Photosynthesis, calcification, and organic carbon and nitrogen fluxes from coral reef primary producers measured with in-situ chamber experiments

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Photosynthesis, calcification, and organic carbon and nitrogen fluxes were studied with an in-situ benthic chamber using major coral reef primary producers (two reef-building corals: *Acropora pulchra* and *Porites cylindrica*, seagrasses, macroalga (*Sargassum* sp.), and bare-sand communities) on Shiraho Reef, Ishigaki Island, the southwestern part of the Ryukyu Islands, Japan. The measurements were carried out for 24 hours (2hours x 12 times) for each benthic community in Jul.-Aug. (bare sand and two coral communities) and Oct. 2012 (seagrass and macroalgal communities). The calcification and photosynthetic rates were measured through analyses of carbonate chemistry parameters (total alkalinity and dissolved inorganic carbon) and combination of DO-pH sensors. Total organic carbon (TOC), TN, and nutrients (NH_4^+, NO_3^-, NO_2^-) were also measured to calculate organic C and N fluxes.
Daytime photosynthetic rates clearly followed the PAR in all the experiments even in bare sand. Dark respiration became largest right after sunset and gradually decreased during night, and this trend was related to water temperature. Daytime calcification followed the PAR in two coral experiments, and that in bare sand and macroalgal communities were slightly positive while that in seagrass community was negative indicating dissolution of carbonate sand in seagrass meadow even in daytime. In the dark, corals calcification decreased as pH decreased during night. The dark calcification was higher for *A. pulchra* compared to *P. cylindrica*. Bare sand showed dissolution when pH became lower than 8.1, and the seagrass community showed larger dissolution rates than bare sand community, suggesting organic matters derived from seagrasses decompose and enhance carbonate dissolution.
Regarding organic matter fluxes, *A. pulchra* released more TOC during daytime compared with nighttime. Seagrass and macroalgal communities released TOC regardless of day or night, and the fluxes were greater than those of corals. Organic N flux was also the higher for seagrass and macroalgal communities compared to corals. The results suggest that seagrass and macroalgal communities are important exporters of both organic C and N to the neighboring communities.

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