Unexpected temperature and light influence respectively upon coral carbon and oxygen isotopic composition: information provided by culture

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Since causes of the variations in the isotopic composition of coral skeletons is a matter of debate, the study of specimens cultured under controlled conditions is the only way to investigate the effect of one parameter at a time.

Culture technique

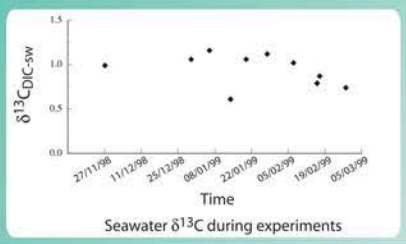
Tips of a single colony of *Acropora* sp. (a branching zooxanthellate scleractinian coral) were glued on glass slides and grown under controlled conditions in the laboratory at different temperatures(21, 23, 25, 27 and 29°C), and different irradiances(260 and 130 µmol m^{-2} s^{-1}),on a 12:12 photoperiod. Aquaria were supplied with heated Mediterranean seawater pumped from a depth of 50 m. The seawater renewal rate was 5 times per day and the seawater was continuously mixed.

Sampling and isotopic analysis

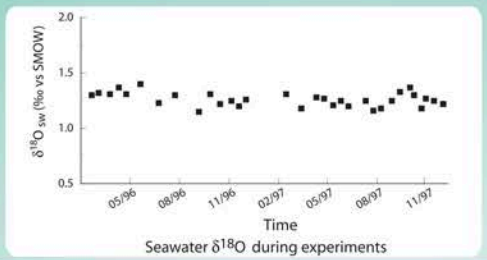
At the end of each experimental condition, the ring of skeleton deposited on the glass slide was removed with a scalpel, dried overnight at room temperature and ground. The powder was then soaked in hydrogen peroxide (12 h, to eliminate the organic matter), filtered and dried at 40°C. A sub sample of 100 µg was dissolved in 95% H_3PO_4 at 90°C. The CO_2 gas evolved was analyzed using a VG Optima mass spectrometer. Carbon and oxygen isotopic composition of seawater ($\delta^{13}C_{sw}$ and $\delta^{18}O_{sw}$) were measured on samples collected once a week, poisoned with $HgCl_2$. Skeletal $\delta^{18}O$ and $\delta^{13}C$ were corrected for changes in seawater $\delta^{18}O$ and $\delta^{13}C$.

Photosynthesis

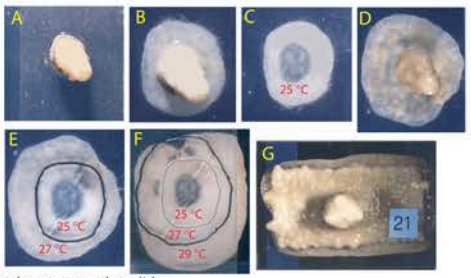
Coral nubbins were placed in a perspex chamber (kept in a thermostated water bath) for a 30 min pre-incubation and then incubated for 1h to measure the production of oxygen. The chamber was flushed after each incubation. Dissolved O_2 was measured in the chamber using a Ponselle polarographic electrode, and stored every 1 min. The rate of net photosynthesis was estimated using a linear regression of O_2 against time. Photosynthesis values were normalized with the surface of the coral.



Seawater $\delta^{13}C$ during experiments

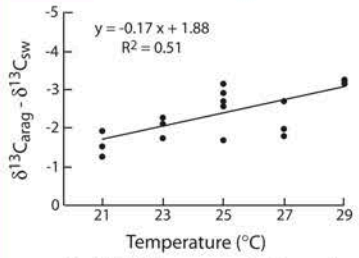


Seawater $\delta^{18}O$ during experiments



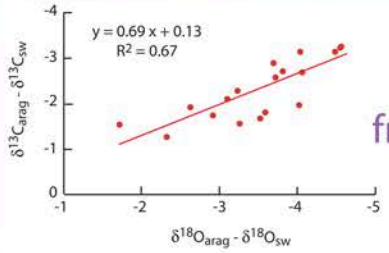
Corals grown on glass slides.
A: Top view of a small piece of *Acropora* sp. glued on glass slide at the beginning of the experiment.
B: The same piece of coral after 54 days at 25 °C.
C: Underneath view of picture B.
D: Top view of the same nubbin after 104 days.
E: Underneath view of picture D. The skeleton deposited at 25 and 27 °C is shown.
F: Underneath view after 185 days of culture.
G: Top view of the colony after 1 year of culture. Note that the vertical branch was cut.

$\delta^{13}C$ is known to be influenced by light (depth, photosynthesis), but...



Skeletal $\delta^{13}C$ versus seawater temperature

$\delta^{13}C$ is also controlled by temperature

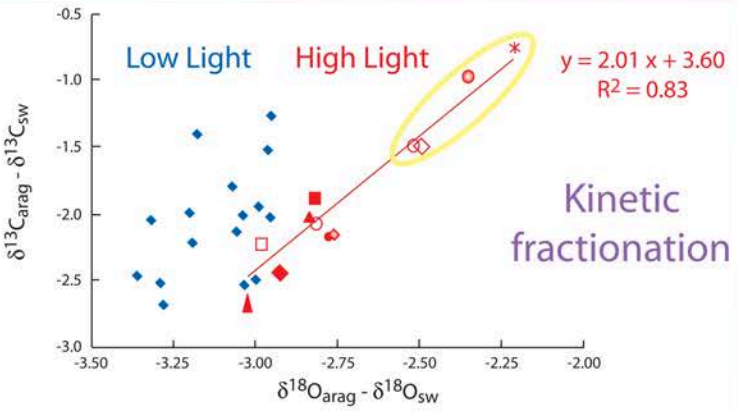


Skeletal $\delta^{13}C$ vs. skeletal $\delta^{18}O$ at different temperatures

Kinetic fractionation

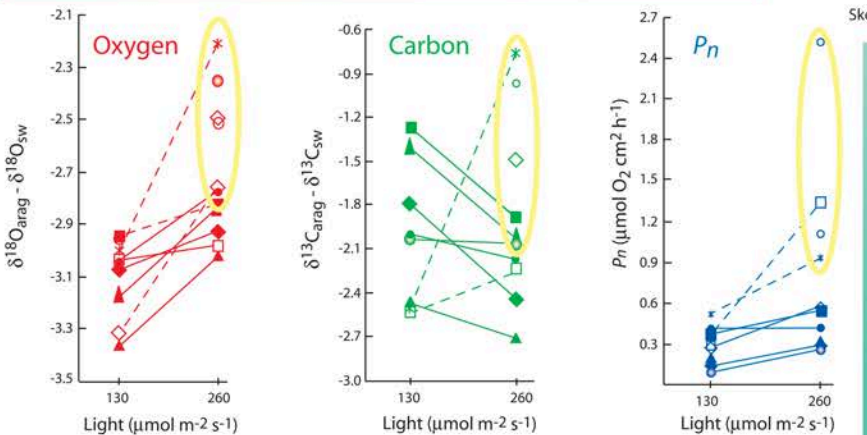
$\delta^{18}O$ is known to be influenced by temperature and salinity, but...

$\delta^{18}O$ is also controlled by light



Skeletal $\delta^{13}C$ vs. skeletal $\delta^{18}O$ at 2 light levels (each red symbol corresponds to a different nubbin)

Kinetic fractionation



Skeletal $\delta^{18}O$, $\delta^{13}C$ and net photosynthesis (P_n) of *Acropora* sp. nubbins cultured under 2 light levels

Be careful when interpreting stable isotope data !!!...

Acknowledgements

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