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Organic-Matter Pores: New Findings from Lower-Thermal-Maturity Mudrocks

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ABSTRACT

New pore analyses of low-thermal-maturity (Ro <0.7%) organic matter of possible or probable terrestrial origin (type III kerogen) from three mudrock units in Texas contradict previous pore work on low-thermal-maturity, mostly marine organic matter from the Barnett and Eagle Ford Shales. In early work on mudrocks containing primarily marine organic matter, organic matter at Ro <0.75% was observed to typically lack pores, whereas some thermally mature organic matter did develop pores. However, this pattern of pore development was not observed by all researchers working on other units, some of whom did see pores in organic matter at lower thermal maturities. To understand if predepositional pores in terrestrial organic matter are responsible for the discrepancy in pattern, this study focuses on organic matter at low thermal maturities, which should not have thermally generated pores.

Two beds of organic-matter-rich mudrock from a terrestrial depositional environment were sampled from the Paleogene Wilcox Group of East Texas. The mudrocks have an Ro of <0.5%, a siliceous–argillaceous composition, and >11% total organic carbon (TOC). Based on Rock-Eval pyrolysis results and depositional setting, the kerogen is thought to be dominantly type III. Some silt-size organic-matter grains in these samples contain probable predepositional pores. Pore sizes are up to 5 µm in length, and up to 27% of the organic matter has pores. Pores are more common in the larger organicmatter grains.

Samples from one core interval of the basal Cretaceous Eagle Ford Group on the San Marcos Arch of South Texas have abundant vitrinite (Ro ~0.45%) based on visual analysis, in contrast with shallower layers, which are vitrinite-poor. Rock-Eval pyrolysis results suggest the presence of type III kerogen. Although these basal mudrock samples are more argillaceous than the rest of the Eagle Ford, they were deposited in a marine environment. Some of the organic matter in these samples has predepositional pores. Some of these pores are elongate, with sizes >1 µm.

Pennsylvanian Smithwick Shale samples from the Fort Worth Basin of Texas have thermal maturity ranging from 0.4 to 0.71% Ro. Although much of the unit is marine, observed plant fossils suggest a mixed-organic-matter source. Some Rock-Eval pyrolysis results also suggest type III kerogen. Much of the organic-matter shows a newly identified organic-matter pore texture. Instead of consisting of a mass of organic matter with spherical holes, the organic-matter is a composite grain made up of smaller, spherical organic-matter bodies. These organic-matter bodies vary slightly in size, but most are 60 to 100 nm in diameter. Pore space is present between the organic-matter bodies.

Several possible formation mechanisms exist for these organic-matter bodies, but they strongly resemble “nannobacteria” described by previous researchers.

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Reed, R. M., 2017, Organic-matter pores: New findings from lower-thermal-maturity mudrocks: Gulf Coast Association of Geological Societies Journal, v. 6, p. 99–110.