Mobility of gold during metamorphism: Otago and beyond

The sources of metals for orogenic gold deposits have long been debated but much recent research has supported the metamorphic dehydration model where metal-rich fluids are produced during prograde metamorphic dehydration reactions. Investigations of a number of orogenic belts including the Otago and Alpine Schists, New Zealand, and the Dalradian Metasedimentary Belt (DMB) in Scotland show that considerably more gold is mobilized than is trapped in orogenic gold deposits in these regions. The metamorphic mobilization of gold and other elements associated with orogenic gold deposits such as As and Sb is shown through systematic depletions of these elements with increasing metamorphic grade (Pitcairn et al. 2006). Recrystallisation of sulfide minerals during prograde metamorphism, in particular the recrystallisation of pyrite to pyrrhotite, is considered to be the driving force for the release of metals into the metamorphic fluids. Metamorphic processing of Torlesse Terrane source rock beneath the Southern Alps of New Zealand is thought to have mobilised 1000s of t of Au in the last 5 Myrs, with only a fraction of that gold being trapped in the gold deposits observed in the Southern Alps. In the DMB of Scotland, systematic depletions of the same suite of elements has been observed, with around 1.5 t Au estimated to have been mobilised from every 1 km3 of source rock during greenschist to amphibolite facies metamorphism. The DMB of Scotland, which covers an area in excess of 15000 km², is poorly endowed with orogenic gold deposits.
These investigations indicate that the production of gold-rich fluids is not the major control on
generation of large orogenic gold deposits and provinces, but that other processes such as efficient fluid
focusing and potent precipitation mechanisms may be the key.

Pitcairn et al., 2006 Economic Geology 101, 1525-1546.

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