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LETTER: ACTINIDES IN GEOLOGY, ENERGY, AND THE ENVIRONMENT†

Chemistry and radiation effects of davidite

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ABSTRACT

Davidite ($A_{1-x}M_{21}O_{38}$) samples from five different geological localities contain approximately 0.2 to 9.5 wt% UO_2 (0.02 to 0.65 atoms per formula unit) and <0.1 to 1.3 wt% ThO_2 (<0.01 to 0.09 atoms per formula unit). Maximum amounts of other notable cations include 3.7 wt% V_2O_3, 4.1 wt% Cr_2O_3, 2.5 wt% Y_2O_3, 5.6 wt% La_2O_3, 6.0 wt% Ce_2O_3, 4.0 wt% MnO, 2.4 wt% ZnO, 2.7 wt% SrO, and 4.9 wt% PbO. As a result of the variation in age and Th-U content, the calculated α decay dose ranges from ~0.2 to 44×10^{16} α/mg (~0.06 to 14.5 dpa). For samples with ages of 275–295 Ma, the critical dose for amorphization based on electron diffraction is ~0.8×10^{16} α/mg. Natural davidite is commonly altered to rutile, ilmenite, titanite, and other minor phases.

Keywords: Davidite, α decay, uranium, thorium, lanthanides, alteration, amorphization