Chemical Characteristics and Origin of Ordovician K-Bentonites along the Cincinnati Arch

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Abstract: K-bentonites of the Middle Ordovician High Bridge Group along the Cincinnati arch are characterized by interstratified illite/smectite (I/S) clays with rectorite-type ordering. Approximately 20% of the layers are expandable. They are structurally similar to I/S formed at temperatures exceeding 100 ° C during burial diagenesis, however stratigraphic evidence and a color alteration index of < 1.5 for conodonts in associated carbonates reveals they have never been deeply buried or subjected to temperatures greater than 80 ° C.

Whole-rock samples of K-bentonites contain ~8% K_2O and ~4% MgO, whereas the <0.1-μm size fraction contains 6 – 7% K_2O and 5% MgO. By comparison with a hypothetical parent ash, these values represent a net gain of K and Mg and a net loss of Si, Fe, Ca, and Na during post-depositional alteration. K-fixation is accounted for by a layer charge imbalance arising primarily out of octahedral substitution of Mg^{+2} for Al^{+3}, indicating that the interstratification evolved from a montmorillonite precursor. The chemical characteristics of I/S layers in K-bentonites developed early during the alteration of volcanic ash to montmorillonite. Relatively high contents of K and Mg probably reflect both seawater and parent material composition at the time of formation. The composition and ordered stacking in K-bentonites was determined by the composition of the original smectite rather than by the pressure-temperature conditions of burial diagenesis.

Key Words: Bentonite • Chemical composition • Illite/smectite • Interstratification • K-bentonite • Rectorite

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