MINERALOGY OF EGYPTIAN BENTONITIC CLAYS II: GEOLOGIC ORIGIN

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ABSTRACT

Egyptian bentonitic clays have diverse clay mineral assemblages that reflect their geologic origins and influence their industrial applications. The goal of this investigation was to use abundance changes in five XRD predictor clay minerals, to determine the relative contributions of weathering and parent rock changes on the origin of clay minerals in Tertiary bentonitic clays from the North Western Desert (NWD) of Egypt. The XRD predictor minerals, selected in an earlier discriminant function analysis (DFA) of quantitative abundances of 14 minerals, provided a simpler approach to the interpretation of clay mineral origins because they are the minerals that were most responsible

for statistically significant differences among the samples. Changes in mineral composition were basically a function of parent rock lithology, drainage, and climate interactions. A Paleo-Climate Index (CI), the ratio of coarsely-crystalline kaolinite to Fe-rich smectite, and a Parent Rock Index (PI), the ratio of the illitic phases and quartz abundances to pure smectite were established to track the paleo-climate and parent rock changes, respectively. Low CI values indicated a long seasonally dry climate prevailed during the Middle Eocene, uppermost Eocene, Lower Miocene, and Upper Pliocene bentonitic clay deposits. Lowermost Upper Eocene and the Middle Miocene bentonitic clays were produced when a wet climate prevailed throughout the year. Moderate to high PI values suggested derivation of the clays from the acidic basement crystalline rocks at Uweinat-Bir Safsaf uplift and Lower Paleogene shales during the Middle Eocene and lowermost Upper Eocene. The youngest Upper Eocene and Lower Miocene materials contained abundant Fe-smectite and low PIs indicating derivation from tholeiitic basalts. Diagenetic and sedimentary segregation modifications were not apparent. Direct evidence for *in situ* derivation from volcanic precursor materials was lacking in general, but volcanic eruptions were common in the region. The minerals in the Egyptian bentonitic clays formed as weathering products on land and have been transported by north-flowing streams and rivers to the sites of accumulation.

Key Words: Bentonitic clays; climate; Egypt; origin; parent rock.