A Shallow Metamorphic Source for Tungsten (Scheelite) in the Turbidite-Hosted Orogenic Gold Deposits of the Otago Schist, New Zealand

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Recent advances have been made on the source(s) of economic and gangue elements associated with turbidite-hosted orogenic gold deposits. These investigations have centered on the turbidite-hosted orogenic gold deposits of the Otago Schist and Alpine Schist of southern New Zealand, with their discoveries being applied widely to orogenic gold mineralization in other metasedimentary belts.

The turbidite-hosted orogenic gold deposits of the Otago Schist are enriched in a variety of trace elements including the following: Au, As, Ag, W, Sb and Hg. Progressive metamorphism of the host-metasediments has been shown to mobilize significant amounts of all these elements, with the subsequent investigations of Pitcairn et al. and Large et al. identifying diagenetic pyrite in the subgreenschist facies rocks as the host for these elements (excluding W). Concurrent with progressive metamorphism of the metasediments, Pitcairn et al. and Large et al. observed diagenetic pyrite, firstly recrystallizing to metamorphic pyrite and then to pyrrhotite at approximately greenschist facies. In situ trace element analyses (LA-ICP-MS and EMPA) of these mineral phases revealed significant mobilization of Au, As, Ag, Sb, and Hg occurred during this mineral transition promoting Pitcairn et al. and Large et al. to attribute the source and liberation of these elements in the orogenic gold deposits of southern New Zealand to this mineral reaction. The source of W (in the form of scheelite), however, was not identified in the course of these studies, with both authors suggesting W is sourced elsewhere in the sedimentary-metasedimentary pile. Here, we present trace element data, identifying detrital rutile as the most important host for W in the prehnite-pumpellyite facies rocks of the Otago Schist. Concurrent with progressive metamorphism (pumpellyite-actinolite to chlorite greenschist facies) of the metasediments, detrital rutile is observed recrystallizing to metamorphic titanite. In situ trace element analyses (LA-ICP-MS) revealed that, on average, metamorphic titanite contains significantly lower amounts of W, with mass-balance techniques following Lucassen et al. indicating significant amounts of W are released during this mineral transition. Observations of the incipit development of scheelite within the fabric of the lower pumpellyite-actinolite facies rocks, then in synmetamorphic veins by upper pumpellyite-actinolite facies provides further evidence that significant amounts of W is mobilized from the rutile to titanite mineral reaction, and that this liberation is the source of W enrichment in the orogenic gold deposits of the Otago Schist.