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Intercolony variability of skeletal oxygen and carbon isotope signatures of *Porites* corals: thermostated tank experiment and field observation

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The skeletal oxygen isotope ratio of *Porites* corals, together with the carbon isotope ratio, is the most frequently used proxy of past seawater temperature and composition for tropical oceans. We conducted tank experiments in which we grew *Porites* spp. colonies in thermostated seawater at five temperature settings between 21°C and 29°C under moderate light intensity of 250 μmol $m^{-2}s^{-1}$ with a 12:12 light:dark photoperiod. The incubation period lasted for 142 days. A skeletal isotope microprofiling technique applied along the major growth axis of each colony revealed that the oxygen isotope ratios of newly deposited skeleton in most colonies remained almost constant during tank incubation. However, the oxygen isotope ratios displayed a surprisingly large intercolony variability (~1‰) at each temperature setting although the mean slope (~0.15‰ $°C^{-1}$) obtained for the temperature–skeletal oxygen isotope ratio relationship was close to previous results. The variations in the oxygen isotope ratios were apparently caused by kinetic isotope effects related to variations in the skeletal growth rate rather than by species-specific variability or genetic differences within species. While no correlation was found between skeletal carbon isotope ratios and temperature, carbon isotope ratios showed significantly inverse correlation with linear growth rates, suggesting a kinetic isotope control at low growth rates. We also examined oxygen and carbon isotope ratios of *Porites* corals collected from Sekisei Reef of southern Ryukyu Islands, Japan. In shallow faster-growing corals, oxygen and carbon isotope ratios showed out-ofphase annual fluctuations. In contrast, in deep slower growing corals (mean annual linear extension < 4.8 mm yr^{-1}), oxygen and carbon isotope fluctuations were in phase, which has been identified as a pattern influenced by kinetic isotope effects. The phase offset between oxygen and carbon isotope annual fluctuations appeared to depend on the relative intensities of kinetic isotope effects and metabolic isotope effects during calcification process. The slower growing corals were strongly influenced, and the faster growing corals weakly influenced, by kinetic isotope effects over metabolic isotope effects. Growth-rate-related kinetic isotope effects found in both the cultured corals and the deep slower-growing corals may be, at least partly, attributed to low light condition.