

INTEGRATING PALEONTOLOGY, GEOTHERMOMETRY, AND SEDIMENTOLOGY IN DETERMINING THE HISTORY OF THE REELFOOT BASIN, SOUTHERN MIDCONTINENT, U.S.A.

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The northeast-trending Reelfoot basin, extending from northeast Arkansas and westernmost Tennessee into southeastern Missouri, southernmost Illinois, and westernmost Kentucky, is geologically, and socioeconomically, significant because it is co-extensive with the New Madrid Seismic Zone, one of the most seismically active areas of the central and eastern United States. The basin has been periodically active from its inception as a rift basin in the Proterozoic to the present and has accumulated up to at least 5,000 m of sediment, including up to at least 1 km of Cretaceous and Tertiary sedimentary strata near the head of the Mississippi Embayment. Structural and stratigraphic interpretations within the subsurface pre-Mesozoic part of the basin have been based almost entirely on geophysical and physical stratigraphic criteria; these interpretations have been loosely constrained due to an extreme sparsity of drillhole data through the Paleozoic sequence. Recent analysis of Cambrian and Ordovician fossils (conodonts, palynomorphs, brachiopods, and trilobites) from cuttings and core from a very few drillholes allows establishment of the beginnings of a verifiable stratigraphy for this part of the sequence. The paleontological data also provide (1) biofacies evidence for interpretations of the depositional setting during part of the Late Cambrian and Early Ordovician interval and (2) thermal maturation data pertaining to the post-depositional geothermal history of these strata.

Upper Cambrian phosphatic brachiopods and trilobites provide improved correlations between strata in the basin, the Ozark shelf to the northwest, and the Upper Mississippi River Valley. Cold-water-realm palynomorphs and trilobites from siliciclastic rocks of turbiditic origin in the central part of the Reelfoot basin support an interpretation, based on sedimentary structures in a short interval of core, of a deep-water basinal origin for these strata.

Lower Ordovician conodonts provide a biostratigraphy for the carbonate rocks of this part of the sequence; correlations can be made with the shallow-water sequences of the Knox, Prairie du Chien, and Arbuckle Groups, and the Ozark sequence of the adjacent shelf areas to the east, north, and west. The uppermost Lower Ordovician strata in the basin record a short-term incursion of cooler water environments, reflected by the character of both the conodont fauna and the lithofacies. The youngest Paleozoic dates known from the basin south of the Pascola arch are latest Ibexian (Early Ordovician).

Thermal alteration indices of both the Cambrian palynomorphs (organic-walled microphytoplankton) and Ordovician conodonts in the deeper parts of the basin, corroborated by fluid inclusion thermometry, vitrinite reflectance, and other geochemical techniques, are of higher values than predicted using any published estimates of overburden burial. These maturation values most likely reflect burial enhanced by the passage of hydrothermal fluids on a regional scale; they place constraints on interpretations of the tectonothermal evolution of the basin.