

## **Boron metasomatism of the Alta stock contact aureole, Utah: Evidence from borates, mineral chemistry, and geochemistry**

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### **ABSTRACT**

Geochemical study of the Alta stock and adjacent contact aureole rocks provides information concerning the source, composition, and physical-chemical conditions of infiltrating fluids. Special emphasis was given to boron (B) as a tracer of fluid-rock interactions due to the occurrence of borate minerals (ludwigite, kotoite, and szaibelyite) in skarn deposits around the stock. In addition, thin section alpha-track mapping implies significant B enrichments in fluid-altered minerals within the stock, stockwork veins and related selvages, igneous sills near the stock, contact skarns, and in marbles up to 500 m from the stock. Forsterite, clinohumite, lizardite, and malachite contain between 50 and 1200 ppm B. Diopside, calcite, clintonite, phlogopite, brucite, hedenbergite, tremolite, and other minerals host B to a lesser extent. Aureole B enrichments correlate well with major and other trace-element enrichments, and support existing models of element transport in magmatic fluids with lateral down-temperature flow. Large variations in mineral B concentrations reflect changes in B concentrations of these fluids through time. Mass-balance calculations indicate that magmatic fluids emanating from the Alta pluton could supply most B in the Alta aureole. It is estimated that the emplaced magma had an initial B concentration between 7–10 ppm; indicated exhalative losses of B from the pluton are on the order of 50%. We estimate that the exsolved fluids had a time-integrated B concentration of  $160 \pm 40$  ppm, although much higher concentrations may have attended local borate mineralization.