Computer shows plume of hot rocks didn't form Yellowstone's supervolcano

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The Grand Prismatic Spring in Yellowstone National Park is the largest hot spring in the United States, and the third largest in the world. Below the hot springs at Yellowstone lies a sleeping supervolcano. Wikipedia

A supervolcano sleeps deep beneath Wyoming's Yellowstone National Park. The supervolcano is not expected to erupt or explode anytime soon. If it did, though, the eruption would be powerful enough to blanket the western U.S. with ash.

Scientists have long debated the origins of the Yellowstone supervolcano. The most popular idea was that it was formed by a mantle plume. Such plumes shoot columns of hot rocks from deep below the Earth's crust to the surface. A mantle plume is what many people think of when they imagine a volcano erupting.

A new computer test, or simulation, shows that this popular idea is wrong. The simulation shows that a mantle plume could not have reached the surface at Yellowstone. The plume would have been blocked by a slab of rock from an ancient tectonic plate. These plates are huge, moving pieces of the Earth's crust.

Looking Back At History Through A Computer

Lijun Liu is a geologist at the University of Illinois at Urbana-Champaign. He studies the Earth and how it works. He built the computer simulation with his student Tiffany Leonard. After entering information about Yellowstone into a computer, the simulation re-created the history of the supervolcano. The simulation went as far back as 40 million years ago. It recreated volcanic activity in the area around Yellowstone.

No matter how they changed the settings of their simulation, Liu and Leonard could not re-create most of the recent volcanic eruptions. The reason for that is simple. It is hard to get anything, even a mantle plume, past a giant slab of rock. “Slabs are the bully,” says Eugene Humphreys, a University of Oregon scientist. “Plumes are just pretty wimpy in comparison.”

Slab Sinks, Clamps Lid On Magma

The slab of rock was once part of a larger tectonic plate. It was part of one of the many plates that make up the surface of the Earth. This slab of rock was pushed deep into the Earth’s mantle about 100 million years ago. As the slab sank downward, the hot and semi-liquid rocks of the mantle flowed around it.

The simulation shows that 15 million years ago the slab began to break. A hole formed in it. A mantle plume below the slab shot through the hole. This plume created a huge flow of those hot and semi-liquid rocks, called magma, on the Earth's surface. Evidence of this magma flow remains visible in many states close to Yellowstone.

The simulation stops matching what is visible on the Earth's surface after that. There may have been a hole in the sunken slab, but the plume did not continue to rise through it. That is because the mantle is thick, like honey. As the slab sank, it pulled the surrounding mantle down around it. This mantle eventually sealed the hole in the slab. The slab became a lid over the plume, blocking it from reaching the surface again.

Research Shows Theory Of Caldera Is Not Correct

Knowing that the slab blocked the plume changes our understanding of Yellowstone. It shows that the theory that a mantle plume created the Yellowstone supervolcano is wrong. Scientists need to come up with a new idea of how Yellowstone was formed, Liu said.

Liu's team needed to find another heat source for the supervolcano. Leonard thinks this could come from the Juan de Fuca ridge. The Juan de Fuca ridge is a volcanic area in the Pacific Ocean near America's West Coast. It is 1,600 kilometers (nearly 1,000 miles) away from Yellowstone. Even at that distance, the ridge can still affect the park.

The ridge lies at the western edge of the Juan de Fuca tectonic plate. Millions of years ago the Juan de Fuca plate was likely pushed under the North American plate. This would have created a string of volcanic eruptions. It eventually would have helped form Yellowstone's supervolcano.

Scientists will continue to argue over how Yellowstone was formed. However Liu's simulation makes one thing clear: Slabs are much more important than scientists previously thought.

Quiz

1 Based on information in the article, which of these statements is TRUE?

(A) The Juan de Fuca ridge is clearly what led to the supervolcano at Yellowstone.

(B) The computer simulations show that there has never been a mantle plume at Yellowstone.

(C) There was one mantle plume at Yellowstone, but then it was blocked by a giant slab of rock.

(D) The computer simulation showed scientists exactly how Yellowstone was created.

2 A mantle plume cannot explode if it is covered by a slab of rock.

Which selection from the article BEST supports this idea?

(A) It is hard to get anything, even a mantle plume, past a giant slab of rock.

(B) The slab of rock was once part of a larger tectonic plate.

(C) This slab of rock was pushed deep into the Earth's mantle about 100 million years ago.

(D) There may have been a hole in the sunken slab, but the plume did not continue to rise through it.

3 Which of the following BEST summarizes the main idea of the article?

(A) Scientists have long debated the origins of the Yellowstone supervolcano. The most popular idea was that it was formed by a mantle plume.

(B) About 100 million years ago, the tectonic plates shifted, pushing a giant slab of rock deep into the Earth's mantle. This slab of rock was very important.

(C) Some people think that the main heat source for the supervolcano is actually the Juan de Fuca plate being pushed under the North American plate.

(D) Scientists used a computer simulation to learn that the supervolcano was not created by mantle plumes, because there is a giant slab of rock in the way.

4 Which excerpt from the article would be MOST important to include in a summary of the article?

(A) The simulation shows that a mantle plume could not have reached the surface at Yellowstone.

(B) Lijun Liu is a geologist at the University of Illinois at Urbana-Champaign. He studies the Earth and how it works.

(C) “Slabs are the bully,” says Eugene Humphreys, a University of Oregon scientist. “Plumes are just pretty wimpy in comparison.”

(D) The slab of rock was once part of a larger tectonic plate. It was part of one of the many plates that make up the surface of the Earth.