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POSTER PRESENTATION

Provenance and Sedimentary Routing Pathways of the Salin Sub-Basin, Myanmar

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This research looks at the understudied Oligocene Shwezetaw, Paduang, and Okhmintaung Formations in the Salin sub-basin, which is part of the Central Myanmar Basin, with the aim of determining provenance of clastic sediments and reconstructing evolving depositional environments. Data has been collected through a fieldwork campaign targeting well-exposed sediments along the western margin of the sub-basin. The outcrops studied span approximately one hundred kilometres from north to south, and a series of sedimentary logs, palaeocurrent data, 2D panel diagrams, and samples for petrographical analysis have been collected and interpreted. This work presents the results from this field season and from a preliminary provenance study.

Interpretation of the field data suggests very few changes to overall depositional environments during the Oligocene. Continental fluvial systems dominate the northern area of the basin, with intermittent terrestrial deposition in related lacustrine and vegetated over-bank environments. Palaeocurrent data suggest southward flow throughout the entire Oligocene, mainly directed from the Himalayan foothills, with some input from the Indo-Burman Ranges (IBR) to the west and the Sino-Burman Ranges (SBR) to the east. The data suggest a gradation into marginal marine (e.g. deltaic, sandy shoreface) towards the south of the basin, and eventually into shallow marine settings, with intermittent evidence of deep marine (e.g. debrites, seismites) deposition. Rapid sea level fluctuations are interpreted throughout the three formations, but an overall transgression is evident. The provenance study will assess the degree of mixing from the Himalaya, the IBR and the SBR.

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POSTER PRESENTATION

Provenance of Sediments from Sumatra, Indonesia - Insights from Detrital U-Pb Zircon Geochronology, Heavy Mineral Analyses and Raman Spectroscopy

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The island of Sumatra, at the southwestern margin of the Indonesian archipelago, is the sixth largest island in the world, and includes major sedimentary basins of hydrocarbon interest. This work is a multi-proxy provenance study utilizing U-Pb detrital zircon dating by LA-ICP-MS combined with optical and Raman spectroscopy-based heavy mineral analysis. It will help improve the stratigraphy of Sumatra, aid palaeogeographic reconstruction of western SE Asia, and contribute to understanding of Sumatran petroleum systems. Thin section analyses, heavy mineral assemblages, and U-Pb zircon ages, from samples acquired during two fieldwork seasons indicate a mixed provenance for Cenozoic sedimentary formations, including both local igneous sources and mature basement rocks.

Characteristic Precambrian zircon age spectra are found in all analysed Cenozoic sedimentary strata. These can be correlated with zircon age populations found in Sumatran basement rocks. The Phanerozoic age spectra of the Cenozoic formations are characterised by distinct Carboniferous, Permo-Triassic, and Jurassic-Cretaceous zircon populations. Permo-Triassic zircons are interpreted to come from granitoids in the Malay peninsula or Sumatra itself. Cenozoic zircons appear only from the Middle Miocene onwards. This change is interpreted to indicate a new contribution from a local volcanic arc and is supported by a change of both the heavy mineral signatures and light mineral modes.

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POSTER PRESENTATION

Provenance and Significance of Neogene Sediments from Offshore NW Borneo, Malaysia

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This study focuses on the provenance of the Neogene clastic sediments in offshore Sabah, NW Borneo, particularly in the offshore Sabah fold and thrust belt, with thick Neogene sediments, which is a major hydrocarbon province. There have been a few previous studies concerned with sediment provenance and geochronology in NW Borneo, but all of them have been performed on land. There have been no studies of the provenance of offshore sandstones and this is the first study utilising sediments from offshore Sabah. The primary aim is to determine the sources of the Neogene clastic sediments supplied to this area and to link offshore to onshore geology. This will provide a clearer indication of the temporal and spatial changes in provenance of sands offshore and subsequently help understand tectonic influences on the distribution of these sediments.

Previous provenance studies of the sediments of onshore Sarawak and Sabah have suggested sources include nearby Borneo and Sundaland. The initial results from this research suggest similar interpretations. Heavy minerals indicate contributions from ophiolites and granitic rocks. The age populations of the detrital zircons indicate SW Borneo and Peninsula Malaysia as potential sources for some of the NW Borneo offshore sediments but sources for some zircon age groups have not yet been identified. Further analyses are in progress to build a more robust provenance database for the offshore sediments in NW Borneo.

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POSTER PRESENTATION

A Reconnaissance of the Cycle I of Offshore Sarawak NW Borneo

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Offshore Sarawak has been one of the main petroleum exploration areas in Malaysia. The shallow and deep-water regions of the Sarawak Basin comprise eight tectono-stratigraphic provinces filled with thick Cenozoic sediments. The Sarawak "Cycles" were introduced to correlate sequences in the Sarawak Basin in the late 1970's and are still in use today. Unlike age equivalent onshore formations defined by lithology and facies, the time-stratigraphic cycles are defined by an initial transgression changing gradually to a regression, and correlatable transgressive events were tied to planktonic foraminifera zones and nannofossils.

The palaeogeography and sediment sources of Palaeogene Cycle I (equivalent to Nyalau Formation onshore) are still uncertain. This reflects limited biostratigraphic sampling, few pre-Miocene well penetrations and challenging seismic coverage. This study is concerned with provenance of Cycle I offshore based on light and heavy minerals and geochronology of detrital zircons, using well samples (conventional core, sidewall core and ditch cuttings). Three exploration wells, L1, S1 and D1, were selected based on their oldest penetrated stratigraphic units, sand intervals and location. The Cycle I sands in these wells are texturally and compositionally immature with grains that are generally very angular. Heavy mineral assemblages include abundant detrital zircons of various sizes and shapes that represent different ages and source regions.

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POSTER PRESENTATION

Geometry and Distribution of Latest Cretaceous / Paleocene Turbidites and their Prospectivity, Great South Basin, Offshore SE New Zealand

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The Great South Basin, situated to the southeast of New Zealand's South Island, has seen growing interest in the global oil and gas industry. The frontier basin, with under 10 wells drilled in its entire history, is still largely under explored since the award of its first licence in 1969. The basin holds a variety of common, globally understood conventional plays with a working petroleum system as demonstrated by the Kawau 1A discovery of 1977, but the remoteness and harsh environment has discouraged operators in the past. However, could taking a big risk lead to a big reward and unlock this deep-water basin?

The Great South Basin was formed as a result of rifting from the break-up of Gondwanaland in the Cretaceous [1]. This formed syn-kinematic packages against large NE-SW extensional faults. Within the Great South Basin, there are four distinguishable groups, the Hoiho, Pakaha, Rakiura and Penrod. Each of these represents a tectonic regime from extension in the Hoiho Group, a passive stage of post rift subsidence in the Pakaha and Rakiura, to a compressional phase in the Miocene [2]. Identified also is a small pulse of compression within the Pakaha group in the Paleocene, inverting some of the NE-SW faults in this study area, creating prospectivity.

Latest Cretaceous to Paleocene turbidites are also apparent within the study area and appear to be fed by submarine channels. The relationships between aggradational style channel systems and erosional ones have different implications for sediment deposition in the subsequent submarine turbidite fans.

Within the study area, turbidite fans with potentially good reservoir properties have been draped over a basement high due to post-rift subsidence creating an area of interest, as well as a channel system folded against a large fault due to Paleocene inversion.

Hydrocarbon exploration has been successful in the basin in terms of shows and a small discovery, but there has been no development. The identification that turbidites are present and that they possibly hold large accumulations demonstrates potential both inside and outside the study area.

This poster analyses the structure and stratigraphy of the basin as well as zooming in to a study area covered by high quality 3D seismic, assessing local structure and channel and turbidite geometries. Furthermore, using IHS Markit EDIN data, the poster will also showcase numerous prospects which have been mapped in the basin, outlining further basin potential.

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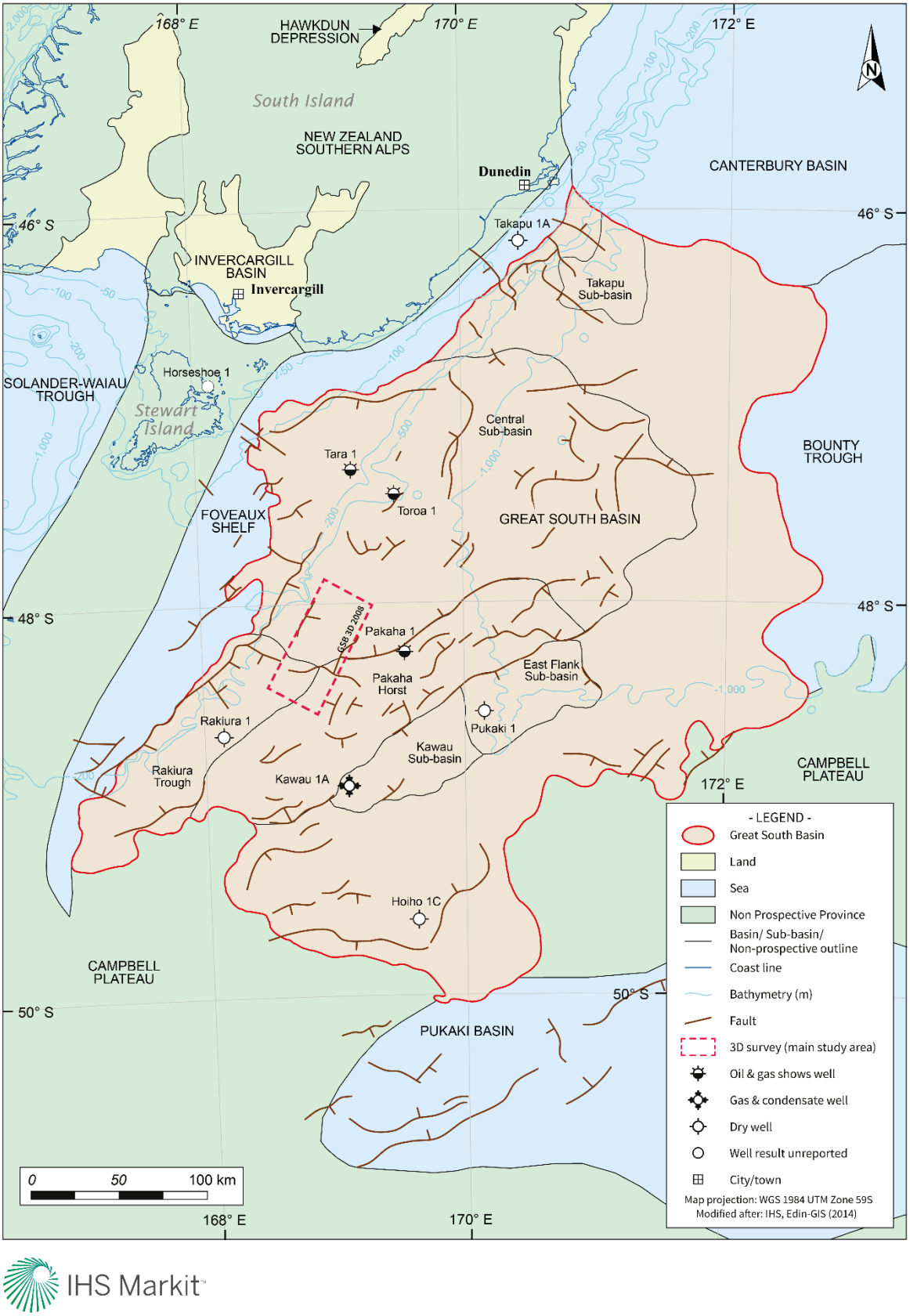

Figure 1. Structural framework map of the Great South Basin. The red rectangle shows the position of the 3D survey which acted as the main study area.

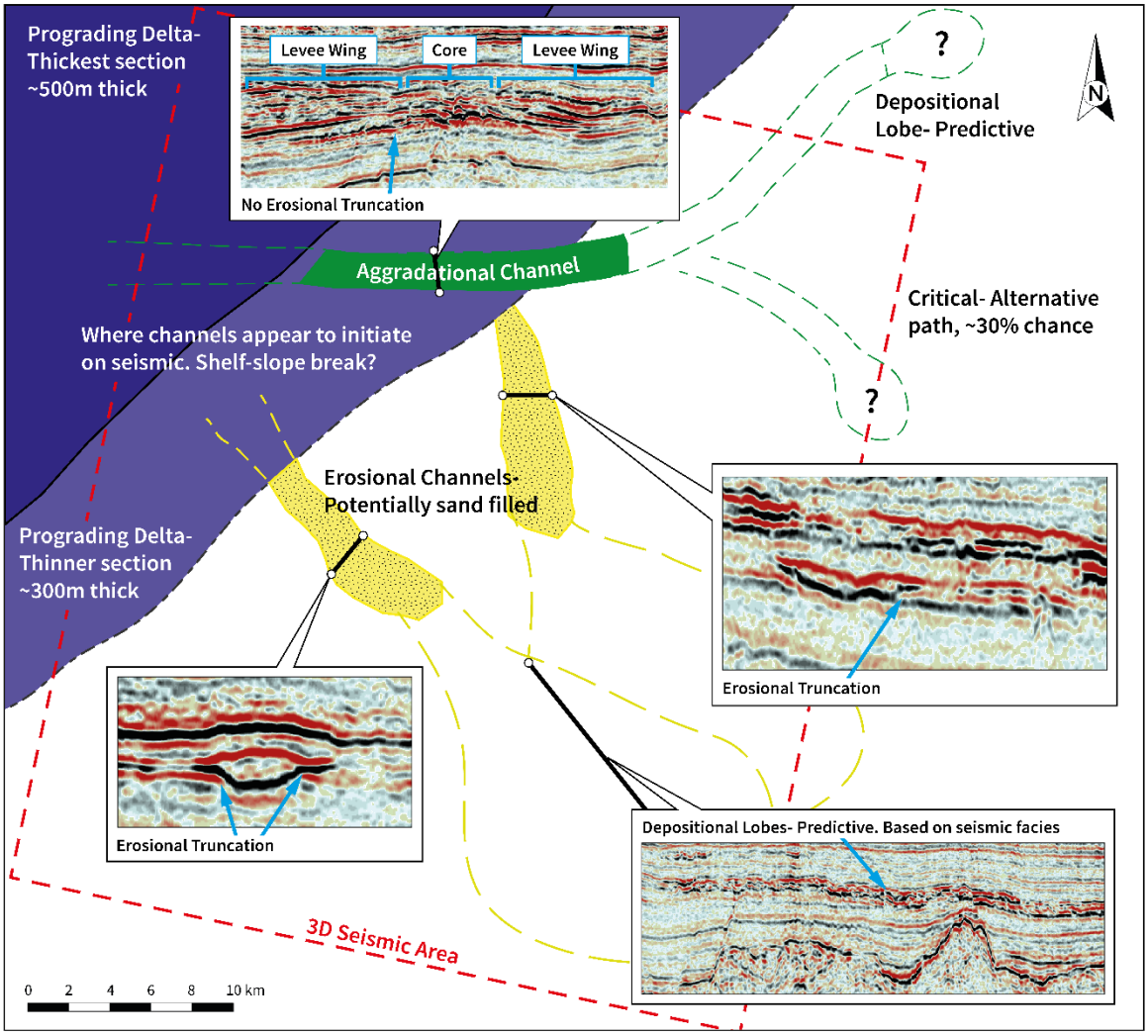

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Figure 2. Late Cretaceous / Paleocene GDE map, showing seismic sections from the 3D seismic.

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POSTER PRESENTATION

Understanding Malaysian Carbonates – the Complexities of Rock Typing

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Carbonates form major oil and gas plays around the world, however their complex deposition, texture and pore network contribute to the difficulties of modelling their heterogeneity. Therefore, carbonates present us with some of the greatest challenges and a number of fundamental geological parameters are key to developing a robust facies scheme. Understanding the carbonate facies and their connection to porosity and permeability are fundamental to reservoir characterization. Often the addition of bioturbation and vugs can alter the 'typical' poro-perm characteristics of a facies, with vugs providing vast porosity sometimes with little to no permeability. Superimposed on the complex facies schemes are fractures, which can also contribute significantly to production, enhancing permeability through the fracture density, orientation, and aperture, but can also increase the risk of water cut. In addition, Asian carbonates commonly are mounded with subsurface karst networks which boost production, but cause major drilling hazards, limiting data acquisition.

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POSTER PRESENTATION

New Data Brings New and Deeper Play Insight for North Madura, Indonesia

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1. INTRODUCTION

North Madura has never lacked drillable prospects; however, results have had variable success. Understanding where the main kitchen is located and the potential migration paths have been the main challenge, largely due to vintage seismic with limited offset, depth and old conventional recording techniques, which has made it difficult to map and to differentiate one kitchen from another.

2. REVEALING NEW DEEPER PLAYS

New recording and imaging techniques have been introduced to Indonesia for the first time ever, bringing the potential to record deep, low frequency data. Specifically, for this North Madura case study, intra-carbonate reflectors have brought improved porosity estimations for the Kujung (Mid Miocene) level, where there are still a number of untested leads. More importantly however is the detailed imaging under the carbonates and opening up of the deeper Ngimbang play as well as the potential basement play. The potential in the Ngimbang has been proven by the recent Sidayu well and this new play is prevalent across the area, as evidenced in the deep recorded GeoStreamer data and presented in this poster. The kitchen area and migration paths into the potential shallower reservoirs are better understood and the plays in the self-sourcing Ngimbang are revealed for the first time.

The North Madura Platform and its associated grabens is an area previously thought to be understood, however this poster will show that new technologies both in acquisition and imaging can provide new insights to mature areas and open new plays and near field exploration.

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POSTER PRESENTATION

An Active Petroleum System in the New Ireland Basin: Papua New Guinea's New Frontier Carbonate Play

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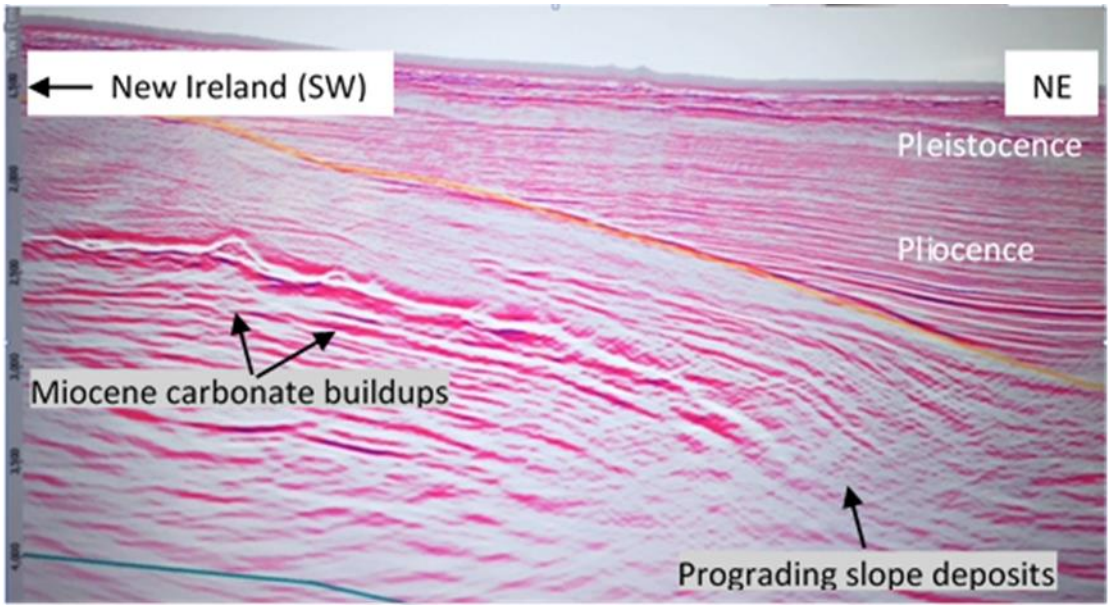
The New Ireland Basin (NIB) is one of three frontier onshore / offshore basins in NE Papua New Guinea, including the Cape Vogel and the Bougainville Basins. The NIB is a 900 km by 180 km fore-arc basin initially formed between the New Ireland island arc and the Manus trench during westward subduction of the Pacific Plate below NE PNG. Oligocene to Early Miocene rocks exposed on New Ireland include interbedded volcaniclastics, tuffaceous limestones and mudstones with up to 2.7% TOC (Jaulu Volcanics and Lossuk River Beds) deposited at neritic to upper bathyal depths (Sandy, 1986). Basinward equivalents recovered during dredging operations include intercalated foraminiferal wackstones and organic-rich claystones (1.3% TOC) which infer that periods of oxygen minima existing across the basin during this period.

Around 15 million years ago, the Ontong Java Plateau (OJP), an unusually thick volcanic province of the Pacific Plate, collided with the Australasian-Pacific plate margin. The thickness and relative buoyancy of the OJP prevented it from subducting, resulting in subduction reversal and tectonic inversion of the forearc to shallow depths where regionally continuous deposits of Late Miocene shelf limestones (Lelet Limestone) accumulated. On New Ireland, Miocene exposures of massive foraminiferal-algal biomicrite sediments, occasionally interbedded with minor lenses of cannel coals (up to 43% TOC), have been interpreted as variants of back reef lagoonal sediments (Glikson and Owen,1986; Sandy, 1986). The absence of framework reef lithologies on New Ireland suggests the likely existence of a drowned platform margin offshore.

In 2017, Searcher Seismic and BGP acquired a new long offset, deep tow 2D multiclient seismic survey in the New Ireland Basin. The processed lines reveal a significant depocentre in the basin with over 5 km of sediment. A line perpendicular to the strike of New Ireland (figure 1) has imaged apparent Miocene carbonate buildup structures with prograding slope sediments that extend eastwards into the basin and which are onlapped by a thick sequence of Pliocene-Pleistocene sediments. Miocene algal and coral boundstones with 11-16% porosity dredged in the central basin may be the lateral equivalents of a basin-wide carbonate platform, and indicate that potential for a basin-wide carbonate play exists.

Evidence for charge includes active thermogenic hydrocarbon (C1 –C4) seeps (Schmidt et al., 2002) and pyrobitumen-bearing sandstone clasts within volcanic rocks erupted 220Kyr ago in the central basin. Offshore seismic and bathymetric surveys reveal sediment deformation by horst blocks, half grabens and positive flower structures. Pliocene to Pleistocene alkaline volcanism is coincident with, and controlled by, the development of horst structures, and suggests a link between mantle upwelling, thermal inversion and transpressional shortening processes in the New Ireland Basin.



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POSTER PRESENTATION

Sources of Cenozoic Sediments around the Southern South China Sea

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The southern and western margins of the South China Sea include thick Oligocene to Miocene sedimentary successions that are of major hydrocarbon interest. Provenance studies, particularly using heavy minerals and detrital zircons, have been conducted onshore and offshore of SE Vietnam and NW Borneo that allow identification and characterisation of source regions. Sandstones analysed have characteristic detrital zircon age populations that suggest different blocks were sources for these sediments. Three distinctive populations have been identified: (1) Cretaceous zircons derived from igneous sources in SE Vietnam and SW Borneo, (2) Permian-Triassic, c. 1.8 Ga and 2.5 Ga zircons which are related to the East Malaya – Indochina block, and (3) c. 500 Ma, 800 Ma and 1.2 Ga zircons, suggesting a Sibumasu / Tin Belt contribution. These studies allow assessment of previously untested suggestions of sediment provenance, they enable reconstruction of sediment pathways, and provide further understanding of the sedimentary history of the South China Sea margins and development of drainage patterns on land.

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POSTER PRESENTATION

Papua New Guinea's Northern Basins: A Fresh Look at the Bougainville Basins

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The Bougainville Basin is one of the three frontier sedimentary basins offshore NE Papua New Guinea (the others being the Cape Vogel and New Ireland Basins). The Solomon Sea 2D Multiclient Survey comprising 3768 km of (mostly) long offset, deep tow seismic data was acquired by Searcher Seismic and project partner BGP in early 2017. The majority of the survey is situated in the New Ireland Basin, but the survey also includes a number of lines covering the Bougainville and Cape Vogel Basins.

The Bougainville Basin is located southwest of Bougainville Island. The last exploration activity in the area occurred over 40 years ago, when Shell and Amoco acquired 2D seismic data and drilled one well, L'Etoille-1 (1975). The well encountered volcanoclastic sediments rather than the prognosed carbonate reef and failed to encounter any indications of petroleum. However, there appears to be a significant depocentre in the basin that could contain more than 10 kms of sediment. A number of alternative potential play types have been identified, but they cannot be effectively assessed further due to the poor data quality of the available vintage data. The new data acquired over this area is expected to clarify the nature and extent of some of the main plays and structural elements in the basin.

The new data is currently being processed and will be available in late 2018. Modern acquisition and processing techniques are anticipated to provide a significant improvement over the vintage data in these areas and should provide new insights into the deep structure, stratigraphy and evolution of this frontier area.

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POSTER PRESENTATION

Re-Evaluating Fluvial Architecture of Pre-Vegetation Reservoirs Using Large Digital Outcrop Datasets from the Tumblagooda Sandstone, Western Australia, Southern Carnarvon Basin

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Very few studies quantitatively document the geometries of fluvial systems prior to the evolution of rooted plant systems. The colonisation of land by plants influenced weathering, energy of the system and the stability of channel banks. Many authors have compared them to modern ephemeral environments, dominated by upper-flow regime runoff and described "sheet-braided" architectures. Studying fluvial architecture is difficult as most outcrops have limited extent and thus prevent acquisition of a large enough dataset to fully evaluate these typically laterally extensive systems.

This study examines the Ordovician-Silurian Tumblagooda Sandstone of Western Australia, exposed within extensive 3D outcrops along a gorge system, that enables acquisition of a large digital dataset to document and quantify the fluvial architecture of a classic pre-vegetation paralic sandstone outcrop. Using detailed sedimentary logging over a large area, integrated with the newly acquired 3D photogrammetry derived from UAV imagery, a quantitative database has been extracted to characterise the architectures. 1579 channels have been recorded, exhibiting low- and high-relief lenticular architectures, interbedded with the more typical sheet geometries. Parallel lamination is rare within the study area, suggesting sheet-floods are not the dominant process. Complex accretion surfaces have been identified indicating upstream, downstream and lateral accretion. Results suggest a system dominated by low-sinuosity, low amplitude, channel-braided architecture with bar accretion surfaces. Its preserved architecture has been interpreted to reflect limited accommodation, that resulted in cannibalising and reworking of channels and the preservation of broad amalgamated channel bodies. Frequent channel avulsion resulted in the amalgamation of channel scours within large channel belts, enhanced by bank instability due to the lack of plants, that in modern systems colonise and bind the overbanks.

Modelling geobody architecture is a key input parameter for reservoir modelling. Previously pre-vegetation systems were thought to be sheet- and lobe-like, laterally continuous, with relatively homogeneous– Kh. This study shows that many pre-vegetation systems more likely have a labyrinth geometry, comprising a complex suite of channels with limited lateral extent. This results in Kh being more heterogeneous, which has a profound effect on reservoir facies prediction and reservoir production.

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Quantitative Analysis of Geobody Geometries and Architectural Elements within Paralic Depositional Systems: A Case Study from the Mungaroo Fm, Carnarvon Basin, Western Australia

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A key criterion to model subsurface fluvial reservoirs is the definition of dimensions and architecture of component geobodies. Schemes for classifying fluvial architectural elements are however complex, with a multitude of different terminologies in use and the published range of dimensions for the different elements is often large. There is also a lack of robust statistical databases and thus key input parameters for reservoir models, such as W:T range, is often poorly constrained.

This study presents a classification of geobodies from a paralic system that has been used to generate a robust set of statistical parameters (spatial and temporal width:thickness and sinuosity trends). The dense geobody dimension database offers a lower margin of uncertainty and improved confidence levels for W:T ranges of the encountered fluvial architectural elements in these types of depositional system. This can be applied to similar paralic depositional systems globally to help constrain geobody dimensions and reduce uncertainties associated with reservoir modelling.

The large database comprises 6,236 statistical data points for width, sinuosity and wavelength, extracted from the 3D seismic data, integrated with 36 channel thickness measurements constrained by well data. This very large dataset has been sampled over an area of approximately 10,000 km^2 from the Triassic fluvio-deltaic Mungaroo Formation, in the Northern Carnarvon Basin, NW Shelf Australia. Five architectural elements can be identified from seismic attribute analysis, comprising fluvial channel belts, crevasse splays and inter-channel areas. Morphometric measurements such as width, thickness, wavelength, amplitude, orientation and sinuosity data have been extracted and collated into a geobody database comprising 27,370 measurements that define three series of geobody classes. Width and thickness data are compared to published literature. This dense dataset is a contribution to refine the classifications of fluvial architectural elements within this type of depositional system, which previously have been difficult to differentiate.

Spatial and temporal analyses of the geostatistics reveal several trends in the rate of change of a range of metrics, which can be related to process changes and stratigraphic evolution of the depositional system. Downstream decreases in geobody widths and thicknesses are attributed to increased channel bifurcation and the distributive nature of the lower delta plain, whilst decreases in geobody width & thickness through time suggest an overall transgression of the depositional system. Higher order stratigraphic progradational and transgressive cycles are also revealed by this statistical analysis, providing further evidence for the interpretation of sequence boundaries and amalgamated multistorey channel belts.

The results presented are the first published statistical dataset for this region and the largest dataset published for paralic reservoirs from an integrated well and seismic study. Statistics extracted from this subsurface study, integrated with our current understanding of geobody dimensions (and their relative distributions) from ancient and modern-day analogues, can be incorporated into future stochastic models. This approach enables reservoir modellers to predict the distribution of a range of geobodies / reservoir elements, even those below seismic resolution, and model their interaction and connectivity within this type of depositional system.

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POSTER PRESENTATION

Petroleum Seepage Analysis in Java-Sumatra Forearc Basins

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Subsurface fluid flow in sedimentary basins has been intensively studied in recent decades due to its significances in the petroleum industry such as identifying petroleum plays in frontier basins and shallow geo-hazard potency, and beyond the petroleum industry in such areas as climate change and marine ecosystems. Recent advancement in seismic imaging has aided the identification of fluid flow phenomena through a magnificent visualisation of fluid flow elements in subsurface such as seepage's termination, seal bypass systems, and potential fluid sources. Nonetheless, lack of access to high resolution seismic data and seismic interpretation calibration, due to paucity or confidentiality of data, has left gaps in the study of subsurface fluid flow phenomena around the world. In this study, a high resolution seismic dataset from the Java-Sumatra forearc basins has been analysed through state-of-the-art seismic imaging techniques to define the fluid plumbing system in the study area and distinguish petroleum seepages.

Bottom simulating reflectors (BSR), which indicate the base of gas hydrate stability and require methane to form, were widely identified in these basins. BSRs may also indicate a potential shallow geo-hazard due to the risk of gas hydrate or free gas blow out during drilling activities. A coincidence of many BSR occurrences above potential oily fluid conduits such as strike slip faults indicates a prospect of oil leakage from a deep source. Through tectonostratigraphic analysis from previous studies, Eocene source rock / reservoir at the deepest sedimentary succession in the forearc basins was inferred as a source of oily hydrocarbons, which could contribute to the presence of shallow DHIs including the BSRs. A possibility of biogenic hydrocarbon contribution in the BSR formation has also been considered but requires further geochemical analysis to be confirmed. Thus, migration of oily hydrocarbons was interpreted through seismic imaging in the Java-Sumatra forearc basins. Through this result, it can be inferred that a prospective source rock may lie on the deepest part of the Java-Sumatra forearc basins and a potential shallow geo-hazard may exist as indicated by the BSR appearance in relation to structures. Additional work will be done to calibrate the seismic anomalies by sea surface seepage slick analysis from satellite imagery in order to further probe the potential for active oil-migration in the study area. The results of this analysis should be available in time for the conference.

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POSTER PRESENTATION

Myanmar PSC H Block – Fresh Insights from the Reprocessing and Interpretation of Legacy Gravity and Magnetic Data

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An airborne gravity and magnetic survey over the PSC H area was carried out in 1990 by Carson Services Inc. on behalf of BHP Petroleum (Myanmar) Inc. The original digital survey data had been lost in-country with no record of where the data might be found. Pacific Hunt Energy eventually recovered the original survey data with the help of BHP Petroleum, whose geoscientists spent weeks searching their archives before finding the original digital copy of the 27-year-old dataset. Subsequently, Getech reprocessed the data to diminish line noise and develop a suite of derivatives for interpretation.

The reprocessed gravity and magnetic data together with Getech's regional gravity data were integrated with selected legacy seismic, well, Landsat and other data sets to provide a comprehensive, detailed and reliable understanding of structural framework and sediment thickness to help further our understanding of the tectonic evolution of the area.

The influence of Sagaing Fault in the area and its precise location were investigated in our interpretation. The N-S trending Sagaing Fault divides the exploration block into two contrasting domains comprising two plates with distinctively different compositions, as evidenced by a clear density contrast, fundamental differences in the magnetic character and rapid changes in sediment thickness. In addition, based on the regional gravity data and 2D gravity and magnetic profile modelling work, we demonstrate that the Wuntho-Popa Volcanic Arc which is evident to the north of the block may extend further to the south than previously thought, manifesting as a high-density body in the lower crust. These conclusions potentially impact on models for sediment dispersal and source rock maturity and hence have a fundamental impact on the evaluation of hydrocarbon potential of the area.