CALCIUM ISOTOPIC COMPOSITION OF THE KREEPS

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Introduction: The difference of calcium isotopic compositions of the Bulk Silicate Moon (BSM) and the Bulk Silicate Earth (BSE) is one of the key factors to understand the formation of the Earth-Moon system. The calcium isotopic composition of BSE could be constrained by investigating the calcium isotopic compositions of the Earth mantle because it contains about 99% of the Earth calcium. However, unlike the BSE, the calcium isotopic composition of BSM is not well constrained mainly because calcium budget in lunar crust and KREEPs should not be ignored. That means, just like the lunar crust, KREEPs (potassium, rare-earth element, phosphor-rich), as the product of the last stage of the lunar magma ocean and an important record of the magma activity on the Moon (e.g. [1], [2]), also contains a certain amount of the lunar calcium. Thus, the calcium isotopic compositions of the KREEPs should be an important part to be considered to estimate the composition of the BSM. Here we attempted to reveal that by detailed work on a lunar meteorite NWA 5000. NWA 5000 is a KREEP basalt with obvious presence of KREEP-bearing materials and is further confirmed by its unusually high REE concentration and negative Eu anomaly.

Experiments: Both the chemical and instrumental analyses were performed in the State Key Laboratory of Isotope Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences (GIG, CAS), following the procedure described in Zhu et al. (2016)[3]. The sample was grounded to 200 mesh before a certain amount of the powder was weighted into a Teflon beaker and digested in a mixture of conc. HF and conc. HNO_3. All chemical analyses were done from a single mother solution of the sample digest. The trace elements of NWA 5000 are measured on an iCAP Qc ICP-MS instrument (Thermofisher Scientific, USA), Calcium isotopes are measured on a Triton TIMS (Thermofisher Scientific, USA) for 6 times and precision was given based on these 6 measurement. The obtained $\delta^{44/40}$Ca (relatively to SRM915a) of NIST SRM 915a, IAPSO seawater, BHVO-2 and BCR-2 ran in the same period as the sample are 0.02±0.02‰ (2SE, n=26), 1.82±0.03‰ (2SE, n=17), 0.76±0.02‰ (2SE, n=19) and 0.80±0.02‰ (2SE, n=18) respectively, well agreed with document.

Conclusions: Our recent practices indicated that NWA 5000 shares a similar $\delta^{44/40}$Ca (0.78± 0.04‰, 2SE, n=6) with feldspar breccia [4]. This implies that KREEPs and the feldspar breccia may have similar calcium isotopic composition. Alternatively, the proportion of KREEPs in NWA 5000 has little effect on modifying the bulk rock calcium isotopic compositions. Based on the average concentrations of Th (0.37ppm) and K_2O (0.027 wt.%) in the lunar crust [5] and those in KREEP (Th, 12.4ppm; K_2O, 0.5 wt.%; [6] [7]), we estimated that NWA 5000 contains approximately 30~50% KREEPs, the CaO content in KREEPs could be 7-12% and the calcium isotopic composition of the KREEP is about 0.82-0.86‰. This indicates that the Ca isotopic composition of the KREEPs is indistinguishable from that of the lunar crust under the current analytic techniques.

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References: [1] Taylor S. R. (1982) *Lunar and Planetary Institute, Houston*, Abstract #502. [2] Jolliff B. L. et al. (2006) *Mineralogical Society of America.* [3] Zhu et al. (2016) *Geostandards and Geoanalytical Research* 40:185-194. [4] Schiller M. et al. (2018) *Nature* 555:507-510. [5] Korotev R. L. et al. (2003) *Geochim. Cosmochim. Acta* 67:4895-4923. [6] Neal C.R. and Taylor L.A. (1992) *Geochim Cosmochim Acta* 56:2177-2211. [7] Hess P.C. and Parmentier E.M. (2001) *Journal of Geophysical Research:Planets*, 106, #11.