Clay Minerals in Mixtures: Sample Preparation, Analysis, and Statistical Interpretation

C. M. Gold[1], P. A. Cavell[2] and D. G. W. Smith[2]

[1] Earth Sciences Division, Alberta Environment, Edmonton, Alberta T5K 2J6, Canada
[2] Department of Geology, University of Alberta, Edmonton, Alberta T6G 2E3, Canada

Abstract: A method of clay mineral sample preparation for electron microprobe analysis has been developed in which a film of clay plus 10 – 12 wt. % colloidal graphite is deposited on a porous ceramic disc using a specially designed suction device. Correction procedures are used to obtain quantitative elemental analyses representing the average chemical composition of the prepared sample. A statistical technique is employed to estimate the most likely proportions of clay minerals representing the known composition. Chemical compositions of clay minerals are presented in terms of five coordinates (" Si, " " Al, " " Mg, " " K, " and " Fe "). Using literature data, the chemical compositions of 13 different clay mineral groupings were defined statistically by their multivariate means and variance-covariance matrices. A correlation parameter, χ^2, was calculated to compare the chemical composition of a sample with that of any mixture of the defined clay mineral groupings, the minimum χ^2 indicating the best-fit mixture.

From chemical analyses of artificial mixtures only approximate day mineral proportions could be determined when the various clay mineral groupings had been defined statistically from literature analyses. The best results were obtained when the actual compositions of the end-members forming the artificial mixtures replaced the statistical definitions. Tests of the estimation procedure on day mineral mixtures for which chemical compositions and corresponding clay mineral proportions were found in the literature, indicate that the technique has appreciable merit.

Key Words: Electron microprobe • Illite • Kaolinite • Mixed layer • Montmorillonite • Quantitative mineral analysis • Statistical method

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