PETROLOGY AND GEOCHEMISTRY OF THE NWA 3368 EUCRITE. K. G. Gardner[1], D. S. Lauretta[1], D. H. Hill[1], J. S. Goreva[1], K. J. Domanik[1], I. A. Franchi[2], M. J. Drake[1] [1]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, [2]Planetary and Space Sciences Research Institute, The Open University, Milton Keynes, MK7 6AA, United Kingdom; *kgardner@lpl.arizona.edu*.

Introduction: A considerable amount of debate exists on the petrogenesis of eucrites, basaltic meteorites believed to have originated on the asteroid 4 Vesta [1]. One school of thought, developed by Stolper [2], suggests that most eucrites are primary partial melts of chondritic material, while another by Mason [3] suggests that eucrites are residual liquids that resulted from fractional crystallization from a chondritic magma that had previously crystallized diogenites. Many scientists have further speculated on the formation event, supplementing ideas to the models by Mason and Stolper ([4], [5], *etc.*). In order to distinguish between hypotheses, an understanding of both the major and trace element compositions of all eucrites is imperative. In this study, we report the petrology and trace element geochemistry of NWA 3368.

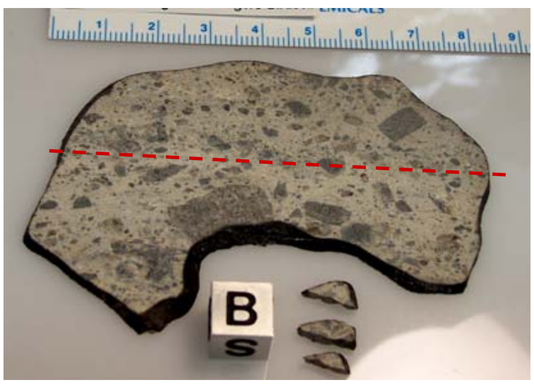

Figure 1: Cut slab of NWA 3368; fresh, black fusion crust is seen at the edge
(1 cm^3 block and cm-ruler at top for scale)

Petrology Methods: Two thin sections and one 20.5 gram polished slab were studied using optical microscopy and the Lunar and Planetary Laboratory's Cameca SX-50 electron microprobe. Element maps of major elements were prepared, and analyses were made of all phases.

Geochemistry Methods: Six sub-samples including four clasts, a section of light-colored matrix, and a section of dark-colored matrix were separated from the polished slab using a rock splitter, and each chunk was divided in two: one for use in INAA and one for use in ICP-MS. Two small chips of NWA 3368 were sent to Open University to determine oxygen isotope composition.

Instrumental Neutron Activation Analysis: A suite of major, minor and trace elements were analyzed by INAA at the University of Arizona Nuclear Reactor Laboratory and LPL's Gamma Ray Analysis Facility. 60-sec. irradiations in the Rabbit Facility of the UA-TRIGA reactor were followed by a 3-hr. Lazy Susan irradiation. Samples were counted in series grouped by decay.

Inductively Coupled Plasma Mass Spectrometry: A similar suite of major, minor and trace elements were analyzed using a Thermo Finnigan Element2 ICP-MS. Each of the six NWA 3368 clasts and matrix pieces were dissolved using standard dissolution procedure. A series of custom-made solutions of basaltic composition and the Geological Society of Japan standard basalt JB-2 were used as standards.

Results: *Petrology*: NWA 3368 has a variety of dark and light angular clasts that range in size from several millimeters to a couple of centimeters in length. They range in texture from coarse- to fine-grained. The fine-grained matrix has both a light and dark pink hue, and the two colored matrix regions are separated by a slight foliation in the matrix texture (marked in Fig 1 as a red dashed line). Only a minor amount of weathering is present.

Electron microprobe analyses yielded pyroxene compositions of $Wo_5En_{36}Fs_{59}$ for low-Ca pyroxene and $Wo_{43}En_{30}Fs_{27}$ for high-Ca pyroxene (Fig 2). All Fe/Mn ratios lie between 28 and 32, typical for eucrites [6].

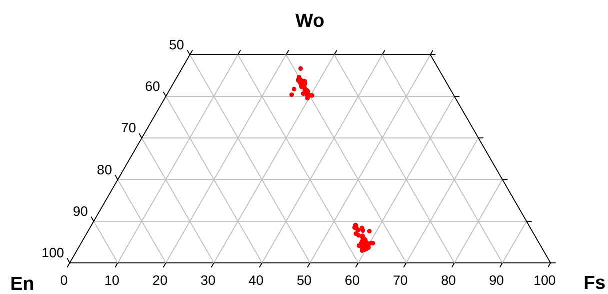

Figure 2: Range of pyroxene compositions and their associated exsolution lamellae (atomic %)

Plagioclase in NWA 3368 has a composition of $An_{90}Ab_{10}Or_{0.4}$. Ilmenite and troilite grains are abundant, along with chromite containing 5 to 27% TiO_2 and ~5% Al_2O_3. Other phases include iron metal and silica. Figure 3 shows a BSE electron microprobe image of a high-Ti content chromite grain with ilmenite exsolution lamellae.

Two main texture types exist in NWA 3368. A BSE image of the fine-grained texture is shown in Figure 4, and a BSE image of the coarse-grained texture is shown in Figure 5. The fine-grained texture is composed of abundant plagioclase and lamellae-free pyroxene, while the coarse-grained texture contains abundant pyroxenes with varying degrees of exsolution lamellae.

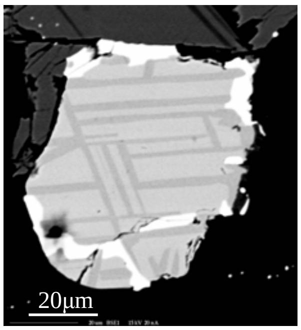

Figure 3: Chromite with ilmenite exsolution lamellae

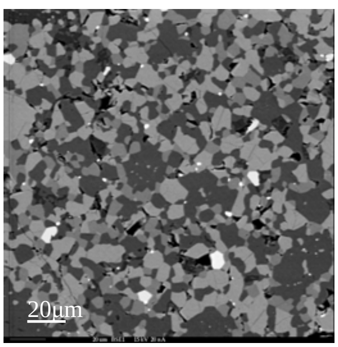

Figure 4: Example of fine-grained texture

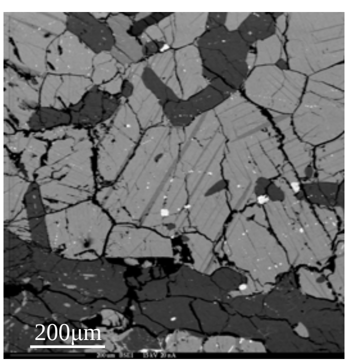

Figure 5: Coarse-grained texture and exsolution observed in some clasts

Oxygen isotope data are consistent with all other HED meteorites (Table 1).

δ17‰	δ18‰	Δ17‰
1.714	3.753	-0.237

Table 1: Oxygen isotope data

INAA: INAA data reveal a flat REE pattern with a slightly negative Eu anomaly. Figure 6 represents REE data for both matrix regions and several representative clasts.

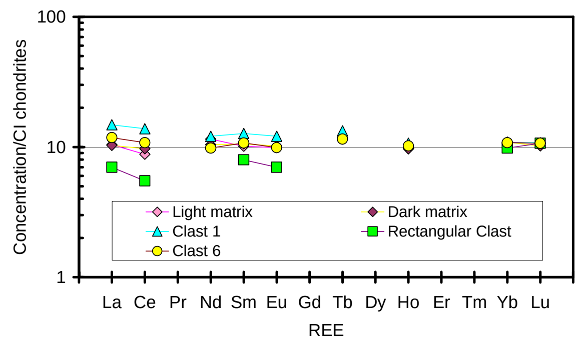

Figure 6: REE data measured by INAA

ICP-MS: At the date of submission of this abstract, ICP-MS data was not finalized for publication. Please see conference presentation or further publications for these results.

Conclusions: NWA 3368 is a non-cumulate, monomict eucrite breccia related to known normal eucrites. The two separate lithologies, particularly the pyroxene exsolution, probably represent two separate thermal events that may be either metamorphic or primary igneous in origin. The REE abundances and patterns, as well as other trace element abundances, are typical of normal or main group eucrites. At this point in the study, the trace element data do not reveal the nature of the pink coloration.

References: [1] Consolmagno G. J. and Drake M. J. (1977) *Geochim. Cosmochim. Acta*, 41, 1271-1282. [2] Stolper E. M. (1977) *Geochim. Cosmochim. Acta*, 41, 587-611. [3] Mason B. (1962) *Meteorites*. 274 pp. [4] Ikeda Y. and Takeda H. (1985) *LPSC XV*; *JGR, 90* (suppl), C649-C663. [5] Righter K. and Drake M. J. (1997) *M&PS*, 32, 929-944. [6] Mittlefehldt, D. W. et al. (1998) *Planetary Materials, 36*, 4-103—4-130.

Acknowledgements: This work was supported by NASA grant NAG 12795 to M. J. Drake. Special thanks go to William Boynton for the use of his Gamma Ray Laboratory to count the irradiated samples from INAA.