

Paleosea-floor Volcanic-Associated Massive Sulfide Mineralization Related to a Cooling Komatiite Flow, Abitibi Subprovince, Canada

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Abstract

Paleosea-floor, volcanic-associated massive sulfide mineralization has been discovered 50 to 150 m upsection from a Late Archean peridotitic komatiite flow, where the flow is thickest in a thermal erosion channel. The Terminus massive sulfide occurrence is within carbonaceous argillites that are intercalated with basaltic komatiite flows and flow breccias. It contains appreciable Zn and Cu contents and is associated with silicification and chlorite-epidote alteration.

Ultramafic magmas are ideal heat sources for hydrothermal convective systems because of their extremely high liquidus temperatures and their tendency to become less permeable during serpentinization, which impedes advective cooling. Heuristic calculations indicate that there is sufficient enthalpy in the peridotitic komatiite flow to drive the hydrothermal system responsible for the Terminus mineralization. This hypothesis is tested using two-dimensional, finite element heat and fluid-flow simulations. The results suggest that, under the right circumstances (1) relatively thick komatiite flows may take hundreds of years to cool; (2) komatiite flow-driven hydrothermal systems can form sea-floor or subsea-floor deposits comparable in mass to those along the mid-Atlantic Ridge; (3) much of the metal leaching by hydrothermal fluids occurs below, and adjacent to, the flow; and (4) the shape of heat source komatiite flows, or subsea-floor magma chambers, affects the locus and distribution of hydrothermal upwelling. Similar, base metal-precipitating paleohydrothermal systems are present above ponded komatiite flows broadly along strike at the Potter Zn-Cu deposit in Munro township, Ontario. These paleohydrothermal systems, and the calculations presented here, suggest that thick, ponded basaltic flows on the modern sea floor have sufficient enthalpy to form significant hydrothermal sulfide accumulations.