Is ozone gas an earthquake precursor?

Emitted when rocks are crushed, it may indicate signs of impending quakes

Crystal Gammon, OurAmazingPlanet, 12-2-11

Stories abound of animals behaving oddly in the moments before an earthquake: dogs bark incessantly, birds gather in tight flocks, toads flee their ponds. What could they be sensing that humans don't?

That question led a group of University of Virginia physicists to start grinding rocks and measuring gases in a lab experiment designed to mimic an earthquake and see what might be setting the animals off. What they found was dramatic: The rocks they crushed produced ozone gas at levels up to 100 times higher than a smoggy Los Angeles day.

"Even the smallest rock fracture produced ozone," team member Catherine Dukes told OurAmazingPlanet. "The question is, can we detect it in the environment?"

If that answer is "yes," the ozone signal Dukes and her colleagues saw might someday be used to warn of impending quakes.

Crushing rocks

Dukes' group tested several igneous and metamorphic rock types in their lab — including basalt, granite, gneiss and rhyolite, which together account for more than 95 percent of the Earth's crust.

The crushed rocks produced ozone at levels ranging from 100 parts per billion (ppb) to 10 parts per million (ppm). The ozone signatures were all higher than background levels, which can range from less than 40 ppb in rural areas to more than 100 ppb in urban centers.

Exactly how the crushed rocks produced ozone is not clear, but it was likely due to differences in the electric charge between fractured rock surfaces, said Dukes. Electrons from charged rock surfaces break down oxygen molecules in the air, which recombine to form ozone at ground level.

"It's like mini lightning strikes," Dukes said.

Haiti quake ozone

The University of Virginia study, detailed in the Nov. 14 issue of the journal Applied Physics Letters, is the first to measure ground-level ozone associated with rock fracturing. Other groups, though, have found increased atmospheric ozone in the wake of major earthquakes.

After the 2010 Haiti earthquake, Chapman University geophysicist Ramesh Singh used satellites to detect rising ozone levels in the days immediately following the quake. Whether the ozone came from fractured rocks, as in the University of Virginia lab experiment, is unclear, but a variety of observations will help scientists unravel the physical processes at work, Singh said.

"What they're seeing in the lab at a small scale may begin to explain the measurements we've taken by satellite," Singh said in an interview, "but the whole Earth is a very complex system of systems."

Not a prediction

Eventually, Dukes and her colleagues would like to see if there is a correlation between ground movements and ozone measurements by placing arrays of ground-level ozone detectors (which are inexpensive and simple to use) in areas with active faulting and low background ozone levels.

Dukes and Singh both emphasized that studies like theirs are not intended to predict earthquakes. Rather, they help explain the physical processes behind earthquakes and other natural phenomena.

"This is not a way to predict earthquakes. We will never be able to say, 'we found some ozone, now you have five minutes,'" Dukes said. "It's just a way to warn that the Earth is moving and something — an earthquake, or a landslide or something else — might follow."