IN SITU U-PB AGE ANALYSIS OF APOLLO 17 IMPACT MELT BRECCIAS Barry J. Shaulis[1,3], David A. Kring[1,3], Thomas J. Lapen[2,3], and Allan H. Treiman[1,3]. [1]Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, Texas 77058, USA (shaulis@lpi.usra.edu), [2]University of Houston, Houston, Texas 77204, USA, and [3]NASA Solar System Exploration Research Virtual Institute.

Introduction: The Apollo 17 mission landed in the Taurus-Littrow Valley, a basalt-filled valley near the edge of Mare Serenitatis between two massifs. The two massifs are part of the ring structure associated with the Serenitatis impact basin and are composed of highland material. Three main types of impact related rocks were returned from this mission: i) poikilitic impact melt breccias, ii) aphanitic impact melt breccias, and iii) granulitic breccias.

Both aphanitic and poikilitic impact melt breccias have mafic compositions and are composed of plagioclase and pyroxene that crystallized out of the melt. The granulitic breccias are more feldspathic. Some aphanitic and poikilitic impact melt breccias contain clasts of granulitic breccia suggesting the granulitic breccias formed earlier [1].

Subsequent studies of Apollo 17 poikilitic and aphanitic impact melt breccias have failed to provide a consensus on the impact event from which these rocks were derived, whether from Serenitatis, Imbrium, both, or some other event that pre- or post-dates the Serenitatis impact [2-6].

In this project we further investigate these findings by examining thin sections from 8 lunar samples (5 poikilitic impact melt breccias, 2 aphanitic impact melt breccias, and 1 feldspathic granulitic breccia) for *in situ* U-Pb age analysis of zircon, baddeleyite, and Ca-phosphates (apatite and merrillite) to better understand the crystallization and impact history of the Apollo 17 region.

Analytical Techniques: For each thin section an X-ray element map was produced using a JEOL JXA-8530F HyperProbe following the procedures of [7] but adapted to this machine (Fig. 1). BSE images of target locations were then generated using a JEOL 5910LV SEM to assess mineral assemblages. Quantitative analyses of minerals in the thin sections were conducted using a Cameca SX100 using standards appropriate to the minerals being analyzed. All three instruments are located at NASA JSC.

Lastly, *in situ* U-Pb isotopic analyses of suitable grains of zircon, baddeleyite (>7 μm), and Ca-phosphate (> 25 μm) are obtained by LA-ICPMS using a Varian 810 Quadrupole Mass Spectrometer coupled with a Photon Machines Analyte.193 Excimer Laser Ablation System at the University of Houston [8].

Poikilitic Impact Melt Breccias: *72395* was collected from 'Boulder 2' at Station 2. An Ar-Ar analysis of 72395 yielded and age of 3893±16 Ma [9], within error of the suggested age of the Serenitatis Impact (3893±9 Ma [9]). No other ages have been reported for this sample.

We identified both apatite and merrillite grains ~50 μm or greater in the longest dimension, a few baddeleyite grains ~10 μm in size, and other small baddeleyite grains that are too small to analyze by LA-ICPMS.

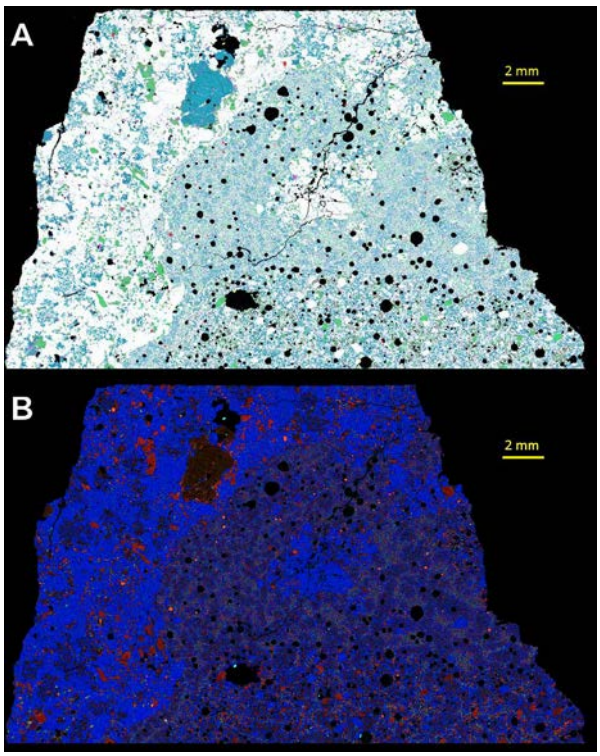

Figure 1: *Example of false color element maps of Apollo 17 sample 77135,128. (A) Is a 7-color element map where Fe = red, Mg = green, Si = blue, Al = white, Ti = magenta, K = cyan, and Ca = yellow, and (B) is a 3-color element map where Fe = red, P = green, and Ca = blue, used to identify zircon (green), apatite (cyan), and sulfide (yellow) minerals. Small apatite grains can be seen in two of the large void spaces in the sample.*

72735 was collected as part of a rake sample at Station 2. Compared to other Apollo 17 samples, 72735 is more potassic and enriched in incompatible elements and may represent a distinct impact event [9]. Previous Ar-Ar attempts only yielded a minimum age of 3850 Ma [9]. No other ages for 72735 have been reported. In 72735,12 we found ~20 apatite and merrillite grains in this sample along with granular zircon

and idiomorphic poikilitic zircon with silicate chadacrysts.

76035 was chipped from a small boulder at Station 6, and has not been dated. In 76035,32 one single apatite and one zircon grain were the only target minerals identified in this sample.

77035 was collected from the regolith at the base of the North Massif. It contains numerous clasts, but the sample has been welded, making it difficult to remove individual clasts for analysis. No radiometric ages have been reported for this sample. We examined 4 thin sections (68, 73, 224, and 225). Split ,68 contains apatite, baddeleyite, baddeleyite rimmed with zircon, and granular zircon. No suitable mineral grains were found in ,73. A single apatite was found in ,224. Split ,225 contains several large grains (>50 μm) of both apatite and merrillite.

77135 was collected from a boulder at Station 7. Several attempts at Ar-Ar analysis of this sample have yielded young apparent ages from 1700-2170 Ma to peak ages between 3830 and 3990 Ma and ages in between [9-13]. Rb-Sr ages vary between 3890±80 Ma and 4140±80 Ma [14-15]. In 77135,128 we identified nine large apatite grains and a single small baddeleyite in this section.

Aphanitic Impact Melt Breccias: *73215* was recovered as a hand sample from the light mantle regolith area of Station 3. The sample was located on the rim of a small 10 m crater that is located on the rim of the larger Lara Crater. This sample is composed of numerous different lithologic clasts, which is reflected in the range of radiometric ages for this sample. Ar-Ar ages range from 3920±10 Ma to 4460±40 Ma [16-17]. Additional U-Pb zircon ages range from 4189±30 Ma to 4389±42 Ma [18-19]. In 73215,119 we identified apatite, merrillite, zircon, and baddeleyite. The apatite and merrillite grains are generally large ~25-100 μm in size while baddeleyite is generally small (<20 μm). Zircon varies in size from ~20 μm up to 100 μm × 100 μm in size.

73255 was recovered as a hand sample from a location similar to sample 73215. The clasts in 73255 are also lithologically diverse. Ar-Ar ages range from 3870±30 Ma to 4200 Ma [20-21]. A Sm-Nd age of 4230±50 [22] has also been reported for this sample. No other ages have been reported. Both apatite and zircon were found in 73255,287, however, the apatite is the only grain large enough for analysis by LA-ICPMS.

Feldspathic Granulitic Breccia: *79215* was collected near the Van Serg Crater at Station 9. Ar-Ar analysis of this rock has yielded ages between 3871±40 Ma to 4030±20 Ma [23-25]. In 79215,51 we identified several apatite grains.

U-Pb Results: Preliminary results from the *in situ* analysis of phosphates from sample 79215,51 yielded a $^{206}Pb/^{238}U$ weighted average age of 3936±46 Ma which is consistent with previously reported Ar-Ar ages [23-25]. The determined age overlaps the age of Serenitatis [9] but is also similar to U-Pb phosphate ages found in Apollo 14 impact melt breccias which were interpreted to be related to the Humorum or Serenitatis impacts [26].

Additional U-Pb analyses of Ca-phosphates, zircon and baddeleyite are underway and will be reported at LPSC.

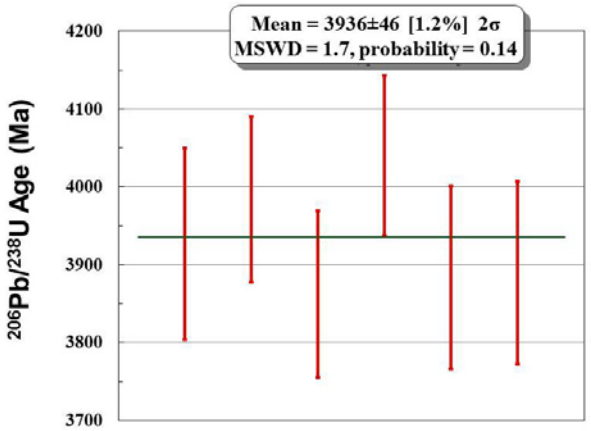

Figure 2: *Weighted average $^{206}Pb/^{238}U$ age of Ca-phosphates in 79215,51.*

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