Rethinking Models for Phanerozoic Orogenic Gold Deposits

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Orogenic gold deposits have become attractive exploration targets because of the potential for relatively high grades. Existing published models for orogenic gold deposits are based heavily on the world-class Late Archean deposits, especially those in the Abitibi Belt in Canada and the Yilgarn Province in southwest Australia. These models typically emphasize the critical importance of crustal-scale faults, commonly terrane-bounding transpressive structures, with which many Archean orogenic gold deposits are at least spatially closely associated. Most Phanerozoic orogenic gold deposits, however, are not associated with crustal-scale faults; hence, the published models do not provide an adequate basis for either understanding or exploring for most Phanerozoic orogenic gold deposits.

We have developed a conceptual framework that redefines and reclassifies Phanerozoic orogenic gold deposits into four (possibly five) subtypes, which differ in terms of tectonic setting, host-rock lithologies, metal sources, vein styles and, possibly, grade/tonnage potential. Although it is very likely that the same range of processes was responsible for most or all of these subtypes (which we consider to represent end-members within a very broad spectrum of deposit styles), we believe that this more refined classification of Phanerozoic orogenic gold deposits provides an improved framework with which to understand and develop exploration strategies for such targets. The subtypes, along with two or more reasonably well known and well characterized global examples of each, are as follows:

1. Mother Lode type (Mother Lode Belt and Alleghany District, CA; Bridge River-Bralorne, BC; Juneau, AK): Complex quartz-carbonate vein arrays associated with major, potentially crustal scale strike-slip fault zones, some of which represent transpressional sutures, with metals apparently derived from deeper crustal levels. This subtype includes the only Phanerozoic deposits that resemble typical Archean orogenic gold deposits.

2. Otago type (Otago Schist Belt, NZ; Chugach Belt, AK): Dispersed quartz-carbonate vein arrays hosted by clastic sedimentary rocks in a fore-arc setting, with metals derived from prograde metamorphism at deeper crustal levels, potential for large tonnage if associated with a substantial structure (e.g., Macraes), and, in at least some cases, related to ridge subduction.

3. Klondike type (Klondike District, YT; Wells-Barkerville Camp, BC): Form late in the development of collisional orogens, with widely distributed quartz veins and vein arrays which, individually, have relatively limited areal extent. This subtype is usually not associated with major structures. Metals are commonly locally derived, indicating a strong lithological control on gold localization and, in some cases, there is evidence for gold mobilized from previously enriched source rocks. They are locally high grade but mostly small.

4. Slate belt type (Victoria Gold District, AU; Meguma Belt, NS): Occur in a variety of sedimentary basinal settings. This subtype has classic saddle reef and related wing veins and may include bedding-parallel veins, which are thin but can be high grade. Veining can be very extensive and locally very high grade (e.g., Victoria), but is usually too widely spaced to be bulk mineable.

5. Central Asian type (Muruntau, UZ; Kumptor, KY): These very large sediment-hosted vein deposits are provisionally distinguished as a fifth deposit subtype. They may be better grouped with the slate belt type of deposits, although there is increasing evidence that they may represent some variation on intrusion-related gold.