Neoproterozoic Basement Structures Control New Guinea Deep Structure

Alan P.M. Vaughan,[1*] Christian Seiler,[1] Andrew J. Bladon[1], Jennifer F. Ellis[1] and Sugeng Widodo[2]

[1]Midland Valley Exploration Ltd., 144 West George Street, Glasgow G2 2HG, U.K.
[2]Freeport - McMoRan Copper & Gold Inc., 333 North Central Avenue, Phoenix AZ 85004, USA.

*E-mail, avaughan@mve.com

A regional synthesis and re-evaluation of the deep crustal structure in western New Guinea has identified Neoproterozoic normal faults and transfer structures in the crystalline basement of the Australian Plate. Cenozoic reactivation of these structures appears to control the location and orientation of brittle-ductile structures formed during the Central Range Orogeny.

The island of New Guinea is the emergent part of one of the most tectonically complex places on the Earth's surface. Three major plates and more than a half dozen microplates interact in a continent-ocean collision zone that has been evolving since the Oligocene. Although the collision zone in western New Guinea strikes predominately east-west, northeast-trending fault structures are also prominent. Of these, the Gauttier Offset can be traced from the Gauttier Mountains in the north of Papua province of Indonesia 300 km south to the Mapenduma Anticline. Comparison with the orientations and scales of Neoproterozoic basement structures developed in the Arafura Sea north of Australia, and the strike and location of basement lows in new reflection seismic maps of Neoproterozoic basement south of New Guinea, indicate that the Gauttier Offset is likely to be a reactivated Neoproterozoic extensional fault. Neoproterozoic extensional faults in the Arafura Sea show domains of opposing extension-polarity bound by east-west transfer structures.

Similar structural relationships may be inferred in New Guinea associated with the Gauttier Offset and other parallel structures, although here possible Neoproterozoic transfer structures are reactivated as more recent west-northwest-striking strike-slip faults. The zone of intersection between west-northwest-striking faults and the Gauttier Offset coincides with the location of Pliocene magmatism and mineralization; the fault intersection appears to provide a structural control for emplacement of magmatic rocks. Other northeast trending faults and lineaments are evident in Papua Province east and west of the Gauttier Offset structure, and in Papua New Guinea.

Given the possible origin of these structures as reactivated Neoproterozoic basement faults, northeast-striking faults and alignments are likely to have a deep-seated control on east-west variation in Mesozoic and younger stratigraphic thickness, the location and depth of pre-Mesozoic basins, and magma pathways to shallow crustal levels. This has implications for mineral exploration and the development of petroleum source rocks and reservoirs. Recognition of Neoproterozoic basement control in Cenozoic structural evolution represents a first order re-evaluation of the deep structure of New Guinea.