

Quantitative Stratigraphic Models of Rifts Based on Orbitally Induced Lake Cycles

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Orbitally induced lacustrine ***cycles*** in the rift sequences of the Newark Supergroup provide a direct measure of sedimentation rates (S) averaged at the 20 thousand year level. For the Triassic, the basins followed a pattern exemplified by the Newark basin: early fluvial fill, followed by lacustrine deposition where S slowly and exponentially decreased.

Once lacustrine deposition began, lakes fluctuated with orbital ***cycles***; however, maximum ***lake*** depth (MLD) began shallow, rapidly deepened, then slowly and exponentially shallowed toward the Triassic-Jurassic boundary.

These observations suggest a model ***based*** on the filling of a trough, the simplest of which is a graben where the volumetric sedimentation rate (V) is constant and extension is uniform. First, S equals subsidence until hydrographic closure. Afterward, $S = BV/L[B^2D^2 + [2BVt(A - D)]/L]^{-1/2}$ (t = time after closure and A, D, B, and L are the final widths, depth, and length of the graben). The observed changes in MLD conform to the predictions of this filling model. Half-graben are more complex, but similar patterns result. Major deviations reflect tectonic events.

One dramatic deviation occurred at the Triassic-Jurassic boundary, where S and MLD greatly increased. This coincided with massive tholeiitic magmatism, probably reflecting increased extension rates and a marked basin asymmetry.

This model explains why Newark hydrocarbon targets are in strata of either the early Late Triassic or Early Jurassic, because those intervals were deposited by the deepest lakes.