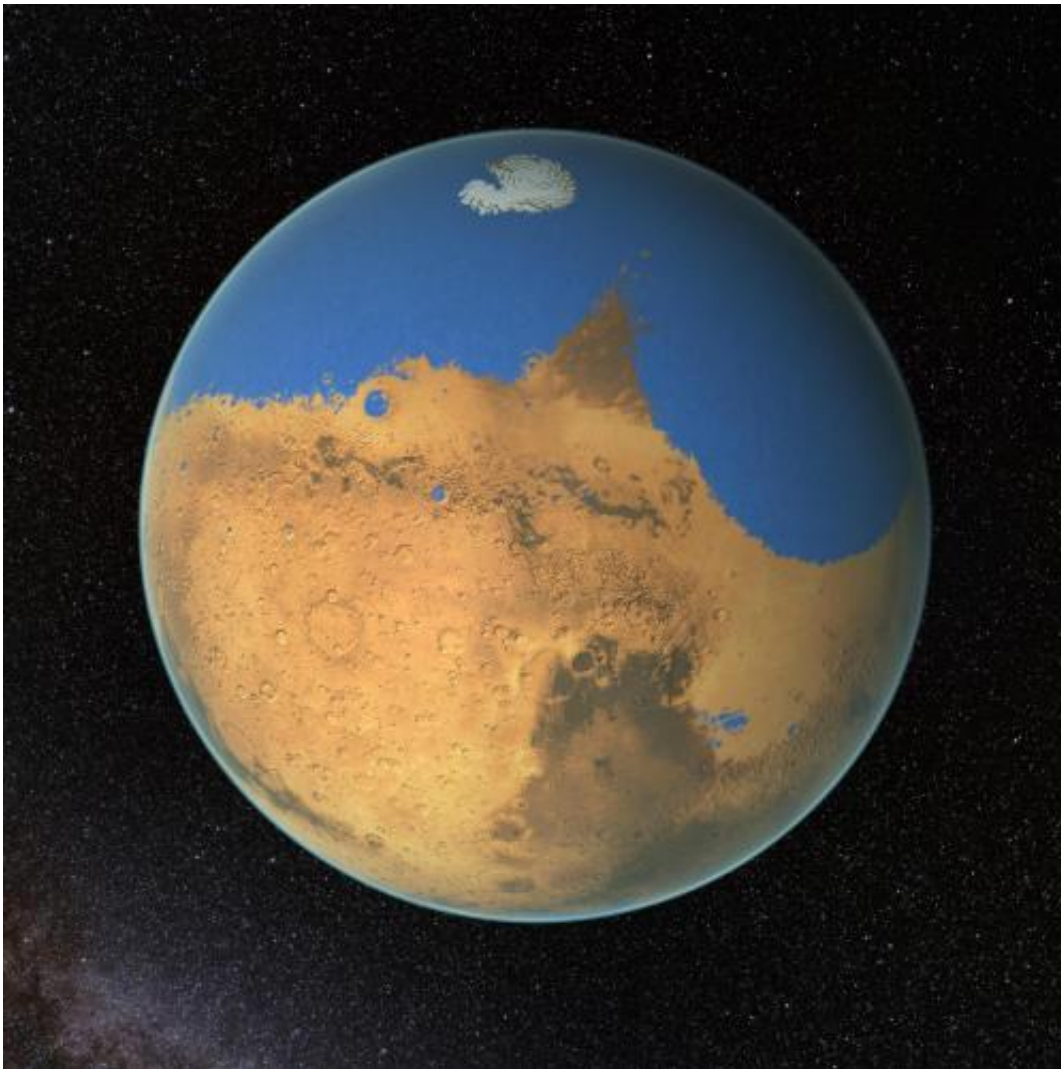


# Research suggests Mars once had more water than Earth's Arctic ocean

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NASA scientists have determined that a primitive ocean on Mars held more water than Earth's Arctic Ocean and that the Red Planet has lost 87 percent of that water to space. Credit: NASA/GSFC

A primitive ocean on Mars held more water than Earth's Arctic Ocean, according to NASA scientists who, using ground-based observatories, measured water signatures in the Red Planet's atmosphere.

Scientists have been searching for answers to why this vast [water](#) supply left the surface. Details of the observations and computations appear in Thursday's edition of *Science* magazine.

"Our study provides a solid estimate of how much water Mars once had, by determining how much water was lost to space," said Geronimo Villanueva, a scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and lead author of the new paper. "With this work, we can better understand the history of water on Mars."

Perhaps about 4.3 billion years ago, Mars would have had enough water to cover its entire surface in a liquid layer about 450 feet (137 meters) deep. More likely, the water would have formed an ocean occupying almost half of Mars' northern hemisphere, in some regions reaching depths greater than a mile (1.6 kilometers).

The new estimate is based on detailed observations made at the European Southern Observatory's Very Large Telescope in Chile, and the W.M. Keck Observatory and NASA Infrared Telescope Facility in Hawaii. With these powerful instruments, the researchers distinguished the chemical signatures of two slightly different forms of water in Mars' atmosphere. One is the familiar H<sub>2</sub>O. The other is HDO, a naturally occurring variation in which one hydrogen is replaced by a heavier form, called deuterium.

By comparing the ratio of HDO to H<sub>2</sub>O in water on Mars today and comparing it with the ratio in water trapped in a Mars meteorite dating from about 4.5 billion years ago, scientists can measure the subsequent atmospheric changes and determine how much water has escaped into

space.

The team mapped H<sub>2</sub>O and HDO levels several times over nearly six years, which is equal to approximately three Martian years. The resulting data produced global snapshots of each compound, as well as their ratio. These first-of-their-kind maps reveal regional variations called microclimates and seasonal changes, even though modern Mars is essentially a desert.

The research team was especially interested in regions near Mars' north and south poles, because the polar ice caps hold the planet's largest known water reservoir. The water stored there is thought to capture the evolution of Mars' water during the wet Noachian period, which ended about 3.7 billion years ago, to the present.

From the measurements of atmospheric water in the near-polar region, the researchers determined the enrichment, or relative amounts of the two types of water, in the planet's permanent ice caps. The enrichment of the ice caps told them how much water Mars must have lost – a volume 6.5 times larger than the volume in the polar caps now. That means the volume of Mars' early ocean must have been at least 20 million cubic kilometers (5 million cubic miles).

Based on the surface of Mars today, a likely location for this water would be in the Northern Plains, considered a good candidate because of the low-lying ground. An ancient ocean there would have covered 19 percent of the planet's surface. By comparison, the Atlantic Ocean occupies 17 percent of Earth's surface.

"With Mars losing that much water, the planet was very likely wet for a longer period of time than was previously thought, suggesting it might have been habitable for longer," said Michael Mumma, a senior scientist at Goddard and the second author on the paper.

NASA is studying Mars with a host of spacecraft and rovers under the agency's Mars Exploration Program, including the Opportunity and Curiosity rovers, Odyssey and Mars Reconnaissance Orbiter spacecraft, and the MAVEN orbiter, which arrived at the Red Planet in September 2014 to study the planet's upper atmosphere.

In 2016, a Mars lander mission called InSight will launch to take a first look into the deep interior of Mars. The agency also is participating in ESA's (European Space Agency) 2016 and 2018 ExoMars missions, including providing telecommunication radios to ESA's 2016 orbiter and a critical element of the astrobiology instrument on the 2018 ExoMars rover. NASA's next rover, heading to Mars in 2020, will carry instruments to conduct unprecedented science and exploration technology investigations on the Red Planet.

NASA's Mars Exploration Program seeks to characterize and understand Mars as a dynamic system, including its present and past environment, climate cycles, geology and biological potential. In parallel, NASA is developing the human spaceflight capabilities needed for future round-trip missions to Mars in the 2030s.

**More information:** Strong water isotopic anomalies in the Martian atmosphere: probing current and ancient reservoirs, *Science*, 2015.

[www.sciencemag.org/lookup/doi/ ... 1126/science.aaa3630](http://www.sciencemag.org/lookup/doi/.../1126/science.aaa3630)

Provided by NASA

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