Geochronology Of Clasts In Polymict Ureilite Dar Al Gani 665. B. A. Cohen[1], T. D. Swindle[2], and E. K. Olson[2], [1]Institute of Meteoritics, University of New Mexico, Albuquerque, NM 87131 (bcohen@unm.edu), [2]Adepartment of Planetary Sciences, University of Arizona, Tucson, AZ 85721.

Introduction: Polymict ureilites are regolith breccias, composed mainly of monomict ureilite-like material, but containing ~2 vol.% of feldspathic clasts. O-isotope compositions of most feldspathic clasts in polymict ureilites plot along the ureilite mixing line (slope ~1) with $d^{17}O$ values similar to those in monomict ureilites [1, 2]. Feldspathic clasts may therefore be pieces of "missing basalts," material complementary to monomict ureilites, providing unique insights into the evolution of the ureilite parent body (UPB).

Several subsets of feldspathic clasts have been identified in polymict ureilites [2-5], some of which represent common igneous lithologies whose mafic minerals show a normal (carbon-free) igneous fractionation trend and are likely to be early partial melts from the UPB [3]. Other clast populations have common mineralogies, but their petrographic origin has not been definitively determined.

We chose three relatively large feldspathic clasts in the polymict ureilite DaG 665 (graciously provided by L. Folco at the Museo Nazionale dell'Antartide), previously described as being parts of different clast populations [3], for ^{40}Ar-^{39}Ar study to further investigate their origins. DaG 665 is a fragmental breccia with lithic and mineral clasts embedded in a cataclastic matrix [6]. Lithic clasts are dominantly material similar to monomict ureilites, with minor components of feldspathic material and dark objects. It may be paired with DaG 319 [7, 5].

Clasts: Clast E38 (Fig. 1) is a single grain of calcic plagioclase (An_{97}). Single anorthite grains in polymict ureilites have been interpreted as Angra dos Reis-like clasts that were contributed by impactors [8-10], though it is possible that anorthitic plagioclase could be created through partial melting processes on the UPB [3].

Clast E50 has a clastic texture and appears to be a partially melted or plastically deformed breccia. This large (2 cm) clast consists of irregular swathes of labradoritic plagioclase (An_{56}) around clasts of magnesian olivine (Fo_{83-89}) and augite ($Wo_{39}En_{56}Fs_5$). The mafic mineral chemical relationships are controlled by carbon redox. Pockets of plagioclase/pyroxene melt areas are common and randomly distributed (Fig. 1). We interpret this clast to be a product of impact processing on the UPB.

Clast E51 belongs to the most abundant feldspathic clast population in polymict ureilites, characterized by albitic plagioclase in association with pyroxenes, phosphates, ilmenite, silica, and incompatible-element enriched glass. Clast E51 is a large (2-cm) clast from this population, with a typical intersertal texture in which plagioclase laths are intergrown with skeletal pyroxene and a glassy mesostasis (Fig. 1). Model calculations suggest that these clasts are indigenous products of igneous differentiation on the UPB, derived by extensive fractional crystallization of low-degree partial melts of chondritic precursor material [3].

Geochronology: Subsamples of the three clasts were extracted from a 100-μm thick section using a microcorer and irradiated for 500 hours at the Ford reactor. Laser step-heat experiments were conducted in the University of Arizona noble gas lab using a continuous Ar-ion laser heating system and VG5400 mass spectrometer. Due to the small size and low K content, few heating steps could be performed on each sample. Because carbon was present from both samples and residual epoxy, we routinely monitored three locations in the mass 39 region to identify, and correct for, hydrocarbon interference. A blank contribution from HCl at masses 36 and 38 was also subtracted. All data were also corrected for blanks, reactor-induced interferences, decay time, and cosmic-ray spallation. No trapped argon component was evident in any of the samples. Preliminary plateau ages (further refinements in fluence, interferences, etc. are in progress) derived using the UC Berkley Isoplot software for Excel are reported in Table 1 for the five samples we have so far analyzed.

Two subsamples of clast E51 yielded well-defined plateaus (Fig. 2). Adding together the gas released in all heating steps from both samples gives a single age of 4716 ± 113 Ga (1σ). We expect this age will improve as we analyze more subsamples from this clast and refine our fluence measurement, but it is consistent with other ages determined on clasts in this population in DaG 319: a ^{53}Mn-^{53}Cr age (determined on the glass phase) of 4.5 ± 0.4 Ma prior to the angrites, or a calculated absolute age of 4.562 Ga [11], and a Pb-Pb age of 4.559 ± 28 Ga [12]. This age is similar to that of the oldest eucrites, demonstrating that melting on the UPB began very early in the history of the solar system.

Two subsamples of Clast E50 have significantly younger ages, ~3.1 Ga. If these represent an impact-reset age, it is most similar to only a few young impact ages in HED meteorites [13]. We have a few more E50 subsamples and hope to be able to derive K/Ca ratios for these gas releases to aid in their interpretation. Clast E38 has an even younger age of 2158 ± 990 Ga. Even at the upper end of this range,

Table 1: DaG 665 samples and plateau ages

Sample	Weight (μg)	$\%^{39}$Ar	Age (Ga)
E38	80	100	2158 ± 990
E50A	153	100	3179 ± 109
E50B	154	100	3095 ± 260
E51E	180	100	4687 ± 300
E51F	206	100	4756 ± 78
E51*	386	100	4716 ± 113

* integrated gas age from all heating steps in E51E and E51F.

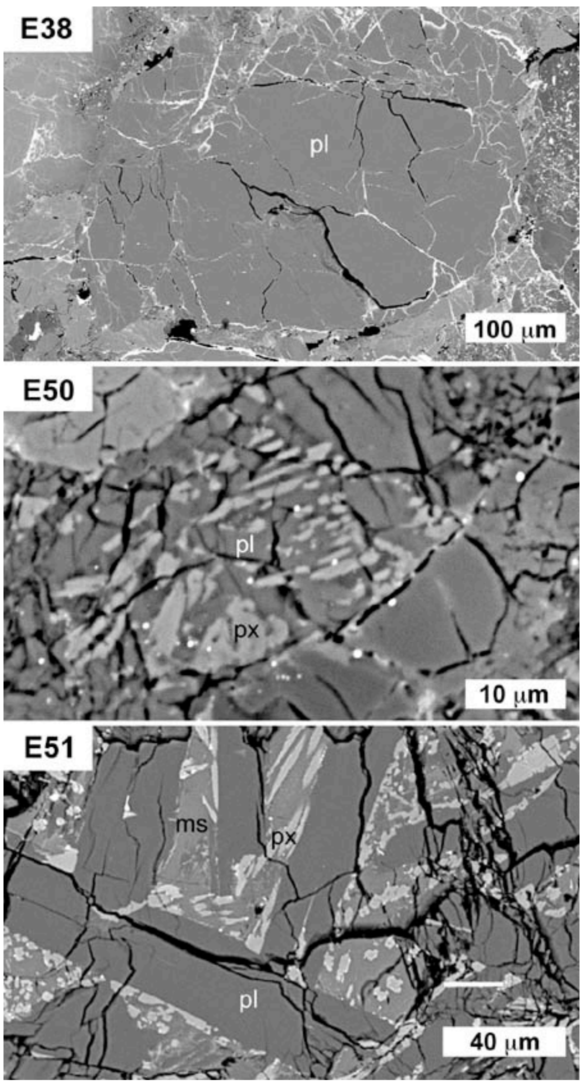

Fig. 1: Backscattered-electron images of clast E38 (anorthite grain), E50 (impact-deformed breccia) and E51 (albitic clast). Darker grays are feldspar (pl), ligher grays are pyroxene (px) and in E51, glassy mesostasis (ms).

this clast appears to be too young to have been generated in very early partial melting events on the UPB, supporting an origin as a foreign clast contributed by (and possibly reset or disturbed in) a later impact event on the UPB.

References: [1] Guan and Leshin (2001) *MAPS* **36**, A74. [2] Kita et al. (2004) *GCA* **68**, 4213. [3] Cohen et al. (2004) *GCA* **68**, 4249. [4] Ikeda and Prinz (2001) *MAPS* **36**, 481. [5] Ikeda et al. (2000) *Ant. Met. Res.* **13**, 177. [6] Grossman and Zipfel (2001) *MAPS* **36**, A293. [7] Grossman (1998) *MAPS* **33**, A221. [8] Prinz et al. (1986), *LPSC 17,* 681. [9] Prinz et al. (1987) *LPSC* **18**, 802. [10] Kita et al. (1999), *Symp. Ant. Met. 24,* 72. [11] Goodrich et al. (2002) *MAPS* **37**, A54. [12] Kita et al. (2002) *MAPS* **37**, A79. [13] Bogard (1995) *Meteoritics* **30**, 244.

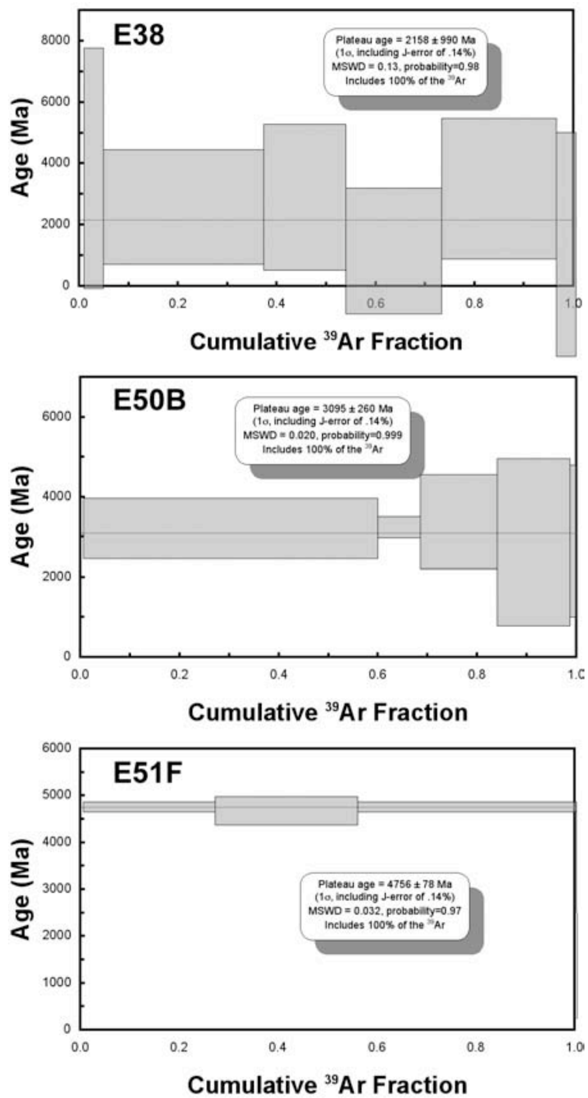

Fig. 2. Stepwise argon release profiles for E38 (anorthite grain), E50B (impact-deformed breccia), and E51F (albitic clast).