PRELIMINARY CHEMICAL DATA FOR SOME ALLAN HILLS POLYMICT EUCRITES.

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Preliminary chemical data obtained by instrumental neutron activation analysis (INAA) for six polymict Allan Hills (ALHA) eucrites are presented in Table 1 as part of the Reid consortium effort. The samples comprised 0.1 to 0.4g rock chips primarily extracted from the interior portions of the achondrite by A. Reid. ALHA 78132,28 is from a poorly defined layer that is richer in small white clasts whereas ALHA 78132,39 is from interior pieces just as are the other eucrites reported in this work. Due to striking heterogeneities observed in rock chips from ALHA 78158,13 we have labeled them splits 1 and 2. Most of these samples are fine-grained gray to pale gray in color and consist of microcrystalline pyroxene, plagioclase, silica, and glass with accessory opaque phases. ALHA 77302,53 has visible plagioclase laths, light brown pyroxenes, and metallic accessory phases. ALHA 78165,13 shows some conspicuous glassy spherules within a microcrystalline matrix indicative of possible impact melt alterations. Previous petrographic observations of ALHA 76005 report the presence of a 4.5mm anorthositic clast along with numerous smaller clasts of fine-grained plagioclase plus pigeonite with typical ophitic to subophitic texture (6). We did not observe any large clasts in ALHA 76005,23 and therefore we assume this sample represents normal eucritic compositions. Other petrographic data will be presented in this volume. The petrogenetic interpretations are based primarily on chemical data alone.

Major element oxides reported in Table 1 generally fall near or within the ranges of previously determined monomict normal eucrites (1). Values of Fe' (Fe/Fe+Mg mole ratio) range from 0.52 to 0.66 (+0.02) suggesting a considerable range of differentiation; however, high Fe' values are often inconsistent with TiO2, CaO, and K2O concentrations leading us to suspect that the values observed in some samples (ALHA 78165,13; ALHA 78158,31) could be attributed either to significant troilite or metallic Fe, or to the large uncertainties in the Mg determination.

Chondritic normalized (C.N.) trace element abundances are illustrated in Fig. 1 and can be compared with the trace element abundances of known monomict eucrites in Fig. 2 (1-4). The REE patterns of these polymict eucrites are strikingly symmetrical about a ~8X chondritic REE profile just as portrayed by both normal and cumulate eucrites previously studied. ALHA 78158,13 is obviously heterogeneous with respect to trace and major element abundances. The enrichment of REE abundances of split 1 relative to split 2 is consistent with Fe' values and suggests some fractional crystallization of pyroxenes (2?). In general this eucrite REE pattern is similar to that of Moore County (4) suggesting cumulate affinities. Whole rock observations of this sample show heterogeneities but do not show significant enrichments of plagioclase. Until min-pet studies have been done on these rocks petrogenesis can conceivably be attributed to the partial melting from a pyroxene rich source.

ALHA 78132,39 represents either a small degree of partial melting from a plagioclase peridotite source or represents an extensively differentiated eucritic flow as inferred from major and trace element abundances. The relative trace element abundances shown in Fig. 1 are similar to those of Stannern which plots along a partial melt trend (see Fig. 3) contrary to ALHA 78132,39 which plots along the fractional crystallization trend. Since these data are preliminary and could conceivably be modified with respect to the MgO values (+17% uncertainty for this sample), ALHA 78132,39 could represent a partial melt liquid. ALHA 78123,28, although separated from the same
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meteorite, does not exhibit major or trace element abundances observed for ALHA 78132,39 again emphasizing the polymict nature of some eucrites. The petrogenetic relationship of these two individual rocks may be accounted for by invoking equilibrium fractional crystallization of ~45% pig + plag (1:1) from a parent with a composition of ALHA 78132,28, thereby generating the Ba, Sr, K, REE, Sc, Th, and the high Fe' abundances of ALHA 78132,39. ALHA 77302,53 may represent the least differentiated eucritic composition. This eucritic composition can best be illustrated in Fig. 3.

The behavior of the incompatible lithophile trace elements (LREE) upon equilibrium partial melting is also similar to the behavior of these elements during fractional crystallization. On the other hand, Fe' values behave quite differently in each of these two petrologic processes since equilibrium partial melting is strongly dependent on source residuals whereas fractional crystallization depends on major mineral compositions. The two trends shown are calculated trends using appropriate distribution coefficients in batch equilibrium partial melting and Rayleigh type fractional crystallization equations and are analogous to Stolper's (6) two differentiation trends using Ti as the incompatible lithophile element. ALHA 77302,53 plots on this graph along a trend suggesting that this eucrite is parental (to a first approximation) to 78132,28, 76005,23, and 78165,13, and is a result of an extensive partial melt from a plagioclase rich (~15%) source. The similarity of the REE abundance pattern with that of Haraiya (1) (Fig. 2) is consistent with the fractional crystallization trend in Fig. 3. In conclusion, it has been shown that the polymict ALHA eucrites represented in this work conform to representatives of previously known monomict eucrites as well as the finding of new eucrites which may represent parental magmas to previously interpreted parental magmas (Sioux County or Juvinas). These observations emphasize the importance of magma differentiation processes on the eucritic parent body. Accounting for the petrogenesis of ALHA 78158,13 could introduce some subtleties not previously recognized in development of a consistent model for cumulate eucrite origins.

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Chondrite Normalized Trace Element Abundances of Known Eucrites

- STANNERN (3) Fe²⁺/Fe = .60
- Jonzac (4) .60
- Staux County (1) .60
- Staux County (2) .60
- Nuevo Laredo (1) .66
- Moore County (4) .50
- Jarva (1) .44
- Juvinas (1) .35
- Haraya (1) .60

Fe²⁺ = Fe / (Fe + Mg) mole fraction

FIG. 1

FIG. 2

La (ppm)

FIG. 3

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