Estimating a depth of entrapment for three-phase saline aqueous fluid inclusions in the East Bull Lake Intrusion, Ontario, Canada

BRANDON M. BOUCHER
Ore Fluids and Exploration Laboratory, Department of Geology, Saint Mary's University, Halifax, Nova Scotia B3H 3C3

Halite-bearing fluid inclusions are present in a vast range of geologic settings and deposits, most commonly porphyry and magmatic-hydrothermal ore deposits, and represent the only evidence of an original fluid composition involved in system evolution. Microthermetric studies on three-phase inclusions that homogenize via halite dissolution (after vapour bubble disappearance) can be useful in determining the minimum pressure of entrapment in a particular system by relating the liquid-vapour homogenization temperature ($Th_{L\text{-}V}$) to the halite dissolution temperature (Tm_{halite}). Once homogenization temperatures for an inclusion are recorded, an isochore can be plotted that intersects the halite liquidus. This point of intersection can then be used to determine a relative depth of entrapment of a deposit.

This method was used on mafic pegmatite samples collected from the East Bull Lake pluton in Ontario, Canada. The area is an exploration prospect for PGE-Cu-Ni sulphide mineralization, as well as a prospective site for safe, long-term disposal of nuclear waste by Atomic Energy of Canada Limited. If applied correctly, this information can be useful in expanding our understanding of current ore distribution and exploration models.

Results from this study conclude (1) the inclusions that report the highest homogenization temperatures, and therefore highest salinity, represent fluids trapped at the highest pressures and minimum depth of entrapment; (2) subsequent inclusions reporting pressures lower than the minimum depth of entrapment represent late stage (post-solidus) magmatic-hydrothermal solutions that circulated through the system after initial mineralization; (3) minimum depth of entrapment of the EBL intrusion is estimated at about 10 km, and corresponds to a minimum trapping pressure of ~300 Mpa for the deepest inclusions.

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