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Disentangling Catchment and Water Depth Controls on Sediment Organic Matter Sources in a Large Tropical Lake

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Tropical lakes are globally significant sites of organic carbon burial, yet the mechanisms controlling organic matter sources, transformation, and preservation remain poorly constrained, particularly in regions experiencing rapid landscape change. Lake Izabal, a large (671 km2) tropical Guatemalan lake surrounded by protected forest, agricultural land, residential settlements, and mining sites, represents an interesting system in which to study the complex processes of organic matter supply and degradation within sediments. Its mixed land-use perimeter allows the examination of how varying natural and anthropogenic land uses and inputs influence carbon sources and burial, and analysis of sediments across depth gradients allows for analysis of how organic matter inputs change with distance from sources of terrestrial organic matter. In 2025, we sampled 18 sites across 3 transects representing a gradient of water depth and distance from the shoreline to capture contributions of three river inflows. At each site we collected sediments, as well as particulate organic matter from surface and deep waters. We also collected samples of the most likely organic matter sources, including terrestrial and aquatic plants, phytoplankton, woody debris, and soils. We present initial stable isotope results (TOC, TN, δ13C, δ15N) used to distinguish terrestrial (allochthonous) versus aquatic (autochthonous) organic carbon contributions. Bulk isotopic fingerprints are integrated with spatial gradients in depth and distance from shore to evaluate how riverine inputs, in-lake productivity, and land-use variation influence organic matter composition. Initial results from depth profiles across transects show distinct profiles between rivers both in conductivity and dissolved oxygen, including a zone of significant oxygen depletion at the mouth of a river draining an agricultural area. Ongoing Bayesian mixing model application will further quantify source contributions and constrain spatial variability in OM sourcing.