American Mineralogist, Volume 96, pages 417–422, 2011

Synthesis and characterization of françoisite-(Nd): $Nd[(UO_2)_3O(OH)(PO_4)_2]\cdot 6H_2O$

Christopher R. Armstrong,[1,*] Kenneth L. Nash,[1] Peter R. Griffiths,[2] and Sue B. Clark[1]

[1]Department of Chemistry, Washington State University, Pullman, Washington 99164, U.S.A.
[2]Department of Chemistry, University of Idaho, Moscow, Idaho 83844, U.S.A.

Abstract

In this report, synthesis and characterization data for françoisite-(Nd), $Nd[(UO_2)_3O(OH)(PO_4)_2]\cdot 6H_2O$ are presented. Experimental studies including chemical digestion, thermogravimetric analysis (TG), attenuated total reflection infrared spectroscopy (ATR-IR), Raman spectroscopy, and X-ray powder diffraction (XRD) were conducted. The local bonding environments of uranyl and water were investigated with ATR-IR and Raman spectroscopy. The average axial uranium-oxygen bond lengths [R(U=O)] and the oxygen-oxygen hydrogen bond distances [R(O···O)] in water were calculated from the vibrational frequencies of the stretching modes of uranyl and water, respectively. The IR spectra of protiated and deuterated françoisite-(Nd) appear to confirm a coordinated hydroxyl group bridging vicinal uranyl groups in the structural unit. These studies provide the basis for further thermodynamic (e.g., calorimetry, solubility, and sorption) and geochemical modeling investigations of hydrated uranyl phosphate compounds.

Keywords: Françoisite-(Nd), uranyl phosphates, mixed actinide solid phases, spent nuclear fuel corrosion, uranium remediation