Ce ANOMALIES IN THE ANTARCTIC EUCRITE LEW 85300. Christine F. Heavilon and Ghislaine Crozaz. Earth and Planetary Sciences Department and McDonnell Center for the Space Sciences, Washington University, St. Louis, MO 63130 USA.

During most geochemical processes, the rare-earth-elements (REE) in the trivalent state are fractionated as a smooth function of ionic radius. Anomalies in the REE pattern are commonly exhibited by Eu, which can exist in the divalent state under reducing conditions. Less frequently, Ce is oxidised to Ce (IV). Terrestrially this occurs primarily in the marine environment. Seawater has a strong negative Ce anomaly which appears to result from the lower solubility of Ce (IV) than the trivalent REE [1]. However, studies on altered submarine basalts suggest that Ce behaves inconsistently during weathering. In meteorites numerous examples of Ce anomalies have been reported [2-4]. Although there are exceptions [5], the bulk of Ce-anomalous meteorites appear to come from Antarctica, and have positive anomalies, with reported Ce/Ce* (where Ce is the measured value and Ce* the value obtained from interpolation between La and Pr) ratios up to 2.56. These studies also show that the eucrites dominate the population of Ce-anomalous Antarctic meteorites.

Shimizu *et al.* [6] analysed inner and outer portions of the polymict eucrite ALHA 78132, in an attempt to determine if the anomalies could be attributed to terrestrial or pre-terrestrial processes. An inner sample of the meteorite had a small negative Ce anomaly, while four outer portions had positive ones. The latter also had lower REE concentrations, as well as slightly lower contents of FeO, MgO and CaO. The authors concluded that weathering in the Antarctic ice was responsible for these observations. In addition, recent geochemical studies of Antarctic and non-Antarctic eucrites [7] have revealed interesting differences. From INAA data, it is apparent that a significant fraction of Antarctic eucrites have positive Ce anomalies, most pronounced when La concentrations are low, while non-Antarctic eucrites lack this component [8]. The implication is that Ce is preferentially retained over the other REE during alteration in the Antarctic ice.

In this study we have focussed on one Antarctic polymict eucrite, LEW 85300. Our specific goal was to determine in which phase or phases the Ce anomalies were found and whether or not they were spatially associated with cracks or a given lithology. The meteorite has been classified as weathering grade A/B, with few rust stains and minor fractures. We used secondary ion mass spectrometry (SIMS) to analyse individual minerals in two polished thin-sections. The sections contain a number of distinct basaltic clasts, consisting of calcic plagioclase and inverted pigeonite, embedded in a glassy matrix. Isolated fragmented and shocked plagioclase and pyroxene grains also occur in the matrix. One of the thin-sections also contains regions which appear to have undergone extensive alteration. We primarily selected fresh-looking, seemingly unweathered pyroxene and plagioclase grains, although a few analyses were also made of the altered regions and the glassy matrix.

Of 17 plagioclase grains analysed, only two have Ce anomalies, both of them negative (Ce/Ce* = 0.34 and 0.53). Three analyses of glassy matrix have relatively flat, non-anomalous REE patterns with concentrations of 10 x C1, similar to typical bulk eucrite analyses. Pyroxene analyses are more interesting. Of 52 apparently unweathered pyroxene grains, 32 have positive Ce anomalies ($1.64 \leq$ Ce/Ce* ≤ 30.0) (Figure 1a), 14 have negative anomalies ($0.31 \leq$ Ce/Ce* ≤ 0.54) (Figure 1b) and the remainder are normal. In addition, a traverse of eight analyses across a single pyroxene grain revealed anomalies of both types, but no obvious trend. Positive and negative Ce anomalies are found adjacent to each other, and next to non-anomalous analyses. A magmatic source for the Ce anomalies is thus ruled out. A plot of Ce/Ce* ratio vs. Nd concentration shows that the largest Ce anomalies are found at low Nd concentrations, consistent with leaching of the REE in the Antarctic ice and preferential retention of Ce. However, this picture is complicated by data from the altered areas. Three analyses show variably fractionated REE patterns, all, however, with large negative Ce anomalies (Ce/Ce* ≈ 0.25) (Figure 2). This is somewhat surprising because the data for the "unweathered" pyroxene grains suggest a preferential retention rather than loss of Ce.

Pyroxene is clearly the mineral most strongly affected. The anomalies appear to be randomly distributed in all clasts, as well as in the matrix. They are not preferentially associated with a given lithology, nor are they necessarily located near cracks or fractures. It is evident that there has been widespread mobilization of the REE, even within grains which appear to be unweathered. The exact mechanism for this mobilization is unclear, but it is most probably due to weathering in the Antarctic ice. Even samples which appear relatively fresh and unweathered have apparently undergone some alteration, the extent of which varies on the microscale. This has important implications for the use of REE and other trace element data in petrogenetic modelling of the Antarctic eucrites. Terrestrial processing must be ruled out before such data can be used to interpret the petrogenesis of these meteorites.

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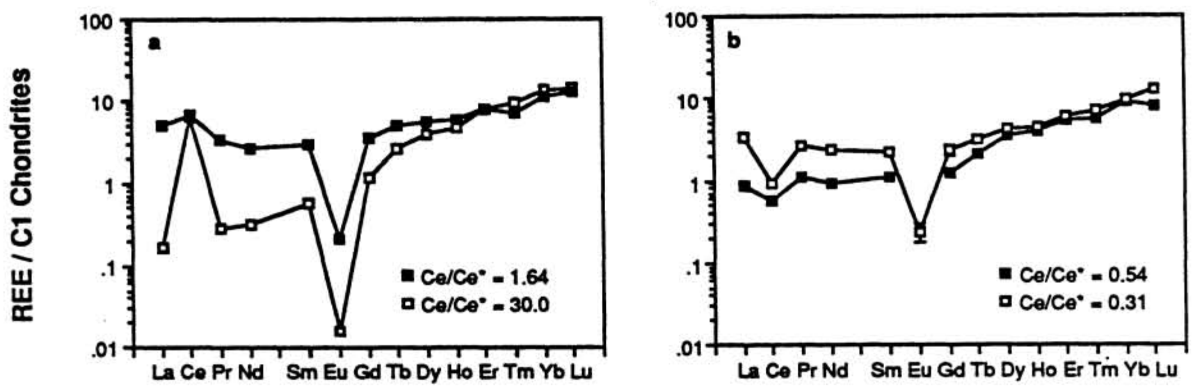

Figure 1. C1-chondrite normalized REE patterns for pyroxene from LEW 85300
a) the largest and smallest positive Ce anomalies
b) the largest and smallest negative Ce anomalies.

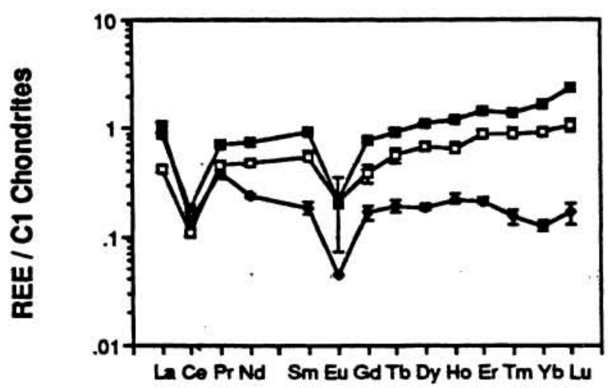

Figure 2. C1-chondrite normalized REE patterns for altered regions from LEW 85300.