Tethys: The iciest moon?

The ice-rich moons of Jupiter and Saturn, revealed in the past two years by the Voyager spacecraft, represent a whole new category of satellites in planetary scientists' experience, differing inside and out from the rocky bodies of the inner solar system. And Saturn's moon Tethys, whose density appears to be the lowest of all the solar-system objects for which reasonably precise measurements exist (except gaseous Saturn itself, which would float if placed on a big enough ocean), may be the iciest of all.

The lower the density, the more ice and less rock, and according to the Voyager team, the density of Tethys is a low 1.0 ± 0.1 grams per cubic centimeter (compared to Rhea at 1.35, Dione at 1.45 and Mimas at 1.2). One gram, in fact, is also the weight of a cubic centimeter of liquid water, which might seem to suggest that Tethys is water through and through, but the situation is not quite that extreme. Water ice is less dense than the liquid variety, and it has been estimated that a ball of solid water ice the size of Tethys (diameter 1,050 ± 20 km) would have an overall density of only about 0.93 g/cc, so the Voyager measurement still leaves room for the presence of a rocky core.

Indeed, Ray Reynolds of the National Aeronautics and Space Administration's Ames Research Center in California calculates that if the rock in Tethys has the same density as Jupiter's apparently water-free moon Io (3.5 g/cc, more dense than earth's moon), the satellite could have a core 316 km in diameter. Such a core would embody nearly a tenth of Tethys' mass, and could be larger still if the rock is less dense, or if the overlying ice is fractured (reducing its bulk density) or contains lighter-weight ices such as methane or ammonia. Still, it would be significantly smaller than that of nearby Dione, a satellite that has a similar diameter (1,120 ± km) but about a 50 percent greater density. And it is possible, says Laurence Soderblom of the U.S. Geological Survey in Flagstaff, Ariz., that the difference could make itself felt all the way to Tethys' surface—as he believes Voyager 1's photos may show.

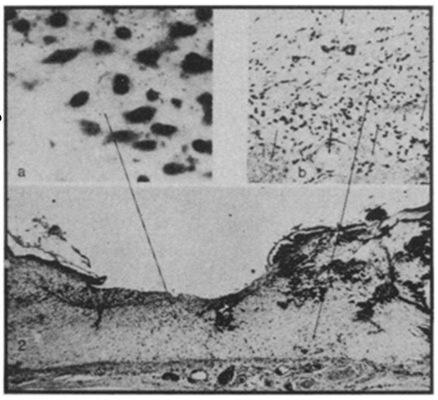
Now the photos have been combined into a map (see pp. 172-173) by the USGS Branch of Astrogeologic Studies, showing the imaged portion of Tethys minus the effects of camera distortion and shadowing. An International Astronomical Union committee is still in the process of approving official names for surface features, but the features are there to see.

Most conspicuous is a vast groove stretching as much as a third of the way around the satellite. In places 100 km wide, it is suggested by shadow measurements to be up to 4 km deep, with a raised rim sometimes a half kilometer high. Such grooves on similar bodies have sometimes been tentatively attributed to cracks created as the object's watery interiors froze and expanded, and Soderblom believes that Tethys' super-crack could have resulted from the greater expansion of its higher percentage of ice (nearly 95 percent by volume in Reynolds's model). The map also suggests to Soderblom that craters on Tethys are deeper for their diameters than craters on Dione, which he says could result from Tethys having a more rigid crust. This could be due to the small size of Tethys' rocky core, possibly a sign that only small amounts of radioactive elements are present to heat the satellite's interior and soften its ice.

Indeed, notes Harold Masursky of the USGS, Jupiter's major icy moons—Europa, Ganymede and Callisto—are all larger and more dense than either Tethys or Dione, and their potentially greater internal heat could be one reason that their surfaces appear much smoother. Yet among Saturn's smaller satellites, he points out, Tethys has its super-crack, Dione and perhaps Rhea show "wispy" features that may have been born of lesser fissures, and even Enceladus (whose 500 ± 20 km diameter makes it barely half the size of Tethys) appears unusually smooth to Soderblom in the limited-resolution photos taken by Voyager 1. So the little moons may be more than passive lumps of ice. "We're now getting to the Antarctic equivalent in the exploration of the solar system," says Masursky, "and the whole game is different."

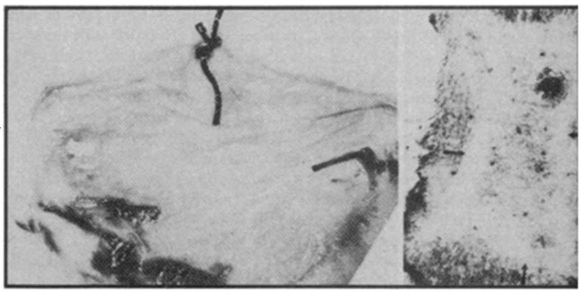
In August, Voyager 2 will fly much closer to Tethys than did its predecessor, photographing the super-crack with as much as 12 times the resolution of Voyager 1 and following it down under the south pole where it may turn out to be even longer and more spectacular than the preliminary map indicates. □

Lab-grown skin for burn victims



Magnification x 130

Photos: Bell/Science



Magnification x 5

Cultured fibroblasts (dark spots) are visible in autoradiograph of one-week-old skin-equivalent graft. Small arrows point to new blood vessels. Photos at right show graphs after 4 days (a) and 50 days (b).

A wide variety of materials have been used to cover burns, including pig skin, cadaver skin and artificial skin made of silicone, collagen and a polysaccharide (SN: 1/3/81, p. 4). But the best covering still seems to be a patient's own skin, a material unfortunately in short supply when the burns cover most of the body.

Recent work in two laboratories at the Massachusetts Institute of Technology has produced methods to supplement a patient's skin supply. Both groups of scientists take cells from the intended recipient, grow them in the laboratory to make a skin-like tissue and then graft the tissue onto the recipient. Such procedures avoid problems of graft rejection; the immune system does not attack the tissue as foreign.

Different types of cells are grown in the laboratory in the two experimental procedures. Eugene Bell, working with H. Paul Ehrlich of Shriners Burns Institute in Boston, cultures fibroblasts, part of the inner layer of skin. Those cells organize a solution of collagen into a tissue-like lattice, and Bell applies epidermal cells, which make up the outer skin layer, to that lattice. He reports in the March 6 SCIENCE that such tissue made with rat cells and grafted onto rats will be supplied with blood vessels and incorporated as are skin grafts from elsewhere on the animal.

In late February Bell attempted the first human graft of a tiny patch of the "skin-equivalent" tissue onto a healthy volunteer. It is too early to tell whether that graft will be successful.

Growing sheets of the outer skin (epidermal) cells is the other new approach to burn coverings. Howard Green of MIT, Nicholas E. O'Connor of Peter Bent Brigham Hospital in Boston and colleagues have successfully grafted such tissue onto burn victims. In work reported in the Jan. 10 THE LANCET skin samples 2 centimeters square from two burn victims were cultured for two to three weeks until the cells formed a sheet across the dish. The sheet was removed, washed and placed directly on the wound area. The lab-grown skin grew to resemble conventional skin grafts and survived the eight-month observation period. In this case the lab-grown tissue made up only a small fraction of the total grafts, but the researchers point out that epithelium could be generated to cover large areas of body surface. □