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Abstract

I am investigating areas of the seabed that are already acidified by carbon dioxide, so that we can see which organisms thrive and which are most vulnerable. To do this I am investigating underwater volcanoes where carbon dioxide bubbles up like a Jacuzzi, acidifying large areas of the seabed for 100s of years. The natural gradients of carbon dioxide are like a time machine, showing which organisms can survive and what coastal habitats might look like in the coming years. But a major criticism has been that all my work was focused on one volcanic vent site off Ischia Island near Vesuvius; so how is this relevant to the people who grow shellfish in the NE Atlantic or those that show tourists the Great Barrier Reef?

For the past year my group has been repeating the Ischia experiments at other volcanic vents in Europe, Baja California and Papua New Guinea. What concerns me most is that as the carbon dioxide levels increase to those we expect to see in our life-times this causes a dramatic loss of marine biodiversity, both in temperate and in tropical systems. Key groups, like sea urchins and coralline algae, cannot survive as the water becomes corrosive, and fish avoid the high carbon dioxide areas when they lay their eggs.

Some organisms are able to adapt to the effects of long-term acidification – some can calcify even faster at high carbon dioxide levels - but the vents mainly benefit non-calcified organisms. Invasive species of algae and stinging jellyfish do especially well. Some species have an outer layer of protective tissue that allows them to tolerate acidified seawater, such as Porites corals in the tropics and Mytilus mussels in temperate areas. But these carbon dioxide tolerant organisms can only survive if they are not stressed by other factors.

We have found that the combination of acidification and rising temperatures kills-off corals and shellfish and that increasing carbon dioxide reduces biodiversity across-the-board, from simple organisms (such as bacteria and microalgae), to flora (like seaweeds and seagrasses), and fauna (such as corals and molluscs). I hope that information from these naturally acidified areas will be used to strengthen marine conservation efforts, as unstressed systems are more resilient than stressed ones.