

Yellowstone's killer hazard -- earthquakes, not eruptions

Becky Oskin, LiveScience, 10-28-13

DENVER — A supervolcano blasting Yellowstone National Park to smithereens may capture the imagination, but the region's real risk comes from earthquakes, researchers reported here Sunday at the Geological Society of America's annual meeting.

"The pervasive hazard in Yellowstone is earthquakes," said Robert Smith, a seismologist at the University of Utah. "They are the killer events."

Smith and his collaborators analyzed 4,520 earthquakes in and around Yellowstone that struck between 1985 and 2013. Their goal: Create the best picture ever of the magma chamber hidden beneath the park's colorful hot springs and spectacular geysers. A side benefit was a better view of the seismic risk from nearby faults.

Constant trembling

One of these faults triggered the most destructive earthquake ever recorded in the Rocky Mountains — the deadly magnitude-7.3 Hebgen Lake quake in 1959. The epicenter was about 15 miles (24 kilometers) north of West Yellowstone.

Smith said the probability of another magnitude-7 or larger earthquake on one of the major faults near Yellowstone is 0.125 percent. The number reflects the chance an earthquake will occur in any given year, based on past records.

The annual probability of a Yellowstone supereruption is a much smaller 0.00014 percent, Smith said.

Yellowstone National Park is cradled inside a gentle depression created by a giant volcanic eruption 640,000 years ago. The ground collapsed, leaving a bowl-shaped caldera. It was the third in a series of massive eruptions, the first of which exploded 2.1 million years ago.

A mantle plume (also called a hotspot) feeds Yellowstone's supereruptions. Hotspots are massive rising blobs of hot rock from Earth's mantle, the layer beneath the crust. As the planet's tectonic plates trundle over hotspots, the plumes punch through the crust, forming volcanic chains like Hawaii or the Idaho's Snake River Plain and Yellowstone.

In the millennia since the last massive volcanic blowout, magma has again built up beneath Yellowstone. The park trembles constantly with tiny earthquakes as gas and hot fluids course through underground fractures, escaping from the molten rock below.

Beneath Yellowstone

Led by graduate student Jamie Farrell, the University of Utah group used these tremors like a CT scan, building a precise image of the underground magma reservoir.

However, Yellowstone's magma chamber isn't just a giant pool of molten rock. What's called a partial melt — small interconnected zones of magma filling fractures and small spaces — fills 6 to 7 percent of the crust beneath Yellowstone, Smith said. "The Yellowstone crustal reservoir is 250 percent larger than previously imaged," Smith said.

The actual volume of molten magma is between 200 to 600 cubic km (50 to 145 cubic miles), he said.

The reservoir is shaped like a dog's knobby chew toy, with one end about 9 miles (15 km) below the center of Yellowstone National Park, and the other rising to the northeast, about 3 miles (5 km) below the surface.

The shallow end extends 12 miles (20 km) northeast of the caldera rim created 640,000 years ago, Smith said. That distance matches the total tectonic drift of the North American plate over the Yellowstone mantle plume since that time, he said.