Consideration to petrogenesis of the Akaishi lava, a hydrous low-K and -Mg ultrabasic "foidite" lava from northern Hyogo Prefecture, Japan

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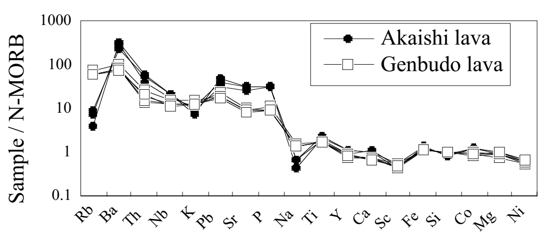
The Akaishi lava, which is among the alkali basalts erupted in northern Hyogo area in late Cenozoic Era, has unusual features in many ways compared to underlying Genbudo lava and other alkali basalts in the area. This cpx-phyric lava characteristically contains abundant groundmass glass and accessory phlogopite. The chemical composition shows that the rock is ultrabasic (SiO_2 =37.5-43.3wt%, MgO=6.7-7.5wt%), and poor in alkalis (Na_2O=0.9-1.8, K_2O=0.7-1.8%) and rich in P_2O_5 (2.1-2.2%), CaO (10.6-13.0%) and volatiles (LOI=1.4-6.6%). The elemental abundance patterns also show the distinct chemical feature of the Akaishi lava (Fig.1), the results being consistent with those by Genbudo Research Group [GRG] (1989). GRG (1989, 1991) concluded that the observed chemical feature of the rock could be formed secondarily by hydration and alteration of the glass and suggested that the rock was originally an ordinary alkali basalt. This conclusion, however, seems questionable because such secondary processes can not fully explain the characteristic petrography (e.g. cpx-phyric texture, presence of phlogopite and well-preserved, clear glass) and bulk chemistry as shown in Fig. 1. Alternatively, we examined the other case that the observed chemical composition was primary and such magma was generated by partial melting of upper mantle materials. In this case, considering that the lava contains phlogopite and is poor in K and Rb, the source material and the residue could have contained phlogopite as an essential K- and Rb-host. Mantle phlogopite is much more refractory under hydrous conditions than under dry conditions, therefore the magma of Akaishi lava possively generated uniquely by very small degrees of partial-melting of phlogopite-bearing peridotite (?) under a hydrous condition. If this is the case, such mantle processes can be significant in relation to generation of basalt magmas of HIMU signature.

Fig. 1 Spidergram.



Rare earth elements and O isotopes of chondrules in enstatite chondrites

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Chondrules formed through high temperature processes and were believed to lose primordial noble gases (Kim&Marti, 1994; Miura&Nagao, 1997; Nakamura et al., 1999). However, laser probe noble gas analyses for chondrules in enstatite (E) chondrites revealed that some chondrules contain great amounts of primordial noble gases (Okazaki et al., 2001). To elucidate the origin of the noble-gas-rich chondrules, we have measured O isotopes and rare earth elements (REEs) of chondrules from E chondrites using a Cameca 6f ion probe at ASU.

Polished sections were prepared from Yamato (Y) 791810 (EH4) and St. Marks (EH5). These polished sections are ~300μm thick to provide enough material for subsequent noble gas measurements. We have developed an improved sample preparation technique for O isotope measurements.

Oxygen isotopes for most of the chondrules in Y791810 and St. Marks plot around the bulk compositions previously reported for several EH chondrites (Clayton et al., 1984; Newton et al., 2000). The variation in $\delta^{18}O$ is within 10‰ for both meteorites. These results suggest that the precursor material of the E-chondrite chondrules has a common oxygen isotopic composition similar to those for the Earth and Moon.

In contrast to the oxygen isotopes, there are variations in REE abundances. We obtained 3 types of REE abundance patterns for the bulk chondrules: 1) flat relative to the CI-chondrite abundances; 2) LREE enriched relative to HREE in variable degree; 3) LREE depleted. Superimposed on these patterns are several anomalies. A Ce depletion is common in most objects from both meteorites. A negative Eu anomaly accompanies the Ce anomaly in several chondrules from Y791810. Positive Yb+Sm anomalies were found in some Y791810 chondrules. These variable REE patterns for E-chondrite chondrules may be inherited from the chondrule precursors and may not directly reflect conditions that prevailed during chondrule formation.

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