

## Skeletal oxygen and carbon isotope records of corals during the 1997-1998 mass bleaching event

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Coral bleaching was originally reported in the Caribbean during the early 1980s and extensive coral mortality in the eastern Pacific during the 1982-83 El Nino drew attention to coral bleaching in the context of global warming. During 1997-98, severe coral bleaching was reported from many coral reefs in the tropical and sub-tropical regions of the world. Extensive coral bleaching was witnessed in the Great Barrier Reef, Australia, during the austral summer of 1997-1998 and appeared later in the Northern Hemisphere. For the first time, corals around the Ryukyu Islands, Japan, exhibited severe bleaching that resulted in extensive coral mortality. The 1997-98 global-scale coral-bleaching event coincided with one of the strongest El Nino-Southern Oscillation (ENSO) events and the warmest global temperatures on record.

We report skeletal oxygen and carbon isotope evidence for perturbations in coral skeletal growth due to bleaching at Ishigaki Island, Japan, and Pandora Reef, Great Barrier Reef during the 1997-1998 mass bleaching event. Coral cores and colonies were sectioned into seven-mm-thick slabs and cleaned with deionized water for X-radiography. The microsampling interval for isotopic analysis was 0.2 mm along the major growth axis for most coral specimens. Microsamples for Pandora and Yasura-zaki corals were reacted with H<sub>3</sub>PO<sub>4</sub> in an automated carbonate device (Multiprep, Micromass Co. Ltd.) coupled with a Micromass Optima mass spectrometer at the National Institute of Advanced Industrial Science and Technology.

a pattern of annual periodicity is clearly observed in oxygen isotope profiles for the Ishigaki corals. A rapid -0.7 per mil shift towards higher oxygen isotope ratios occurs in the profile for the bleached coral during the fall of 1998. The rapid shift falls within a single microsampling increment spanning only 0.2 mm. Bleached corals showed abrupt reductions in skeletal extension rate immediately after summer temperature maxima, indicating that bleaching inhibits coral calcification. Based on the length of time-gaps observed in the annual isotopic cycle, the typical time required for a coral to recover from bleaching is estimated to be about 5-6 months. The effect of bleaching on the oxygen isotope ratio - temperature relationship was negligible. However, the Ishigaki corals showed lower carbon isotope ratios during bleaching indicating depressed coral metabolism associated with a reduction in calcification.