A New Chronostratigraphy for the Upper Tertiary of Offshore Sabah, Northwest Borneo, Malaysia

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Graphic correlation analysis of biostratigraphic data from the Upper Tertiary of more than 70 wells in offshore Sabah, northwest Borneo, has revealed the presence of at least 13 major hiatuses (SBH10 to 110) that separate 14 sequences(SBS10 to120). These widespread hiatuses tend to merge inboard and on-structure and diverge outboard and off-structure. Although all seven Shell Sabah seismic horizons correspond to biostratigraphic hiatuses, graphic correlation has defined an additional six major sequences within the Upper Tertiary. This enhanced resolution reveals that seismic horizons may consist of several merged hiatuses that can be easily confused unless identified by biostratigraphy. Maps, depositional models, and estimates of hydrocarbon expulsion based on misidentified seismic horizons are inaccurate and misleading. The results prove that graphic correlation can be applied in active tectonic basins with reworked sediments and can provide stratigraphic resolution beyond that obtained from seismic data alone. This new chronostratigraphy for the Upper Tertiary of offshore Sabah facilitates the accurate correlations that will be essential for successful exploration in that region.

Late Miocene Syntectonic Development and Anatomy of the Pinang Deepwater Channel System, NW Borneo

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A key uncertainty in deep-water reservoir characterization concerns the recognition of detailed sandbody geometric patterns, related depositional settings and processes. The interaction between synsedimentary faulting and subsidence in deepwater NW Borneo has created a complex slope topography of intra-slope basins and diapiric shale structures. Channels often follow complicated routes through this topography, and may develop highly variable channel sequences with narrow, erosional confined systems, or aggradational, broader systems as end members, often changing significantly over a few kilometres within a single system.

The Pinang channel system is a 2-3 kilometers wide and 200-300 meters thick complex, with strong similarities to numerous Ainsa Spain outcrops in terms of dimensions, lithofacies association, stratal geometries and stratigraphic stacking. As well, the dimensions and stacking patterns observed in these simple to complex, highly sinuous NW Borneo deep-water channel systems are similar to many of the deep-water West Africa reservoirs.

This paper investigates the slope to basin floor transition of the Pinang system where a wide range of channel geometries and stacking patterns are preserved in different stages of evolution. A variety of 3D seismic visualization techniques were employed to quickly and accurately depict and analyze channel evolution using seismic geomorphology, seismic stratigraphy and comparison to outcrop analogs. Techniques utilized included amplitude mapping from time slices and horizon slices, coherence, opacity rendering, inversion, surface illumination, and attribute co-rendering using a series of migrated stacked 3D seismic volumes. Subsurface, outcrop and analog examples will be used to illustrate the turbidite channel systems of NW Borneo.

New Source and Seal Types for Malaysia – the Key to Unlocking the Oil Potential of Deepwater NW Borneo

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The discovery of the deepwater Kikeh oil field overturned the widely held belief that the NW Borneo deepwater play was “gas-prone”. This paper will present the data and geological principles that explain why this area has such significant oil potential and hence why it has become one of the most successful oil plays in the recent history of Malaysian oil exploration.

A new source rock has been discovered, and, with the aid of extensive conventional coring, fluid sampling and geochemical evaluation carried out by Murphy and our partners Petronas Carigali, a link to the oils and gases reservoired in the deepwater discoveries can be demonstrated. These data point to an entirely new charge system which can be demonstrated from 2D basin modeling to be the likely primary charge mechanism for the Malaysian deepwater oil discoveries made so far.

Further laboratory analyses of core material combined with extensive pressure tests from Kikeh and other Murphy-Petronas Carigali discoveries have contributed the final piece of the puzzle by proving that the seal type is a crucial element of the oil story.

Structural and Stratigraphic Controls on the Distribution of Hydrocarbons in the Greater Kinabalu Field, Sabah, Malaysia

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The Kinabalu Field, discovered in 1989 on the shelf of Sabah, Malaysia, consists 3 distinct accumulations, Main, Deep, and East, that are fault dependant closures with Late Miocene shelf sandstones reservoirs. Using new long cable 3D seismic, high-resolution biostratigraphy, and a full Field static model the following issues will be discussed:

1. The structural and stratigraphic evolution of the area in relation to controls on the contrasting distribution of hydrocarbons between these fields.
2. The origin and timing of the Kinabalu Fault (tectonic extension ~ 8.0 ma) and its control on reservoir quality and hydrocarbon distribution.
3. Reservoir subdivisions of the 4th to 5th order parasequences from the standpoint of column lengths, fault seal, and the

timing of reservoir pressure measurements. Over “geological time” the major reservoirs behave as a tank, whereas over the time scale of production (6 years, intra-sequence shales vertically compartmentalize them, e.g., static vs. dynamic top seals.
4. Rapid deposition of hydrocarbon-barren TB 3.2 transgressive systems tract in P, Q, and R sequences during maximum growth of Kinabalu Fault influenced the position of top over pressures.

The Kikeh Field, Sabah, East Malaysia

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The deep water area of Sabah in East Malaysia had, for many years, been thought to be essentially gas prone and hence of limited commercial importance. With the discovery of the Kikeh Oil Field in 2002 a new perspective was provided on the deep water potential of Sabah, overturning long held ideas regarding the commerciality of the area.
The Kikeh field is a thrust related anticline trending North East to South West. The thrust faulting has inverted the deep water sediments and provided structures for hydrocarbon accumulation.
The reservoir sands which make up the field are interpreted to be deep water basin floor deposits and are separated from one another by thick (100's m) Mass Transport Deposits (MTD's).
The sands and MTD's are thought to be related to tectonic uplift of the hinterland and slope failure and are considered to be genetically related, with the MTD's not only controlling subsequent sand deposition, by forming seafloor topography, but also eroding underlying reservoir intervals.
These complex depositional relationships present significant technical subsurface challenges, made more difficult by the poor seismic imaging caused by the presence of a large gas cloud over the field.
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