Study attributes varying explosivity to gaseous state within volcanic conduits

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This image of ash and gases exploding from Volcan de Colima was taken by the

research team during the study. Credit: Paul Cole/Plymouth University

The varying scale and force of certain volcanic eruptions are directly influenced by the distribution of gases within magma inside a volcano's conduit, according to a new study.

Using state of the art equipment including UV cameras and electron microscopes, researchers from Plymouth University led a project to analyse the eruptive plumes and ash generated by Volcán de Colima, the most active volcano in the Americas.

Working alongside academics from the University of Cambridge and the Universidad de Colima in Mexico, they documented for the first time marked differences in the vesicularity, crystal characteristics and glass composition in juvenile material from the volcanic explosions.

The results led them to suggest that degassing which occurs during magma ascent leads to a build-up of both fast-ascending gas-rich magma pulses together with slow-ascending gas poor pulses within the volcano's conduit, which in turn determine the explosivity of any resulting eruption.

This particular type of volcanic activity is known as a Vulcanian explosion, and while they are explosive and short-lived, they often see large amounts of ash and magma fired more than 10km into the Earth's atmosphere.

Dr Paul Cole, Lecturer in Geohazards at Plymouth University, said: "Vulcanian explosions can be hazardous, and the purpose of this study is to try and get some understanding of what controls the explosions themselves. Volcan de Colima became active again in 2013, and our

concern is that this may be the forerunner to something more serious as it has previously erupted every 100 years or so, with the last major eruption in 1913. With tens of thousands of people living in communities regularly evacuated because of the volcano, any increased knowledge of its activity could obviously have a marked effect."

Vulcanian explosions are among the most common types of volcanic activity observed at silicic volcanoes, and have also recently been in evidence at the Calbuco volcano in Chile.

Magma ascent rates have often been invoked as being the fundamental control on their explosivity, yet until now this factor is poorly constrained, partly due to the rarity of ash samples and low gas fluxes.

For this study, researchers employed a multi-disciplinary approach to address this, measuring sulphur dioxide fluxes emanating from the summit, as well as collecting ash for subsequent quantitative crystal and micro-geochemical analysis.

Dr Cole added: "This research has enhanced our knowledge, but we now need to explore whether the phenomena we have identified here are mirrored elsewhere. The current eruptions at Calbuco in Chile can also further our understanding of this type of activity and assist in our efforts to build a picture of how this gaseous interaction takes place, and the effects it has. Ultimately, it could help in our ongoing efforts to improve safety for communities living in the shadow of volcanoes."

Provided by University of Plymouth