Permian to Cretaceous Palaeogeographic Evolution and Petroleum Systems of the Northern Margins of the Australian Plate

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In northern Australia, the southern margin of Tethys evolved by successive shedding of microcontinents, which subsequently drifted and accreted to SE Asia. Uplift of central Australia in the Middle Carboniferous was followed by initiation of the Westralian Superbasin during Late Carboniferous-earliest Permian extension. The Sibumasu microcontinent then broke away in the Sakmarian. Simultaneously, the Greater Bird's Head rotated clockwise, opening the proto-Banda Sea. A Middle Triassic magmatic arc formed along northeastern Australia from NSW to the Greater Bird's Head. Large deltas formed on northwestern Australian margins from the Middle Triassic to Middle Jurassic. Outboard of these deltas, carbonate build-ups developed from the Wombat Plateau to PNG, while deepwater marls accumulated between them. Argoland/West Burma broke up in the Oxfordian after widespread basaltic magmatism. Breakup was followed by a long period of localised extension in northwestern Australia, forming discontinuous grabens from the Exmouth Subbasin to the Aru Trough. The Berriasian Barrow and Toro deltas were followed by Valanginian breakup between Greater India and Australia. The northwestern graben system was then abandoned and the whole plate margin subsided into deep water until after the Aptian. Prolific petroleum source systems include wet gas-prone deltaic source rocks in the Upper Triassic-Lower Jurassic (North West Shelf) and Upper Permian (Bird's Head, Bonaparte), and oil-prone source rocks in the Upper Jurassic marine rifts (Carnarvon, Bonaparte, PNG). However, another source system occurs in Upper Triassic marine carbonates, responsible for high-sulphur oils in Seram, which may be represented in other areas of the former outer continental margin.

Late Jurassic Deepwater Depositional Systems of the Dampier Sub-Basin, North West Shelf, Western Australia

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The Dampier Sub-Basin lies at the northern end of the Carnarvon Basin on the North West Shelf of Australia. In terms of the amount and quality of data available the Dampier Sub-Basin is perhaps one of the best examples of a failed intra-continent rift within the Asia-Pacific region. Almost the entire rift and a significant proportion of its margins are covered by 3D seismic data and over 300 exploration, appraisal and development wells have been drilled within the rift and its immediate surrounds. It provides an excellent natural laboratory within which to study aspects of the structural and depositional evolution of a rift system. This paper uses regional 3D seismic interpretation and visualisation to illustrate the structural development of the Jurassic rift system and the effect of the evolving rift topography on the geometries of deepwater depositional systems during this time.

Within the Dampier Sub-Basin the rift climax occurred during the Callovian-Oxfordian. The resultant rift basin fill is dominantly comprised of deep marine clastic sediments which attain thicknesses of over 2000 metres in the depocentres. This paper integrates observations from well data with an evolving structural template defined by regional isopachs of key sequences in order to illustrate depositional models for the main deep marine sand fairways within the Late Jurassic rift.

Reconciling Contiguous Permian-Jurassic Deep and Shallow Water Facies, East Timor

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The islands of the Outer Banda Arc, South East Asia, contain fragments of sedimentary basins that formed the northeastern Gondwana margin during the Permian to Jurassic. A complex arrangement of depositional environments located in rift basins and on structural highs typified the margin during this period. Understanding the facies relationships within this setting will play an important part in future petroleum exploration of the region. Here we present findings on the facies relationships in the East Timor region of the margin.

Data was gathered during numerous river and road transects throughout East Timor. Coherent stratigraphic sections were logged and sampled. Facies and facies associations were interpreted from these logs along with petrographic and biostratigraphic analyses of samples. Using high-definition biostratigraphy facies associations were correlated to the geological timescale and for selected time-slices depositional models were interpreted.

Throughout the Permian several shallow-water carbonate facies were deposited alongside deltaic siliciclastic facies. In some sections these facies are interbedded highlighting the close spatial relationship and indicating overlapping of facies boundaries. The Triassic saw similar relationships with shallow-water ooilitic facies deposited alongside outer-neritic siliciclastic and hemipelagic carbonate facies with facies boundaries overlapping. Uniform, outer-neritic pelagic carbonate facies dominate the Lower to Middle Jurassic stratigraphy of East Timor.

Permian to Jurassic sedimentation in the East Timor region occurred in intracratonic rift-basin settings with highly variable environmental factors e.g. bathymetry, salinity, dissolved oxygen and energy levels. Levels of terriginous organic and lithogenic detrital matter were also variable throughout this period and largely controlled by local relative sea-level fluctuations.

Petroleum Systems of South Caspian Basin: Integrated Approach to Understanding Reservoirs and Hydrocarbon Entrapment

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Understanding the distribution of regionally extensive reservoir sands within the Pliocene Productive Series (PS) of the South Caspian Basin (SCB) is crucial for petroleum systems analysis. Laterally extensive reservoirs influenced charge and migration history as well as sealing capacity of the large SCB structural traps. Conditions that allowed for deposition

of the laterally extensive fluvio-lacustrine PS reservoir facies, were initiated in Late Miocene (Messinian), when isolation of the marine basin led to large-scale base level fall. This base level fall resulted in incision of the Paleo-Volga canyon, integration of the major river systems and focus of large volumes of sediment to the SCB. The regionally extensive sands within PS now act as the main reservoirs for oil and gas offshore and the extensive lacustrine shales, interbedded with the sands form intraformational seals. In the Late Pliocene a major regional flooding event resulted in the deposition of deepwater marine shales throughout the South Caspian. This regional flooding event was followed by a period of compression, which led to the uplift and erosion of late Miocene-early Pliocene Productive Series reservoirs in onshore Azerbaijan. This phase of uplift and erosion resulted in rapid basin-scale dewatering and pressure regression in the laterally continuous reservoir carrier beds which was crucial in the formation of hydrodynamic seals. This compression also resulted in the initiation and renewal of fold growth, which generated many of the present-day structural traps in the basin. Hydrocarbons migrated into traps after the pressure regression were able to form extremely large columns due to enhanced seal capacity as a result of hydrodynamic effects. Regional mapping of reservoir and seals shows the extent of connected sands and is key to understanding the complex interactions of these petroleum system.

A Regional Overview of the Exploration Potential of the Middle East

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The Middle East is the world's most prolific petroleum province and contains 5 of the 6 largest oil producing countries. Namely Saudi Arabia, Iran, Iraq, Kuwait and the U.A.E. This success is largely due to the stacked nature of what are essentially very simple petroleum systems with multiple carbonate platform and deltaic reservoirs, regional evaporitic seals, world class source rocks and the overprint of very large compressional anticlines.

BP's unique database gathered during some 100 years of exploration activity in the region has been used to generate a plate scale understanding of the geological evolution of the Middle East and an evaluation of the regional resource potential of the region.

A detailed tectonostratigraphic history of the plate is used to define a total of 6 play fairways ranging in age from Late Palaeozoic to Tertiary, which are analysed for their petroleum potential.

All major fields are seen to be related to:

i) compressional folding either as thin skinned Zagros folds or as thick skinned inversions of older Infra-Cambrian (north-south) and Permian-Triassic (northwest-southeast) rifts ii) salt cored anticlines

The areal distribution of the various play types is determined by the interplay of regional facies and burial trends. These are discussed using a series of detailed palaeo facies and depth maps.

Finally, we comment briefly on the remaining exploration potential in the region from a play fairway point of view.