Oldest direct evidence of hot water activity on Mars found

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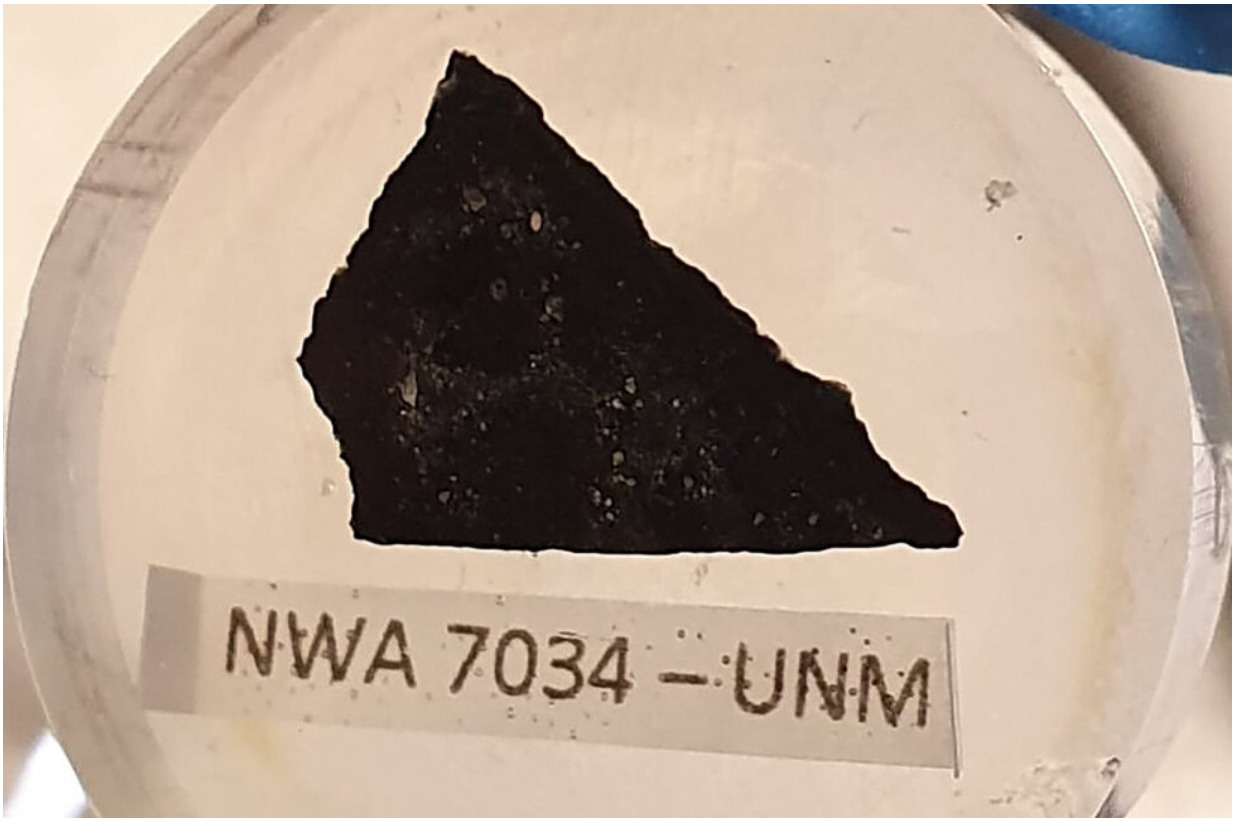

A sample of the Martian meteorite known as Black Beauty. Credit: Curtin University/Aaron Cavosie

New Curtin University-led research has uncovered what may be the oldest direct evidence of ancient hot water activity on Mars, revealing

the planet may have been habitable at some point in its past.

The study analyzed a 4.45 billion-year-old zircon grain from the famous Martian meteorite NWA7034, also known as Black Beauty, and found geochemical "fingerprints" of water-rich fluids.

Study co-author Dr. Aaron Cavosie from Curtin's School of Earth and Planetary Sciences said the discovery opened up new avenues for understanding ancient Martian hydrothermal systems associated with magmatism, as well as the planet's past habitability.

"We used nano-scale geochemistry to detect elemental evidence of hot water on Mars 4.45 billion years ago," Dr. Cavosie said. "Hydrothermal systems were essential for the development of life on Earth and our findings suggest Mars also had water, a key ingredient for habitable environments, during the earliest history of crust formation.

"Through nano-scale imaging and spectroscopy, the team identified element patterns in this unique zircon, including iron, aluminum, yttrium and sodium. These elements were added as the zircon formed 4.45 billion years ago, suggesting water was present during early Martian magmatic activity."

The findings are published in the journal *Science Advances*.

Dr. Cavosie said the research showed that even though Mars' crust endured massive meteorite impacts that caused major surface upheaval, water was present during the early Pre-Noachian period, prior to about 4.1 billion years ago.

"A 2022 Curtin study of the same zircon grain found it had been 'shocked' by a meteorite impact, marking it as the first and only known shocked zircon from Mars," Dr. Cavosie said.

"This new study takes us a step further in understanding early Mars, by way of identifying tell-tale signs of water-rich fluids from when the grain formed, providing geochemical markers of water in the oldest known Martian crust."

Lead author Dr. Jack Gillespie from the University of Lausanne was a Postdoctoral Research Associate at Curtin's School of Earth and Planetary Sciences at the time of the study, which was co-authored by researchers from Curtin's Space Science and Technology Centre, the John de Laeter Centre and the University of Adelaide.

More information: Jack Gillespie, Zircon trace element evidence for early hydrothermal activity on Mars, *Science Advances* (2024). DOI: 10.1126/sciadv.adq3694

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