

**SEAPEX Field Trip
Reservoir Sandstones of NW Borneo
22nd – 25th September 2011**

Led by Joe Lambiase

NW Borneo is well-known as one of SE Asia's oldest and most prolific petroleum provinces with billions of barrels of production in the nearly 100 years since the initial discoveries. Despite this illustrious history, prediction of reservoir properties and sand body geometries remains difficult because the depositional setting of the sandstones that reservoir the hydrocarbons is not as well understood as may be expected. This, in turn, is at least partly due to the fact that classical facies and sequence stratigraphic models do not work well in NW Borneo's tectonic, hydrodynamic and climatic environment.

The objective of the field trip is to give participants an overview of the reservoir sandstones of NW Borneo. The focus will be recent concepts about NW Borneo's depositional systems and stratigraphic development as they relate to the prediction of reservoir properties and sand body geometry. The field trip will visit two areas within Malaysia; it will begin on the island of Labuan and conclude in the Miri-Lambir Hills region of northern Sarawak.

Thursday 22nd September

Fly from Kuala Lumpur International Airport (KLIA) at 8:40pm to arrive at Miri at 10:50pm on flight MH2598.

Friday 23rd September

The Entulang outcrop represents the oldest sands in the Baram Delta Province and signals the first major progradation onto the underlying open marine shelf Sibuti facies of the Setap Shale. Approximately 20 m of high energy, clean upper shoreface sandstones interbedded with muddy, bioturbated lower shoreface sandstones overlie about 10 m of shales that contain subordinate thin sandstone beds.

The Seman Outcrop is a complex of stacked tidal channel sandstones with a few thin interbedded mudstones. This facies has very good, although variable, reservoir properties and is an important reservoir in many of the producing fields in NW Borneo. This stop also highlights the problems associated with correlating channel sands in the subsurface.

An outcrop with three different sandstone facies, namely fluvial channel, tidal channel and shoreface sands; the latter two are the most important reservoirs in NW Borneo. The succession demonstrates the importance of facies identification in sequence stratigraphic interpretation and reservoir evaluation.

A brief overview of the subaerial portion of the modern Baram Delta. The modern delta lobe has a symmetrical, cusped shoreline geometry that forms a prominent coastal protrusion at the point where its single active distributary channel enters the South China Sea. A large mouth bar, with an area of approximately 11 km² in the intertidal and shallow subtidal zone forms the proximal delta front of the Baram Delta and is the site of nearly all present-day sedimentation.

Visit the site of the first discovery well in NW Borneo on the top of Canada Hill overlooking the town of Miri. Details of the discovery and production history are described at the memorial; one notable fact is that the oilfield is at a higher elevation than the town.

An oil-saturated sandstone only a few hundred metres from the Miri #1 Well at the base of Canada Hill that demonstrates fault compartmentalisation of the shallow marine reservoir sands. A fault between the oil-saturated outcrop and the nearby well seals the Miri oilfield.

Saturday 24th September

The Airport Road outcrop in the middle to late Miocene Miri Formation is interpreted as an analogue for the modern Baram Delta. Approximately 23 m of stratigraphic succession are exposed on the crest of a surface anticline that exhibits keystone extensional faulting. The basal of three units is at least 5 m thick and consists of thin sandstones with interbedded thin shales that are interpreted as a sandy tidal flat deposit that was occasionally subjected to storm conditions. The overlying 6 m of clean medium to fine-grained, channel sandstone is interpreted as stacked tidal channels. At least 8 m of generally fine-grained sandstone with interbedded muddy sandstones and thin shales overlies the tidal channel sands. All evidence indicates deposition in a wave-dominated environment with some tidal influence. The clean sandstone beds are interpreted as upper shoreface sands whilst the interbedded muddy sands and shales are interpreted as lower shoreface and offshore deposits respectively.

Return to Miri Airport for the 11:20 flight to Labuan, MH3226.

Storm sands that were deposited in an offshore transition environment comprise the lower part of a few hundred metre thick succession that is exposed along the west coast of Labuan. Approximately 30 m of cross-bedded, pebbly fluvial channel sandstones overlie the offshore transition strata. There is an active gas seep within the sands. The contact between the offshore transition succession and the fluvial sandstones represents a significantly large relative sea level fall and probably is a sequence boundary.

Approximately 460 m of section semi-continuously exposed along the north coast of Labuan is the stratigraphic continuation previous outcrop. The base of the section is about 30 m of stacked, cross-cutting channel sandstones that were deposited by a meandering river. A flooding surface marks the boundary of the fluvial sandstones with the shallow marine strata that comprise the remainder of the succession. The succession is mostly shoreface strata that comprise shelf, lower shoreface and upper shoreface environments; tidal channel and tidal flat deposits comprise the remainder. A maximum flooding surface separates a retrogradational parasequence set from an overlying progradational parasequence set.

Sunday 25th September

The Kampong Ganggarak outcrop which is an approximately 170 m thick succession of predominantly sandstone overlying predominantly shallow marine mudstones. The sandstones include braided(?) fluvial deposits plus tidal flat, tidal channel and shoreface sands. The contact between the sandy and shaley units represents a significant sea level lowstand and may be a sequence boundary.

Return to Labuan Airport for the MH2633 flight at 17:20 to Kuala Lumpur.

Logistics – What to expect

The trip will have a maximum of 20 participants. Transportation will be in 22 seat buses. Hotels are 4-5 star standard. Field trip fees will include flights (Kuala Lumpur-Labuan-Miri-Singapore), hotels, 2 breakfasts, 2 lunches and 2 dinners. There will be some walking required but no difficult terrain to be negotiated. Soft drinks/water will be available during the day. Shoes with good grip (NO sandals or open footwear) are required but boots are not necessary. NW Borneo in June will be warm and humid, with rain showers possible at any time. Protection from the sun – hat and sunscreen – is an absolute necessity. Geological hammers are strongly discouraged, and are forbidden in the some parts of the National parks.

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