HIGH RESOLUTION SHRIMP PHOSPHATE U-PB AGES IN SAYH AL UHAYMIR 169: POSSIBLE AGE OF THE PRE-IMBRIUM IMPACT

X. C. Che[1,2], A. A. Nemchin[1,3,4], T. Long[1,2] and D. Y. Liu[1,2], [1]Beijing SHRIMP Center, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, 102206, China (E-mail: cxc@bjshrimp.cn), [2]Shandong Institute of Geological Sciences, Jinan, 250013, China, [3]Department of Applied Geology, Curtin University, Perth, WA 6845, Australia, [4]Department of Geosciences, Swedish Museum of Natural History, Stockholm, SE-104 05, Sweden.

Introduction: Lunar meteorite **Sayh al Uhaymir 169** (SaU-169) was found in the Sayh al Uhaymir region of Oman in 2002. SaU-169 is an extremely KREEP (High K, P, REE)-rich polymict sample, which consists of crystalline impact-melt breccia and adherent regolith as described in Gnos et al [1]. The identical, within uncertainties, zircon ages of 3909 ± 13 [1], 3920 ± 13 Ma [2] and 3921 ± 3 Ma [3] in impact melt breccia of SaU-169 have been reported by several studies. Combined with results obtained for zircon from Apollo-12 samples [2], these ages were interpreted to represent the age of the Imbrium event. In this study, we have investigated phosphate grains from the impact melt breccia portion of SaU-169.

Meteorite Sample and Analytical Methods: Phosphate grains were identified in the mounted pieces of the sample by the energy-dispersive X-ray spectroscopy (OXFORD X-Max^{N}20) attached to ZEISS MERLIN Compact scanning electron microscope and U-Pb dating was performed on the SHRIMP IIe-Mc at the Beijing SHRIMP Center, Chinese Academy of Geological Sciences. Sample mounts for SHRIMP analysis were cleaned with ethanol and distilled water before gold coating. The analytical spot size was 10μm and the primary current was 2nA. The analytical conditions were identical to those described by [4, 5]. $^{206}Pb^+$, $^{238}U^+$, and $^{238}U^{16}O_2^+$ were measured sequentially in the single-collector electron multiplier (EM) positioned on the axis and the $^{206}Pb/^{238}U$ ratios calibrated using NW-1 apatite standard [6]. $^{204}Pb^+$, $^{206}Pb^+$, $^{207}Pb^+$ and $^{208}Pb^+$ isotopes were measured simultaneously in four EMs and the $^{204}Pb/^{206}Pb$, $^{207}Pb/^{206}Pb$ ratios were calibrated using BCR-2, BHVO-2 [7].

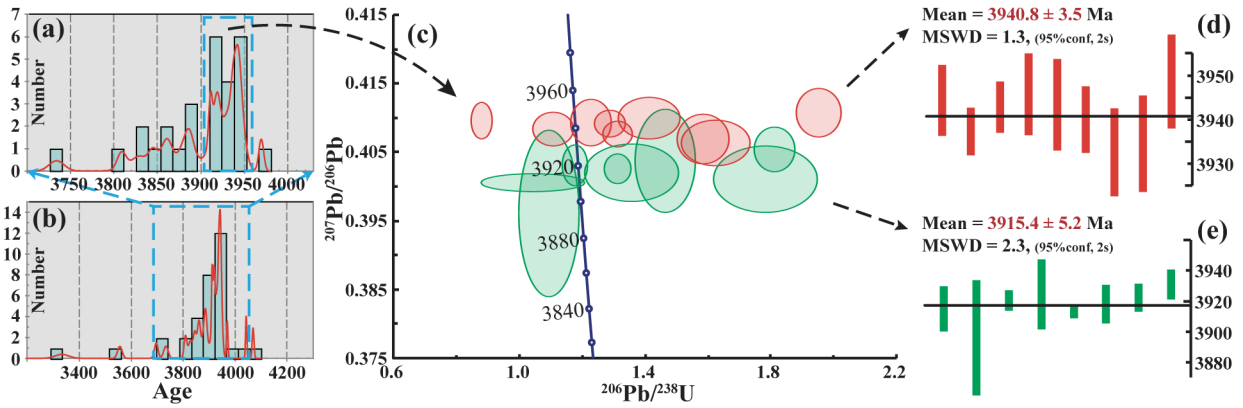

Fig. 1. (a, b) Histograms and relative probability curves for all of SaU-169 phosphates from this study; (c) Concordia plot of phosphate SHRIMP U–Pb analyses within dotted area of Fig. 1(b); (d, e) Weighted mean ages of two groups of phosphates analyzed in SaU-169.

Results and Discussion: Analysis of 33 spots on 33 different phosphate grains yielded $^{207}Pb/^{206}Pb$ ages between 3334-4068 Ma [Fig. 1(b)], which is broader than the range of zircon ages, probably because the U-Pb system in phosphates is easier to disturb under the high P-T conditions compared to that in zircon. Analyses with the younger $^{207}Pb/^{206}Pb$ ages are also significantly discordant. More concordant analyses show a narrower range of $^{207}Pb/^{206}Pb$ ages [Fig. 1(a, c)], and appear to form two groups. The weighted mean age for the first group is 3915.4 ± 5.2 Ma [Fig. 1(d)], which is consistent with the zircon results [1, 2, 3] and possibly represents Imbrium basin-forming event. An older age of 3940 ± 3.5 Ma is determined for the second group [Fig. 1(e)]. It is similar to ages obtained for apatites from different Apollo 14 impact melt breccias 3943 ± 5 Ma (14321,134), 3946 ± 15 Ma (14305,103), 3958 ± 19 Ma (14314,13), and might represent an impact event predating Imbrium basin formation [8, 9].

Acknowledgments: This work was supported by the National Natural Science Foundation of China (41842045).

References: [1] Gnos E. et al. (2004). *Science* 305: 657–659. [2] Liu D. Y et al. (2012) *Earth and Planetary Science Letters* 319-320: 277–286. [3] Lin Y. T. (2012). *Geochimica et Cosmochimica Acta* 85: 19-40. [4] Williams I. S. (1998). *Rev Eco Geology* 7: 1–35. [5] Nemchin A. A. (2011). *Geochimica et Cosmochimica Acta* 75: 2940–2964. [6] Li Q. L. (2012). *Gondwana Research* 21: 745-756. [7] Woodhead J. D. and Hergt J. M. (2000). *Geostandards and Geoanalytical Research* 24: 33-38. [8] Merle R. E. (2014). *Meteoritics & Planetary Science* 49:Nr12 2241-2251. [9] Snape J. F. (2016). *Geochimica et Cosmochimica Acta* 174: 13-29.