

## **Methane and Dissolved Organic Carbon Sustain an Ecosystem within a Density Stratified Coastal Aquifer of the Yucatan Peninsula, Mexico**

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Anchialine caves host a coastal aquifer ecosystem occupied by cave-adapted fauna that reside within distinct meteoric freshwater and deep saline groundwater. Our initial investigation of this subsurface ecotone in the Yucatan Peninsula provides stable isotope-based evidence that methane and dissolved organic carbon (DOC) are the primary sources of energy and carbon for the food web. However, the frequency of observations is sparse, leaving us ‘in the dark’ with respect to the temporal dynamics of the ecosystem function. We obtained undisturbed vertical profiles of methane, DOC and DIC concentration and isotopic composition with the ‘Octopipi’ water sampler from a coastal aquifer. To document the temporal variability of methane availability in the aquifer, we deployed osmotically-driven pumps in the flooded cave passages. Data loggers recorded dissolved oxygen (DO), salinity, temperature and current velocities, and a rain gauge recorded precipitation. Our 6-month water chemistry record reveals high concentrations of methane in the wet season, especially following rainfall events, and relatively lower methane concentrations in the dry season. These observations suggest rain flushes methane generated in overlying anoxic soils into the cave. DO, water level, and groundwater flow patterns were also linked to the precipitation record. These data provide novel insight into the interconnections between external climate forcing and subsurface carbon cycle in an aquifer.