Rock of ages: Clues about Mars evolution revealed

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Tom Lapen and his colleagues' data showed that the true age of ALH84001 is about 400 million years younger than earlier age estimates. Credit: Thomas Campbell

Through the study of a popular Martian meteorite's age, a University of Houston professor and his team have made significant discoveries about the timeline of volcanic activity on Mars.

Thomas Lapen, assistant professor of geosciences at UH, describes his team's findings in a paper titled "A Younger Age for ALH84001 and its Geochemical Link to Shergottite Sources in Mars," appearing April 16 in *Science*, the world's leading journal of original scientific research, global news and commentary.

ALH84001 is a thoroughly studied, well-known Martian meteorite. This stone is unique among Mars rocks available for study on Earth, since its formation age is more than 2.5 billion years older than any other recognized Martian meteorite, giving scientists the only sample of material formed early in Mars' history. Data from this rock may help geologists better understand, through analogy, the processes of early Earth evolution.

Lapen and his colleagues' data showed that the true age of this meteorite is 4.091 billion years old, about 400 million years younger than earlier age estimates. They concluded that this stone formed during an important time when Mars was wet and had a magnetic field, conditions that are favorable for the development of simple life. This finding precludes ALH84001 from being a remnant of primordial Martian crust, as well as confirming that volcanic activity was ongoing in Mars over much of its history.

"This research helps us better refine the history of Mars," Lapen said. "This has huge ramifications for our understanding of volcanic processes active in Mars and for the nature of deeper portions of the planet that are sources of magmas that produced the largest volcanoes in the solar system. These data also are used to refine models of initial planetary formation and early evolution."

With the crystallization age and formation of this rock being debated since its discovery in 1984, Lapen and his team seized an opportunity to better refine the early history of Mars. With samples provided by the NASA Antarctic meteorite curator and the meteorite working group, the researchers used a relatively new method that has never been applied to this stone - lutetium-hafnium isotope analysis.

"We studied variations in isotopic compositions of minerals to determine the age and sources of magmas that produced these rocks," Lapen said.

"We uncovered evidence that the volcanic systems in Mars were likely active more than four billion years. This connection allows the possibility that regions with the largest volcanoes in the solar system perhaps host some of the longest-lived volcanic systems in the solar system."

In addition to Lapen, the team includes Alan Brandon, an associate professor in UH's department of earth and atmospheric sciences, and their two post-doctoral researchers Minako Righter and John Shafer. Other collaborators were Brian Beard from the University of Wisconsin-Madison and NASA Astrobiology Institute, Vinciane Debaille from the University of Bruxelles and Anne Peslier, a research scientist at Jacobs Technology working at NASA Johnson Space Center.

Provided by University of Houston

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