Combining muography with existing technology to improve volcanic eruption predictions

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An international team of researchers is proposing that vulcanologists consider using muography with existing technology to improve volcanic

eruption predictions. In their paper published in *Proceedings of the Royal Society A*, the group describes ways they believe muography could be combined with existing technology to provide volcanologists with more information about the status of a given volcano.

Muons are subatomic particles that are created when cosmic rays strike Earth's atmosphere and collide with its atoms. As the muons rain down on the planet, they pass through everything on the surface and below. But because some materials are denser than others, some of the muons can be lost. This has led to the idea of using them to measure the density of objects—to help find a hidden room in the Great Pyramid, for example. Scientists have developed tools that can be used to measure muons, and their use has led to the science of muography. Prior research has shown that muography can be used to study certain geographical features, such as the density of material in a mountain, or a volcano. Prior research has shown that muographical tools can illuminate the makeup of a volcano, which could perhaps lead to eruption forecasts. In this new effort, the researchers suggest that a better approach is to use both muography and existing technology and techniques to learn even more about a given volcano, and hopefully to better predict when it might next erupt.

More specifically, the researchers suggest muography be added to tools such as acoustic and thermal recordings devices that are used to monitor volcanoes that are located near populated areas. Noting certain changes in density of materials inside of a volcano could, over time, come to be seen as a prelude to an eruption.

The authors also acknowledge that there are roadblocks to using muon detecting equipment as part of eruption prediction—most notably, physical hurdles such as when a volcano is surrounded by an ocean or other mountains that shield it from falling muons. They also note that muon detectors are generally far more expensive than other types of

sensors. They argue that despite these hurdles, the use of muon detection would be well worth it if it saves lives and reduces property damage.

More information: Giovanni Leone et al, Muography as a new complementary tool in monitoring volcanic hazard: implications for early warning systems, *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences* (2021). DOI: 10.1098/rspa.2021.0320