Carbonate-hosted Pb-Zn-Ba-F deposits, and the evolution of Carboniferous Basins in Nova Scotia: a progress report

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The purpose of my thesis project is to investigate how the thermal and structural history of Carboniferous basins in Nova Scotia, is related to the formation of the mineral deposits around their margins. The deposits probably formed as a normal consequence of the evolution of the sedimentary basins. Genetic hypotheses ranging from exhalative syngenetic and early diagenetic, to epigenetic related to basinal brine expulsion or igneous intrusions, have been proposed in the literature for the Nova Scotia deposits. Consequently, the age of the main mineralizing event has been proposed to be Early Carboniferous, Permo-Carboniferous, and even Jurassic. Genetic models for similar carbonate-hosted deposits (Mississippi Valley type and Irish type) throughout the world, range from early hydrothermal fluid circulation, to diagenetic compaction-driven fluid flow, to very late gravity-driven fluid flow. Each model poses constraints on timing, on the isotopic composition of the ores and host rocks, and on the thermal evolution of the basin/deposit system.

(1) The timing of the mineralizing event, and the thermal and structural history of the basins, can be determined by K-Ar dating of hypogene clays, 40Ar/39Ar on microcline, and by fission-track dating of (detrital) apatite and zircon in the host rocks. Vitrinite reflectance, which is essentially an integration of temperature over time, can be used as a check.

(2) The paths of the mineralizing fluids, which show the link between the basins and the deposits, can be mapped by C and O isotopic alteration in the carbonates, and by thermal anomalies recorded in vitrinite, apatite and feldspars in the clastics.

(3) The source of the water, gangue minerals and metals can be determined by D/H analyses of fluid inclusions, Sr isotopes, and Pb isotopes, respectively.

A number of interesting conclusions can be drawn from our preliminary data on some of the Nova Scotia deposits.