EVAPORATION OF MELILITE.

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Introduction: We have been conducting experiments under extremely reducing conditions to investigate the influence of evaporation conditions and cooling rate on textures and mineralogy of Type B CAIs [1–4]. In many such experiments, a melilite rim formed at the surface, as a result of local evaporative loss of magnesium and silicon from the melt, which raises the crystallization temperature of melilite. Under these conditions, evaporation of crystalline melilite occurred within a few μm of the surface, forming new phases. We explore these effects here and discuss implications for observations in CAIs.

Experiments and results: Samples of composition [2,3] (along the solar nebular condensation curve) were held at fixed temperatures of 1351–1422°C for 0.5–22 h or cooled at 2–10°/h in reducing gases in a 1 atm furnace. In experiments run at 1351 and 1385°C, the average melilite composition was $Åk_{28}$ and approached $Åk_{14}$ near the surface. In these samples, spinel near the surface had significant excess Al_2O_3 ($2 \leq (Al/Mg)_{atom} \leq 5$) when enclosed in melilite, but stoichiometric when in contact with glass [4]. In the 1422°C experiments, average melilite was $Åk_{10}$, but approached pure gehlenite near the surface. Gehlenite was intergrown with grossite at the surface. In one area, hibonite and grossite partially replaced spinel (Fig. 1).

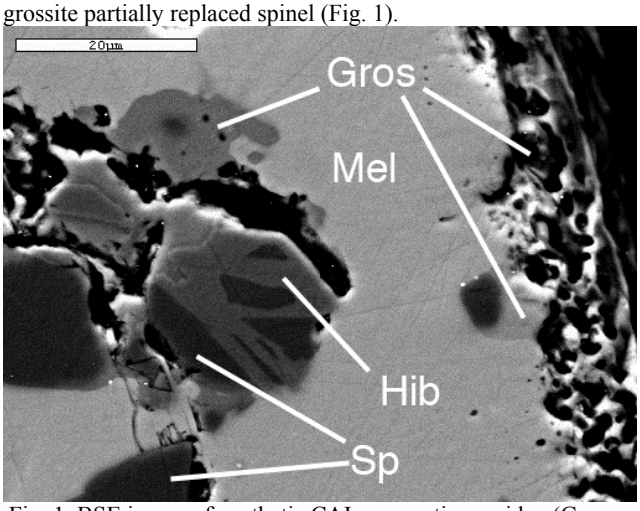

Fig. 1. BSE image of synthetic CAI evaporation residue (Gros—grossite; Hib—hibonite; Mel—melilite; Sp—spinel).

Discussion: The texture and mineral assemblage in Fig. 1 is quite similar to that of a CAI from Murchison, for which a melting temperature of 2100°C and a cooling time of only a few seconds was inferred [5]. It is now apparent that such assemblages (and nonstoichiometric, Al_2O_3-rich spinel) can be made by more prolonged heating and evaporation of crystalline melilite and spinel at much lower temperatures under the reducing conditions typical of a gas of solar composition.

References: [1] Richter F. M. et al. 2002. *Lunar Planet. Sci. XXXIII* Abstract #1901. [2] Mendybaev R. A. et al. 2003. *Lunar Planet. Sci. XXXIV* Abstract #2062. [3] Mendybaev R. A. et al. 2003, *Meteoritics & Planetary Science* 38:A100. [4] Davis A. M. et al. 2003, *Evolution of Solar System Materials Conference Abstracts*, 17–18. [5] Simon S. B. et al. 1994. *Geochim. Cosmochim. Acta* 58, 1937–1949.