PETROLOGY OF TWO NEW EUCRITES FROM NORTH WEST AFRICA. B. Mcferrin, E. A. Worsham, H.Y. McSween, and L.A. Taylor, Planetary Geoscience Institute and Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996-1410, USA. (bmcferri@utk.edu) (eworsham@utk.edu)

Introduction: The HED (howardite-eucrite-diogenite) meteorites formed by igneous processes on a differentiated asteroid, probably 4 Vesta. Eucrites are alkali-poor basalts or gabbros, diogenites are orthopyroxenite cumulates, and howardites are breccias repre-enting mixtures of the two s[1]. By studying and understanding HEDs we can better understand the differentiation and volcanic processes that occurred on the planetesimals that likely formed the terrestrial planets. This study focuses on two new eucrite breccias from North West Africa, NWA-6105 (~12g) and NWA-6106 (~302 g).

Methods: Both meteorites were examined petrographically and analyzed with the electron microprobe, using standard operating procedures. Six unbrecciated clasts were chosen for initial analysis in NWA-6106 and four clasts in NWA-6105; more work on the brecciated matrix will follow.

Results: *Petrography* NWA-6106 contains clasts that are either unbrecciated or the clasts themselves are breccias. However, mineral analyses described below indicate that it is monomict. One clast is over 10 mm in size. Some of the unbrecciated clasts have an ophitic to subophitic texture. The meteorite consists of plagioclase, ortho-and clino-pyroxene, silica, chromite, ilmenite, and Fe-Ni metal. The plagioclase is mostly lathe-shaped with carlsbad and albite twinning. The grain size ranges from <0.1 mm in the crushed matrix to ~0.8 mm in some lithic clasts. Both pyroxenes contain exsolution lamellae and are subhedral to anhedral. Pyroxenes range in size from <0.1-1.7 mm. The smaller grains are anhedral. The chromites, ilmenites, and metals are anhedral, ranging from <0.1 mm to ~0.3 mm. A secondary calcite vein cuts through the thin section.

NWA-6105 is a medium-grained polymict breccia containing a number of distinct types of eucrite clasts. The bulk of the meteorite is mostly made of a matrix of broken pyroxenes and plagioclase. Chromite, ilmenite, silica, and phosphates are the minor minerals present. The pigeonites are mostly subhedral/euhedral and have a grain size of 1-2mm in eucrite clasts and 0.1-0. 2 mm in the crushed matrix. They contain fine exsolution lamellae of clinopyroxene having a thickness of a few microns. The chromites, ilmenites, and phosphates have a grain size of 0.1-0.3 mm and are anhedral/subhedral. Most of the minor minerals are enclosed by low-Ca pyroxenes, but some occur in the matrix. The plagioclase is typically subhedral and has a grain size of ~1 mm in the clasts and 0.01-0.2 mm in the matrix. The plagioclase grains are distinguished by albite and carlsbad twinning. The eucrite clasts are 1-5 mm in size and vary in texture from ophitic to hypiomorphic granular. The clasts are hypocrystalline containing crystals of pigeonite and plagioclase within a matrix of pyroxenes, plagioclase, and sometimes glass. The clasts tend to be coarse-grained and resemble cumulate eucrites, although their pyroxene compositions are not magnesian enough (see below). The eucrite clasts can be distinguished by differences in grain size, texture, and mineral compositions.

EMP. The electron microprobe analyses for the pyroxenes in both the eucrites are shown in the pyroxene quadralateral (Fig. 1), along with their minor element distributions (Fig. 2). The plagioclase and chromite analyses are shown in Figs. 3 and 4, respectively.

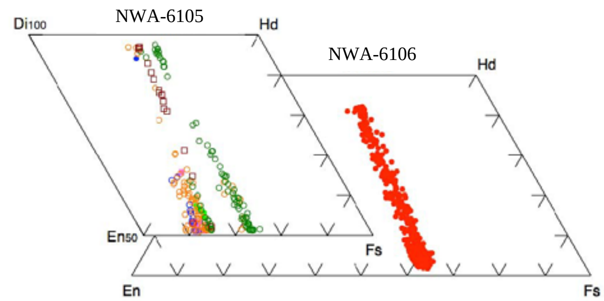

Figure 1: Pyroxene analyses for the NWA-6106 (filled red circles) and NWA-6105 eucrites (other colors).

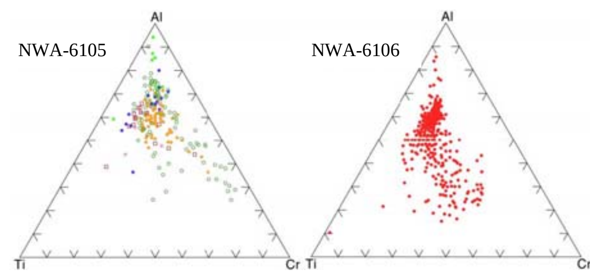

Figure 2: Minor element distributions in pyroxenes. Clasts for NWA-6106 are the same, but various clasts plot differently in NWA-6105.

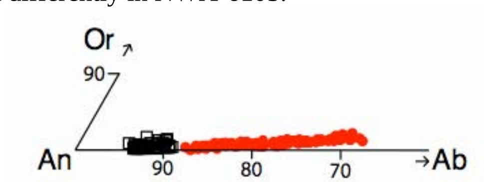

Figure 3: Plagioclase analyses for the NWA-6106 (filled red circles) and NWA-6105 eucrites (open black squares).

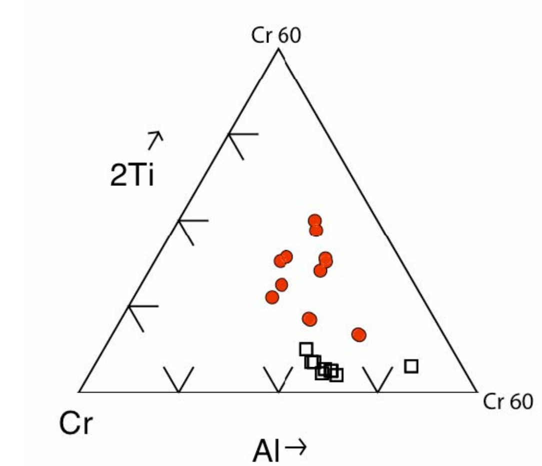

Figure 4: Chromite analyses for the NWA-6106 (filled red circles) and NWA-6105 eucrites (open black squares).

Pyroxenes in the various eucrite clasts have different compositions, and the range of the plagioclase compositions in the NWA-6106 eucrite is much wider than that of NWA-6105.

Discussion: Figure 1 shows that pyroxenes from NWA-6105 plot in different areas of the pyroxene quadrilateral, whereas pyroxenes from NWA-6106 only plot in one area. This confirms that the first is a polymict eucrite and the second is a monomict eucrite. Distinct plagioclase and chromite compositions in the two meteorites also demonstrate that they are unrelated eucrites.

Geothermometry was performed utilizing the two-pyroxene thermometer of [2] (Fig. 5). The augites and pigeonites cover a range of compositions and equilibration temperatures, but we have eliminated those pyroxene compositions that obviously represent overlapping analyses. We used the augite compositions to estimate temperatures. Each clast in the polymict eucrite NWA-6105 equilibrated at a temperature of 450-550 $\pm$ 50 °C. The equilibration temperature for NWA-6106 ranged from 700-900 $\pm$ 50 °C. These are interpreted as metamorphic temperatures.

These two eucrites have pyroxene compositions that are are comparable to those in basaltic unbrecciated eucrites studied by Mayne et al. [3]. NWA-6106 pyroxenes and their minor elements plot in the same area as LEW 85305, EET 87520, GRA 98098, GRO 95533, and others. Different clasts' pyroxenes and their minor elements in NWA-6105 plot in the same area as LEW 88010, LEW 88009, and QUE 97014.

Further petrologic and geochemical characterization of these eucrite breccias is planned.

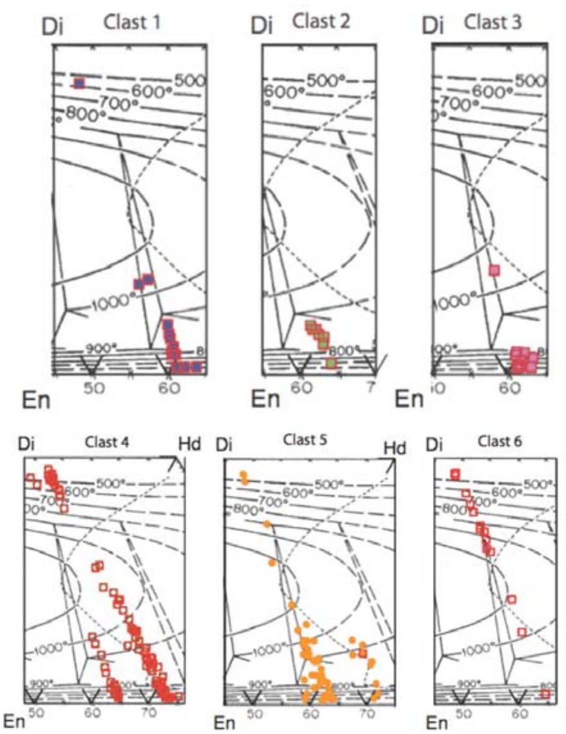

Figure 5: Two pyroxene geothermometer for different clasts in NWA-6105.

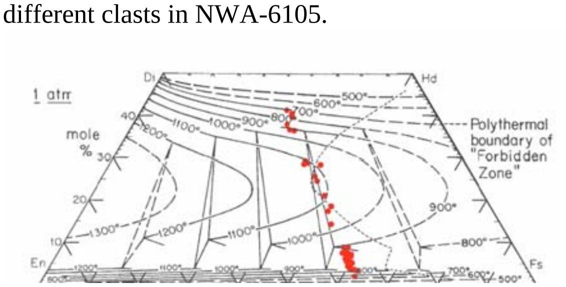

Figure 6: Two pyroxene thermometer for one clast in NWA-6106. Pyroxenes in all other analyzed clasts plot in the same area.

References: [1] McSween H. Y. (1999) *Meteorites and Their Parent Planets*, 127–131. [2] Lindsley D. H. (1983) *Am. Mineral., 68,* 477-493. [3] Mayne R.G. et al. (2009) *Geochim. Cosmochim. Acta, 73,* 794-819.