American Mineralogist, Volume 91, pages 685–701, 2006

Genesis and compositional heterogeneity of smectites. Part III: Alteration of basic pyroclastic rocks—A case study from the Troodos Ophiolite Complex, Cyprus

GEORGE E. CHRISTIDIS*

Technical University of Crete, Department of Mineral Resources Engineering, 73100, Chania, Greece

ABSTRACT

Upper Cretaceous basic pyroclastic rocks, which overlie the Upper Pillow Lavas of the Troodos ophiolitic complex, Cyprus have been altered to bentonites. The resulting smectite is Fe-rich montmorillonite and Fe-rich beidellite, with moderate Mg contents. The smectite is *trans*-vacant and contains abundant exchangeable K. The presence of K is linked with hydrothermal alteration, which affected the higher members of the Troodos ophiolitic suite. The smectite displays significant compositional heterogeneity, which involves substitution of Fe for Al and to a lesser degree substitution of Mg for Al, and that reflects the influence of microenvironmental conditions on smectite formation. The layer charge of the smectite is controlled mainly by the tetrahedral charge, whereas the influence of octahedral charge is of lesser importance, because of Fe for Al substitutions, which does not create a charge deficit. Although the parent pyroclastic rocks were basic, the bentonites contain abundant Si-polymorphs and Si-rich zeolites, from dissolution of abundant radiolarian frustules, which increased the Si-activity of the pore waters, and also produced the partial replacement of smectite by palygorskite at a later stage. Dissolution of frustules was facilitated by the high heat flow from the ocean floor and by the circulation of hydrothermal fluids. The crystal chemistry of smectite and the bulk mineralogy of the bentonites influence the physical properties and industrial applications of the Cyprus bentonites, as well as their response to acid treatment.

Keywords: Troodos ophiolite, Fe-rich montmorillonite, Fe-rich beidellite, layer charge, charge heterogeneity, hydrothermal alteration, bentonite, clinoptilolite