Hydrothermal Alterations of Hisingerite Material from a Basalt Quarry Near Geelong, Victoria, Australia

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Abstract: To understand the genetic relationship between hisingerite material in the joints of an overlying grey basalt and nontronite and Fe-rich saponite in the joints and matrix of a more deuterically altered, underlying green basalt, the hisingerite material was treated in a series of hydrothermal experiments. No well-ordered clay mineral was produced at temperatures <340 ° C, although extended treatment for 445 days and at 110 ° C or 42 days at 180 ° C resulted in the formation of materials that gave broad, weak, basal X-ray powder diffraction (XRD) reflections characteristic of 2:1 phyllosilicates. Hematite did not form at 110 ° C, but it did form at 180 ° C in 1- and 6-week runs. Treatments at 340 ° C in Pt, Ag-Pd, and Au containers resulted in mixtures of Fe-rich saponite + hematite, but the same starting material treated at 340 ° C in stainless steel yielded, in addition, some chlorite, probably due to the more reducing conditions in the stainless steel container. Treatment of the unaltered grey basalt at 340 ° C and 50 MPa for 10 days resulted in complete alteration of olivine (and probably glass) to a trioctahedral smectite.

The Fe-rich saponite produced by the hydrothermal treatment of the hisingerite material has a composition and XRD pattern similar to the Fe-rich saponite found in the green basalt and an XRD pattern similar to that produced by the hydrothermal treatment of the grey basalt; thus these clays may have had a similar origin. The compositions and XRD patterns of these clays are not similar, however, to those of the nontronite in the joints of the green basalt. The nontronite probably formed during a subsequent low-temperature alteration.

Key Words: Basalt • Deuteric alteration • Hisingerite • Hydrothermal treatment • Nontronite • Saponite

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