The Snows of Mars

**NASA scans the polar wastelands.(около 5000 знаков.)**

Mars holds a special place in the human imagination as the planet most like the Earth. It has an atmosphere, seasons, and distinctive polar ice caps. The ice caps, first observed by Giovanni Cassini in 1666, immediately raised tantalizing questions. Are they made of water ice like the giant glaciers that smother Antarctica? Are they the frozen remains of long-vanished oceans? If they melted, could Mars become a habitable place? NASA's Mars Global Surveyor, currently in orbit about the Red Planet, is finally providing some solid answers.

The Surveyor has already revealed unexpected details about the size and structure of Mars's northern cap. By the end of February, the spacecraft will begin mapping, for the first time, the topography and composition of the even more poorly understood southern polar ice cap. The new information (along with upcoming data from the Mars Polar Lander, which will arrive in December) will strip away many of the lingering mysteries of the Martian poles.

On Mars, the presence of water--essential for life, past or present--is always an issue of great interest. "Some people have proposed that there were oceans early in Martian history; others have said there were not. "But for all of those theories, one needs to understand the water cycle: how much water there was, where it went to, and where it's at now." If scientists find substantial reserves of frozen water, it would bolster the view that Mars was once a balmy, moist world where life could have started.

Until about two months ago, planetary astronomers believed that the southern cap contained nothing but frozen carbon dioxide, also known as dry ice. New research suggests otherwise: a thick sheet of carbon dioxide ice would be too soft to stay stable. "The thought now is that carbon dioxide ice is so weak that it would flow away, like a glacier, even at very low temperatures," Zuber explains. "So to maintain the topography of the south polar cap, there has to be water ice in there stiffening it up."

Zuber and her colleagues also analyzed Mars's much larger northern polar cap. The ice cap is cut by deep troughs and chasms; some of these depressions extend down over a mile to the base of the planet's crust. Many researchers off guard. "There are no troughs of that kind in any of the ice caps on Earth," said Global. "We don't know how this formed

Zuber's results confirmed that the northern cap is composed entirely of water ice, in some areas interspersed with layers of wind-blown dust and sediment. That piece of good news came as no surprise, because summer temperatures at the cap (which has an elevation several miles lower than the southern cap) are high enough to vaporize frozen carbon dioxide. But the Global Surveyor also produced the first accurate measurement of the size of the northern cap--and that was a surprise.

Seven hundred and fifty miles across, and up to two miles thick, the northern cap has a volume just half that of the Greenland ice sheet. It may sound large, but doesn't contain nearly enough water to account for the flood channels and other erosion features that appear all over the place on Mars. "It's not even close to what is generally believed to have once been on the surface," says Zuber. Scientists like Michael Carr at the U.S. Geological Survey who believe oceans once covered much of Mars face a serious challenge from the Global Surveyor studies. The northern cap contains no more than one tenth the amount of water needed to fill an ancient ocean. On the other hand, the fissures and ring of residual ice around the perimeter of the cap suggest it has lost a great deal of water over the millennia.

The Global Surveyor has also provided some clues about the way water circulated about on Mars in the distant past. The northern ice cap sits nestled within a deep depression that covers essentially the entire northern hemisphere of Mars and drops in elevation as it nears the pole. The cap "looks something like a hockey puck in that depression," David Smith of NASA's Goddard Space Flight Center reported at the AGU press conference. Researchers are not sure how the giant lowland formed (perhaps through a large impact), but they do know that it has been there since very early in Martian history, and so has clearly played an important role in the planet's water cycle.

"Before we made these measurements of the northern hemisphere, it used to be thought that the only way you could get water to the north pole of Mars was through the atmosphere," Zuber says. But because the northern cap lies at a lower elevation than the rest of the planet, "water than you put down almost anywhere in the northern hemisphere is going to flow toward the pole. It is quite probable, then, that you once had standing bodies of water at high northern latitudes. They might not have persisted for very long, because we don't know how warm it was and things may have frozen over quickly. But you clearly could get the water up close to the pole."

Clearly, Mars was not always the frozen wasteland it is today. What happened? Some of the ancient water could have been lost to the atmosphere and then, over countless millennia, ejected into space through complicated interactions with the Martian magnetic field. Some might still be locked in aquifers and other formations beneath the surface. And some may exist in the southern polar cap--but not much. The southern cap is significantly smaller than the northern one. Even if the Mars Global Surveyor finds water ice in the south, it won't come close to eliminating the water shortage, according to Zuber.

"We haven't either improved or diminished the possibility of life on Mars," she says. "Essentially, what we have done is exacerbate the problem of there being too little water on Mars today compared to where there was earlier. Now those people who have proposed oceans have a bigger task in explaining where the water went."

--Kathy Svitil

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