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Title: GOLD AND TECTONICS: A DYNAMIC LINK

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Abstract: Analysis of plate- and arc-scale geodynamic history can be used to assess the gold (and copper) prospectivity of arc terranes, including the generation of giant intrusion-related low-sulphidation epithermal gold systems such as Lihir, Porgera, Cripple Creek and Emperor. Here we use the example of the giant (10 M oz) Emperor deposit in Fiji to demonstrate the connection between plate dynamics, arc magmatism, and mineralisation.

A 10 Ma island arc-oceanic plateau collision interrupted subduction, and caused metasomatism of the sub-arc mantle. Subduction flipping stimulated alkalic magmatism, but plate re-configuration terminated magmatism, with ensuing magma fractionation and caldera collapse synchronous with regional compression. Epithermal mineralisation overprints post-caldera metal-poor porphyry-Cu-style alteration. Both systems formed at

3.9 Ma from sulphur-poor, mildly acidic, hybrid magmatic-meteoritic fluids (Begg, 1996). Temperatures declined from ~350°C to ~250°C in the porphyry-Cu-style system, and to <170°C by end of the epithermal ore stage. Despite a spatial, temporal, isotopic, and temperature continuum between the two systems, the precious-metal-rich nature of the epithermal fluids, their higher salinities and CO₂ content, indicate that the two systems tapped different fluids.

It is hypothesized that a gold-rich magmatic-hydrothermal fluid exsolved from the crystallising subvolcanic magma chamber, but was trapped at depth. An overlying convecting meteoric water system produced porphyry-style alteration assemblages in the upflow path. Sealing and overpressuring of this upflow path, coupled with the regional compression, generated fractures allowing escape of the trapped gold-rich magmatic-hydrothermal fluid. This resulted in the switch to epithermal conditions and the generation of gently-dipping mineralised thrusts and fractures. Precipitation of epithermal ores was through a combination of wallrock sulphidation reactions and boiling, reflecting fluid pressure fluctuations arising from “epithermal-fault-valve” behaviour.

References

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