SAYH AL UHAYMIR 300: PETROLOGY, MINERALOGY, AND TRACE ELEMENT GEOCHEMISTRY. W. Hsu[1], A. Zhang[1], Y. Guan[2], T. Ushikubo[2], R. Bartoschewitz[3] [1]Laboratory for Astrochemistry and Planetary Sciences, Purple Mountain Observatory, Chinese Academy of Sciences, Nanjing 210008, China. wbxu@pmo.ac.cn. [2]Dept of Geological Sciences, ASU, Tempe, AZ 85287, USA. [3]Bartoschewitz Meteorite Lab, Lehmweg 53, D-38518 Gifhorn, Germany

SaU 300 is a newly recovered lunar meteorite from Oman in 2004 [1,2]. It is predominantly composed of fine-grained matrix with abundant mineral fragments and a few polymict breccias. Numerous euhedral to subeuhedral mineral fragments (~ 100 μm) of olivine, anorthite, and pyroxenes are set in the fine-grained matrix. Both feldspathic and mafic lithic clasts occur in irregular or round shapes and range in size from several hundred microns to a few mm. Impact melts often appear as glass veins. Glass spherules (~ 100 μm) are also observed. They are often devitrified and contain plagioclase and pyroxene grains. One of the striking features of impact melts is the abundant relict grains of plagioclase, olivine and pyroxene set in the glass. FeNi metal and troilite grains are also present in the matrix.

Minerals in SaU 300 show considerable chemical variations. Olivine in most lithic clasts has a range of Fo_{58-82}. Olivine fragments display a larger chemical variation (Fo_{43-91}). The molar FeO/MnO ratios of olivine are generally consistent with the lunar trend. Most pyroxenes in SaU 300 have a low Ca content (Wo_{5-22}). Pyroxene fragments exhibit similar chemical ranges as those in lithic clasts. The molar FeO/MnO ratios in pyroxene plot between the lines of Moon and Earth. Plagioclase grains in lithic clasts have a wider compositional range (An_{93-98}) than plagioclase fragments (An_{95-97}) in matrix.

REE microdistributions in SaU 300 were analyzed with the ASU Cameca 6f ion microprobe. Measurements were carried out in olivine, anorthite, pyroxenes, and apatite within lithic clasts and the matrix (Fig. 1). Olivine exhibits a HREE-enriched pattern with Lu at 3-10×CI and Gd at 0.4-0.6×CI. Within the same clast, olivine has relatively homogeneous REEs. REEs vary by a factor of 3 in olivine from different clasts. Anorthite varies significantly in REEs both within clasts and among different clasts. It has a relatively LREE-enriched pattern with a positive Eu anomaly (~ 20×CI). La varies from 0.8 to 22×CI and Y, an analog of HREE, from 0.5 to 8×CI. Both high-Ca and low-Ca pyroxenes were analyzed. They exhibit typical HREE-enriched pattern with a negative Eu anomaly. High-Ca pyroxene has higher REEs (La 3-25×CI, Lu 20-50×CI) than low-Ca pyroxene (Lu 3-10×CI). One anorthositic clast contains an apatite grain (30×150 μm). Apatite has very high REEs with a relatively LREE-enriched pattern (La 2800×CI and Lu 650×CI) and a negative Eu anomaly (Eu 30×CI). Impact glass veins have homogeneous REEs with a relatively LREE-enriched (La 17×CI, Sm 12×CI), a positive Eu anomaly (Eu 17×CI) and a relatively flat HREE (12×CI) pattern.

On an Mg#-An plot, plagioclase and coexisting mafic minerals of highlands rocks usually fall within the distinct FAN and HMS regions [3]. Most lithic clasts of SaU 300 fall in the FAN envelope and a few plot within the FAN-HMS gap (Fig. 2). In addition, REEs in olivine, pyroxenes and plagioclase of SaU 300 (Fig. 1) are similar to those of FAN [4-6]. SaU 300 has a very strong affinity to FAN, which is the major component of the lunar highland crust.

Ba and Sr positively correlate with REEs in plagioclase of FAN rocks and lunar highlands meteorites [4]. The correlation between Ba and Ce is stronger than that of Sr and Ce (Fig. 3). Most plagioclase grains in SaU 300 fall in the region of FAN and lunar highlands meteorites, and a few plot close to the HMS suite rocks. Some plagioclase grains exhibit extremely high Sr concentrations (290 to 2720 ppm) (Fig. 3). In a systematic investigation of chemical alteration in meteorites from hot and cold deserts, Crozaz et al. [7] noted that Sr and Ba are elevated in two lunar feldspathic breccias, DaG 262 and 400, from the Sahara desert. Individual olivine and pyroxene grains in the meteorites have Sr and Ba concentrations that are up to 3 orders of magnitude higher than those of the FANs. Enrichment of Ba was also observed in plagioclase grains. It is clear that terrestrial weathering has modified mineral chemistry of meteorites from hot deserts

The bulk composition of SaU 300 is close to that of Dhofar 1180, Y983885 and Calcalong Creek. Mineral chemistry and trace element abundances of SaU 300 fall into the ranges of lunar feldspathic breccias and the FAN rocks. SaU 300 is a basaltic-bearing feldspathic regolith breccia and shows a strong affinity to the FAN rocks. On the basis of the low Th concentration and the dearth of KREEP clasts, the source of SaU 300 could be related to the lunar far side highlands terrane.

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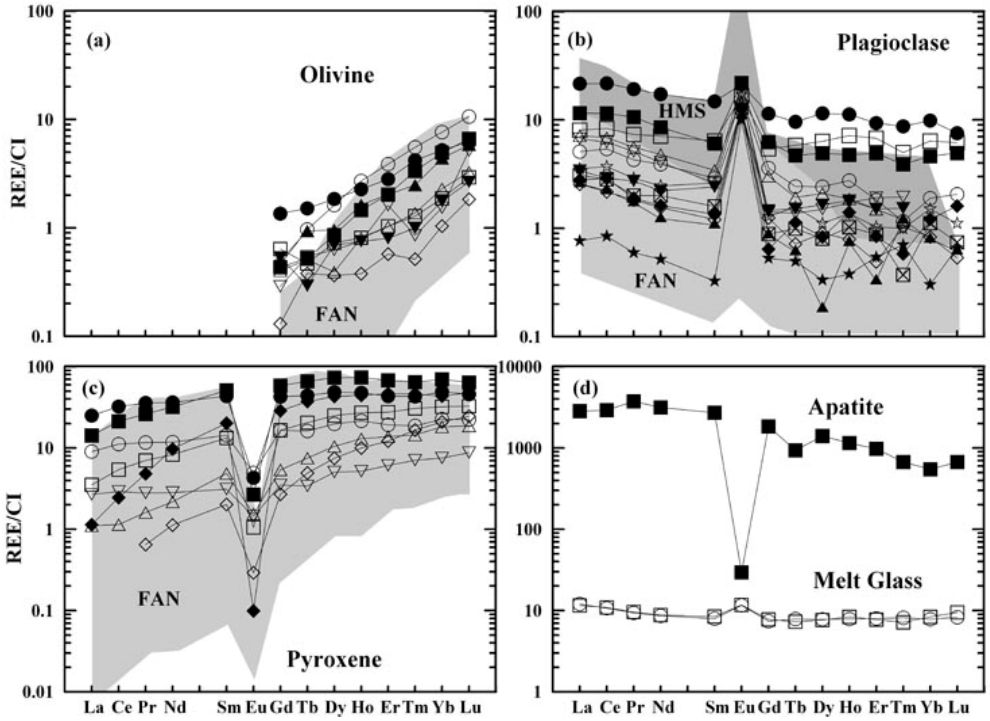

Fig. 1 REE microdistributions in minerals of SaU 300. FAN and HMS envelopes are adopted from Floss et al. [4] and Papike et al. [5,6].

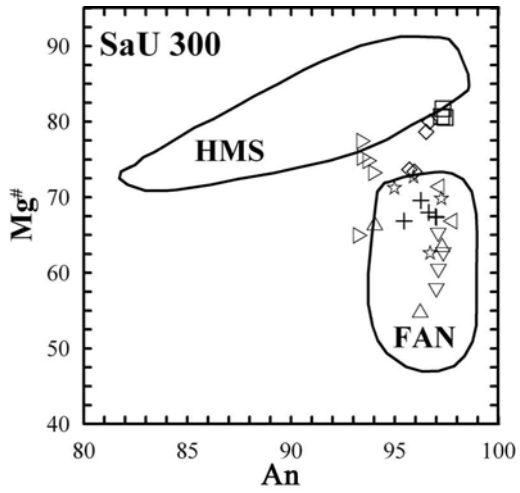

Fig. 2 Mg# of mafic phases (olivine and pyroxenes) versus An content of plagioclase in lithic clasts of SaU 300 and comparison with FAN and HMS suite rocks [3].

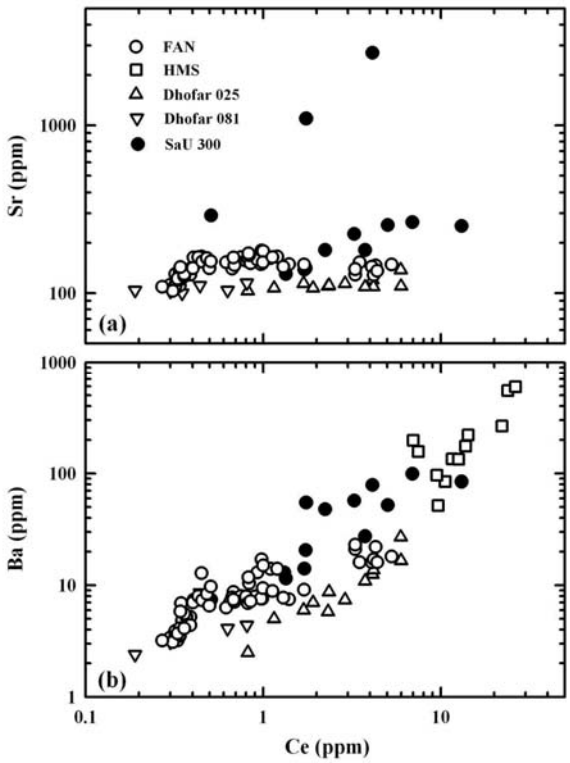

Fig. 3 Sr, Ba and Ce concentrations in plagioclase of SaU 300 and comparison with lunar highlands meteorites Dhofar 025 and 081 [8] and FAN and HMS [4-6].