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Occurrence of tuite and ahrensite in Zagami and their significance for shock-histories recorded in martian meteorites

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Abstract

We report on the discovery of two high-pressure minerals, tuite and ahrensite, located in two small shock-induced melt pockets (SIMP 1 and 2) in the Zagami martian meteorite, coexisting with granular and acicular stishovite and seifertite. Tuite identified in this study has two formation pathways: decomposition of apatite and transformation of merrillite under high-*P*-*T* conditions. Chlorine-bearing products, presumably derived from the decomposition of apatite, are concentrated along the grain boundaries of tuite grains. Nanocrystalline ahrensite in the pyroxene clast in SIMP 2 is likely to be a decomposition product of pigeonite under high-*P*-*T* conditions by a solid-state transformation mechanism. The pressure and temperature conditions estimated from the high-pressure minerals in the shock-induced melt pockets are ~12–22 GPa and ~1100–1500 °C, respectively, although previous estimates of peak shock pressure are higher. This discrepancy probably represents the shift of kinetic relative to thermodynamic phase boundaries, in particular the comparatively small region that we examine here, rather than a principal disagreement between the peak shock conditions.

Keywords: Tuite, ahrensite, Zagami, martian meteorite, high-pressure minerals