Solid-ice volcanism on Uranian moons

The ice-clad satellites of Jupiter, Saturn and Uranus, photographed over the last decade by the Voyager spacecraft, introduced a whole new category of planetary bodies to observers on Earth — neither bare, rocky surfaces nor deep, dense atmospheres. A major question has been why many places on these satellites look as though they have been resurfaced — smoothed over, cracked or otherwise modified — when the energy sources thought responsible for such changes seem conspicuously absent.

Now a careful study of Voyager 2's closeup photos of the Uranian moons, taken in 1986, has yielded another possibility. According to David G. Jankowski and Steven W. Squyres of Cornell University, reporting in the Sept. 9 SCIENCE, the pictures reveal the first observational evidence for "solid-ice volcanism" on any objects in the solar system.

The researchers base their conclusion primarily on findings about two of the satellites, Ariel and Miranda. One example is a canyon-like feature on Ariel called Brownie Chasma, which resembles a "graben," a crack formed when the surface is pulled apart. Ariel's density (measured by its effect on Voyager 2's trajectory when the spacecraft flew by) suggests its composition is more than half ice, and one might expect that material rising through the crack would be in the form of liquid that would form a flat surface before it froze. The liquid, after all, should find its own level.

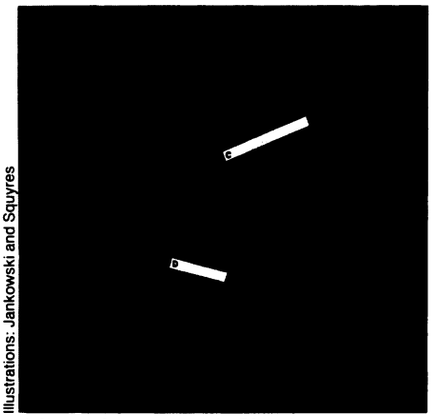
Instead, however, the floor of the chasm is anything but level. Measuring the brightness of sunlight reflected from different parts of the terrain, the scientists used a technique called photoclinometry to determine differences in the surface elevation. Rather than lying flat between the walls, which are about 50 miles apart, the chasm floor bulges up into a round-topped ridge or linear hill about a mile high.

How could a liquid, mostly water, form what amounts to a pile? The answer, Jankowski and Squyres conclude, is that it was not a liquid at all, but a plastic ice. Oozing up through the crack, it held itself together instead of simply running out over the surface, and at Ariel's estimated surface temperature of about -203°C, it simply froze that way.

The limited Voyager photos offer only a few areas in which lighting angles allow photoclinometry studies, but a few other sites show the same kind of ridged floors. In addition, the researchers note, both Ariel and Miranda preserve places where the leading edges of icy flows along the surface are convex, curving downward toward the level surface beneath them rather than lying flat against it even when they are not trapped between canyon walls. The implication is that the flows, unlike water running along a ditch, were simply so viscous that they could not travel enough to flatten out before they froze.

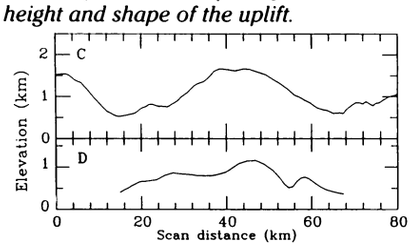
A fundamental question remains: What caused the ice to rise through the cracks in the absence of heat sources such as buried radionuclides and tidal stresses caused by gravitational interactions with Uranus' other satellites? The researchers say one factor could be the presence in the ice of other materials such as ammonia, methane or carbon monoxide. These could affect the density of the pure ice, making it buoyant in relation to the surrounding rock-ice mixture. This idea has been proposed by other scientists, but experimental laboratory tests, the Cornell duo notes, "are sorely needed."

— *J. Eberhart*



Illustrations: Jankowski and Squyres

A linear feature nearly 50 miles wide in this Voyager 2 photo of Uranus' ice-covered moon Ariel resembles a canyon with a level floor, as might have been formed by a layer of liquid that later froze. Close study, however, indicates the floor is convex, piled nearly as high in midcanyon as the walls on either side, as though soft ice were squeezed up from beneath and froze solid before it could flatten out. Profile measurements (below) across two places on the feature (C and D in photo) indicate the height and shape of the uplift.

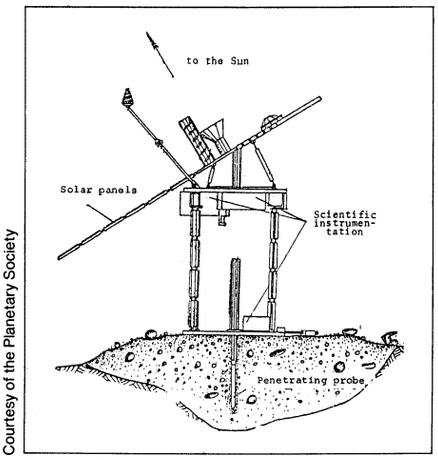


Phobos 1: Trouble on the way to Mars

The first spacecraft sent toward Mars since the two U.S. Viking craft took off in 1975 is in trouble. The Soviet Union's Phobos 1 vehicle, launched on July 7 and due to reach the little Martian moon Phobos in January, went out of control on Sept. 2 after a ground controller sent it an incorrect command.

The craft is one of two in the elaborate mission, designed to photograph, probe and sample its target (SN: 6/18/88, p.392). But Phobos 1's problems affect more than just the Mars mission. Scientists have hoped Phobos 1 would work jointly this month with the Earth-orbiting U.S. Solar Maximum Mission satellite, making stereo images of the sun by looking at it simultaneously from different angles. The U.S.-Soviet collaboration has been anticipated as a major activity in a 13-country effort called the International Solar Month (SN: 8/27/88, p.134).

Phobos 1 and Phobos 2, launched July 12, are similar but not identical. Phobos 1, for example, is the only one equipped with the white-light coronagraph and X-ray telescope envisioned for the solar observations. It is also the only one carrying an extreme ultraviolet solar emissions detector, as well as a neutron spectrometer whose measurements could help researchers judge the water content of Martian rocks. Phobos 2, on the other hand, has the mission's only "hopper," designed to be deposited on the moonlet's surface, where it will jump from place to place on spring-loaded legs, making measurements at the different sites.



Courtesy of the Planetary Society

Even if Phobos 1 does not survive its trip to the Martian moon, a landing craft (different from the hopper) designed to anchor itself to the surface is duplicated on Phobos 1 and 2.

Phobos 1's problem appeared when the craft apparently lost its proper orientation and began following a conical wobble, so that its solar panels failed to pick up enough energy to sustain even its transmitter. Nothing had been heard from the craft as recently as Sept. 14, but officials were hoping the solar panels might get properly aligned with the sun later this month to restore power.

— *J. Eberhart*