GEOCHEMICAL STUDY OF FELDSPATHIC LUNAR METEORITES DHO 307, 309, 908 AND DHO 733.

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Introduction: Dhofar 307, 309 and 908 are paired meteorites with Dhofar 303 and 489 (Dhofar 303 et al.) [1]. Total 15 stones are included in Dhofar 303 et al. [1]. Dhofar 489 has lower rare earth elements (REE) abundances and higher Mg# (bulk molar Mg/[Fe+Mg] x 100) than those of ferroan anorthosites in Apollo samples [2]. Takeda et al. [2] indicated that Dhofar 489 originated from the lunar farside.

Dhofar 733 is a magnesian granulitic breccias having very high Na and Eu abundances among feldspathic lunar meteorites [1, 3]. Wittmann et al. [4] indicated that an impact melt rock Dhofar 1766 is paired with Dhofar 733 from their chemical compositional similarities. Foreman et al. [3] and Wittmann et al. [4] indicated a possibility that Dhofar 733 and Dhofar 1766 originated from the unknown location in the feldspathic highlands.

Well-constrained chemical compositions of Dhofar 303 et al. and Dhofar 733 will help the identification of their source regions and the understanding of their formation processes. In this study, we determined chemical compositions of Dhofar 307, 309, 733 and 908 and compared our data with those of previous studies [2, 5, 6, 7, 8] to evaluate representative chemical compositions of these feldspathic lunar meteorites.

Samples & methods: We have analyzed 6 subsamples from four feldspathic lunar meteorites Dhofar 307, 309, 733 and 908. Several clasts and matrix were separated from Dhofar 309 and 908. From Dhofar 309, matrix (m) and brown clast (b.c.) were prepared, and from Dhofar 908, gray clast (g.c.) and white-rich clast (w.c.) were prepared.

Bulk chemical compositions of these 6 subsamples were determined by prompt gamma-ray analysis (PGA) and instrumental neutron activation analysis (INAA). For INAA, neutron irradiations were performed two times with different irradiation periods except for Dhofar 309b.c. and Dhofar 908w.c. PGA and INAA were performed at Japan Atomic Energy Agency (JAEA). The REE compositions were determined by inductively coupled plasma mass spectrometry (ICP-MS) at Tokyo Metropolitan University except for Dhofar 309b.c.

Results and Discussions: Figure 1 shows Al_2O_3 abundances and Mg# values of our data and literature data of Dhofar 303 et al. [2, 5, 6, 7] and Dhofar 733 [6, 8]. Dhofar 307 and Dhofar 908g.c. data are in good agreement with each other and are similar to literature data of Dhofar 303 et al. [2, 5, 6]. Dhofar 309m and Dhofar 309b.c. show mafic-rich, magnesian compositions relative to the other subsamples and are similar to those of magnesian anorthositic granulite clasts reported in Dhofar 309 [7]. These two subsamples may be related to magnesian anorthositic granulites. Dhofar 908w.c. has relatively high Al_2O_3 abundances and low Mg# among our subsamples. The abundance of Al_2O_3 is similar to that of white anorthositic clast in Dhofar 489 (Dhofar 489 clast d2) [2], but Mg# is clearly different (Mg# = 75 vs. 90). Our data of Dhofar 733 show slightly lower Al_2O_3 contents and Mg# values relative to those of literature study [6, 8].

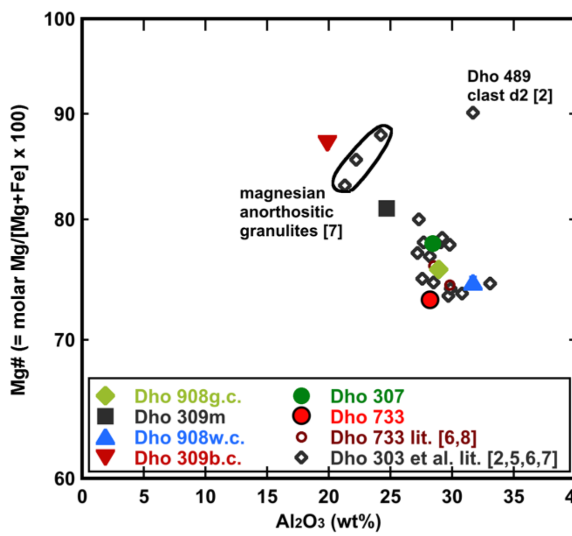

Fig. 1. Al_2O_3 abundances vs. Mg# values of Dhofar 303 et al. and Dhofar 733.

Figure 2 shows CI-normalized REE abundances of our data and literature data [2, 5, 6, 8]. The REE abundances of Dhofar 307, Dhofar 908g.c. and Dhofar 309m are consistent with each other. The REE abundances of Dhofar 307, Dhofar 908g.c. and Dhofar 309m are within the range of those of literature data of Dhofar 303 et al. [2, 5, 6]. The REE abundances of Dhofar 908w.c. are about half of Dhofar 303 et al. except for Eu. The La abundance in Dhofar 908w.c. is comparable with those of Dhofar 489d2 [2], but heavy REE abundances are significantly different. This indicates that Dhofar 908w.c. contains non-negligible amounts of mafic minerals such as orthopyroxene and/or olivine. The REE abundances of Dhofar 733 in this study are within the range of literature data [6, 8]. However, when we see the detail, there are some differences between our data and literature data.

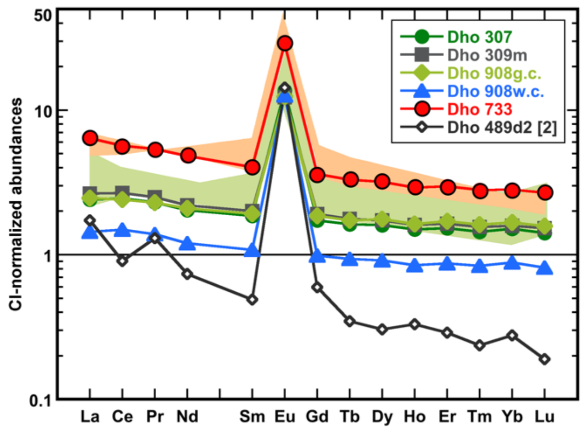

Fig. 2. CI-normalized REE abundances of Dhofar 303 et al. and Dhofar 733. Red and green shaded areas represent the chemical compositional range of literature data for Dhofar 733 [6, 8] and Dhofar 303 et al. [2, 5, 6], respectively. CI chondrite values are from [9].

Figure 3 shows Eu abundances and CI-normalized La/Yb ratios of our data and literature data [2, 5, 6, 7, 8]. The REE characteristics of Dhofar 307, Dhofar 309m, Dhofar 908g.c., Dhofar 908w.c. are consistent with each other and show good agreement with the literature data from [2, 5]. Both La/Yb ratios and Eu abundances of Demidova et al. [6] are widely scattered. Although the CI-normalized La/Yb ratios of magnesian anorthositic granulites [7] seem to be slightly lower than that of Dhofar 309m, literature data from [7] have large uncertainties (40%), so these differences may be within the analytical uncertainties. The CI-normalized La/Yb ratios of Dhofar 908w.c. and Dhofar 489d2 [2] are significantly different. Dhofar 908w.c. may not represent pure plagioclase fraction. Our data of Dhofar 733 is significantly different from the literature data [6, 8]. The Al_2O_3 abundances of our data and Demidova et al. [6] are comparable (28.2 wt% vs. 28.5 wt%), but the Eu abundances show 1 ppm difference. This difference is difficult to explain. The CI-normalized La/Yb ratios of our Dhofar 733 data and Hudgins et al [8] are different, but it can be explained in terms of the difference of plagioclase abundances.

We have evaluated major elements and REE abundances of Dhofar 303 et al. and Dhofar 733. Chemical compositions of Dhofar 307 and Dhofar 908g.c. show good agreement with literature data for Dhofar 303 et al. [2, 5, 6]. Dhofar 309m and Dhofar 309b.c. may be related to magnesian anorthositic granulites [7] and we may be able to constrain detailed chemical compositions of these granulites. Dhofar 908w.c. is expected to have similar chemical compositions to those of white anorthositic clast in Dhofar 489 [2], but it was unlikely. For Dhofar 733, our data and two literature data [6, 8] show slightly different chemical compositions from each other. Comparison of other minor and trace element compositions such as siderophile element compositions will be performed.

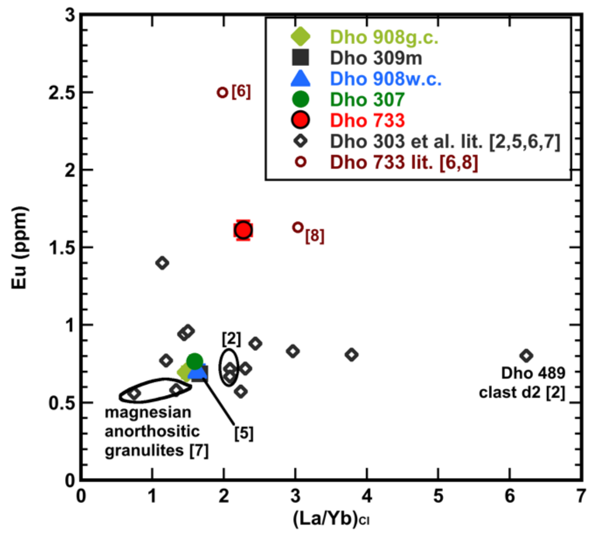

Fig. 3. CI-normalized La/Yb ratios vs. Eu abundances of Dhofar 303 et al. and Dhofar 733. CI chondrite values are from [9].

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