Fossil supervolcano in Italian Alps may answer deep mysteries around active supervolcanoes

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Jim Quick studying geologic map

There's nothing subtle about the story told by the rocks in northern Italy's Sesia Valley. Evidence of ancient volcanic activity is all around, says geologist and volcanologist James Quick, Southern Methodist University, Dallas.

But the full story is much less obvious, Quick notes.

Quick led an international team that in 2009 announced they had discovered a 282-million-year-old fossil supervolcano in Sesia Valley. The find was the result of nearly two decades of geological research in the valley and its surrounding mountains.

The discovery has attracted scientific attention worldwide for its unprecedented view of a supervolcano's internal plumbing to a depth of 15.5 miles.

But that's not the end of the story—rather the beginning, says Quick, a professor in SMU's Roy M. Huffington Department of Earth Sciences in Dedman College of Humanities and Sciences.

The supervolcano holds clues—and ultimately answers—to critical scientific questions about the processes by which volcanoes erupt.

"I am certain that continued study of this unique geologic exposure will reveal significant insight into the operation of active supervolcanoes," he says.

There are six active supervolcanoes in the world, including Yellowstone, Long Valley and Valles in the United States.

Volcanic plumbing, normally hidden from examination deep within the earth, is the internal geological structure through which lava migrates from the earth's mantle, up through the crust, to ultimately explode.

Volcanic plumbing and the processes within it remain matters of speculation, as volcanologists explore how lava forms and traverses through the earth.

News of a supervolcano initially sparked alarm

Supervolcanoes are one of the most potentially violent events in the world. They erupt hundreds of cubic miles of lava and ash, and have caused catastrophic changes in global climate.

Sesia Valley's supervolcano last erupted 282 million years ago, when it erupted more than 186 cubic miles of molten rock, ash and gas.

The discovery by Quick and scientists from the University of Trieste made headlines worldwide in 2009. Sesia Valley residents were alarmed.

"They held a big town meeting in the largest of the communities, Borgosesia, and more than 500 people came from all over the valley," Quick says. "People were extremely worried the volcano would erupt again."

The scientists reassured residents they had nothing to fear. A fossil, the supervolcano no longer poses a danger.

Supervolcano is a super attraction for its scientifically unique features

Now its rocks are a popular destination for scientists, college students, villagers, tourists and school groups. Proud residents enthusiastically brand many of the valley's events and activities with their supervolcano identity.

Sesia Valley mountains

Even acclaimed Italian winemaker Cantalupo in 2013 honored the unique volcanic origins of its Sesia Valley grapes by labeling its Christmas wine with a painting of the exploding supervolcano.

The supervolcano also is a central feature of the new Sesia-Val Grande Geopark, recently designated by the U.N.'s UNESCO agency.

Residents of the Piedmont region's Sesia Valley, with diverse history and cultures, joined forces after the discovery was announced to pursue the coveted UNESCO geopark status. One of only 100 geoparks in the world, Sesia-Val Grande Geopark spans tens of thousands of acres and more than 80 Alpine communities.

Chaotic riverbed blocks are key to solving volcanic rock puzzle

Rock strata of the Sesia Valley supervolcano are exposed along the banks of the Sesia River for 22 miles, sitting sideways like a tipped-over layer cake. In some places, the rocks protrude haphazardly from the sides of mountains; in other places they are obscured beneath dense forest, roads, bustling villages, fields and pastures, outdoor sports locales and tourist destinations.

Some of the supervolcano's deepest sections serve as a backdrop for Varallo, one of many communities in the Alpine valley.

Granite boulders littering the bed of the Sesia River were formed in the supervolcano's magma chamber.

Atop a hill overlooking Varallo, more than 40 chapels of the 15th century world-famous monumental religious complex Sacro Monte di Varallo were built on the furnace that powered the volcanic system.

So how did an entire valley not see an ancient fossil supervolcano until now?

Like an ant looking at an elephant, it's difficult to see something so gigantic for what it really is. In the United States, for example, it's only in about the last 30 years that geologists deciphered that Yellowstone is a supervolcano.

Scientists have known for more than a century, however, about the presence of volcanic rocks in Sesia Valley.

That's what drew Quick to the area in 1989. He sought insight into the processes in the deep crust that influence eruptions. What Quick found kept him coming back every summer for 16 years, including as head of the Volcano Hazards Program for the U.S. Geological Survey.

Quick's quest made him the first scientist in more than 50 years—building on the work of Italian geologist Mario Bertolani before World War II—to methodically tramp every mile of the steep mountainsides, sometimes with colleagues, often alone, to extensively identify and map the valley's rocks.

Years of intrepid geological work yield a supervolcano hiding in plain sight

Quick endured pounding rain, fierce lightning, poisonous snakes, mosquitos, treacherous topography, slippery waterfalls and unexpected sheer drop-offs. More than once he feared for his life.

Rock pile

"Working in the mountains there I was frequently terrified," Quick said recently, during one of his frequent treks to the valley. "I'd wonder, is

this the next traverse that claims my life? I had many frightening experiences. The vegetation looks thick, but underneath the canopy it's easy to walk, except there are lots of cliffs hidden by the trees. Another problem—locating your position; because you can't look out and see the topography. We started this before GPS, doing it old school, by triangulation, reading the map, carefully locating where we were, and using altimeters."

Summer 2005 brought an unexpected breakthrough.

Quick was invited by his Italian colleague to see some puzzling rocks in the riverbed of the Sesia River in hopes he could identify them. Upon seeing the chaotic assemblage, Quick recognized the rocks were gigantic blocks torn from the rim of the volcano and mixed with volcanic ash during the eruption—an assemblage geologists call a megabreccia.

In 2009, following additional work to confirm the discovery, Quick and his team announced their discovery in the scientific journal "*Geology*." They estimated the mouth of the volcano when it was active would have been at least eight miles in diameter, although its true size will never be known because much of it is covered by younger sedimentary deposits of the Po Plain.

Fossil supervolcano sits against ancient boundary separating Africa, Europe

In its youth, Sesia Valley's supervolcano was inland on the supercontinent of Pangea. When Pangea began to break up into smaller continents more than 200 million years ago, the supervolcano was stranded on the coast of what we now call Africa.

About 20 million years ago, another tectonic shift sent Africa colliding

into southern Europe. The coastal edges of both continents were heaved upward, creating a massive uplift – the Alps.

The Sesia Valley supervolcano, in the process, was tilted sideways and shoved upward, exposing its plumbing.

Today the supervolcano is a mecca for geologists not only for its volcanic story, but as one of the best samples of the earth's mantle exposed at the surface.

Calling it the "Rosetta Stone" of supervolcanoes, Quick says the Sesia Valley fossil supervolcano ultimately could solve the mystery, "How does magma build up in the crust in the run up to a supereruption?"

Quick honored for scientific achievements

In 2010 the Italian Geological Society awarded Quick the Capellini Medal, presented to foreign geoscientists for a significant contribution to Italian geology.

In 2013, Quick was named a Fellow of the American Association for the Advancement of Science. Along with his Italian colleague, Silvano Sinigoi, Quick also was awarded honorary citizenship of Borgosesia, the highest award given to civilians by the largest city in the Sesia Valley.

"The discoveries in the Sesia Valley demonstrate the value of supporting basic research," says Quick, who came to SMU in 2007 after a 25-year scientific career with USGS. Quick serves also as associate vice president for research and dean of graduate studies at SMU.

Provided by Southern Methodist University