Sm-Nd, Rb-Sr, and Mn-Cr Ages of Yamato 74013. L. E. Nyquist¹, C.-Y. Shih², and Y. D. Reese³, ¹Mail Code KR, NASA Johnson Space Center, Houston, TX 77058-3696, USA, lawrence.e.nyquist@nasa.gov, ²Mail Code JE-23, ESCG/Jacobs Sverdrup, P.O. Box 58477, Houston, TX 77258-8477, USA, ³Mail Code JE-23, ESCG/Muniz Engineering, Houston, TX 77058, USA.

Introduction:
Yamato 74013 is one of 29 paired diogenites having granoblastic textures [1]. The ⁹²Ar-⁹⁰Ar age of Y-74097 is ~1100 Ma [2]. Rb-Sr and Sm-Nd analyses of Y-74013, -74037, -74097, and -74136 suggested that multiple young metamorphic events disturbed their isotopic systems [3]. Masuda et al. [4] reported that REE abundances were heterogeneous even within the same sample (Y-74010) for sample sizes less than ~2 g. Both they and Nyquist et al. [5] reported data for some samples showing significant LREE enrichment. In addition to its granoblastic texture, Y-74013 is characterized by large, isolated clots of chromite up to 5 mm in diameter [1]. Takeda et al. [1] suggested that these diogenites originally represented a single or very small number of coarse orthopyroxene crystals that were recrystallized by shock processes. They further suggested that initial crystallization may have occurred very early within the deep crust of the HED parent body. Here we report the chronology of Y-74013 as recorded in chronometers based on long-lived ⁸⁷Rb and ¹⁴⁷Sm, intermediate-lived ¹⁴⁶Sm, and short-lived ⁵³Mn.

REE abundances:
REE element abundances for our sample of Y-74013 were determined by mass spectrometric isotope dilution analyses during the earlier investigation [5]. Combined with data from [3] and [4], they illustrate the extent of trace element variability due to sample heterogeneity, and provide a useful context for the isotopic studies (Fig. 1). Comparing the whole rock REE analyses reported by [4] and [5] shows close agreement for Lu, Yb, and Eu abundances, but significant discrepancies for the other REE.

Y-74013 consists almost entirely of opx [6] into which the HREE (Heavy Rare Earth Elements) are strongly partitioned. That opx dominates the abun-

![Figure 1. REE abundances in Y-74013.](image1)

![Figure 2. Sm and Nd abundances in separated phases compared to those in a bulk sample [5].](image2)

![Figure 3. ¹⁴⁷Sm-¹⁴³Nd isochron for Y-74013.](image3)
REE abundances reported by [4] were atypical, due to an atypically high modal abundance of a leachable phase present in the leachate WR(l) and tentatively identified with phosphates. WR(l) appears initially to have been in isotopic equilibrium with opx, represented essentially by the residue after leaching, i.e., WR(r) (Fig. 3). These two phases determine an isochron for an age $T = 4.65\pm 0.13$ Ga and initial $\varepsilon_{\text{Nd}, \text{HED}} = +0.71\pm 1.0$ relative to the HED reservoir value (HEDR) determined for eucrites earlier [7].

Because of the low $55\text{Mn}/52\text{Cr}$ ratio of the bulk chromite from the Asuka 881394 unique magnesian "eucrite" [10]. The latter has been dated at 4566.52±0.33 Ma by the $207\text{Pb}/206\text{Pb}$ method [11]. Because of the low $53\text{Mn}/52\text{Cr}$ ratio of the bulk Y-74013 diogenite, we are unable to say whether the chromite formed contemporaneously with crystallization of the whole rock, or later during metamorphism. Nevertheless, our results verify that the diogenite formed during initial differentiation of the HEDPB, and before several eucrites, unless the $53\text{Mn}-53\text{Cr}$ isochrons of the latter were reset ~10 Ma after differentiation of the parent body (Fig. 6 and [10]).

Conclusions: Our results confirm that the Y-74013-type granoblastic diogenites formed very early in solar system history. Their relationship to the apparently younger diogenites Tatahouine and Johnstown [9] is unclear, and is perhaps further evidence of a multiplicity of HED-like differentiated parent bodies within the early solar system, including apparently a separate parent body for A-881394 [12].

References: