Seasonal distribution and effects of herbicides on coral reefs around Okinawa, Japan

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Introduction

It is apprehensive about future degradation of coral reef caused by artificial chemicals such as herbicide and pesticides. Diuron [N'-(3, 4-dichlorophenyl)-N, N-dimethylurea] is one of the active substance contained in a herbicide. The used amount of diuron in Okinawa is the second highest in Japan [1]. Moreover, diuron has been using recently for antifoulant of ships as a replacement for organotin compounds. We investigated seasonal variation of herbicide contained in water and sediment around coral reef area in Ishigaki Island in Okinawa Japan, and carried out experiments to see the effect of the herbicide on coral metabolisms of photosynthesis and calcification.

Materials and Methods

Samples from twelve stations in the Shiraho lagoon and five in the Todoroki river were taken seasonally from August 2010 to May 2011. Diuron and other active substances were extracted using a solid-phase column and measured with a liquid chromatography with tandem mass spectrometry (LC–MS/MS).

Results and Discussion

Higher diuron of 222 ng/L was detected at the headwater of the Todoroki river in August. It decreased to 85 ng/L toward the river mouth. However, diuron in seawater and sediments at lagoon were significantly low level compared to the river. Because herbicide is mainly used in July to September in Okinawa and ground water from the catchment area flows geometrically to the headwater, the highest concentration was detected during summer season. The concentration in the lagoon has not reached to the level at which metabolic activity of coral colony is degraded.

[1] Sheikh *et al*. (2008) *Mar. Pollut. Bull*. **58**, 1922–1925.

Coral records of ocean acidification and physiological processes in the southern Great Barrier Reef

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Ocean acidification, the process of declining seawater pH due to increased uptake of CO_2 from anthropogenic emissions, is likely to have severe impacts on marine calcifiers and related ecosystems. However, long-term records of ocean acidification from marine biota have rarely been evaluated. Here, we present high-resolution records of boron isotopic compositions ($\delta^{11}B$) as a paleo-pH proxy and calcification rates from two *Porites* corals (over 150 year old) from the southern limits of the Great Barrier Reef, Australia.

Carbon isotopes ($\delta^{13}C$) and trace element ratios (Mg/Ca and Sr/Ca) were also determined. The results from coral boron isotopic systematics show the obvious impact of enhanced uptake of anthropogenic CO_2 on the ocean chemistry, resulting in a trend of decreasing seawater pH (-0.0016 ± 0.0002 pH unit yr^{-1}) and decreasing $\delta^{13}C$ compositions (-0.015 ± 0.002 ‰ yr^{-1} since 1960) due to fossil fuel burning (Suess effect). Ocean warming is also observed in the coral skeleton Sr/Ca record with slightly increased measured annual calcification from both corals during the observed period. This indicates that warming of the surface oceans may be countering the effect of decrease in carbonate ion concentration on coral calcification rates. Evidence of kinetic effects during coral calcification was also found in the long-term record; strong negative and positive correlation of coral growth with detrended $\delta^{13}C$ and Mg/Ca. This suggests that CO_2 hydroxylation is a dominant reaction in high calcifying conditions resulting in depleted $\delta^{13}C$. Also higher rate of coral growth could generate the kinetic effect on Mg partitioning and lead to greater incorporation into the aragonite skeleton of corals.