PETROLOGY OF THE IMPACT MELT CLASTS IN 60016, ANCIENT REGOLITH BRECCIA. Takafumi Niihara[1, 2], Lillian Schaffer[3], David A. Kring[1, 2]. [1]Center for Lunar Science and Exploration, Lunar and Planetary Institute, Houston, TX. 77058 (niihara@lpi.usra.edu), [2]NASA Lunar Science Institute. [3]Dept. of Earth and Atmospheric Sciences, University of Houston.

Introduction: Early impact bombardment dramatically affected the evolution of the Moon's surface. It has been hypothesized that the basin-forming epoch occurred in a cataclysmic spike of impactors [1–3] that are dominantly from the asteroid belt [4, 5]. Data remain scarce, however, and the hypothesis requires additional tests. In particular, it is still necessary to compare the impact age distributions among different populations of impact melt. We are, thus, examining fragments of melt that survive in cm-size clasts within the 60016 ancient regolith breccia. This rock was classified as a B2-type ancient regolith breccia. It was assembled from regolith produced from the Cayley Formation [e.g., 6].

Samples and Analytical Procedure: We have been allocated six impact melt clasts that are 1-2 cm in size (Clasts 1-6). Here we report petrological analyses of three of six clasts: Clast 1 (,319), Clast 2 (,320), and Clast 6 (,321). We conducted optical microscopic observations, back-scattered electron (BSE) image observations, and elemental mapping using a Field Emission –Scanning Electron Microscope (JEOL JSM-7600F), and major elements analyses using an Electron Probe Micro Analyzer (EPMA; CAMECA SX-100) at JSC. EPMA analyses of silicates were performed with an accelerating voltage of 15 kV, electron beam current of 20 nA, and a focused beam. Defocused beam (20 μm diameter) analyses (DBA) of representative areas for each clast were performed by EPMA to estimate bulk compositions.

Results: *Clast 1, a clast-rich poikilitic melt,* contains ~45 % of relict mineral fragments of plagioclase (An_{97-95} $Or_{0.6-0}$; 39 %), olivine (Fo_{79-69}; 5 %), and pyroxene ($En_{77-58}Wo_{2.5-5.2}$; 1 %). Plagioclase relicts have a slightly Na-rich overgrowth along their rims and show euhedral to anhedral morphologies. The Na-rich rims contain small Fe-Ni droplets (less than 1 μm in diameter). Melt products locate at the interstices of relict fragments. Interstitial materials consists pyroxene ($En_{82-46}Wo_{42-3}$), plagioclase (An_{97-95} $Or_{0.6-0}$), Fe-Ni metal, sulfides, oxide and glass. Pyroxene encloses fine-grained euhedral to subhedral plagioclase and rounded relict olivine.

Clast 2, a clast-poor poikilitic melt, contains ~15 % of relict olivine (Fo_{82-73}; 12 %), plagioclase (An_{97-93} $Or_{0.4-0}$; 2 %), and pyroxene ($En_{84-78}Wo_{3.9-2.8}$; 1 %). Plagioclase relicts have a slightly Na-rich rim and have euhedral to anhedral crystal morphologies. The Na-rich rims contain small Fe-Ni droplets (less than 1 μm in diameter). Olivine and pyroxene are irregular in shape. This clast has a poikiloblastic texture of up to 2 mm pyroxene ($En_{83-49}Wo_{41-3}$) that encloses fine-grained euhedral plagioclase (An_{96-84} $Or_{1.3-0.1}$) and is embedded in an olivine- and feldspar-bearing mesostasis.

Clast 6, a clast-poor porpyiritic melt, contains ~15 % of relict olivine (Fo_{86-80}; 9 %) and plagioclase (An_{98-90} $Or_{1.0-0}$; 6 %). Plagioclase relicts are rimmed and have euhedral to anhedral shapes. The groundmass of this clast is filled by large amounts of fine-grained dendritic pyroxene, plagioclase (An_{97-90} $Or_{0.6-0.1}$), and interstitial glass.

Bulk compositions (DBA): Clast 1 has high Al_2O_3 (26.6 wt. %) and low FeO+MgO (9.78 wt. %) values, similar to those of Group2 melts [e.g. 7]. Clast 2 and 6 have high K_2O (~0.50 wt. %) and FeO+MgO (~19.6 wt. %) values, and low Al_2O_3 (~19.1 wt. %) similar to Group 1 melts [e.g. 7].

Discussion and summary: Clast 1 has a different bulk composition than the other two samples (Fig.1). The high concentration of Al and low concentrations of Fe and Mg in the clast 1 probably reflects the large amount of relict plagioclase. The compositions of relict olivine and plagioclase in Clasts 1 and 2 are similar, but those in Clast 6 are significantly different. Relict olivine in Clast 6 is more forsteritic than that in the other clasts (Fig. 2). In addition, the compositional range in plagioclase in Clast 1 is wide; Clast 6 contains more sodic plagioclase grains (Fig. 3). Although bulk chemical compositions for Clast 2 and 6 are similar, differences in compositions of relict minerals imply that these clasts originate from at least two different impact melts. Thus, the three clasts represent three different types of impact melts.

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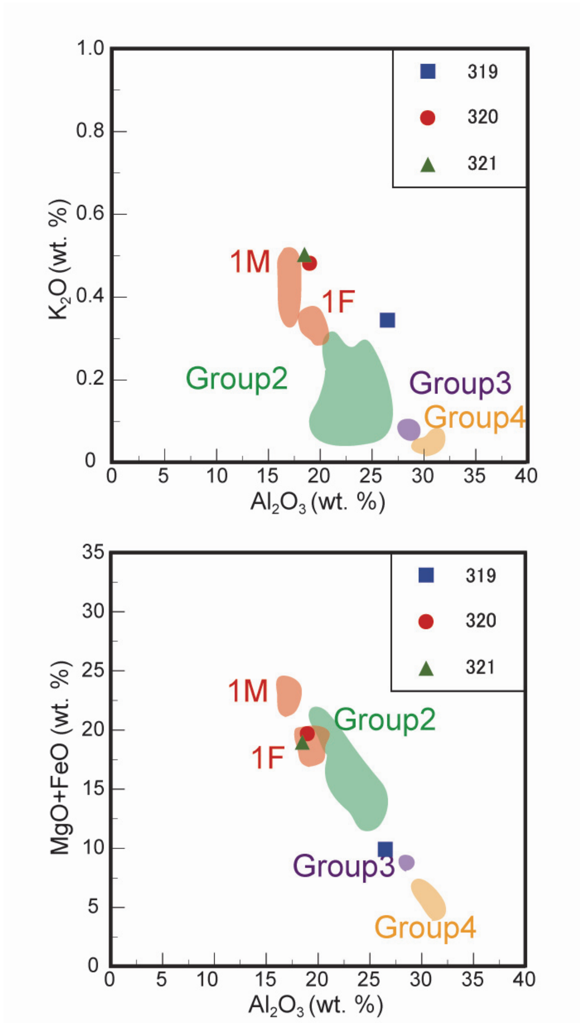

Fig.1. Al_2O_3 vs. K_2O and MgO+FeO plots for bulk (DBA) compositions of Clasts 1, 2 and 6. Reference values for impact melt groups were obtained from [7] and reference therein. These impact melts groups were classified on the basis of Sm and Sc concentrations [7].

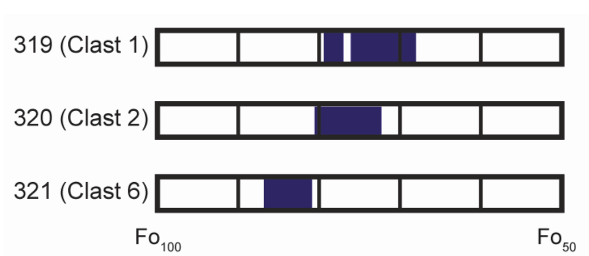

Fig.2. Composition of relict olivines in Clasts 1,2 and 6. Clast 6 has more folsteritic composition than other clasts.

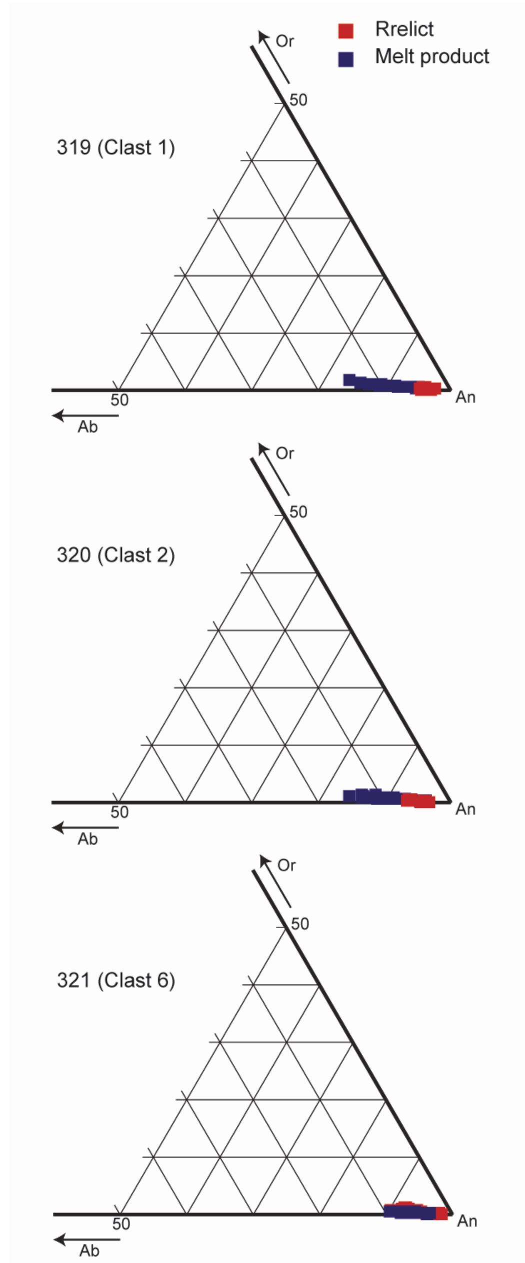

Fig.3. Composition plagioclase in Clasts 1,2 and 6. Red square: Relict plagioclase. Blue square: Melt products.