U-Pb AND ^{207}Pb-^{206}Pb AGES OF ZIRCONS FROM BASALTIC EUCRITES. M. Righter[1], T. J. Lapen[1], B. Shaulis[1]. [1]Department of Earth and Atmospheric Sciences, University of Houston, Houston TX 77204-5007 (mrighter@mail.uh.edu).

Introduction:

The main focus of this study is to obtain *in situ* U-Pb and ^{207}Pb-^{206}Pb ages of zircon from unbrecciated eucrites in the U.S. Antarctic meteorite collection. Unbrecciated eucrites are ideal samples for these analyses because they have escaped complications of lithologic mixing. The timing of formation, thermal and shock metamorphism of those meteorites are important to understand early differentiation of the eucrite parent body. Mayne et al. (2009) [1] conducted detailed petrological studies for all unbrecciated eucrite in U.S. Antarctic meteorite including degree of thermal metamorphism. Unfortunately there are only few age data available for these meteorites. In this study, we focus on unbrecciated eucrites to obtain the age data and to better refine the early differentiation history of the eucrite parent body.

Samples and Analytical Techniques: We have examined twelve unbrecciated eucrites (ALHA 81001, BTN 00300, CMS 04049, EET 87520, EET 90020, GRA 98098, GRO 95533, LEW 85305, PCA 82501, PCA 82502, QUE 97053, QUE 97014) from the U.S. Antarctic meteorite collections. Polished thin sections of these samples were examined by scanning electron microscopy and electron probe microanalysis (Cameca SX100) at NASA-JSC. We found zircon grains from four (EET 87520, GRO 95533, PCA 82501 and QUE 97053) out of 12 samples. Baddelyite was found in five samples (BTN 00300, CMS 04049, GRA98098, LEW 85305 and PCA 82502). Relatively large zircon (≥10 μm in size), which enable use of the LA-ICP-MS for U-Th-Pb isotopic analysis, were identified in coarse-grained metamorphosed eucrite EET 87520, shocked granulated eucrite GRO 95533 (its Ar-Ar age strongly reset during the time of the cataclysmic bombardment, Ar-Ar age of 3.58 ± 0.04 Ga [2]), and subophitic shocked eucrite PCA 82501.

EET 87520 contains pyroxenes that are more MgO rich than most other noncumulate eucrites. The trace element signature of EET 87520 is characteristic of a melt: slight enrichment of LREEs relative to HREE and slight depletion of Eu, enriched in Sc, Hf, Ta, Th and U [3]. These calacteristics indicate that the trace element signature of EET 87520 is dominated by melt compositon. EET 87520 contains more abundant zircon grains compare to other eucrites. Zircon grains in EET 87520 most commonly occurs with ilmenite. Some of them occur within pyroxene grains. Those zircon grains typically have rounded to subrounded shapes that probably result from recrystallization and some have highly irregular shapes. HfO_2 contents of zircons in EET 87520 have narrow range (1.06-1.30 wt%) . The Sm-Nd data defined ages of 4.598 ± 0.007 Ga [4], but reported Ar-Ar age and Pb-Pb ages were yonger (4.463 ± 0.020 Ga [3] and 4.420 ± 0.020 Ga [4] respectively).

GRO 95533 is unbrecciated, but has shoked featuressuch as granulated pyroxene [5]. Its pyroxene exsolution temperature is around 706 °C which is lower than EET 87520. Pyroxene has homogenous major element compositions. The Ar-Ar age is 3.557 ± 0.016 Gyr [3], which places it in the age range of widespread eucrite degassing interpreted to occur across the HED parent body [6]. Zircon grains in GRO 95533 occur with ilmente. HfO_2 contents of zircons in GRO 95533 vary from 1.16-1.79 wt%, which is wider than those in EET 87520.

PCA 82502 is unbrecciated eucrite with fracture (shocked) features. The pyroxenes are relatively Fe-rich and have been homogenized in Fe-Mg by metamorphism but preserve minor element zoning [1]. Pyroxene exsolution temperature is around 784 °C which is much lower than those of EET 87520 but slightly higher than GRO 95533. PCA 82502 shows a typical basaltic eucrite texture. Zircon grains in PCA 82502 occurs with ilmenite in contact with silica phases. These zircon grains are typically rounded to subrounded. HfO_2 contents of zircons in PCA 82502 vary from 1.19-1.99 wt%, which is wider than those in other two eucrites.

In situ U-Th-Pb isotopic analysis was carried out with a Photon Machines Analyte 193 laser blation system coupled to a Varian 810-MS ICP-MS at University of Houston. The laser ablation will be completed using 10 μm spot sizes with repetition rate of 6Hz and an energy output of 3 J/cm^2. Individual spot analyses are 60 seconds in length and are split into three parts with each lasting approximately 20 seconds: background measurements, ablation and wash-out. With this system we can consistently measure U-Pb ages of zircons within 1.5% of their known TIMS ages, and can routinely achieve precisions of pooled ages of ± ~ 0.3% (2σ) and 1-7% for individual spot analyses, depending on U concentration, age, and grain size [7].

Results: Total of 7 zircons from EET 87520, GRO 95533 and PCA82501 eucrites have been analyzed for U-Pb systematics by LA-ICP-MS. The preliminary U-Pb and ^{207}Pb-^{206}Pb age of zircons are both 4546 ± 13

(2σ), which is consistent with inferred formation age of eucrite basalt ~4.56 Ga and also zircon ages from other basaltic eucrites reported by Misawa et al. (2003) [8] but significantly older than reported Pb-Pb and Ar-Ar ages [2,4]. The U-Pb data indicate no resolvable difference in ages between the three samples analyzed here. The U-Pb dating of zircons and baddeleyites from other eucrites is still in progress.

References: [1] Mayne R. G. et al. (2009) *GCA, 73,* 794–819. [2] Bogard D. D. and Garrison D. H. (2003) *Meteoritics & Planet. Sci., 38*, 669-710. [3] Mittlefehldt D. W. and Lindstrom M. M. (2003) *GCA, 67,* 1911-1935. [4] Lugmair et al. (1991) *Meteoritics & Planet. Sci., 26,* 368 (abst.) [5] Antarctic Meteorite Newsletterhttp:// curator.jsc.nasa.gov/natmet/antmet.htm. [6] Bogard D. D. (1995) *Meteoritics & Planet. Sci., 30*, 244-268. [7] Shaulis B. et al. (2010) G3 doi:10.1029/2010GC003198. [8] Misawa K. et. al. (2005) *GCA, 69,* 5847–5861.

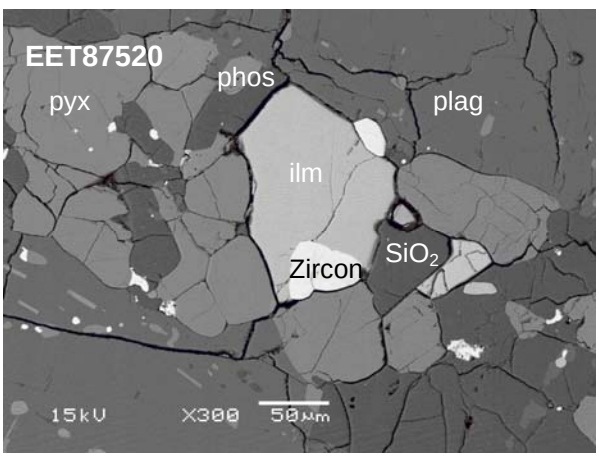

Fig. 1. BSE images of zircons in EET 87520.

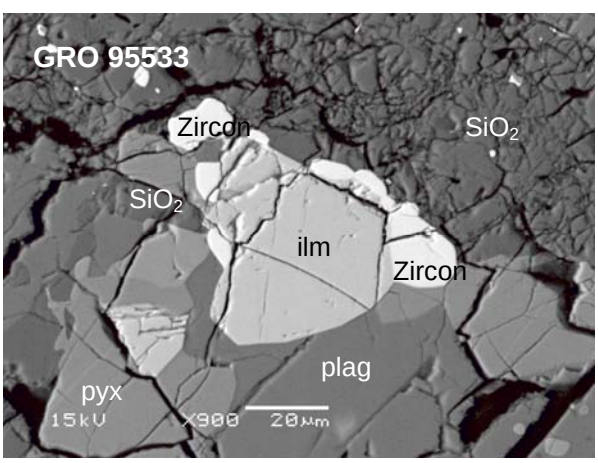

Fig. 2. BSE images of zircons in GRO 95533

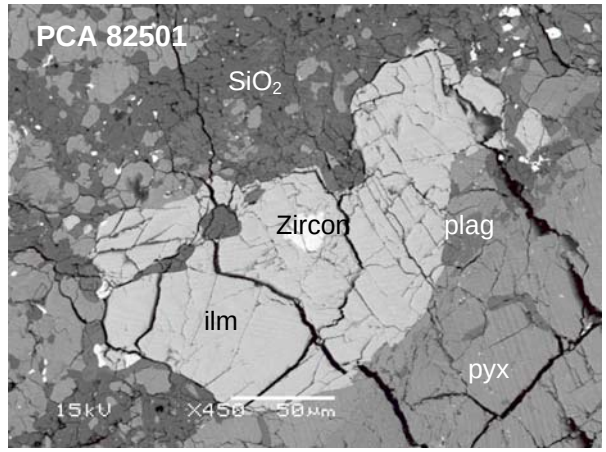

Fig. 3. BSE images of zircons in PCA 82501.

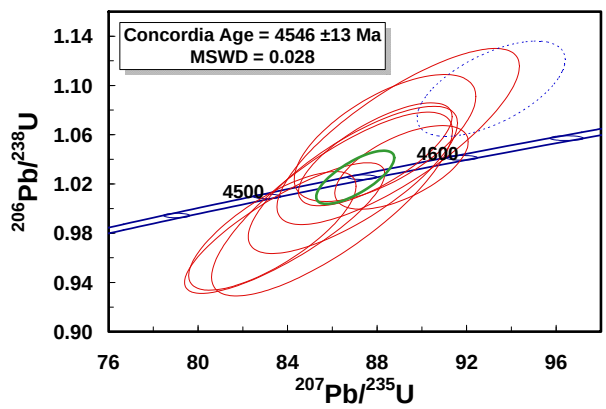

Fig. 4. U-Pb Concordia diagram for zircons in EET 87520, GRO 95533 and PCA 82501 eucrites. The blue elipse was not included in the regression. Green elipse is the weighted average.

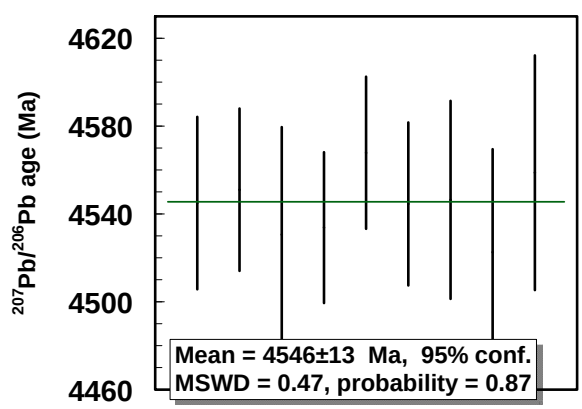

Fig. 5. The weighted mean of ^{207}Pb-^{206}Pb zircon ages is 4546 ± 13 Ma for EET 87520, GRO 95533 and PCA 82501 eucrites which is identical to the concordia age.