**147Sm-143Nd AND 146Sm-142Nd SYSTEMATICS OF BASALTIC EUCRITES.** S. Kagami¹, T. Yokoyama¹, and T. Usui¹, ¹Department of Earth and Planetary Sciences, Tokyo Institute of Technology, (2-12-1 Ookayama, Meguro, Tokyo 152-8551, Japan, e-mail: kagami.s.ab@m.titech.ac.jp).

**Introduction:** Eucrites are interpreted to have originated from the asteroid 4-Vesta’s crust [1]. They are petrographically classified into two groups; basaltic eucrites with subophitic texture quenched near the surface, while cumulate eucrites having gabbroric texture are the residual melt crystallized slowly deep in the crust [2]. The eucrite parent body has experienced magma ocean associated with core formation and silicate differentiation within several years after the formation of the solar system as investigated by the ¹⁸²Hf-¹⁸⁵W and ⁵³Mn-⁵¹Cr systematics [3, 4].

Sm-Nd dating is one of the most suitable approaches for investigating the crust crystallization age because both Sm and Nd are lithophile elements. The Sm-Nd systematics has two chronometers: the long-lived ¹⁴⁷Sm-¹⁴³Nd (T₁/₂ = 1.06×10⁹ y) and the short-lived ¹⁴⁸Sm-¹⁴²Nd (T₁/₂ = 1.03×10⁶ y) [5] systematics. Bouvier et al. [6] presented the ¹⁴⁷Sm-¹⁴²Nd isochron age for bulk rocks of 23 basaltic and cumulate eucrites to be 4532 ± 170 Ma. That study revealed that the variation of Sm/Nd ratios for basaltic eucrites were several times smaller than the entire range of Sm/Nd ratios for all eucrites, making it difficult for obtaining the precise Sm-Nd whole-rock isochron age for basaltic eucrites alone.

In this study, we determine the ¹⁴⁷Sm-¹⁴³Nd and ¹⁴⁶Sm-¹⁴²Nd ages for bulk rocks of basaltic eucrites. To obtain highly precise age data, we applied the techniques developed in our previous studies for determining the Sm/Nd ratios and Nd isotope compositions in meteorite samples [8, 9]. We report the ¹⁴⁷Sm-¹⁴³Nd and ¹⁴⁶Sm-¹⁴²Nd ages of five basaltic eucrites, and compare the results with the ages obtained from previous studies on basaltic and cumulate eucrites using different radiometric dating methods.

**Samples:** We investigated five basaltic eucrites, NWA 7188, NWA 5229, Juvinas, Agoult, and Nuevo Laredo, all of which are classified into monomict [10–14]. Of these, NWA 7188 is slightly affected by brecciation while Agoult is unbrecciated.

**Experimental:** The meteorite chips were cleaned with acetone and Milli-Q water, then powdered using an agate mortar and pestle. The powdered samples were decomposed using a high-pressure digestion system (DAB-2, Berghof) with HF and HNO₃ to completely dissolve refractory minerals including zircon. Subsequently, the samples were treated with HClO₄ to eliminate insoluble fluorides. After the sample digestion, ~10% of the solution was removed and mixed with the ¹⁴⁹Sm- and ¹⁴⁵Nd-enriched spikes. The spiked solution was passed through TRU Resin (Eichrom) for separating REEs from the matrix elements. We measured the ¹⁴⁶Nd/¹⁴⁴Nd and ¹⁴²Sm/¹⁴⁴Sm ratios in the sample separated for determining the Sm/Nd ratios by isotope dilution using a quadrupole ICP-MS at Tokyo Tech (X-series II, Thermo). The remainder of the sample solution was used for highly precise Nd isotope analysis. The solution was first passed through a cation exchange column filled with a 1:1 mixture (w/w) of AG50W-X8 and AG50W-X12 (Bio-Rad) to separate REEs from major elements. Next, Ce was removed from the rest of REEs by passing through Ln Resin (Eichrom), during which Ce⁺⁺ in the sample solution (10M HNO₃) was oxidized into Ce⁴⁺ using KBrO₃ [15, 16]. Finally, Nd was separated from Sm using Ln Resin in HCl media. We achieved Ce/Nd = ~3×10⁻⁵ and Sm/Nd = ~4×10⁻⁵ with >91% Nd recovery. The ¹⁴²Nd/¹⁴⁴Nd and ¹⁴³Nd/¹⁴⁴Nd ratios were analyzed by TIMS at Tokyo Tech (TRITON plus) with the dynamic multicollection method. The reproducibilities of the ¹⁴²Nd/¹⁴⁴Nd and ¹⁴³Nd/¹⁴⁴Nd ratios for a standard JNd-1 (500 ng) were 4.8 ppm and 3.7 ppm (2σ), respectively.

**Results and Discussion:** For the ¹⁴⁷Sm-¹⁴³Nd system, the basaltic eucrites examined in this study yielded an isochron age of 4538 ± 220 Ma with an initial ¹⁴⁷Nd/¹⁴⁴Nd of 0.50660 ± 0.00030 (MSWD = 0.104; Fig. 1). This ¹⁴⁷Sm-¹⁴³Nd whole-rock isochron age is consistent with the whole-rock ¹⁴⁷Sm-¹⁴³Nd isochron age for 23 basaltic and cumulate eucrites obtained previously (4532 ± 170 Ma [6]). In addition, we obtained the ¹⁴⁶Sm-¹⁴²Nd whole-rock isochron age for the basaltic eucrites to be 4565 ± 42 Ma (MSWD = 4.1; Fig. 2) by assuming an initial Solar System ratio of ¹⁴⁶Sm/¹⁴⁴Sm = 0.00828 at 4567 Ma and T₁/₂ = 103 Myr for ¹⁴⁶Sm as suggested in [5]. Boyet et al. [7] investigated the ¹⁴⁶Sm-¹⁴²Nd evolution diagrams for bulk rocks of three basaltic and three cumulate eucrites. By applying the same initial ¹⁴⁶Sm/¹⁴²Nd and T₁/₂ for ¹⁴⁶Sm, the ¹⁴⁶Sm-¹⁴²Nd age is recalculated to be 4556 ± 30 Ma. It should be noted that the recalculated age of Boyet et al. [7] was determined dominantly by the data for three cumulate eucrites with variable Sm/Nd ratios, thereby most likely representing the age of cumulate eucrites for a differentiation event. Although the analytical uncertainties are large, this age is consistent with that for basaltic eucrites determined in this study, suggesting that the parent body processes associated with
the last Sm-Nd isotopic closure were contemporaneous for basaltic and cumulate eucrites.

According to the Pb-Pb systematics [17], the mean age for small zircons found in basaltic eucrites was 4541 ± 11 Ma, which was consistent with the $^{146}\text{Sm} - ^{142}\text{Nd}$ age for basaltic eucrites obtained in this study (4565 ± 32 + 59 Ma) within analytical uncertainties. This suggests that the $^{146}\text{Sm} - ^{142}\text{Nd}$ age may be likely the crystallization age of the crust from basaltic magma. Kleine et al. [3] presented the Hf-W whole-rock isochron age for 7 basaltic and 1 cumulate eucrites to be 4563.2 ± 1.4 Ma. This most likely represents the formation age of the basaltic eucrite source reservoir. The $^{146}\text{Sm} - ^{142}\text{Nd}$ age in this study for basaltic eucrites and the Hf-W whole-rock isochron age are consistent with each other within analytical uncertainties. This implies that there is no apparent age difference between the formation of source mantle for basaltic eucrites and the crystallization of the crust represented by basaltic eucrites.