The seemingly unremarkable crystals that could help predict volcanic eruptions

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The research team on Mt Etna, Sicily. Credit: Dr Teresa Ubide.

They may look inconspicuous and unremarkable, and most people wouldn't notice them, but small crystals in volcanic rocks, such as lava, may hold the key to better understanding advance warnings of volcanic eruptions.

The crystals form inside the volcano when molten rock—magma—starts moving upwards from depths of up to 30 km towards the Earth's surface. The crystals are carried in the erupting magma, and they often continue to grow as they are being transported. Importantly, they also change in composition on their way to the surface.

Two scientists—Dr Teresa Ubide from the University of Queensland, and Professor Balz Kamber from Trinity College Dublin—conducted the research in a project funded mainly by Science Foundation Ireland. They used a laser technique to examine the inside of these crystals in a novel way. And what they discovered is that the crystals contain a memory in the form of growth layers that look similar to tree rings. Reading the history from these layers may lead to more effective volcanic hazard monitoring, including for dormant volcanoes.

Dr Ubide said: "They essentially 'record' the processes right before the eruption starts. At Mount Etna, we found that the arrival of new magma at 10 km depth is a very efficient trigger of eruptions—and within only two weeks."

Panoramic of Mt Etna, Sicily. Credit: Dr Teresa Ubide.

"In this case, therefore, earth tremors at the depth of magma recharge must be taken as serious signs of potential imminent eruptions. At other volcanoes, the method will allow to establish the relationship between recharge depth, recharge frequency and eruption efficiency. This can then help scientists to better relate physical signs of recharge to eruption potential."

The findings have just been published in leading international journal *Nature Communications*. The research was conducted on Mount Etna, in Sicily, which is Europe's most active volcano. Dr Ubide's team is now planning to expand the approach to other volcanoes around the world, and to combine the information with geophysical signs of magma movement.

It remains very difficult to predict volcanic eruptions - as evidenced by the eruption at Mount Agung in Bali, which started last November after two months of precursory earthquakes. It led to the evacuation of over 70,000 people and caused massive disruptions in air traffic and tourism, affecting over 100,000 travellers.

Professor of Geology and Mineralogy at Trinity, Balz Kamber, added:

"The new approach may also prove useful for studying volcanoes that have remained dormant, such as the currently erupting volcano on Kadovar Island, Papua New Guinea."

"For many volcanoes there is no eruption history, but geologists can collect lavas from past eruptions and study their crystals."

More information: Teresa Ubide et al, Volcanic crystals as time capsules of eruption history, *Nature Communications* (2018). DOI: 10.1038/s41467-017-02274-w

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