Impacts in the lunar highlands: Shocked zircon from Apollo 16

K. H. JOY[1], J. F. SNAPE[2], A. A. NEMCHIN[2,3], M. J. WHITEHOUSE[2], V. VISHNYAKOV[4].

[1]SEAES, University of Manchester, Manchester, UK. (katherine.joy@manchester.ac.uk)

2Dept. of Geosciences, Swedish Museum of Natural History, Stockholm, Sweden.

3Dept. of Applied Geology, Curtin University, Perth, Australia.

[4]School of Computing and Engineering, University of Huddersfield, Huddersfield, UK.

Science Context: Zircon grains in lunar samples typically preserve ancient >3.8 Ga ages associated either with ancient KREEP-driven magmatic episodes or formation / reset during impact cratering / basin-forming events [1]. We report the first age dates of zircon collected from the Apollo 16 landing site, shedding light on geological processes in the central nearside highlands of the Moon [2].

Sample 65745 is a sub-mature (I_s/FeO 27) regolith breccia collected from the Cayley Plains deposit at Station 5 (Stone Mountain) at the Apollo 16 landing site. We located two zircon-bearing clasts in thin section 65745,7.

Methods: The section was imaged in BSE and CL, and was then gold coated and analysed using the CAMECA IMS 1280 ion microprobe at the NordSIMS facility in Sweden [3].

Results: Clast 1 has a felsic composition: K-feldspar and Si mineral intergrowth with troilite and two large (50-150 μm) zircon grains. Both zircon grains have been shocked, and contain decomposed regions where the zircon has broken down to a porous granular texture, indicative of shock metamorphism to >70 GPa [4]. The Clast 1 zircon has a minimum formation/reset ^{207}Pb/^{206}Pb age of 4125 Ma ranging to 3879 Ma in the mineral core. The decomposed areas record younger resetting events from 3663 Ma to 3342 Ma.

Clast 2 is a devitrified KREEP-rich impact melt glass with a clast of plagioclase (An_{88-91}) and a 50 μm zircon. The Clast 2 zircon yields dates of 3986 Ma to 3894 Ma.

Implications: The zircon grains have had a variable resetting history. The oldest ~4.15 Ga ages are similar to KREEP-rich high-alkali suite samples [1]. The ~3.9 Ga ages are consistent with resetting by the Imbrium basin-forming event at 3926 Ga [3], which emplaced the Cayley Plains deposit. The younger 3.7-3.4 Ga events, consistent with Apollo 16 argon-isotope impact records [5], record post-basin-formation cratering events in the central highlands.

[1] Meyer et al. (1996) *MAPS* **3**, 370-387. [2] Norman and Nemchin (2014) *EPSL* **288**, 387-398. [3] Snape et al. (2016) *GCA* **174**, 13-29. [4] Timms et al. (2012) *MAPS* **47**, 120-141. [5] Fernandes et al. (2013) *MAPS* **48**, 241-269.