Volcanic Quakes Help Forecast Eruptions

December 22 2009, By Emilie Lorditch, ISNS

Magma becomes lava after leaving the Earth's crust, shown here on Mount Redoubt. Credit: Bretwood Higman

Monitoring the earthquakes caused from magma movements inside an active volcano could help to improve the accuracy of forecasting an eruption.

According to Emily Brodsky, the magma inside a volcano appears to be the real driving force of pre-eruption quakes, indicating how soon an eruption will follow.

"It is really that simple," said Brodsky, an associate professor of Earth and Planetary Sciences at the University of California, Santa Cruz. "It all

comes back to physics and the fluid dynamics of magma in the volcano."

Brodsky worked with Luigi Passarelli, a visiting graduate student from the University of Bologna in Italy, who observed 54 eruptions around the world.

"Passarelli collected the data, and it revealed obvious patterns in eruption activity," said Brodsky. "This kind of work isn't glamorous, but it is very important to find these patterns, and they have led to something that is really very simple."

What Brodsky and Passarelli discovered is that they can use a volcano's "run-up" time -- the time between the beginning of pre-eruption earthquakes and the actual volcanic eruption itself -- to improve the accuracy of future volcanic eruption alerts.

A volcano with frequent eruptions has a short run-up time. These volcanoes have little earthquake activity due to the runny magma within that contains very little silica. The magma flows easily, filling the internal chamber before quickly exiting the mouth of the volcano and allowing only a small amount of time to issue an eruption warning.

Alternatively, a dormant volcano has a very long run-up period. Dormant volcanoes contain magma that is full of thick, slow moving silica. It takes much more time for this kind of magma to fill a volcano and reach its mouth. As the thick magma pushes its way up the volcanic neck and presses on the surrounding rock causing earthquakes that provide more advanced warning of an upcoming eruption.

Brodsky and Passarelli hope that this information will be applied to volcanoes around the world.

"Volcanoes like Mount Rainer are already monitored by the USGS

Cascades Volcano Observatory, but there are many other unmonitored volcanoes around the world," said Brodsky. "By applying what we've found, we can improve eruption forecasts and provide better alerts."

"Volcanoes are complex beasts and this research is telling us that they are all controlled by magma -- it's really a very simple process," she said. Brodsky presented her work with Passarelli in a December meeting of the American Geophysical Union meeting in San Francisco, Calif.