American Mineralogist, Volume 87, pages 1557–1563, 2002

Characterization of the Waukesha Illite: A mixed-polytype illite in the Clay Mineral Society repository

GEORG H. GRATHOFF[1,*] AND DUANE M. MOORE[2,†]

[1]Department of Geology, Portland State University, Portland, Oregon 97207, U.S.A.
[2]Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, Illinois 61820, U.S.A.

ABSTRACT

The Waukesha Illite is an excellent example of the illites found in argillaceous rocks, typical for Paleozoic shales that have undergone significant burial diagenesis during their geologic history. It consists of a mixture of detrital $2M_1$, interpreted to be a residuum of karstification within Silurian carbonates, and diagenetic $1M$ and $1M_d$ illite. The chemistry and the age of the illite polytypes are different. Extrapolating to 100%, the $1M$ and $1M_d$ polytypes have an apparent diagenetic age between 295 and 325 Ma. The chemistry of the $1M$ polytype could not be determined because of its low abundance. The approximate chemical composition of the $1M_d$ polytype is 0.67 K, 3.6 Si, and 1.9 Al per half unit cell. The $2M_1$ polytype has an apparent detrital age between 440 and 520 Ma, and an approximate chemical composition per half unit cell of 0.78 K, 3.4 Si, and 2.1 Al, all within our margin of error.

X-ray diffraction (XRD) results of both random powder and oriented preparations both indicate that the Waukesha Illite consists of a mixture of illites. The XRD patterns of the random powder preparation indicate it is a physical mixture of three different illite polytypes. This result was confirmed using 3 different methods: (1) by measuring illite polytype-specific reflections; (2) by mixing illite polytype reference samples; and (3) by mixing WILDFIRE calculated XRD patterns. Decomposition of the illite 001 XRD peak from oriented preparations also indicates mixtures of illites. However, the proportions of the three illitic components derived from the oriented 001 peak decomposition differ from those results derived from the analysis of the random powder data. Therefore, the shape of the 001 reflection of the Waukesha Illite cannot be explained by mixing the three different illite polytypes.