PETROGRAPHY, GEOCHEMISTRY, AND AGE OF A GRANOPHYRE CLAST IN THE LUNAR METEORITE DEW 12007.

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Introduction: Granitic clasts of lunar meteorites are important to reveal a magmatic evolution history of the Moon. Here we present petrographic, geochemical, and geochronological information for a granophyre clast (C3) in the mingled lunar breccia DEW 12007 [1].

Methods: A thin section (JK-1) of the DEW 12007 was used for petrography and mineral chemistry with the field-emission electron microprobe JXA-8530F at KOPRI, and zircon age dating with SHRIMP IIe at KBSI. Bulk composition was calculated by a modal recombination method.

Results: C3 is an oval-shaped (~4 mm) granitic clast with dense microfractures. It contains barian alkali feldspar ($An_{1.2\text{-}11.3}Ab_{17.4\text{-}41.1}Or_{46.0\text{-}76.2}Cn_{0.4\text{-}11.5}$; ~51 vol %) and plagioclase ($An_{27.0\text{-}37.1}Or_{0.7\text{-}1.7}$; ~3%), intergrown with silica (~40%). "Ternary" feldspar [2] ($An_{11.1\text{-}39.0}Ab_{33.6\text{-}55.7}Or_{11.6\text{-}53.8}Cn_{0.0\text{-}2.6}$) is compact without fractures, contrary to the surrounding plagioclase and alkali feldspar. Olivine is anhedral and chemically homogeneous with Fa_{90} which is lower than $Fa_{\sim 97}$ of olivines from other lunar granophyres [3, 4]. Minor phases include needle-shaped ilmenite, tranquillityite, RE-merrillite, and apatite, and skeletal zircon. Troilite, baddelyite, and monazite are trace. No pyroxene appears. C3 has a granitic bulk composition, i.e. high SiO_2 (74.01 wt %), K_2O (4.81), Na_2O (1.82), and BaO (1.24; the highest among lunar samples [3]), and low P_2O_3 (0.12), TiO_2 (0.71), FeO (5.57), MgO (0.30), and CaO (0.87). SHRIMP U-Pb isotopic data (n=16) for five zircon grains give the upper intercept age of 4340.2 ± 7.5 (2σ) Ma in a concordia diagram. The weighted mean of ^{207}Pb-^{206}Pb ages is 4332.4 ± 1.6 (2σ) Ma. These ages belong to the oldest ones reported from zircons of lunar granophyres [5].

Discussion: Fractional crystallization of a basaltic magma is unlikely to directly produce a granitic residual magma [3, 6]. The bulk composition with high SiO_2 content of C3 is similar to those of experimentally produced silicic immiscible liquids [6]. However, it is not certain that the liquid immiscibility is related to the formation of C3, due to a lack of a high-Fe fraction of immiscible liquids. Granophyric intergrowths, needle-shaped ilmenites and phosphates, and skeletal zircons represent a high degree of undercooling of a granitic magma. Ternary feldspar likely has formed by impact melting of plagioclase and alkali feldspar followed by rapid cooling, on the basis on the compact texture and intermediate composition.

References: [1] Collareta A. et al. 2014. Abstract #5104 77th Annual Meteoritical Society Meeting. [2] Ryder G. et al. 1975. 6th Proc. Lunar Science Conference 435-449. [3] Seddio S. et al. 2013. *American Mineralogist* 98:1697-1713. [4] Warren P. H. 1983. *Earth & Planetary Science Letters* 64:175-185. [5] Meyer C. et al. 1996. *Meteoritics & Planetary Science* 31:370-387. [6] Hess P. C. et al. 1975. 6th Proc. Lunar Science Conference 895-909.