



Molten halides in mafic igneous systems: legitimate melts or artifacts of post-entrapment modification ?

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Giant mafic intrusions (e.g., Bushveld, Stillwater, Sudbury) host late-stage inclusions of halide melt composed of NaCl or CaCl₂ (> 90 wt% eq. salt). The salt melts may have formed by the “dehydration” of initially low salinity magmatic fluids during the late-stage hydrous alteration of cumulus minerals. To test this theory, aqueous fluid (20 wt% eq. CaCl₂; Ca:Mg = 5:1) and a solid assemblage of diopside-enstatite-quartz were reacted in cold seal vessels at conditions consistent with post-cumulus alteration (700-800°C, 0.4-0.5 kbar; 200-240 hrs). The solid assemblage reacted with the fluid to stabilize Mg-tremolite. Synthetic hydrosaline inclusions were trapped along fractures in the quartz. Inclusion salinities increase linearly across inclusion trails from 22 wt% eq. to > 96 wt% eq. CaCl₂. The increase in salinity is attributed to the incorporation of OH into tremolite (Cl excluded due to Mg-Cl structural avoidance). LA-ICP-MS analyses show that, with increasing salinity, the Ca:Mg ratio of the salt melt phase increases from 5:1 to >20:1. This “purification” of the salt melt phase may result from Ca-Mg exchange with the solid assemblage during tremolite formation, consistent with natural salt melts (i.e., dominated by only one major cation).

Although the results indicate that true salt melt phases may form in magmatic systems, researchers must scrutinize any suspected inclusions for evidence of post-entrapment modification. At Sudbury, for example, very high salinity (> 70 wt% eq. NaCl) inclusions occur in granophyre dikes near the intrusion. These inclusions are comparable to those in layered intrusions (irregular, non-cubic morphologies and high salt fill ratios). However, they contain additional solid phases that do not dissolve upon heating (calcite, hematite, barite). These solid phases indicate decomposition of inclusion H₂O and H₂ loss during post-entrapment oxidation, causing a dramatic and entirely artifi-

cial increase in the salinity of the inclusions.