# TOC Estimation of the New Albany Shale Group and Maquoketa Shale-Using ΔlogR Evaluation Technique, Southern Illinois

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## ABSTRACT

Accurate quantification of the total organic carbon (TOC) content of source rocks is a crucial parameter in the evaluation of organic-rich unconventional reservoirs. Organofacies in source intervals can vary dramatically in a lateral and vertical sense. Petrophysical data provide an avenue to map these changes without relying on expensive lab analyses. In mature basins, the vast majority of petrophysical data is determined from older logging suites. The ΔlogR technique developed by Passey, et al., 1990, allows the use of this data in mapping reliable TOC estimates. For this study, eight wells were selected to compare core-derived TOC data with those computed from the ΔlogR technique in southern Illinois. Shale intervals within the New Albany Shale Group (Devonian to lower Mississippian) and Maquoketa (Ordovician) were analyzed. The ΔlogR technique relies on the density difference of organic carbon (0.9-1.05 g/cc) and mineral matrix (2.65-2.71 g/cc) that porosity logs (sonic, density, or neutron) measure. This requires the overlaying of a sonic, density, or neutron curve in arithmetic scale on a deep resistivity curve on logarithmic scale. Baseline is determined in a shale interval with low organic content. Once baseline is established, the separation between the porosity and resistivity curves can be calibrated over intervals with higher organic content. This calibration requires an estimation of the level of organic metamorphism (LOM) or how far density or transit time deviates from that of barren rock at the same state of compaction. Level of organic metamorphism (LOM) was calculated by using cross plots of measured TOCs from analyses vs ΔlogR, and by vitrinite reflectance (Ro) data determined from nearby wells. Results computed from the ΔlogR method indicate a range of values between 2 to 9% TOC for the New Albany Shale Group and 0.5 to 3.2% TOC for the Maquoketa Shale. More importantly, the TOC values computed from the ΔlogR method compare reasonably well with values determined from sample analyses. The ΔlogR technique for these intervals gives satisfactory results with a range of 0.8 to 1.36% TOC standard deviation. Problems arise in correlating laboratory and log data when there are depth matching errors between logs and core and digitized petrophysical curves are of poor quality. In summary, ΔlogR technique can provide reasonable TOC estimate for shale intervals within the Illinois Basin.