CLAST POPULATIONS IN THREE ANTARCTIC ACHONDRITES

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INTRODUCTION. Preliminary petrography and mineral chemistry are presented from a consortium study of three achondrites from the 1987 U.S. collection at Elephant Moraine: EET87509 (584g), EET87513 (394g), and EET87531 (527g). Studies of EET87509 and EET87531 are organized by J. C. Laul and of EET87513 jointly by Laul and D. Mittlefehldt. The prime purpose of the initial processing is to provide preliminary descriptions of the larger lithic clasts and to produce clean clast separates for more detailed study.

The three achondrites are similar in appearance; a breccia matrix composed of monomineralic fragments contains lithic clasts that are abundant but small in size. Matrix pyroxene compositions in all three meteorites display a similar range from magnesian 'diogenitic' orthopyroxenes to 'eucritic' ferropigeonites; feldspar compositions (An_{74-95}) and minor phases are also comparable. EET87513 is a howardite with abundant diogenitic pyroxene in the matrix. Magnesian orthopyroxenes are somewhat less abundant in EET87531 and in EET87509, which might be classified as a polymict eucrite.

Each meteorite has a distinctive suite of larger clasts (cf. Takeda, et al. (1)). Brief descriptions are given below of the clasts we separated: stated weights are for the amount of clean clast material obtained. The list does not include the very small carbonaceous clasts separated.

CLASTS IN EET87509.

Clast D (.156g) is a very fine-grained eucrite with intergrown pyroxene and plagioclase (<.3 mm) in a texture indicative of rapid cooling with no evidence of subsequent annealing.

Clasts Q, T, and U (.501g, .008g, and .003g) are pigeonite vitrophyres with large, partly skeletal phenocrysts in a fine-grained groundmass (cf. ALHA77302 (2)); the texture is similar to some Apollo 15 pigeonite vitrophyres. Phenocrysts are zoned with low calcium cores as magnesian as En_{72} and pigeonite rims richer in Fe and Ca. Zoning is irregular and may partly reflect a subsolidus redistribution of iron related to healed fractures in the pyroxene.

Clasts E and W (.286g and .015g) are porphyritic eucrites with zoned phenocrysts of plagioclase (An_{76-92}) and pigeonite along with minor fine-grained groundmass.

Clast K (.007g) is probably a diogenite fragment; the single thin section contains an orthopyroxene grain (En_{70}) that locally, near the attached matrix, is more iron-rich.

Clast X (.024g) contains strained, subrounded pyroxenes (low Ca, En_{40-62}) and a few feldspars in a dark, fine-grained matrix; it is probably an impact breccia.

The unusual pigeonite vitrophyres in EET87509 are apparently derived from liquids more magnesian and more pyroxene rich than the common eucrites. The striking feature of the entire clast assemblage is the abundance of rapidly cooled volcanic products, characterised by quench or porphyritic textures and derived from a range of eucritic melts. Examination of the breccia matrix shows the presence of a number of glassy fragments containing microphenocrysts that, by analogy with the clast population, may be volcanic glasses rather than impact melts.

CLASTS IN EET87513. Some of the eucrite and diogenite clasts in EET87513 are part of the Mittlefehldt consortium and will be described elsewhere. The following is thus a partial listing.

Clast B (.08g) is a deformed, equilibrated eucrite with high iron pyroxenes that are unzoned but show fine exsolution lamellae (Juvinas-type), cloudy feldspar, and ilmenite.

Clast Y (.084g) is a highly deformed, recrystallised eucrite with abundant high Ca plagioclase (An_{96-97}) and low calcium, Mg-rich pyroxene (En_{63-68}), nearing diogenitic compositions (cf. Yamato 7308 (3)).

Clasts A and EE (.042g and .024g) are fine-grained, equigranular pyroxenites with magnesian orthopyroxene (En_{72-77}) and minor olivine (Fo_{66}). We interpret these as recrystallised diogenite fragments.

Clast N (.036g) is a carbonaceous chondrite fragment with matrix bulk composition resembling CM chondrites and silicates that are generally very low iron olivine, orthopyroxene, and diopside. The clast closely resembles carbonaceous fragments in the howardite Bholghati (4), but is significantly larger (4x5mm).

Like other howardites, EET87513 has both eucrite and diogenite (recrystallised) clasts. No pigeonite vitrophyres were recognised; but there are eucritic fragments with more magnesian pyroxenes than the common eucrites, an unusually large carbonaceous chondrite fragment, and some small glass clasts.

CLASTS IN EET87531.

Clast J (1.242g) is a large eucrite clast. The single thin section of this clast shows an apparent boundary between material displaying igneous texture with zoned pyroxenes and material which appears to be moderately recrystallised, but also has inhomogeneous pyroxenes. More thin sections are needed to categorise this clast, which is the largest one separated.

Clasts P and N (.909g and .425g) are apparently unequilibrated eucrites with pyroxenes showing a patchy zoning that may reflect original growth zoning partly modified by secondary subsolidus diffusion effects. Both clasts show some secondary weathering effects.

Clast R (.49g) is an ordinary equilibrated eucrite with unzoned but exsolved iron-rich pyroxenes, plagioclase with many inclusions, opaques, and no obvious mesostasis.

Clast T (.131g) is interpreted as a recrystallized diogenite. The clast has fine-grained equigranular texture, orthopyroxene compositions En_{69-79}, and is similar to the pyroxenites in EET87513.

The significant aspect of EET87531 for future study is the presence of both equilibrated and unequilibrated eucrite clasts of moderately large size. The exact nature of the pyroxene zoning in these clasts and the extent to which primary and secondary processes have contributed to the variability has still to be defined. It is apparent, however, that these clasts have varied thermal histories; consortium studies may be able to assess the effects of thermal history on trace element and isotope chemistry.

SUMMARY. These three Elephant Moraine achondrites derive from regoliths that are broadly similar on a fine scale but contain significantly different suites of larger lithic clasts. The range of clast types available for study includes: quench eucrites, porphyritic eucrites, pigeonite vitrophyres, eucrites with primary zoning, eucrites with pyroxenes that are heterogeneous as a result of metamorphic redistribution, equilibrated eucrites, magnesian eucrites, and diogenites.

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