American Mineralogist, Volume 87, pages 1571–1579, 2002

Characteristics of mixed-layer smectite/illite density separates during burial diagenesis

MATTHEW W. TOTTEN,[1,*] MARK A. HANAN,[1] DENISE KNIGHT,[2] AND JONIELL BORGES[3]

[1]Department of Geology and Geophysics, University of New Orleans, New Orleans, Louisiana 70148 U.S.A.
[2]Kerr-McGee Corporation, 16666 Northchase, Houston, Texas 77060 U.S.A.
[3]Deptartment of Geological Sciences, Northwestern University, Evanston, Illinois 60208 U.S.A.

ABSTRACT

We report a method to physically separate smectite from illite in natural shale samples. This method is based upon the large contrast in the density of mixed-layer clay minerals reported in the literature. Our objective was to investigate the behavior of separate density fractions of mixed-layer smectite and illite during burial diagenesis.

Samples were obtained from shale cuttings hand-picked from a well drilled offshore Louisiana. Each sample was separated into 5 fractions: "pure" end-member smectite (EMS), smectite-rich mixed-layer clays (SML), illite-rich mixed-layer clays (IML), "pure" end-member illite (EMI), and quartz (FGQ). The mineralogy of each clay-mineral separate as determined by XRD was reasonably consistent at all depths, although the abundance of the mixed-layer separates varied. The illite-rich mixed-layer fraction increased in abundance with depth at the expense of the smectite-rich mixed-layer fraction. The fine-grained quartz fraction showed an increase in abundance, a decrease in average grain size, a loss of K-feldspar, and a heavier isotopic signature with depth. We did not, however, find a correlation with depth in the amount of the end-member clay fractions. The isotopic signature of the end-member smectite shows evidence of equilibration with depth, but the end-member illite does not. We conclude that the discrete illite fraction is detrital in origin and was not involved in the clay-mineral transformation at the depths sampled in our well. It reflects the sediment provenance.

The results of this study illustrate the efficacy of the newly developed density separation technique for physically isolating clay mineral species from one another.