PETROGRAPHIC AND MINERALOGICAL STUDIES OF THE LUNAR METEORITE DHOFAR 1180

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Introduction: Lunar meteorites provide important clues to better understand the formation and evolution of the Moon. Up to now, near 40 lunar meteorites were identified, and most were found in cold- and hot-deserts [1]. Dhofar 1180 is a newly recovered lunar breccia from Oman in 2005. Here, we present petrographic and mineralogical studies of this new lunar meteorite.

Results: Dhofar 1180 is a polymict breccia that contains lithic clasts of gabbro, anorthositic gabbro, granulite, subophitic basalt, troctolite, Ti-rich clast (olivine and pyroxene grains set in Ti-rich glass), microporphyritic crystalline impact melt breccia and gabbroic anorthosite. They usually occur as angular fragments ranging in size from 0.1 to 1 mm. Individual mineral fragments of pyroxenes, olivine and anorthite are abundant in the matrix, as well impact glass with various sizes. They range in size from 0.1 to 1 mm. Some pyroxene grains display fine exsolution. Most large mineral fragments show undulose extinction.

Mineral chemistry varies from clast to clast. Olivine usually has a Fa value of 31 to 69. In the Ti-rich clast, the value in olivine varies from 54 to 98. For olivine grains with MnO > 0.10 wt%, the molar FeO/MnO ratio varies from 70 - 110 with an average of 93, which falls within the range of typical lunar olivines [2]. Pyroxene also shows extensive chemical variation among clasts. Pyroxene mainly occurs as pigeonite ($En_{24-66}Fs_{23-59}Wo_{6-24}$), augite ($En_{11-41}Fs_{23-59}Wo_{28-38}$), and pyroxferroite ($En_{1-9}Fs_{65-86}Wo_{14-26}$). The molar FeO/MnO ratio of pyroxene varies from 50 to 70 with an average of 63. Anorthite is highly enriched in Ca and shows a small compositional variation (An_{91-99}) among clasts. Chromite-spinel-ulvospinel solid solution and ilmenite were also found in clasts. The impact glass has a composition of anorthite and contains several per cents of MgO and FeO.

Discussion: Whole rock compositions of Dhofar 1180 bear many characteristics of lunar meteorites [3]. It was classified as a fragmental or regolith breccia. Petrography and mineral chemistry of plagioclase, olivine and pyroxene are consistent with a lunar origin [4, 5]. The existences of anorthositic clasts and pyroxferroite further confirm the conclusion.

Among well-defined lunar meteorites, Dhofar 1180 has Al_2O_3 (23 wt%) and FeO (9.2 wt%) contents similar to those of Yamato 983885 and Calcalong Creek [1,3]. However, its Th concentration (0.9 ppm) is significantly lower than that of Yamato 983885 (2 ppm) and Calcalong Creek (4 ppm) [3]. Our data shows that KREEP basalt that occurred in both Yamato 983885 and Calcalong Creek is absent in Dhofar 1180. In Dhofar 1180, Ti-rich clast and impact glass are abundant, but are absent in Yamato 983885 and Calcalong Creek although low-Ti basalt clast was reported in Calcalong Creek [4,6]. The above distinction among Dhofar 1180, Yamato 983885 and Calcalong Creek suggests that Dhofar 1180 probably represent a unique lunar breccia.

References: [1] Korotev R. L. 2005. *Chemie der Erde* 65, 297-346. [2] Papike J. J. 1998. *Review in Mineralogy* V36. [3] http://epsc.wustl.edu/admin/resources/moon_meteorites.html. [4] Arai T. et al. 2005. *Antarctic Meteorite Research* 18, 17-45. [5] Kaiden H. and Kojima H. 2002. Abstract #1598. XXXIII LPSC. [6] Hill D. H. and Boynton W. V. 2003. *Meteoritics & Planetary Science* 38, 595-626.