Evidence for Halloysite Formation from Weathering of Ferruginous Chlorite[1]

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Abstract: Evidence of chlorite weathering to halloysite appears to be limited. Trioctahedral ferruginous chlorite occurring in granitic rocks and *in situ* altered phases isolated from the horizons of two soils in southern Korea were studied by scanning and transmission electron microscope (SEM, TEM), chemical, and X-ray diffraction (XRD) techniques to determine the mechanism of alteration and nature of alteration products. Chlorites were entirely converted to halloysite, kaolinite, and Fe-oxyhydroxides in the thick Bt horizon. In the E and BC horizons, in addition to 1:1 silicate clays and Fe-oxyhydroxides, chlorite-like and intergradient vermiculite-kaolin minerals were also found. Total chemical analysis of chlorite flakes revealed losses of substantial amounts of Fe and Mg. Large parallel sets of galleries suggested extensive exfoliation and expansion of chlorite flakes. Tubular halloysite formed bridges between the walls of galleries. The SEM and TEM analyses showed very distinct coatings (0.2 – 0.3 μm thick) of Fe-oxyhydroxides above and below the surface of galleries that consisted of rounded, sub-rounded, elongated, ultramicrocrystalline particles (goethite and hematite). The 1:1 mineral species found in the thick Bt horizon had a tubular and crumpled lamellar morphology. The presence of Fe likely creates a misfit between tetrahedral and octahedral sheets and results in the morphology of the 1:1 clays observed under SEM and TEM. The presence of intergradient minerals between chlorite and 1:1-type clays in the surface and transitional BC horizon suggests that, in addition to losses of OH sheet -Fe and -Mg, the chlorite with mostly Al-octahedra is partly transformed to double 1:1 silicate clays and intergradient minerals.

Key Words: Chlorite (ferruginous) • Electron microscope • Halloysite • Intergradient minerals (2:2 to 1:1 minerals) • Iron-oxyhydroxides • Kaolinite • Weathering

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