Saponite and Vermiculite in Amygdales of the Granby Basaltic Tuff, Connecticut Valley

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Abstract: Clay of apparent hydrothermal origin that fills amygdales in the Granby Basaltic Tuff (Lower Jurassic) of the Connecticut Valley was analyzed and found to consist of two exceptionally well-crystallized Fe-rich, trioctahedral 2:1 layer expandable phyllosilicates. Based on chemical and XRD analyses, the minerals were tentatively identified as saponite and vermiculite. The saponite exists predominately in the two-water hydration state, but also displays one- and three-water layer hydration states, which suggests heterogeneous layer charge distribution—a phenomenon not uncommon in smectites. The identity of the second clay remains equivocal, but XRD analyses, especially with regard to the swelling properties of the clay, indicate that it is a vermiculite. The well-crystallized nature of the Granby clay and the large size of the clay flakes (up to 1 mm) allowed us to use SEM/EDS X-ray imaging and spot analysis techniques in an attempt to detect chemical differences between the saponite and vermiculite. Results showed that the chemistry of individual crystals, within and among amygdales, was essentially uniform. This suggests that the saponite and vermiculite are chemically similar and that variations in their swelling properties result from other factors, such as crystal size, layer charge density, or charge localization within the unit layers. Crystal size differences in the Granby clay were observed with both the petrographic and scanning electron microscope. Changes in layer charge density or charge localization within unit layers could have been affected by the oxidation of Fe^{2+} to Fe^{3+}, a transformation inferred from the green-to-brown color changes observed in the larger amygdales. The Granby clay is of special importance, because it is one of the few examples of a naturally occurring mixture of two well-crystallized, Fe-rich trioctahedral 2:1 layer expandable phyllosilicates with crystallochemical and swelling properties that appear to bridge the operational definitions for the smectite and vermiculite groups.

Key Words: Amygdales • Basalt • Fe-rich smectite • Saponite • Saponite-vermiculite intermediate • Smectite • Vermiculite

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