



Metamorphic and volcanic quartz of the siliciclastic Tipuma Formation, West Papua, Indonesia: an insight into Triassic palaeogeography of northern Australia

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The origin and Triassic evolution of the Bird's Head of West Papua has been a subject of active discussion. Many interpretations have been proposed for the Triassic evolution, from active margin to passive margin models. The Bird's Head region is underlain by Australian continental crust and has a relatively complete stratigraphy from Palaeozoic to Recent. The Tipuma Formation is a Mesozoic siliciclastic sequence and a potentially important reservoir. Its sedimentation may record parts of the region's Mesozoic tectonic history, including several phases of rifting. Little is known about the variations in lithologies and their composition, and nothing is known about its provenance.

The Tipuma Formation is dominated by red to cream well-bedded mudstone, sandstone and conglomerate. It rests unconformably on the Kemum Formation and is overlain by the Cretaceous Jass Formation. It is difficult to assess the depositional age of the Tipuma Formation due to the absence of fossils. The suggested Triassic age is based solely on its stratigraphic position. The Tipuma Formation was previously thought to be deposited in a stable continental setting.

Detrital modes indicate acid plutonic, metamorphic, and recycled sedimentary source rocks for the Tipuma Formation sandstones. Angular volcanic quartz and elongate euhedral zircons suggest a contribution from previously unrecognised contemporaneous acid volcanics. New interpretations suggest that the widespread Permo–Triassic volcanic activity in the Bird's Head was caused by subduction associated with an Andean-type active margin and that the Tipuma Formation was deposited in a fluvial setting close to the volcanic arc.

Cathodoluminescence (CL) characteristics of quartz depend on variations in temperature, pressure, and geochemical environment during crystal growth and subsequent events. The CL colour spectra of quartz can be correlated with the formation conditions of the quartz. They can therefore be used as a provenance indicator along with other techniques. Quartz from Tipuma Formation sandstone is dominated by quartz of low-T metamorphic and volcanic origin and only with little plutonic quartz. This strongly suggests an input of detritus derived from contemporaneous acid volcanic rocks and some local low-grade metamorphic rocks. The results confirm assessment based on zircon study of the main contemporaneous volcanic activity, which waned or ceased during deposition of the Middle Member of the Tipuma Formation. Widespread Permo–Triassic volcanic activity in the Bird's Head possibly caused contact metamorphism in the area with uplift and erosion of low-T metamorphic rocks. The Tasman Line continues from Eastern Australia through New Guinea, into the Bird's Head region. At least since the Triassic, the Bird's Head has been part of the Gondwana margin and for the first time, we can provide compelling evidence that volcanic activity has played a major role in this region.