

Mangkalihat

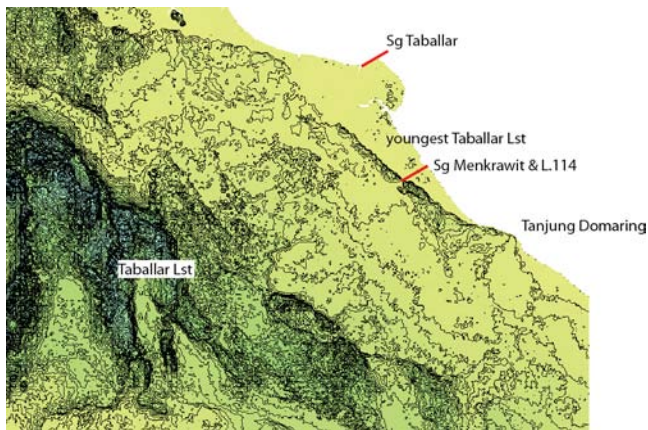
Geology: Extensive late Middle Eocene-Early (?Middle) Miocene carbonate platforms developed on a structural high distal from clastic input on the Mangkalihat Peninsula (Wilson et al. 1999). The stratigraphic high marks the boundary between the Sangkuliran/Kutai basin to the south and the Bulungan/Tarakan basin to the north. In this area, the northern margins of the platforms were high-energy reef rimmed margins. Shallow-marine, platform top deposits vary from protected, and perhaps restricted, inner platform wackestones and packstones, to patch reef, shoal and open marine, tidally influenced packstones and boundstones (Wilson et al. 1999). Larger benthic foraminifera, coralline algae and echinoderm debris are common throughout the platform- top deposits, whereas corals and *Halimeda* are also present in many Miocene and some Oligocene successions. Corals seem to be mostly present along the platform edge (Wilson et al 1999), but unidentifiable grains can make up a considerable fraction of the carbonate sand of the platform top starting in the Early Oligocene (Naturalis collection).

Along the northwestern edge of the Mangkalihat platform a deeper marine facies is deposited. This partly consists of deeper marine (planktonic) foram and shallow marine marls/clays. According to sources in the Naturalis collection (unpublished exploration reports, field maps and samples), as well as publications (Van der Vlerk, 192*9; Beets 1942 etc) this is a section three conformable overlying lithostratigraphic units: the Taballar Lst, Menkrawit layers and the Domaring Lst.

Taballar Lst: Late Eocene-Early Miocene limestone.

Menkrawit: Beets (1942) published a monograph covering the mollusks of a locality at the base of the Menkrawit layers collected by Leupold in ~1920, who did an explorative survey in this area. This publication figures many well preserved mollusks (present in the Naturalis collection), and described that these are from marls rich in corals, large benthic foraminifera, bryozoa etc. The surprise (at least to me) came when I looked at the LBF fauna, expecting a Late Miocene age. The LBF assemblage is typical of the Middle Miocene, with many taxa that mark the middle Miocene extinction still in it. The overlying samples in the Leupold samples contain very few complex Nephrolepidina, and the youngest sample even only Nephrolepidina without miogypsinids, indicating Late Miocene (Tf3) age.

Domaring Lst: This is described as a reef limestone with intercalations of fossil rich marls. LBF indicate a Pliocene age in the absence of miogypsinids and lepidocyclinids. These are described as massive lst, but with lenses of clays at least containing benthic foraminifera.



Map of the NW shore of Mangkalihhat Peninsula. Fold axes are NW-SE and can be traced in the topography.

Outcrops The base of this succession is exposed along the Taballar river, about 40 km southeast of Tanjung Redeb. From the mouth a limestone cliff is exposed, that is interrupted where the Menkrawit river cuts through. This is where the Menkrawit layers are exposed (the mollusc, coral etc sample described above at the base). Leupold collected here a series of samples in the Menkrawit layers. The overlying Domaring Lst is exposed in the cliff face towards Tanjung Domaring.

Accessibility All these observations are based on a report (in Dutch) and samples in the collection of Naturalis, collected ~1920 by Leupold. No information is available on present day logistics, such as accessibility and places to stay.

Northern Kutai basin

Along the northern margin of the Kutai basin coastal sediments were deposited in shallow marine environments bordering mainland Borneo and the Mangkalihhat carbonate platforms. Major features are several karstic areas, marking Middle Eocene to Miocene carbonate platforms. One of these features, about 60 km west of Bengalon, is described in detail by Wilson et al. (1999). Here I will discuss the (potential) study sites from south to north.

Bontang

We have all worked here, so descriptions can be relatively brief. The lowest unit that we looked at is the (late?) Burdigalian limestones in the Indominco mine and lateral equivalents even though they might be deposited in two different systems. In age these are comparable with the Batu Putih in Samarinda, although stratigraphic resolution at this point is not good enough to say that they actually are equivalent. This is the northernmost exposure of this unit by looking at geological topographical maps.

The stratigraphically overlying are the limestones and marls immediately west of Bontang. This unit starts off with a unit dominated by more massive lst (predominantly floatstones, but locally reef framework as well), alternated with fossil rich marls rich in branching corals and locally mollusks. Both LBF and calcareous nannoplankton (data Jeremy Young) indicate an early Tortonian age. There are 3-5 marl incursions in about 200m of section, the lowest being the thickest (up to ~55-60 m), the next getting increasingly thinner, with the uppermost one being hardly more than a meter. This is overlain by thick fluvial sands, which also occur between the marine marls. This unit appears to be rather localized in the area between TF110- TF19, and is not yet described in scientific literature.

Sangatta- Kari Orang

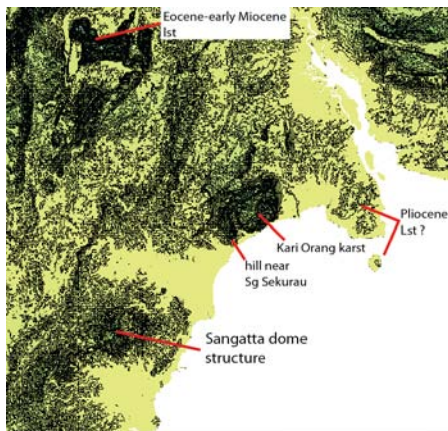
40-80 km north of Bontang there is the next large coal mine (KPC). During the December 2010 trip Fauzie, Juan-Carlos, Ken and me have visited this area. Near Sangatta there is a dome structure resulting in a circular limestone outcrop, overlain by marl with a high potential of providing good fossils.

We have not been able to reach neither the Lst nor the overlying outcrops. We have been in touch with the mining company, and asked for permission to study these sites.

A second area (in the same mine) are the outcrops described by Beets and Gerth as 'hill near Sekurau'. We have been able to relocate this hill and the series of outcrops described by Beets. The oldest part of the section is formed by a bedded alternation of sandstones and clays, locally with small mollusks. The youngest parts are formed by a massive limestone with coral heads.

To the North this hill extends into a relative small karst area of ~10 x 7 km. We have not been able to get into this karstic area, but there appear to be accessible outcrops. It is expected that this limestone comparable to the Domaring Lst from Mangkalihat.

Along the northwest edge of this karstic area we found a river section with exceptionally well preserved corals and locally (not too diverse?) mollusc faunas in very dark marls, in literature often referred to as Gelingseh layers. This section is overlain by a massive limestone, likely to be the base of the limestones in the karst.



Sangkulirang

The area now forming the estuary of the Sangkulirang river consists of sediments deposited in deeper environments than those in the Sangatta-Kari Orang area. In this area no coal deposits have been found, and land cover is dominated by oil palm plantations (with lots of grasses) and outcrops are limited. Along Sangkulirang bay there should be cliff outcrops in Late Miocene-Pliocene marls. These are shallowing upwards, and the tip of the peninsula consists of Pliocene Lst.

It is likely that similar successions can be observed along the southern shores of the Mangkalihat peninsula.

Accessibility to the area is not easy, but the Sangatta-Kari ORang area can be studied from bases in either Sangatta or Bengalon and by using 4-wheel drive cars. The karstic area should be accessed from the coast in the northeast corner of the mine. This is a long drive from Bengalon, but possibly a base can be established in the mining camps that are present in this area. We did not manage to reach Sangkulirang, but is expected that this village can serve as a base as well. It is unknown whether there are roads from Sankulirang into the Mangkalihat peninsula, and if they are there whether they are accessible even for 4 wheel drives.

Meratus Mountains (information by Duncan Witts, SE Asia research group)

If you take the main highway north from Banjarbaru there are loads of roads and tracks heading east into the foothills of the Meratus Mts. where there are plenty of easily accessible exposures of LST (Berai Formation). I have had some dating done using larger forams and the formation is late Early Oligocene to early Miocene (Te5 - lower Tf1). I can give you some location points, but as the LST is not the focus of my study, I was not giving it too much attention....more like trying to get through the stuff rather than looking at it, but as they use it for building material, most of the roads that head toward the LST ridges end up at a small quarry with plenty of exposure.

OK, there are a few locations I can recommend visiting. The positions are given below (in no particular order), which collectively show the transition from Late Eocene through to Early Miocene.

(2) Fossils are pretty limited. A few interesting ones at Loc 120 (corals, bivalves, but this is a very small exposure in a roadside gully). There are some large boulders of LST around this location, but possibly overgrown now...might need a perrang. Most of the LST has various valve fragments, but all recrystallised. At location 97 (very important road section with regard to dep. environment - age of section is Late Te5 - Middle Tf1) there are bryozoa, shell frags and other platy fossils that I have no idea of!). If you continue along the road ~100m, past the section, the road goes over a small but deep gully. It's worth a scramble down and upstream (take a parrang), as this leads to the top LST's of the Berai Fm.

Once you are in the area (SE Kalimantan) you will easily find other quarries, river sections etc. If you want to do a nice river section (on a blazing hot day, I can heartily recommend it), there is a lovely river with clean water and numerous exposures of LST at S 2° 04' 18.8", E 115° 37' 35.6".

By the way, just to give you an idea on travelling times...from Banjarbaru to location 120...leave a day to get there.

Best places to stay are Banjarbaru, Rantau, Barabai and Tanjung