

The possible role of the petroleum system in the metallogenesis of gold in Meguma metaturbidites: Geochemical investigation in the Touquoy deposit, Moose River, Nova Scotia

Ian Borg¹, Marcos Zentilli¹, Milton Graves¹, and Tim Bourque² - 1. *Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia B3H 4R2, Canada <ian.borg@dal.ca>* 2. ¶ *Atlantic Gold, 6749 Moose River Rd, RR#2, Middle Musquodoboit, Nova Scotia B0N 1X0, Canada*

At the onset of the Acadian orogeny in the Early Devonian, the Meguma Supergroup represented an ideal petroleum play with abundant source rock, laterally continuous sand layers, suitable permeability contrasts with shales overlying greywackes, and numerous trap structures in the form of developing anticlines and domes. Coincidentally, most important (orogenic) gold deposits in the Meguma occur within domal and anticlinal structures, as arrays of quartz-carbonate-arsenopyrite veins or as disseminations associated with black metapelites. Basinal processes would have generated abundant hydrocarbons, which probably affected cementation, effective pressure, and structure. Stable isotopic studies suggest that the carbon in vein carbonates formed by oxidation of organic matter, and fluid inclusions at Touquoy contain methane. Gold was deposited at temperatures above 300 °C (greenschist- facies conditions); hence, any residual petroleum occurs as bitumen or graphite.

Published genetic hypotheses for orogenic gold suggest that the metal could have been scavenged from turbidites, black shales, or from gold-rich diagenetic iron sulphides. Gold would have been mobilized during prograde metamorphism by oxidized complexes, migrated following hydraulic gradients imposed by tectonics and the rise of magmas, and precipitated where these complexes were destabilized by sudden decompression or reaction with reducing pore fluids. Others suggest that petroleum could have contributed to gold transport, whereas some authors dismiss petroleum as a significant agent.

The Touquoy disseminated deposit occurs on the hinge and limbs of the Moose River – Fifteen Mile Stream Anticline. Our limited sample set hinders answering fundamental questions, yet they provide some insight when combined with data from previous studies. The host strata at Touquoy (Lower Goldenville Group) contain up to two orders of magnitude more carbon (total) and CO₂ than unmineralized Goldenville strata elsewhere. Within the ore zone, Au shows a positive correlation with As, S, K/Na, Y, and Eu, and negative with Ca and W.

Although the Meguma Supergroup has been long assumed to represent a passive margin, the metagreywackes and argillites analyzed have a composition indistinguishable from volcanic dacite to andesite, rocks generally associated with active margins and volcanic arcs. This volcanic affinity supports recent interpretations by others that suggest the Meguma was deposited adjacent to a volcanic arc of Avalonia, and that the Acadian orogeny occurred in an Andean type setting. Gold and arsenic are known to be preferentially enriched in subduction-related arcs such as the Andes. It is likely that Meguma strata provided an adequate disseminated source for these elements now concentrated in gold deposits.