



Groundwater-fed vents of bubbling gas

It's no surprise that coral reefs are in danger. As human activity adds more carbon dioxide to the atmosphere, some of it dissolves in the ocean and leaves the water more acidic and less hospitable. Scientists aren't as sure how natural submarine groundwater discharge—the underground flow from land out to sea—is affecting coral reefs and the coastal ecosystems they support. Bayani Cardenas from the University of Texas at Austin and a few colleagues suspected that the coast of the reef-rich Calumpán Peninsula that juts off the Philippine island of Luzon would have submarine groundwater discharge, so they collected seawater samples there for three years. The groundwater-fed hydrothermal springs that they discovered, pictured here, belch out so much CO_2 that the local concentration is as high as 95 000 ppm; the highest previously reported level, found in Italy in 2008, was 60 000 ppm.

The researchers followed the flow of groundwater by

analyzing the geochemistry of the samples, including their pH and the amount of radon-222. The latter can be picked up by groundwater moving past igneous and metamorphic rocks where it's the product of the radioactive decay of radium-226. (Its natural occurrence explains why home basements are routinely checked for Rn accumulation.) Cardenas and his colleagues found substantial ^{222}Rn activity in the groundwater measured from wells and in seawater samples that mixed with the groundwater when it discharged into the ocean on the southeastern coast of the peninsula. That's where Cardenas and his colleagues found less robust coral reefs amidst a collection of hydrothermal vents spewing out almost entirely CO_2 from volcanoes in the region. The pH around those vents measured 6.65; in the nearby open ocean, it's 8.11. (M. B. Cardenas et al., *Geophys. Res. Lett.* **47**, e2019GL085730, 2020. Photo by Bayani Cardenas, courtesy of the University of Texas at Austin Jackson School of Geosciences.) —AL

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