Submarine groundwater discharge in coral reefs: A driver or buffer of ocean acidification?

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Submarine groundwater discharge (SGD) can release nutrients, dissolved organic carbon (DOC), and dissolved inorganic carbon (DIC) to coral reefs. While nutrients stimulate primary productivity that ultimately removes DIC from seawater, DOC drives respiration adding DIC to coral reefs. DIC contains carbonate alkalinity (CA) and CO_2. While CO_2 decreases seawater pH, CA inputs locally buffer global anthropogenic ocean acidification. Hence, the net effect of SGD on coral reef acidification is related to complex interactions among these biogeochemical components. Here, we investigate six globally-distributed, diverse coral reefs to assess whether SGD is a net driver or buffer of ocean acidification. We rely on (1) a radon mass balance approach to quantify SGD, (2) shore perpendicular transects away from the SGD source, (3) detailed groundwater sampling, and (4) interpretation of stoichiometric ratios. Two coral reefs near land masses received fresh SGD, while four coral reefs had only saline SGD inputs. The average radon-derived SGD rates ranged from 4±4 to 32±26 cm/day, with uncertainties representing natural variability. Groundwater samples at all sites were enriched in alkalinity, carbon dioxide and nutrients. However, most of the groundwater nitrogen was attenuated before reaching the ocean. The net effect of SGD on surface water pCO_2 was highly variable. Even though primary productivity was the major temporal driver of pCO_2, SGD inputs were usually enough to shift the coral reefs from a net sink to a net source of atmospheric CO_2. Our observations imply that SGD is a net source of CO_2 and a localized driver of ocean acidification in the coral reefs investigated.