

# Tectonic, Climatic, and Biotic Modulation of Lacustrine Ecosystems—Examples from Newark Supergroup of Eastern North America

Paul E. Olsen  
Lamont-Doherty Geological Observatory  
Columbia University  
Palisades, New York, U.S.A.

---

Rift-related early Mesozoic lacustrine strata of the Newark Supergroup provide a background for exploration of general concepts of lacustrine paleoecology and stratigraphic architecture. The large-scale tripartite sequence of depositional environments (i.e., fluvial basal part, deep lacustrine middle part, and shallow lacustrine or fluvial upper part), commonly seen in lacustrine deposits, including the Newark, can be quantitatively modeled as the result of relatively simple interaction between basin filling and subsidence. Whereas tectonic processes produced the rifts and the maximum depths of the lakes they contain, high-frequency fluctuations in the depths of rift lakes are largely controlled by climate. Milankovitch-type climatic cycles caused by variations in the Earth's axis and orbit produce lake-level cycles with periods of 21, 41, 100, and 400 k.y. The magnitude and mode of these lake-level changes are governed by position within the climate system and by orography.

Three major classes of lacustrine facies complexes are recognized in the Newark Supergroup. These are, in order of increasing overall dryness, the Richmond, Newark, and Fundy types. Each is characterized by different suites of highstand and lowstand deposits, different sedimentary cycle types, and different amounts of organic carbon-rich rocks. Organic-carbon content of the strata is largely a function of ecosystem efficiency, which, in turn, responds to lake depth. Finally, the long-term trends in evolution of bioturbators must be taken into account because they affect not only the carbon cycle and oxygen state within lakes but also our ability to interpret the metabolic state of ancient lake systems.

## INTRODUCTION

Triassic and Lower Jurassic lacustrine rocks of the Newark Supergroup of eastern North America (Figure 1) were deposited in a long chain of rift valleys for about 30 m.y. prior to the breakup of Pangea. They comprise one of the world's largest examples of fossil lacustrine systems and provide a rich environment for examining macroscopic controls on lacustrine ecosystem development and evolution. This paper outlines the major themes of Newark Supergroup lacustrine ecosystems and their relation to lake systems in general.

## GEOLOGICAL CONTEXT

Newark Supergroup deposits (Olsen, 1978; Froelich and Olsen, 1984) occupy a series of half-grabens exposed along the eastern Appalachian orogene from Nova Scotia to South Carolina. In cross section each half-graben is bounded on one side by a series of major basinward-dipping faults (the border fault system) and on the other by a gently dipping, more diffusely deformed floor of hanging-wall basement rocks with some synthetic as well as antithetic faults (Figure 2). In longitudinal section the basins comprise gentle synforms. Basins tend to be linked together into

