A Photographic Journey through the Cretaceous-Tertiary Stratigraphy of the Meratus Mountains-Barito Basin Margin, SE Kalimantan

J.T. (Han) van Gorsel
Houston, Texas, USA.

Corresponding author: jtvangorsel@gmail.com

INTRODUCTION AND SUMMARY

The SE margin of the Barito Basin shows a relatively simple succession of WNW dipping beds, brought to the surface during Late Miocene or younger uplift of the Meratus Mountain Range. Outcrops of Cretaceous - Miocene rocks can be studied east of the Trans-Kalimantan Highway East and NE of Banjarmasin, between Martapura in the south and Rantau and Kandangan in the north (Figure 1).

A vast body of literature exists on the geology of this region. For references see the 'Bibliography of the geology of Indonesia and surrounding areas' (online at www.vangorselslist.com)

The photos shown here were taken by the author in 2010, during a fieldtrip reconnaissance along the uplifted eastern margin of the Barito Basin along the SW Meratus Range. I'd like to thank Afin Sjapawi and Ellen de Man (ExxonMobil) and Agus Pujubroto and Roy Widiarta (Sugico) and others for guidance and help with logistics.

MERATUS RANGE PRETERTIARY ROCKS

The Pretertiary rocks outcropping in the southern part of the Meratus Mountains are mainly of Cretaceous age. They represent parts of a mid-Cretaceous collision zone, composed of an 'obducted' ophiolite complex of partly serpentinized ultrabasic rocks and high-pressure metamorphic rocks, overlain by Upper Cretaceous arc volcanics and volcanoclastics (Figures 3 to 5). Further North (not illustrated here) are also granitic complexes and mid-Cretaceous limestones with *Orbitolina*.

BARITO BASIN TERTIARY ROCKS

The Meratus Mountains are flanked by the Barito basin to the West and the Asem Asem basin to the East (Figure 2). Stratigraphic similarities, sediment provenance and current direction patterns suggest that they formed a single basin before the Late Neogene uplift of this part of the Meratus Range (Late Miocene-Pliocene Dahor Formation 'molasse').

Like most other western Indonesia Tertiary basins, the Barito Basin started forming during a Middle Eocene extensional period, which also led to the opening of the Makassar Straits. The Middle-Late Eocene Tanjung Fm is dominated by fluvial-lacustrine facies in the lower half and deltaic deposits and thin shallow marine *Nummulites* limestones in the upper half. The Late Eocene-Early Miocene marine interval shows more marine influence than in most other Tertiary basins of Western Indonesia and Malaysia, but is similar to the other Sundaland margin basins of East Java and the East Java Sea.

The main economic significance of the Barito Basin Tertiary section is the coal formations in the Middle Eocene Tanjung and Middle-Late Miocene Warukin Formations. Eocene coals have been mined in the region since 1848. The best outcrops of Tertiary sediments are in the active and abandoned open pit coal mines and in road cuts along the coal hauling roads. Figures 6 to 15 illustrate the principal Tertiary rock formations.

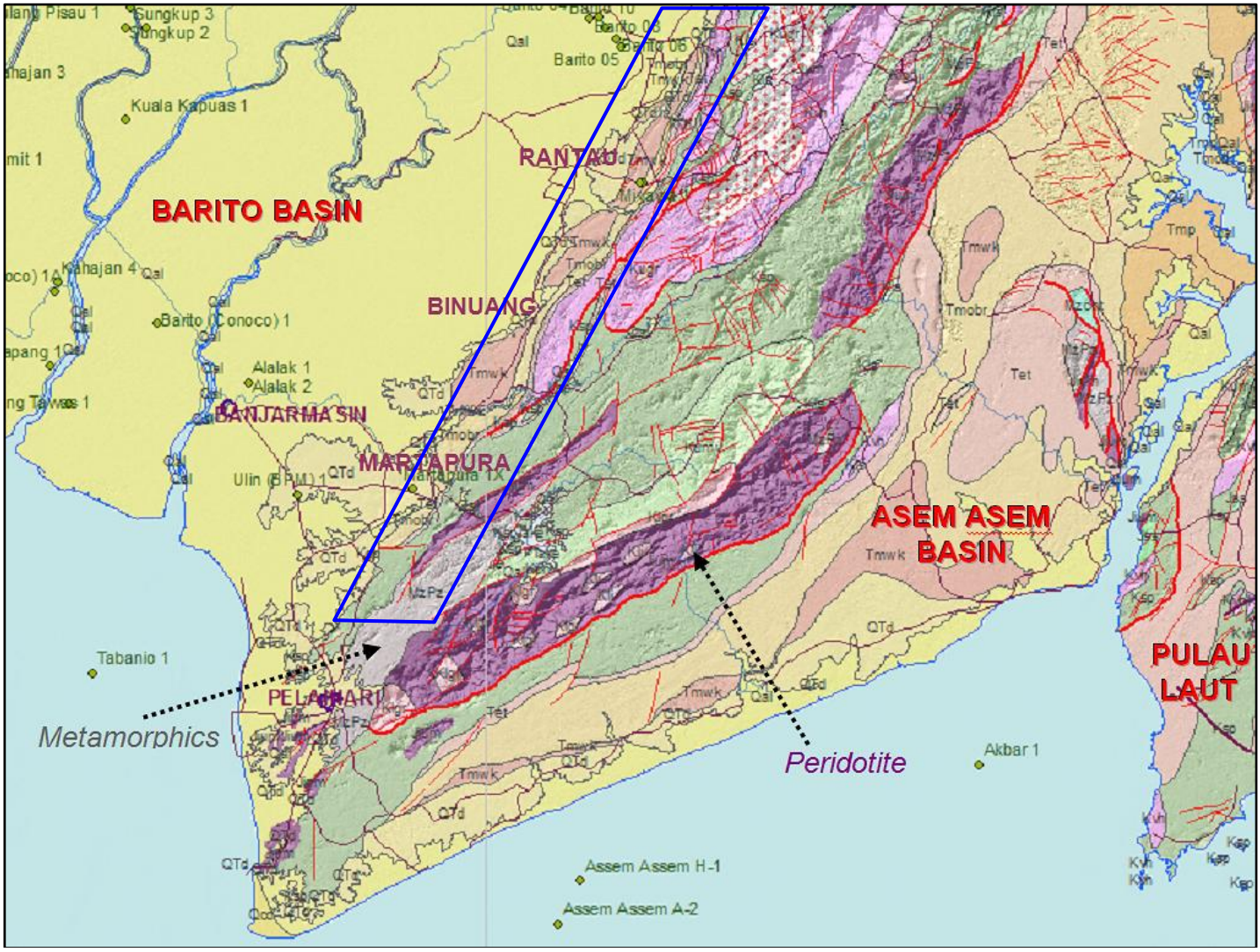


Figure 1. *Surface geology of the SE Barito Basin and southern Meratus Mountains. With box outline of area of outcrop photos. Dark purple colors are the Meratus and Bobaris ophiolites.*

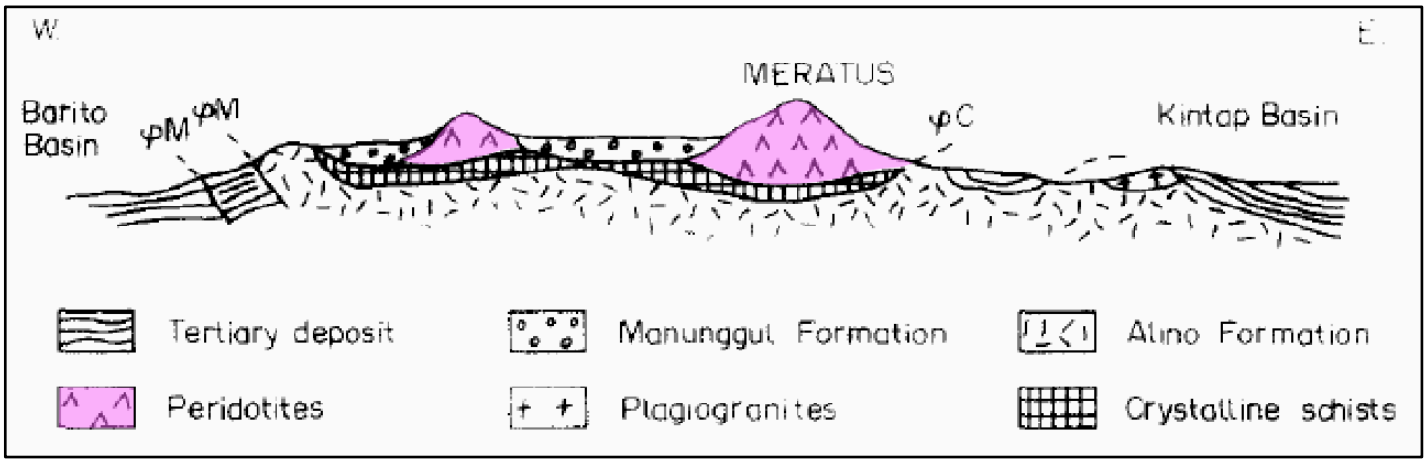


Figure 2. *W-E cross-section across Barito Basin margin - Meratus Mountains - Asem Asem (Kintap) Basin, showing relatively flat-lying obducted ophiolite nappe over metamorphic sole of crystalline schists, overlain by Upper Cretaceous Manunggul Fm volcanoclastics (Yuwono et al. 1988, after Priyomarsono 1985).*



Figure 3. *Intensely fractured peridotite near Aranio village (18 km ESE of Banjarbaru on road to Aranio, Bobaris Range, ESE of Martapura). Larger fractures are lined with green serpentine, and have slickenside-like striations (= extensional shearing during exhumation?). These ultrabasic rocks now form the highest hills in the Meratus Range and are believed to be relatively flat-lying slabs over high-pressure metamorphic rocks. These rocks represent latest Triassic - Early Jurassic oceanic lower crust and upper mantle (Pt-Os radiometric dates ~200 Ma; Coggon et al., 2010).*



Figure 4. *Lower Cretaceous laminated metamorphic rocks with small shear folds of the Hauran/ Pelaihari Fm (Aranio River, 1 km E of Aranio Village, ESE of Martapura). Thin sections show these are quartz-rich muscovite-actinolite-epidote schist and glaucophane-epidote schist. These are high pressure - low temperature metamorphics, which probably formed at the interface of mantle and a deep (30-50km) subducted slab. Quartz content of ~50% suggests the original rock was of continental composition (granitic or continental margin sediment). K-Ar cooling ages of this formation 110-119 Ma (late Aptian - Early Albian). A 113 Ma age (latest Aptian) was obtained from hornblende schist from near here by Sikumbang & Heryanto (GRDC, 1994).*



Figure 5. *Upper Cretaceous deep marine sediments of the Manunggul or Pitap Fm (20 km E of Rantau, near Tapin River bridge). Turbiditic sands are composed of andesitic volcanic lithics and probably represent volcanic island arc debris. Fine-grained beds contain radiolaria. Also thin Interbeds of white tuffs? and soft black claystones rich in manganese and iron.*



Figure 6. *Outcrop of the Eocene? basal conglomeratic sandstone of the Tertiary basin section. With pebbles of volcanic rocks, milky quartz (metamorphic vein quartz?), red radiolarian chert and ultrabasic rocks. At other localities reportedly also with mid-Cretaceous Orbitolina limestone pebbles. Latest Cretaceous - Paleocene uplift resulted in widespread erosion and probable peneplanization, before the onset of the Middle Eocene rift event.*



Figure 7. *Middle Eocene Lower Tanjung Formation coal and thin-bedded (tide-influenced?) overbank / delta plain clastics (abandoned KCM coal mine, East of KM 71 on Banjarmasin-Tanjung highway, S of Bintuan and N of Pengaron). Total thickness of the coaly-sandy Lower Tanjung Fm along the Meratus mountain front is generally between ~200-400m. Eocene coal beds are thinner (typically 1-2m thick), but higher grade than Middle Miocene Warukin Fm coals.*



Figure 8. *Middle Eocene Tanjung Fm in Panian abandoned coal mine near Miyawa Village. Tidal flat deposits between two depleted coal seams. With clay-draped ripples, overlain by burrowed surface ('Diplocraterion'), overlain by sandstone ripples with opposing current directions.*



Figure 9. *'Cone-in-cone' structures in Tanjung Formation-same locality. The origin of these structures is still unclear, but is probably diagenetic.*



Figure 10. *Berai Limestone at the entrance of Batu Hapu cave (Goa Batu Hapu; ENE of Binuang). With larger foraminifera Spiroclypeus, Eulepidina, Borelis pygmaeus and Heterostegina borneensis, suggesting a Late Oligocene age. Thickness of the Berai platform carbonates in this area is about 200-300m.*



Figure 11. *Middle Miocene 'Lower Warukin' Formation with interbedded coals and fluvial sandstones - claystones (N of KM55 of main coal hauling road, E of Rantau). Three relatively thin coal beds in section dominated by quartzose fluvial sandstones. Total thickness of the Warukin Formation in the area is probably over 2000m, with the thickest coals in the upper part.*



Figure 12. *Tabular cross-bedding in Middle Miocene Lower Warukin Formation quartz-rich fluvial sandstones (N of KM55 of coal hauling road E of Rantau). Like in all thick Warukin Fm distributary channel sandstones we observed in the area, cross-bedding foresets dip in a direction opposite of the present-day WNW structural dip. This suggests the dominant current was to the SE/E, i.e. towards the Meratus Range, suggesting the Meratus Mountains (1) were not the sediment source and (2) did not exist yet as a topographic high in Middle Miocene time.*



Figure 13. *Middle Miocene Lower Warukin Formation massive quartz-rich fluvial-estuarine sandstones, overlying lowest Warukin Fm coal bed, in abandoned coal mine E of Rantau. Cross-bedding dips at this location also suggest current directions from W/NW to E/SE, i.e. towards the present-day Meratus Mountains.*



Figure 14. *Thick, dipping coal bed in Middle Miocene Upper Warukin Formation (KPP mine, ~10km ESE of Rantau). Coal seams in Upper Warukin Fm may be up to 50 m thick. Warukin Fm coals are generally low-grade (lignite to sub-bituminous), with ash content of 1-18%.*



Figure 15. *Base of a formerly 50m thick coal-seam in uppermost Warukin Fm (?Late Miocene; Salam Babaris-BGM coal mine, ~9 km East of Tambarungan). Note large fossilized tree trunks.*



Figure 16. *Diamond mine near Cempaka village, South of Martapura. Diamonds have been mined from Quaternary alluvial conglomeratic sandstones across much of Kalimantan since the 1600's, but the source rocks from which diamonds have been eroded remain unknown.*