Turbidite-hosted gold deposits: potential in the Late Proterozoic of the northern Cariboos

G.M. Ross[1]

The northern Cariboo Mountains of eastern B.C. are underlain by a thick succession of Late Proterozoic metasedimentary rocks that include over 7 km of siliciclastic turbidites. Many of the features of this region (deformation, metamorphism, lithology, etc.) compare favourably with features associated with deposits of bedding-concordant gold-quartz veins hosted in Paleozoic turbidites of Nova Scotia, which have produced nearly 1,000,000 ounces of gold since 1861. This report briefly compares the geology of auriferous Nova Scotia turbidites with the relatively unexplored homologous strata of the northern Cariboos and identifies potential regions for gold exploration.

NOVA SCOTIA EXAMPLES

The Meguma Terrane of Nova Scotia consists of Cambro-Ordovician deep-water clastics of the sandstone-rich Goldenville Formation and overlying slate-rich Halifax Formation. The Meguma Terrane was accreted to North America during the Late Paleozoic Acadian Orogeny. The collision had a strong component of right-lateral obliquity that imparted the doubly-plunging en echelon fold style and slaty cleavage that typifies this terrane. Metamorphic grade ranges up to upper greenschist and the relationship between isograds and regional structure suggests that metamorphism was late syn- to post-kinematic. The entire terrane has been intruded by peraluminous granitoid bodies that are largely post-metamorphic (and thus post-kinematic) although pre- and syn-kinematic intrusions are present).

Auriferous quartz veins occur as bedding concordant arrays limited exclusively to the hinge zones of anticlines. Quartz is the predominant mineral in the veins along with trace amounts of carbonate (generally ankerite), white mica, chlorite, arsenopyrite, pyrite, sphalerite, galena, chalcopyrite, pyrrhotite and spectacular hematite. The spatial distribution of the auriferous veins reflects the important influence of several regional features on vein emplacement in addition to obvious structural control. These are the proximity to the Goldenville-Halifax Formation boundary, the chlorite-biotite "isograd" and contacts with granitoids. These features reflect the strong control of mechanical anisotropy (layering) in the sediments on the localization of veins in addition to metamorphic and hydrothermal(?) fluid fluxes.

THE NORTHERN CARIBOOS

In the northern Cariboo Mountains, Late Proterozoic strata consist of a thick (3 km+) sequence of turbiditic grits of the Kaza Group overlain by 4 km of the slate-rich Isaac Formation of the Cariboo Group. These rocks form the low-grade carapace to the Omineca Belt and record the structural and metamorphic effects of Mesozoic collision. At the latitude of McBride (53°N), B.C., plate collision deformed these strata into upright east-verging folds (D1) and a superposed set of west-verging structures (D2).

The Kaza Group consists of feldspathic grits with minor interbedded pelite. The overlying Isaac Formation is a slate-rich unit with subordinate grit and limestone. Pyritic black shale is common, especially in the Isaac Formation, and one black shale unit in the Kaza Group is associated with a Cu anomaly. Two distinct phases of metamorphic mineral growth are present: an early phase that was contemporaneous with D1 deformation and a younger post-tectonic (post-D2) phase. Metamorphic grade ranges from subgreenschist to upper greenschist.

---

[1]Geological Survey of Canada, 3303 - 33rd Street N.W., Calgary Alberta T2L 2A7 oldest vein

Roundup '89

Quartz veins are common throughout the region and are dominated by simple mineralogy that includes quartz, ankerite-siderite, white mica, chlorite and rare sulphides. Relationships between regional structural elements and veins indicates a range in the timing of vein emplacement. The systems comprise bedding concordant veins, up to 1 m thick, that are folded by D2 structures yet also contain breccia fragments of foliated wall rock, apparently indicating a syntectonic origin to the veins. In several major anticlinal closures close to the Kaza/Isaac boundary, vein systems are associated with pervasive carbonate (siderite) alteration of wall rock. Assayed grab samples indicate low gold values (up to 84 ppb) in the wall rock but significantly this in an order of magnitude above background. In addition, streams that drain these closures (Goat and Milk River) are known to carry placer gold. Younger veins are generally transverse to regional structures and are not associated with wallrock alteration.

PROGNOSIS

Syntectonic veins in both Nova Scotia and the northern Cariboos are inferred to have been emplaced during dilation of well-layered sediments during deformation. The strong mechanical anisotropy across the Kaza-Isaac boundary and the analogous Goldenville-Halifax boundary, apparently acted to concentrate stress and aided vein formation. In Nova Scotia fluids may have been derived from metamorphic dehydration reactions, as suggested by the spatial relationship between gold veins and the chlorite-biotite "isograd", although hydrothermal fluids derived from the peraluminous granites may have been important. In the northern Cariboos, fluids are inferred to have been derived largely from metamorphic dehydration reactions and modified by pressure solution during cleavage formation. Abrupt changes in the slope of the solubility curves for both silica and gold as a function of temperature suggest that precipitation of these species probably occurred during the cooling of fluids below ca. 400° C, the approximate temperature for the first appearance of biotite. The potential for gold mineralization in the northern Cariboos, and low grade Late Proterozoic turbidites on either side of the Southern Rocky Mountain Trench, is considered good. Exploration should be concentrated on structural-stratigraphic targets (anticlines developed close to grit-slate contacts) in regions close to (or below) the first appearance of biotite.