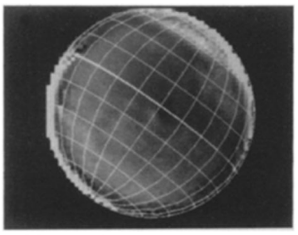
Astronomy

Ron Cowen reports from Houston at the annual Lunar and Planetary Science Conference

Mars: A frosty finding

Astronomers have found the first pictorial evidence suggesting that clouds of carbon dioxide ice reside in the Martian atmosphere.



Bell, Calvin, David Crisp, James Pollack

Mars infrared map depicts absorption likely due to carbon dioxide ice. White patches are areas of highest absorption.

Several theories about the evolution of Mars' climate, which many planetary scientists believe was warmer and wetter in the past, require carbon dioxide gas to condense into ice in the atmosphere, notes James F. Bell III of NASA's Ames Research Center in Mountain View, Calif. But the only previous indication that carbon dioxide ice clouds exist on Mars came from data gathered by infrared spectrometers aboard the Mariner 6 and 7 spacecraft, which flew past the planet in 1969.

The new, ground-based observations seem to confirm the Mariner findings, Bell says. But he adds that his team hasn't entirely ruled out other explanations to account for the strong absorption of a specific wavelength of near-infrared light in the Mars images. However, he notes, carbon dioxide ice absorbs strongly at this one wavelength, whereas water ice absorbs over a broader range of wavelengths.

Bell adds that Martian images, most of which were taken in November 1990 when the north pole of Mars had winter, show that the greatest absorption indeed occurred near the north polar cap. This is what one would expect, he says, if carbon dioxide ice absorbed the near-infrared light, since a thicker layer of the ice would form where the planet is coldest.

He cautions that the images can't distinguish between carbon dioxide frost on Mars' surface and ice clouds in the planet's atmosphere. But the variation in absorption within the polar region suggests that some of the material hovers in the atmosphere.

Bell and his colleagues, including Wendy M. Calvin of the U.S. Geological Survey in Flagstaff, Ariz., used the NASA Infrared Telescope atop Mauna Kea in Hawaii to produce their images. They connected a near-infrared imaging spectrometer called ProtoCAM to the telescope and studied the planet at a wavelength band that included 3.33 microns — an infrared wavelength at which carbon dioxide ice absorbs light.

In a separate study, Calvin and her colleagues reanalyzed the Mariner data. They found evidence that grains of carbon dioxide ice on the Martian surface ranged in diameter from millimeters to several centimeters.

Seeds of life found in dust

Interplanetary dust particles may rank among the oldest materials in the solar system. Now, for the first time, researchers have detected polycyclic aromatic hydrocarbons — a key family of organic molecules — in the dust. The discovery supports suggestions that tiny dust particles from outer space helped seed Earth with the chemicals necessary for life.

Two teams collaborated on the analysis of dust, which was collected by a NASA aircraft. At Washington University in St. Louis, Robert M. Walker and his colleagues measured the abundance of different isotopes of the same element to conclude that the dust truly originated outside Earth. At Stanford University, a group including Simon J. Clemett and Richard N. Zare vaporized and then ionized organic molecules in the dust. Sorting the ions with a mass spectrometer, the scientists concluded that they had indeed detected polycyclic aromatic hydrocarbons.

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Proxima Centauri: Alpha's sibling?

Generations of astronomy students have learned that the red dwarf star Proxima Centauri, the sun's closest stellar neighbor, tours the galaxy locked in a gravitational embrace with Alpha Centauri, a binary star system that shines in the southern hemisphere constellation Centaurus.

Now, two British astronomers are challenging this astronomical tenet. Their recalculation of Proxima's motion through space — based on a widely quoted 1967 measurement — undermines the observational evidence that Proxima orbits Alpha Centauri, a pair of middle-aged stars similar in age and composition to the sun.

Robert Matthews, an amateur astronomer in Oxford, England, performed the labyrinthine calculations at the heart of the new study, described in the March 15 MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY. He and coauthor Gerard F. Gilmore, an astrophysicist at the University of Cambridge, hope their challenge will stimulate wider interest in the Centauri system.

"Our understanding of the nearest star to the solar system is not in the sort of state [of certainty] that one might expect it to be," Matthews asserts.

Discovered in 1915, Proxima lies some 4.22 light-years from the sun — a quick hop in astronomical terms. Because Proxima and Alpha lie near each other and move through the galaxy at similar velocities, most astronomers believe they form a single system.

Initially, Matthews cast his mathematical eye on Proxima to figure out when the star would move far enough through the galaxy to lose its privileged status as our nearest stellar neighbor. But he also discovered a problem with an important and widely accepted measurement of Proxima's motion toward or away from Earth — a quantity called radial velocity. Basing his calculations on the radial velocity cited in textbooks, Matthews found that Proxima may move too rapidly for the double suns of Alpha Centauri to hang on to it.

According to the standard description, Proxima's presumed orbit around Alpha is 330 times larger than Pluto's orbit around the sun. At that distance, Matthews calculates, the velocities of Proxima and Alpha must match within 1 percent for astronomers to conclude that they form a single system. Only a new and more precise measurement of Proxima's radial velocity — accurate to within a few hundred meters per second — can prove what astronomers have taken for granted, Matthews and Gilmore argue.

If Proxima indeed orbits Alpha — and therefore probably arose from the same stellar nursery at the same time — then researchers will have to reconsider certain important theoretical issues, Matthews and Gilmore say. Proxima is a flare star, given to periodic and dramatic surface brightenings. Theory dictates that such stars should cease most flare activity before reaching Alpha's estimated 5-billion-year age. Thus, proof of common lineage and similar age between Proxima and Alpha might encourage astrophysicists to rethink their ideas about flare stars, Matthews says.

"We need to sort out how old Proxima is so we can say something with confidence," he adds. "If a really hard, concerted effort were made [now] with the best technology, I think we could probably sort this out."

It won't be easy, warns Karl W. Kamper of the University of Toronto, who specializes in precision observations of the motions of stars and their distances from the Earth. Kamper says Proxima is so dim and cool that the details of its spectral fingerprint "blend and blur," making it difficult to obtain an unambiguous measurement of its motion. "The fact that Proxima is a very red star makes [the measurement of radial velocity] almost impossible to do," he says.