data will make an impact on survival figures." He predicts that by 1994, the 100th anniversary of the first published description of radical mastectomy in a surgical journal, the procedure will be all but obsolete — an opinion echoed by oncologist Nikolay Dimitrov of Michigan State University in East Lansing.

Others, however, note that despite the encouraging results, women may be slow to trust the experimental regimen. Both Bonadonna and Hendre Falkson of the University of Pretoria in South Africa say all their women colleagues have told them they'd opt for mastectomy with reconstructive surgery rather than worry about the risk of recurrence that might come with lumpectomy. Moreover, Falkson notes that even under Bonadonna's regimen, lumpectomy patients receive six weeks of post-surgical radiation therapy. "Six weeks of radiotherapy is not innocuous treatment," she says.

Emphasizing that only large-scale, prospective trials of various treatments will settle the debate, she decries U.S. doctors' failure to enter their patients in controlled trials where treatment variables can be standardized and results interpreted in statistically meaningful ways. Of the tens of thousands of new breast cancer patients identified each year, she says, only a few hundred enroll in such research protocols. — *R. Weiss*

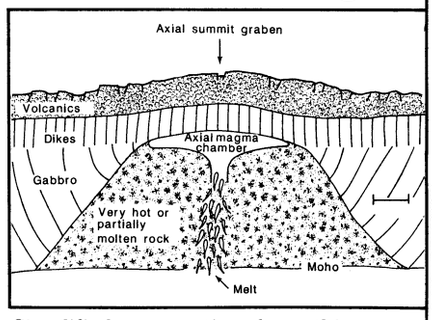
Magma reservoir seen under ocean ridge

In the geophysical equivalent of a CAT scan, scientists have identified key parts of the molten-rock plumbing system underneath a mid-ocean ridge — offering new insight into the process that forms two-thirds of the planet's surface.

Mark S. Burnett, David W. Caress and John A. Orcutt of the Scripps Institution of Oceanography in La Jolla, Calif., used computer tomographic techniques to analyze data from a 1982 experiment, called MAGMA, on the East Pacific Rise off the coast of Mexico. During MAGMA, researchers exploded thousands of charges near the ocean surface, generating seismic waves that traveled through the ocean crust. Instruments on the submerged ridge and the sea floor several kilometers to the east recorded waves that had refracted in rock layers underneath.

Researchers had previously only analyzed slices of the MAGMA data in a "trial and error fashion," says Orcutt. Tomography, used here for the first time to study a ridge, resembles the x-ray technique that produces three-dimensional medical images.

The new analysis helps resolve the structure of the magma—or molten rock—reservoir that feeds sea-floor spreading at the ridge, the researchers report in the May 18 NATURE. The seismic waves reveal that a long region of hot rock, only about 6 kilometers wide, sits underneath the ridge. Because of the way the seismic waves slow as they passed through the area, Orcutt says this hot zone is made of mostly solid rock, containing a small amount of melted material.



Macdonald/Nature

Simplified cross section shows thin magma pool on top of hot rock zone.

A more complete picture of the ridge emerged from combining these results with those from a different type of experiment, using reflected seismic waves. This project had shown that magma lies directly under the ridge at a depth of about 1.4 kilometers, but it could not resolve what sits beneath the magma. The composite results indicate that molten rock forms a thin "mushroom" capping the hot rock zone. The magma chamber itself may only be a few tens of meters thick, Orcutt says.

The new tomographic images in combination with other measurements "provide the best glimpse yet of the axial magma reservoir," says Ken C. Macdonald of the University of California, Santa Barbara. Researchers had overestimated the size of the melted pool in previous theories. Future studies will aim to determine the true size of the chamber. — *R. Monastersky*

Pluto's atmosphere: More than methane

Astronomers first detected methane on Pluto several years ago from spectral measurements, but could not tell whether it existed in the form of an atmosphere or solid frost on the surface. When Pluto passed in front of a star last June 9, the gradual refraction and dimming of the star's light as the planet got in the way showed a planetary atmosphere (SN: 6/18/88, p. 391), but researchers remained uncertain of its composition.

Now Roger V. Yelle and Jonathan I. Lunine of the University of Arizona in Tucson report in the May 25 NATURE that there is not only methane but also another constituent, a substance whose molecules are considerably heavier. Others have suggested the existence of such a constituent, based on assumed abundances of other gases in the cosmos, but Lunine describes the results of the new analysis as "the first real piece of evidence showing that there is heavier gas there."

The authors cite observations of the star's occultation made by other researchers from the University of Tasmania Observatory in Hobart, Australia, and from NASA's Kuiper Airborne Observatory. The atmosphere's average temperature, they calculate, is about 106 kelvins, rather than the 60 K surface temperature measured in 1983 by the Infrared Astronomy Satellite.

The researchers compared the amount of the sun's heat absorbed by the methane in the atmosphere with the amount reradiated upward to space and conducted down to the surface. They find that the resulting "energy balance" shows the thin mixture of gases around Pluto to have a mean molecular weight of about 25, meaning that "a molecule heavier than (and in addition to) methane must be present in the atmosphere."

Yelle and Lunine conclude that the likeliest candidate is carbon monoxide, with a molecular weight of 28 compared to methane's 16. Other possibilities include argon and molecular nitrogen. Carbon dioxide would probably freeze onto the surface instead of remaining as a gas, though Lunine notes cosmic rays might produce carbon monoxide from the CO_2.

The change in the starlight measured as Pluto blocked it off showed a "kink" that other observers have interpreted as evidence of a layer of haze in the atmosphere. In work reported at the recent American Geophysical Union meeting in Baltimore earlier this month and now submitted to the journal ICARUS, William B. Hubbard of the University of Arizona suggests together with Yelle and Lunine that the kink could result from the effect of Pluto's cold surface on its atmospheric density.

One implication of the cold plutonian surface could be that there are no cumulus clouds overhead, adds Lunine, because the atmosphere, unlike Earth's, gets warmer with altitude so that moisture does not condense into droplets, though there could be early morning ground fogs.

Hubbard and his colleagues suggest that Pluto's radius may be about 1,180 kilometers, though the presence of a dust layer could make the planet as small as 1,140 km. The Voyager 2 spacecraft's upcoming flight in August past Neptune's moon Triton, where methane has also been detected, could help understand Pluto, says Lunine, in the question of "how cold, thin atmospheres work."

— *J. Eberhart*