Characterization of Dehydration-Induced Luminescence of Kaolinite

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Abstract: Dehydration-induced luminescence (DIL), the emission of light from a clay paste upon dehydration, was characterized experimentally for a colloidal kaolinite. The relationship between total photon count of the emitted light and film thickness is linear up to a thickness of 30 μm. The photon emission was obtained over a critical range of water contents (25–60%) of the oven-dry clay, and the kinetics of photon emission was presumed to be closely associated with the kinetics of film dehydration. Whether drying proceeded throughout the bulk or via a moving front was undetermined, but in either mode it was preceded by the formation of a thin dry film at the interface with the atmosphere. Grinding of the kaolinite for several minutes by mortar and pestle before paste preparation resulted in an overall increase of photon emission compared to unground kaolinite and in the formation of more than one emission peak, as well as a prolongation of the light emission. This effect on the kinetics of light emittance was observed for about two months after the application of the mechanical stress and suggests a means of detecting the mechanical stress history of a clay.

An estimate was made of the spectral characteristics of the emitted light using optical filters and by incorporating tryptophan and salicylic acid into the kaolinite paste where they acted as fluorescent probes. The latter technique shifted the frequency of the light emitted by the kaolinite from the ultraviolet to the visible range where it was less effectively reabsorbed. The first method showed that the wavelengths of 97% of the emitted light was <460 nm and that 75% of the light had wavelengths <410 nm. The second method showed that the total intensity of DIL increased in the presence of fluorescence molecules, suggesting that the emittance was in the ultraviolet range.

Key Words: Dehydration • Fluorescent probes • Grinding • Kaolinite • Luminescence

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