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Depositional Controls on Lacustrine Petroleum Source-Rock Potential: Case Studies from Several African Lakes

Petroleum source-rock research has historically focused on organic-rich marine shales, but there has been a recent acknowledgement of the importance of lacustrine source rocks in several basins along the South Atlantic margins and in Asia. Some of the best modern analogues for these systems are the lakes of the East African Rift. However, large lakes are composed of a variety of depositional environments that impact organic matter production and preservation, which is reflected in the heterogeneity of surface sediment geochemistry. In order to understand this relationship, we use high-resolution seismic reflection and sediment core data to characterize distinct depositional environments that can be related to sedimentary organic geochemistry. Total organic carbon (TOC), total nitrogen, Rock-Eval pyrolysis, and bulk organic stable isotopic composition are used to characterize petroleum source-rock potential. This approach is applied to a large rift lake (Lake Malawi), and two smaller basins (Lake George, Uganda and Lake Bosumtwi, Ghana). While TOC values are higher on average for sediments deposited in anoxic environments, there is no correlation between TOC and water depth when considering all environments. Hydrogen Index (HI) values show no significant difference between oxic and anoxic environments, and no correlation with water depth. These results suggest that the distribution of organic facies in lacustrine systems is controlled by a complex interaction of anoxic preservation of autochthonous organic matter and dilution by clastic sediment and allochthonous organic matter. The hemipelagic and levee facies most consistently record the highest TOC and HI values, even higher on average than the deeper abyssal plain facies. This latter environment may be effected by significant amounts of littoral sediments transported through sublacustrine canyons and turbidites. Climate may also act as a primary control on organic geochemistry (e.g., inducing changes in primary productivity) or as a secondary factor (e.g., changes in lake level redistributing sediments).