fieldwork on islands bordering S and E rim of Halmahera II basin prior to drilling (Kofiau, Boo, Klaarbeck; compared to other islands and sole exploration well in area, Bantanta A-1x))

Hase, T., K. Yonezu, T. Tindell, Syafrizal & K. Watanabe (2015)- Mineralization characteristics of the Kencana deposit, Gosowong mining area, Halmahera, Indonesia. Proc. IGC 2015 (2nd Int. Conf. and 1st Joint Conf. Fac. Geology Universitatas Padjadjaran and Fac. Sci. Nat. Res. University Malaysia Sabah), p. 205-212.
(online at: http://seminar.ftgeologi.unpad.ac.id/wp-content/uploads/2016/02/Mineralization-Characteristics-of-the-Kencana-deposit.pdf)
(Gosowong gold mining area in N-C Halmahera with three deposits: Gosowong (1994), Togurachi (2000) and Kencana (2003). Kencana deposit three veins in Neogene andesites of Halmahera volcanic arc; classified as low-sulfidation Au-Ag epithermal deposit with chalcopyrite, electrum, Au-Ag-Te minerals, galena, sphalerite)

Jaffe, L.A., D.R. Hilton, T.P. Fischer & U. Hartono (2004)- Tracing magma sources in an arc-arc collision zone: Helium and carbon isotope and relative abundance systematics of the Sangihe Arc, Indonesia. Geochem., Geoph. Geosystems, AGU, 5, 4, p. 1-17.
(Sangihe Arc presently colliding with Halmahera Arc in NE Indonesia, forming only extant example of arc-arc collision zone. He and C data suggest variations in primary magma source characteristics along strike of arc, which may be caused by greater volumes of sediment subduction in N, variability in subducted sediment composition, or enhanced slab-derived fluid/melt production. Northern volcanoes high contribution of CO2 from carbonate associated with subducting slab)

Kanig, M., T. Soeprapto & G. Friedrich (1990)- Die Bindungsformen von Si, Mg, Fe, Al, Mn, Cr, Ni und Co in Saprolit und Laterit uber Serpentinit, Insel Gebe, Indonesien. Issue Zeitsch. Pflanzenernahrung und Bodenkunde 153, 6, p. 425-431.
('The fixation of Si, Mg, Fe, Al, Mn, Cr, Ni and Co in saprolite and laterite above serpentinite, Gebe island, Indonesia' Gebe Island part of Halmahera group. In laterite, most of extractable Si, Al, Cr and Ni bound to goethitic Fe-hydroxide. In saprolite and laterite Co bound to Mn-oxides)

Kraeff, A. (1954)- De geologie van de chrysotiel- asbest voorkomens van de Oost-arm van Halmaheira. Djawatan Geologi, Bandung. Report K54-1, p. 1-40. *(Unpublished)*
('The geology of chrysotile-asbestos occurrences in the East Arm of Halmahera')

Kuenen, P.H. (1932)- Een geologische verkenningstocht op Morotai. Tropisch Nederland 5, 18, p. 275-283.
('A geological reconnaissance on Morotai'. Notes on 1930 trip to Morotai Island N of Halmahera by geologist of Snellius Expedition. W coast rocks mainly composed of old volcanic rocks with enclosed blocks of limestone. Mainly travelog, not much on geology)

Kuenen, P.H. (1933)- Een geologische verkenningstocht op Morotai- II (Slot). Tropisch Nederland 5, 19, p. 291-294.
('A geological reconnaissance on Morotai- part 2 of 2'. Notes on 1930 trip to Morotai. No geology.

Kusnama (1989)- Petrography and provenance of Neogene sandstones of South Halmahera, East Indonesia. M.Phil. Thesis, University of London, p. *(Unpublished)*

Kusnama (2008)- Karakteristik batubara daerah Patani, Halmahera Timur, Maluku Utara. Proc. 37th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 745-760.

('Characteristics of coal in the Patani area, E Halmahera, N Moluccas'. Around 1m thick Paleocene coals in Dorosagu Fm of Patani area in two blocks: Paniti Blocks autochthonous coal with vitrinite reflectance Rv 0.42- 0.54%; Bicoli Block allochthonous deltaic coal deposits with clay partings and average Rv 0.36- 0.43)

Kusnama & D. Sukarna (1996)- The provenance of Neogene sandstones South Halmahera, East Indonesia. Bull. Geol. Res. Dev. Center, Bandung, p. 181-201.
(Two provenance areas in Late Neogene Weda Group: in W mainly derived from andesitic volcanics, in E mainly foraminiferal limestones?. With 3 paleogeographic maps for Late Miocene, E Pliocene, Late Pliocene)

Kusworo, A., L.D. Santy & A.J. Widiatama (2017)- Karakteristik ichnofosil pada endapan turbidit karbonat-silisiklastik Formasi Weda, Pulau Halmahera. Proc. Joint Conv. HAGI-IAGI-IAFMI-IATMI (JCM 2017), Malang, 5p.
('Characteristics of ichnofossil in carbonate-siliciclastic deposits of the Weda Formation, Halmahera Island'. Two deep marine trace fossils associations in 60m of Late Miocene Weda Fm turbiditic series in Lili River: Thalassinoides and Zoophycos-Chondrites)

Lallemand, S.E., M. Popoff, J.P. Cadet, A.G. Bader, M. Pubellier, C. Rangin, & B. Deffontaines (1998)- Genetic relations between the central and southern Philippine Trench and the Sangihe Trench. J. Geophysical Research 103, p. 933-950.
(On junction between C and S Philippine Trench and Sangihe Trench near 6°N. Model favors N extension of Halmahera Arc up to 8°N, with three segments offset left-laterally along NW-SE transform faults. Accretion of N segment to Mindanao Island at 4-5 Ma resulted in failure in Philippine Sea Plate. Sangihe deformation front recognized up to 7°N, but seems active only S of 6°N)

MacPherson, C.G., E.J. Forde, R. Hall & M.F. Thirlwall (2003)- Geochemical evolution of magmatism in an arc-arc collision; the Halmahera and Sangihe Arcs, eastern Indonesia. In: R.D. Larter & P.T. Leat (eds.) Intra-oceanic subduction systems; tectonic and magmatic processes, Geol. Soc. London, Spec. Publ. 219, p. 207-220.
(Molucca Sea Collision Zone site of collision of two active subduction systems. Both Halmahera subduction zone in E and Sangihe zone in W have subducted oceanic Molucca Sea Plate, now consumed. Both volcanic arcs active since Neogene and show increased evidence for sediment recycling as collision progressed)

Malaihollo, J.F.A. (1993)- The geology and tectonics of the Bacan region, East Indonesia. Ph.D. Thesis University of London, p. 1-406. *(Unpublished)*

Malaihollo, J.F.A. & R. Hall (1996)- The geology and tectonic evolution of the Bacan region, East Indonesia. In: R. Hall & D.J. Blundell (eds.) Tectonic evolution of SE Asia, Geol. Soc. London, Spec. Publ. 106, p. 483-497.
(Bacan near convergence Eurasian, Philippine Sea and Australian plates. Old? Sibela metamorphics with young isotope ages juxtaposed against Sibela ophiolite with Cretaceous isotope age with Oligocene-Miocene overprint. N Bacan oldest rocks low metamorphic U Eocene Bacan Fm arc volcanics and turbiditic volcaniclastics. Similar Lower Miocene sequence in S Bacan. Major Lower Miocene (~22 Ma) unconformity, representing Australian continent- Philippine Sea plate collision, overlain by shallow marine E-M Miocene limestones with interbeds of Amasing Fm volcaniclastic sands. U Miocene- Pleistocene Kaputusan Fm arc andesites from four eruption centres, shallow marine pyroclastic rocks and fringing coastal reef limestones. Volcanic rocks produced by E-ward subduction of Molucca Sea plate. Quaternary basalts related to movement along Sorong fault. Most of Bacan part of Philippine Sea plate since Cretaceous. Evidence for continental crust of Australian origin in Bacan area by E Miocene)

Matsuoka, K. (1981)- Dinoflagellate cysts and pollen in pelagic sediments of the northern part of the Philippine Sea. Bull. Fac. Liberal Arts, Nagasaki University Natural Science 21, 2, p. 59-70.

McCaffrey, R. (1982)- Lithospheric deformation within the Molucca Sea arc-arc collision- evidence from shallow and intermediate earthquake activity. J. Geophysical Research 87, p. 3663-3678.

(Local earthquake survey in Molucca Sea arc-arc collision zone. Concentration of earthquake foci in 10- 50km depth range in limited region under Talaud-Mayu Ridge suggests convergence between arcs proceeds by shortening within basement of intervening Molucca Sea plate)

McCaffrey, R. (1983)- Seismic-wave propagation beneath the Molucca Sea arc-arc collision zone, Indonesia. Tectonophysics 96, p. 45-57.

McCaffrey, R. (1991)- Earthquakes and ophiolite emplacement in the Molucca Sea collision zone, Indonesia. Tectonics 10, 2, p. 433-453.
(Earthquakes indicate high-angle (30-60°) thrust faults beneath Talaud-Mayu Ridge in Central Molucca Sea, penetrating at least 15 km into upper mantle and elevate pieces of crust and upper mantle at rapid rate. These pieces likely include thick ophiolites detached from Molucca Sea lithosphere. High seismic activity consistent with Molucca Sea accommodating much of Philippine-Eurasian convergence)

McCaffrey, R., E.A. Silver & R.W. Raitt (1980)- Crustal structure of the Molucca Sea collision zone, Indonesia. In: D.E. Hayes (ed.) The tectonic and geologic evolution of Southeast Asian seas and islands 1, American Geophys. Union (AGU), Geophys. Monograph 23, p. 161-178.
(online at: http://web.pdx.edu/~mccaf/pubs/mccaffrey_mol_sea_agu_1980.pdf)
(Scripps 1976-1977 Molucca Sea seismic refraction profiles showing thick low-velocity collision complex. Gravity models suggest steep upthrusted (up to 6 km) oceanic basement slab under Talaud- Mayu Ridge)

Micklethwaite, S., S. Feig, T. Falloon & S. Meffre (2012)- Subduction polarity reversal, complex slab interactions and rapid changes to arc extension: Halmahera island arc, Indonesia. In: Cause and effects of deformation in the lithosphere, Specialists Group in Tectonics and Structural Geology (SGTSG) Conf., Waratah Bay, Geol. Soc. Australia, v. 102, p. 89. *(Abstract only)*
(Active island arc of Halmahera located at polarity reversal between subducting Molucca and Philippines Sea Plates. Majority of active volcanic arc tied to subducting Molucca Sea Plate but in N arm of Halmahera arc diverges towards tip of Philippines subduction zone. Thrust faulting of Oligocene- Miocene rocks in S and C Halmahera, but not in N. Pliocene volcanism when subduction of Philippines Sea Plate initiated and interacted with subducting Molucca Sea Plate, also leading to high-grade epithermal gold deposits at Gosowong)

Micklethwaite, S. & D. Silitonga (2011)- Transient kinematic changes in epithermal systems: Toguraci deposit, Halmahera. In: Proc. 11th Biennial Conf. SGA, Townsville 2011, p.
(On Late Pliocene epithermal vein systems in Toguraci Au-Ag deposit of Gosowong goldfield, N Halmahera. Host rocks bimodal basaltic to andesitic volcanic lavas, volcaniclastics and diorites with zircon U-Pb isotopic ages of ~3.1-3.7 Ma. Epithermal mineralisation dated as 2.8-2.9 Ma)

Milsom, J., R. Hall & T. Padmawidjaja (1996)- Gravity fields in eastern Halmahera and the Bonin Arc; implications for ophiolite origin and emplacement. Tectonics 15, 1, p. 84-93.
(Classic large ophiolite bodies generally associated with large gravity anomalies. No large anomalies in ophiolitic fragmented terranes like E Halmahera-Waigeo terrane. Ophiolites probably Jurassic age and associated with Cretaceous- M Eocene island arc volcanics. Crust at least 20km thick, probably thickening in intra-oceanic island arc. Waigeo also has Oligocene volcanoclastics)

Milsom, J., L. Parson, D. Massom, G. Nichols, N. Sikumbang & B. Dwiyanto (1996)- Tectonics of the Palau-Halmahera- Waigeo triangle. In: G.P. & A.C. Salisbury (eds.) Trans. 5th Circum-Pacific Energy and Mineral Resources Conference, Honolulu 1990, Gulf Publishing, Houston, p. 385-395.
(Region E of Halmahera occupied by number of blocks of thickened island-arc crust and regions of deeper water underlain by oceanic crust. Geological history still obscure. East Philippine Sea Arc formed in Eocene; had E-W strike in Oligocene, now N-S alignment after rotation of Philippine Sea Plate. In earliest Miocene, a second arc terrane, wich also included Eocene volcanics, welded onto New Guinea which at that time was 2000km S of present position)

Moore, G.F., D. Kadarisman, C.A. Evans & J.W. Hawkins (1981)- Geology of the Talaud Islands, Molucca Sea collision zone, northeast Indonesia. J. Structural Geol. 3, p. 467-475.
(Talaud Islands at N margin of collision zone between Sangihe and Halmahera island arc systems. Oldest rock units are dismembered ophiolites and Early Miocene(?) tectonic melange with blocks of serpentinite, M Eocene radiolarian chert, etc. Overlain by folded, W-verging M Miocene-Pleistocene marine sediments)

Moore, G.F., D. Kadarisman & Sukamto (1980)- New data on the geology of the Talaud Islands, Molucca Sea. Bull. Geol. Res. Dev. Centre 13, p. 5-12.
(Talaud islands at N end of Molucca Sea with E-dipping slabs of ophiolite in tectonic melange, associated with M Eocene cherts and limestones. Overlain by moderately deformed, very deep marine M Miocene- Pliocene sediments. Talaud ophiolites interpreted as fragments of Eocene or older oceanic crust and mantle, emplaced into forearc terrane in Early Miocene. Talaud Island block uplifted >2000m since Pliocene)

Moore, G.F. & E.A. Silver (1983)- Collision processes in the northern Molucca Sea. In: D.E. Hayes (ed.) The tectonic and geologic evolution of Southeast Asian seas and islands 2, American Geophys. Union (AGU), Geophys. Monograph 27, p. 360-372.
(Collision zone between two facing island arcs. W Mindanao Arc collided in mid-Tertiary with E Mindanao Arc. Thick sediments, presently being deformed in Molucca Sea collision zone, eroded from New Guinea and Halmahera in S and from collision zone in Mindanao. Substantial strike-slip motion during collision. Two new subduction zones at Cotabato and Philippine trenches are propagating S-ward)

Morrice, M.G. (1982)- Mineralogy, petrology and geochemistry of the Sangihe Arc; volcanism accompanying arc- arc collision in the Molucca Sea, Indonesia. Ph.D. Thesis University of California, Santa Cruz, p. 1-363.

Morrice, M.G. & J.B. Gill (1986)- Spatial patterns in the mineralogy of island-arc-magma series-Sangihe-Arc, Indonesia. J. Volcanology Geothermal Res. 29, p. 311-353.
(500km long Sangihe arc is W part of two colliding arcs in NE Indonesia. Andesites dominate. Plagioclase basalts at S volcanic front evolve to two-pyroxene andesites. Augite basalts behind volcanic front and to N where collision more complete, evolve to hornblende andesites. Percentage of mantle fusion highest at S volcanic front)

Morrice, M.G., P.A. Jezek, J.B. Gill, D.J. Whitford & M. Monoarfa (1983)- An introduction to the Sangihe arc: volcanism accompanying arc-arc collision in the Molucca Sea, Indonesia. J. Volcanology Geothermal Res. 19, p. 135-165.
(In Molucca Sea region Sangihe and Halmahera arcs presently colliding (earth's only example of collision between facing volcanic arcs). Collision more advanced in N Molucca Sea where back-arc thrusting occurs along Cotobato and Philippine trenches and volcanic centers are inactive and dissected. Sangihe Arc ~500 km long, from NE tip of Sulawesi to Mindanao, Philippines, with 25 Quaternary volcanic centers. Active volcanic belt 70 km wide, 100-180 km above top of W-dipping Benioff zone. Rockes range from basalt to rhyolite, mainly andesites. Tholeiitic suites confined to S volcanic front. Calcalkaline suites throughout arc. S to N increase in LIL-elements without corresponding changes in Sr-isotopes interpreted as decreasing partial melting N-ward)

Morris, J.D., P.A. Jezek, S.R. Hart & J.B. Gill (1983)- The Halmahera island arc, Molucca Sea collision zone, Indonesia: a geochemical survey. In: D.E. Hayes (ed.) The tectonic and geologic evolution of Southeast Asian seas and islands, 2, American Geophys. Union (AGU), Geophys. Monograph 27, p. 373-387.
(W Halmahera volcanic arc above 45° E-dipping Benioff zone, present down to 230 km. Three regions with distinct chemistry and tectonic setting. Most volcanoes part of calc-alkaline oceanic segment. Continental suite on Bacan reflects intersection of oceanic arc with continental fragment. Origin of alkaline rocks on inactive volcanic islands along Sorong Fault zone unclear)

Nichols, G.S. & R. Hall (1991)- Basin formation and Neogene sedimentation in a backarc setting, Halmahera, eastern Indonesia. Marine Petroleum Geol. 8, p. 50-61.
(Halmahera Basin formed by subsidence of thickened crust of imbricated Mesozoic-Paleogene arc and ophiolite rocks. In Miocene basement complex formed thickened crust on which reef and reef-associated

sediments were deposited, similar to Philippine Sea Plate plateaux and ridges. Late Miocene convergence between Philippine Sea Plate- Eurasian margin resulted in formation of Halmahera Trench to W. Subduction of Molucca Sea Plate at trench caused development of volcanic island arc. Subsidence in back-arc area produced sedimentary basin filled by clastics eroded from arc and uplifted basement and cover rocks. Basin asymmetric, thickest sediments on W side, against volcanic arc. Halmahera Basin modified by Plio-Pleistocene E-W compression as Molucca Sea Plate was eliminated by subduction).

Nichols, G., R. Hall, J. Milsom, D. Masson, L. Parson, N. Sikumbang, B. Dwiyanto & H. Kallagher (1990)- The southern termination of the Philippine Trench. Tectonophysics 183, p. 289-303.
(Philippine Trench in process of propagating S and some of ESE-WNW convergence is transferred via broad NE-SW zone of dextral strike-slip across N Halmahera into Molucca Sea Collision Zone. E Halmahera-Waigeo Ophiolite Terrane area of shallow water and islands underlain by ophiolitic basement between Halmahera and Sorong Fault Zone. Halmahera is in diffuse boundary zone at margin of Philippine Sea Plate)

Nichols, G., Kusnama & R. Hall (1991)- Sandstones of arc and ophiolite provenance in a backarc basin, Halmahera, eastern Indonesia. In: A.C. Morton, S.P. Todd & P.D.W. Haughton (eds.) Developments in sedimentary provenance studies, Geol. Soc., London, Spec. Publ. 57, p. 291-303.
(Late Neogene backarc basin on Halmahera distinctive detrital sandstones mineral assemblages. Quartz extremely rare, indicating no input from continental sources. Two provenance areas: volcanics in W half of basin and black sands of ultrabasic origin interbedded with carbonate mudstones in E of basin. These reflect nature of terrains which bordered Halmahera Basin)

Olberg, D.J. (2001)- Ore shoot targeting in the Gosowong vein zone, Halmahera, Indonesia. M. Econ. Geol. Thesis, University of Tasmania, p. 1-227.
(online at: http://eprints.utas.edu.au/11602/2/Whole-Olberg%2C_2001_thesis.pdf)
(Gosowong gold mineralization in N arm of Halmahera low-sulfidation epithermal quartz vein deposit with strike length of ~400m, hosted in two S-plunging ore shoots in ?Late Miocene Gosowong Fm andesitic-dacitic volcanics, along E-dipping normal fault.)

Olberg, D.J., J. Rayner, R.P. Langmead & J.A.R. Coote (1999)- Geology of the Gosowong epithermal gold deposit, Halmahera, Indonesia. In: G. Weber (ed.) Proc. PACRIM '99 Congress, Bali 1999, Australasian Inst. of Mining and Metallurgy (AusIMM), Parkville, Publ. 4/1999, p. 179-185.
(Gosowong deposit classic low-sulphidation epithermal copper-gold porphyry in Neogene Halmahera magmatic arc. Elongate dome formed by magma intrusion. Host rocks ?Late Miocene intermediate-basic volcanics and volcaniclastics. Multiphase epithermal quartz-adularia and quartz-chlorite fissure veins, breccias, and stockworks)

Palmer, M.R. (1991)- Boron- isotope systematics of Halmahera arc (Indonesia) lavas: evidence for involvement of the subducted slab. Geology 19, 3, p. 215-217.
(Sediments and altered oceanic crust are enriched in boron and cesium relative to uncontaminated mantle products. Combination of B-isotopes and Cs concentrations in Halmahera arc lavas suggests influence by fluids derived from dehydration or melting of subducted slab)

Permanadewi, S., J. Wahyudiono & A. Tampubolon (2017)- Cebakan nikel laterit di Pulau Gag, Kabupaten Raja Ampat, Provinsi Papua Barat. Bul. Sumber Daya Geologi 12, 1, p. 55-70.
(online at: http://buletinsdg.geologi.esdm.go.id/index.php/bsdg/issue/archive)
('Lateritic nickel deposit on Gag Island, Raja Ampat Regency, West Papua Province'. Lateritic nickel (Ni, Co, Fe) deposits cover 2/3 of Gag island, derived from weathering of ultramafic rocks (serpentinite, harzburgite and pyroxenite). Ophiolite complex oceanic crust tectonically emplaced onto continental margin and island arc. Secondary nickel ore garnierite. Lateritic zone with 1.2% Ni. Iron >30% Fe in limonitic layer)

Priadi, B., H. Permana, R. Binns & I. Zulkarnain (2006)- Maselihe Volcano: a new discovery submarine volcano in the Sangihe Arc, Eastern Indonesia. Volcano International Gathering, Yogyakarta 2006, p.

Priadi, B., I. Zulkarnain, R. Binns, H. Permana, I. Prasetyo et al (2004)- Oceanic-island alkaline volcanism among submarine volcanoes along the Sangihe Arc, Eastern Indonesia. Proc. Asia Oceania Geoscience Seminar, Singapore 2004, p.

Prihatmoko, S., H. Lubis & E. Suherman (2013)- Mineral district of Bacan Island, North Maluku: geology and gold-copper exploration status. In: Papua & Maluku Resources, Indonesian Soc. Econ. Geol. (MGEI) Ann. Conv., Bali, p. 65-88.
(Same paper as below)

Prihatmoko, S., H. Lubis & E. Suherman (2014)- Mineral district of Bacan Island, North Maluku: geology and gold-copper exploration status. Majalah Geol. Indonesia 29, 3, p. 199-224.
(Bacan islands SSW of Halmahera several tectonic domains and magmatic arcs since pre-Eocene. Incl. Eocene-E Miocene Bacan Fm volcanic arc (N-ward subduction of Australian Plate under Philippine Sea Plate). Collision of Australian continental fragment (Sibela Metamorphics) with volcanic arc in M Miocene. Late Miocene- Pliocene Kaputusan Fm arc volcanics, produced by E-ward subduction of Molucca Sea Plate under Halmahera, and Quaternary volcanics. Mineralization types in Bacan Fm include porphyry copper-gold, skarn metasomatism and polymetallic veins. High-sulphidation epithermal mineralization in Kaputusan Fm)

Prihatmoko, S. & F.E. Nugroho (1998)- Tertiary volcanic and intrusive rocks in Obi Island, Maluku Indonesia and related hydrothermal mineralization. Proc. 27th Ann. Conv. Indon. Assoc. Geol. (IAGI), Sumberdaya Mineral Energi, Yogyakarta, p. I 29-I 45.
(Obi islands between two strands of Sorong Fault zone. Pre-Tertiary with Triassic- Jurassic micaceous sandstones with Pentacrinus and Eocene-Miocene volcanics more similar to W Papua Birds Head than to W Halmahera volcanic arc. Three mineralized prospects)

Pringle, I.J. (1989)- Exploration for epithermal gold mineralisation in West Halmahera- Bacan island area, North Maluku Province. In: B. Situmorang (ed.) Proc. 6th Regional Conf. Geology Mineral and Hydrocarbon Resources of Southeast Asia (GEOSEA VI), Jakarta 1987, IAGI, p. 291-299.
(Stream sampling located 16 gold/ metal anomalies in W Halmahera and Bacan, hosted by Tertiary andesitic lavas. Bacan Island mainly Tertiary volcanics with uplifted core of Sibela Fm high-grade metamorphics)

Pubellier, M., A.G. Bader, C. Rangin, B. Deffontaines & R. Quebral (1999)- Upper plate deformation induced by subduction of a volcanic arc: the Snellius Plateau (Molucca Sea, Indonesia and Mindanao, Philippines). Tectonophysics 304, 4, p. 345-368.
(N Molucca Sea incipient subduction of composite oceanic- arc volcanic block (Snellius-Halmahera- SHB) beneath Sangihe Arc outer ridge. In Mindanao, convergence generated shortening of forearc basin and backthrusting of SHB. Classic system of paired subduction (Philippine Trench) and strike-slip fault (Philippine Fault) was installed. Transition from lithospheric subduction to crustal overthrusting where Philippine Trench s.s. begins, coinciding with offshore extension of Philippine Fault. Reversal of thrusts from E-ward vergence in Molucca Sea to W-ward vergence in Mindanao at latitude where forearc is uplifted and downgoing SHB crust deepens, resulting in strong gravity low above accretionary wedge)

Pudjowalujo, H. & D. Bering (1982)- Rock multi element geochemistry at the copper- gold anomaly in Kaputusan (Bacan Island), Moluccas, Indonesia. In: S.T. Watson (ed.) Trans. Third Circum-Pacific Energy and Mineral Resources Conference, Honolulu 1982, AAPG, p. 303-324.
(Gold-copper anomaly 12 km NE of Kaputusan village (Bacan Island, W of Halmahera) tied to presence of porhyry copper mineralization. Bacan Island composed mainly of Oligo-Miocene intermediate volcanics)

Pudjowaluyo, H. & N. Suryono (1982)- Mineralisasi logam tembaga di Hulu S. Kaputusan, P. Bacan, Maluku Utara. Geologi Indonesia (IAGI) 9, 1, p. 28-35.
(Copper mineralization at Kutusupan, Bacan island)

Purwanto, H.S. & S. Agustini (2014)- Lateritisasi nikel Pulau Pakal, Kabupaten Halmahera Selatan, Provinsi Maluku Utara. J. Ilmiah Magister Teknik Geologi (UPN) 7, 1, p..

(online at: http://jurnal.upnyk.ac.id/index.php/mtg/article/view/268/231)
(Nickel lateritization of Pakal Island, South Halmahera Regency, North Maluku Province'. Nickel laterite study in weathered ultramafic rocks in S part of Pakal island. Weathering of non-serpentinized rocks faster than serpentinites. Enriched Ni >1.5 % in saprolite zone and transition zone)

Rangin, G., D. Dahrin, R. Quebral & The MODEC Scientific Party (1996)- Collision and strike-slip faulting in the Northern Molucca Sea (Philippines and Indonesia): preliminary results of a morphotectonic study. In: R. Hall & D. Blundell (eds.) Tectonic evolution of southeast Asia, Geol. Soc., London, Spec. Publ. 106, p. 29-46.
(N Molucca Sea survey reveals presence of almost complete Sangihe arc and forearc, etc.)

Richards, T.H. & B.D. Priyono (2004)- Discovery of the Toguraci epithermal Au-Ag deposits, Gosowong Goldfield, Halmahera Island, East Indonesia. In: Proc. PACRIM 2004 Conf., Adelaide 2004, Australasian Inst. of Mining and Metallurgy (AusIMM), Melbourne, 5/2004, p. 359-366.
(Toguraci low sulfidation epithermal gold vein deposits 2 km WSW of Gosowong mine, part of Gosowong Goldfield in Neogene magmatic arc on Halmahera)

Richards, T.H., I.K.G. Suyadnya, N. Tyasmudadi, D. Darmawan & A. Muryanto (2005)- The discovery of the Kencana low sulfidation epithermal deposit, Gosowong goldfields, Halmahera, Island, East Indonesia. In: Proc. NewGen Gold Conference, Perth, p. 151-167.

Roberts, S.J. (1993)- The foraminiferal biostratigraphy and biofacies of the Neogene sediments of the Halmahera region, NE Indonesia. Ph.D. Thesis University of London, p. 1-287. *(Unpublished)*

Roothaan, H.P. (1928)- Geologische en petrografische schets der Talaud en Nanusa eilanden. Jaarboek Mijnwezen Nederlandsch-Indie 54 (1925), Verhandelingen II, p. 174-220.
('Geologic and petrographic sketch of Talaud and Nanusa Islands'. Islands mainly composed of igneous core, of mainly gabbros and peridotites, with thin sediment cover (probably Mesozoic radiolarian chert, breccias, overlain by presumably Tertiary unfossiliferous sandstones and marls). With 1:200,000 map)

Ryan, M., H. Butcher, T. Halvorsen, L.W. Kuilman, J. Demichelis, Sayentika, A. Jansson et al. (2012)- An early look at the hydrocarbon prospectivity of the Halmahera Basin, Eastern Indonesia. Proc. 36th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA12-G-078, p. 1-14.
(On Halmahera II PSC in Halmahera frontier basin acreage. Prospective plays Oligocene/Miocene carbonate reefal buildups and Miocene re-deposited carbonates. Potential source rocks source rock marine Miocene Klamogun and Klasafet-equivalent formations (but see also Yustiana et al. 2016)

Sartono, S. & S. Hadiwisastra (1989)- Ophiolitic melange in Gebe Island and its olistostromal origin. In: B. Situmorang (ed.) Proc. 6th Regional Conf. Geology Mineral Hydrocarbon Resources of Southeast Asia (GEOSEA VI), Jakarta 1987, IAGI, p. 157-169.
(Gebe Island between Halmahera and Waigeo with nickel-chromite deposits. Chaotic basement complex overlain by U Miocene-Pliocene bioclastic limestones. Basement probably olistostrome, with ultrabasic and metamorphic clasts and probably Eocene- E Miocene age)

Setyanta, B. & I. Setiadi (2011)- Model struktur subduksi kerak di perairan Laut Maluku dan vukanisme berdasarkan analisis gaya berat dan kegempaan. J. Sumber Daya Geologi 21, 4, p. 213-223.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/148/144)
('Model of crustal subduction structure in Molucca Sea waters and volcanism by analysis of gravity and seismicity'. N-S Bouguer anomalies of -100 to 260 mGal. Gravity modelling indicates subducting slab under Halmahera steeply dipping E, while in W part (below N arm of Sulawesi) it is not visible)

Silitonga, D. (2013)- Characteristics of Gosowong goldfields epithermal deposits. Proc. Indonesian Soc. Econ. Geol. (MGEI) Annual Conv. 2013, Papua & Maluku Resources, Bali, p. 115-124.

Silitonga, P.H., H. Pudjowalujo & H. Mollat (1981)- Geological reconnaissance and mineral prospecting on Bacan Island (Moluccas, Indonesia). In: A.J. Barber & S. Wiryosujano (eds.) The geology and tectonics of eastern Indonesia, Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 2, p. 373-381.
(Bacan Island oldest rocks intensely deformed mica schists and amphibolites and associated ultrabasic rocks of unknown age and NNE-SSW foliation. Oldest dated rocks probably Late Oligocene- Early Miocene age submarine andesites intruded by granodiorites and with intercalated coral limestones. Volcanic series overlain byE-M Miocene marine clastics with common volcanic detritus, overlain by Late Tertiary- Quaternary Young volcanics. Recent coral reefs raised to 700m above sea level)

Silver, E.A. & J.C. Moore (1978)- The Molucca Sea collision zone, Indonesia. J. Geophysical Research 83, B4, p. 1681-1691.
(Same as Silver & Moore 1981. N- trending Sangihe and Halmahera volcanic arcs face each other and underlain by opposing Benioff zones. Talaud-Mayu Ridge between arcs consists exclusively of deformed rocks, and underlain by at least 8-10 km of low-density material. Length of lithosphere subducted by colliding arcs >1000 km (length of Benioff zones). Obduction of melange and ophiolite belts against island arcs or continental margins. Central part of mostly submarine Talaud-Mayu ridge 1-3 km higher than flanking troughs. Two opposing vergence directions in rocks of collision complex: (1) during subduction, verging away from arcs, (2) during present phase of collision, verging towards arcs)

Silver, E.A. & J.C. Moore (1981)- The Molucca Sea collision zone. 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. 327-340.
(Scripps 1977 seismic profiles across Molucca Sea. Molucca Sea zone of crustal collision bordered by N trending Sangihe and Halmahera volcanic arc underlain by opposite-dipping Benioff zones. Length of Benioff zones suggest at least 1000km of subducted lithosphere. At least 8-10 km of low-density collisional melange material, now exposed on Talaud, Mayu, Tifoe islands)

Sodik, A., M.G. Rukmiati & J. Purnomo (1993)- Hydrocarbon potential of frontier Weda Basin, South East Halmahera. Proc. 22nd Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 2, p. 653-663.
(Southernmost Halmahera metamorphic terrane is microcontinent derived from Irian Jaya (Kemum?), moved W along Sorong FZ. E arms of Halmahera are Jurassic-age ophiolite terrane. Up to 5000m of sediment in Weda basin, offshore SE Halmahera, with Miocene carbonates as main potential play)

Soeria Atmadja, R. (1981)- Ophiolites in the Halmahera paired belts, East Indonesia. In: A.J. Barber & S. Wiryosujano (eds.) The geology and tectonics of eastern Indonesia. Geol. Res. Dev. Centre Indonesia, Spec. Publ. 2, p. 363-372.
(Halmahera is connected double arc. N and S arms are W volcanic arc, mainly Quaternary volcanics, Neogene marine sediments and Oligo-Miocene volcanics. NE and SE arms large ophiolite belt (subduction zone ophiolite) with ultramafic rocks imbricated with Mesozoic deep water sediments and E Tertiary rocks)

Soeria-Atmadja, R. & R. Sukamto (1979)- Ophiolitic rock association on Talaud islands, East Indonesia. Bull. Geol. Res. Dev. Centre 1, p. 17-35.
(Ophiolite rocks as isolated blocks in melange complex, with scaly clay matrix)

Suasta, I.G.M. & G. Hartono (2011)- Kaputusan porphyry copper-gold project, Bacan island. Proc. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-096, 19p.
(Kaputusan copper-gold porphyry prospect on Bacan Island comprised of volcanic rocks intruded by three types of Neogene intermediate intrusive rocks)

Sukamto, R. (1980)- Tectonic significance of melange on the Talaud islands, Northeastern Indonesia. In: T. Kobayashi et al. (eds.) Geology and Palaeontology of Southeast Asia 21, Symposium Tsukuba 1978, University of Tokyo Press, p. 291-302.
(Talaud Islands part of N-S trending non-volcanic outer arc between Sangihe and Halmahera island arcs in Molucca Sea N of E Sulawesi. Melange basement of intensely tectonized peridotites, gabbros, pillow basalts,

metamorphic rocks, greywacked and red pelagic sediments (blocks in matrix of scaly clay). Overlain by M Miocene- Pliocene marine sediments)

Sukamto, R. (1989)- Halmahera, a typical Cainozoic volcanic island arc in eastern Indonesia. Geologi Indonesia (IAGI) 12, 1 (Katili volume), p. 177-191.
(Halmahera volcanic in W, related to subduction of Molucca Sea in W. Eastern province non-volcanic, characterized by common ophiolites imbricated with Late Jurassic- Cretaceous deep water sediments. Western arc three magmatic cycles: Late Oligocene- E Miocene, Plio-Pleistocene and Holocene.

Sukamto, R., T. Apandi, S. Supriatna & A. Yasin (1981)- The geology and tectonics of Halmahera Island and surrounding areas. In: A.J. Barber & S. Wiryosujano (eds.) The geology and tectonics of eastern Indonesia. Geol. Res. Dev. Centre (GRDC), Bandung, Spec. Publ. 2, p. 349-362.
(Halmahera area three sub-parallel N-S 'arcs': (1) E Halmahera- Waigeo non-volcanic arc with imbricated Jurassic-age ophiolites and Late Jurassic- E Cretaceous deep sea sediments, overlain by Paleogene flysch-type rocks with ultramafic clasts and limestones with Eocene Ta-Tb forams. In SE arm also coal interbeds (2) W Halmahera- Obi volcanic arc, intermittently active since Oligocene and (3) Talaud- Tifore Ridge in Molucca sea composed of imbricated ?Eocene ophiolites and melange)

Sukamto, R. & N. Suwarna (1976)- Melange di daerah Kepulauan Talaud, Indonesia Timurlaut. Proc. 5th Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, Geologi Indonesia 2, p. 19-27.
('Melange in the Talaud Islands region'. See also Sukamto 1980)

Sukamto, R. & N. Suwarna (1979)- Tectonic significance of melange on the Talaud Islands, Northeastern Indonesia. Bull. Geol. Res. Dev. Centre 2, p. 7-19.
(Talaud-Tifore Ridge is zone of collision between two island arc systems, Sangihe to W, Halmahera to E. Talaud island melange basement consists of blocks of serpentinized peridotite, gabbro, pillow basalt, metamorphic rocks, greywackes, chert, limestone, etc., all tectonized in pervasively sheared mass. Overlain by M Miocene- Pliocene marine sediments)

Sukamto, R. & N. Suwarna (1986)- Geologic map of the Talaud Quadrangle, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Also 2nd Edition, 1995. Geologic map of Talaud islands in Molucca Sea, NE of NE Sulawesi. Mainly intensely faulted Neogene sediments (ENE-dipping faults) and Karakelang melange, with large blocks of ultramafic rocks (Kabaruang Fm) (= uplifted accretionary prism?). Overlain by Oligo-Miocene Pampini Volcanics and E Miocene Tifore Fm marine sediments)

Suparan, P., R.A.C. Dam, S. van der Kaars & T.E. Wong (2001)- Late Quaternary tropical lowland environments on Halmahera, Indonesia. Palaeogeogr. Palaeoclim. Palaeoecology 171, p. 229-285.

Supriatna, S. (1980)- Geologic map of the Morotai Quadrangle, North Maluku. Geol. Res. Dev. Centre (GRDC), Bandung, p.
(Geologic map of N part of Halmahera, 1:250,000 scale. NW Arm mainly Quaternary volcanics. NE Arm with Pretertiary Ultrabasic complex, overlain(?) by Upper Cretaceous sediments with Globotruncana and Oligo-Miocene Bacan Fm andesitic volcanics with limestones with Miogypsina)

Supriatna, S., T. Apandi & W. Simandjuntak (1977)- Geologic map of Waigeo Quadrangle, Irian Jaya, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, p.
(Geologic map of Waigeo and Gebe islands, NW of West Papua Birds Head. Also as 1995 second edition. Intensely folded structure, with widespread Jurassic? ultramafic rocks, overlain by Late Jurassic? Tanjung Bomas Fm deep marine greywacke, shale and chert with Calpionella and Microglobigerina)

Sutisna, D.T., D.N. Sunuhadi, A. Pujobroto & D.Z. Herman (2006)- Perencanaan eksplorasi cebakan nikel laterit di daerah Wayamli Teluk Buli, Halmahera Timur sebagai model perencanaan eksplorasi cebakan nikel laterit di Indonesia. Bul. Sumber Daya Geologi 1, 3 p. 48-56.

(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/554)
(Planning of nickel laterite exploration in Wayamli area, Buli Bay, East Halmahera, as a planning model of laterite nickel exploration in Indonesia)

Swift, L.R. & M. Alwan (1990)- Discovery of gold-silver mineralization at Binabase, Sangihe Island, Indonesia. Proc. Pacific Rim Congress (PACRIM90), Australian Inst. Mining Metallurgy (AusIMM), Parkville, p. 533-540. *(Extended Abstract)*
(Gold prospect on Sangihe Island (see also Wisanggono et al. 2012))

Syafrizal (2009)- Morphology and geologic structure control of nickel laterite deposition: case study nickel laterite deposit in the Gee Island and Pakal Island, East Halmahera, North Maluku. In: L.D. Setijadi et al. (eds.) Int. Conf. Earth Science and Technology, Yogyakarta 2009, p. 219-226.
(Laterite is weathering product of ultramafic rocks. Maxumum thickness of soil on Gee Island 9m, on Pakal island up to 17m)

Syefriandi & W. Akhmad F. (2013)- Tertiary Halmahera carbonate outcrop and the implications for the Halmahera Basin petroleum system. Proc. 37th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA13-G-031, p. 1-13.
(Limestone outcrops in SE arm of Halmahera, on Cretaceous peridotite basement. Two different ages: (1) Batugamping Fm Eocene reef limestones with Pellatispira, Nummulites, and (2) Weda Fm E-M Miocene detrital limestone with Miogypsina?)

Totok, D. & G. Friedrich (1988)- Chromite potential of the nickel laterite deposit of Gebe/ Mollucas (Indonesia). Erzmetall 41, 11, p. 564-569.
(Up to 19m thick laterite profile on ultramafic rocks of Gebe Island rich in Cr, Ni)

Umbgrove, J.H.F. (1938)- Corals from an elevated marl of Talaud (East Indies). Zoologische Mededelingen, Leiden, 20, p. 263-274.
(online at: www.repository.naturalis.nl/document/150648)
(Corals collected by Kuenen during Snellius expedition from marine marl near Mahammale, Talaud Island. Well preserved, 15 species, all still living, so young, probably Pleistocene- Holocene age)

Uneputty, H., S. Supriatna & F. Hehuwat (1991)- Evaluasi stratigrafi wilayah Halmahera dan kaitannya dengan potensi hidrokarbon. Proc. 19th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung 1990, 1, p. 52-68.
('Evaluation of Halmahera stratigraphy and relation to hydrocarbon potential'. In East ?Jurassic-age ophiolitic rocks overlain by U Cretaceous carbonates and Paleo-Eocene clastics. Weda Bay possibly 6000m of sediments)

Van der Ent, A., A.J.M. Baker, M.M.J. van Balgooy & A. Tjoa (2013)- Ultramafic nickel laterites in Indonesia (Sulawesi, Halmahera): mining, nickel hyperaccumulators and opportunities for phytomining. J. Geochemical Exploration 128, p. 72-79.
(Sulawesi and Halmahera have some of largest surface exposures of ultramafic bedrock in world, with proven and potential for phytomining. Phytomining extracts residual nickel from stripped land)

Vening Meinesz, F.A. (1961)- Orogeny in the New Guinea, Palao, Halmaheira area (geophysical conclusions). Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, B64, p. 240-244.
(Mountain range of New Guinea not essentialy folded, but is huge block overthrust from N with some E-ward displacement. Deforming stress believed to mantle current rising under Asia, moving to ~N160°E), in New Guinea diverging to ~N135°E. No current radiating from Australian continent)

Verbeek, R.D.M. (1908)- Halmahera. In: Molukken Verslag, Jaarboek Mijnwezen Nederlandsch Oost-Indie 37 (1908), Wetenschappelijk Gedeelte, p. 154-176.
(First significant geologic survey of Halmahera in 1899, describing main patterns of island geology with abundant Mesozoic or older ultrabasics in C and E part of island, mainly andesitic volcanics in W. Presence of

Eocene alveolinid limestone in float at E coast reported by Van Nouhuys (1903), Miocene Lepidocyclina limestone, etc.)

Verstappen, H.T. (1964)- Some volcanoes of Halmahera (Moluccas) and their geomorphological setting. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 81, p. 297-316.
(Brief descriptions of some of the active volcanoes in the N-S curved belt of NW and W Halmahera. NE and SE peninsulas part of non-volcanic arc)

Wanner, J. (1913)- Zur Geologie der Inseln Obimajora und Halmahera in den Molukken. Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 36, p. 560-585.
('On the geology of Obi and Halmahera islands in the Moluccas'. Halmahera with many localities with ultrabasic rocks and andesitic volcanics. Little known Obi Island S of Halmahera with in SW corner along Akelamo River claystones with M Jurassic ammonites Phylloceras, Stephanoceras and Macrocephalites. Also Miocene limestone with Lepidocyclina and Miogypsina, gabbro and peridotites, granites, andesites, etc. Raised young coral reefs to ~300m)

Wicaksono, A., W.A. Faridsyah & F.D. Priasmara (2012)- Depositional facies and structural analysis based on field observation of Fritu Area, Halmahera Island. Proc. 36th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA12-SG-010, p. 1-14.
(Fieldwork on SE Halmahera encountered peridotites and sediments, incl. M Eocene reefal limestone with Pellatispira and E Miocene(?) limestone)

Wichmann, A. (1898)- Petrographische Studien uber den Indischen Archipel. III. Gesteine von der Insel Gagi, IV. Gesteine von der Insel Banua Wuhu. Natuurkundig Tijdschrift Nederlandsch-Indie 57, 2, p. 196-220.
(online at: http://62.41.28.253/cgi-bin/)
('Rocks from the island Gagi and the island Banua Wuhu'. Gagi (Gag) island (E of Halmahera and W of Waigeo) with lherzolite/ serpentinite at SE coast and diabase. Banua Wuhu new andesitic volcano N of N Sulawesi)

Wichmann, A. (1921)- Die Vulkane der Sangi-Inseln. Verhandelingen Kon. Akademie Wetenschappen, Amsterdam (2), 22, 1, p. 3-52.
('The volcanoes of the Sangi Islands', between Molucca Sea and Celebes Sea)

Widiwijayanti, C., V. Mikhailov, M. Diament, C. Deplus, R. Louat, S. Tikhotsky & A. Gvishiani (2003)- Structure and evolution of the Molucca Sea area: constraints based on interpretation of a combined sea-surface and satellite gravity dataset. Earth Planetary Sci. Letters 215, p. 135-150.
(online at: www.ifz.ru/fileadmin/user_upload/subdivisions/507/articles/Widiwijayanti-etal-EPSL.pdf)
(Gravity interpretation of Molucca Sea area, NE of Indonesia. Bouguer anomalies show extension of Sangihe Trench to N to 5.5°N, joining it to Pujada and Miangas ridge in S Mindanao. Also clear outline of Talaud Archipelago ophiolite body and bounding thrust zones. Results support hypothesis that Talaud Archipelago formed as uplifted Central Ridge block, partly caused by compression of docking of Snellius Plateau. Docking shifted Philippine Trench E-ward and underthrust slivers of forearc lithosphere below Talaud Islands)

Widiwijayanti, C., C. Tiberi, C. Deplus, M. Diament, V. Mikhailov & R. Louat (2004)- Geodynamic evolution of the northern Molucca Sea area (Eastern Indonesia) constrained by 3-D gravity field inversion. Tectonophysics 386, 3-4, p. 203-222.
(online at: http://www.gm.univ-montp2.fr/spip/IMG/pdf/tiberi2004tectono.pdf)
(N Molucca Sea dominated by interaction between ophiolitic ridges, sedimentary wedges and rigid blocks of Philippine Sea Plate. Large density variations in C part of N Molucca Sea. N-S trending density structures along C Ridge and W dipping thrust faults on W side of region clearly imaged. In E part of region several blocks, especially Snellius Plateau, split into two parts. We interpret this as oceanic plateau with thicker crust that previously belonged to Philippine Sea Plate, now trapped between Molucca Sea complex collision zone and Philippine Trench, due to development of new subduction zone at E side)

Widiyantoro, S. (2003)- Complex morphology of subducted lithosphere in the mantle below the Molucca collision zone from non-linear seismic tomography. Proc. ITB J. Engineering Science 35 B, 1, p. 1-10.
(online at: http://journal.itb.ac.id/index.php?li=article_detail&id=37)
(As presented in earthquake distributions studies, new tomographic P-wave model shows two opposing subducted slabs of Molucca Sea plate. W-ward dipping slab penetrates into lower mantle as folded slab, possibly caused by shift of whole subduction system in Molucca region toward Eurasian continent due to W-ward thrust of Pacific plate combined with left-lateral movement of Sorong fault)

Wisanggono, A., P. Abaijah, K. Akiro, D. Pertiwi & R.A. Sauzy (2011)- Supergene enriched, intrusion related low sulphidation deposit Binebase-Bawone, North Sulawesi, Indonesia. In: N.I. Basuki (ed.) Proc. Sulawesi Minerals Resources 2011, Manado, MGEI/IAGI, p. 131-144.

Wisanggono, A., P. Abaijah, K. Akiro, D. Pertiwi & R.A. Sauzy (2012)- Supergene enriched, intrusion related low suphidation deposit, Binebase-Bawone, North Sulawesi, Indonesia. J. Geologi Indonesia 7, 4, p. 241-253.
(online at: http://jgi.bgl.esdm.go.id/index.php/JGI/article/view/38/30)
(Same paper as Wisanggonono et al. 2011, above. Gold mineralization at Binebase Prospect on Sangihe Island similar to mineralization typical of other young Pacific Rim intrusion related low sulphidation systems)

Yasin, A. (1980)- Geologic map of the Bacan Quadrangle, North Maluku, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 9p.
(Bacan Island off S Halmahera with core of thick Sibela Fm metamorphics with NW-SE and W-E trending foliation. Unconformably overlain by Late Oligocene- earliest Miocene Bacan Fm volcanics and clastics and later Miocene- Pliocene clastics- volcanoclastics)

Yustiana, F., C. Zwach, D. Rahmalia & P.T. Allo (2016)- Halmahera Basin, Eastern Indonesia- hydrocarbon prospectivity in a frontier basin. Proc. IPA 2016 Technical Symposium, Indonesia exploration: where from-where to, Indon. Petroleum Assoc. (IPA), Jakarta, 34-TS-16, p. 1-23.
(Halmahera II PSC SE of Halmahera is in Tertiary deep water, undrilled frontier basin, now considered area with very high subsurface risk and lack of follow-up prospectivity. Basement most likely ophiolites and volcanics. Potential Miocene carbonate buildups now interpreted to be Oligocene thrust complexes. Clastic reservoir provenance likely dominated by volcanic rocks. No indications of active hydrocarbon system)

Zhang, Q., F. Guo, L. Zhao & Y. Wu (2017)- Geodynamics of divergent double subduction: 3-D numerical modeling of a Cenozoic example in the Molucca Sea region, Indonesia. J. Geophysical Research, Solid Earth, 122, 5, p. 3977-3998.
(Molucca Sea subduction zone in NE Indonesia in SE Asia is unique Cenozoic example of 'divergent double subduction' (DDS). Asymmetrical shape. DDS probably associated with closure of narrow and short oceanic plate; large-scale double subduction is rare in nature)

VI.2. Banggai, Sula, Taliabu, Obi

Agustiyanto, D.A. (1996)- The geology and tectonic evolution of the Obi region, Eastern Indonesia. M. Phil. Thesis, University of London, p. 1-220. *(Unpublished)*
(Obi located within strands of Sorong Fault system at Australian-Philippine Sea plate boundary. Oldest rocks metamorphic complex of phyllites, schists and gneisses, probably Paleozoic in age, in greenschist- amphibolite facies. Overlain by Triassic and Jurassic micaceous sandstones and black shales, considered derived from Australian continental margin. Ophiolitic rocks, of supposed Jurassic age, form basement of most of Obi region, are unconformably overlain by Cretaceous volcaniclastic rocks, limestones and mudstones. Juxtaposition of the ophiolitic and continental rocks in south Obi probably in Late Neogene)

Agustiyanto, D.A. (1998)- Geology of the Obi islands, Eastern Indonesia. J. Geologi Sumberdaya Mineral, 8, 81, p. 2-9.
(Obi islands consist of rocks from Australian (SW) and Philippine Sea (N)plates, juxtaposed in SW part of Obi Majora (in Oligocene or later?). Oldest rocks on Obi island Paleozoic or older 'Australian' Tapas metamorphic complex, regional metamorphic phyllites, mica- schists and gneisses in greenschist to amphibolite facies. Overlain by Triassic- Jurassic Soligi Fm (with Jurassic Pentacrinus) and Kumumu Fms micaceous sandstones and black shales (with Jurassic ammonites in float; Wanner 1913, M-U Jurassic palynomorphs). Most of Obi is 'Philippine Sea' plate with basement of?Jurassic ophiolite, unconformably overlain by U Cretaceous Leleobasso Fm deep water volcanoclastics, limestones and mudstones and Oligocene Anggai River Fm volcanoclastics. Unconformably overlain by E-M Fluk Fm limestone and unconformably overlain by Guyuti Fm M-L Miocene clastics and Woi Fm volcanics and clastics)

Ali, J.R., R. Hall & S.J. Baker (2001)- Palaeomagnetic data from a Mesozoic Philippine Sea Plate ophiolite on Obi Island, Eastern Indonesia. J. Asian Earth Sci. 19, p. 535-546.
(Paleomag of Jurassic(?) age Halmahera ophiolite exposed on SW Obi Island suggest position close to equator in middle Mesozoic. K-Ar ages of ophiolite 96±10 Ma and 103±13 Ma regarded as minimum ages. Diorite intrusions Late Cretaceous ages)

Ali, J.R. & R. Hall (1995)- Evolution of the boundary between the Philippine Sea plate and Australia: paleomagnetic evidence from eastern Indonesia. Tectonophysics 251, p. 251-275.
(Paleomagnetic data from Taliabu Coniacian-Santonian pelagic limestones suggest paleolatitude at 19°± 6°, similar to Misool, suggesting Sula/Taliabu and Misool part of single microcontinent, >10° farther N than expected if attached to Australia, and implying region separated from Australia before Late Cretaceous)

Amiruddin (2000)- Peraluminous and metaluminous Permian-Triassic granitoids of the Banggai-Sula microcontinent and the Northern Australia continent in the Bird Head Papua. J. Sumber Daya Geologi 10, 110, p. 2-15.
(Permian- E Triassic granites on Banggai, Obi and Birds Head. Banggai granite (~225-245 Ma; Triassic) on Taliabu intruded into Carboniferous (~305 Ma) schists, gneiss amphibolite. Anggi granite (~225-295 Ma) in Kemum Terrane metasediments (metamorphosed at 222-258 Ma; Late Permian-Triassic. Netoni granite (225-245; M-L Triassic) in Sorong fault zone of Birds Head intruded low-middle metamorphic rocks. Banggai and Anggi granites mostly S-type, Netoni I-type. All are peraluminous and metaluminous and could be tin granites. Plutons part of magmatic arc extending from E Australia, PNG, W Papua to Banggai-Sula Archipelago)

Boehm, G. (1904)- Die Sudkusten der Sula-Inseln Taliabu und Mangoli. I. Grenzschichten zwischen Jura und Kreide. Palaeontographica, Suppl. IV, Beitr. Geologie Niederlandisch-Indien 1, p. 1-46.
('The South coast of the Sula islands Taliabu and Mangoli: 1- Transitional beds between Jurassic and Cretaceous'. First systematic descriptions of rich Sula islands ammonite-dominated Jurassic- Cretaceous macrofaunas. Incl. ammonites (Hoplites spp., Himalayites, Phylloceras strigile) and bivalves (Mytilus, Nucula). Noticed great similarities with 'Spiti-Fauna' Himalayan assemblages)

Boehm, G. (1907)- Die Sudkusten der Sula-Inseln Taliabu und Mangoli, 2. Der Fundpunkt am oberen Lagoi auf Taliabu. Palaeontographica, Suppl. IV, Beitr. Geologie Niederlandisch-Indien I, p. 47-58.

('The South coasts of the Sula islands Taliabu and Mangoli: 2- The fossil locality at the upper Lagoi on Taliabu'. Rich Late Jurassic belemnite assemblage of Belemnites gerardi group (B. alfuricus n.sp.))

Boehm, G. (1907)- Die Sudkusten der Sula-Inseln Taliabu und Mangoli. 3. Oxford des Wai Galo. Palaeontographica Suppl. Vol. IV, Beitr. Geologie Niederlandisch-Indien 1, p. 59-120.
('The South coasts of the Sula islands Taliabu and Mangoli: 3- Oxfordian of the Galo River, Taliabu. Common ammonites (Phylloceras spp., Macrocephalites spp., Perisphinctes spp., Peltoceras), abundant belemnites (B. alfuricus, B. galoi, B. moluccanus, etc.), Inoceramus (I. galoi, etc.) and brachiopods (Rhynchonella))

Boehm, G. (1912)- Die Sudkusten der Sula-Inseln Taliabu und Mangoli. 4. Unteres Callovien. Palaeontographica, Suppl. IV, Beitr. Geologie Niederlandisch-Indien 1, p. 121-179.
('The South coasts of the Sula islands Taliabu and Mangoli: 4- Lower Callovian. Belemnites mainly Dicoelites, ammonites mainly Macrocephalites (= Gondwanan-Tethyan or Himalayan bioprovince of later workers; JTvG))

Brouwer, H.A. (1915)- Over de geologie der Soela-eilanden (voorlopig reisbericht). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 32, p. 509-512
('On the geology of the Sula islands (preliminary travel report'. First, brief summary of 1915 survey, reporting widespread Jurassic outcrops, locally intensely folded, but not showing complicated thrust tectonics of Timor, Ceram, etc. Also granites and metamorphic rocks

Brouwer, H.A. (1921)- Geologische onderzoekingen op de Soela eilanden I. Jaarboek Mijnwezen Nederlandsch Oost-Indie, Verhandelingen 49 (1920), p. 69-158.
('Geological investigations on the Sula islands-1'. Intensely folded crystalline schists, unconformably overlain by M Jurassic quartz sandstones, at least partly derived from granitic rocks. Overlain by Callovian- Oxfordian marine shales with ammonites and Cretaceous pelagic limestones. Tertiary clastics with thin coaly beds and rare loose material of Miocene limestone. Also various types of granites, probably pre-Jurassic age.)

Brouwer, H.A. (1921)- Studien uber Kontaktmetamorphose, IX. Hornfelse von der Insel Taliabu (Sula-Inseln). Centralblatt Mineralogie Geologie Palaont. 1921, p. 417-422.
(online at: www.biodiversitylibrary.org/item/204060#page/443/mode/1up)
('Studies on contact-metamorphism, 9. Hornfels from Taliabu Island, Sula Islands'. Granitic-dioritic rocks with biotite widespread in W and C Taliabu, with red feldspars similar to Banggai island granites, but not Mangoli granites. Many types of contact-metamorphic rocks: andalusite-, biotite-, epidote-, amphibole-, garnet-diopside-, etc. hornfels, possibly reflecting various Jurassic sedimentary protoliths, but actual contacts with granite not seen)

Brouwer, H.A. (1924)- Bijdrage tot de geologie der Obi-eilanden. Jaarboek Mijnwezen Nederlandsch-Indie 52 (1923), Verhandelingen, p. 5-62.
('Contribution to the geology of the Obi Islands'. Mesozoic rocks reminiscent of those from Sula, Buru, Misool. Possibly Triassic micaceous sandstones, M Jurassic phyllitic shales and marls with ammonites on SW Obi Besar, possibly Cretaceous pelagic limestones, E Miocene shallow carbonates, etc. Also serpentinites, crystalline schists and various igneous rocks)

Brouwer, H.A. (1926)- Geologische onderzoekingen op de Soela eilanden- II. Jaarboek Mijnwezen Nederlandsch Oost-Indie, Verhandelingen 54 (1925), 1, p. 3-11.
('Geological investigations on the Sula islands-2'. Brief descriptions of traverses on Taliabu and Mangoli islands. Outcrops mainly Jurassic- Lower Cretaceous, with common ammonites. Oldest rocks Upper Liassic. With table of macrofossil distribution at different localities by Kruizinga)

Challinor, A.B. & S.K. Skwarko (1982)- Jurassic belemnites from Sula Islands, Moluccas, Indonesia. Geol. Res. Dev. Centre, Seri Paleontologi 3, p. 1-89.

(17 belemnite species from M-L Jurassic of Sula Islands. Assemblages dominated by species of Belemnopsis, Dicoelites and Hibolithes, which, with absence of Tethyan genus Duvalia, suggest it is not low-latitude Tethyan, but higher latitude 'Austral'/'peri-Gondwanan' assemblage)

Ding, J., S.G. Zhang, Z.F. Xu & X.L. Qin (2011)- Geological and geochemical characteristics and genesis of the Sn-Fe polymetallic deposit in Taliabu Island, Indonesia. Acta Geoscientica Sinica 32, 3, p. 313-321. *(in Chinese, with English abstract)*
(online at: www.cagsbulletin.com/dqxbcn/ch/reader/create_pdf.aspx?file...)
(Large Sn-Fe polymetallic deposit in C Taliabu, Banggai-Sula islands, sourced from Triassic monzogranite derived from partial crustal melting. Mineralization in contact zone between granite and Carboniferous metasediments, including skarn type iron ore in contact with Carboniferous marble. Ore deposit belongs to E Australia metallogenic belt that moved to SE Asia)

Dipatunggoro, G. (2011)- Survey tinjau bahan galian nikel daerah Soligi, Kecamatan Obi Selatan, Kabupaten Halmahera Selatan, Maluku Utara. Bull. Scientific Contr. (UNPAD) 9, 2, p. 97-106.
(online at: http://jurnal.unpad.ac.id/bsc/article/view/8266/3813)
('Survey of nickel in Soligi area, South Obi, North Maluku'. Pretertiary ophiolite and metamorphics are oldest rock in W and S Obi Island. Nickel and cobalt-bearing laterite weathering zones at tops of hills)

Diria, S.A., W. Permono, J. Anwari, H. Purba & J.T. Musu (2017)- Uses of satellite gravity to map subsurface condition (case study : WK Sula II). Proc. Joint Conv. HAGI-IAGI-IAFMI-IATMI (JCM 2017), Malang, 6p.
(Gravity modeling of E Sula basin area suggests E Sula (Taliabu) island on continental crust, with oceanic crust to N and S. Basement depth in block from -954 to -10245m, gradually deepening to S. E-M Jurassic rift fill clastics (Bobong Fm) in N-S trending grabens)

Ferdian, F. (2015)- Frontier exploration using an integrated approach of seafloor multibeam, drop core and seismic interpretation- a study case from North Banggai Sula. Berita Sedimentologi 32, p. 27-34.

Ferdian, F., R. Hall & I. Watkinson (2010)- A structural re-evaluation of the North Banggai-Sula area, Eastern Indonesia. Proc. 34th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA10-G-009, 20p.
(2D seismic interpretation N of Banggai-Sula. No evidence of continuous E-W-trending N Sula-Sorong Fault)

Francis, G. & G.E.G. Westermann (1993)- The Kimmeridgian problem in Papua-New Guinea and other parts of the Indo-Southwest Pacific. In: G.J. & Z. Carman (eds.) Proc. 2nd PNG Petroleum Convention, Port Moresby, p. 75-93.
(Sula Islands most complete Jurassic ammonite sequence in W Pacific. Oxfordian 3 zones. Lower zone in Wanaea spectabilis dinoflagellate zone, middle zone with upper W. spectabilis and upper zone with Wanaea clathrata dinozones. Ammonite-rich zone overlain by ammonite-poor zone, then latest Tithonian- earliest Berriasian assemblage with P. iehiense dinos. Uncertainties of correlation of Kimmeridgian due to scarcity of age-diagnostic Kimmeridgean ammonites)

Garrard, R.A., J.B. Supandjono & Surono (1988)- The geology of the Banggai-Sula microcontinent, Eastern Indonesia. Proc. 17th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 23-52.
(Comprehensive overview of Banggai-Sula microcontinent stratigraphy and M Miocene- Pliocene collision with NE Sulawesi. Carboniferous-age metamorphic basement intruded by Late Permian- Triassic granite intrusives. Locally thick Mangole Fm Triassic volcanics affected by block faulting and unconformably overlain by Early Jurassic redbeds, then M Jurassic to Lower Cretaceous Buya Fm marine section and Late Cretaceous Tanamu Fm chalky pelagic marine sediments. Unconformably overlain by Eocene- M Miocene Salodik Fm platform carbonates. No record of Mio-Pliocene 'Sulawesi Molasse'. Raised Quaternary reefal carbonates up to 1000m. Wet gas seep in N Mangole, possibly tied to Jurassic coaly source)

Jaworski, E (1921)- Ein Beitrag zur Kenntnis des Untersten Doggers von Taliabu (Sula-Inseln). Jaarboek Mijnwezen Nederlandsch-Indie 49 (1920), Verhandelingen 2, p. 191-206.

('A contribution to the knowledge of the basal Dogger (= Middle Jurassic) of Taliabu, Sula islands'. Relatively poorly preserved molluscs (Rhynchonella, Pecten spp., Lima, Arca, etc.), Belemnites and ammonite fragment (Hammatoceras), indicative of Dogger/ Aalenian age)

Kadarusman, A., N.L. Basuki & R. Suria-Atmadja (1994)- Komplek batuan dasar Kepulauan Sula: sebuah studi pendahuluan. Proc. 30th Anniv. Symposium, R&D Centre for Geotechnology LIPI, V.1, p. 106-127.
('The basement complex of the Sula Islands: a preliminary study')

Kadarusman, A. & D.H. Natawidjaja (1995)- Komplek malihan di Kepulauan Sula, Maluku- suatu interpretasisi sejarah struktur dan metamorfisma. In: Proc. Seminar Sehari Geoteknologi dalam indistrialisasi, Puslitbang Geoteknologi LIPI, Bandung, p. 76-93
('The metamorphic complex in the Sula Islands, Moluccas; a historical interpretation of structure and metamorphism'. On Paleozoic(?) regional metamorphic rocks in outcrops on Mangole (amphibolite, granulite), Taliabu and Sulabesi (greenschist))

Khadafi, B.M., C. Danisworo & H.S. Purwanto (2013)- Potensi nikel sulphida daerah IUP Harita di Pulau Obi, Kabupaten Halmahera Selatan, Provinsi Maluku Utara. J. Ilmiah Magister Teknik Geologi (UPN) 6, 2, 8p.
(online at: http://jurnal.upnyk.ac.id/index.php/mtg/article/view/262/224)
('Potential of nickel sulphides in the PT Harita area on Obi Island, S Halmahera, N Maluku Province')
(NW part of Obi Island mainly Mesozoic ultramafic rocks, overlain by Oligocene- E Miocene Bacan Fm andesitic volcanoclastics. Four areas on Obi Island with potential for nickel sulphide deposits and two for other mineralization)

Kholiq, A., R. Widiastuti, T. Bambang S.R. & I. Firdaus (2011)- Zonasi foraminifera plangtonik Kapur Akhir dari Formasi Tanamu, Desa Parigi, Taliabu Timur, Kepulauan Sula. Proc. Joint. 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-108, 11p.
(Upper Cretaceous planktonic foraminifera zonation of the Tanamu Fm, Parigi Village, East Taliabu, Sula Islands'. Planktonic foraminifera zones in Tanamu Fm (unconformably on Upper Jurassic?) indicative of Lower Coniacian-Campanian: Dicarinella primitiva, D. concavata, D. asymetrica, Globotruncanita elevata and Globotruncana ventricosa zones. Good correlation with nannoplankton)

Klompe, T.H.F. (1954)- The structural importance of the Sula Spur (Indonesia). Indonesian J. Natural Science (Majalah Ilmu Alam untuk Indonesia) 110, p. 21-40.
(Summary of geology of N Moluccas, Ceram, Buru and Sula Spur (Banggai, Sula, and Obi islands region). Sula spur is remnant of western termination of Australian-New Guinea Variscan (Paleozoic) fold belt, which acted as obstacle during Tertiary crustal movements and caused the double loop in Banda fold arcs)

Klompe, T.H.F. (1956)- The structural importance of the Sula Spur (Indonesia). Proc. 8th Pacific Science Congress, Philippines 1955, 2A, p. 869-889.
(Same as Klompe 1954)

Koenadi, H.S. (1995)- Gempabumi tektonik di Selat Obi, Maluku Utara. J. Geologi Sumberdaya Mineral 5, 44, p. 12-24.
('Tectonic earthquakes in Obi Straits, N Moluccas')

Koolhoven, W.C.B. (1930)- Verslag over een verkenningstocht in den Oostarm van Celebes en de Banggai Archipel. Jaarboek Mijnwezen Nederlandsch-Indie 1929, Verhandelingen, p. 187-228.
('Report of a reconnaissance survey in the East arm of Sulawesi and the Banggai Archipelago'. Banggai islands basement crystalline schists intruded by granodiorites, unconformably overlain by E Miocene micaceous sandstones and limestones with Spiroclypeus and Miogypsina, unconformably overlain by ?Plio-Pleistocene Peling Limestone. M or Late Miocene folding event and up to 1000m Quaternary uplift)

Kruizinga, P. (1921)- De belemnieten uit de Jurassische afzettingen van de Soela eilanden. Jaarboek Mijnwezen Nederlandsch Oost-Indie 49 (1920), Verhandelingen 2, p. 161-189.

(The belemnites from the Jurassic deposits of the Sula Islands'. Jurassic belemnites collected by Brouwer, mostly float material. No confident age conclusions, possibly Callovian- Oxfordian. Mainly Belemnopsis gerardi Oppel (includes forms formerly described as Belemnites taliabicus, B soelarum, B. moluccanus and B. galoi by Boehm), Belemnopsis alfoericus, Belemnopsis indicus n.sp., Belemnopsis rumphii n.sp., Hibolites brouweri n.sp., H. lagoicus, H. verbeeki n.sp., Dicoelites sp.)

Kruizinga, P. (1926)- Ammonieten en eenige andere fossielen uit de Jurassische afzettingen der Soela eilanden. Jaarboek Mijnwezen Nederlandsch Oost-Indie 54 (1925), Verhandelingen 1, p. 13-85.
('Ammonites and some other fossils from the Jurassic deposits of the Sula islands'. M-L Jurassic cephalopods from Brouwer collection. Basal M Jurassic (Aalenian) in neritic facies, Bajocian- Tithonian in pelagic facies)

Kuenen, Ph.H. (1942)- Obilatoe, Kisar and Siboetoe. Contributions to the geology of the East-Indies from the Snellius Expedition II. Geologie en Mijnbouw 1942, 4, p. 81-90.
(Geological observations from short visits to islands of Obilatu, Kisar and Sibutu with 1929 Snellius Expedition. Obilatu composed mainly of basic-ultrabasic igneous rocks and some tuffs, similar to NW part of Obimajor. Evidence of recent submergence)

Kusnama (2008)- Fasies dan lingkungan pengendapan Formasi Bobong berumur Jura sebagai pembawa lapisan batubara di Taliabu, Kepulauan Sanana-Sula, Maluku Utara. J. Geologi Indonesia 3, 3, p. 161-173.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/229)
('Facies and depositional environment of the Jurassic Bobong Fm at the Taliabu coalfield, Sula islands, North Moluccas'. E-M Jurassic Bobong Fm lower part conglomerate facies, followed by fluvial quartz sandstone with claystones, changing to shallow marine claystone-mudstone. Upper section well exposed in W and N Taliabu Island. Coal beds in upper Bobong Fm of N Taliabu. Two seams 30-40 cm and 100-120 cm thick, sulfur 3-5%, fixed carbon 46-54%, ash 8-16%, subbituminous to high volatile bituminous rank)

Kusnama, E. Partoyo & Rusmana (2007)- Batubara Formasi Bobong Pulau Taliabu, Maluku Utara. Majalah Geologi Indonesia (IAGI) 21, p.
('Coal of the Bobong Formation, Taliabu Island, North Moluccas'. On E-M Jurassic coal of Sula Islands)

Lelono, E.B. & Nugrahaningsih (2012)- Australian palinomorphs from the Buya Formation of the Sula Island. Scientific Contr. Oil Gas, Lemigas, 35, 3, p. 115-127.
(online at: www.lemigas.esdm.go.id/id/pdf/scientific_contribution/...)
(Palynology of 1200m thick section of Jurassic marine Buya Fm of Mahigo River near Modafumi, Mangole Island, Sula Islands. Three microflora zones, from old to young: Contignisporites cooksoniae, Murospora florida and Retitriletes watheroensis zones. Four dinoflagellate zones, from old to young: Caddasphaera halosa, Wanaea clathrata- Wanaea indotata, Dingodinium swanense and Criboperidinium perforans zones. Omatia montgomeryi shown as ~Oxfordian-Kimmeridgean. Both zonations suggest age of Buya Fm Bathonian-E Tithonian, Middle- Late Jurassic. Palynomorph succession very similar to Australian NW Shelf)

Malod, J.A., J. Clermonte, J.P. Rehault, S. Burhanuddin, L. Sarmili, M. Villeneuve et al. (1993)- The South Sula fracture zone; a reactivated southern arm of the Sorong Fault (East Indonesia). In: 10th anniversary of the French-Indonesian cooperation in oceanography; ocean research, technology and maritime industry, Jakarta 1992, Ambassade de France en Indonesie, Adiwarna Citra, Bandung, p. 103-107

Martin, K. (1904)- Jungtertiare Kalksteine von Batjan und Obi. Sammlungen Geol. Reichs-Museums Leiden, ser. 1, VII, p. 225-230.
(online at: www.repository.naturalis.nl/document/552413)
(Young Tertiary limestones from Bacan and Obi'. Occurrence of probably Early Miocene age limestone with common Lithothamnium, Lepidocyclina and Heterostegina in SW Bacan (associated with coal beds?). N-Central Obi limestones with same fauna (occurrences not reported by Verbeek 1899)

Nainggolan, D.A. (2015)- Pola anomali geomagnet daerah Pulau Taliabu dan Pulau Mangole, Maluku Utara. J. Geologi Sumberdaya Mineral 16, 2, p. 93-102.

(online at: http://kiosk.geology.esdm.go.id/artikel/pdf/pola-anomali-geomagnet-daerah-pulau-taliabu...)
('Geomagnetic anomaly pattern in the Taliabu and Mangole Islands, North Maluku'. Areas of unusually high magnetic anomalies in S)

Nasution, F.A., B. Nugroho, A. Krisyunianto & A. Bachtiar (2008)- Overview petroleum system of Taliabu-Mangole synrift in Sula sub basin. Proc. 37th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 1, p. 761-772.
(Triassic-Jurassic Taliabu-Mangole N-S trending synrift basin with gas seeps and oil odor indicating mature hydrocarbons. Surface mapping, seismic interpretation and evaluation of two wells suggest Jurassic Buya Shale and E-M Jurassic Bobong Coal potential source rocks and mature, but dominantly gas prone. On Taliabu Shelf source rock is immature, offshore Mangole source is mature. Bobong sand and fractured basement potential reservoirs, Buya Shale is regional seal. Common thrust anticlinal structural traps. No figures?)

Natawidjaja, D.H. & A. Kadarusman (1994)- The structural natures of the Pre-Tertiary rock complexes of the Sula Islands and their tectonic significances: a preliminary view. Proc. 23rd Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 1, p. 433-446.
(Foliation in pre-Jurassic metamorphic rocks of Banggai-Sula islands variable with two or more deformation phases. Different orientations between Taliabu-Mangole Islands and Sulabesi may be due to 90° CCW rotation of Taliabu- Mangole. Most granitoids altered and brittle-fractured; Pre-Tertiary sediments only slightly folded. Tectonic events: (1) Paleozoic Pre-rift structures and metamorphism; (2) Triassic- Jurassic synrift (N-S?) extensional structures; (3) U Cretaceous- Miocene drift structures with rotations; (4) Late Miocene collisional structures; (5) post-colisional compressional deformation and uplift of Sula islands)

Ngadenin (2016)- Kajian geologi, radiometri, dan geokimia Granit Banggai dan Formasi Bobong untuk menentukan daerah potensial uranium di Pulau Taliabu, Maluku Utara. Eksplorium 37, 1, p. 13-26.
(online at: http://jurnal.batan.go.id/index.php/eksplorium/article/view/2669/pdf)
('Geological, radiometrical and geochemical studies of Banggai granites and Bobong Formation to determine potential uranium areas in Taliabu Island, North Maluku'. Late Permian-Triassic Banggai granite is potential uranium source, E-M Jurassic fluvial-deltaic sandstone of Bobong Fm is potential host rock)

Oloriz, F. & G.E.G. Westermann (1998)- The perisphinctid ammonite *Sulaites* n. gen. from the Upper Jurassic of the Indo-Southwest Pacific. Alcheringa 22, p. 231-240.
(New genus Sulaites comprises Oxfordian group of 'Perisphinctes' sularus and moluccanus, described from Sula Islands, and Late Oxfordian-?E Kimmeridgian 'Pseudoparaboliceras aramaraii' group described from W Papua. Genus Sulaites also known from W Papua, PNG and probably New Zealand and Nepal)

Panjaitan, S. & Subagio (2014)- Pola anomali gayaberat daerah Taliabu- Mangole dan laut sekitarnya terkait dengan prospek minyak bumi dan gas. J. Geologi Kelautan 12, 2, p. 65-78.
(online at: http://ejournal.mgi.esdm.go.id/index.php/jgk/article/view/247/237)
('Gravity anomaly pattern of Taliabu- Mangole area and surrounding seas, related to oil and gas prospectivity')

Panuju (2011)- Pre-Tertiary nannoplankton biostratigraphy of Bobong, Buya and Tanamu Formations, Banggai-Sula basin. Proc. Joint 36th HAGI and 40th IAGI Ann. Conv., Makassar, JCM2011-053, 12p.
(Nannoplankton from three M Jurassic- Cretaceous outcrop sections of Sula islands (no locality details), each through different formations. Babong Fm contains zone NJ9 (Bajocian, M Jurassic; with Watznaueria brittanica, Diductius constans). Buya Fm zone NJ17 (Tithonian, Late Jurassic, with Zeugrhabdotus embergeri at bottom, Stepanolithion bigotii at top). Tanamu Fm zones CC13-CC17 (Coniacian- Campanian, Late Cretaceous, with Marthasterites furcatus at bottom, Quadrum gartneri at top))

Panuju, Irwansyah & E.B. Lelono (2011)- The Jurassic- Cretaceous paleogeography of the Sula area, North Maluku. Lemigas Scientific Contr. 34, 1, p. 67-83.
(7 depositional sequences in Jurassic-Cretaceous succession of Sula area. Sequences 1 (Bobong Fm), 2, 3 and 4 (Buya Fm) of Jurassic age, sequences 5, 6 and 7 (Buya Fm) attributed to Cretaceous. General deepening of depositional environment to North. Deepest environment is outer neritic (100m-200m). Jurassic-Cretaceous depocenter in N part of study area)

Permana, H. (1987)- Ofiolit daerah Akelamo, Pulau Obi, Maluku Utara. J. Riset Geologi Pertambangan (LIPI) 8, 1, p. 13-24.
('Ophiolite in the Akelamo area, Obi Island, North Moluccas'. Melange complex of SW Obi (presumably post-Jurassic), with basic-ultrabasic rocks (peridotite, gabbro with dikes of plagiogranite and basalt), crystalline limestone, etc. Overlain by Oligocene volcanoclastics and younger sediments)

Pertamina/BPPKA (1996)- Petroleum geology of Indonesian basins, VI-IX Eastern Indonesian Basins, VI-Banggai, Jakarta, p. 1-24.

Pessagno, E.A. & D. Meyerhoff Hull (2002)- Upper Jurassic (Oxfordian) radiolaria from the Sula Islands (East Indies): their taxonomic, biostratigraphic, chronostratigraphic, and paleobiogeographic significance. Micropaleontology 48, 3, p. 229-256.
(L-M Oxfordian radiolarians from Buya Fm mudstones of Mangole Island with common Praeparvicingula and rare pantanelliids and association with Austral ammonites suggest assemblage from outside Central Tethyan Pantanellidae realm, but belongs to Northern Austral Province Parvicingula- Praeparvicingula Realm (>30°S paleolatitude), in keeping with Gondwana origin of Sula. New species Bigrumpta moluccaenis, Crucella capaluluensis, C. hamiltoni, C. taliabuensis, C. westermanni, Grumpta australis, Acanthocircus tansinhoki, A. waigaloensis, etc.)

Pigram, C.J., Surono & J.B. Supandjono (1985)- Geology and regional significance of the Sula Platform, East Indonesia. Bull. Geol. Res. Dev. Centre (GRDC), Bandung, 11, p. 1-13.
(Sula Platform basement Paleozoic slates-schists (K-Ar age 305 Ma) and Late Permian-Triassic granitoids-acid volcanics. Unconformably overlain by E Jurassic non-marine Kabauw Fm clastics, grading upward into fossiliferous Buya Fm M Jurassic- E Cretaceous bathyal black shale, overlain by Late Cretaceous Tanamu Fm calcilutites. Unconformably overlain by Miocene shallow marine limestones. Sula stratigraphy correlates poorly with W Irian Jaya stratigraphy, but most similar to central PNG. May be detached from PNG in Jurassic. Unlikely to be transported to E Indonesia by transcurrent faults, which in PNG did not develop before Late Oligocene)

Pigram, C.J., Surono & J.B. Supandjono (1985)- Origin of the Sula Platform, Eastern Indonesia. Geology 13, p. 246-248.
(Similar to paper above. Sula Platform stratigraphy closer to Central PNG between 141°-145° than to W New Guinea, implying E to W displacement of >2500 km. Sula stratigraphy characterized by Paleozoic low-grade metamorphics, Permo-Triassic granitoids and rel. complete marine Jurassic section, similar to PNG. Cretaceous on Sula is bathyal Late Cretaceous carbonates only, different from PNG which has more complete Cretaceous section, suggesting separation of Sula Platform in Early Cretaceous?)

Rahmalia, D., P.T. Allo, C. Zwach, R. Heggland & S.I. Midtbo (2017)- Hydrocarbon prospectivity in the South Obi Basin. Proc. 41st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA17-119-G, 15p.
(Seismic data in deepwater basin between Obi and Bacan/ S Halmahera, formed as pull-apart basin along Sorong fault zone. Indications of Miocene Kais carbonate buildups and potential gas chimneys)

Rudyawan, A. & R. Hall (2012)- Structural reassessment of the South Banggai-Sula area: no Sorong fault zone. Proc. 36th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA12-G-030, p. 1-17.
(New seismic data suggests strands of Sorong Fault can be traced from New Guinea towards Sula Islands, but no through-going Sorong Fault Zone traceable to S of Banggai-Sula block. Absence of through-going strike-slip fault zone along S Taliabu Shelf indicates Banggai-Sula block not transported to W by Sorong Fault Zone)

Rutten, L.M.R. (1927)- De noordelijke Molukken en de Radja-Ampat groep. In: L.M.R. Rutten (1927) Voordrachten over de geologie van Nederlandsch Indie, Wolters, Groningen, p. 761-782.
(Review of geology of Northern Moluccas (Sula Islands, Obi, Bacan, Misool) and Radja Ampat Group (Waigeo, Batanta, Salawati))

Ryacudu, R., T. Wibowo & 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.
(Banggai-Sula microcontinent with carbonates in U Cretaceous (bathyal, tight), and Eocene-Miocene shallow marine carbonates with good reservoir potential)

Sardjono (1999)- Gravity field and structure of the crust of the Banggai Island region, Eastern Indonesia, implications for tectonics and hydrocarbon prospects. J. Geologi Sumberdaya Mineral 9, 99, p. 16-29.
(Rel. high gravity over Banggai Islands suggest attenuated continental crust (22km), thinning to 9km in Tomori Basin to S, and dipping gently to N, with drowned carbonate platforms. In E arm of Sulawesi gravity suggests exposed ultramafic rocks do not extend to any great depths (<1 km, except on Poh Head, where it may extend ~5km into root zone). In Molucca Sea tectonic melange up to 8km thick on oceanic crust)

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 suggests Banggai- Sula Archipelago composed of blocks of severely attenuated continental crust)

Sartono, S., K.A.S. Astadiredja, H. Mirwanto, K. Pontjomokono & B. Suprapto (1991)- Banggai microplate Sunda subduction zone collision. Proc. 20th Ann. Conv. Indon. Assoc. Geol. (IAGI), p. 376-395.

Sato, T., G.E.G. Westermann, S.K. Skwarko & F. Hasibuan (1978)- Jurassic biostratigraphy of the Sula Islands, Indonesia. Geol. Res. Dev. Centre Bull. 4, 1, p. 1-28.
(Sula Islands Jurassic section rich in fossils, probably <1500m thick. Mainly calcareous shales, some conglomerate and sandstone. Typical 'Indo-Pacific' series with Lower Callovian Macrocephalites fauna, Oxfordian Mayaites, U Tithonian Blanfordiceras, etc. Age range Late Toarcian- Tithonian, but Aalenian and M-U Callovian missing)

Schmid, K. (1934)- Biometrische Untersuchungen an Foraminiferen (*Globorotalia menardii* (d'Orb.)- *Globorotalia tumida* (Brady) und *Truncatulina margaritifera* Brady- *Truncatulina margaritifera granulosa* Fischer) aus dem Pliocaen von Ceram (Niederl.-Indien). Eclogae Geol. Helvetiae 27, 1, p. 45-134.
(online at: http://retro.seals.ch/cntmng?type=pdf&rid=egh-001:1934:27::574&subp=hires)
('Biometric investigations on foraminifera (...) from the Pliocene of Seram'. Extensive measurements on selected planktonic and smaller benthic forams from ?Pliocene Fufa Beds foram marls from Wai Wahai hinterland of N Central Seram. Most of samples collected by Weber. (not overly useful))

Septriandi, I. Syafri, Y. Adriana S. & F. Ferdian (2012)- Jurassic sandstone characteristic of Bobong Formation in Taliabu Island, Eastern Indonesia: outcrop and petrography observations. Proc. 36th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA12-SG-068, p. 1-13.
(E-M Jurassic Bobong Fm sandstone on Taliabu (Sula Islands) in alluvial fan, fluvial and beach facies. Provenance from continental block (Banggai granite and low grade metamorphics). Porosity 9-19%)

Silver, E.A. (1977)- The Sula Spur enigma. Geol. Soc. America (GSA), Abstracts with programs 9, 7, p. 1175-1176.

Smit Sibinga, G.L. (1933)- Heeft de Banggai-Archipel in Jongtertiairen tijd een afwijkende ontwikkeling gehad? Onhoudbaarheid der Pliocene Molukkenbrug? Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 50, p. 227-238.
('Did the Banggai Archipelago have a different development in Late Tertiairy time? Untenability of the Pliocene Moluccas land bridge?'. Discussion of Koolhoven (1930) conclusions on relation/ differences between Late Tertiary of the Banggai Archipelago and Sulawesi. S.S. argues in favor of zoogeograpic connection)

Soeria-Atmadja, R., M.E. Suparka & Y.S. Yuwono (1988)- Petrology of the Pre-Tertiary and Tertiary volcanic rocks from Obi, North Molucca. Majalah Geologi Indonesia (IAGI) 13, 1, 10p.

(Obi Island Pretertiary melange basement with blocks of ultrabasic rocks, basalts and Jurassic ammonite-bearing sediments in foliated clay matrix. Overlain by less-deformed Tertiary shallow marine clastics with intercalations of andesitic arc volcanics, and in upper part with reefal limestones)

Sudana, D., A. Yasin & K. Sutisna (1994)- Geological map of the Obi sheet, Maluku. Geol. Res. Dev. Centre (GRDC), Bandung, 1: 250,000.
(Obi Island composed of Triassic-Jurassic ultramafics and metamorphic rocks, overlain by Late Oligocene- E Miocene Bacan Fm andesitic volcanics and volcanoclastics and Miocene- Pliocene clastics-carbonates. Original mapping in 1975-1976)

Sukamto, R. (1975)- Geologi daerah Kepulauan Banggai dan Sula. Geologi Indonesia 2, 3, p. 23-28.
('Geology of the Banggai and Sula islands region'. Includes two broad K-Ar ages for Mangole Volcanics on Mangole Island: radiometric ages of 330± 90 Ma and 210± 25 Ma (?). Basal metamorphic complex radiometric age 305 ± 6 Ma (Late Carboniferous), Banggai granite radiometric ages 235 ± 10 Ma to 245 ± 25 Ma (Triassic))

Sukamto, R. & G.E.G. Westermann (1992)- Indonesia and Papua New Guinea. In: G.E.G. Westermann (ed.) The Jurassic of the Circum-Pacific, Cambridge University Press, p. 181-193.
(With summary of Jurassic stratigraphy of Banggai-Sula Platform: 1000-2500m thick Jurassic section exposed on Sula islands, with richest Jurassic ammonite faunas of Indonesia. Basal part terrestrial- shallow marine Kabauw, Bobong and Nanaka Fms, mainly coarse clastics with some coal. Overlain by open marine sediments, with Macrocephalites assemblages in M Jurassic, Mayatites- Perisphinctes in Late Jurassic, etc.)

Supandjono, J.B. & E. Haryono (1993)- Geological map of the Banggai Quadrangle, Sulawesi-Maluku, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 13p.
(Geologic map of Taliabu, Banggai and E Peleng islands (W part of Banggai Sula islands). With M-L Jurassic marine Buya Fm rich in macrofossils: ammonites (Irianites moermanni, Stephanoceras, Macrocephalites spp., Mayaites), belemnites (Belemnopsis spp.), and bivalves. Underlying E-M Jurassic Bobong Fm thics 'redbeds' with coal, unconformable on metamorphic and igneous basement (incl. Late Triassic Banggai granite; K/Ar ages ~225Ma))

Supandjono, J.B. & Surono (1987)- Stratigraphic correlation between Banggai- Sula Platform and Irian Jaya. Proc. 16th Ann. Conv. Indon. Assoc. Geol. (IAGI), p.

Surono & D. Sukarna (1993)- Geological map of the Sanana Quadrangle, Maluku, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Geologic map of Manggole, Sanana and E Talibu islands (E part of Banggai Sula islands). Buya Fm M-L Jurassic rich in macrofossils: ammonites (Blanfordiceras, Himalayites, Stephanoceras, Macrocephalites), belemnites (Belemnopsis stolleyi, B. mangolensis), bivalves (Inoceramus, Malayomaorica))

Van Nouhuijs, J.W. (1910)- Bijdrage tot de kennis van het eiland Taliaboe der Soela groep (Moluksche Zee). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap (2), 27, p. 945-976 and p. 1173-1196.
('Contribution to the knowledge of Taliabu island of the Sula Group'. Report on first collections of famous Jurassic ammonites and belemnites in 1900 (with Boehm) and 1904, by navy officer Van Nouhuijs. Fossils from folded dark shales underlain by crystalline schist. Including famous Keeuw locality at Wai Miha River, described by Boehm (1912))

Walpersdorf, A., C. Vigny, P. Manurung, C. Subaraya & S. Sutisna (1998)- Determining the Sula block kinematics in the triple junction area in Indonesia by GPS. Geophysical J. Int. 135, p. 351-361.
(Triple junction of three major plate boundaries (Australia- Eurasia- Philippines) is transition zone that includes Sula domain, which shows clockwise rotation)

Wanner, J. (1913)- Zur Geologie der Inseln Obimajora und Halmahera in den Molukken. Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 36, p. 560-585.

('On the geology of islands Obi Besar and Halmahera in the Moluccas' Along Akelamo River of SW Obi: (1) serpentinized peridotite, (2) Pliocene marine marls and (3) black shales with concretions with M Jurassic ammonites Phylloceras, Stephanoceras and Macrocephalites, similar to 'Coronatenschichten' of Sula. E-M Miocene limestone with Miogypsina and Lepidocyclina near S coast near Ngutenute. Also andesitic volcanics, etc. Young raised coral reef terraces up to 320m elevation along S coast)

Watkinson, I.M., R. Hall & F. Ferdian (2011)- Tectonic re-interpretation of the Banggai-Sula-Molucca Sea margin, Indonesia. 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. 203-224.
(New bathymetric and seismic data from area N of Banggai-Sula Islands provide new insight into boundary between E Sulawesi ophiolite, Banggai-Sula microcontinent and Molucca Sea collision zone. Previously interpreted major faults such as Sula Thrust and N Sula-Sorong Fault, are not seen. Gently dipping strata of Banggai-Sula microcontinent margin can be traced N-wards beneath younger rocks)

Westermann, G.E.G. & J.H. Callomon (1988)- The Macrocephalitinae and associated Bathonian and early Callovian (Jurassic) ammonoids of the Sula islands and New Guinea. Palaeontographica A, 203, p. 1-90.
(Five Bathonian- Early Callovian ammonite assemblages on S Taliabu. Also from Bathonian at PNG Strickland River. East Indian faunas dominated by Macrocephalitidae, many of which are species unknown outside Indonesia- New Guinea (one other SW Pacific occurrence in New Zealand). Because of high endemicity at species level in Macrocephalitinae and at genus level in Satoceras and Irianites, E Indonesia and PNG may be considered as separate ammonite faunal province or subprovince, perhaps part of Maorian/SW Pacific Province during Late Bajocian- E Callovian. Diversity and compositions of ammonite faunas suggest Sula was in warmer waters than Birds Head Peninsula)

Westermann, G.E.G., T. Sato & S.K. Skwarko (1978)- Brief report on the Jurassic biostratigraphy of the Sula Islands, Indonesia. Newsletters Stratigraphy 7, 2, p. 96-101.
(Classic ammonite localities on Taliabu and Mangole reexamined. U Toarcian sst with Hammatoceras overlain by thick Bajocian micaceous marly shales (Fontannesia, etc.). No evidence for Aalenian. Overlying thick marly claystones with E Callovian 'Keeuw fauna' (Macrocephalites, etc.) and 'Wai Galo fauna' with E-M Oxfordian ammonite assemblages (Mayaitidae, Perisphinctes, etc.). No new evidence for Bathonian or higher Callovian. Thick Kimmeridgian-M Tithonian argillaceous sequence in belemnite-bivalve facies (Belemnopsis, Inoceramus, Malayomaorica). Upper Tithonian claystones again rich ammonite fauna (Haplophylloceras, Blanfordiceras, etc.))

Wichmann, A. (1914)- On some rocks of the Island of Taliabu (Sula-Islands). Proc. Kon. Nederl. Akademie Wetenschappen, Amsterdam, 17, 1, p. 226-239.
(online at: www.dwc.knaw.nl/DL/publications/PU00012640.pdf)
(Description of granites and other igneous rocks, metamorphics, Jurassic iron oolite with belemnites. Oldest rocks are highly folded phyllites)

VI.3. Seram, Buru, Ambon

Adlan, Q., S.M. Kartanegara. A.H.P. Kesumajana & E.A. Syaripudin (2016)- Explanation of Seram Islandôs more prolific oil potential compared to its offshore area using palinspastic and basin modeling approaches. Proc. 40th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA16-294-G, 15p.
(Structural restoration of SW-NE seismic line in Seram Trough E of Seram. Compressional deformation in imbricated thrust belt began at ~5 Ma, with peak of shortening at 3.5 Ma. Some Lengkuas 1 well data)

Adlan, Q., A.H.P. Kesumajana & E.A. Syaripudin (2016)- Impacts of fold-thrust belt forming on hydrocarbon occurrence in Seram Trough: Outer Banda Arc foreland system. Proc. 40th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA16-58-G, 14p.
(Basin modeling of petroleum systems in deepwater Seram fold-thrust belt and Seram Trough foreland basin, S of Misool-Onin-Kumawa Ridge. Hydrocarbon shows in Jurassic of Lengkuas-1 (SSW of South Onin 1 well) indicates oil accumulation before Plio-Pleistocene tectonic event)

Adlan, Q., J. Wahyudiono, A. Susilo, B. Salimudin, A.K. Gibran & E.S. Wiratmoko (2018)- Petroleum system potential of Lofin and Banggoi area, Seram Island. Proc. 42nd Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA18-250-G, 6p.
(Brief review, showing highly variable porosity and TOC in Triassic Kanikeh Fm outcrop samples)

Al-Shaibani, S. (1983)- The micropalaeontology of the Middle Triassic to Upper Miocene sediments of Seram, Eastern Indonesia. Ph.D. Thesis Imperial College, University of London, p. 1-469.
(online at: https://spiral.imperial.ac.uk/handle/10044/1/36159)
(Planktonic foraminifera of Nief Beds indicate deposition during Cretaceous, Paleocene, Eocene and Miocene in deep bathyal environment. Corroded radiolaria in U Jurassic- Lower Cretaceous part of Nief Beds indicate deposition close to silica compensation depth at ~4000m. Fine grain-size and radiolaria-dominated microfauna of Saman Saman Lst indicate deposition in very deep marine water. Microfaunas of Late Triassic Asinepe Lst reveal deposition during Norian in reefal- sublagoonal environment)

Al-Shaibani, S., D.J. Carter & L. Zaninetti (1983)- Geological and micropaleontological investigations in Upper Triassic (Asinepe Limestones) of Seram, Outer Banda Arc, Indonesia. Archives Sciences Geneve 36, 2, p. 301-316.
(Foraminifera from U Triassic Asinepe Fm tropical-reefal carbonates of Seram show Norian- Rhaetian age. Two distinct foram facies associations: (1) muddy lagoonal facies dominated by Involutinidae, with Triasina hantkeni, Aulatortus spp., etc. and (2) near-reefal facies dominated by porcellaneous forams. No location maps, stratigraphy, etc.)

Al-Shaibani, S., D.J. Carter & L. Zaninetti (1984)- Microfaunes associees aux Involudinidae et aux Milioporidae dans le Trias superieur (Rhetien) de Seram, Indonesie: precisions stratigraphiques et paleoecologie. Archives Sciences Geneve 37, 3, p. 297-313.
(Upper Triassic microfaunas from Asinepe Fm reefal and lagoonal platform limestone, Seram with Rhaetian index foram Triasina hantkeni. Many similarities with U Triassic Tethyan faunas in Europe and Asia)

Aquantino, S., N. Nastiti & A.S. Dradjat (2012)- Penggunaan metoda "the look ahead VSP survey" untuk pencitraan target Formasi di bawa mata bor pada sumur pemboran eksplorasi Lofin 1. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-E-30, 5p.
('The use of the "look ahead VSP survey" method for imaging targets during drilling of exploration well Lofin 1'. Lofin-1 exploration well ~70km W of Oseil 2. Target Manusela Lst deeper than pre-drill predictions;not reached at TD of 10957' (in Upper Nief Fm). Look-ahead VSP used to help predict target depths (Lofin 1 ST penetrated ~500' of gas-oil bearing fractured Manusela Fm limestone below ~14000'; JTvG))

Audley-Charles, M.G. & D.J. Carter (1977)- Interpretation of a regional seismic line from Misool to Seram: implications for regional structure and petroleum exploration. Proc. 6th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 2, p. 3-12. *(also in Oil and Gas Journal 23, 1, p. 20-23)*

(Misool to Seram regional seismic shows imbricate zone at boundary of Seram island arc with New Guinea continental shelf. S wall of Seram Trough is like N wall of Timor Trough, interpreted as foothills-type fold belt. This may be regarded as an A-zone (Bally, 1975), representing margin between Banda Arc developing fold belt and Australian craton. Benioff subduction zone interpreted between non-volcanic Outer Banda arc and volcanic Inner Arc. A- and B-zones can be traced around Banda Arcs from Seram to Timor and beyond)

Audley-Charles, M.G., D.J. Carter, A.J. Barber, M.S. Norvick & S. Tjokrosapoetro (1979)- Reinterpretation of the geology of Seram: implications for the Banda arcs and northern Australia. J. Geol. Soc. London 136, p. 547-568. *(also in: Geology and Tectonics of eastern Indonesia, GRDC Spec. Publ. 2, 1981, p. 217-237).*
(Remarkable similarities between Mesozoic-Miocene deep-water 'para-autochthonous' and shallow water 'allochthonous' successions of Seram and Timor. Triassic limestones in 'Australian facies' mostly planktonic facies Saman Saman Lst in 'para-autochthonous', structurally overlain by 'Asian facies'Asinepe Lst in 'allochthonous'.)

Bachri, S. (2011)- Tectonostratigraphy and structures of Eastern Seram. J. Geologi Indonesia 6, 2, p. 85-93.
(online at: www.bgl.esdm.go.id/publication/index.php/dir/article_detail/305)
(Seram geology re-interpreted in E Timor-analog tectonic complexes. Most of E Seram is 'Para-autochthonous complex', with Permian Kobipoto metamorphics, overlain by Triassic-Jurassic Kanikeh Fm flysch and age-equivalent Manusela Fm massive limestone, overlain by Cretaceous- Miocene pelagic deposits. 'Allochthonous' overthrusted sequence of ultrabasic rocks comparable to Timor Banda allochton (called Permian age in text, Jurassic-Cretaceous in Fig. 3; JTvG). Salas Complex is M Miocene- M Pliocene deep water olistostrome, similar to Timor Bobonaro Complex. Thrusting Neogene age and verging to NE)

Baroncini Turricchia, G. & and A. Benassi (2012)- Cave and karst prospecting within Seram Island (Maluku province) Indonesia), 23 May-22 June 2012. Rome, p. 1-31.
(online at: www.circolospeleologicoromano.it/csr/wp-content/uploads/2014/01/Seram2012.pdf)

Beckinsale, R.D. & S. Nakapadungrat (1979)- A Late Miocene K-Ar age for the lavas of Pulau Kelang, Seram, Indonesia. In: S. Uyeda, R.W. Murphy & K. Kobayashi (eds.) Geodynamics of the Western Pacific, Proc. Int. Conf. Geodynamics Western Pacific-Indonesian Region, J. Physics of the Earth 26, Suppl. 6, p. 199-202.
(K-Ar determinations for 10 samples of pillow basalts of Kelang island, W Seram (with paleomagnetic analysis by Haile) gave Late Miocene ages of 4.7- 10.6 Ma (average 7.6 Ma, Late Miocene))

Boehm, G. (1905)- Uber Brachiopoden aus einem alteren Kalkstein der Insel Ambon. Jaarboek Mijnwezen Nederlandsch-Indie 34, Wetenschappelijk Gedeelte (Verbeek Ambon report), p. 88-93.
('On brachiopods from an older limestone of Ambon Island'. Brachiopods from dark, mica-bearing, impure limestone in sandstone series in Batu Gantung River are all new species, probably of Early Paleozoic age, possibly Triassic. Probably same faunas determined as Late Triassic by Jaworski 1925)

Boehm, G. (1908)- Vorjurassische Brachiopoden von Ambon. In: Geologische Mitteilungen aus dem Indo-Austratrischen Archipel VI, Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 25, 2, p. 293-303.
('Pre-Jurassic brachiopods from Ambon'. New species of Spiriferina, Athyris, Rhynchopora, Dielasma from Batu Gantung valley near town of Ambon. Age uncertain, probably Late Paleozoic- Triassic. (Deninger 1918, p. 30: similar to Late Triassic of Seram))

Boehm, G. (1910)- Zur neuen obertriadischen Fauna aus den Molukken. Centralblatt Mineralogie Geologie Palaont. 1910, 6, p. 161-163.
(online at: www.biodiversitylibrary.org/item/192869#page/185/mode/1up)
('On the new Upper Triassic fauna from the Moluccas'. Brief note commenting on Krumbeck (1909) note on highly folded Upper Triassic asphalt beds near Fogi (W Buru) and Bara Bay (NW coast Buru), containing Daonella indica and ammonites. Buru U Triassic limestones in bivalve-cephalopod facies, different from 'athyrid facies' of Misool (mainly brachiopod-coral facies))

Brouwer, H.A. (1919)- Geologische onderzoekingen in Oost-Ceram. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 36, 6, p. 715-751.
(Geological survey of E Seram. Folded Late Triassic 'flysch-type', locally bituminous, calcareous sandstones-shales, with interbeds of 80-100m thick, dark brachiopod and coral limestones. Sandstones locally common plant fragments and muscovite (look like immature, delta-front turbidite sands, from granitic-metamorphic terrane; JTvG). These are thought to be thrusted over 'Nief Series' (as exposed in Wai Nief canyons). Nief series at base different Triassic limestone: massive, oolitic, poor in age-diagnostic macrofossils, similar to rocks from Timor (but not Misool), and overlain by ?Jurassic, Cretacous and Tertiary cherty pelagic limestones and foram marls. Mesozoic of Ceram succession remarkably poor in macrofossils compared to Misool. Gas and oil seeps in Triassic rocks near Bula and Wai Nief)

Brouwer, H.A. (1925)- Over insluitsels en cordierietgehalte van bronziet-dacieten van het eiland Ambon. Verhandelingen Geologisch-Mijnbouwkundig Genootschap Nederland Kol., Geol. Serie 8 (Verbeek volume), p. 73-80.
('On inclusions and cordierite content of bronzite-dacites on Ambon island'. Common inclusions of gneiss, some with cordierite phenocrysts)

Brouwer, H.A. (1927)- Over Mesozoische afzettingen en eenige vulkanische gesteenten van het eiland Ambon. Jaarboek Mijnwezen Nederlandsch-Indie 55 (1926), Verhandelingen III, p. 233-245.
('On Mesozoic deposits and some volcanic rocks of Ambon island'. Reinterpretation of Verbeek (1908) conclusions and reiterates similarities of Ambon with NE part of W Timor. Upper Triassic sandstones, similar to Seram, with common quartz, possibly derived from mix of granites and schists. Also Upper Triassic dark grey limestones with crinoids, sponges, foraminifera and 11 species of brachiopods (Jaworski 1927), similar to Seram. Radiolarites of uncertain age)

Charlton, T.R. & J.T. van Gorsel (2014)- The Manusela Limestone in Seram: Late Triassic age for a óJurassicô petroleum play. Berita Sedimentologi 31, p. 57-69.
(online at: www.iagi.or.id/fosi/files/2014/12/BS31-Biostratigraphy_SEAsia_Part3.pdf)
(No biostratigraphic evidence to support a Jurassic age for Manusela Limestone, which forms oil reservoir in the'Jurassic Limestone hydrocarbon play' of Oseil oilfield in NE Seram. Many paleontological studies on outcrops and wells instead document only Late Triassic macro- and microfaunas and microfloras)

Davies, G.R. & S. Tommasini (2000)- Isotopic disequilibrium during rapid crustal anatexis: implications for petrogenetic studies of magmatic processes. Chemical Geology 162, 2, p. 169-191.
(online at: https://flore.unifi.it/retrieve/handle/2158/224189/2816/2000ChemGeolv162_DisMelting.pdf)
(Rapid crustal anatexis may prevent full isotopic equilibration. Dating metamorphic rocks using mineral-whole rock or mineral-mineral pairs may yield erroneous ages, as observed in pre-Triassic metasediments of Seram where ages range from ~15 to 201 Ma, despite anatexis at 6 Ma. Consequently, some age estimates in literature may be incorrect)

Darman, H. & P. Reemst (2012)- Seismic expression of geological features in Seram Sea: Seram Trough, Misool-Onin Ridge and sedimentary basin. Berita Sedimentologi 23, p. 28-34.
(online at: www.iagi.or.id/fosi/)

De Jong, H. (1923)- Studien uber Eruptiv- und Mischgesteine des Kaibobogebietes (West Ceram). In: L. Rutten & W. Hotz (eds.) Geological, petrographical and palaeontological results of explorations 1917-1919 in the Island of Ceram, First Ser., Petrography, 1, Amsterdam, p. 1-87.
(Petrographic descriptions of igneous rocks from Kaibobo area, W Seram: granites/ gneissess (incl. cordierite granites), peridotites/ serpentinites, gabbros, etc.))

Deninger, K. (1914)- Morphologische Ubersicht der Insel Seran. Petermanns Geogr. Mitteilungen 60, 2, p. 16-18.
('Morphological overview of Seram island'. Brief geographic description with little or no geology)

Deninger, K. (1915)- Geographische Ubersicht vom West-Seran. Petermann Geogr. Mitteilungen 61, p. 385-388.
('Geographical overview of West Seram'. Mainly brief review of Seram population. Very little geology)

Deninger, K. (1918)- Zur Geologie von Mittel-Seran (Ceram). Palaeontographica, Suppl. IV, Beitr. Geologie Niederlandisch-Indien III, 2, p. 25-58.
('On the geology of Central Seram'. Report on four N-S traverses of C Seram during 'Second Freiburger Moluccas Expedition' of 1911. With geologic map, cross-sections. Pre-Triassic metamorphic rocks overlain by Late Triassic micaceous sands and shales with Monotis salinaria, Hallorella, plant material, etc., becoming more sandy in W direction. Grade upwards into Late Triassic- M Jurassic limestones (~150m thick), with brachiopod Misolia, 'Pharetronen' (= calcareous sponges), corals and hydrozoans. Overlain by massive grey and white limestones, locally cherty, also with Misolia. Overlain by ~20m 'Fatjet-shale' with Inoceramus and belemnites, then (~100m) red-white Late Jurassic- Cretaceous 'Fatjet-limestone', rich in Inoceramus, forams (in upper part common 'Discorbinen' = U Cretaceous Globotruncana; JTvG), radiolarians and rare canaliculate belemnites. Overlain by ~100-150m Tertiary Globigerina marls. Seram Jurassic-Cretaceous deeper marine facies than comparable series on Misool. Overlain by ~400m Tertiary massive limestone with orbitoids, alveolinids)

De Smet, M.E.M. & A.J. Barber (1992)- Report on the geology of Seram. University of London SE Asia Research Group Report 109, p. 1-103. *(Unpublished)*
(Overview of early work and stratigraphy. Extensive metamorphic complexes probably mainly Permian- E Triassic age. Kabipoto Complex metamorphics of S/SW Seram associated with ultramafic rocks, may be result of 4-5 Ma ophiolites obduction of ophiolites that once may have covered large part of Seram. Late Triassic Manusela oolitic Lst facies is large lens-like bodies in Kanikeh Fm clastics sequence, not from separate terranes as argued by earlier authors. Seram is thrustbelt composed of material from microcontinent that collided with Banda Arc in Late Miocene-Pliocene)

De Smet, M.E.M., P.A. Sumususastro, I. Siregar, L.J. van Marle, S.R. Troelstra & A.R. Fortuin (1989)- Late Cenozoic geohistory of Seram, Indonesia. Geologie en Mijnbouw 68, p. 221-235.
(online at: https://drive.google.com/file/d/0B7j8bPm9Cse0N1hmWGFtRUYxVm8/view)
(SW Seram Plio-Pleistocene basin on top of Paleozoic metamorphics records up to 1500m of Late Pliocene- E Pleistocene subsidence after Late Miocene compressional deformation and uplift. Subsidence followed by 1-2 km of Late Pleistocene (~1 Ma) uplift)

Djoehanah, S. (1997)- Foraminifera Pra-Tersier dan Paleogen di daerah Saleman- Sawai, Seram Utara. Jurnal Teknologi Mineral (ITB) 4, 1, p.
('Pre-Tertiary and Paleogene Foraminifera from Saleman- Sawai area, North Seram'. Triassic benthic foraminifera in Manusela Limestone: Glomospira, Glomospirella, Diplotremina, and Meandrospira. Upper Cretaceous Sawai Fm only planktonics: Globotruncana, Hedbergella, Heterohelix, Globotruncanella, Rugoglobigerina and Rotalipora sp. Lisabata Fm has Paleogene (Oligocene?; JTvG) planktonics such as Catapsydrax dissimilis, C. unicava, Globigerina eocenica, G. tripartita, G. venezuelana, G. selli, etc.)

Douville, H. (1923)- Sur quelques foraminiferes des Moluques orientales et de la Nouvelle Guinee. Jaarboek Mijnwezen Nederlandsch-Indie 50 (1921), Verhandelingen 2, p. 107-116.
('On some foraminifera from the eastern Moluccas and from New Guinea'. Brief description of Eocene larger forams in samples collected by Brouwer in Halmahera (Nummulites, Discocyclina, Alveolina), Roti (large Nummulites, Discocyclina), Ceram (E Miocene Lepidocyclina in breccia with reworked angular clasts of Upper Cretaceous pelagic limestone), New Guinea, Kai Besar (rounded fragments of Eocene Lacazina in quartz sandstone, etc. No location info)

Dradjat, A.S. & C.S. Patandung (2012)- Geomechanical approach for cores analysis of Jurassic Manusela carbonate fractured reservoir from Oseil Field. AAPG Workshop Fractured carbonate reservoirs, Bali 2012, Search and Discovery Art. 201489, p. 1-17.
(online at: www.searchanddiscovery.com/documents/2012/20149dradjat/ndx_dradjat.pdf)

Dradjat, A.S., X. Hu & R. Primasari (2012)- Application of pre-stack seismic anisotropy for fracture detection, in Oseil Field carbonate reservoir, Seram Island, Eastern Indonesia. Presentation AAPG Workshop Fractured Carbonate Reservoirs, Bali 2012, Search and Discovery Art. 20157, p. 1-17.
(online at: www.searchanddiscovery.com/documents/2012/20157dradjat/ndx_dradjat.pdf)
(Geophysical study of fracture intensity in Oseil field, East Indonesia, is fractured carbonate in Manusela Fm)

Dradjat, A.S. & C.S. Patandung (2012)- Geomechanical approach for rock strength and litholoy anisotropy of Jurassic carbonate Manusela fracture reservoir from Oseil field. Proc. 41st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2012-EG43, p.
(On geomechanical relationship between lithology and rock strength in fractured limestone of Oseil field, Seram. Higher rock strength has fewer fractures and less porosity. In E Nief-1 well, compacted dolostone core has highest rock strength, is less fractured and non-reservoir, while oolitic limestone has lower rock strength, more fractures and good reservoir. In Oseil-1 and 4 wells oolitic limestone and dolostone both highly fractured and highly porous)

Dwijanto, B., T.A. Soeprapto & K. Budiono (1992)- Marine geology and geophysics of Ambon Bay. J. Sumber Daya Geologi Indonesia(GRDC) 2, 12, p. 1-16.

Everwijn, R. (1874)- Marmer op het eiland Amboina. Jaarboek Mijnwezen Nederlandsch Oost-Indie 3, 1, p. 172-173.
('Marble on Ambon Island'. Brief note on samples of light grey, grey and black marble. Age unknown)

Fischer, P.J. (1921)- Eine Pliocanfauna von Seran (Molukken). Centralblatt Mineralogie Geologie Palaont. 1921, 8, p. 242-251 and p. 278-286.
(online at: www.biodiversitylibrary.org/item/204060#page/568/mode/thumb)
('A Pliocene fauna from Seram (Moluccas). Listings of marine molluscs (158 species of gastropods and bivalves) and smaller benthic foraminifera (54 species). Molluscs Indo-Pacific assemblages, 74 species still extant (47%); many new species. No figures? (see also Fischer (1927))

Fischer, P.J. (1927)- Beitrag zur Kenntniss der Pliozanfauna der Molukkeninseln Seran und Obi. Palaeontologie von Timor, Schweizerbart, Stuttgart, 15, 25, p. 1-179.
('Contribution to the knowledge of the Pliocene fauna of the Moluccan islands of Seram and Obi'. Mainly on molluscs from Fufa valley outcrop collected by Wanner in 1902 and from well near Bula, Seram. Also molluscs and foraminifera from Akalamo valley on Obi, incl. Amphistegina wanneriana n.sp.)

Flugel, E. (1981)- Paleoecology and facies of Upper Triassic reefs in the Northern Calcareous Alps. In: D.F. Toomey (ed.) European fossil reef models, SEPM Spec. Publ. 30, p. 291-359.
(Review of faunal and facies distributions of U Triassic reefs in Alps. Mentions Seram (p. 351): up to 150m limestone, many calcareous sponges corals, hydrozoans; believed to be of Late Norian age)

Fortuin, A.R., M.E.M. de Smet, P.A. Sumasusatro, L.J. Van Marle & S.R. Troelstra (1988)- Late Cenozoic geohistory of NW Buru, Indonesia and plate tectonic implications. Geologie en Mijnbouw 67, 1, p. 91-105.
(https://drive.google.com/file/d/0B7j8bPm9Cse0MVNjSTByNVVBYlk/view)
(Buru stratigraphy: Paleozoic? metamorphics overlain by >2500m Triassic clastics with bituminous shale near top, unconformably overlain (break-up ?) by Late Jurassic (with basaltic volcanics) and Cretaceous- Eocene pelagic marls, limestones, cherts. Oligocene unconformity (folding, uplift) overlain by deep water Late Oligocene and E Miocene. Andesitic lavas present in E Miocene. Mid-Late Miocene unconformity.

Gafoer, S., Suwitodirjo & Suharsono (1994)- Geological map of Bula and Watubela Islands Quadrangle, Seram, 1: 250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 13p.
(Oldest rocks in Seram outcrops are presumably Permian age metamorphics, overlain by Triassic Kanikeh Fm flysch and Manusela Fm limestone, overlain by Cretaceous pelagic calcilutite/ shale. Salas melange complex

formed in Mio-Pliocene, and is unconformably overlain by Pliocene Wahai Fm marls and Pleistocene Fufa Fm coarser clastics)

Germeraad, J.H. (1946)- Geology of Central Seran. In: Geological, petrographical and palaeontological results of explorations carried out from September 1917 till June 1919 in the Island of Ceram by L. Rutten and W. Hotz, 3rd Ser., Geology, 2, Amsterdam, p. 1-135.
(The geology of Central Seram, compiled from notes and study of rocks collected by Rutten & Hotz 1918-1920. Metamorphic rocks overlain by Late Triassic greywacke/ flysch, Late Triassic platform carbonates, etc.)

Gerth, H. (1909)- Echte und falsche Hydrozoen aus Niederlandisch-Indien. Sitzungsberichte Niederrheinischen Gesellschaft Natur und Heilkunde, Bonn, 1909, A, p. 17-25.
('Real and fake hydrozoans from Netherlands Indies'. Includes first record from Indonesia of ?pelagic Late Triassic hydrozoan Heterastridium from Seram, collected by Verbeek from Teri Mountain, East Seram (also locally common on Timor, see Gerth 1915; JTvG). New Cretaceous coral genus from Langkat, N Sumatra: Actinacis sumatrensis)

Gerth, H. (1910)- Fossile Korallen von der Molukkeninsel Buru nebst Bemerkungen uber die polygenetischen Beziehungen der Gattung *Alveopora*. Neues Jahrbuch Mineral. Geol. Palaeont. 1910, 2, p. 16-28.
('Fossil corals from the Moluccas island of Buru, with remarks on the polygenetic relations with the genus Alveopora'. Descriptions of Late Triassic corals from Buru, incl. Alveopora deningeri n.sp. from Miocene. Also U Triassic Lovcenipora intabulata from Tifu at S coast (formerly described as Pachypora intabulata Wanner 1907 from Seram))

Godefroy, W. (1897)- Verslag van een onderzoek naar petroleum nabij de Boela-Baai op noordoostelijk Ceram. Kolff & Co, Batavia, p.
('Report of an investigation into petroleum near Bula Bay on NE Seram'. With map of oil and gas localities)

Grosch, P. (1910)- Zur Geologie des indo-australischen Archipels, VI. Uber eine riffbildenden Koralle aus Nord-Ost Serang (Ceram). Centralblatt Mineralogie Geologie Palaont. 1910, p. 391-395.
(www.biodiversitylibrary.org/item/192869#page/416/mode/1up)
('On a reef-building coral from NE Seram'. Colonial coral collected by Wanner in 1902 in float of Fufa River, 11 km from mouth, described as Prionastraea cf. verbeeki (=Favites?, species originally described by Dollfus (1908) from Verbeek collection from Plio-Pleistocene? of Daweloor Island, Babar islands; JTvG))

Guntoro, A. (2000)- Structural, sedimentary and tectonic evolution of the Buru Island, central Molucca, Indonesia; in relation to the hydrocarbon prospect. AAPG Int. Conf., Exhib., Bali 2000, American Assoc. Petrol. Geol. (AAPG) Bull. 84, 9, p. 1432 *(Abstract only)*
(Buru Island part of non-volcanic outer Banda Arc and is microcontinent derived from Australian continent. Mesozoic sediments similar to Seram. Low gravity anomaly in center of island. Gravity models show deep crustal structure and provide a better understanding of basin evolution)

Hadiwisastra, S., S. Djoehanah, D. Mulyadi & D. Trisukmono (1996)- Sedimentasi batuan Pra-Tersier dan Tersier di daerah busur tektonik aktif, Seram Utara. In: Sampurno et al. (eds.) Pros. Seminar Nasional Geoteknologi III, LIPI, Bandung, p. 347-373.
('Sedimentology of Pretertiary and Tertiary rocks in the area of an active tectonic arc, North Seram'. Geology of Seram similar to Timor. Study of Triassic massive Manusela Limestone, Cretaceous calcilutites, etc.)

Haile, N.S. (1978)- Paleomagnetic evidence for the rotation of Seram, Indonesia. In: S. Uyeda et al. (eds.) Geodynamics of the Western Pacific, Proc. Int. Conf. Geodynamics of the Western Pacific- Indonesian Region J. Physics Earth 26, Suppl. 6, p. 191-198.
(Upper Triassic shale with Halobia spp. from near S coast of C Seram indicates paleolatitude 12 ± 7° S (= probably farther North than Australia NW Shelf and New Guinea at that time) and CCW rotation of 98° since Late Triassic. Late Miocene (~7.6 Ma) pillow basalt from Kelang Island, W of Seram, indicates paleolatitude 5°S and 74° CCW rotation since Late Miocene)

Hakim A.S. & B.H. Harahap (2003)- Review on the stratigraphy of Buru Island, Maluku Eastern Indonesia. Buletin Geologi (ITB) 34, 3, Special Ed. (Prof. Soejono Martodjojo volume), p. 141-156.

Hall R., A. Patria, R. Adhitama, J.M. Pownall & L.T. White (2017)- Seram, the Seram Trough, the Aru Trough, the Tanimbar Trough and the Weber Deep: a new look at major structures in the eastern Banda Arc. Proc. 41st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA17-91-G, 19p.
(Seram Trough began to form in Late Pliocene due to loading by Seram fold-thrust belt. Tanimbar Trough originated in Late Miocene as elongate extensional structure within Australian continental margin. Weber deep is major young extensional feature. None of troughs are subduction zones. Etc.)

Hammarstrom, J.M., B.T. Setiabudi, D.N. Sunuhadi, G.R. Robinson, C.L. Dicken, S. Ludington, A.A. Bookstrom & M.L. Zientek (2013)- Porphyry copper assessment for Tract 142pCu7201, Ambon Arc, Central Molucca Islands- 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 J, p. 164-174.
(online at: http://pubs.usgs.gov/sir/2010/5090/d/sir2010-5090d_text.pdf)
(Assessment of porphyry copper deposits in Pliocene-Quaternary Ambon island arc. Two suites of island-arc magmas: (1) 5- 3.2 Ma, low-K calc-alkaline basalts, andesites, dacites and rhyolites, evolved from basaltic magmatism from mantle melting above W Irian Jaya Plate as it subducts along Seram Trough; (2) 2.3-1 Ma, high-K calc-alkaline andesites, dacites, rhyolites and granites (incl. ambonites= cordierite-bearing dacites) and granites, representing magmas that assimilated continental crust. Hila porphyry Cu-Au prospect on Ambon Island (3.6 Ma))

Harahap, B.H. (2002)- Stratigraphy of the Duna River Buru Island, Maluku: hydrocarbon indications. Bull. Geol. Res. Dev. Centre 22, p. 1-18.
(Duna River section near NW coast of Buru shows ~1500m Triassic- Pleistocene sediments overlying Permian metamorphics. Rel. thick M-U Triassic unconformably overlain by thin Jurassic Mefa Fm lavas, interbedded with belemnite-rich clastics, overlain by Late Cretaceous- Eocene Kuma Fm pelagic limestone, unconformably overlain by Plio-Pleistocene coarse clastics. Oil seeps from Triassic Geghan Fm calcilutite and shale)

Harahap, B.H. & S. Poedjoprajitno (2006)- The stratigraphy and lithology of the Kuma River area, Buru Island, Maluku. J. Sumber Daya Geologi 16, 2 (152), p. 62-74.
(Stratigraphy of Kuma River area, from old to young: (1) Triassic Dalan Fm well-bedded clay-sand turbidites; (2) Jurassic Duna Fm interbedded pelagic limestone and ammonites-belemnites-rich beds; (3) Upper Cretaceous- Eocene Kuma Fm well-bedded pelagic limestone with abundant planktonic forams, (4) Oligocene-Miocene Waeken Fm micaceous mudstone, (5) Wakatin Fm massive reefal limestone; (6) Pleistocene Leko Fm conglomerate. Structuring related to block faulting)

Helmers, H., J. Sopaheluwakan, S. Tjokrosapoetro & E. Surya Nila (1989)- High-grade metamorphism related to peridotite emplacement near Atapupu, Timor with reference to the Kaibobo peridotite on Seram, Indonesia. In: J.E. van Hinte et al. (eds.) Proc. Snellius II Symposium, Jakarta 1987, Netherlands J. Sea Research 24, 2/3, p. 357-371.
(On metamorphism associated with ophiolites obduction on Seram and N coast of Timor.)

Henny, G. (1922)- Eerste verslagen der Boeroe Expeditie, A: Geologisch onderzoek. Maatschappij ter bevordering van het Natuurkundig Onderzoek der Nederlandsche Kolonien, Amsterdam, Bull. 78, p. 1-24.
('First reports of the Buru Expedition, A: geology investigation'. Brief report with first geological results of 1921-1922 expedition to Buru island, Moluccas. Mainly on traverses from S coast (Tifoe, etc.) to Rana Lake)

Henny, G. & L.J. Toxopeus (1922)- Eerste verslagen der Boeroe-expeditie. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap 39, p. 42-64.
('First reports of the Buru Expedition'. Extract of Henny (1922) on travel, geological and biological observations during 1921 SW Buru Expedition. Not much detail on stratigraphy/ fossils. Interesting find of white Nummulites-Discocyclina limestone N of Wai Ekin, not reported on later GRDC geologic maps)

Hill, K.C. (2005)- Tectonics and regional structure of Seram and the Banda Arc. Proc. 30th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 559-578.
(Tectonic reconstruction assuming Permian age of Banda Sea oceanic crust. Suggests Seram Triassic Kanikeh Fm flysch was sourced from E (New Guinea) (Conflicts with pre-WWII Rutten field observations suggesting Triassic more sandy and coarser to W, and derived from metamorphic/ volcanic arc terrane; JTvG))

Hill, K.C. (2012)- Tectonic and regional structure of Seram and the Banda Arc. Berita Sedimentologi 23, p. 5-16.
(online at: www.iagi.or.id/fosi/)
(Same paper as above)

Honthaas, C., R.C. Maury, B. Priadi, H. Bellon & J. Cotten (1999)- The Plio-Quaternary Ambon arc, Eastern Indonesia. Tectonophysics 301, 3-4, p. 261-281.
(Pliocene- Quaternary N Banda Arc at Ambon, S Seram, Kelang, Haruju, Saparua, Ambelau and Banda Api with low-K arc volcanics, but on Ambon also high-K cordierite dacites-granites, probably derived from low-K magmas with massive assimilation of overlying Seram-Ambon continental crust. Two magmatic pulses: 5- 3.2 Ma and 2.3- 1 Ma. Active subduction of New Guinea crust below Ambon-Seram supported by volcanism, earthquakes, etc., but N Banda slab not connected to S Banda Arc Wetar-Manuk segment)

Hummel, K. (1923)- Geologische Ergebnisse der Reisen K. Deninger's in den Molukken. II. Die Oxford-Tuffite der Insel Buru und ihre Fauna. Palaeontographica Suppl. IV, 4, p. 113-184.
('Geological results of K. Deniger's travels in the Moluccas, 2: The Oxfordian tuffites of Buru islands and its fauna'. Descriptions of Late Jurassic fossils from 9 localities at SW coast and NW Buru, collected by Boehm and Deninger in 1907, 1912. These are from reddish 'Mefa Beds tuffites', 200-300m thick?, most fossiliferous near top. Almost everywhere overlain by thick, latest Jurassic- Cretaceous deep water Buru Limestone, and probably directly overlying U Triassic Lovcenipora limestone or bituminous shale. Fossils mainly ammonites (Phylloceras spp., Harpoceras, Oppelia, Perisphinctes), rare belemnites (to be described by Stolley), thick-walled bivalves (Opis, Pecten, Alectryonia; no Inoceramus), ribbed brachiopods (Rhynchonella spp.), etc.. Age believed to be E Oxfordian. Facies rel. shallow marine compared to generally bathyal facies of age-equivalent rocks in Moluccas (Sula, Seram). Faunal affinities with Mediterranean-Caucasian Realm)

Idrus, A., Fadlin, I. Setiawan, S. Abdullah & B. Smith (2012)- Preliminary study on primary gold mineralization in Buru Island, Moluccas Province, Indonesia. In: N.I. Basuki (ed.) Proc. Banda and Eastern Sunda arcs, Indonesian Soc. Econ. Geol. (MGEI) Ann. Conv. 2012, Malang, p. 233-242.
(Gold nuggets from quartz vein mineralization hosted by mica schist of Carboniferous-Permian Wahlua Metamorphic Complex, discovered in 2012 around Gunung Botak, E Buru Island. Two types: (1) early quartz veins, discontinous and low in gold; (2) Quartz veins in 'mineralized zone' ~100m wide and ~1000m long. Ore mineralization characterized by pyrite, native gold, pyrrhotite and arsenopyrite. Mineralizing hydrothermal fluid CO2-rich, Temperature 300-400 ºC and low salinity (0.36- 0.54% NaCl eq). Mineralization in Buru Island meets characteristics of 'mesothermal' gold deposit type or 'orogenic' gold deposit type)

Idrus, A., S. Prihatmoko, Ernowo & Franklin (2013)- Update of metamorphic rock-hosted gold mineralization in Buru Island, Moluccas Province. In: Proc. Papua and Maluku Resources, Indonesian Soc. Econ. Geol. (MGEI) Ann. Conv., Bali, p. 89-98.

Idrus, A., S. Prihatmoko, H.G. Hartono, Fadlin, Ernowo, Moetamar & I. Setiawan (2014)- Some key features and possible origin of the metamorphic rock-hosted gold mineralization in Buru Island, Indonesia. Indonesian J. Geoscience 1, 1, p. 9-19.
(online at: http://ijog.bgl.esdm.go.id/index.php/IJOG/article/view/172/172)
(Buru primary gold deposits mainly in 2 localities Gogorea and Gunung Botak in E half of island, Two types of gold-bearing quartz veins in micaschists of U Carboniferous- Lw Permian Wahlua Fm metamorphic complex (similar to Bombana in Pompangea complex, E Sulawesi).Mineralization may be controlled by N-S of NE-SW trending strike-slip faults)

Jaworski, E. (1927)- Obertriadische Brachiopoden von Ambon (Molukken). Jaarboek Mijnwezen Nederlandsch-Indie 55 (1926), Verhandelingen III, p. 201-229.
('Upper Triassic brachiopods from Ambon (Moluccas)'. Brachiopods from dark limestones (locally bituminous) intercalated in several 100m thick sandy-shales series. With Rhynchonella, Spiriferina spp., Spirigera, etc., indicating Late Triassic age)

Juhanah, S. (1987)- Foraminifera plankton Plio-Plestosen dari Pulau Ambon. LIPI/ IAGI? 13p.
(Plio-Pleistocene planktonic foraminifera from Ambon island')

Kemp, G. (1992)- The Manusela Formation- an example of a Jurassic carbonate unit of the Australian Plate from Seram, Eastern Indonesia. In: C.T. Siemers et al. (eds.) Carbonate rocks and reservoirs of Indonesia: a core workshop, Indon. Petroleum Assoc. (IPA), Jakarta, Core Workshop Notes 1, p. 11/1-11/31.
(Manusela Fm high energy skeletal and oolitic grainstones deposited on NW margin of Australian Plate in Pliensbachian-Bathonian (E-M Jurassic) (more likely U Triassic?; JTvG), before onset of Callovian breakup and sea-floor spreading. Subsequent N-ward movement of Australian plate and collision with Eurasian/ Pacific-Philippine Plates in Late Miocene, resulted in development of detached thrust belt and formation of Seram island. Matrix and fracture porosity in Manusela. East Nief-1 with uncommercial hydrocarbons)

Kemp, G., R. Barraclough, W. Mogg, E. Budhiman & N. Heriyanto (1996)- Seram Basin. In: Pertamina/BPPKA (eds.) Petroleum geology of Indonesian Basins VIII, p. 1-33.
(Review of Seram geology and hydrocarbons)

Kemp, G. & W. Mogg (1992)- A re-appraisal of the geology, tectonics, and prospectivity of Seram Island, eastern Indonesia. Proc. 21st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta), p. 499-520.
(Distinguish 'Australian' (Triassic- U Miocene) and 'Seram' Series (U Miocene-Recent). 'Australian' series E Triassic and older pre-rift), E Triassic- M Jurassic intracratonic syn-rift, latest M Jurassic- E Cretaceous continental breakup and E Cretaceous- Late Miocene post-breakup/ passive margin sequence. Late Miocene-Present Seram Series strongly influenced by interaction of Australian, Pacific-Philippine and Eurasian plates, which led to periods of thrusting, uplift and erosion and are reflected in structural style)

Kemp, G., W. Mogg & R. Barraclough (1995)- Exploration in the Mesozoic in the Seram PSC, eastern Indonesia: recent developments in geological knowledge. Symposium & Workshop on the Mesozoic of Eastern Indonesia, Jakarta 1995, Pertamina, 26p. (*Unpublished*).

Kendrick, D. & N. Nilandaroe (2004)- Fracture characterization from outcrop data, Manusela Formation, Seram Island, Indonesia. 7p.
(online at: www.3d-geo.com/publications)
(Well-developed fracturing in 'Jurassic' Manusela Fm in Nief Gorge outcrop is possible analog to fracture porosity in Oseil oilfield, ~10km to NW)

Koch, R. (1925)- Eine jungtertiaren Foraminiferenfauna aus Ost-Seran. Eclogae Geol. Helvetiae 19, p. 207-213.
(online at: https://www.e-periodica.ch/digbib/view?pid=egh-001:1925-1926:19#220)
'A Young Tertiary foraminifera fauna from East Seram'. Marl sample collected by Muhlberg in 1902 along Kasama River in 9 km W of Waru in NE Seram contains rich Pliocene shallow marine foraminifera fauna with 85 species)

Kossmat, F. (1906)- Bemerkungen uber die Ammoniten aus den Asphaltschiefern der Bara-Bai (Buru). Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 22, p. 686-691.
('Remarks on the ammonites from the asphalt shales of Bara Bay, Buru'. Float collected by Boehm in Wai Sifu River at Bara Bay, NW coast of Buru, contains Jurassic 'Buru Limestone' with inoceramids and belemnites. Also common flat pieces of dark bituminous shales with numerous ammonites, incl. generally crushed Tissotia weteringi. This ammonite was interpreted by Kossmat to signify Upper Cretaceous age, but was subsequently re-identified as Neotibetites of Late Triassic (Norian) age by Krumbeck 1909, 1913)

Krumbeck, L. (1909)- Kurze vorlaufige Mitteilung uber eine neue obertriadische Fauna aus den Molukken. Centralblatt. Mineral. Geol. Palaont., 1909, p. 561-562.
('Brief preliminary communication on a new Upper Triassic fauna from the Moluccas'. Ammonites from Buru interpreted as Cretaceous by Kossmat (1909) are Upper Triassic in age)

Krumbeck, L. (1913a)- Obere Trias von Buru und Misol. A. Die Fogi-Schichten West Burus. Palaeontographica Suppl. IV, 2, Beitrage Geologie Niederlandisch-Indien II, 1, p. 1-119.
('Upper Triassic of Buru and Misool. A. The Fogi Beds of West Buru'. Macrofaunas collected by Boehm and Wanner from the lower Norian? Fogi-Beds of W Buru. Distal, but not very deep marine dark marls and limestones with bituminous limestone interbeds (up to 19% bitumen). Rich in fossils: mainly bivalves (Pseudomonotis, Pinna, Lima, Pecten, Placunopsis, Alectryonia, Nucula, Myophoria, Cardita, ?Megalodon, Protocardia, Burmesia, etc.), also ammonites (Sibirites, Sagenites, Tibetites, Neotibetites weteringi) and brachiopods (Misolia). Faunas similar to Juvavites Beds of Spiti, N India Himalayas)

Krumbeck, L. (1913b)- Obere Trias von Buru und Misol. B. Die Asphaltschiefer am Sifu (N.W.-Buru). Palaeontographica, Suppl. IV, 2, Beitr. Geologie Niederlandisch-Indien II, 1, p. 120-127.
('Upper Triassic of Buru and Misool. B. The asphalt beds at Sifu (NW Buru)'. Macrofaunas collected by Boehm and Wanner from Triassic (Lower Norian?) asphalt beds of NW Buru: bivalves (Pecten), ammonites (Neotibetites weteringi), fish scales. Age similar to Fogi Beds)

Krumbeck, L. (1923)- Geologische Ergebnisse der Reisen K. Deninger's in den Molukken. III. Brachiopoden, Lamellibranchiaten und Gastropoden aus der oberen Trias der Insel Seram (Mittel-Seram). Palaeontographica, Suppl. IV, Beitr. Geologie Niederlandisch-Indien III, 5, p. 185-246.
('Geological results of Deniger's 1912 trip in the Moluccas, III. Brachiopods, bivalves and gastropods from the Upper Triassic of Seram island (Central Seram)'. On Carnian Halobia shales of Wai Isana near Manusela with Halobia spp., Norian Kanikeh Beds with Myophoria, Cardita, Trigonia, etc., and Monotis bed at Wai Ehana (typical Monotis limestone rich in Monotis salinaria). Also Misolia Limestone)

Krumbeck, L. (1923)- Zur Kenntnis des Juras der Insel Timor, sowie des Aucellen-Horizontes von Seran und Buru. In: J. Wanner (ed.) Palaeontologie von Timor 12, 20, Schweizerbart, Stuttgart, p. 1-120.
('On the knowledge of the Jurassic of Timor, as well as the Aucella horizon of Seram and Buru'. Includes first description of Upper Jurassic 'Aucella' (=Malayomaorica) malayomaorica from Seram, also known from Timor, Buru, etc.)

Kuenen, P.H. (1949)- Ambon and Haroekoe. Contributions to the geology of the East Indies from the Snellius Expedition III. Verhandelingen Nederl. Geologisch Mijnbouwkundig Genootschap, Geol. Serie 15, p. 44-62.
(Brief description of parts of Ambon and Haruku Islands. Presence of folded Triassic sediments on crystalline schists, peridotites, granites and 'ambonites' volcanics)

Kusnida, D., T. Naibaho & Y. Firdaus (2016)- Depositional modification in Seram Trough, Eastern Indonesia. J. Geologi Sumberdaya Mineral 17, 2, p. 99-106.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/22/22)
(Seismic profiles at Seram Trough show avalanches of Pliocene- Quaternary base-of slopes material in front of Seram accretionary prism)

Lapulisa, A.K., R. Andrianto & A.S. Dradjat (2012)- Seismic to geological modeling workflow, an integrated approach to determine the reservoir quality of a fractured limestone: Oseil Field example. Berita Sedimentologi 23, p. 47-52.
(online at: www.iagi.or.id/fosi/)
(On the use of seismic attributes to predict fracture porosity in 'Jurassic' Manusela Lst heavy oil reservoir. Oolitic, partly dolomitized limestones with low matrix porosity. Early extensional faulting, followed by SW-NE directed compression)

Lopulisa, A.K., R. Andrianto & A.S. Dradjat (2012)- Seismic to geological modeling workflow, an integrated approach to determine the reservoir quality of a natural fractured limestone reservoir: Oseil Field example AAPG Workshop Fractured Carbonate Reservoirs, Bali 2012, Search and Discovery Art. 20144, p. 1-26.
(online at: www.searchanddiscovery.com/documents/2012/20144lopulisa/ndx_lopulisa.pdf)

Linthout, K. & H. Helmers (1994)- Pliocene obducted, rotated and migrated ultramafic rocks and obduction-induced anatectic granite, SW Seram and Ambon, Eastern Indonesia. J. Southeast Asian Earth Sci. 9, p. 95-109.
(SW Seram and Ambon ultramafics obduction minimum age ~4.4 Ma. Obducted oceanic lithosphere was created at ~14.5 Ma. Obduction probably simultaneous with strong anticlockwise rotation of Seram)

Linthout, K., H. Helmers & P.A.M. Andriessen (1991)- Dextral strike-slip in Central Seram and 3-4.5 Ma Rb/Sr ages in pre-Triassic metamorphics related to Early Pliocene counterclockwise rotation of the Buru-Seram microplate (E. Indonesia). J. Southeast Asian Earth Sci. 6, p. 335-342.
(Major WNW trending right-lateral strike slip fault in SW Seram. Pre-Triassic metamorphics show Pliocene radiometric ages, possibly resetting from ophiolite obduction. Structural analyses suggest 45° counter clockwise rotation and radiometric age resetting between 4.5- 3 Ma, and final ~30° rotation in last 3 Ma)

Linthout, K., H. Helmers, J. Sopaheluwakan & E. Surya Nila (1989)- Metamorphic complexes in Buru and Seram, northern Banda Arc. In: J.E. van Hinte et al. (eds.) Proc. Snellius II Symposium, Jakarta 1987, Netherlands J. Sea Research 24, 2/3, p. 345-356.
(SE Buru Wahlua and C Seram Tehoru metamorphic complexes similar pre-Triassic metamorphic history, and probably originated in same belt. Mylonites in N Tehoru indicate right-lateral, N300E directed strike-slip along transcurrent fault between metamorphics in S and non-metamorphic block in N, caused by anticlockwise rotation of Seram since Late Triassic. Kaibobo metamorphics T up to 740°C, caused by overriding ultramafic sheet in Late Miocene- E Pliocene. K/Ar ages of 4-5 Ma of micas from Wahlua and Tehoru complex explained by re-heating of pre-Triassic mica due to overthrusting by hot mantle slabs, now largely eroded. Average uplift of ~0.1 cm/yr during last 4-5 Ma in SE Buru and C Seram. Thrusting of metamorphics over non-metamorphics in 'median' Seram and of ultramafic sheet in SW Seram also related to Seram anticlockwise rotation)

Linthout, K., H. Helmers, J.R. Wijbrans & J.D.A.M. van Wees (1996)- 40Ar/39Ar constraints on obduction of the Seram ultramafic complex: consequences for the evolution of the southern Banda Sea. In: R. Hall & D.J. Blundell (eds.) Tectonic Evolution of SE Asia. Geol. Soc. London, Spec. Publ. 106, p. 455-464.
(On Kaibobo (SW Seram) obduction of hot oceanic lithosphere produced high-grade metamorphism and granite in overthrust continental crust. Ages from sole 5.65- 6.0 Ma and 5.4 Ma. Post-emplacement exhumation began < 8 Ma ago. Undoing 8 Ma of migration back-tracks Kaibobo to site where obduction ended: near SE corner of Banda Sea plate. Similarities between Kaibobo and N Timor ophiolites suggests E Miocene slow spreading in oceanic lithosphere S Banda Sea, S of current volcanic arc)

Liu, Z.Y.C. & R.A. Harris (2013)- Discovery of possible mega-thrust earthquake along the Seram Trough from records of 1629 tsunami in eastern Indonesian region. Natural Hazards, February 2013, p. 1-18.
(online at: http://link.springer.com/content/pdf/10.1007%2Fs11069-013-0597-y.pdf)
(Most likely source of mega-thrust earthquake that caused 15m high tsunami in 1629 at Banda Islands is Seram Trough, ESE of Seram Island. Mega-thrust earthquakes of magnitude needed to produce tsunami observed in Banda Islands have rupture lengths of >500 km)

Martin, K. (1888)- Ein *Ichthyosaurus* von Ceram. Sammlungen Geol. Reichs-Museums Leiden, Ser. 1, 2, p. 70-86.
(online at: www.repository.naturalis.nl/document/552431)
('An Ichthyosaurus from Seram'. Skull/ jaw fragment of large Mesozoic (Jurassic?) Ichthyosaurus ceramensis n. sp., probably collected at E Seram South coast)

Martin, K. (1888)- Ein *Ichthyosaurus* von Ceram. Jaarboek Mijnwezen Nederlandsch Oost-Indie 17 (1888), Wetenschappelijk Gedeelte, p. 3-18.
(*('An Ichthyosaurus from Seram'. Same as Martin (1888) paper above*)

Martin, K. (1901)- Over de geologie van West-Seran (Ceram). Handelingen 8e Nederlandsch Natuur- Geneeskundig Congres, Rotterdam 1901, p. 301-304.
('On the geology of West Seram'. Old, brief summary of W Seram. Widespread 'Archean' metamorphics, locally associated with peridotites, Paleozoic greywackes and limestones, steeply dipping Mesozoic chert-bearing globigerinid-radiolarian limestone, overlain by brightly colored Globigerina limestone. No maps or figures)

Martin, K. (1901)- Reise Ergebnisse aus den Molukken. Centralblatt Mineralogie Geologie Palaont. 1901, p. 460-464.
(online at: www.biodiversitylibrary.org/item/196149#page/379/mode/1up)
('Travel results from the Moluccas'. Summary of geological observations on Seram. No figures. More detail in Martin (1903))

Martin, K. (1902)- Reise Ergebnisse aus den Molukken. 3. Ein Profil durch Buru. Centralblatt Mineralogie Geologie Palaont., 1902, 15, p. 460-464.
(online at: www.biodiversitylibrary.org/item/192789#page/476/mode/1up)
('Travel results from the Moluccas, 3, a traverse through Buru'. Brief, early description of Buru stratigraphy across N-S traverse. No figures, fossils)

Martin, K. (1903)- Reisen in den Molukken, in Ambon, den Uliassern, Seran (Ceram) und Buru. Geologischer Teil. Brill, Leiden, p. 1-296.
('Travels in the Moluccas, in Ambon, the Uliassers, Seram and Buru- Geologic part'. Early reconnaissance of Moluccas islands. First N-S traverse through Buru Island, etc.)

Martini, R. L. Zaninetti, B. Lathuilliere, S. Cirilli, J.J. Cornee & M. Villeneuve (2004)- Upper Triassic carbonate deposits of Seram (Indonesia): palaeogeographic and geodynamic implications. Palaeogeogr. Palaeoclim. Palaeoecology 206, 1-2, p. 75-102.
(Seram Upper Triassic limestones of Gondwanian-Australian type in 'Parautochthonous' and of Laurussian-Asian type in 'Allochthonous'. Carnian-Norian to Rhaetian Asinepe Lst (=Manusela Fm) part of allochthonous series. Four reefal facies: (1) boundstone forming buildup cores with calcisponges and calcareous algae, <20% coral; (2) oncolitic grainstones; (3) foraminiferal packstone-grainstones; (4) foraminiferal-megalodont mudstones. Geochemical and geodynamic interpretations placed Seram-Buru Block as derived from New Guinea. Palynology suggests Seram-Buru Block more tropical than Sulawesi/ Kolonodale Block, but cooler than Timor/ NW Shelf. Foraminifera suggest Seram, E Sulawesi, Wombat Plateau and Sinta Ridge all part of same N Australian margin marine bioprovince)

Menzie, W.D., D.A. Singer, N. Karangan & H. Tresnadi (1997)- The Hila Prospect: a recently discovered copper occurrence on Ambon Island, Republic of Indonesia. U.S. Geol. Survey (USGS) Open-File Rept. 97-86, p. 1-17.
(online at: http://pubs.usgs.gov/of/1997/0086/report.pdf)
(Mineral prospect in part of Indonesia with no previously reported mineralization. Hila Prospect, SE of Hila village, NW Ambon, with copper sulfide minerals in Pliocene (4.4 Ma) Ambon volcanics. Host rocks andesite, dacites, breccia and tuff locally intruded by biotite and biotite-cordierite granite. Geologic setting, alteration, sulfide minerals, and geochemistry suggest possible periphery of porphyry copper-gold deposit)

Milsom, J. (1979)- Preliminary gravity map of Seram, eastern Indonesia. Geology 5, p. 641-643.
(Steep gravity gradients in survey area, related to transition from continental to oceanic crust and existence of root zone of ultramafic thrust sheet S of islands. Positive anomaly over rel. small area of ultramafic outcrop near Kaibobo, mainland Seram)

Milsom, J.S. (1979)- Origin of the Uliasser Islands, Eastern Indonesia. J. Geol. Soc. 136, 5, p. 581-582.
(Seram segment of Banda Arc appears to conform to structure of typical arc, but geology of area reveals a number of deviations. Late Tertiary or Quaternary volcanoes forming Uliasser Islands mark S margin of

extensional zone, and intruded along localized transform fault. Interpretation of geology of Seram area simplified if Uliasser volcanics are not regarded as subduction-related)

Monnier, C., J. Girardeau, J.P. Rehault et al. (2002)- The Seram ophiolites complexe (Central Indonesia): geochemical evidences for Early Miocene arc-splitting, 19e RST Nantes, p. 181-182. *(Abstract)*

Monnier, C., J. Girardeau, J.P. Rehault, H. Permana & H. Bellon (2003)- Dynamics and age of formation of the Seram-Ambon ophiolites (Central Indonesia). Bull. Soc. Geologique France 174, 6, p. 529-543.
(online at: http://documents.irevues.inist.fr/handle/2042/282)
(Seram-Ambon peridotites-gabbros mostly back arc basin characteristics, with 20-15 Ma K/Ar ages. Formed in small Early Miocene transtensional basin, bordered in E by active margin and in W by passive continental margin over which it was later obducted towards SW, in Late Miocene, 9-7 Ma)

Moss, S.J., J. Milsom & M.E.J. Wilson (1996)- The geology of Buru Island, Eastern Indonesia. London University, Southeast Asia Research Group, Report 150, 22p. *(Unpublished)*
(Late Paleozoic metamorphics overlain by >1000m Triassic sediments. Two facies: sandy slope turbidites and carbonate/ bituminous shale with reefal facies. Triassic unconformably overlain by ~1000m deep water Late Jurassic- Paleogene calcilutes/ marls, with ~100m of Late Jurassic submarine basaltic volcanics. Late Oligocene marls overlain by thick, folded Early Miocene marine sediments with earliest Miocene arc volcanics. Pliocene NE- prograding fan-delta sediments above major unconformity. Quaternary reefs and terraces up to 750m above sea level. No complex thrusting like Seram. Buru-Seram microcontinent originally part of 'Greater Sula Spur', separated from N Australia margin (Bonaparte Gulf?) by mid-Jurassic)

Moyle, I. P., S. Dyer, D.G.S. Lamb & W.G. Mogg (2000)- Experiences in underbalanced drilling and testing low gravity oil from a high productivity reservoir in Seram Island, Maluku Province, Indonesia. Proc. 27th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 1-36.
(Oseil 2 and 4 wells drilling. Oseil 2 720' of oil column in Manusela Fm fractured carbonate, testing up to 650 BOD of 22°API oil. Oseil 4 410' of oil pay, testing 2200 BOD of 16.1° API oil)

Muliani, R. (2005)- Haruku base metal deposits, Maluku. In: S. Prihatmoko et al. (eds.) Indonesian mineral and coal discoveries, Indon. Assoc. Geol. (IAGI) Spec. Issue, p. 118-136.
(Haruku Island, between Ambon and Saparua, with some poorly known Cu-Pb-Zn-Ag-Au high-sulphide mineralization prospects, with galena, sphalerite, chalcopyrite, etc.., hosted by U Miocene- Lower Pliocene? brecciated andesitic-dacitic volcanics)

Munasri, H. Permana & S. Siregar (1999)- Is Seram island the mirror image of Timor island? In: I. Busono & H. Alam (eds.) Developments in Indonesian tectonics and structural geology, Proc. 28th Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 1, p. 51-61.
(In Indonesian. Many similarities in tectonostratigraphies of Seram and Timor. Cretaceous Sawai Fm of N Seram (Albian- Campanian) and Nakfunu Fm (Berriasian- Aptian) on Timor show differences in lithology and radiolaria biostratigraphy)

Munasri, S. Siregar & D. Mulyadi (1999)- Studi geodinamika sedimentasi satuan batuan sedimen di Pulau Seram dan korelasinya dengan yang di Pulau Timor. Laporan Penelitian Puslitbang Geoteknologi-LIPI, 1998/1999, p. 45-60.
('Study of geodynamics of sedimentation of sedimentary rock units of Seram Island and correlation with Timor'. Micropaleontological, petrographic and sedimentological analysis of Triassic- Tertiary series suggest Timor is mirror image of Seram)

Nilandaroe, N. (2005)- Relationship between facies and fracturing- a comparison of fractured carbonate reservoirs on Seram Island, Indonesia and Southern Italy. Indon. Petroleum Assoc. (IPA) Newsletter 2005, 11, p. 20-24.
(online at: www.ipa.or.id/download/news/IPA_Newsletter_11_2005_10.pdf)

(Brief comparison of fracturing in 'Jurassic' Manusela Fm in Seram fold-thrust belt and fractured carbonates in Apennines. Larger fractures better developed in coarser-grained facies (oolitic grainstones) than in muddier facies of Manusela Fm carbonates)

Nilandaroe, N., W. Mogg & R. Barraclough (2001)- Characteristics of the fractured carbonate reservoir of the Oseil Field, Seram Island, Indonesia. Proc. 28th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, p. 439-456.
(Oseil oil field reservoir is fractured 'E-M Jurassic' Manusela carbonate (recrystallised oolitic grainstone, dolomites, wackestones). Reservoir extensively fractured with pervasive, open, near-vertical fractures, preferentially striking in NNE-SSW orientation. Fracture porosity <5-8%; negligible matrix porosity due to complex diagenesis)

Noor, M.K., A. Tonggiroh & A. Maulana (2016)- Type of gold hydrothermal deposits on metamorphic rock, District Buru, Province Maluku. Int. J. Engineering and Science Applications (UNHAS) 3, 1, p. 39-45.
(online at: http://pasca.unhas.ac.id/ojs/index.php/ijesca/article/view/276/160)
(Gold-bearing quartz veins in greenschist facies metamorphic rocks (muscovite schist and phyllite; probably metasediments) at Gunung Botak, Buru, reflect epithermal- high sulphidation gold mineralization)

Oemar, S. & C.H. Remington (1993)- A new view on the petroleum geology of the Buru Island, Eastern Indonesia. Proc. 22nd Ann. Conv. Indon. Assoc. Geologists (IAGI), Bandung, 2, p. 693-703.
(Brief summary of Pertamina fieldwork on Buru. Main sedimentary basin in S part of island, but gravity study suggests W and N parts of island may also have enough sediments for hydrocarbon accumulation)

OõSullivan, T.D., D. Pegum, & J. Tarigan (1985)- Seram oil search, past discoveries and future oil potential. Proc. 14th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 3-20.
(Bula oilfield in E Seram discovered in 1897, produced >13 million barrels of oil have been produced, mainly form Pleistocene Fufa Fm. Seram is imbricate accretionary prism formed by subduction of Australian Plate. Shale diapirism and regional left-lateral wrenching important roles in structural development)

Panuju, J.S. Hadimulyono & J. Anwari (2015)- Hydrocarbons resource assessment of the eastern offshore area of Seram Island, Indonesia. Proc. 39th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA15-G-196, 15p.

Pairault, A.A., R. Hall & C.F. Elders (2003)- Tectonic evolution of the Seram Trough, Indonesia. Proc. 29th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, IPA03-G-013, p. 1-16.

Pairault, A.A., R. Hall & C.F. Elders (2003)- Structural styles and tectonic evolution of the Seram Trough, Indonesia. Marine Petroleum Geol. 20, 10, p. 1141-1160.
(Study of recent 2D seismic lines across Seram Trough in N part of Banda Arc, between Birds Head of New Guinea and Seram Island. Formerly interpreted as (1) subduction trench, (2) intra-continental thrust zone and foredeep, and (3) strike-slip fault zone. E Pliocene inversion of Misool-Onin anticlinorium produced angular unconformity, which truncates sediments as old as M Jurassic, later folded and now dippping S towards Seram Trough. Contraction in Trough occurred after E Pliocene and continues to present day. This work suggests Seram Trough is not subduction trench but foredeep within Australian continental margin, produced in response to loading by Seram fold-thrust belt. (This ignores dipping subducting slab as imaged by tomography, earthquake epicenters, also >100km wide accretionary prism, etc.; JTvG))

Patria, A. & R. Hall (2017)- The origin and significance of the Seram Trough, Indonesia. Proc. 41st Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA17-19-G, p. 1-19.
(Seram Trough commonly interpreted as accretionary wedge/ subduction zone beneath Seram, but is shallower than typical subduction zone and marks deformation front of fold-thrust belt resulting from young oblique convergence between Outer Banda arc and Birds Head. Fold-thrust belt zone narrower in W (with thrusting cesing thrusting ceases at E edge of Buru oceanic basin) and widens to SE. Thrusting at the trough started in Late Pleistocene)

Pertamina/BPKKA (1996)- Petroleum geology of Indonesian basins, vols. VI-IX Eastern Indonesian Basins, VIII- Seram, p. 1-33.

Pia, J. (1924)- Einige Dasycladaceen aus der Ober-Trias der Molukken. Jaarboek Mijnwezen Nederlandsch Oost-Indie 52 (1923), Verhandelingen, p. 137-149.
(First record from Indonesia of U Triassic (probably Norian) dasyclad algae from (1) NE Seram: Bula river, Macroporella sondaica n.sp. from limestone breccia interbed in Monotis-bearing flysch-like Upper Triassic series; (2) SW Buru: S of Tifu, massive U Triassic limestone with Lovcenipora and Macroporella irregularis n.sp.; (3) NW Buru: Wai Tina 'Fatu Lst', possibly Jurassic. Few species, all new)

PND- Patra Nusa Data (2006)- Northern offshore Seram. Inameta J. 2, p. 26-29.
(online at: www.patranusa.com) (Brief overview of Seram geology and prospectivity)

PND- Patra Nusa Data (2006)- Misool and Seram Basin. In: Indonesia Basin Summaries (IBS), PT Patra Nusa Data, Inameta Series, Jakarta, p. 392-409.
(Brief summary of hydrocarbon system elements of Misool-Seram region. Saman Saman- Manusela Limestone Formations of Seram shown as Late Triassic- Middle Jurassic in age)

Pownall, J.M. (2014)- Neogene tectonometamorphic evolution of Seram, eastern Indonesia. Ph.D. Thesis, Royal Holloway, University of London, p. 1-538. *(Unpublished)*

Pownall, J.M. (2015)- UHT metamorphism on Seram, eastern Indonesia: reaction microstructures and P-T evolution of spinel-bearing garnet-sillimanite granulites from the Kobipoto Complex. J. Metamorphic Geol. 33, 9, p. 909-935.
(Seram Kobipoto Metamorphic Complex with Mio-Pliocene granulite facies migmatites and less common granulites. Migmatites associated with ultramafic rocks of lherzolitic composition, exhumed by lithospheric extension beneath low-angle detachment faults. Post-peak evolution of granulites may be related to published U-Pb zircon and 40Ar/39Ar ages of ~16 Ma. Kobipoto Complex granulites demonstrate how UHT conditions may be achieved by extreme lithospheric extension, in this case driven by slab rollback of Banda Arc)

Pownall, J.M., R.A. Armstrong, I.S. Williams, M.F. Thirlwall, C.J. Manning & R. Hall (2018)- Miocene UHT granulites from Seram, eastern Indonesia: a geochronological-REE study of zircon, monazite and garnet. In: S. Ferrero et al. (eds.) Metamorphic geology: microscale to mountain belts, Geol. Soc. London, Spec. Publ. 478, p.
(Ultra-high T (>900°C) garnet-sillimanite granulites of Seram formed by extensional exhumation of hot mantle rocks behind rolling-back Banda Arc. Miocene age confirmed by ~16 Ma zircons and monazites U-Pb ages. These geochronometers date retrograde overprints. Zircons shielded within garnet with 216–173 Ma ages (Late Triassic- E Jurassic. UHT conditions very short-lived and very rapid exhumation of granulite complex)

Pownall, J.M., M.A. Forster, R. Hall & I.M. Watkinson (2017)- Tectonometamorphic evolution of Seram and Ambon, eastern Indonesia: insights from 40Ar/39Ar geochronology. Gondwana Research 44, p. 35-53.
(Two main phases in Seram Neogene tectonic evolution: (1) 16 Ma episode of extreme extension that exhumed hot lherzolites from subcontinental lithospheric mantle and drove UHT metamorphism and melting of adjacent continental crust (kyanite-grade metamorphic event of Tehoru Fm across W and C Seram); and (2) 5.7, 4.5 and 3.4 Ma episodes of extensional detachment faulting and strike-slip faulting that further exhumed granulites and mantle rocks across Seram and Ambon. Events interpreted to be result of W Seram ripping off from SE Sulawesi, extended, and dragged E by Banda Slab subduction rollback)

Pownall, J.M. & R. Hall (2014)- Neogene extension on Seram: a new tectonic model for the northern Banda Arc. Proc. 38th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA14-G-305, 17p.
(Neogene tectonic evolution of Seram not dominated by thrusting and shortening due to collision of N Banda Arc with Australian passive continental margin, but peridotites represent subcontinental lithospheric mantle rapidly exhumed beneath low-angle detachment faults during extreme crustal extension. KobipotoMts of C Seram with peridotites intimately associated with granulite facies migmatite, recording ultrahigh P/T of 25-30 km depth. Granitoids emplacement across Seram and Ambon from 16 Ma (Kobipoto Mts) until 3.5 Ma

(Ambon). Seram experienced extreme extension by detachment faulting best explained by E-ward rollback of Banda slab since 16 Ma)

Pownall, J.M., R. Hall & R.A. Armstrong (2017)- Hot lherzolite exhumation, UHT migmatite formation, and acid volcanism driven by Miocene rollback of the Banda Arc, eastern Indonesia. Gondwana Research 51, p. 92-117.
(N Banda Arc (Seram) exposes upper mantle lherzolites and lower crust granulite facies migmatites of 'Kobipoto Complex'. Granulites experienced ultrahigh-T (> 900˚C) at 16 Ma due to heat supplied by lherzolites exhumed during slab rollback in Banda Arc. Ages of detrital zircons from Kobipoto Complex 3.4 Ga- 216 Ma, suggesting W Papua/ W Australian Archean protolith and post-Late Triassic metamorphism. Zircons in granulites 3 later growth episodes: 215-173 Ma (= subduction beneath Birds Head and Sula Spur?), 25-20 Ma (collision between Sula Spur and N Sulawesi?), and ~16 Ma. 16 Ma zircon rims grew during M Miocene metamorphism and melting of Kobipoto complex rocks beneath Seram under HT–UHT conditions. Extension during continued slab rollback exhumed both lherzolites and adjacent granulites beneath extensional detachment faults in W Seram at 6.0-5.5 Ma, and on Ambon at 3.5 Ma. Ambonites and dacites sourced mainly from melts generated in Kobipoto Complex migmatites erupted on Ambon from 3.0-1.9 Ma.)

Pownall, J.M., R. Hall, R.A. Armstrong & M.A. Forster (2014)- Earthôs youngest known ultra high temperature granulites discovered on Seram, eastern Indonesia. Geology 42, 4, p. 279-282.
(late Early Miocene (16 Ma) ultrahigh-T (≥900 °C) granulite metamorphics in Kobipoto Mountains, Seram, youngest at Earth surface. Slab rollback-driven lithospheric extension caused core complex-style exhumation of hot subcontinental lithospheric mantle)

Pownall, J.M., R. Hall & I.M. Watkinson (2013)- Extreme extension across Seram and Ambon, eastern Indonesia: evidence for Banda slab rollback. Solid Earth 4, 2, p. 277-314.
(online at: www.solid-earth.net/4/277/2013/se-4-277-2013.pdf)
(Seram island in N part of Banda Arc previously interpreted as fold-and-thrust belt formed during arc-continent collision, with ophiolites intruded by granites. New geological mapping and re-examination of field relations suggest recent N-S extension caused high-T exhumation of mantle peridotites and granites (Kobipoto Complex) beneath low-angle lithospheric detachment faults)

Price, P.L., T. OôSullivan & R. Alexander (1987)- The nature and occurrence of oil in Seram, Indonesia. Proc. 16th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, 1, p. 141-172.
(First Seram oilfield Bula in 1897, with oil produced from Pleistocene clastics and Late Triassic- E Jurassic carbonates. Oil from carbonat source, probably Late Triassic, but no source rock identified)

Priem, H.N.A., P.A.M. Andriessen, N.A.I.M. Boelrijk et al. (1978)- Isotopic evidence for a Middle to Late Pliocene age of the cordierite granite on Ambon, Indonesia. Geologie en Mijnbouw 57, 3, p. 441-443.
(online at: https://drive.google.com/file/d/0B7j8bPm9Cse0aXVNVFJuSnAxVlk/view)
(Rb-Sr dating of cordierite-biotite granite from Ambon yields age of 3.3 ± 0.1 Ma and K-Ar age of biotite of 3.8 ± 0.2 Ma, both suggesting Middle-Late Pliocene age for associated 'ambonite' basaltic magmatism. Initial 87Sr/ 86Sr = 0.7221. Geology of Ambon related to SW subduction from Seram Trough)

Rittmann, A. (1931)- Gesteine von Kellang und Manipa. Geological, Petrogr. and Palaeont. results of explorations carried out from September 1917 till June 1919 in the Island of Ceram by L. Rutten and W. Hotz, First Ser., Petrography, 2, De Bussy, Amsterdam, p. 1-135.
(Petrographic descriptions of rocks from Manipa and Kellang Islands between Buru and Seram. Primarily igneous (peridotites/ serpentinites, gabbros, basalts) and metamorphic rocks (primarily contact metamorphism from ultramafics and gabbro intrusions). Sediments ony in central syncline of Kellang: Triassic sandstones rich in feldspars, muscovite and plant remains and shales and grey-red limestone lenses with corals and brachiopods, all similar to those found in W Seram)

Roques, D. (1999)- The metamorphic core of Buru. University of London SE Asia Research Group, Report 204, p. 1-49. *(Unpublished)*

(Buru phyllites/ schist/quartzites usually interpreted as Late Carboniferous-E Permian metamorphosed flysch. Amphibolite facies corresponds to burial depth of 20-25 km. Metamorphics overlain by unmetamorphosed Triassic. Young cooling ages reflect uplift/ exhumation between 5- 2.5 Ma, removing >6 km of sediment)

Rutten, L.M.R. (1918)- Uit het eerste verslag over de geologische expeditie naar Ceram. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 35, p. 112-121.
(First of series of ten reports by Rutten-Hotz on the geological expedition to Seram from August 1917- June 1919, sponsored by 'Maatschappij tot Bevordering van Natuurkundig Onderzoek der Nederlandse Kolonien' and the Netherlands Geographic Society. Mainly summaries of travel, but with geological observations. Unfortunately, no other documentation from this extensive fieldwork was published, except in the Rutten (1927) chapter on Seram and in in late 1940's theses by Rutten's Ph.D. students Germeraad, Valk and Van der Sluis)

Rutten, L.M.R. (1918)- De geologische expeditie naar Ceram- tweede verslag (13 Aug.- 11 Sept. 1917). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 35, p. 228-234.
('The geological expedition to Seram- Report 2')

Rutten, L.M.R. (1918)- De geologische expeditie naar Ceram- derde verslag (12 Sept.-11 Nov. 1917). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 35, p. 368-378.
('The geological expedition to Seram- Report 3')

Rutten, L.M.R. (1918)- De geologische expeditie naar Ceram- vierde verslag (12 Nov. 1917- 4 Jan. 1918). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 35, p. 547-555.
('The geological expedition to Seram- Report 4')

Rutten, L.M.R. (1919)- De geologische expeditie naar Ceram- vijfde verslag (4 Jan.- einde Maart 1918). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 36, p. 36-42.
('The geological expedition to Seram- Report 5')

Rutten, L.M.R. (1919)- De geologische expeditie naar Ceram- zesde verslag (April- Mei 1918). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 36, p. 42-48.
('The geological expedition to Seram- Report 6'. Traverses in East Ceram. Visit to Nief Gorge, the only place where Rutten observed oil seeps on Seram)

Rutten, L.M.R. (1919)- De geologische expeditie naar Ceram- zevende verslag (Juni- Juli 1918). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 36, p. 199-207.
('The geological expedition to Seram- Report 7')

Rutten, L.M.R. (1919)- De geologische expeditie naar Ceram- achtste verslag. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 36, p. 460-466.
('The geological expedition to Seram- Report 8')

Rutten, L.M.R. & W. Hotz (1919)- De geologische expeditie naar Ceram- negende verslag (medio September- medio December 1918). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 36, p. 559-579.
('The geological expedition to Seram- Report 9')

Rutten, L.M.R. & W. Hotz (1920)- De geologische expeditie naar Ceram- tiende verslag (medio September- medio December 1918). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 37, p. 17-31.
('The geological expedition to Seram- Report 10')

Rutten, L.M.R. (1920)- De geologische expeditie naar Ceram- elfde (laatste) verslag. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap, Ser. 2, 37, p. 32-42.
('The geological expedition to Seram- Report 11 (final)')

Rutten, L.M.R. (1927)- Ceram, Ambon, Boeroe en de kleinere eilanden in hunne omgeving. In: L.M.R. Rutten (1927) Voordrachten over de geologie van Nederlandsch Indie, Wolters, Groningen, p. 716-749.
(Review of geology of Seram, Ambon, Buru and adjacent small islands)

Sachse, F.J.P. (1906)- Toelichtingen bij de schetskaart van de afdeelingen Wahai en West-Seran op het eiland Seran. Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap (2) 23, 3, p. 439-450.
('Explanatory notes with sketch-map of the districts of Wahai and West Seram on Seram island'. Early geographic description)

Sapiie, B. & M. Hadiana (2014)- Analogue modeling of oblique convergent strike slip faulting and application to the Seram Island, Eastern Indonesia. Indonesian J. Geoscience 1, 3, p. 121-134.
(online at: http://ijog.bgl.esdm.go.id/index.php/IJOG/article/view/189/181)
(Sandbox modeling to understand deformation of Seram Island. Best matched as oblique convergent strike-slip transpressional regime)

Sapiie, B., M. Hadiana, M. Patria, A.C. Adyagharini, A. Saputra, P. Teas & Widodo (2012)- 3D structural geology analysis using integrated analogue sandbox modeling: a case study of the Seram thrust-fold belt. Proc. 36th Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA12-G-045, p. 1-14.
(Offshore+onshore Seram fold-thrust belt broad deformation zone >400 km long, ~100 km wide. Peak deformation in last 3 My. Fault pattern changes along strike (trends in W mainly E-W, middle NW-SE, and E (SE) mainly N-S), accompanied by change in dip of faults from NE to SW. Large amounts of shortening. Left-lateral strike-slip component in deformation, suggesting oblique convergent system)

Schneider, C.F.A. (1852)- Geognostisch uitstapje naar de zuidkust van Ceram. Natuurkundig Tijdschrift Nederlandsch-Indie 3, 1, p. 101-107.
(online at: http://62.41.28.253/cgi-bin/)
('Geognostic excursion to the south coast of Seram'. Early description of rock types encountered along S coast of Seram. Not much detail, no maps)

Schroeder van der Kolk, J.L.C. (1895)- Mikroskopische Studien uber Gesteine aus den Molukken. 1. Gesteine von Ambon und den Uliassern. Jaarboek Mijnwezen Nederlandsch-Indie 24 (1895), p. 1-57.
('Microscopic studies of rocks from the Moluccas, I. Rocks from Ambon and the Uliasser islands')

Schroeder van der Kolk, J.L.C. (1900)- Mikroskopische Studien uber Gesteine aus den Molukken, 2. Gesteine von Seran. Sammlungen Geol. Reichs-Museums Leiden, ser. 1, 6, p. 1-39.
(online at: www.repository.naturalis.nl/document/552397)
('Microscopic studies of rocks from the Moluccas, 2. Rocks from Seram'. Petrographic descriptions of rocks collected by K. Martin, incl. granite (with and without cordierite), diorite, peridotite, Augite-andesite, cordierite gneiss, amphibolite, mica schist, greywacke and breccia))

Schroeder van der Kolk, J.L.C. (1902)- Mikroskopische Studien uber Gesteine aus den Molukken, 3. Gesteine von Buru. Sammlungen Geol. Reichs-Museums Leiden, ser. 1, 6, p. 77-127.
(online at: www.repository.naturalis.nl/document/552389)
('Microscopic studies of rocks from the Moluccas, 3. Rocks from Buru'. Petrographic descriptions of rocks collected by K. Martin, incl. granite from N coast near Waepote, andesites from 2 localities, gneiss from Batubua and Lumaiti, mica schists, phyllites and quartz schists from several localities, graywackes, conglomerate and limestone)

Setyanta, B. & I. Setiadi (2007)- Anomali gaya berat dan tataan tektonik sekitar perairan Laut Banda dan Pulau Seram. J. Sumber Daya Geologi 17, 6 (162), p. 408-419.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/319/287)
(Gravity anomalies of Banda Sea and Seram Island used to build crust structure model. Banda Sea mainly composed of basaltic crust. Banda Sea basaltic crust under volcanic Banda Island, while granitic crust is under Pre-Tertiary sediments at Seram)

Setyanta, B. & I. Setiadi (2010)- Pola struktur dan geodinamika Cekungan Bula, berdasarkan anomali gaya berat. J. Sumber Daya Geologi 20, 1, p. 41-55.
(online at: http://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/161/156)
('Structure and geodynamics of the Bula Basin, based on gravity anomaly data'. Seram. Gravity shows two regional fault structures, horizontal faults trending NE-SW and E-W)

Setyawan, W.B., B. Wijaya & A. Guntoro (2000)- Mengurai perkembangan tektonik Pulau Seram dan Ambon. Proc. 29th Ann. Conv. Indon. Assoc. Geol. (IAGI), Bandung, 4, p. 33-45.
(Analysis of the tectonic development of Seram and Ambon islands')

Siagian, H.P., B.S. Widijono, J. Nasution, B. Setyanta, Nurmaliah, K. McKenna & A. Noetzli (2016)- High resolution magnetic anomaly modelling and its implication for petroleum prospectively on Seram Island, Maluku, Indonesia. Proc. 25th Geophys. Conf. Exhib. ASEG-PESA-AIG 2016, Adelaide, p. 207-210.
(online at: http://www.publish.csiro.au/ex/pdf/ASEG2016ab173)
(Airborne magnetic survey over Seram- Buru in 2012 shows high anomalies mainly in W part of survey area and small anomalies in SE of island, interpreted as Paleozoic Taunusa Fm. Medium anomaly range in E, NE and WNW of Seram reflects occurrence of Mesozoic rocks from Kanikeh Fm. Low magnetic anomalies in C and NE reflect 'Jurassic' Manusela Fm. Modelling of magnetic anomalies indicates folds, thrust fault structures, basement fractures and thickness of (Triassic) Kanikeh Fm source (~2623m), Jurassic seal rocks (~1166m))

Sopaheluwakan, J. (1994)- Basement evolution of the Buru- Seram microplate and its bearing on hydrocarbon occurrences. In: J.L. Rau (ed.) Proc. 30th Sess. Comm. Co-ord. Joint Prospecting Mineral Resources in Asian Offshore Areas (CCOP), Bali 1993, 2, p. 17-32.
(Two types of metamorphic rocks comprise Buru- Seram crystalline basement: (1) Paleozoic low-grade schist of continental character on Buru and S Seram; (2) W Seram low- to high-grade (greenschist to granulite) metamorphic sole at base dismembered ophiolite is Neogene re-metamorphism of Paleozoic during obduction of hot Weber Deep materials)

Sopaheluwakan, J., K. Linthout, H. Helmers & H. Permana (1992)- Peridotite- metamorphite relation in West Seram: constraints to vertical movements of the North Banda Arc. Proc. 21st Ann. Conv. Indon. Assoc. Geol. (IAGI), Yogyakarta, 2, p. 599-609.
(W Seram Three or 4 metamorphic complexes (Kobipoto, Saku, Tehuru, Taunusa). Paleozoic low-grade metamorphics overthrusted in Pliocene from ESE by peridotite, a hot mantle slab of NW Weber Deep origin, forming metamorphic sole with granulite-facies mylonite near contact. Surprisingly young Rb-Sr age of 3-4.5 Ma (K-Ar 4-6 Ma). Same age as cordierite granite on Ambon (3.3Ma), which may be product of melting of continental crust below peridotite)

Supandjono, R.J.B. (1994)- Geologi daerah Lofin, Seram Tengah. Proc. 23rd Ann. Conv. Indon. Assoc. Geol. (IAGI), Jakarta, 1, p. 112-122.
('Geology of the Lofin area, C Seram'. Most of area ~1500m M-L Triassic Kanikeh Fm sands, shale and coaly beds. Overlain by ~500m Late Triassic- E Jurassic Manusela Lst (with Halobia, Montivaltia, Lovcenipora= Triassic? JTvG) bedded, nodular calcilutites with radiolaria and bituminous lenses. In S unconformably overlain by ~300m latest Oligocene-E Miocene Lisabata Lst (with Spiroclypeus, Miogypsina). In N ~250m of latest Miocene- Pliocene (N18-N19, NN11) marine Wahai Fm clastics directly on folded Triassic Kanikeh clastics. Two major N-directed thrust faults)

Susilo, A., I. Budiman, I. Setiadi & T. Padmawijaya (2006)- High gravity anomaly around the Kelang Island, Maluku. Proc. Jakarta 2006 Int. Geosc. Conf. Exhib., Indon. Petroleum Assoc., Jakarta06-PNS-07, 4p. *(Abstract)*
(High gravity anomaly around Kelang Island, W of Seram, is expression of N end of Banda Sea basaltic ultra-basic crust and it continues to peak to S and SW (S of Buru)).

Sykora, J.J. (2000)- The buried fold-thrust belt of offshore Seram. AAPG Int. Conf. Bali 2000, AAPG Bull. 84, p. 1502. *(Abstract only)*

Tjokrosapoetro, S. (1977)- The regional structure of Seram island as interpreted from satellite imagery. Proc. 13th Sess. Comm. Co-ord. Joint Prospecting Mineral Resources in Asian Offshore Areas (CCOP), Kuala Lumpur, p. 366-377.

Tjokrosapoetro, S., A. Achdan, K. Suwitodirdjo, E. Rusmana & H.Z. Abidin (1993)- Geological map of the Masohi quadrangle, Maluku, scale 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung.
(Geological map of Central Seram. N part of island folded Kanikeh Fm Triassic/Jurassic 'flysch' interfingering with Manusela Fm limestones, overlain by pelagic limestones and red shale (Nief Beds of older authors?) of Upper Cretaceous (Sawai Fm) and Paleo-Eocene age (Hatuolo Fm) and Oligo-Miocene Lisabata shallow marine limestone with Spiroclypeus, Miogypsina, etc. Unconformably overlain by Miocene-Pliocene Salas Complex 'block clay' and Plio-Pleistocene Wahai and Fufa sediments. South part of island mainly ?Permian-Triassic Tehoru-Saku metamorphic complexes, commonly associated with ?Jurassic-Cretaceous ultramafics, all thrusted to N over Triassic rocks)

Tjokrosapoetro, S. & T. Budhitrisna (1982)- Geology and tectonics of Northern Banda Arc. Bull. Geol. Res. Dev. Centre (GRDC), Bandung, 6, p. 1-17.
(Comparison of Buru, Seram and Misool, mainly based on stratigraphy. Buru geology similar to Misool in Late Paleozoic- Miocene. Seram more complicated with overthrusts, mantle rocks, etc., and similarity with Timor. In M Miocene- Present Buru displaced SW along Buru Fracture between Buru and Seram. Pliocene S-dipping subduction below Seram terminates in W by Buru Fracture)

Tjokrosapoetro, S., T. Budhitrisna & E. Rusmana (1993)- Geology of the Buru Quadrangle, Maluku, scale 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 24p. + map.
(Second edition of 1981 map. Buru much less structured than Seram. Widespread outcrops of probable Late Carboniferous- Permian metamorphics. Unconformably overlain by Triassic turbiditic clastics of Dalan Fm (with clasts of quartz and metamorphics), probably overlain by up to 2000m of Ghegan Fm (limestones and bituminous marls with Triassic Halobia, etc.= Fogi beds of Wanner 1922). Unconformably overlain by Late Jurassic- Paleo-Eocene Kuma Fm deep water calcilutites. Near contact Ghegan-Kuma rel. small outcrops of ~100m Mefa Fm basalts and marly tuffs with (Late?) Jurassic ammonites. In S Buru Kuma Fm and Triassic rocks ?unconformably overlain by sandy-marly Waeken Fm of latest Oligocene- E Miocene age. Folded Oligo-Miocene sediments unconformably overlain by Pliocene marine sediments. Pliocene andesites (dated as 4.5 Ma) similar to Ambon)

Tjokosapoetro, S., E. Rusmana & Suharsono (1994)- Geology of the Ambon Sheet, Maluku, 1:250,000. Geol. Res. Dev. Centre (GRDC), Bandung, 15p. + map.

Umbgrove, J.H.F. (1924)- Report on Pleistocene and Pliocene corals from Ceram. In: L. Rutten & W. Hotz (eds.) Geological, petrographical and palaeontological results of explorations, carried out from September 1917 till June 1919 in the island of Ceram, 2nd ser., Palaeontology, p. 1-22.
(Corals collected by Rutten from 13 localities in C and E Seram. 25 species identified, about 80 Recent species, probably all Late Pliocene or younger age)

Usna, L. (1977)- Note on a seismic reflection profile across the Seram Trough. Newsl. Indonesian Geol. Survey 9, 16, p. 193-194.

Valk, W. (1945)- Contributions to the geology of West Seran. Doct. Thesis University of Utrecht. In: Geological, petrographical and palaeontological results of explorations carried out from September 1917 till June 1919 in the Island of Ceram by L. Rutten and W. Hotz, De Bussy, Amsterdam, 3rd ser., Geology, 1, p. 1-109.
(Geology of W Seram, compiled from notes and study of rocks collected during Rutten & Hotz (1918-1920) Seram fieldwork. Pre-Upper Triassic metamorphics (folded schist, phyllite, gneiss, amphibolite) more common

than in E Seram. Upper Triassic more sandy than in C and E Seram: greywacke sandstones composed mainly composed of detritus of schists, phyllites and andesites and are probably of Norian- Carnian age. Overlying shales Upper Norian. Also U Triassic coralline limestone, U Eocene conglomerates with Discocyclina, non-metamorphic peridotites, etc.)

Van der Sluis, J.P. (1950)- Geology of East Seran. Doct. Thesis University of Utrecht. In: Geological, petrographical and palaeontological results of explorations carried out from September 1917 till June 1919 in the Island of Ceram by L. Rutten and W. Hotz, De Bussy, Amsterdam, 3rd ser., Geology, 3, p. 1-71.
(The geology of East Seram, compiled from notes and study of rocks collected during Rutten & Hotz (1918-1920) Seram fieldwork. Mainly listings of rock types and faunas (crystalline schists and phyllites, Triassic limestone, Upper Cretaceous-Paleocene cherty limestone, Eocene marl, Plio- Pleistocene marls, etc.) (Upper Triassic Lovcenipora limestone was re-interpreted as being to Late Jurassic age, a suggestion accepted by Van Bemmelen (1949) but disputed by Wanner (1952) and subsequent authors; JTvG))

Van Gogh, F.A.A. (1913)- Geologisch onderzoek in Noord Oost Ceram van 15 Juni tot 15 September, 1913. BPM Report 4575, p. *(Unpublished)*
('Geological investigations in NE Seram, from 15 June to 15 September 1913'. Unpublished BPM report)

Van Gogh, F.A.A. (1914)- Geologische beschrijving der vergunningen tot het verrichten van mijnbouwkundige opsporingen Nos. 101, 102, 103, 104, Exploratieterreinen Boela Bai en Nief, Oost Ceram. BPM Report No. 4623, p. *(Unpublished BPM report)*
('Geologic description of the permits to carry out mining exploration numbers 101, 102, 103, 104, exploration areas Bula Bay and Nief, East Ceram' (Price et al. 1986: oils from Triassic Nief /Manusela carbonate sequence of different origin from that of Fufa oils)

Van Marle, L.J. (1989)- Recent and fossil benthic foraminifera and late Cenozoic palaeobathymetry of Seram, Eastern Indonesia. In: J.E. van Hinte et al. (eds.) Proc. Snellius II Symposium, Jakarta 1987, Netherlands J. Sea Research 24, 4, p. 445-457.
(Two M Pliocene- Pleistocene (N19-N22) outcrop sections in SW Seram, directly on Paleozoic metamorphics, suggest paleobathymetries between 400- 1100m (probably 600-900m) and >2 km of post E Pleistocene uplift)

Verbeek, R.D.M. (1899)- Over de geologie van Ambon- I. Verhandelingen Kon. Akademie Wetenschappen, Amsterdam, sect. 2, 6, 7, p. 3-26.
(online at: www.dwc.knaw.nl/DL/publications/PU00011831.pdf)
('On the geology of Ambon-1'. Ambon composed of two peninsulas, Hitoe and Leitimor. Complex geology, including granites, perodotites, metamorphic rocks, Triassic sandstone- limestone interbeds, younger volcanics and Pliocene or younger reefal limestone terraces up to 500m above sea level, etc.)

Verbeek, R.D.M. (1900)- Over de geologie van Ambon- II. Verhandelingen Kon. Akademie Wetenschappen, Amsterdam, sect. 2, 7, 5, p. 3-9.
(online at: www.dwc.knaw.nl/DL/publications/PU00011896.pdf)
('On the geology of Ambon-2'. Continuation of paper above. Age of Banda Sea is Early Miocene or younger)

Verbeek, R.D.M. (1905)- Geologische beschrijving van Ambon. Jaarboek Mijnwezen Nederlandsch Oost-Indie 34, Wetenschappelijk Gedeelte, p. 1-308.
('Geological description of Ambon'. On geology and rock types of Ambon. With four maps, cross sections)

Von Huene, F. (1931)- Ichthyosaurier von Seran und Timor. Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 66, B, p. 211-214.
('Ichthyosaurus fossils from Seram and Timor'. Collected by BPM geologist Weber: vertebrae of Eurypterygius from E Jurassic? of Bula, NE Seram, and material from Triassic? of Basleo, W Timor)

Von John, C. (1906)- Ueber die chemische Beschaffenheit der Asphaltschiefer der Bara Bai (Buru). Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 22, p. 691-692.

('On the chemical properties of Bara Bai asphalt shales of Buru'. Ammonite-rich Late Triassic bituminous shales from Bara Bai, NW Buru, with 23% organic matter)

Von Rosenberg, H. (1860)- Aardolie van Ceram. Natuurkundig Tijdschrift Nederlands-Indie 21, p. 336, (also vol. 22, p. 366 and 412.
('Petroleum from Seram'. Short communication on bottle of oil, collected from active seep at N coast of Seram, E of Wahai. First report on oil from Seram. No locality details or map)

Wahyudiono, J., A. Susilo, R. Adlan, B. Salimudin, A.K. Gibran & E.S. Wiratmoko (2018)- Integrated field mapping, organic chemistry and subsurface geological interpretation of Kanikeh Formation as potential source rock in Seram Island. Proc. 42nd Ann. Conv. Indon. Petroleum Assoc. (IPA), Jakarta, IPA18-247-G, 6p.
(Outcrop samples of Kanikeh Fm clastics on Seram with Triassic (Carnian-Norian) Halobia spp. and gas-prone Type III kerogen. Analysis of seven oil samples from Oseil and Bula oil fields suggest no terrestrial organic source material; hydrocarbons from Type II marine algae in carbonate rocks deposited in reducting conditions)

Wanner, J. (1907)- Zur Geologie und Geographie von West-Buru. Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 24, 1907, p. 133-160.
(Summary of 3-week reconnaissance geological survey in Fogi region of West Buru in 1904. Various types of Mesozoic deep marine rocks. Also limestone breccia with clasts of white Buru Limestone with chert (= Cretaceous?; HvG) and with Eocene alveolinids and Discocyclina in matrix)

Wanner, J. (1907)- Triaspetrefakten der Molukken und des Timorarchipels. Neues Jahrbuch Mineral. Geol. Palaont., Beilage Band 24, p. 159-220.
('Triassic fossils from the Moluccas and Timor Archipelago'. Late Triassic molluscs, corals, ammonites faunas from Misool (Carnian dark shales with Daonella), Seram (typical Tethys-Mediteranean Norian molluscs Monotis salinaria, Amonotis and brachiopod Halorella). From Seram limestone come corals Thecosmilia aff. clathrata and Montlivaltia molukkana and Pachypora intabulata (= Lovcenipora). Also Triassic fossils from Timor-Roti- Savu (generally deeper water facies, but potentially similar 'alpine' character with mainly Halobia, Daonella, but also 'Pacific' mollusc Pseudomonotis ochotica). Timor/Roti/ Savu Triassic reminiscent of North Sumatra Upper Triassic described by Volz, 1899. First author to recognize Alpine/ Tethyan affinities of Late Triassic bivalves and ammonites of Seram and Timor)

Wanner, J. (1923)- Geologische Ergebnisse der Reisen K. Deninger's in den Molukken. I. Beitrage zur Geologie der Insel Buru, nach den Tagebuchern und Sammlungen K. Deniger's. Palaeontographica Suppl. IV, Beitr. Geologie Niederlandisch-Indien III, 3, p. 59-112.
('Geological results of the travels of K. Deninger in the Moluccas, I. Contributions to the geology of Buru island'. Summary of field notes of Deninger's 1912 Second Freiburg University Moluccas expedition. NE half of Buru mainly schists and phyllite, overlain by Triassic flysch. Overlain by Fogi Beds bituminous limestones and marls, rich in molluscs and ammonites (Lower Norian), grey Misolia limestone and Norian massive limestones/ dolomites with Lovcenipora. E-M Jurassic appears to be missing. Oldest Jurassic rocks red-brown marine tuffites (Sasifu beds; upper Callovian or Lower Oxfordian), overlain by Oxfordian Mefa Beds green-brown tuffites rich in ammonites, with age-equivalent volcanics at W coast. Youngest Jurassic beds probably Oxfordian dense Kartina limestone with chert lenses. Cretaceous represented by pelagic limestones with red-brown chert. Rare Eocene limestone with Discocyclina, Nummulites, alveolinids, etc., and also reworked Cretaceous carbonate clasts near Fogi near W coast. More widespread E-M Miocene clastics and limestone)

Wanner, J. (1928)- Ueber einige Juvaviten von Ceram (Molukken). Wetenschappelijke Mededeelingen Dienst Mijnbouw Nederlandsch-Indie 10, Bandung, p. 37-42.
('On some Juvavites from Seram (Moluccas)'. Description of 'Tethyan' ceratitid ammonites collected by Weber from Late Triassic flysch of Wai Sabora in SE Seram. Probably of Norian age. Incl. Juvavites ceramensis n.sp. and J. aff. continuus)

Wanner, J. (1949)- Lebensspuren aus der Obertrias von Seran (Molukken) und der Alpen. Eclogae Geol. Helvetiae 42, p. 183-195.

(online at: http://retro.seals.ch/cntmng?type=pdf&rid=egh-001:1949:42::702&subp=hires)
('Trace fossils from the Upper Triassic of Seram (Moluccas) and the Alps'. On deep-water Palaeodictyon seranense n.sp., Chondrites gonidioides n.sp. and other trace fossils from Norian flysch of E Seram)

Wanner, J. & H.C.G. Knipscheer (1951)- Der Lias der Niefschlucht in Ost-Seran (Molukken). Eclogae Geol. Helvetiae 44, 1, p. 1-18.
(online at: https://www.e-periodica.ch/digbib/view?pid=egh-001:1951:44#5)
('The Liassic of the Nief Gorge in East Seram'. In Nief Gorge very thin (60 cm) glauconitic limestone with Middle Liassic diverse brachiopods (Rhynchonella spp., Spririferina spp., Terebratula), cephalopods (Oxynoticeras, Phylloceras, Lytoceras, Dactylioceras, etc.), bivalves and gastropods (Pleurotomaria, etc.), overlying (Triassic?) massive oolitic limestone. Most species related to European Tethys faunas)

Wanner, J., H.C.G. Knipscheer & E. Schenk (1952)- Zur Kenntnis der Trias der Insel Seran (Indonesien). Eclogae Geol. Helvetiae 45, 1, p. 53-84.
(online at: http://retro.seals.ch/cntmng?type=pdf&rid=egh-001:1952:45::440&subp=hires)
('On the knowledge of the Triassic of Seram'. Good documentation of NE Seram Late Triassic (Carnian-Norian) 'flysch', limestones and macrofossils. Carnian dominated by clays, marls, quartz sandstones with plant debris; Norian more platy limestones, marly limestones and calcareous sandstones. Upper Norian with lenses of massive Lovcenipora- Halorella limestone. Lovcenipora coral limestones erroneously interpreted as Late Jurassic in age by Van der Sluis (1949) and Van Bemmelen (1949). Similar Upper Triassic limestones in C Seram, S Buru and Timor. Triassic macrofaunas dominated by Tethyan elements like Monotis salinaria, Halobia spp. and Juvavites. Triassic overlain by Jurassic- Cretaceous deep water marls and limestones. Rare loose fossil material suggests limited presence of E-M Jurassic. Upper Jurassic represented by marly calcareous shales with Aucella malayomaorica and Belemnopsis gerardi)

Weber, F. (1926)- Eindrapport omtrent het geologisch onderzoek en den vooruitzichten van Oost Ceram. BPM Report 9611, p. *(Unpublished)*
('Final report on the geological survey and the prospectivity of East Seram'. Unpublished BPM report. Sediment series of E Seram starts with Upper Triassic; no older sediments present. Carnian-Norian flysch is poor in fossils. On S coast of Seram Triassic sequence is locally complete and includes~100m thick late Norian limestone, the base of which is bitumen-impregnated and has asphaltic joint fillings. In E part of S Mountains 300-400m thick oolitic limestone. E Seram folded/uplifted above sea level in E Eocene: in narrow strip N of the S mountains is pink coarse lime-sandstone with Eocene Nummulites and Alveolina, and Cretaceous is missing. Main folding- thrusting in Seram is towards end of Miocene)

Welter, O.A. (1923)- Bemerkungen uber die von Deninger gesammelten Ammoniten und Nautilidenreste von Seran. Palaeontographica, Suppl. 4, III, 4, p. 245.
('Remarks on the ammonite and nautilid fossils collected by Deninger from Seram'. Appendix in Krumbeck (1923) Seram brachiopod/mollusc paper. Fragments of Upper Triassic ammonites (Choristoceras, Anatomites, Juvavites) and nautilids (Phoioceras) from C Seram resemble species known from Timor and of 'alpine' affinity)

Wichmann, C.E.A. (1898)- Der Wawani auf Amboina und seine angeblichen Ausbruche (parts 1-2). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap (2), 15, p. 1-20 and p. 200-218.
('The Wawani on Ambon and its reported eruptions, parts 1-2)')

Wichmann, C.E.A. (1899)- Der Wawani auf Amboina und seine angeblichen Ausbruche (part 3). Tijdschrift Kon. Nederlands Aardrijkskundig Genootschap (2), 16, p. 109-142.
('The Wawani on Ambon and its reported eruptions, part 3'. Wawani mountain on Ambon with diabase and porphyric igneous rock, but is not a volcano)

Wilckens, O. (1937)- Korallen und Kalkschwamme aus dem obertriadischen Pharetronenkalk von Seran (Molukken). Beitrage zur Palaontologie des Ostindischen Archipels 14, Neues Jahrbuch Mineral. Geol. Palaeont., Beilage Band B77, p. 171-211.

('Corals and calcareous sponges from the Upper Triassic Pharetronen-limestone of Seram'. Triassic corals and sponges of Seram and Timor have 'alpine' character. Includes new coral species Thecosmilia alfurica, Isastrea seranica, etc., and new calcareous sponge genera Deningeria, Seranella, Cryptocoelia. Flugel (2002, p. 420) suggested W Seram Late Triassic corals and sponges mostly endemic taxa or taxa known from Timor, but Martini et al. (2004) found no endemic fauna, only species of Tethyan affinity. Flugel also suggests close similarities with Timor Fatu Limestone)

Xi, Z., X. Hu, Y. Fang, X. Yin & H. Du (2016)- Tectonic evolution of North Seram Basin, Indonesia, and its control over hydrocarbon accumulation conditions. China Petroleum Exploration 21, 6, p. 1-8.
(online at: www.cped.cn/CN/item/downloadFile.jsp?filedisplay=20161230153808.pdf)
(N Seram Basin evolution interpreted as four stages: E Triassic initial rifting, M Triassic- M Jurassic rifting, Late Jurassic- M Miocene passive continental margin and Late Miocene-Quaternary thrusting of foreland foldbelt (Seram and Birds Head viewed here as part of same continental block; no subduction/collision))

Zillman, N.J. & R.J. Paten (1975)- Geology and petroleum prospects of Seram island, eastern Indonesia. Australian Petrol. Explor. Assoc. (APEA) J. 15, p. 73-80.
(Two main Pliocene- E Pleistocene basins in N and NE Seram (Bula and Wahai) with up to 1400/ 2800m of sediment. Oil seeps common in Bula but not in Bahai basin. Bula field 1897 discovery in Pleistocene clastics; producing horizons ~80-280m below SL. Folded Pre-Tertiary rocks regarded as basement by BPM and AAR. Middle or Late Miocene folding preceded Early Pliocene renewed subsidence. Early Pleistocene uplift created rel. subtle regional unconformity.

Zillman, N.J. & R.J. Paten (1975)- Petroleum prospects, Bula Basin, Seram, Indonesia. Proc. 4th Ann. Conv. Indon. Petroleum Assoc. (IPA), 2, p. 129-148.
(Plio-Pleistocene Bula Basin with Early Pleistocene unconformity. Bula field 1897 BPM discovery below surface oil seep in shallow Pleistocene sands, producing since 1913. Limited hydrocarbons and potential in Mesozoic Nief limestone)