PETROLOGY, MINERALOGY AND MINERAL CHEMISTRY OF ANTARCTIC MONOMICT EUCRITES CMS04049 AND QUE 97053. M. Righter[1] and T. J. Lapen[1], [1]Department of Geosciences, University of Houston, Houston TX 77204-5007 (mrighter@mail.uh.edu).

Introduction: The howardite-eucrite-diogenite (HED) meteorites represent the largest groupd of achondrites and are generally regarded as being samples from the crust of the asteroid 4 vesta [1, 2]. Since the non-cumulate eucrites were derived from the same parent body, it is likely that the EPB should once have had a uniform ^{176}Hf/^{177}Hf isotope composition. However, based on previous Lu-Hf data [3-5], the HED parent body appears have been heterogeneous with respect to Hf isotope composition. Many eucrites are breccias formed by impact mixing near the surface, and these impacts disturbed the mineralogy, texture and isotopic ages. To get prisice isotope and age data, it is important to select unbrecciated sample to avoid age mixing. So, we selected two monomict eucrites CMS04049 and QUE97053. They both are classified as "a unbreccciated eucrite" [6, 7]. Old Mn-Cr age of 4558.4±0.6 Ma are also reported [8]. But there is no petrologic detail about this meteorite. Since almost all eucrite have experienced metamorphism, it is important to evaluate thermal hisoty. We will report preliminary geochemical and petrologic studies of two such eucrites and will discuss them in relation to eucrite petrogenesis.

Samples and Analytical Techniques: We performed petrologic and geochemical comparison to better understand the history of this meteorite to apply age. Polished thick sections were examined by a SEM and Cameca SX100 electron microprobe at NASA-JSC, with a 20kV accelerating voltage and 15nA sample current.

Trace element microanalysis was performed using a CETAC LSX-213 laser ablation system coupled to a Varian 810-MS ICP-MS at University of Houston. Elemental abundances were determined in spot mode, from the isotopes: $^{25,\ 26}$Mg, ^{44}Ca, ^{45}Sc, ^{49}Ti, ^{53}Cr, ^{59}Co, ^{62}Ni, ^{65}Cu, ^{66}Zn, ^{71}Ga, ^{72}Ge, ^{86}Sr, ^{89}Y, ^{90}Zr, ^{93}Nb, ^{137}Ba, ^{139}La, ^{140}Ce, ^{141}Pr, ^{146}Nd, ^{147}Sm, ^{153}Eu, ^{157}Gd, ^{159}Tb, ^{163}Dy, ^{165}Ho, ^{166}Er, ^{169}Tm, ^{172}Yb, ^{175}Lu, and ^{178}Hf. Ablated spots were 50 and 100 μm in diameter, depending on the grain size. The standard used was the BHVO-2G and BIR-1G, with Mg, Ca as an internal standard for normalization.

Texture and mineral chemistry:

CMS04049: The PTS shows an unbrecciated subophitic texture consisting of large (200-2000μm), interepenetrating plagioclase that are surrounded by anhedral, Fe-rich low-Ca Minor minerals are silica, ilmenite, chromite, troilite, and zircon. Shock effects ar extensive including darkening (clouding) of silicates. Pyroxenes have closely spaced, fine augite exsolution lamellae up to ~5μm. Pares of low-Ca pyroxene and augite ($Wo_{5.5}En_{38.5}$ and $Wo_{40.9}En_{31.0}$) (Fig. 1.) indicate the equilibration temperature of ~880°C [9]. Mg/Fe of low-Ca pyroxene are homogeneous. Chemical compositions of fine-grained plagioclase in mesostasis area are in the range of An75-84. In contrast, the plagioclase laths are in the range of An84-94. Ilmenite.. big grains Fine-grained chromite and troilite are scattered throughout, but there is no grain bigger than a few micron size. Zircon grains are found in this meteorite. Those grains are small (up to 20 μm in diameter), closely associated with ilmenite. Molar FeO/MnO ratios of pyroxene (~32) are similar range of other basaltic eucrites (31.2-32.2) [10].

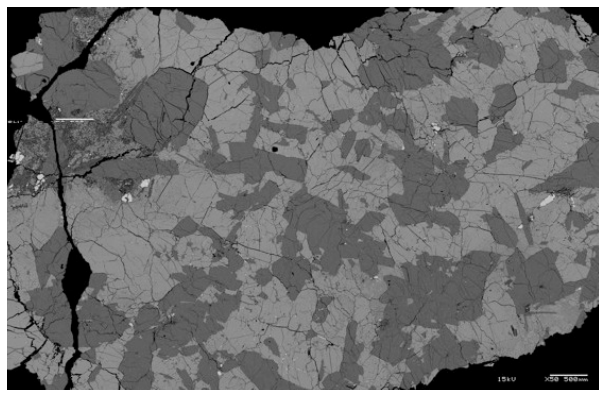

Fig 1. BSE image of CMS 04049.

QUE97053: The PTS shows coarse-grained (up to 2mm) unbrecciated subophitic texture mainly consisting of plagioclase and pyroxene. Minor minerals are

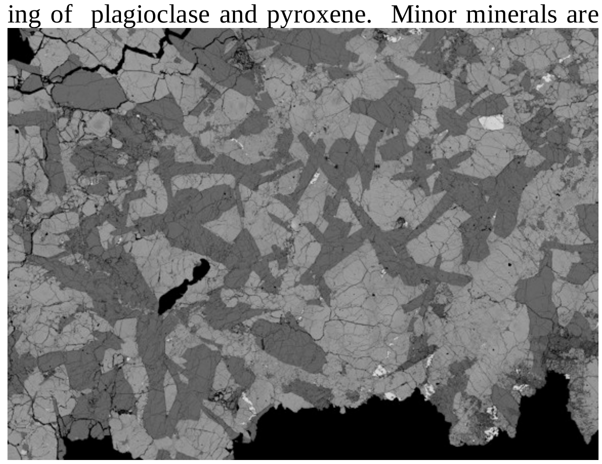

Fig 2. BSE image of QUE 97053.

silica, ilmenite, chromite. Shock effects ar extensive including darkening (clouding) of silicates. Pyroxenes are low-Ca pyroxene with fine scale augite lamellae (a few μm). Exsolution temperature of QUE 97053 is ~801°C [7]. Chemical compositions of plagioclase are in the range of An79-90.

Trace element abundances in minerals:

Plagioclase: Plagioclase has a LREE-enriched REE pattern (La ~0.5-2 ×CI; CI-normalized La/Nd ~1.7) (Fig. 4).

Pyroxene: As discussed in an earlier section, both eucrites contain two pyroxene (low-Ca pyroxene and augite). The spot sizes of 50-100μm in diameter we used for LA-ICP-MS measurement are much larger than the width of the exsolution lamellae. Therefore, the compositions show in Fig. 4 resasonably approximete the compositions of the original unexsolved pyroxene (Fig. 5).

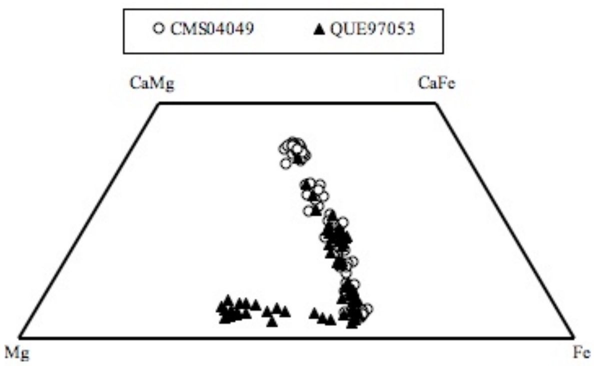

Fig. 3. Portion of pyroxene quadrilateral for CMS04049 (open circle) and QUE97053 (solid triangle).

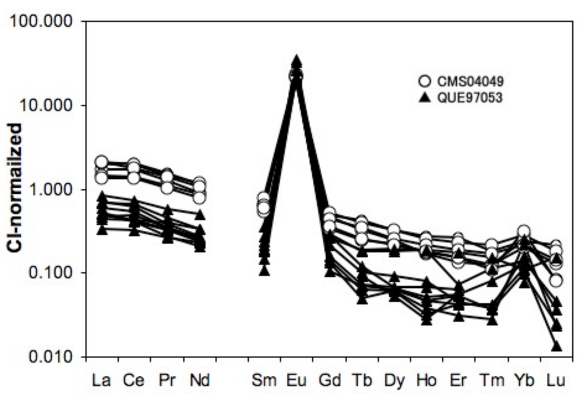

Fig. 4. Range of rare earth element abundances in plagiclase of CMS04049 and QUE97053.

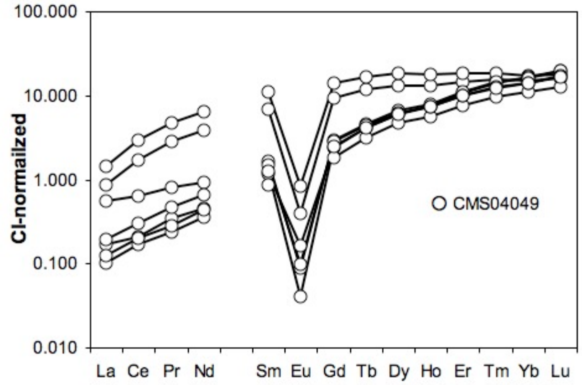

Fig. 5. Range of rare earth element abundances in pyroxene of CMS04049.

Chromite and ilmenite: There is only one large chromite grain in QUE97053. Concentrations of Hf in this grain is ~ 5ppb. On the other hand, Hf concentration in ilmenite are ~ 6.5 ppm. Lutetium concentration in chromite and ilmenite are 0.4 ppb, 0.5 ppm.

Discussion: The texture and mineral composition of CMS 04049 and QUE 97053 are broadly consistent with basaltic eucrites. The presence of fine-exsolution lamellae of augite in low-Ca pyroxenes indicates the rapic cooling after annealing. The equilibration temperature (CMS04049 - 880 °C; QUE97053 - 800 °C) estimated from the fine augite lamellae may be a final annealing temperature. QUE 97053 has lower pyroxene equilibrated temperature than CMS 04049. The presence of large plagioclase laths wih normal igneous zoning in QUE97053 also suggests that this rock experienced less metamorphism than CMS 04049. Trace element in QUE 97053 shows wider variation than CMS 04049 also suggesting QUE is less equilibrated than CMS 04049.

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