

Where's your apatite? Criteria affecting formation of apatite and its ability to incorporate iodine species

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Iodine-129 (^{129}I) is a byproduct of nuclear fission reactions which can pose a particular hazard to human health due to its relatively long half-life (15.7 Ma), ability to migrate in subsurface environments, and propensity to accumulate in the human thyroid [1]. In order to prevent environmental contamination via long-lived radionuclides, deep geologic storage is a preferred form of storage for spent nuclear fuels. ^{129}I typically exists in various forms including iodide (I^-) and iodate (IO_3^-). It has been previously demonstrated that apatite can incorporate iodide and effectively entrap iodate from mildly acidic aqueous solutions [2] through conducting brushite ($\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$) to apatite transformation experiments. In addition, crystallization of monetite (CaHPO_4) at temperatures below 100°C has been observed, which is consistent with previous studies where monetite formed in acidic solutions along with calcium phosphate phases [3]. To evaluate conditions at which apatite crystallizes as the only phosphate mineral phase, time series experiments in iodate bearing solutions at different values of pH and temperature are conducted. Iodine aqueous species, which are sensitive to pH, are analyzed with ultraviolet-visible spectrophotometry. Crystallized apatite samples are to be examined with X-ray diffraction and microscopy techniques, followed by electron microprobe or neutron activation analyses.

References:

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