Icelandic volcanoes help researchers understand potential effects of eruptions

July 14 2008

Volcanic eruptions from the volcano Askja created the small crater Víti (foreground) and large lakes, such as Öskjuvatn (background).

(PhysOrg.com) -- For the first time, researchers have taken a detailed look at what lies beneath all of Iceland's volcanoes – and found a world far more complex than they ever imagined.

They mapped an elaborate maze of magma chambers - work that could one day help scientists better understand how earthquakes and volcanic eruptions occur in Iceland and elsewhere in the world.

Knowing where magma chambers are located is a key first step to understanding the chemical composition of the molten rock that is flowing within them - and of the gases that are released when a volcano erupts, explained Daniel Kelley, doctoral student in earth sciences at Ohio State University.

Kelley and Michael Barton, professor of earth sciences at Ohio State, have determined that the volcanoes in Iceland are likely to have explosive eruptions that shoot debris far into the atmosphere. That's because the magma moves very quickly to the surface from deep within the magma chambers. Fast-moving magma propels sulfur and ash out of a volcano and high into the atmosphere, where it can spread around the planet.

"One of the reasons we're trying to understand these volcanoes is to determine exactly what the chances are of a large eruption there. We know that a large eruption in Iceland would not only have devastating local effects, but potential global effects as well - by affecting the climate," Barton said.

Previous eruptions in Iceland and elsewhere have released gas into the atmosphere that had global affects. An eruption of a volcano in modern-day Indonesia in 1816 led to the "year without a summer." The explosive eruption forced sulfur and ash high into atmosphere, blocking the sun for several months and leading to global crop failure, famine, and a death toll in the thousands. Similar effects were also recorded after an eruption in Iceland in 1783.

This new study was based on the analyses of basaltic glasses -- volcanic rocks created when magma from deep within the Earth is cooled very quickly at the surface and becomes glass-like. The researchers traced the origin of basaltic glass rocks gathered from the surface of Iceland to magma chambers under 28 different volcanoes, by analyzing the composition of the rocks and calculating the pressures at which the glasses were formed.

In addition to his own field work, Kelley compiled published reports of more than 500 basaltic glasses analyzed by other researchers from every volcanic center in Iceland. The study, which is the first of its kind to look at all of Iceland's volcanoes, was published in *Journal of Petrology*.

Rather than using conventional methods, Kelley and Barton focused on a more unusual way to study Iceland.

"Most of the studies looking for magma chambers are done using seismic or satellite data to infer where a magma chamber might be. But by analyzing the glass, you have something that directly represents the liquid magma beneath the surface and gives you the exact location of the magma chamber," Kelley said.

This new research strongly supports the idea that the middle and lower layers are actually hotter than ever imagined, up to 400 degrees Celsius (more than 750 degrees Fahrenheit) higher at the base of the crust. And with stacked chambers ranging from 1 to 35 kilometers (1 to 21 miles) below the surface, many volcanoes lie above large bases of molten rock.

At the base of the crust beneath every volcano, researchers also found complex groupings of magma chambers. Magma is constantly flowing through the chambers or injected into cracks in the crust, resulting in increased volcanic activity.

Over thousands of years, that increased volcanic activity has created a lot of basaltic glass, giving scientists clues at how magma chambers have changed over time and where eruptions have taken place in the past, Kelley said.

Knowing the sizes and locations of magma chambers past and present, scientists can better understand the events that happen shortly before and after a volcanic eruption. Previous research has suggested that earthquakes and volcanic eruptions follow one another, giving scientists a possible warning of an eruption.

"There's a lot of magma moving inside reservoirs underneath volcanoes as they fill, the crust around them becomes deformed and that tends to generate the earthquakes. And so one of the ways you are able to predict an eruption is by looking at the seismic data," Barton said.

Iceland is the perfect place for scientists such as Kelley and Barton to study the placement of magma chambers.

It's a land of contrasts: glaciers blanket portions of Iceland, while pools of magma flow beneath the surface. The entire island country sits atop the Mid-Atlantic Ridge, a giant crack in the earth's crust. The ridge separates the North American and Eurasian tectonic plates and exposes the inside of the Earth.

Almost all mid-ocean ridges lie deep under water, but Iceland is the only land-based location in the world where researchers can take this kind of first-hand look into Earth's interior.

"A great deal of volcanic activity is centered around mid-ocean ridges, but they are almost all underwater, so we can usually only study them from ocean dredging and drilling. Iceland is the only place in the world where we can put our feet right on a mid-ocean ridge and study it," Kelley said.

Over the next few months, Kelley plans to collect more glasses from Iceland personally. Focusing on the Askja volcano in the country's central highlands, Kelley hopes to determine how the volcanic system has evolved over time. This new focus will add another dimension to how scientists interpret the changes in volcanic systems, he said.

Source: Ohio State University

Citation: Icelandic volcanoes help researchers understand potential effects of eruptions (2008, July 14) retrieved 18 April 2024 from https://phys.org/news/2008-07-icelandic-volcanoes-potential-effects-eruptions.html