## Geological, geochemical, and fluid inclusion studies of the Gays River Pb-Zn deposit, southern Nova Scotia: a carbonate-hosted replacement deposit of Carboniferous age

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The Gays River Pb-Zn deposit (reserves 2.4 million tonnes 6.3% Pb, 8.7% Zn) is one of several significant Pb-Zn deposits hosted by Carboniferous rocks of Atlantic Canada. Mineralization is hosted by a dolomitized, Windsor Group (Viséan) carbonate-reef complex developed upon a basement high composed of Cambro-Ordovician metaturbiditic sedimentary rocks of the Meguma Group. The local mine stratigraphy (bottom to top) includes: (1) mixed psammites and pelites of the Meguma Group overlain unconformably by (2) a basal breccia unit consisting of Meguma Group clasts cemented by dolomitized limestone, (3) a complex package consisting of dolomitized carbonate lithologies (i.e., carbonate build-up), (4) evaporite (gypsum, anhydrite), and (5) a mixture of variably consolidated, Cretaceous-aged sedimentary debris (the "trench sediments"). Mineralization consists of both massive and disseminated ore, with the former by far the most important volumetrically and it is localized to the front of the reef rather than the saddle. The massive ore consists almost exclusively of fine-grained, Fe-poor sphalerite and Ag-poor galena and is formed from constant volume replacement of the dolostone; its thickness varies from several centimetres up to a few metres. In the central and western part of the deposit the massive ore generally has trench material as the hanging wall, while evaporite forms the hanging wall in the eastern part of the deposit. Important features of the ore include: (1) a primary control reflecting the locus of the precursor dolostone it replaced, (2) a limited vertical extent (ca. 86% of ore contained in 60 m vertical interval), and (3) ore textures suggestive of supersaturation and constant volume replacement origin. The disseminated ore, occurring both as a partial replacement and infilling of primary porosity, forms a broad halo of variable thickness beneath the apron of massive ore. Distribution of the breccia units suggests that it does not have a primary influence on the mineralization.

New S isotopic analysis, while confirming results of previous work, also indicates that there is a slight depletion in $^{34}S$ for galena mineralization in the breccia unit versus massive replacement ore ($\partial^{34}S_{gal}$ -9.5 versus 12.5). REE analyses of dolostone, massive and disseminated ore and sparry calcite indicate several reservoirs for REE and that massive ore has inherited the REE signature of the dolostone. Fluid inclusion studies indicate salinities of <25 wt. % equivalent NaCl with a large apparent range in $T_H$ (60° to >250°C). Preliminary interpretation of the data suggests that mineralization precipitated from saline brines of ca. 150° to 160°C and that the high $T_H$ values possibly reflect (1) dissolved carbonic species in the fluid and/or (2) post-entrapment modification.


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