Organic Carbon Content Determined from Well Logs: Examples from Cretaceous Sediments of Western Canada

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Core petrophysical (porosity, density) and geochemical (mineralogy, organic properties) data for Colorado Group shale have been used to calibrate well log methods for determining total organic carbon (TOC) content. Log data include sonic transit-time (Δt), density (ρ), resistivity (R), and neutron porosity (ϕ_N). Both single (Δt, ρ, ϕ_N) and multi-log (Δt-R, ρ-R, ϕ_N-R, Δt-ρ, Δt-ϕ_N) techniques are presented. Log data are not normalized nor do we require *a priori* knowledge of thermal maturity. Thus our methods are less subjective than some published empirical methods. Our equations include physical parameters for the inorganic rock matrix (ma) that are determined using core measurements e.g. Δt_{ma}, R_{ma}, ρ_{ma} and ϕ_{Nma}. Δt, ρ and ϕ_N are expressed as functions of porosity and TOC content whereas R depends on porosity and thermal maturity. We tested our methods using core data from wells in Alberta and Saskatchewan. Calculated and measured TOC show good correspondence in wells with good borehole conditions and quality logs. For the test wells, our approach yields more accurate results than the Δ log R method (Passey et al., 1990). Our formulation is general and can be applied to any sedimentary basin provided that model coefficients are adjusted to reflect changes in the factors that control log responses (e.g. lithology, stress, diagenesis, temperature). In principle, it should be possible to use well logs to determine organic matter type and maturity as well. In addition to source rock characterization, our methods can be used to study compaction, erosion and pore pressures in sedimentary basins.