Global Surveyor maps Mars' northern ice

Greg Shirah/SVS

Close-up of part of Mars' north polar region.

"Her ups, her downs, are second nature to me now." Those are the lyrics Professor Henry Higgins is inspired to sing in "My Fair Lady" after knowing his pupil, Eliza Doolittle, for just a few months.

Astronomers could now say the same thing about Mars, especially the north polar region. Using the Mars Global Surveyor spacecraft, which has orbited the Red Planet for only a year, scientists have become extraordinarily familiar with the most northern parts of Mars and have generated the first accurate, three-dimensional map of the area. Charting the highs and lows of features to an accuracy of 5 to 30 meters, scientists now know the topography of the icy surface, on average, better than they do parts of Antarctica and Greenland.

The volume, shape, and placement of the north polar ice cap appears to hold some puzzles for scientists hoping to understand how water may once have flowed on the Red Planet. Shaped like a hockey puck and consisting mostly of water ice, the cap's total volume now appears to be at the low end of the amount that researchers had estimated. Moreover, the cap lies at the bottom of a bowl-shaped depression 5 kilometers deep and several thousand km wide.

Evidence suggests that over thousands of years, the poles of the planet tip toward and away from the sun. Researchers have proposed that when tipped toward the sun, the caps melt and some water migrates toward the equator. The equator is crisscrossed with channels, now dry, that indicate that water once coursed through the area.

"The [new] finding raises significant questions about how water could have flowed from the poles to the equator," says study coauthor James W. Head of Brown University in Providence, R.I.

"You'd need a lot of hydrostatic pressure to push water [out of the bowl] toward the equator, 5 kilometers uphill," adds Maria T. Zuber of the Massachusetts Institute of Technology and NASA's Goddard Space Flight Center in Greenbelt, Md. The possibility that liquid water once collected in the bowl-shaped region makes it a promising place to search for past life, she adds. Zuber, Head, and their colleagues reported their work this week at a meeting of the American Geophysical Union in San Francisco. Details appear in the Dec. 11 SCIENCE.

The team relied on Surveyor's laser altimeter, a device that measures elevation by beaming laser pulses toward the planet and measuring how long they take to reflect back to the craft. To construct their map, Zuber's team assembled some 2.6 million laser measurements taken last spring and summer.

The researchers found that the cap straddles an area about 1.5 times the size of Texas, or half the size of the Greenland ice cap. It contains only about one-tenth the minimum volume of water that may have existed as an ocean on Mars several hundred thousand years ago.

Where did the rest of the water go? Some may have evaporated into space or migrated to the much smaller southern polar cap, and a substantial amount may have seeped underground. "Researchers now have to do deal with the fact that there's a lot more lost water to account for," says Zuber. "We've created a bigger problem—a larger gap between the present and past [amounts of] water."

Victor R. Baker of the University of Arizona in Tucson maintains, however, that most of the water on Mars today probably lies underground. The northern cap, by itself, may not play a large role in the flow of water, he says. Stephen Clifford of the Lunar and Planetary Institute in Houston notes that the present-day cap may be only 100,000 years old and may better reflect current conditions than the forces that conspired to produce an ocean long ago.

Mounds of ice, several kilometers in length and as much as 1 km in depth, lie near the cap. These features could be remnants of a larger cap, dating from the last time that colder temperatures prevailed at the north polar region, Zuber says. An even higher-resolution map of the north pole and the first map of the south pole are expected once Surveyor settles into a circular orbit next spring. *—R. Cowen*

Carbon gourds hold gas, not water

If sheets of graphite can wrap themselves into balls, tubes, and onions, as researchers have found, why not into gourds?

Zhong Lin Wang and his colleagues at the Georgia Institute of Technology in Atlanta have discovered that carbon can indeed take on such a structure, which they are calling a calabash. Consisting of two carbon spheres joined at the hip, it looks much like the dumbbell-shaped gourds that people use to carry water in many parts of the world, Wang says.

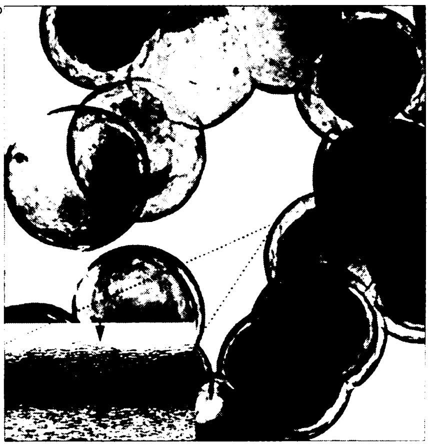
The newly discovered carbon structures are about 0.5 micrometer across, 1,000 times larger than buckyballs. Through an electron microscope, the researchers can see that some of the calabashes are hollow, while others have solid cores. Wang described the calabashes last week at a meeting in Boston of the Materials Research Society.

To make the calabashes, the scientists allow methane gas to flow over a powdered catalyst placed at one end of a quartz tube. They heat the tube gradually to 1,000°C. The methane decomposes, and carbon spheres and calabashes form on the walls of the tube.

The researchers detected the calabashes after changing the catalyst they ordinarily use to make pure carbon spheres. With the new catalyst, about 90 percent of the structures created are spheres, 5 percent are calabashes, and the remainder form a variety of shapes. Wang and his team are currently trying to improve the yield. "We need to make larger quantities to do [additional] spectroscopy" to learn more about their chemical properties, he explains.

The calabashes appear to be much like carbon onions, structures with concentric graphite layers, being studied for use in hard coatings (SN: 8/31/96, p.139), says Jagdish Narayan of North Carolina State University in Raleigh. Calabashes, however, would probably be tapped for other applications.

Like their namesake, the carbon calabashes could be used to carry things. Wang's group has found oxygen gas trapped inside some of the hollow structures. If the calabashes could trap other gases—hydrogen, for example—they might serve as portable storage for gaseous fuel. *—C. Wu*



Wang

Carbon calabashes about 0.5 micrometer in diameter can be hollow or filled, as shown by this transmission electron micrograph. Graphite layers form the 8-nanometer-thick walls (arrows in inset).