The Abundance of ^{92}Nb in the Early Solar System

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The short-lived isotope ^{92}Nb decays to ^{92}Zr with a half-life of 37 Ma. This system has great potential to date early silicate differentiation and core segregation owing to Nb-Zr fractionation during these processes (e.g., [1-4]). Moreover, the initial ^{92}Nb abundance of our solar system provides constraints on *p*-process nucleosynthesis (e.g., [5]). These applications require a well-defined initial ^{92}Nb abundance and distribution in the Solar System. Previous work yields an initial ^{92}Nb/^{93}Nb ratio of 1.7 (±0.6) x 10^{-5} [2, 4], with the possibility that CAIs sampled higher initial abundances [1].

In order to investigate potential ^{92}Nb heterogeneity in CAIs, we measured Zr isotopes and Nb/Zr ratios of 14 "common" calcium-aluminum-rich inclusions (CAIs) from Allende and 1 CAI from Mokoia. The data were obtained on a Neptune Plus MC-ICPMS and a DRC-Q-ICPMS, respectively. Based on rare earth element analyses, the CAIs were divided into Group II and non-Group II inclusions.

Our data show that the non-Group II CAIs display variable Nb/Zr ratios close to chondritic and correlate with ε^{92}Zr. They define an isochron with an initial ^{92}Nb/^{93}Nb of 1.6 (±1.5) x 10^{-5}. This is consistent with previous results obtained from isochrons of chondrites, achondrites and mesosiderites [2, 4, 6] and demonstrates a homogeneous ^{92}Nb distribution within these reservoirs and non-Group II CAIs. Therefore, the ^{92}Nb-^{92}Zr chronometer is now well-constrained and has great potential for dating early solar system events. The Group II CAIs, however, also define a linear correlation in the Nb-Zr isochron diagram with a wider range of Nb/Zr ratios. They yield an initial ^{92}Nb/^{93}Nb of 3.7 (±0.6) x 10^{-5}, indicating heterogeneity for this special CAI group. The correlation between ε^{92}Zr and 1/Zr in Group II CAIs hints at admixing of refractory "p-process" dust. Common CAIs thus likely sampled isotopically distinct and evolving reservoirs in the solar nebula close to the Sun. They reflect condensates and re-melting on the one hand, but also likely record the survival of extremely refractory dust in a hot environment.

[1] Münker et al. (2000) *Science* **289**: 1538–1542 [2] Schönbächler et al. (2002) *Science* **295**: 1705–1708; [3] Wade and Wood (2001) *Nature* **409**: 75-78; [4] Iizuka et al. (2016) *EPSL* **439**: 172-181; [5] Lugaro et al. (2016) *PNAS* **113**: 907–912; [6] Haba et al. (2017) *LPSC* abstract: 1739.