Martian close-up images tell a watery tale

The sharpest images of Mars ever recorded from an orbiting spacecraft suggest that two ingredients deemed necessary for life—water and a source of heat—were once plentiful on or just beneath the surface of the Red Planet.

Planetary scientists have known since the 1970s, thanks to images taken by the Mariner 9 and Viking Orbiter spacecraft, that dried-up channels crisscross much of the Martian surface. Scientists agree that some channels are the result of flash floods, but the resolution of these images is too poor to determine whether a steady flow of water could have carved any of the features.

The new pictures provide the first compelling evidence that in some regions liquid water flowed on the surface for an extended period, perhaps millions of years. The pictures were taken by the Mars Global Surveyor spacecraft during the past year as it descended through the planet's upper atmosphere. Surveyor is scheduled to begin its main 2-year mission, compiling a global map of Mars, on March 8.

The narrow, wandering paths of several dry channels seen by Surveyor's camera "are much more supportive of sustained erosion, sustained water flow" than of floods, says Michael H. Carr of the U.S. Geological Survey in Menlo Park, Calif.

One striking example, he notes, is a 200-meter-wide trough that Surveyor spied at the bottom of a canyon called Nanedi Vallis (SN: 2/7/98, p. 84). "It certainly looks as though we have a river channel that meandered across a plane and [that] the flow was sustained so that the meander got deeper and deeper."

Carr and his colleagues, including Michael C. Malin of Malin Space Science Systems in San Diego, describe these and other findings in the Feb. 18 NATURE.

The Surveyor pictures also indicate that the water that once filled these channels came from underground, probably frozen, reservoirs rather than rain or snow falling from the atmosphere. Precipitation would have created an abundance of tiny tributaries as well as larger channels, but Surveyor's camera has found a dearth of the small structures.

"It's clear the source [of water] is beneath the surface," comments Maria T. Zuber of the Massachusetts Institute of Technology.

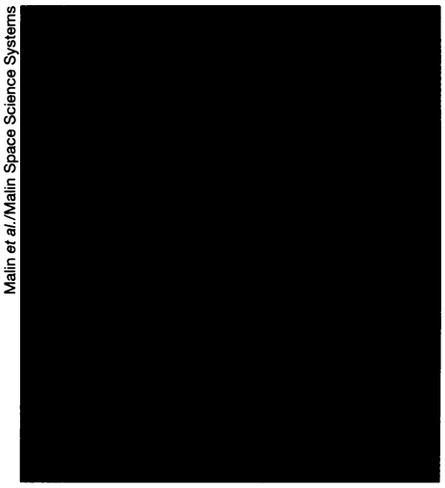
Other Surveyor findings may explain how frozen water in underground reservoirs could have melted and come to the surface. Using the images to examine in unprecedented detail a 4,000-kilometer-long Martian canyon called Valles Marineris, Alfred S. McEwen of the University of Arizona in Tucson and his colleagues found that thick layers of material form the canyon's walls.

The researchers, who include Malin, Carr, and William K. Hartmann of the Planetary Science Institute in Tucson, suggest that the layers were mainly formed by volcanic lava. If their hypothesis is correct, Mars was much more volcanically active during its first billion or so years than scientists have thought.

Frequent and widespread volcanic activity could have melted underground deposits of frozen water that then found their way to the surface, notes Steven W. Squyres of Cornell University.

Hartmann and his colleagues also have tentative evidence that some volcanic eruptions might still be going on today. Using Surveyor images to count the number of small craters, an indicator of how long ago a volcanically active region last erupted, Hartmann finds that some places on Mars spewed lava within the past 100 million years. He describes the findings both in NATURE and the March METEORITICS AND PLANETARY SCIENCE.

If volcanism is continuing—even in just a few small regions—it could up the odds that some places on Mars have hot springs not far from the surface, offering "nice, hot water for microbes," Hartmann says. *—R. Cowen*



Malin *et al.*/Malin Space Science Systems

Layered material along the walls of the canyon Valles Marineris could be a sign of copious volcanic activity on early Mars.

New combination vaccine may fight malaria

The human immune system faces a losing battle in fighting off the parasites that cause malaria. The invaders metamorphose through four different stages as they assail the body—expressing different genes and surrounding themselves with different proteins at each stage. An immune-system attack against one form leaves the others unscathed. In an effort to counter this insidious disease, researchers have constructed a vaccine that could allow the immune system to find and fight the parasite on 21 different fronts.

The need for new measures has become more urgent as malaria parasites, including the deadly *Plasmodium falciparum*, have developed resistance to drugs (SN: 11/29/97, p. 340). Worldwide, the incidence of malaria is increasing—the World Health Organization estimates that 300 million to 500 million people fall ill each year and as many as 3 million die.

To protect the 40 percent of the world's population living in malarial zones, a vaccine should hit *P. falciparum* in all its guises, says immunologist Altaf A. Lal of the Centers for Disease Control and Prevention (CDC) in Atlanta. Lal and his colleagues report their work on the new vaccine in the Feb. 16 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

"Even if you have 99 percent protection against one stage, the one or two [parasites] that escape that layer of immunity are going to cause full-blown disease," he says. The parasites enter the body through a mosquito bite, proliferate asexually in the liver, invade red blood cells, and reproduce sexually.

Studies in western Kenya have shown that if children survive to age 10 in malaria-infested areas, they build up enough varied antibodies to resist the disease's worst effects. These antibodies recognize short protein parts, or epitopes, that adorn different stages of the parasite.

Researchers led by Ya Ping Shi of CDC chose bits of *P. falciparum* DNA that encode many of these epitopes. They created a synthetic gene by stringing together 21 fragments representing all four parasite stages.

The researchers then produced the composite protein encoded by the synthetic malaria gene and immunized rabbits with it. The rabbits produced antibodies to all stages of *P. falciparum*. Test-tube studies showed that these antibodies fought the parasite effectively.

Next month, CDC researchers will begin testing the vaccine's efficacy in primates. Other vaccines targeting multiple stages are also in the pipeline, says Lal.

Immunologist Louis H. Miller of the National Institute of Allergy and Infectious Diseases in Bethesda, Md., is cautious about the prospects for any single approach. "Malaria is getting worse," he says.

In the 1950s, mosquitoes were felled by pesticides, and the drug chloroquine controlled malaria in people who received it. Both the insects and the disease they carry have bounced back, and the epidemic continues to grow. Future control programs will have to combine a variety of effective strategies against the disease—drug treatments, mosquito eradication, and vaccines—Miller says. *—L. Helmuth*