Study: Ozone from rock fracture could serve as earthquake early warning

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Researchers the world over are seeking reliable ways to predict earthquakes, focusing on identifying seismic precursors that, if detected early enough, could serve as early warnings.

New research, published this week in the journal Applied Physics Letters, suggests that ozone gas emitted from fracturing rocks could serve as an indicator of impending earthquakes. Ozone is a natural gas, a byproduct of electrical discharges into the air from several sources, such as from lightning, or, according to the new research, from rocks breaking under pressure.

Scientists in the lab of Raúl A. Baragiola, a professor of engineering physics in the University of Virginia School of Engineering and Applied Science set up experiments to measure ozone produced by crushing or drilling into different igneous and metamorphic rocks, including granite, basalt, gneiss, rhyolite and quartz. Different rocks produced different amounts of ozone, with rhyolite producing the strongest ozone emission.

Some time prior to an earthquake, pressures begin to build in underground faults. These pressures fracture rocks, and presumably, would produce detectable ozone.

To distinguish whether the ozone was coming from the rocks or from reactions in the atmosphere, the researchers conducted experiments in pure oxygen, nitrogen, helium and carbon dioxide. They found that ozone was produced by fracturing rocks only in conditions containing

oxygen atoms, such as air, carbon dioxide and pure oxygen molecules, indicating that it came from reactions in the gas. This suggests that rock fractures may be detectable by measuring ozone.

Baragiola began the study by wondering if animals, which seem – at least anecdotally – to be capable of anticipating earthquakes, may be sensitive to changing levels of ozone, and therefore able to react in advance to an earthquake. It occurred to him that if fracturing rocks create ozone, then ozone detectors might be used as warning devices in the same way that animal behavioral changes might be indicators of seismic activity.

He said the research has several implications.

"If future research shows a positive correlation between ground-level ozone near geological faults and earthquakes, an array of interconnected ozone detectors could monitor anomalous patterns when rock fracture induces the release of ozone from underground and surface cracks," he said.

"Such an array, located away from areas with high levels of ground ozone, could be useful for giving early warning to earthquakes."

He added that detection of an increase of ground ozone might also be useful in anticipating disasters in tunnel excavation, landslides and underground mines.

Provided by University of Virginia