

Depositional model of the Marcellus Shale in West Virginia based on facies analysis

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A lithologic analysis of well exposed Marcellus outcrops has identified six different facies in West Virginia and neighboring states: (1) light gray calcareous shale, (2) fossiliferous limestone, (3) black calcareous shale, (4) black noncalcareous shale, (5) dark gray noncalcareous shale, and (6) K-bentonite. Close interbedding of these rock types attests to a complex, ever-changing environment on the eastern foreland ramp of the Appalachian basin. The environmental setting was clearly not a deep trough, permanently anoxic, salinity stratified, sediment starved, and populated exclusively by phytoplankton—the traditional depositional model. To the contrary, our sedimentary data suggest a rather shallow water depth, intermittent anoxia, normal-marine salinity, a fluctuating input of siliciclastic mud, and faunal communities of low and moderate diversity.

Interbedding of the shale and limestone lithofacies as well as the vertical stacking of facies associations is explained most simply by fluctuations in water depth coupled with fluctuations in sediment supply. The sea floor was, at times, immediately below wave base (Facies 1 and 2), around the depth of the thermocline (Facies 2 and 3), or below the thermocline (Facies 4 and 5), relative sea level changing through two sequences of lowstand, transgression, and highstand. Simultaneously the supply of siliciclastic mud was greater at times of lowstand (increased erosion) and highstand (prograding shoreline), and the supply smaller during transgression (sediment stored in distant coastal plain).