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Nb-Zr systematics of rutiles from the Mile IIE iron meteorite

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The ^{92}Nb-^{92}Zr decay system with a half-life of 37 Ma has been recognized as a promising tool to provide chronological information in the early Solar System [1,2]. A recent study for mesosiderite rutiles indicates that the ^{92}Nb/^{93}Nb ratio of the Solar System started with $(1.66 \pm 0.10) \times 10^{-5}$ [3]. In contrast, a higher initial ratio has been reported for Northwest Africa 6704 which likely originated from the outer Solar System [4]. Thus, the heterogeneity of ^{92}Nb distribution in the early Solar System must be evaluated for utilizing the Nb-Zr chronometer. Meteoritic rutiles are a suitable mineral for ^{92}Nb-^{92}Zr dating because of their high Zr and Nb contents with large variations [3]. In this study, we used the Miles IIE iron meteorite and aimed to prepare three rutile fractions with different Nb/Zr ratios to obtain a precise internal isochron.

Rutile were hand-picked after dissolving the metal part in 6M HCl and the silicate inclusions in concentrated HNO_3-HF. The individual rutile grains were examined for Nb and Zr concentrations using FE-EPMA and were arranged into three fractions depending on their Nb/Zr ratios. The fractions were dissolved in concentrated HNO_3-HF using Parr$^{Â®}$ bombs. Reference materials (BHVO-2, NIST SRM 154c) were also processed to validate the method. The ^{93}Nb/^{90}Zr ratios were measured with a Thermo X series 2 quadrupole ICP-MS by taking up a few % sample aliquots.

The FE-EPMA analysis of rutiles yielded concentrations of up to 21000 ppm Nb and 200–8300 ppm Zr and ^{93}Nb/^{90}Zr ratios of 0.05–20.1. The preliminary ICP-MS analysis yielded ^{93}Nb/^{90}Zr ratios of 0.58 ± 0.05, 3.1 ± 0.3, and 16.6 ± 0.4 (2σ) for the three fractions. This variation is the largest among the previous ^{92}Nb-^{92}Zr studies using internal isochrons [1–4] and demonstrates that our method using rutiles would provide a precise initial ^{92}Nb/^{93}Nb ratio of the parent body.

References: [1] Schönbächler et al. (2002) *Science*, 295, 1705–1708. [2] Iizuka et al. (2016) *EPSL*, 439, 172–181. [3] Haba et al. (2021) *PNAS*, 118, e2017750118. [4] Hibiya et al. (2019) *82nd Annual Meeting of The Meteoritical Society*, p. 6370.