
Particle Morphological Evolution During the Conversion of I/S to Illite in Lower Cretaceous Shales from Sergipe-Alagoas Basin, Brazil

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Abstract: The illitic end of mixed-layer illite-smectite series (I/S) in shales from Lower Cretaceous Barra de Itiúba Formation, Sergipe-Alagoas basin, was examined with X-ray powder diffraction (XRD) and transmission electron microscopy (TEM). A mathematical decomposition of XRD patterns shows different I/S and illite populations. All the samples contain ordered ($R = 1$) I/S, poorly crystallized illite (PCI) and well crystallized illite (WCI). A randomly interstratified ($R = 0$) I/S was also identified in a fractured zone at 1020 m. The percentage of expandable layers in ordered I/S decrease progressively from 20% to 10%. TEM observations show a continuous change in morphology between two basic particle shapes: elongated (lath) and isometric. The size and morphology of particles change with increasing depth. The proportion of laths decreases while isometric particles become predominant. However, both particle types continuously grow and enrich the larger size fraction. The growth process is driven by a mass transfer from the dissolving small particles of predominantly I/S ($R = 1$) composition to the larger (more illitic) lath and isometric ones. The proportion of lath-shaped particles decreases with depth indicating that the more stable population upon increased burial is the isometric well crystallized illite (WCI) particles. Very large laths are observed in the fault zone where conditions may favor faster growth processes.

Key Words: Illite • Illite/smectite • Morphology • Shale • TEM • XRD

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