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TITLE: Volcanic carbon dioxide vents show ecosystem effects of ocean acidification

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ABSTRACT:

The atmospheric partial pressure of carbon dioxide (p(CO(2))) will almost certainly be double that of pre-industrial levels by 2100 and will be considerably higher than at any time during the past few million years. The oceans are a principal sink for anthropogenic CO(2) where it is estimated to have caused a 30% increase in the concentration of H(+) in ocean surface waters since the early 1900s and may lead to a drop in seawater pH of up to 0.5 units by 2100 (refs 2, 3). Our understanding of how increased ocean acidity may affect marine ecosystems is at present very limited as almost all studies have been in vitro, short-term, rapid perturbation experiments on isolated elements of the ecosystem. Here we show the effects of acidification on benthic ecosystems at shallow coastal sites where volcanic CO(2) vents lower the pH of the water column. Along gradients of normal pH (8.1-8.2) to lowered pH (mean 7.8-7.9, minimum 7.4-7.5), typical rocky shore communities with abundant calcareous organisms shifted to communities lacking scleractinian corals with significant reductions in sea urchin and coralline algal abundance. To our knowledge, this is the first ecosystem-scale validation of predictions that these important groups of organisms are susceptible to elevated amounts of p(CO(2)). Sea-grass production was highest in an area at mean pH 7.6 (1,827 (mu)atm p(CO(2))) where coralline algal biomass was significantly reduced and gastropod shells were dissolving due to periods of carbonate sub-saturation. The species populating the vent sites comprise a suite of organisms that are resilient to naturally high concentrations of p(CO(2)) and indicate that ocean acidification may benefit highly invasive non-native algal species. Our results provide the first in situ insights into how shallow water marine communities might change when susceptible organisms are removed owing to ocean acidification.

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