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Mineralogy, chemistry, and formation of oxidized biotite in the weathering profile of granitic rocks

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ABSTRACT

Biotite was oxidized in deep saprolitic weathering profiles developed on granitic rocks in a humid temperate climate in the Youngju-Andong area of South Korea. The mineralogy and chemistry of these oxidized biotites were characterized by chemical analysis, electron microscopy, X-ray diffraction, thermal analysis, and radiogenic Ar analysis. The results showed that a decrease in the b_o-dimension, loss of radiogenic Ar, and formation of vermiculite are fairly well correlated with the degree of oxidation of ferrous iron. The chemical composition of oxidized biotite was modified by a non-stoichiometric removal of interlayer and octahedral cations to compensate for the charge imbalance induced by oxidation of Fe. The pervasive loss of cations and radiogenic Ar suggests their diffusion through oxidizing biotite in a non-expanded state. Iron oxidation and cation loss caused a decrease in the b_o-dimension with the formation of discontinuities that acted as conduits for the weathering solutions, resulting in partial vermiculitization (<10%). The Fe oxidation was nearly completed in the lower part of the profile, concomitant with mineralogical and chemical modification to oxidized biotite that persists throughout the profile without further notable modification. Cation release from biotite is governed in early stage by the formation of oxidized biotite, and later by its decomposition.