Tectonic/structural control to Papua New Guinea Au-Cu mineralisation

G.J. Corbett
Consultant, PO Box 282 Willoughby, NSW, Australia

The setting and structural controls to many porphyry and epithermal Au-Cu occurrences in Papua New Guinea (PNG) reflect development within a complex oceanic-continental plate collision zone (figure 1, Corbett, 2005, Corbett and Leach, 1998). In many instances magmatic arc intrusion-related ore systems are localised by steep dipping arc-parallel structures, locally as terrain boundaries, or arc-normal deep crustal transfer structures, which tap deep magma sources (Corbett, 1994). Intersections of these two trends are important settings for ore systems (Porgera, Yandera, Frieda River), although mineralisation may extend along either trend, and structures display activity over protracted periods of time. At the Yandera porphyry Cu-Mo prospect, arc-parallel aligned mineralisation is dissected by arc-normal faults. Pronounced uplift and erosion in the collision setting has been important to expose at the surface, the youthful (1.2 m.y.) Ok Tedi porphyry Cu-Au mineralisation which must have formed at a depth of at least 1 km. While porphyry Cu-Au deposits (Panguna, Ok Tedi, Frieda River, Yandera) which developed at deep crustal levels host bulk-tonnage, lower Au grade mineralisation (with Cu and local Mo), the epithermal deposits formed at higher crustal levels may contain bonanza Au grades (and Ag) within dilatant portions of host structures (Corbett and Leach, 1998; Corbett, 2005).

Au-rich alkaline rocks of the Pliocene-Recent Lihir-Tabar island arc are considered to have been derived by the remelting of previously melted oceanic crust as a result of the reversal of subduction following the Miocene closure of the south facing subduction as it became blocked by the thick Otong Java plateau oceanic crust. Here, mineralisation within the porphyry-epithermal Au transition is controlled by regional deep seated NS arc-normal structures, and best mineralisation locally occurs in the steeper dipping portions of listric faults developed during sector collapse of the Luise volcano, which triggered ore formation.

A series of NNE trending arc-normal transfer structures localise intrusion-related ore systems in the fold-thrust collision zone of mainland PNG and continue into West Papua (Grasberg), particularly at the intersections of major arc-parallel structures. Important examples include Porgera, where much of the early low sulphidation epithermal carbonate-base metal Au mineralisation is aligned within the transfer trend, while the arc-parallel Roamane fault hosts later bonanza grade low sulphidation epithermal quartz Au-Ag style Zone VII mineralisation. Thrust erosion is interpreted to have initiated the later higher crustal level epithermal mineralisation and the nearby Mt Kare Au mineralisation is considered to represent the thrust-off top of Porgera. Arc-normal transfer structures are also recognised at Wafi, Ok Tedi, Frieda River, Yandera and Bilimoia. At Wafi a major transfer structure localises overprinting mineralisation. The early porphyry Cu-Au is upgraded by the diatreme-flow dome hosted high sulphidation Au-Cu system, which evolves to marginal low sulphidation carbonate-base metal Au mineralisation, where higher Au grade better metallurgy ores are recognised.

At Bilimoia, a corridor of major arc-parallel structures, formed as part of the Markham Fault (a terrain suture, figure 1), host porphyry and deep level epithermal low sulphidation quartz-sulphide style Au mineralisation over a strike distance of some 20 km. Similarly, the Frieda-Nena mineralisation is localised by a splay formed at the intersection of the arc-parallel Fiak-Leonard Schultz Fault and arc-normal Ok Tedi transfer structure. Here, a block faulted 10 km long corridor hosts Cu-Au mineralisation developed at different crustal levels, varying from the deep eastern Horse-Ivaal Cu-Au porphyry systems, to Nena shallow level high sulphidation epithermal Au-Cu mineralisation at the western portion of the trend.

The Morobe Goldfield is localised within the major intra-arc extensional Bulolo Graben (figure 1) where Pliocene felsic volcanics and diatreme-flow dome complexes overlie basement metamorphic and granitic rocks. Here, some low sulphidation epithermal Au-Ag occurrences are localised within graben bounding structures (Hamata, Hidden Valley), while others occur within intra-graben structures such as the Escarpment Fault (Wau), especially at the intersection with cross structures (Kerimenge, Edie Creek). Best mineralisation occurs within steeper dipping portions of graben-related listric faults (Hidden Valley) and immediately adjacent to diatreme breccia pipes (Kerimenge, Wau, Edie Creek). As typical of the pronounced vertical zonation in low sulphidation epithermal u mineralisation, bonanza Au grades are best developed at the highest elevation (Edie Creek) in a region of deeply dissected topography.

The Tolukuma classic chalcedony-ginguro style low sulphidation epithermal Au-Ag banded quartz vein system occurs within a graben bounding structure separating volcanic and basement metamorphic rocks. Normal and strike-slip fault movement have localised bonanza Au bearing ore shoots within dilatant fault portions. Similarly, the Umuna Lode low sulphidation carbonate-base metal epithermal Au mine at Misima Island lies within a fault jog formed by a component of strike-slip movement on regional arc-parallel faults. At Woodlark Island the Kulumadau group of mineral occurrences extend along a major horst bounding structure, while the Busai mineralisation occurs as flat dipping lower Au grade tension veins constrained between steep structures which locally host bonanza Au grade lodes.

On the Papuan Peninsular where southward collision has obducted oceanic crust onto the basement mainland rocks, sub-economic Cu-Au mineralisation occurs in flatter dipping portions of reverse faults and Ni occurrences are under investigation.

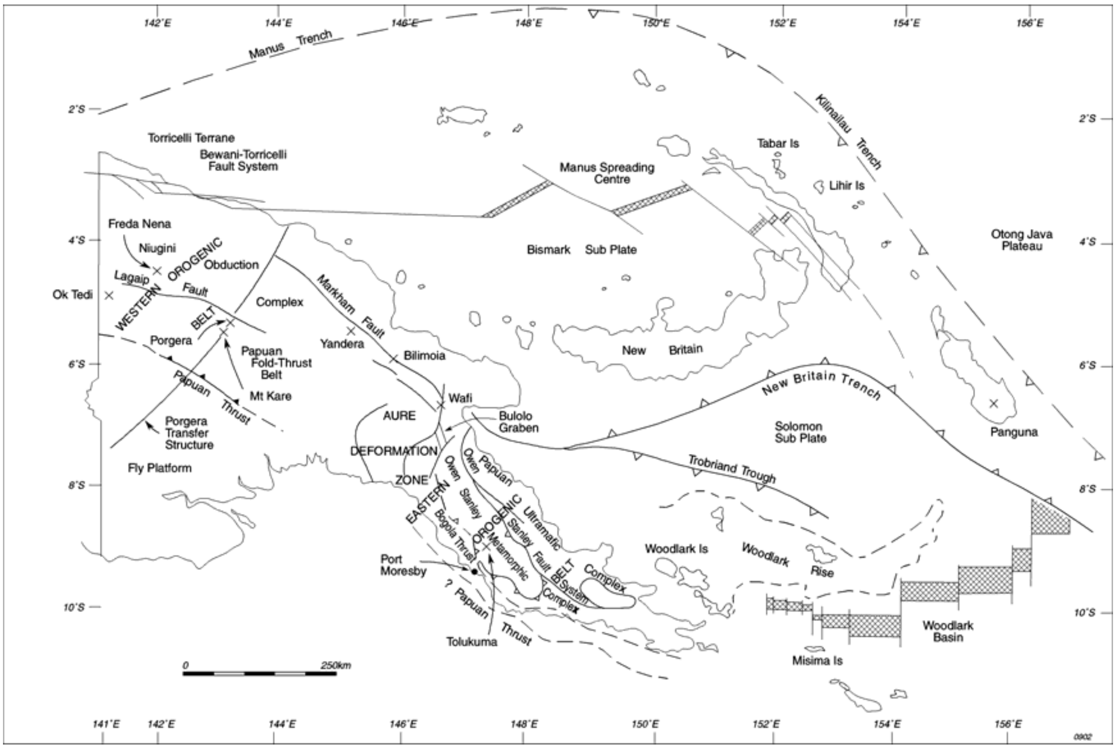

Figure 1. Locations of mineral occurrences discussed superimposed upon the tectonic elements of Papua New Guinea, from Corbett (2005).

References cited
CORBETT, G.J., 1994, Regional structural control of selected Cu/Au occurrences in Papua New Guinea, *in* Rogerson, R., ed., Geology, exploration and mining conference, June 1994, Lae, Papua New Guinea, proceedings: Parkville, The Australasian Institute of Mining and Metallurgy, p. 57-70.

CORBETT, G.J., 2005, Geology and Mineral Potential of Papua New Guinea: Ed. A Williamson & G Hancock, Papua New Guinea Department of Mining, 152p.

CORBETT, G.J., and LEACH, T.M., 1998, Southwest Pacific gold-copper systems: Structure, alteration and mineralization: Special Publication 6, Society of Economic Geologists, 238 p.