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Surface analytical approaches to artificial weathering of Aji-granite and its constituent minerals under acidic conditions by AFM and XPS

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The Aji-granite is fine-grained massive biotite-granite and widely used for the tombstone in Japan. Dissolution experiments in a closed system and surface analyses of Aji-granite and its constituent minerals (single crystals of annite, albite, microcline, and quartz) were carried out to elucidate how they alter during the early stage of weathering under acidic conditions. The effect of solution pH was examined by using acidic solutions of various pH values. Crystal surfaces were observed by atomic force microscopy (AFM), and the chemical composition was determined by X-ray photoelectron spectroscopy (XPS). During alteration of minerals, Fe-oxides, Al-oxides, and Si-oxides were formed. Under neutral to slightly acidic conditions, platelet-like Fe-oxides precipitated in annite, and particulate Al-oxides precipitated in albite and microcline. Under strongly acidic conditions, relatively spherical Si-oxides were formed in annite and albite. During alteration of Aji-granite, Fe-oxides and Si-oxides were formed. Under neutral to slightly acidic conditions, plagioclase dissolved, and then pH increased. Iron dissolved from biotite precipitated smoothly as Fe-oxides. At low pH, dissolution of biotite was predominant. In alteration of Aji-granite, biotite and plagioclase show two relationships under neutral to slightly acidic conditions: (a) the increase of pH due to plagioclase dissolution promotes Fe-oxide precipitation; (b) and the presence of some cations in aqueous solution due to biotite dissolution probably inhibits Al-oxide precipitation. These relationships increase the reactivity of biotite.