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A multidisciplinary study of the elemental sources and fluxes fueling nitrogen fixation fixation on the oligotrophic West Florida Shelf

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Abstract Text:
The West Florida Shelf (WFS) in the Gulf of America (formerly the Gulf of Mexico) is oligotrophic, with inorganic nitrogen (N) and phosphorus (P) concentrations typically at or below detection limits, and yet significant rates of primary productivity, including blooms of the harmful algal species *Karenia brevis*, are observed there. Additionally, multiple clades of the cyanobacterial diazotroph *Trichodesmium* spp. are endemic on the WFS. Consequently, dissolved organic nitrogen (DON) and dissolved organic phosphorus

(DOP) are thought to be the primary sources of assimilative macro nutrients on the WFS. Here we present results from a multidisciplinary study conducted on spring and summer 2023 cruises that 1) quantified rates of N2 fixation on the WFS; 2) characterized the diazotroph community composition; 3) measured dissolved inorganic and organic and suspended particulate organic nutrient concentrations and isotopic compositions; 4) measured trace element concentrations, speciation, and isotopic composition; 5) characterized dissolved organic matter chemical composition; and, 6) quantified fluxes of these elements from submarine groundwater discharge using a radium isotope mass balance model. Additionally, quarterly sampling of the geochemistry of riverine and submarine groundwater wells defined the chemical composition of margin (i.e., riverine and submarine groundwater) inputs. Together, we use these results to understand whether submarine groundwater discharge is the dominant source of bioavailable DON, DOP, dissolved iron, and iron-binding ligands on the WFS. Additionally, we use the results to ask whether the abundance of *Karenia brevis* and *Trichodesmium* spp. are associated with enhanced submarine groundwater inputs, and whether rates of N2 fixation carried out by two different *Trichodesmium* spp. are associated with enhanced submarine groundwater inputs.

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