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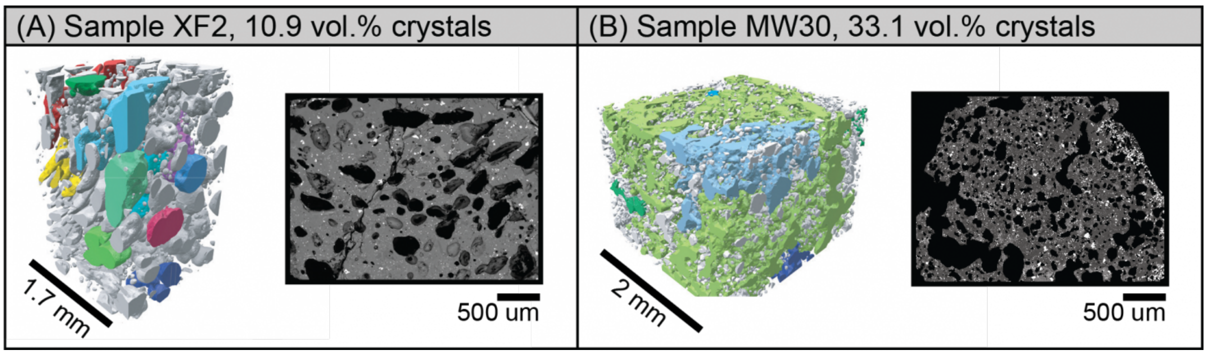
Crystals help volcanoes cope with pressure

July 11 2017, by Meghan Murphy



Magmas with more than 20 percent crystals tend to form connected networks that channel the gas. The image on the right shows magma that is 33.1 percent crystals. The crystals are channeling the gas bubbles, shown in green and blue. The image to the left does not contain enough crystals to channel the gas. Credit: Image courtesy of Amanda Lindoo

University of Alaska Fairbanks researchers have discovered that volcanoes have a unique way of dealing with pressure—through crystals.

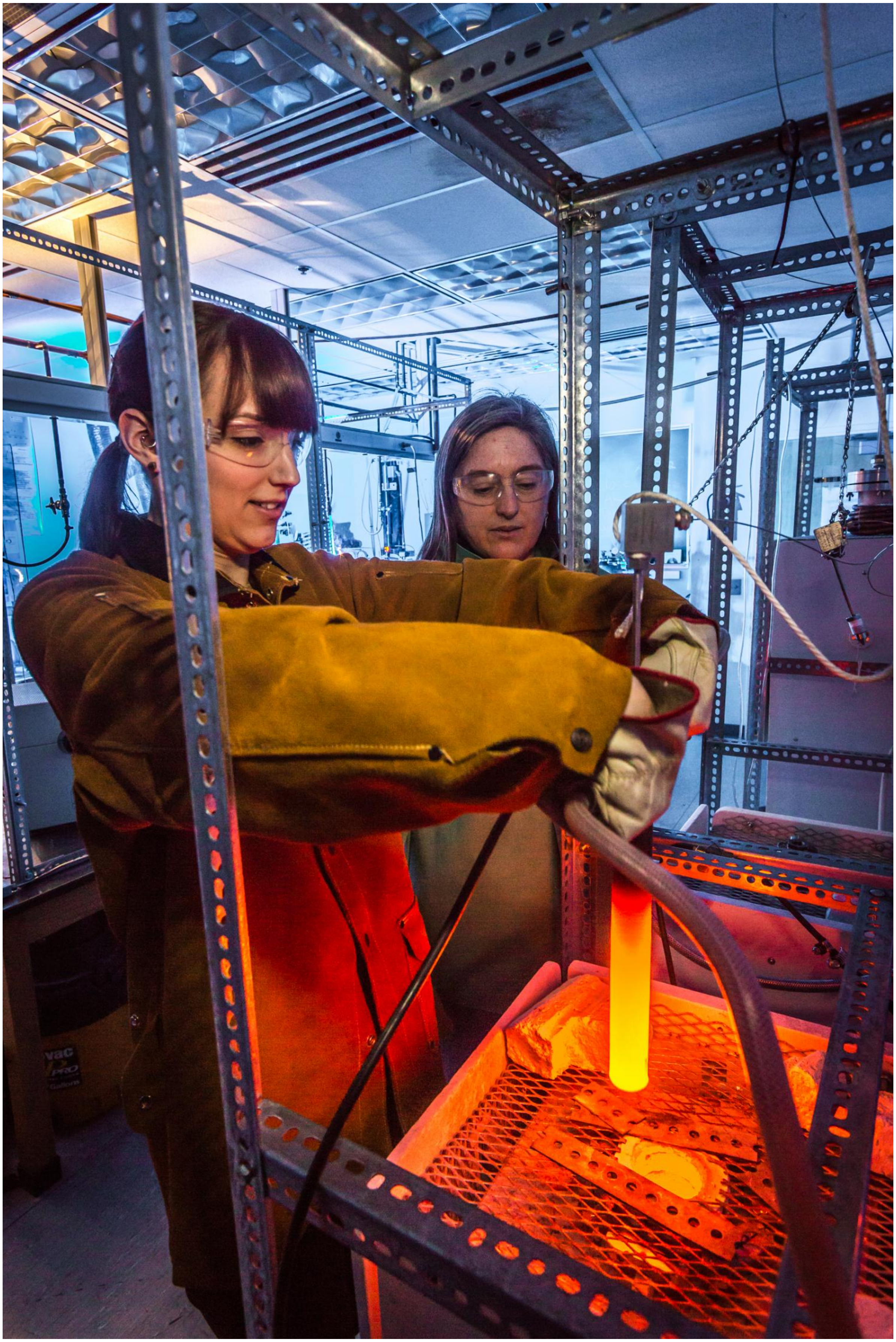
According to a new study published in the *Journal of Geology*, a network of microscopic crystals can lessen the internal pressure of rising magma and reduce the explosiveness of eruptions.

Crystals can form in the rising molten rock in as little as 18 minutes. If the magma becomes more than 20 percent crystals, they can act like guard rails that funnel gas to possible cracks within the volcano or to the opening at the Earth's surface.

"The problem is when the gas can't get out," said Amanda Lindoo, lead author and UAF geosciences doctoral student. "That causes a buildup in pressure that can lead to the very explosive eruptions that shoot ash plumes. The crystals can alleviate that."

Co-author Jessica Larsen, a volcanologist with the UAF Geophysical Institute, said the findings challenge the prevailing assumption that the amount of silica in magma is the major driver in gas escape.

The usual rule of thumb, she said, is that magmas with lots of silica are slow-moving, which can make it hard for gas to escape. While scientists know that these magmas tend to form fewer crystals, she said not much research has focused on the crystal's role in eruptions.



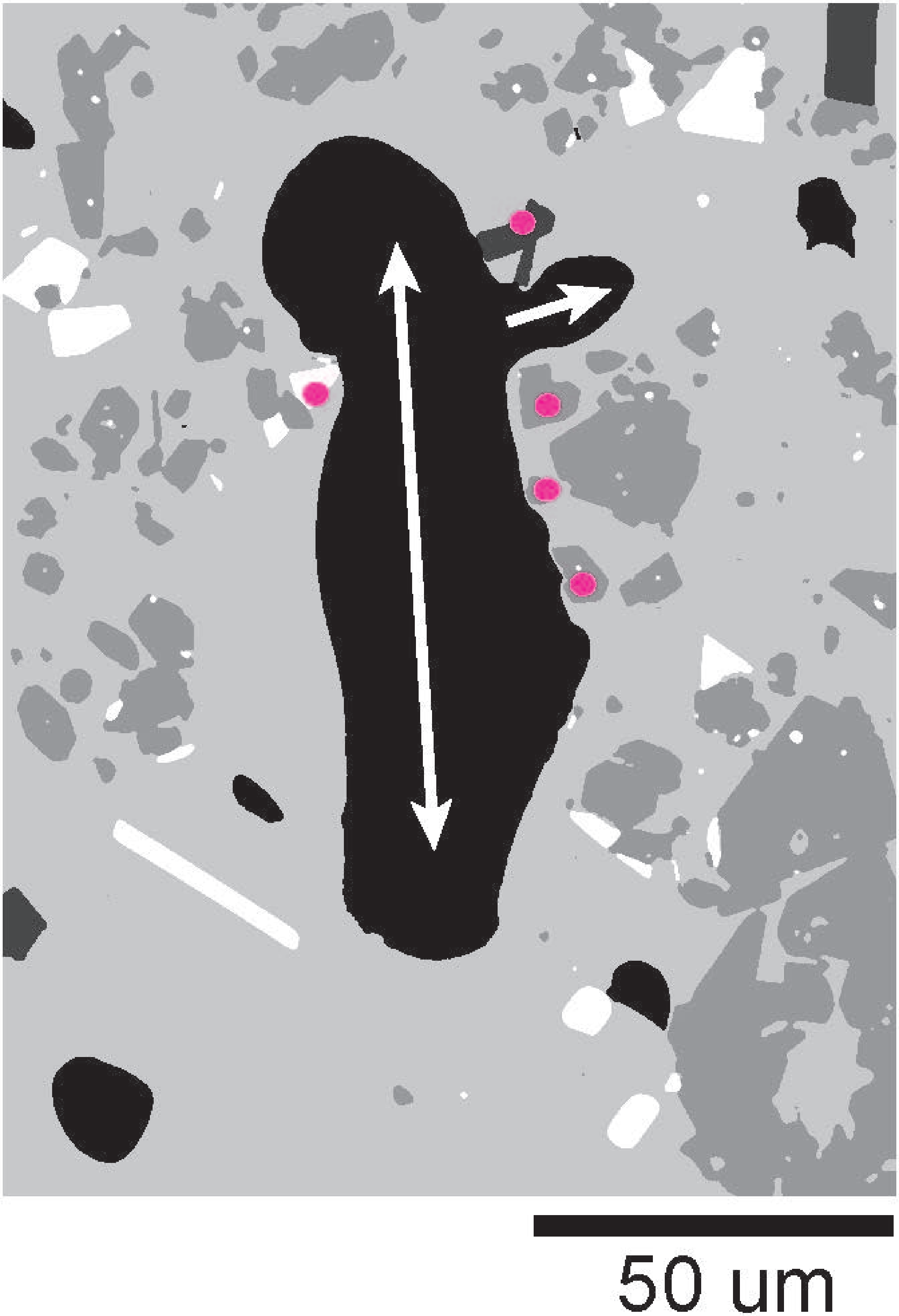
University of Alaska Fairbanks doctoral student Amanda Lindoo pulls a rod containing a snapshot of magma from a furnace in the experimental petrology lab under the watchful gaze of Research Assistant Professor Jessica Larsen. The apparatus allows scientists to take pictures of processes within the magma at specific temperatures and pressures. Credit: UAF Todd Paris

Volcanoes in the Aleutian Islands, the Cascade Range and Central America aroused Larsen's curiosity. Some volcanoes in those regions have magma consistently high in silica, while others have low-silica magma.

"If you follow the rule of thumb, then the volcanoes with low-silica magma shouldn't produce hazardous, explosive eruptions," she said. "And yet they do. We wanted to know what was swinging the pendulum, because it's important to understanding the hazards of eruptions."

To study the crystals, Lindoo worked with Larsen in the Geophysical Institute's Experimental Petrology Lab, which has a furnace that can superheat volcanic rocks up to 2,400 F and melt them back into molten lava. It also has pressurizing pumps, pressure lines and valves.

Lindoo created magma from eruptive materials from the Aleutian Islands. She applied extreme pressure to the magma to simulate pressures in the Earth, but then reduced pressure to mimic the way low-silica magma rises.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This black elongated shape is a gas bubble traveling through a crystal network in magma. The pink dots are select crystals affecting the bubble shape. Credit: Image courtesy of Amanda Lindoo

As the magma "rose," dissolved water formed into gas bubbles—much as bubbles form when opening a bottle of pressurized soda. Crystals also grew in the molten part. Lindoo then compared lab samples to those taken from volcanic explosions and found patterns of crystal networks channeling gas where crystal formation was high.

Larsen said temperature, the amount of water in the magma and the speed of the magma's rise all play a role in crystal formation.

"For awhile we've understood how crystals form," said Larsen. "But we didn't know how profoundly the crystals influenced gas escape."

Larsen said she will continue the research, but the next phase will look at how the different sizes and shapes of crystals influence gas escape.

Kasatochi Island in the Aleutian Islands was formed by a volcano. Researchers at the University of Alaska Fairbanks are studying transitions in eruption styles in volcanoes such as this. Credit: Photograph courtesy of Burke Mees

More information: *Journal of Geology*, DOI: 10.1130/G39157.1

Provided by University of Alaska Fairbanks