

Morphological features of altered minerals and precipitates in thin granite rock sections reacted with solutions with various pHs

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The cement components of the deep geological disposal facility for high-level radioactive wastes can increase the pH of groundwater, which may alter minerals contained in natural barriers. These mineral alterations and colloidal precipitates formed during the mineral alterations can affect the radionuclide retardation capacity of the natural barriers. Many previous studies have used a single mineral powder sample to investigate mineral alteration and precipitate formation under various conditions and evaluated the mineral alteration by determining the mineral dissolution rate based on concentrations of dissolved elements in the aqueous solutions. On the other hand, in this study, morphological features were investigated using thin granite rock sections reacted with various pH solutions via various analytical methods to directly show various minerals alterations and precipitate formation. The batch kinetic alteration tests using thin granite rock sections were conducted for 20 days in aqueous solutions of different pHs (1, 9, and 11). After the tests, thin granite rock sections and solutions were analyzed using optical microscopy, atomic force microscopy (AFM), micro-X-ray fluorescence (μ -XRF), electron probe X-ray micro-analysis (EPMA), and inductively coupled plasma mass spectrometry (ICP-MS). The morphological features of all minerals changed the most in the sample reacted at $\text{pH}_0 = 1$. Micro-fractures and grain boundaries of all minerals in the sample grew much wider and clearer than in other samples ($\text{pH}_0 = 9$ and 11). Biotite and chlorite in the sample reacted at $\text{pH}_0 = 1$ did not show pleochroism indicative of mineral alterations in the optical microscopic analysis. Etch pits on the biotite surface in the sample reacted at $\text{pH}_0 = 9$ observed by AFM widened with increasing reaction time. In addition, the TOT-sheet and brucite-like layer constituting the biotite were dissolved layer by layer. Particularly, precipitates were observed on the microcline surface after the reaction at $\text{pH}_0 = 9$, the size of which increased with increasing reaction time due to the nucleation process. The sample that reacted at $\text{pH}_0 = 11$ showed similar characteristics observed for the sample at $\text{pH}_0 = 9$, however, more reaction time was needed until the characteristics appeared.