Patterns of Organic Sedimentation and Kerogen Type in Ancient Rift Lakes, Early Mesozoic Newark and Richmond Basins, Eastern United States

Malinconico, MaryAnn L.[1] (1) Lafayette College, Easton, PA.

In order to address previous differing results on relative proportions of gas-prone (Type III) vs. oil-prone (Type I-II) kerogen in Newark Supergroup lacustrine rift basin black shales, a detailed organic petrographic study of “underfilled” Early Jurassic Towaco Formation lake cycles of the Newark basin and of “overfilled” Triassic Vinita Formation lacustrine shales of the sister Richmond basin, eastern USA, was undertaken using closely-spaced whole-rock samples from cores. Samples are low maturity: 0.5-0.7%Ro. The goals were to document patterns in organic richness, autochthonous algal/bacterial (Type I-II) vs. allochthonous woody land-plant (Type III) input, and transitions between organic facies relative to lake depth and climate within and between basins.

Organic sedimentation in ~20,000-year dry-wet-dry temperate zone lake cycles of the Newark basin Towaco Formation follows predictable patterns of vitrinite (Type III) abundance during lake transgression and regression and of the increasing decomposition of algal material to amorphous organic matter (AOM) with paleo-lake depth. Both vitrinite and algal detritus increase in concentration in transgressive gray-black dysoxic sediments. Highest TOC (2-3%) is found in highstand laminated black shales dominated by AOM plus minor algal debris (Type I-II) derived from a Pediastrum-like algae. Vitrinite is scarce to absent, however, in highstand black shales, due to distance from shore and limited fluvial or deltaic sources. Vitrinite concentration increases again in regressive sediments, but eventually declines due to decreasing precipitation and terrestrial vegetation. These results contribute to an increased understanding of the variation in organic assemblages and kerogen type in underfilled lakes and provide a predictive framework for future targeted organic geochemical studies.

On the other hand, in the paleoequatorial Vinita Formation (Richmond basin), land-plant organic matter does not show a systematic association with autochthonous kerogen, due to a strong depositional influence from deltaic point sources and deep lake turbidites. Black shales may or may not contain any autochthonous AOM or algal material. TOC from Rock-Eval pyrolysis is 3-8%, and whole rock kerogen, as expected for overfilled lakes, is Type III, rarely Type IV, due to the ubiquitous gas-prone land plant contribution.