Clay Mineralogy and Illite Crystallinity of the Atoka Formation, Arkoma Basin, and Frontal Ouachita Mountains

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Abstract: Clay mineralogy (including illite crystallinity) was studied in Pennsylvanian synorogenic sediments (Atoka Formation) in the subsurface of the Arkoma Basin and the adjacent Ouachita thrust belt. Vitrinite reflectance values range from ⩾0.8% at the surface up to as high as 4.7% R_o at the base of the Atoka Formation. The mineralogy of the <2 μm fraction of the mudrocks is fairly monotonous and composed of illite (<10% interstratified smectite), Fe-chlorite, kaolinite, quartz, and traces of feldspars. Kaolinite is common at shallow levels and "disappears" in most wells at a thermal maturity of 1.9 – 2.1% R_o, suggesting its possible use as an independent paleothermal indicator in this basin. Illite crystallinity (IC) values are fairly high (0.3 – 0.5° 2θ) and show little variation throughout the entire maturity range. In addition, no relation was observed between vitrinite reflectance and illite crystallinity, indicating that IC is not a useful paleothermal indicator in these rocks. Illite is almost exclusively of the $2M_1$ polytype, suggesting a predominantly detrital origin. Incipient metamorphic and low-grade metamorphic mudrocks in the Ouachita thrust belt to the east of the Arkoma Basin are regarded as the source rocks for the clays of the Atoka Formation. Rapid transportation and deposition by turbidity currents probably played a key role in protecting these unweathered micas from pervasive alteration in the terrestrial environment.

Key Words: Anchimetamorphism • Diagenesis • Illite • Illite crystallinity • Polytype • Provenance • Vitrinite reflectance • X-ray powder diffraction

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