Electron-Optical Study of Alteration to Smectite in the Cheto Clay Deposit

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Abstract: Volcanic ash of latitic composition in the Pliocene Bidahochi formation of northeastern Arizona has been altered in place to smectite clay. The Cheto clay, a 4-ft thick bed of high-quality activable smectite, offers an excellent opportunity for electron-optical study of the alteration processes in volcanic glass shards, spherulites, and aggregates in the tuff. No completely unaltered tuff remains in the exposed bed, but transitional materials showing progressive alteration from vitric tuff toward massive smectite have been collected and examined petrographically, electron-optically, and by X-ray diffraction.

The partly altered tuff shows several clearly identified structures relatable to the fresh material: spherical to subspherical spherulites, conchoidally fractured subtriangular to irregular vitric shards dominated by smoothly curved pitted surfaces, massive essentially structureless glass, and columnar fused aggregates which appear interstitial to the shards. Upon alteration these aggregates display an irregular comb-like structure from a planar base in cross-section, and a hackly polygonal to random texture normal to the comb structures. X-ray diffraction reveals only montmorillonite in the materials examined, although minor quartz and plagioclase feldspar have been reported elsewhere in the partially altered ash.

Argillization of the vitric tuff involves several phenomena: (1) the development of layering or banding in the glass; (2) the development of a braided surface aspect perhaps related to banding; (3) the inception of arcuate subparallel lineations on internal curved surfaces of the glass; (4) the growth of pseudohexagonal, weakly curled flakes whose boundaries appear threadlike on glass surfaces, and (5) the growth of grossly hexagonal matted granular networks in completely altered glass. Bladed, comb-like smectite develops along interfaces between glass and more resistant shards and from fused columnar aggregates in the original material. The mechanism appears to be one of essentially pervasive nucleation and growth of smectite in the devitrifying glass with the early development of preferred orientation of individual smectite crystallites. This orientation, manifested in layering and braiding, may reflect simple response to the space problem or response to cryptostruetures and polymerization in the original glass. Relic structures relatable to the unaltered vitric tuff are not obliterated and can be discerned even in the completely altered ash.

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