LIFTING THE VEIL: A PRE-CATACLYSM LUNAR IMPACT MELT. M. Norman[1, 2], L. Taylor[3], C. Shih[4], Y. Reese[4], L. Nyquist[4], and J. Bowen-Thomas[2]. [1]Lunar and Planetary Institute, Houston. [2]Research School of Earth Sciences, Australian National University, Canberra. E-mail: Marc.Norman@anu.edu.au. [3]Planetary Sciences Institute, University of Tennessee, Knoxville. [4]NASA Johnson Space Center, Houston.

Introduction: We are conducting geochemical, geochronological, and petrological studies of lunar samples that may represent impact melts formed prior to the KREEP-rich breccias with ages of 3.8-4.0 Ga. Here we report initial results for the age and petrogenesis of highlands rock 67955.

Rationale: 67955 is a 163 g impactite that was collected from the rim of North Ray Crater. It is a noritic anorthosite that was mildly annealed, brecciated and injected with dark veins of shock melt. Its bulk composition is similar to a magnesian component that was incorporated into the feldspathic fragmental breccias (FFB's), which represent the Descartes terrane of the central nearside lunar highlands. If these breccias represent ejecta from the Nectaris basin, then ages of components in the breccias provide limits on the age of one of the older nearside basins. Our study of the composition and chronology of 67955 will improve our understanding of the impact history of the Moon and the development of the lunar crust.

Methods: We examined 67955 in the JSC lunar curatorial lab, and selected a coherent 3g fragment that was macroscopically crystalline and free of the dark shock melt. A polished thin section was produced from this fragment, and mineral separates prepared for Rb-Sr and Sm-Nd isotopic analyses by TIMS. Mineral compositions were determined by EMP on the thin section and on representative fragments from the mineral seperates. Trace element and reconnaissance Pb isotopic compositions were determined on representative mineral fragments by laser ablation using a quadrupole ICPMS.

Results: The texture of 67955 is consistent with crystallization of a melt. Poikilitic pyroxene encloses euhedral to subhedral olivines (Fo77) and plagioclase (An91-96, strong mode at An93-94). Ilmenite, FeNi metal (7% Ni, 0.6% Co), apatite, zirconalite, chromite, and sulfide are present. Pyroxene is predominantly low-Ca (Wo3En78), but a few grains of high-Ca pyroxene were found. Average mineral compositions fall within the field for Mg-suite highlands rocks on a plot of An vs Mg#.

Incompatible element concentrations in plagioclase span a broad range (e.g., La 0.6-5.4 ppm) and correlate with Sr/Ba ratios, suggesting contributions of both depleted and enriched components that may correspond to ferroan anorthosite and KREEP or Mg-suite lithologies, respectively. Metal has 5x chondritic abundances of PGE, As, and Au but is highly enriched in W indicating reduction of lunar tungsten. Apatite has 3-6 ppm U and 20-35 ppm Th, whereas zirconalite has 1500 ppm U and 0.5-1% Th. Preliminary Rb-Sr isotopic data for plagioclase, pyroxene, and whole rock separates indicate an age of 4.1 $\pm$ 0.2 Ga. Preliminary Pb isotopic data for apatite are consistent with an age of 4.1-4.3 Ga, assuming no common Pb.

Implications: 67955 appears to be an impact melt breccia that predates the 3.8-4.0 Ga nearside basins. The preservation of a large sample of impact melt breccia with an age older than 4.0 Ga shows that the lunar crust was not being continuously resurfaced by impacts after initial differentiation of the Moon, and favors the formation of most nearside basins in a discrete episode of heavy bombardment at ~3.9 Ga.