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ENVIRONMENT & SCIENCE

Rosetta Data Support View That Asteroids Brought Water to Earth

Space Mission's Findings Undercut Theory That Comets Were Main Source of Earth's Water

By **GAUTAM NAIK**

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Findings from Europe's Rosetta spacecraft undercut the theory that most of the Earth's water was brought here by comets, lending new credence to the alternate view that the oceans were seeded by asteroids.

Ever since Rosetta entered into close orbit around a comet called 67P/Churyumov-Gerasimenko in August, it has been analyzing the chemical signature, or makeup, of the comet's gases. One goal was to check whether the comet's water was the same as that found on our planet. If it was, it would support the view that icy comets crashed into the early Earth and brought water for the first time.

But the latest study shows that the chemical signature of water on comet 67P is unlike that on Earth. As 67P is believed to be typical of many comets that originate in the far reaches of the solar system, the findings undermine the view that comets were the main source of water for Earth's oceans.

Some water is made from regular hydrogen atoms, which, in turn, are made from one proton and one electron. But in other cases, the hydrogen is replaced by its heavier isotope called deuterium, which also includes a neutron.

Rosetta's instruments found that 67P's water had a deuterium-hydrogen ratio that is three times that of Earth's water.

"It's not the same as terrestrial water—it's much heavier," said Kathrin Altwegg, physicist at the University of Bern, Switzerland, and lead author of the study,

published Wednesday in the journal Science.

The source of Earth's water has been a long-standing puzzle. About 4.6 billion years ago, the planet was extremely hot and likely harbored little or no water. So where did our planet's vast amount of water come from? The most credible sources are ice-rich comets and asteroids.

By studying the craters found on the moon and elsewhere, scientists theorize that between 4.1 and 3.8 billion years ago a vast number of comets and asteroids peppered Earth and other planets, an event dubbed "the late heavy bombardment." They argue that Earth was seeded with water during this period.

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—Kathrin Altwegg, physicist at the University of Bern, Switzerland

But were
asteroids or
ice-rich
comets the
main
contributor?

There has been a strong case for asteroids. Scientists had shown that the chemical signature of water found in meteorites (which are bits of asteroids) was the same as the signature of Earth's water. Asteroids also were formed between the orbits of Jupiter and Mars—which, in cosmic terms, isn't that far from Earth.

Comets, by contrast, exist much further out in the solar system. Their orbital patterns are extended and far more elongated than the orbits of asteroids, which makes them only occasional visitors to the inner reaches of the solar system. Some studies, such as one published in 1999 on the comet Hale-Bopp, had shown that the water on comets was chemically unlike the water on Earth.

- But in 2011, astronomers studying the water on the comet 103P/Hartley 2 found that it contained water that had the same isotopic composition as Earth's. That was a considerable surprise. It significantly undermined the case for asteroids and bolstered the belief that ice-rich comets had brought water to earth.

With the latest Rosetta results, the pendulum has swung back to asteroids—and quite firmly. "It rules out comets as the dominant source of earth's water," said Geoff Blake, a cosmochemist at the California Institute of Technology, who wasn't involved in the

Science study.

Dr. Altwegg argues that many asteroids—which are typically dry, barren bodies—must have once contained water, too, but lost it over time because of their proximity to the sun. All that is left today is the nonvolatile material that even the sun’s power can’t vaporize.

Scientists now hope to test this theory further. One area of focus will be to study a small subset of asteroids that show comet-like activity. When they fly closer to the sun, these asteroids even develop a comet-like tail, suggesting that they are partially made from icy materials. Is their water the same as the water on earth?

Finding that out “would be the next logical step,” which could go a long way to resolving the puzzle about the origin of Earth’s water, said Dr. Altwegg.

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