American Mineralogist, Volume 95, pages 1343–1348, 2010

The behavior of the Hf isotope system in radiation-damaged zircon during experimental hydrothermal alteration

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Abstract

The application of the Hf isotope composition of zircon as a geochemical tracer requires the preservation of Lu-Hf systematics within individual grains. We performed hydrothermal experiments on a self-irradiation-damaged zircon to test whether hydrothermal alteration would affect its Hf isotopic composition. Severely radiation-damaged zircon from Sri Lanka was reacted in either Teflon reactors or gold capsules at 200 °C (1080 h, autogeneous pressure), 400 °C (120 h, 1 kbar), and 600 °C (72 h, 1 kbar) in a 1 *M* HCl–0.2 *M* HF solution that was spiked with 300 ppm non-natural Hf (98.2% ^{180}Hf) and 970 ppm Yb. Laser ablation inductively coupled plasma mass spectrometry measurements of the Hf- and U-Pb isotope compositions of the altered domains revealed that the U-Pb system of such domains was severely disturbed, resulting in a discordia pointing toward the origin of the concordia diagram, but that the Hf isotope composition was unaffected. In addition, Yb enrichment was observed in the reacted zircon domains, predominantly near the zircon-solution interface. The Yb has apparently diffused into the altered domains. The new data are fully consistent with a diffusion-controlled aqueous alteration process occurring within radiation-damaged zircon.

Keywords: Zircon, alteration, Lu-Hf, radiation damage