TESTIMONY OF
KEN CALDEIRA, Ph.D.
CARNEGIE INSTITUTION OF WASHINGTON

HEARING ON
"CORAL REEF CONSERVATION ACT REAUTHORIZATION AND ENHANCEMENT AMENDMENTS OF 2009"
BEFORE THE
COMMITTEE ON NATURAL RESOURCES
UNITED STATES HOUSE OF REPRESENTATIVES

February 25th, 2009

Good morning. Thank you for inviting me to testify today.

My name is Ken Caldeira and I work for the Carnegie Institution at Stanford University.

I am a scientist and a concerned citizen who has been studying ocean chemistry and the carbon cycle for over 20 years.

I am here to talk to you about how simple actions we take – even turning on the lights for this hearing – can contribute to a problem known as "ocean acidification". Ocean acidification poses an existential threat to ever coral reef in US waters.

Some carbon dioxide was released to the atmosphere to produce the electricity to light this room. Within a year, that carbon dioxide will spread throughout the atmosphere. Once in the atmosphere, carbon dioxide is readily absorbed by the oceans.

In the oceans, carbon dioxide changes chemically to become carbonic acid and acidifies the water.

So, within a year, the carbon dioxide released to power these lights will be damaging coral reefs, including those in Florida, Hawaii, Guam, and Australia's Great Barrier Reef.

Globally, each second, we dump over 1000 tons of carbon dioxide into the atmosphere and, each second, about 300 tons of that carbon dioxide is going into the oceans.

We can say with a high degree of certainty that all of this CO2 will make the oceans more acidic – that is simple chemistry taught to Freshman college students.

It is less certain how coral reefs, and marine ecosystems generally, will respond, but there are several lines of evidence – all of them disturbing.

Last year, I was with my post-docs and colleagues in the Great Barrier Reef, and we measured coral growth rates that were 40% below what was measured in the same place in the late 1970s. At this rate of decline, we would expect this reef to start dissolving in four or five decades.

Other studies suggest the corals could start dissolving sooner, unless we start cutting carbon dioxide emissions now. Without such action, there will be no place left in the oceans with the kind of chemistry that has sustained coral reef growth over the past millions of years.

Ocean acidification is not the only threat to coral reefs. Coral reefs are also threatened by global warming and by local pressures such as pollution, over-fishing, erosion on land, and a host of other factors.

Each of these factors puts additional stress on coral reefs.

The fact that coral reefs are exposed to global stresses like global warming and ocean acidification means we must work to enhance their resilience. To do this we need to reduce the stresses that we can control – such as pollution and ship strikes – so the coral reefs will be able to cope with the stresses we cannot control so easily – especially acidification and warming.

Twenty years ago, I was studying what happened to ocean chemistry when the dinosaurs became extinct, over 60 million years ago.

When the meteorite hit that killed off the dinosaurs, gases were released that made the oceans acidic.

Coral reefs disappeared, along with many other organisms that make their shells or skeletons out of calcium carbonate.

It took a few tens of thousands of years for ocean chemistry to recover, but it took coral reefs about two million years to become common once again.

Unfortunately, unless we reduce carbon dioxide emissions, it looks like our effect on the oceans will be similar to the effect of the meteorite that wiped out the dinosaurs, except we are taking a few decades to do what the meteorite did in an afternoon.

Coral reefs have been around continuously since they recovered from that meteorite over 60 million years ago. But they might not be around for our children or grandchildren unless we act now.

Unless we curb carbon dioxide emissions soon, we can expect to see the oceans damaged chemically for tens of thousands of years, and damaged biologically for millions of years.

The choices we make this year and actions we take this decade will affect the oceans for millions of years to come.

We are confronted with a pivotal moment both in the history of humanity and the history of our planet.

I trust, that with your leadership, we will act in ways that will make future generations proud of us – and do what is necessary to protect the environment that supports us all.

Thank you.

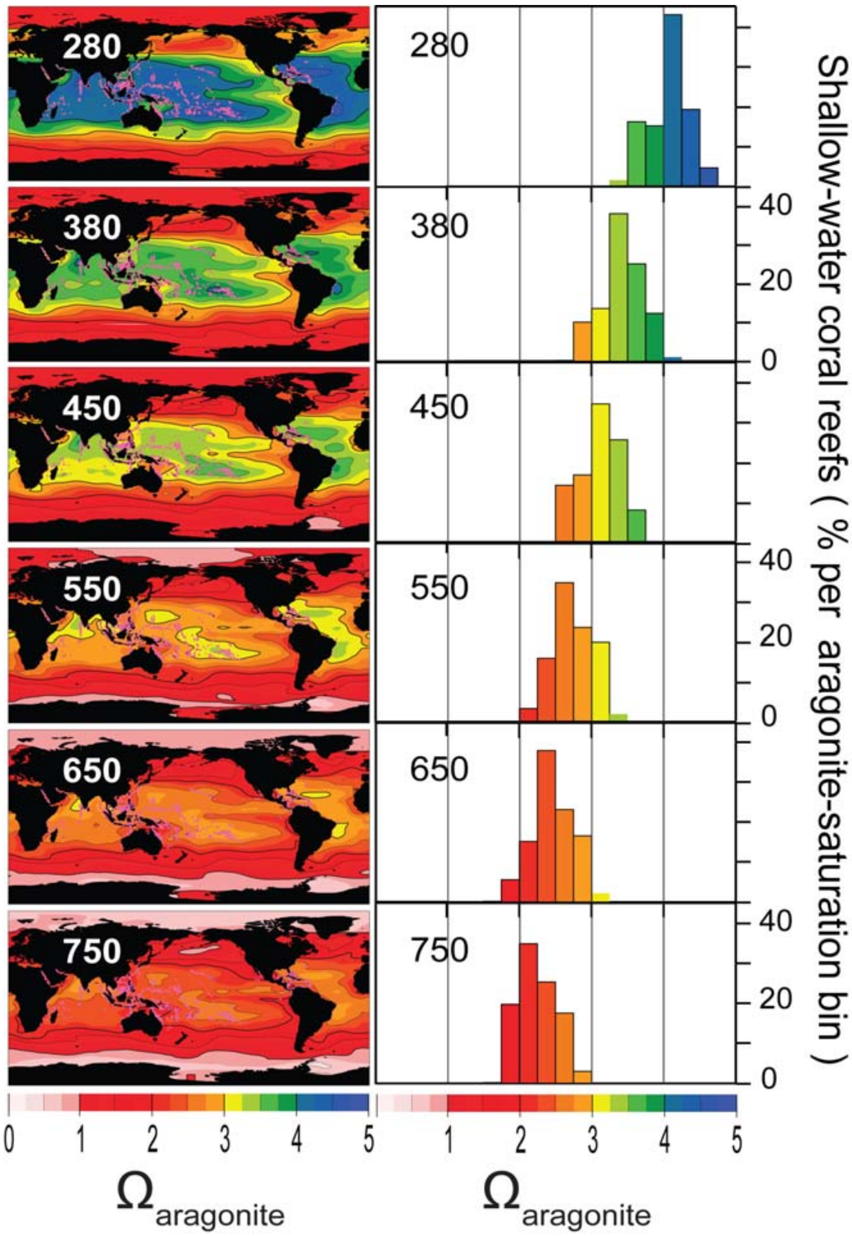

Figure 1. Coral reefs are unlikely to survive in regions colored yellow, orange, or red. In the absence of strong policy, atmospheric CO_2 will reach 550 ppm in several decades. Our analysis show that before the industrial revolution when atmospheric CO_2 level was about 280 ppm, 98.4% of coral reefs were found near open ocean waters with an aragonite saturation state above 3.5. With a CO_2 stabilization of 450 ppm only 8% of coral reefs would be surrounded by open ocean waters with aragonite saturation state above 3.5, and with a stabilization level of 550 ppm no existing coral reefs would be near such waters. [left column] Maps of model-predicted aragonite saturation states at different atmospheric CO_2 stabilization concentrations (ppm) plotted over existing shallow-water coral reef locations (shown as magenta dots). [right column] Percentage distribution of modern day coral reefs at each aragonite saturation bin under different atmospheric CO_2 stabilization concentrations.

(Cao, L., and K. Caldeira (2008), Atmospheric CO_2 stabilization and ocean acidification, *Geophys. Res. Lett.*, 35, L19609, doi:10.1029/2008GL035072)