Novaculitic Chert (Devonian-Mississippian) in the Southern Midcontinent: Organic-Rich Sedimentation and Palaeoceanography Along a Shelf-Rise Transect

Kyrsti A. Cecil[1] and Jack C. Pashin[1]

[1]Oklahoma State University

ABSTRACT

Novaculitic chert in the Woodford Shale and Arkansas Novaculite of Oklahoma is rich in organic matter and is associated with prolific shale reservoirs, yet the significance of this chert as a petroleum source rock and reservoir rock is only beginning to be appreciated. This study employed outcrop, core, thin section and SEM/EDS analysis to characterize and interpret the chert from megascopic to nanoscopic scales. Abundant siliceous microfossils, phosphatic nodules, and organic matter (up to 6% TOC) indicate that the chert formed in a region of marine upwelling and high organic productivity that was associated with an oxygen minimum zone. On the Oklahoma Shelf, novaculitic chert was deposited atop a major Cambrian-Devonian carbonate bank. In the Ouachita Embayment, by contrast, similar chert was deposited in an oceanic setting above Cambrian-Silurian turbidite fan deposits of the continental rise. Paleogeographic analysis indicates that the paleoclimatic setup for upwelling and oxygen minimum zone formation differs significantly from modern examples.

Novaculitic chert within the Woodford Shale is an important component of the unconventional mudrock reservoirs in the southern Midcontinent, not only from the standpoint of brittleness, but also in terms of organic content and hydrocarbon storage potential. The brittleness of the chert contributes to the propagation of hydrofractures, and natural fractures contribute to the storage and producibility of hydrocarbons. Thin section and SEM analysis indicates that rock matrix is composed largely of peloidal silica with interstitial amorphinite. Organic-walled microfossils and remnants of microbial films are common in the chert. Microfabric analysis indicates that the silica-organic matrix is nanoporous and stores hydrocarbons mainly by sorption.