MINERALOGY OF EGYPTIAN BENTONITIC CLAYS I; DISCRIMINANT FUNCTION ANALYSIS

Agha, Mohamed. A.[1], Ferrell, Ray. E.[2], Hart, George. F[2].

[1]Department of Geology, Faculty of Science, Fayoum University, Egypt

[2]Department of Geology & Geophysics, Louisiana State University, Baton Rouge, LA, 70803

ABSTRACT

This investigation reports the application of a discriminant function analysis (DFA) to quantitative mineralogical data from 124 Paleogene and Neogene bentonitic clays from the northern Western Desert of Egypt to establish an objective procedure for grouping of the samples at three distinctly recognizable, but partially overlapping, levels of classification; province or geographic region, geologic age, and quarry. Quantitative mineralogical data were obtained by XRD procedures employing least-squares fitting of simulated and standard mineral patterns with those from the laboratory. All data were transformed by a log-ratio procedure prior to the DFA. Fe-rich smectite (Fe_{oct}-1.4 apfu), coarsely-crystalline kaolinite, and Fe-poor I-S (random with 60% S layers), quartz and illite were the most important discriminator minerals. S-moderate I-S (random with 70% S), S-rich I-S (random with 80% S), two varieties of finely-

crystalline kaolinite, feldspar, and amorphous matter also were present. Calcite and gypsum were present in some samples. The median wt.% values for Fe-rich smectite, coarsely-crystalline kaolinite, Fe-poor I-S, quartz, and illite in all samples were 16.6, 16.0, 15.2, 4.2 and 3.7, respectively. Abundances of quartz and feldspar have a good positive correlation, and finely-crystalline kaolinite and Fe-rich smectite are negatively correlated. Other specific mineral associations are difficult to visually interpret because of the numbers of classes and variables employed in the investigation, however DFA was successful in identifying statistically significant differences amongst the groups.

At the province level, the back-classification of the samples was successful 92% of the time at the highest probability level, or 100% if the first plus second probability results were utilized. For samples of the same age, 80% of the first-choice assignments were correct and >90% were correct when the second choice was included. At the quarry level, the predictability rate ranged from 76% to >90%. Using both probability results, only seven of samples were misclassified. In a blind test of quarry samples, the DFA assignment was 80% correct. These tests confirm the objective reliability of class assignments based on DFA. Results based on this data set can be used to classify new samples in future geological interpretations and economic exploitation of the deposits in the region.

Key Words: Bentonitic clay, smectite, clay mineralogy, Egypt, discriminant function analysis, geographic variability

.