REE CONTENT OF METEORITIC Ca-PHOSPHATES.

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Introduction: Apatite ($Ca_5(PO_4)_3(F,Cl,OH)$) and merrillite ($Ca_9NaMg(PO_4)_7$) are minor phases in most meteorite groups and exhibit varying abundances and grain sizes. Moreover, they are major carrier phases for REEs as well as for halogens and therefore provide insight into the chronology and genesis of their host rocks. However, their abundances and distribution, especially within the early Solar System, are still poorly constrained [1-3].

Material and Methods: Despite their rarity in some meteorite groups, intensive search by EPMA and SEM has established a chemically and petrographically well-documented pool of over 600 phosphates covering nine different meteorite classes. The trace element concentrations (with particular interest in the REE) of selected grains were analyzed by LA-ICP-MS at the University of Münster and/or SIMS at the NORDSIM Laboratory in Stockholm providing data for 133 apatites and 163 merrillites. This dataset covers 6 ordinary chondrites, 1 carbonaceous chondrite, 1 ureilitic trachyandesite [4], 1 eucrite, 3 acapulcoites, 4 shergottites, 1 winonaite, 1 mesosiderite and 1 IAB iron meteorite.

Results: Ca phosphates are major hosts for REE in all observed samples accounting for the majority of the bulk REE budget. This entails enrichments of up to two orders of magnitude compared to the concentrations of the bulk samples. Chondritic phosphates generally show lower REE contents than those of achondrites (up to 300x CI vs. up to 3000x CI), and concentrations in merrillites mostly exceed those in apatites by an order of magnitude. The latter either exhibit flat patterns often with a pronounced negative Eu anomaly and in a few cases a slight depletion in HREE (acapulcoites, ureilitic trachyandesite, winonaite) or they feature enrichment in the LREE with slight Eu anomalies, either positive or negative but coinciding within each sample (carbonaceous and ordinary chondrites). Merrillites show three main REE patterns with varying enrichments: (1) flat patterns with a pronounced negative Eu anomaly and a slight depletion in the HREE (ordinary chondrites, eucrites, acapulcoites); (2) unfractionated patterns without pronounced anomalies (mesosiderites, enriched shergottites) and (3) patterns highly depleted in the LREE, with a slight negative Eu anomaly (depleted shergottites).

Discussion: LA-ICP-MS and SIMS analyses provided concordant data which is also consistent with previous work available on phosphates from some of the analyzed meteorites [5-7]. Variations of REE patterns within meteorite groups appear to be controlled by their location of formation rather than their sequence of crystallization. For instance shergottites feature merrillites as late stage crystallization products, exhibiting varying REE patterns (enriched - depleted) depending on characteristics of their source region and, hence, different basaltic melts [3].

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