THE POLYMICT EUCRITES

Jeremy S. Delaney, M. Prinz, and H. Takeda

2 Mineral Inst., Univ. Tokyo, Japan.

The polymict eucrites are a newly defined subgroup within the basaltic achondrites suite of meteorites (1). They are polymict breccias dominated by clasts derived from many types of mafic rocks. They form a compositional-textural continuum with the howardites (which also contain an important orthopyroxenite component in addition to the mafic clasts). A formal division between the two groups at 10% orthopyroxenite component has been proposed (1). Three Antarctic localities; Yamato Mtns, Allan Hills (ALH) and Elephant Moraine (EET); have yielded polymict eucrites and three non-Antarctic achondrites become polymict eucrites using the definition above. At least 32 specimens are known but the number of meteorites is probably smaller: Bialystok, Nobleborough, Macibini, 2 from Allan Hills, 2 from Elephant Moraine and at least 2 from Yamato Mtns.

Polymict eucrites have bulk compositions generally similar to the monomict eucrites but with important differences. Yamato meteorites have less Al2O3 and more MgO than ALHA or monomict eucrites (3-13). EETA meteorites have low Ca, high Mg/(Mg+Fe) and enigmatic high K2O contents (3). In general, the ALHA polymict eucrites are compositionally most like the monomict eucrites, whereas the Yamato and EETA meteorites are closer to the howardites. Isotopically (7) bulk ALH meteorites are similar to monomict eucrites, but separated clasts have lower 1Sr ratios. At least one separated clast has unusual oxygen isotopes (14) that are not linked to the basaltic achondrites by mass fractionation. Impact mixing of oxygen reservoirs may, however, account for these data (15).

The most characteristic feature of all the polymict eucrites is the diversity of clast types sampled. The monomict eucrites generally have very uniform textures and compositions from clast to clast suggesting that they are truly monomict breccias, but the influence of pervasive metamorphism in all eucrites except Pasamonte has not yet been totally assessed (16). In the polymict eucrites, and in the howardites, many different mafic clast types are known.

Mafic Clasts. The earliest descriptions of Yamato polymict eucrites (9,20) emphasized the presence of both cumulate eucrite and basaltic eucrite pyroxene. Most Yamato meteorites contain pyroxene in lithic and mineral clasts that have exsolution textures and chemistry comparable with Binda, Juvinas, Pasamonte and Nagaria. All of these pyroxene types have also been located in lithic fragments indicating that the Yamato meteorites sampled a wide range of mafic rocks. The ALHA and EETA meteorites appear to be lacking the Binda-like fraction, but sample all the others as lithic clasts. Coarse gabbroic clasts that are not simply comparable with any eucrite textures are also found but their compositions are generally eucritic. In all the Antarctic polymict eucrites, glassy and very fine-grained spherulitic basalt clasts are present sampling either surface volcanics or impact melts. Some glasses have xenocrysts and compositions similar to the bulk meteorites suggesting that they are impact melts but others have compositions suggesting some crystal-liquid fractionation and are, therefore, probably volcanic. Mafic rocks from polymict eucrites are their main components. Although they sample rocks like monomict eucrites (En30-40 Wo5-15+An88-92), rare feldspar cumulate fragments (An93-95+En45-55) and pyroxene cumulate fragments (En64) the most important clasts are those not seen as meteorites. Clasts having Mg/(Mg+Fe) ratios comparable to all eucrites but coexisting with more sodic feldspar (An75-85) confirm the existence of several suites of basaltic rocks on the basaltic achondrite parent body (21). Some unequilibrated clasts are probably impact generated basalts and once recognized, can provide further information of regolith diversity.
range of clast compositions observed (22) does not seem compatible with the simple
dimensional model (23) and requires additional fractionation or variable source
regions.

**Metamorphic Overprint.** In all Antarctic polymict eucrites, clasts may be
subdivided into equilibrated (or annealed) clasts and unequilibrated clasts (cf
17). Evidence for metamorphism of portions of the ALH and EET breccias (18,19)
indicate that the unequilibrated clasts are probably late introductions to the
breccia. The EETA79004 and 79011 breccias are dominated by a metamorphic
overprint that may have equilibrated many of the mafic clasts with one another
(19). In ALHA76005 metamorphism was not so well developed and appears to have
affected limited regions (18). In ALH, non-Antarctic and most Yamato specimens,
annealing or metamorphism of most lithic clasts occurred before incorporation into
the breccia. At least one Yamato meteorite (Y790260), however, has textures
suggesting that it sampled a heavily metamorphosed or even partially melted
breccia. This meteorite is distinct from EETA79004 as the mafic clasts it contains
do not show such complete homogenization of Fe/Mg.

**Pyroxenites.** Careful searches for ‘diogenitic’ pyroxene in the Antarctic specimens
have been generally unsuccessful. Occasional En70+ compositions have been found in
Yamato and Allan Hills specimens but appear to be phenocryst cores rather than
orthopyroxenite fragments. The non-Antarctic meteorites and ALHA78006 all have
diogenitic pyroxene. These meteorites all plot in the monomict eucrite field of the
ol-an-SiO2 pseudoternary (22) and are chemically more like eucrites than some
polymict eucrites. They have, however, modal pyroxene/plagioclase ratios within the
Antarctic polymict eucrite range (2). The whole group is modally transitional
between the howardites and the monomict eucrites and clearly is part of a
continuum of polymict breccias.

**CONCLUSIONS**

(1) The polymict eucrites are part of a continuum of polymict
breccias that extend the howardite range to overlap the monomict eucrites. (2)
Polymict eucrites may be treated in mixing calculations in the same way as
howardites but available data suggest that only some clasts are identical to the
monomict eucrites. Many represent previously unsampled rocks. (3) The mafic clast
population of the polymict eucrites together with that of howardites constitutes a
very diverse suite of volcanic and plutonic igneous rocks that provide much more
rigorous constraints on their parent body than do the eucrites alone. (4) The
petrogenesis of these meteorites involved several stages (i) Formation of an early
igneous crust that was brecciated to form regolith. (ii) Metamorphism of some
areas. (iii) Variable degrees of reworking. (iv) Further igneous activity of either
volcanic or impact origin. (v) Incorporation of late igneous rocks into the present
breccias.

**References**

submitted. (3) Palme et al. (1983) EETA, this volume. (4) Miyamoto et al. (1979)
et al. (1979) MNIPRSI 15, 34. (13) Takeda, Yanai (1982) MNIPRSI, in press. (14)
Clayton et al. (1979) LPS X, 221. (15) Delaney et al. (1982) LPI Tech. Rept. 82-
(1978) MNIPRSI 8, 185. (21) Delaney et al. (1981) LPS XII, 211. (22) Delaney et