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ORAL PRESENTATION

The Exotica Carbonate Megabreccia Debris Flow and Linkages to Active Hydrocarbon Seepage: New Ireland Basin, Papua New Guinea

Brent McInnes[1]

[1]Peak Oil (PNG), Australia

brent.mcinnes@peakoilpng.com

The New Ireland Basin (NIB) is a 900 km x 180 km frontier offshore basin in northern Papua New Guinea (PNG). From the Early Oligocene until the Middle Miocene, the NIB was a fore-arc depocenter between the New Ireland island arc and the Manus trench during the westward subduction of the Pacific Plate below NE PNG. Around 15 million years ago, the Ontong Java Plateau (OJP) collided with the Australia-Pacific plate margin. The thickness and relative buoyancy of the OJP prevented it from subducting, resulting in subduction reversal and thermal activation of the forearc sediments by Pliocene-Pleistocene alkaline volcanism.

On New Ireland, Oligocene andesitic lava and volcaniclastics (Jaulu Volcanics) make up the island arc basement. Subsidence throughout the Miocene resulted in deposition of tuffaceous limestones and mudstones (Lossuk River Beds) followed by thick deposits of carbonate platform sediments (Lelet Limestone). The karstification of the Lelet carbonate platform documents significant tectonic uplift on the order of 1 km during the Pliocene-Pleistocene. Basinward sediments are poorly known apart from offshore dredge samples which are Oligocene deepwater turbiditic sandstone and foraminiferal packstone and wackestone intercalated with dark organic-rich layers (TOC = 1.3%).

Research cruises in the 1990's reported submarine hydrocarbon seeps of thermogenic origin emanating from scarp slopes and volcanic mounds in the deep basin (1500 m bsl). In 2017, Searcher Seismic and BGP carried out a long offset, deep tow 2D multiclient seismic survey (SS2017) at reconnaissance scale over the NIB. The 1,275 km of new seismic data reveal substantial sediment thicknesses (up to 8 km) disrupted by horst blocks, half grabens and volcanic intrusions.

A key seismic line between New Ireland and Lihir Island (L107) crossing two seep locations shows evidence for a gas chimney linking the Mussel Cliffs seep to a seismic interval with numerous mounded, discontinuous and contorted reflections consistent with a debris apron. This seismic unit, named the Exotica Formation, is approximately 45 km long, 32 km wide, 250 m thick and buried to a depth of 2 km. The source of the Exotica debris apron can be traced back to the east coast of New Ireland, where a 160 km^2 section of Lelet Limestone (250-400 m thick) is missing from the stratigraphic record.

A model to explain the combined observational evidence is that tectonic uplift of New Ireland triggered a catastrophic collapse of the coastline, transporting substantial carbonate platform sediments downslope into deep-water to form a toe-of-slope carbonate megabreccia debris flow deposit. The seep emissions suggest that the Exotica Formation is charged with hydrocarbons. Detailed seismic infill lines and marine survey work are necessary to further evaluate this hypothesis.

The New Ireland region is cyclone-free, conflict-free and proximal to the energy-hungry markets of China, Japan and Korea. An energy-intensive gold mine on Lihir Island and a 2018 APEC pledge to promote regional electrification present opportunities to accelerate the development of its hydrocarbon resources.

SPEAKER BIOGRAPHY

Brent McInnes has 34 years' experience in technical exploration and resource development in Canada, USA, Australia, China, Indonesia, Chile, Mongolia, Pakistan, Iran and Papua New Guinea. He completed his PhD at the University of Ottawa in 1995 and worked as a research geoscientist at Caltech and CSIRO. He founded Peak Oil (PNG) Pty Ltd to explore for hydrocarbons in the New Ireland Basin and concurrently serves as Peak's Chairman, Professor of Economic Geology & Geochemistry at Curtin University and as a strategic advisor to the Institute of Geological and Nuclear Science in New Zealand.