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# Paleofluid evolution in the Bonanza base metal hydrothermal system, NWT, Canada

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The Bonanza base metal hydrothermal system is situated on the eastern edge of Great Bear Lake in the Great Bear Magmatic Zone (GBMZ), Northwest Territories, Canada. It is the oldest volcanic belt in the Paleoproterozoic (1.875-1.843 Ga) Wopmay orogen believed to be related to subduction-related magmatism. At Bonanza, the alteration and mineralization are hosted by intermediate volcanic rocks that have undergone widespread hydrothermal alteration, spatially related to a diorite/monzodiorite intrusion. The alteration assemblages include magnetite-actinolite-apatite (MAA), K-feldspar-quartz ± chalcopyrite ± pyrite (potassic), quartz-sericite-chlorite ± pyrite (phyllic), and quartz-chlorite-adularia-sericite (propylitic). Multi-stage tectonism and magmatism prepared the ground and allowed for late-stage epithermal mineralization including quartz-carbonate-nickeline-chalcopyrite-bornite-argentite ± tetrahedrite and quartz-carbonate-chlorite-chalcopyrite ± sphalerite ± cobaltite. These alteration assemblages are characteristic of iron-oxide-copper-gold systems in the Echo Bay district of the GBMZ. However, the low temperature mineral assemblages suggest a near-surface epithermal environment. Average salinity for the potassic alteration was found to be 22.8 wt% NaCl equivalent, and temperatures ranged from ~400°C to lower temperatures where a transition to phyllic alteration occured. The phyllic alteration (quartz-sericite-chlorite ± pyrite) formed at temperatures between 284 to 150 ˚C with salinities ranging between 5.0 and 17.4 wt% NaCl equivalent. Suitable fluid inclusions for characterization of the MAA assemblage were not identified; however, late-stage calcite identified in this assemblage was found to have precipitated at ~175 ˚C with a salinity of 16.9 wt% NaCl equivalent. This may be characteristic of the formation of propylitic alteration. Late epithermal nickeline-bearing veins formed at lower temperatures averaging ~ 133 ˚C with an average salinity of 14.6 wt% NaCl equivalent. Similarly, cobaltite-bearing veins formed at an average temperature ~ 130 ˚C with an average salinity of 10 wt% NaCl equivalent.

The alteration and mineralization assemblages at Bonanza formed from magmatic-hydrothermal fluids that evolved to boiling and were subjected to fluid mixing in a near surface epithermal environment. The evidence suggests that the diorite/monzodiorite intrusion was emplaced at a shallow depth causing near surface alteration and mineralization. Boiling changed the physio-chemical conditions of the metal-rich fluids causing precipitation of ore minerals in the late-stage epithermal veins.