Rb–Sr ISOTOPIC SYSTEMATICS OF ALKALI-RICH FRAGMENTS IN YAMATO-74442 AND BHOLA.


1 Sokendai, Tachikawa, Tokyo 190–8518, Japan. E-mail: yokoyama.tatsunori@nipr.ac.jp.

Introduction: Alkali-rich igneous fragments were identified in the brecciated LL-chondrites, Krähenberg (LL5) [1], Bhola (LL3–6) [2], and Yamato (Y)-74442 (LL4) [3–5], and show characteristic fractionation patterns of alkaline elements [6]. The K-Rb-Cs-rich fragments in Krähenberg, Bhola, and Y-74442 are very similar in mineralogy and petrography (olivine + pyroxene + glass), suggesting that they could have come from related precursor materials [5]. We have undertaken Rb–Sr isotopic studies on alkali-rich fragments in Bhola and Y-74442 to precisely determine their crystallization ages and isotopic signatures of their precursor material(s).

Results and Discussion: Rubidium in alkali-rich fragments from Y-74442 is highly enriched: 20–180 times those of ordinary chondrites (OC). Alkali-rich fragments from Y-74442 yield a Rb–Sr age of 4.429 ± 0.054 Ga (n = 9, error = 2σ) with an initial 87Sr/86Sr ratio I Sr = 0.7144 ± 0.0094 (2σ), indicating a young crystallization age with a high I Sr compared with those of LL-chondrite whole-rocks (TLL = 4.542 ± 0.015 Ga, ISrLL = 0.69901 ± 0.00011; recalculated with λ (87Rb) = 1.402 x 10–11a–1) [7].

Assuming that the precursor material enriched in Rb was formed at T 0 = 4.568 Ga with an 87Sr/86Sr ratio = 0.69888 (i.e., identical to the Allende initial 87Sr/86Sr, ISrALL [8]) and the fragments crystallized from the melt at T = 4.429 Ga, a time-averaged Rb/Sr ratio is calculated to be ~2.5, which is much higher than the Rb/Sr ratios of the solar nebula or CI-chondrites (Rb/SrSOLAR = 0.65 [8]; Rb/SrCl = 0.32 [9]). Any solid/liquid fractionation processes could be ruled out for K, Rb, and (Cs) enrichments since these alkali-rich fragments show flat REE patterns [6]. We suggest that a condensate from the nebular gas was a carrier of alkaline elements. It was formed from the residual nebular gas after removal of a refractory lithophile component (i.e. Sr). The temperature at which the moderately volatile component (i.e. enriched in K, Rb, and Cs) was removed from the gas was relatively high ε970 K, the 50% condensation temperature of Na [10]). This component was isolated from the other lithophile and might have been isolated from the nebular gas without any interaction with high/low temperature components. At 4.43 Ga the condensate was incorporated into ferromagnesian components (i.e., olivine+pyroxene) possibly during an impact melting event. They suffered further fragmentations due to impacts and then were incorporated into the LL-chondritic breccia.