IDENTIFYING AND USING WEATHERED ANTARCTIC EUCRITES. M.M. Strait, Alma College, Alma, MI 48801; D.W. Mittlefehldt, Lockheed ESCO C23, Houston TX 77058; and M.M. Lindstrom, NASA Johnson Space Center, Houston, TX 77058.

Studies of asteroidal differentiation in early Solar System history have been dramatically enhanced by the discovery of large numbers of meteorites in Antarctica. However, recently it has been shown that significant differences in minor and trace element abundances between Antarctic and non-Antarctic eucrites are probably due to weathering (1, 2). This alteration is thought to occur in interstitial material leaving major silicate phases intact and suitable for petrologic modelling (2).

We performed neutron activation analysis for major and trace elements on a suite of eucrites from both Antarctic and non-Antarctic sources to see if there was a reliable way to distinguish Antarctic eucrites with disturbed trace element systematics from unaffected eucrites, short of performing time consuming analyses. In addition, we analyzed a set of mineral separates from a weathered eucrite clast to determine if it would be possible to sidestep the effects of Antarctic weathering on samples.

Prior work with Antarctic eucrites has led to the definition of two groupings based on abundances of the REE: those with normal REE patterns, and those with abnormal patterns, mostly apparent enrichments in Ce and Eu (2). This same study proposed that eucrite phosphates dissolved during the residence of the meteorite in Antarctica. Removal of the phosphates resulted in large depletions of the incompatible element budget of eucrites. Close examination of the data shows that abnormalities in the patterns appear not to be enrichments of Ce and Eu, but rather, depletions of the other REE.

This study had a two-fold purpose: first, to enable abnormal eucrites to be readily recognized and, second, to look at ways to use abnormal eucrites in petrogenetic models.

For the first part of this study, a suite of eucrites from a variety of locales was analyzed. Included in the set were five non-Antarctic eucrites to enable comparisons to be made with stones that have not undergone Antarctic exposure. All five non-Antarctic meteorites were falls. For the Antarctic eucrites both clast and matrix samples were taken, as well as a paired interior/exterior sample.

The suite of samples was examined to determine if there was a simple way to distinguish abnormal from normal Antarctic eucrites by optical inspection. In general, the Antarctic eucrites studied here fall in the same range of trace element abundances as the non-Antarctic eucrites. Exceptions were generally readily explained, such as being extensively weathered (HOW88401,15) or a different lithology (e. g., cumulate eucrite EET87548,12). Abnormal eucrites have been defined as samples which have more than a 10% fractionation of La from Ce (2). Seven of the sixteen samples exhibited Ce anomalies of >10%, however only two of them show greater than 20% fractionation. This data set, therefore is not particularly good for differentiating normal from abnormal eucrites (Figure 1).

Easy, obvious ways of differentiating the two groups are not particularly useful. Weathering, identified either by naked eye or using a binocular microscope, whether ferrous (rusty) or sialic (gray weathering rind), shows no apparent correlation between the amount of weathering observed on the meteorite and the presence of a Ce anomaly (Figure 1). Of the seven samples with Ce anomalies, four of them show no obvious weathering. The most heavily weathered samples (EET87542 - pervasive rust; HOW88401,15 - pervasive rust, exterior sample) had no Ce anomaly (Figure 1).

Even when this data set is combined with earlier data collected to look at the Ce anomaly problem (2), no simple result comes out that unequivocally allows distinction of abnormal eucrites based on appearance. Previous work has shown that Ce/La and Eu/Sm ratios deviate from chondritic ratios more extensively in Antarctic eucrites. This is not clearly demonstrated in this limited data set.

The second part of the study, an abnormal eucrite clast sample, LEW85300,57, examined earlier (2) was utilized. The sample was separated into its constituent minerals. If the weathering truly affected primarily the phosphates, the pyroxene and plagioclase should be minimally affected. Mineral separates were performed by both magnetic separation and heavy liquid density separation. The separates were washed with a series of different acids selected to remove phosphates and cerium oxide, or other weathering products from the pyroxene and plagioclase.

The attempt to see if abnormal eucrites potentially could be used for geochemical modelling seems to have been successful. The mineral separates from eucritic clast LEW85300,57, a weathered basalt with Ce/La ~1.23 and Eu/Sm ~ 1.78 times chondrites, show normal REE patterns with no evidence of the weathering effects present in the whole rock (Figure 2). Comparisons between the results obtained in this study and earlier studies on mineral separates from non-Antarctic eucrites show good agreement (3).

Potentially it appears that abnormal eucrites could still be used for geochemical modelling if carefully prepared mineral separates are used rather than whole rock samples.

References: (1) Shimizu, et al. (1983) Mem. Natl. Inst Polar Res. (Japan), Spec. Issue 30, 341-348; (2) Mittlefehldt, D.W. and Lindstrom, M.M. (1991) GCA, in press; (3) Schnetzler, C.C. and Philpotts, J.A. (1969) In Meteorite Research, (Millman, ed.) Reidel, 206-216.

Fig. 1. Normal (EET, HOW) and abnormal (LEW) REE patterns. LEW appears fresh, EET and HOW are rusty.

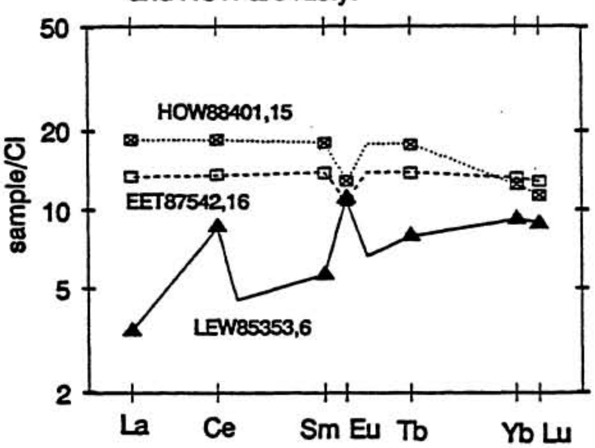

Fig. 2. Whole rock and mineral separates from clast LEW85300,57.