
**BACKGROUND:** Evidence for redistribution of Fe and Mg in plagioclase of lunar and terrestrial samples during high-temperature metamorphism or very slow cooling has been described previously[1]. Redistribution of REEs in plagioclase of terrestrial anorthosites has also been demonstrated whereas lunar anorthosites do not appear to exhibit this effect[2]. Evidence for reequilibration between plagioclase and melts for some eucritic meteorites has also been provided on the basis of the extraordinary partition coefficients that are required to account for the contents of REEs and other components in separated plagioclases and their collateral whole rock eucrites[3]. Isotopic data show REE reequilibration between plagioclase, but not pyroxene, and phosphate in the meteorite Ibitira[4]. Because analyses of separated phases may be compromised by contaminants that could not be eliminated during separation, it is desirable to analyze individual mineral grains for their trace elements and utilize appropriate partition coefficients to test the reasonableness of calculated melts. Although microbeam analyses provide an excellent means for such analyses, sensitivity or interference problems may limit the range of elements and accuracy for such analyses. Therefore, we opted for another means of analysis.

**TECHNIQUE:** In our analyses we utilize a microdrilling technique that removes 40 to 100 μm diameter cores from mineral grains in thin sections analyzed by microprobe. The cores are then analyzed by INAA using the technique of Lindstrom [5]. Three eucrites were selected for application of this analytical technique: monomict breccias Pasamonte and Stannern and unbrecciated EET90020. Pasamonte is among the most unequilibrated of the eucrites on the basis of zoning in pyroxenes and is considered to be an igneous rock not significantly affected by metamorphism[6]. Stannern has igneous texture but its pyroxenes indicate some reequilibration, although little, if any, recrystallization. EET90020 has a granulite texture and has been substantially recrystallized. Our sample of Pasamonte contains several clasts of different grain sizes ranging from glass to fine-grained with diabasic texture containing lathy plagioclase, unexsolved pigeonite, and mesostasis. Cores were taken of the glass and from minerals and mesostases in six lithic clasts which normally allowed sampling of more than one phase per clast. Our sample of Stannern is also a breccia but with little difference in grain size between clasts and matrix. The plagioclase and pigeonite are blocky, twinned and exsolved and coexist with a bit of mesostasis. Cores were taken of plagioclase and pigeonite with no attempt to distinguish separate clasts. EET90020 is a granular mixture of twinned plagioclase and pigeonite having rather uniform size and many triple junctions. Several cores were taken of both phases. Both clear and cloudy grains of plagioclase and pyroxene were sampled in all three eucrites.

**RESULTS:** The results for REEs, Fe, and Mg in plagioclase and pyroxene are shown in Figs. 1 and 2. Because of small grain size in Pasamonte and Stannern, a few cores of plagioclase contain small amounts of pyroxene and vice versa. These results are not included in the figures. The REE values in EET and Stannern are relatively consistent. The slopes for plagioclases in EET are significantly steeper than the more igneous-textured eucrites as also seen in terrestrial plagioclases[2]. Pyroxenes in EET have steeper light REE and flatter heavy REE patterns. The Fe and Mg in plagioclases of EET are lower and more consistent than those in Pasamonte and Stannern. EET and Stannern have equilibrated pyroxenes with limited ranges in Fe/Mg. They are also quite homogeneous in compatible (Co, Cr) and incompatible (Sc, Sm) trace elements. EET is more homogeneous than Stannern, as expected based on its recrystallized texture. Pasamonte, on the other hand, shows variability in Fe/Mg and trace elements.

We find a positive correlation of Fe/Mg vs Sc/Mg and Sm/Mg as expected for igneous zoning. Contrary to expectations we also find a positive correlation of Fe/Mg vs Cr/Mg and Co/Mg. At present, we do not understand the cause of the latter correlations. REE patterns for calculated melts for EET using recent partition coefficients[2, 7] are shown in Fig. 3. The calculated melts are up to 40 times higher than whole rock values for igneous eucrites like Stannern and Pasamonte. Calculated melts for Stannern (Fig. 4) are also many times higher than for Stannern whole rock, and the pyroxenes produce higher values than plagioclase. The small grain sizes of our Pasamonte sample allowed very few good analyses but the few usable values again produce calculated melts that are several times higher than Pasamonte whole rock. Previous analyses of minerals from eucrites[8] produce similar results. Basaltic and diabasic textured eucrites are believed to represent melt compositions[9] which requires that they were closed systems during crystallization. Thus, if igneous equilibrium is maintained, the melt REE patterns calculated from our mineral data should lie between whole rock (initial melt) and mesostasis (residual melt) patterns. We have mesostasis analyses only for Pasamonte and they lie within the calculated melts except for La in pyroxene. The glass clast in Pasamonte is similar in both major and trace elements to Pasamonte whole rock values. The 5 samples of Pasamonte mesostases have REE patterns that are relatively flat, ranging from 15 to 100 times chondrites, but with large Eu depletions. The lowest two of these are broadly similar to...
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Lakangaoon and Nuevo Laredo which may be residual liquids [10]. Fe and Mg contents for calculated melts of EET using partition coefficients for plagioclase [11] are several times less than in igneous-textured eucrites as also seen in terrestrial and lunar recrystallized rocks[1]. Pasamonte's calculated melts have Fe content about right but Mg is about 50% of what is expected. Stannern's calculated melts are scattered about the expected values.

**DISCUSSION:** Clearly the REEs, Fe and Mg in pyroxenes and plagioclases have been redistributed since their initial crystallization in all samples. The very high content of REEs in some mesostases of Pasamonte provides a logical source for the increased REE contents in plagioclase and pyroxene, probably during equilibration with the mesostasis. The EET sample has ample textural evidence for extensive subsolidus recrystallization during which redistribution of components is expected. For Stannern and Pasamonte, however, their igneous textures suggest very little recrystallization. Thus, the redistribution must result from such causes as slow cooling accompanied by extensive reequilibration between melt and mesostasis, shock effects, or some combination of shock effects and a later heating. The fine-grained diabasic to ophitic texture in most eucrites seems to preclude slow cooling during initial stages of crystallization. The time and cause of the redistribution in these igneous textures requires further study and bears heavily on petrologic and isotopic interpretations of eucrites.

**References:**
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