Developing fluorescent dissolved organic matter as an efficient method of tracking contaminated groundwater in coastal reef ecosystems

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\textbf{ABSTRACT:}

Maintaining actively growing coral reefs and associated coastal ecosystem services in a rapidly changing ocean is a top priority for Pacific Island communities. Non-point source groundwater nutrient discharge is an increasing chronic impact to Pacific Island ecosystems that is difficult to document because of spatiotemporal heterogeneity. Eutrophication induced by excess nutrient loading threatens reef accretion by shifting competitive dominance away from corals and other calcifiers toward fleshy algae and cyanobacteria, altering the growth and community composition of bacteria through the release of dissolved organic matter (DOM) and supporting a feedback that prevents recovery of actively growing reefs. We investigated nutrient-rich groundwater inputs to a coral reef ecosystem (Maunalua Bay, O‘ahu, Hawai‘i) using spatial surveys of two reef areas to map biogeochemical parameters across the reef at both low and high tide. Nutrient concentrations in aquifers from anthropogenic sources have significantly increased on O‘ahu due to agricultural activities and urbanization, including leaky septic and sewer systems, and commercial and domestic use of fertilizers. We present our progress identifying fluorescent DOM (fDOM) tracers of groundwater inputs that may serve as efficient and cost-effective management tools for differentiating pollution sources and impacts to the microbial ecology and health of reef ecosystems.

\textbf{1. MAPPING SGD (SUBMARINE GROUNDWATER DISCHARGE)}

\textbf{2. WATER SAMPLES GROUP BY SGD INFLUENCE USING BOTH NUTRIENTS & fDOM}

\textbf{3. fDOM CHARACTER DIFFERS ALONG SGD PLUMES & TRACKS SGD INPUTS}

\textbf{4. CONCLUSIONS: fDOM CAN DISCRIMINATE GROUNDWATER PLUMES IN CORAL REEFS}

\textbf{TAKE-HOME MESSAGE}

Global changes, including climate shifts and population expansion, will continue to alter the chemistry and physics of submarine Groundwater Discharge (SGD) into coastal ecosystems, especially in coral reefs of Hawai‘i. Fluorescent Dissolved Organic Matter (fDOM) is a portion of the total organics in water that is relatively quick and simple to analyze for compositional differences among sites. Here we show that fDOM can be used to map SGD in coral reef systems. We hope that this method will allow rapid and efficient monitoring of groundwater influences in these ecosystems. We seek to further develop this method to allow detection of groundwater contaminants and groundwater source tracking.