Fluid history of the carbonate-hosted Storm Copper showing, Somerset Island, Arctic Canada

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The Cornwallis Zn-Pb district in the Canadian Arctic contains the world-class Polaris deposit as well as numerous Zn+Pb showings occupying an area from the Grinnell Peninsula to Somerset Island. Among the Zn+Pb showings is Storm Copper, a promising Cu showing on Somerset Island, in the southernmost part of the district. Mineralisation is controlled by normal faults and replaces dolostone of the Ordovician-Silurian Allen Bay Formation. Copper mineralisation consists of chalcocite, chalcopyrite, bornite, covellite, malachite, and native copper. Mineralisation can be divided into ore-stage, and post-ore-stage assemblages; the ore-stage is further divided into primary, replacement, and recrystallisation. A suite of in situ microanalytical techniques [fluid inclusion microthermometry, SIMS (O and S isotopes), LA ICP-MS (REE), and evaporate mound SEM-EDS] were used on sulphide and gangue minerals (dolomite and calcite) to characterise the fluid history of the area. Initial precipitation of ore involved two high-temperature (110°C), moderately saline (17 wt. % NaCl equiv.), reduced (no shale-normalised Ce anomaly) fluids that equilibrated with basement rocks ($\delta^{18}O_{H2O}$ = +10‰ SMOW) and mixed at the site of precipitation (variable cation content). Positive shale-normalised Eu anomalies and $\delta^{34}S_{Cpy,Py}$ values (0‰ CDT) suggest a sulphur source from Proterozoic igneous/gneissic basement, whereas Cu was probably sourced from Proterozoic redbeds. Replacement mineralisation was the product of low-latitude meteoric fluid (low salinity, $\delta^{18}O_{H2O}$ > 0‰ SMOW, shale-normalised REE pattern) interacting with primary sulphides, which produced an intermediate $\delta^{34}S_{H2S}$ composition ($\delta^{34}S_{Cpy,Py}$ = 10‰) from mixing of sulphur sources. The low-latitude paleo-location of Laurentia indicates that mineralisation occurred during the (mid-late) Paleozoic, probably related to the Ellesmerian orogeny. Recrystallised chalcopyrite precipitated from high-temperature (110°C) moderately saline (qualitatively assumed) seawater-derived ($\delta^{34}S_{Cpy}$ = 20‰ CDT) fluid. Post-ore-stage mineralisation involved low-salinity (qualitative assumption), oxidised (-Ce shale-normalised anomaly), high-latitude meteoric ($\delta^{18}O_{H2O}$ <-10‰) fluid that leached copper from pre-existing phases and precipitated oxides and native copper. The latest-stage copper phase, atacamite, indicates a high-latitude, arid environment that would have been attained by Laurentia in the Cenozoic. The Storm Copper showing records alternation of hydrothermal mineralisation with meteoric supergene enrichment during and after the Ellesmerian orogeny. Despite limitations of individual analytical techniques, the integration of in-situ analyses provides a means to establish a detailed fluid history of showings, districts, and basins.