Lab-Where'd the Reef Go?

(Modified from International Geosphere-Biosphere Programme)

(MAKEUP VERSION)

Ocean Acidification – The Other CO_2 Problem

The world's oceans are at risk of becoming too acidic to support coral reefs and certain marine life, and a substantial reduction in CO_2 emissions is urgently needed to stem the dramatic rise of acidification, according to research presented at The Second International Symposium on the Ocean in a High CO_2 World. The meeting was co-sponsored by the International Geosphere-Biosphere Programme, UNESCO-IOC, the Scientific Committee on Oceanic Research, and the International Atomic Energy Agency. "The ocean is sick, and one of its problems in ocean acidification," said James Orr, chairman of the symposium's International Scientific Planning Committee. The ocean has provided an important buffer to higher concentrations of CO_2 in the atmosphere by soaking up 4 kg of the 11 kg of greenhouse gas produced by the average person every day. But once it mixes with seawater, CO_2 dissolves, converts to carbonic acid, and makes the oceans increasingly acidic. As CO_2 emissions rise, so does the acidity of the ocean. The ocean acidity level has already increased by 30% since the onset of the industrial revolution, with half of that increase occurring in the last 30 years. The increased acidity is adversely affecting the capability of marine corals and shell-forming organisms to build their skeletal material. It may also be affecting the developmental lifecycles of marine life, reducing growth, production and life spans. This is bad news for fish stocks, which are already stressed by overfishing and warmer sea temperatures. Research presented at the symposium underscores the notion that ocean acidification is happening now and is measureable. Evidence supporting this fact includes:

- Shell weights of pteropods (small plankton) are decreasing
- Calcification rates for coral reefs are decreasing
- Ecosystems located near hydrothermal vents (which emit high levels of CO_2 naturally) have experienced a total loss of some species and reduced biodiversity, providing a glimpse of what may happen on a much larger scale if the rate of ocean acidification continues at its current pace
- Controlled laboratory experiments on the effect of ocean acidification on certain calcifiers (organisms that form their own shell) showed that the organisms could not adapt to a more acidic environment even after 150 generations
- Ocean acidification impacts underwater sound by increasing noise levels, particularly at shallow depth. This impacts echolocation in marine mammals which migrate through those depths.

A key message from the symposium is that ocean acidity is expected to increase to the point where marine corals and other shell forming organisms will actually start to dissolve by the middle of the century. The only way to slow the trend of ocean acidification is substantial and urgent reductions in CO_2 emissions. Prince Albert II of Monaco, whose environmental foundation provided support for the symposium, attended a special session devoted to raising awareness of ocean acidification amongst policy makers and the general public. He re-affirmed his foundation's commitment to supporting the scientific community's research efforts. "Only by working together will we be able to move this important issue forward," he said.

Prelab questions:

1. Why is studying ocean acidification important?

2. How does ocean acidification affect marine organisms?

3. How could ocean acidification affect human populations?

4. How can ocean acidification be slowed or reversed?

What We Did in Class:
Students blew bubbles into a beaker of water, introducing CO_2 and thereby decreasing the pH. They then repeated the experiment with coral in the water, which buffered the pH change.

Watch the video https://youtu.be/fgBozLCGUHY and answer the following questions:

5. What is used in the video to introduce CO2 into the water?

6. By how much did the pH change in the experiment shown?

7. What type of acid is formed from the introduction of CO_2 into water?

8. How does a lower pH affect organisms living in the ocean?

9. What was the average pH of the oceans in preindustrial times? And now?

10. How will a lower pH affect ocean carbonates?

11. How can we address the problem of ocean acidification?