An overview of Meguma gold deposits in the Meguma Terrane of southern Nova Scotia: geology, geochronology, isotopes, fluid inclusions and geofantasy

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The Lower Paleozoic Meguma Group of southern Nova Scotia, composed of a basal sandstone- (Goldenville Formation) and overlying shale-dominant (Halifax Formation) stratigraphy, is host to numerous gold deposits. The Meguma Group was deformed (generally upright, open to closed folds) and metamorphosed (greenschist to amphibolite) during the regional Acadian Orogeny of ca. 400 Ma. The gold deposits occur throughout the Goldenville Formation, but generally in those parts rich in graphitic shales, and appear to have no affinity for metamorphic grade (e.g., Forest Hill vs. Tangier deposits). Deposits can be subdivided into (i) quartz-rich and (ii) quartz-poor (i.e., veins absent). The first type occur in antiformal structures with limb areas being most favourable, especially where secondary structures occur. These deposits can be further subdivided into two groups based on associated mineralogy: (ia) Ca-rich plag-bt-amph-grt-ep-tour-chl-ms-carb; and (ib) ab-chl-carb-ms. The former group are also distinguished by the higher-grade mineral assemblage of the host rocks. Type (ii) deposits, as represented by the Touquoy Zone at Moose River, have only been discovered in relatively recent times and occur in carbonatized and sulfidized graphitic pelites and psammites. The extent and potential for these newer deposits remains unknown. Gold mineralization, as native gold (>900 finess; rare electrum and alloys), varies from coarse nuggets to micron-size disseminated grains and based on textural relationships is assigned a late-stage paragenesis. Associated sulfides include gal, sph, cpy, py, aspy, po and Bi-Te compounds, and there is a general positive correlation of Au with some of these pathfinder elements (Bi, Zn, Te, Pb).

Petrofabric analyses of the gold deposits indicate consistent relationships between structures in the wall rocks, alteration minerals and vein deformation. In all deposits examined vein emplacement was accompanied by ductile-brittle deformation which post-dated regional deformation. Vein emplacement reflects periods of hydraulic fracturing ($P_{fluid}>P_{lithostatic}$), similar to the seimic pump model of Sibson *et al.* (1988). Fluid inclusions (quartz host) are remarkably uniform and indicate the vein fluid was a low salinity (<6 wt. % equiv. NaCl), non-boiling, H_2O-CO_2-CH_4 (X_{CO2}=0.15) type; P_{fluid} is estimated at 2 to 3 kbars. Geochronological studies ($^{40}Ar/^{39}Ar$, Rb/Sr: bt, ms, amph, chl, carb, wr) indicate similar ages of ca. 370 Ma regardless of geographic setting or vein mineralogy. These ages are considered to approximate the time of vein formation rather than reflect slow cooling and/or resetting. We note the coincidence of these ages with widespread mafic and felsic magmatism within the Meguma Terrane. Isotopic data (S, C, O, Sr, Pb) for vein minerals (sulfides, carbonates, silicates) indicate regional variations and mixing of source reservoirs. The light stable isotopic signatures, particularly C and S, reflect variable amounts of Meguma Group contamination, but the radiogeneic isotopes (Sr, Pb) clearly indicate a non Meguma Group source for the fluids. Using the average $\delta^{18}O_{quartz}$ from 5 deposits and T=300-400°C, $\delta^{18}O_{fluid}$ is estimated at +6-12‰; the only deviation is for the West Gore deposit where values of +12-16‰ are calculated. Similar $\delta^{18}O_{fluid}$ values are calculated using +12 to +16‰ isotopic data for carbonates.

The Meguma gold deposits are considered to reflect the influence of widespread generation of mafic and felsic magmas during the Late Devonian. The high temperatures attending this event resulted in devolitization of the lower crust and generation of a CO_2-bearing fluid. This fluid either was derived from or interacted with rocks of similar isotopic (Pb, Sr) composition as the Liscomb gneisses which were emplaced post 400 Ma and pre 380 Ma, thus satisfying the geochronological constraints. The fluids were subsequently focused along Acadian structures, perhaps reactivated hinge zones, during periods of excessive fluid pressure. Gold precipitation occurred as a result of fluid:wallrock interaction and decreasing pressure.