



The Exotica Carbonate Megabreccia Debris Flow Deposit and Associated Hydrocarbon Seeps in the New Ireland Basin, Papua New Guinea

Brent I. A. McInnes

Curtin University; Peak Oil

ABSTRACT

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 buoyancy of the OJP prevented it from subducting, resulting in subduction reversal and thermal activation of the forearc basin by Pliocene-Pleistocene post-collisional alkaline volcanism.

On New Ireland, Oligocene andesitic lava and volcanoclastics (Jaulu Volcanics) make up the island arc basement. Subsidence and erosion 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 1-2 km during the Pliocene-Pleistocene.

Research cruises in the 1990s reported submarine hydrocarbon seeps of thermogenic origin emanating from scarp slopes and volcanic mounds in the offshore basin (Schmidt et al., 2002). The source of the seeps was tested in 2017 by long offset, deep tow 2D seismic—which shows gas chimneys linking the seeps to a seismic interval with numerous mounded, discontinuous and contorted reflections that are consistent with a mass transport complex. This unit, named the Exotica Formation, is ~45 km long, 32 km wide, 100–400 m thick, buried to a depth of 2 km, and overlies 6 km of basin sediment. The source of the Exotica debris apron can be traced to the east coast of New Ireland, where a 160 sq km section of Lelet Limestone (250–400 m thick) is missing from the rock strata in the evacuation area. The vertical relief from head-to-toe of slope is 2 km. Pliocene samples of

bituminous carbonate breccia, collected as xenoliths ejected onto the basin seafloor by kimberlite-type eruptions, may be representative of the Exotica Formation. This lithology is distinct from basin sediments which include: Oligocene-Pleistocene deepwater turbiditic sandstone, foraminiferal packstone, and wackestone intercalated with sapropelic shale (1.3% TOC).

A model to explain the combined observational evidence is that subduction-related earthquake activity triggered a catastrophic collapse of the New Ireland coastline, transporting substantial carbonate platform sediments downslope into deepwater to form a toe-of-slope carbonate megabreccia debris flow deposit. The seep emissions and bituminous samples suggest that portions of the Exotica Formation may be charged with hydrocarbons. Potential global analogues include the Tamabra Formation in the Poza Rica Field in the Gulf of Mexico (Loucks et al., 2011), the K/T carbonate breccias of the Cantarell field in the Gulf of Mexico (Grajales-Nishimura et al., 2000), and the carbonate debris reservoir of the Ruby field in the South Makassar Basin of Indonesia (Pireno et al., 2015).