TRACKING DOWN THE "MISSING" CARBON FROM THE MARTIAN ATMOSPHERE

Mars is blanketed by a mostly carbon dioxide atmosphere—one that is far too thin to prevent large amounts of water on the surface of the planet from subliming or evaporating. But many researchers have suggested that the planet was once shrouded in an atmosphere many times thicker than Earth's. For decades that left the question, "Where did all the carbon go?"

Now scientists from Caltech and JPL think they have a possible answer. The team suggests that 3.8 billion years ago, Mars might have had only a moderately dense atmosphere. The researchers have identified a photochemical process that could have helped such an early atmosphere evolve into the current thin one without creating the problem of "missing" carbon.

"With this new mechanism, everything that we know about the martian atmosphere can now be pieced together into a consistent picture of its evolution," says Renyu Hu, a postdoctoral scholar at JPL, a visitor in planetary science at Caltech, and lead author on the paper that appeared in *Nature Communications*.

When considering how the early atmosphere might have transitioned to its current state, there are two possible mechanisms for the removal of excess carbon dioxide (CO_2). Either the CO_2 was incorporated into minerals in rocks called carbonates or it was lost to space.

A separate study coauthored by Bethany Ehlmann, assistant professor of planetary science at Caltech, used data from several Mars-orbiting satellites to inventory carbonate rocks, showing that there are not enough carbonates in the upper crust to contain the missing carbon from a very thick early atmosphere.

To study the escape-to-space scenario, scientists examined the ratio of carbon-12 and carbon-13, two stable isotopes of the element carbon that have the same number of protons in their nuclei but different numbers of neutrons, and thus different masses. Comparing measurements from martian meteorites to those recently collected by NASA's Curiosity rover, they found that the atmosphere is unusually enriched in carbon-13. To explain that, they describe a mechanism involving a photochemical cascade that produces carbon atoms that have enough energy to escape the atmosphere, and they show that carbon-12 is far more likely to escape than carbon-13.

"With this mechanism, we can describe an evolutionary scenario for Mars that makes sense of the apparent carbon budget, with no missing processes or reservoirs," says Ehlmann, who is also a coauthor on the Hu study. —*KF*

Insider Info

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