

**AAPG HEDBERG CONFERENCE**  
**“Variations in Fluvial-Deltaic and Coastal Reservoirs Deposited in Tropical Environments”**  
**APRIL 29-MAY 2, 2009 – JAKARTA, INDONESIA**

**Paleogene Marine Clastics of the Mangkalihat Peninsula, Borneo: Implications for Petroleum System Development**

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Paleogene clastics are widely reported to have source rock and reservoir potential in rift-related Tertiary basins bordering Sundaland. However, with limited outcrop and subsurface data the sedimentology, diagenesis and their implications for petroleum systems development are poorly understood. Remaining questions include: 1) How did the tectonic, climatic and eustatic setting influence the spatial and temporal variations in environments and petroleum systems development? 2) What role did local geology and environmental conditions play in the provenance, porosity and permeability characteristics of potential reservoir units? 3) How did local environmental conditions affect the development and quality of potential source rocks? 4) How did basin evolution and diagenesis influence petroleum systems development? To address these questions two different shallow/coastal and deep marine Paleogene siliciclastic successions were investigated at outcrop from the eastern and western ends of the northern Mangkalihat Peninsula, respectively, in East Kalimantan. This contribution summarises the occurrence, field observations, petrography, biostratigraphy, provenance, inferred depositional environment and implications for petroleum system development. Characteristic of the two successions are:

- **NW Mangkalihat Outcrops – Deep-water Maliu Mudstone** - Exposures of the Maliu Mudstone consist predominantly of dark grey mudstones of Middle Eocene age (P14 zone of Berggren et al., 1995). Near continuous (km-scale), few-metre high exposures crop-out along the banks of the southern Taballar River. The formation is tilted and dips 10-30° towards the north. A near-vertical, major fault (trending 130-310°) juxtaposes the mudstones against more northerly dolomitised Oligo-Miocene carbonates of the Taballar Limestone. The mudstones contain upper bathyal to bathyal indicators, are locally bioturbated, and were deposited in a low energy setting. Packages of cm to dm-scale, fining-upwards compositionally and texturally immature greywackes are locally present 4-10 km southwest of the main fault. These fine sandstone to siltstones, containing poorly sorted, angular grains of quartz, feldspar and micas in a clay matrix are interpreted as distal turbidites. Calcite cements are common and intergranular porosities are ~2-4%. The provenance, poor sorting and diagenesis of the sandstones has resulted in poor potential reservoir quality, whereas the marine clays may have source potential.
- **NE Mangkalihat Outcrops – Coastal/Shallow-marine Sembakung Formation** - A succession of interbedded coals, sandstones, claystones, and arenaceous carbonates are poorly exposed as localised, and probably fault bounded inliers on the north side of the easternmost

part of the Mangkalihat Peninsula. Few dateable samples were obtained and the succession may range from Middle Eocene to the earliest part of the Late Oligocene (up to Td larger benthic foraminifera zone). Deposition occurred in a range of protected swampy to brackish settings, tidal flat and channel environments as inferred from coals, organic-rich clays (some containing bivalves, gastropods and ?plant roots), rippled sands with clay drapes and trough cross-bedded sandstones. Up sequence the succession becomes richer in arenaceous carbonate beds and the coals are lost indicating a transition to predominantly shallow marine conditions, though still with influx of clastics and carbonaceous material. A mixed carbonate-clastic shelf in close proximity to an eroding landmass is inferred. Up sequence and partially contemporaneous with coastal/shallow water deposition considerable material was resedimented into adjacent, probably fault-bounded small-scale grabens. The coals and organic-rich clays may have source potential, whereas the sandstones are possible reservoir units (10% porosity), though clays may reduce permeability or compartmentalise the system.

**Provenance, regional context and summary** - Provenance indicates different source areas for the clastics, with those in the west derived from a volcanic and low grade metamorphic (magmatic arc to recycled orogen) terrain, whereas those in the east came from a higher grade metamorphic source (recycled orogen) with some cherts. The different source terrains and depositional settings (bathyal in the west and a mixture of coastal, shallow marine and fault-bounded deeper grabens) is consistent with early Paleogene block and basin development influencing environments and sediment pathways. Highly localised environments associated with this tectonically complex setting may limit the volumes and quality of potential source and reservoir rocks. Provenance, diagenesis, basin evolution and depositional environments all strongly influenced the potential for a working petroleum system.