EXPERIMENTALLY DETERMINED CaS-MnS REE PARTITIONING: IMPLICATIONS FOR AUBRITIC OLDHAMITE.

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Introduction: A considerable debate exists about the origin of aubritic oldhamite (CaS), which is the major REE carrier in aubrites [1,2]. Similar REE abundances and patterns between some oldhamite grains in aubrites and enstatite chondrites [3], Yb anomalies in some aubritic oldhamite [3], and the high melting temperature of oldhamite in isolation (>2500 C) have been suggested as evidence for a relict nebular origin for some aubritic oldhamite. In contrast, some aubritic oldhamite REE patterns and textures are best explained by igneous processes [3,4].

Previous Work: While most previous workers [e.g., 3] have studied unrelated grains in the matrix of aubrites, we have documented the REE patterns of co-existing sulfides within an oldhamite-rich lithology in ALH 84008 [5]. Previously we measured a total of 15 oldhamite, 9 alabandite, 2 djerfisherite, 1 troilite and 1 daubreelite grain in three thin sections of the oldhamite-enriched cataclastic zone in ALH 84008 [5]. We have reanalyzed some samples and confirmed that there are two groups of oldhamite with different REE abundance patterns. The grains are petrographically similar to each other. Most of the oldhamite grains have bowed REE patterns with negative Eu anomalies at abundances of ~100-400xCI [5]. This pattern has been interpreted as indicating an igneous origin [3,4]. However, we have confirmed [5] the existence of a few grains with positive Eu and Yb anomalies and depleted HREE. These patterns have been interpreted as nebular [5].

Experimental: We conducted REE partitioning experiments between CaS and MnS in an attempt to understand the origin of these patterns and to provide further clues to the genesis of aubrites. We used 50:50 molar CaS:MnS, doped with 100 ppm of each REE. The sample was ramped from 940ºC to 1275ºC over a period of 4 hours, held at temperature for 1 hour, and then quenched in air. The experiment produced two sulfides—a calcium-dominated sulfide with ~24 wt.% Mn and a Mn-dominated sulfide with ~13.5 wt.% Ca.

Discussion: $(D_{REE})_{CaS\text{-}MnS}$ in ALH 84008 range between 400 for the LREE and 5 for the HREE with some pairs exhibiting positive Eu and Yb anomalies in the partition coefficients. In contrast, experimentally determined $(D_{REE})_{CaS\text{-}MnS}$ for the LREE are approximately 1 and for the HREE are approximately 0.05. The experimental partition coefficients also exhibit positive Eu and Yb anomalies. While the patterns of the partition coefficients are similar, the magnitude of the D_{REE} suggests that REE's strongly prefer oldhamite in the natural system and either show no preference or prefer MnS in the experimental system. We conclude that sulfide-sulfide partitioning did not establish the overall abundances of REE's in natural aubritic sulfides that may have been established by silicate-sulfide partitioning, but may have played a role in producing both Eu and Yb anomalies.

References: [1] Floss C. et al. (1990) *GCA* **54**, 3553. [2] Lodders K. et al. (1993) *Meteoritics* **28**, 538. [3] Floss C. and Crozaz G. (1993) *GCA* **57**, 4039. [4] Wheelock M.M. et al. (1994) *GCA* **58**, 449. [5] McCoy T.J. and Dickinson T.L. (2001) Abstract #1221. 32nd Lunar & Planetary Science Conference.