Insights into the gold metallogeny of the Meguma terrane of Nova Scotia, Canada, from LA-ICP-MS arsenopyrite geochemistry

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The time-space distribution of ore deposits in regards to the evolution of geological terranes is known as metallogeny. In the case of the Phanerozoic Meguma terrane of southern Nova Scotia, the origin of its classic slate-belt hosted orogenic gold systems (i.e., Meguma terrane gold deposits) has been the focus of study for well over a century. Despite considerable effort involving many sub-disciplines (e.g., field studies, structural analysis, lithogeochemistry, geochronology), many unanswered questions remain about these deposits, such as fluid and metal reservoirs, single or multiple ore-forming events, and nature of the mineralization. The advent of in situ LA-ICP-MS analysis has provided the means to assess the geochemical evolution of single minerals using a large elemental database at a spatial resolution (10s μm) not available before. Here we apply a novel approach to processing and interpreting such data generated from mapping arsenopyrite from eight gold deposits across the central and eastern Meguma terrane (i.e., the Ovens to Upper Seal Harbour) to further investigate its gold metallogeny. Using this approach, we first establish an elemental paragenesis for the mineralization in each deposit, assess the number of gold events and their nature (i.e., refractory vs non-refractory), characterize elemental associations and elemental abundances through time, and assess elemental reservoirs (e.g., Co, Ni) using a new set of discriminant diagrams. The results document a similar geochemical fingerprint for gold mineralization across the terrane based on a similar elemental paragenesis in deposits, but also indicates several gold events. Using Au-Ag binary plots with false-color coding to highlight elemental associations, the earliest gold event (>10 ppm Au; Au:Ag = 10) is identified by a Co-Ni-Mo-Sb-Se association which equates spatially to primary growth zones in arsenopyrite. In contrast, a second event, characterized by an Al-Ti-V-Mn element association, Au:Ag >100, and spatially associated with late fractures, is attributed to remobilization and upgrading of earlier refractory gold. A third event, characterized by a Bi-Pb-Cd-In-Ag elemental association, predates the second gold event and is also reflected in archived whole-rock lithogeochemical data. Collectively these results indicate a protracted history of precious-metal mineralization in all deposits from an early refractory event to subsequent remobilization events, which may be similar or separate temporally. In addition, the Co-Ni data may reflect interaction of ore-forming fluids with mafic rocks at depth. This study demonstrates the applicability of our approach to resolving long-standing problems in gold metallogeny, in the Meguma terrane and elsewhere.

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