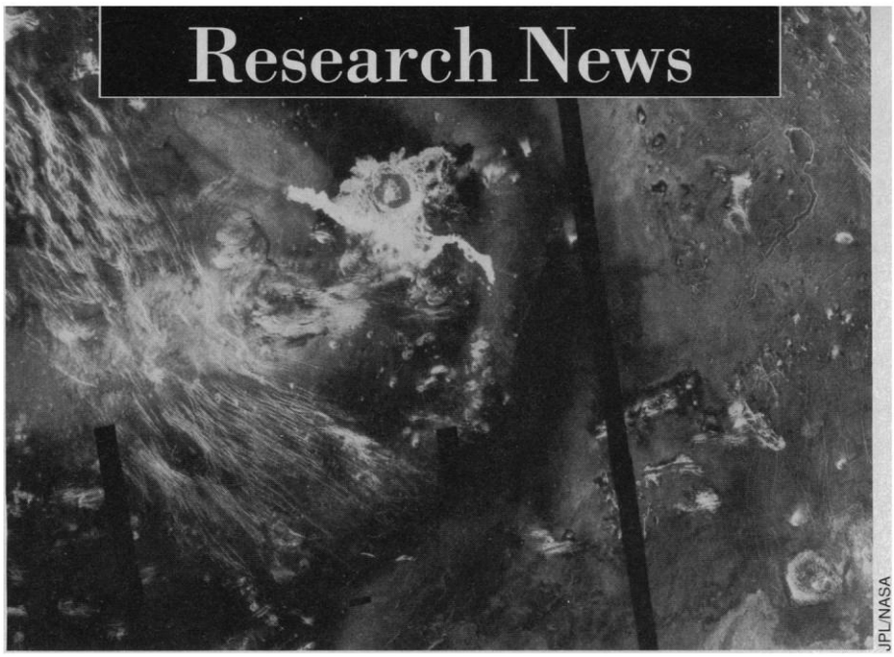


Venus revealed. *A tweak of the focus dial has disclosed a wealth of new surface detail.*

Magellan Paints a Portrait of Venus

The best images yet of Venus are providing unprecedented insights into the planet's geology—and whetting researchers' appetites for more

MUCH TO THE DELIGHT OF PLANETARY SCIentists, the National Aeronautics and Space Administration gave the go-ahead last month for an extension of the Magellan spacecraft's stunningly successful mission to Venus. Magellan, although initially plagued by mission-threatening electronic problems, has mapped more than half of the cloud-shrouded planet in unprecedented detail since it arrived at Venus last August. That detail is evident in the selection of images on these pages from which planetary scientists have deciphered everything from how some Venusian volcanoes work to which way the wind blows.

Although team scientists are thrilled by the crisp radar images they have received so far, they are eager for more. Indeed, unless the craft makes additional circuits of the planet, large holes will remain in the global map of Venusian surface geology. The reason: The shape and orientation of Magellan's initial orbit, coupled with the electronic problems and radio interference by the sun, will cause the spacecraft to miss about 20% of the surface on its first pass.

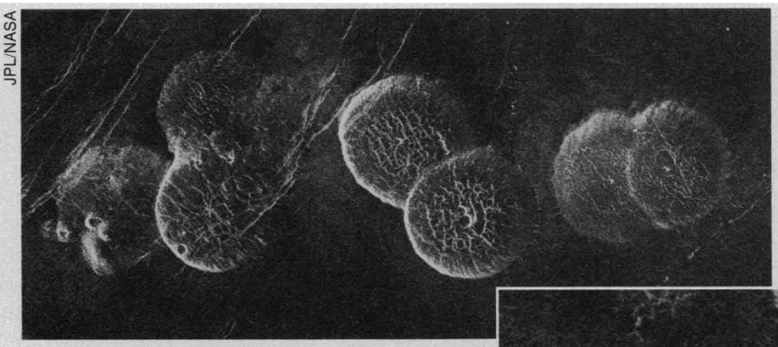
But there will be more to the extended mission than just filling in the holes in the map, says Magellan project scientist Stephen Saunders of the Jet Propulsion Laboratory. Planetary scientists also want to explore subtleties of radar mapping that could help them go beyond just counting craters, volcanoes, and faults to address more difficult questions about Venusian geology. Do volcanoes continue to erupt beneath the planet's enshrouding clouds? Does Venus have its own version of plate tectonics? Indeed, although NASA has just approved a second circuit after Magellan completes the current one in May, team members have enough experiments in mind for four more 243-day circuits.

Although there's plenty of work left, the first half-circuit of routine mapping has already shown just how good Magellan's images are. Their resolution, about 120 meters, is about 10 times better than the best obtained previously by the two Soviet Venera spacecraft. If Magellan were mapping Earth, for example, it could clearly "see" Mount St. Helens (left image below), but when the resolution is degraded to the level of the Soviet craft (1 to 2 kilometers), the mountain nearly disappears. And Mount St. Helens, along with the rest of the surface features, would vanish entirely at the 20 to 70 kilometer resolution of the U.S. Pioneer spacecraft, which had heretofore provided the greatest coverage of the Venusian surface.

Going, going, gone. *Decreasing resolution can make geology inscrutable.*

The myriad detail brought out by high resolution is evident in a recently released Magellan image (above) of the Lavinia region in Venus' southern hemisphere. The image covers a 500-kilometer square. Near its center is a 40-kilometer-wide impact crater with two bright lava flows that may have oozed away immediately after impact—a rare phenomenon elsewhere in the solar system. The dark parabolic feature crossing the image from bottom to top seems to be a newly discovered sort of impact debris pattern. Wind streaks, such as the bright ones in the dark parabola just to the right of the crater, allow wind directions to be traced. In the first quick look by Magellan team members, the winds on Venus' surface seem to fit the broad circulation patterns found there by U.S. and Soviet atmospheric probes, except where craters and other obstacles deflect the winds.

Early Magellan science has revealed other



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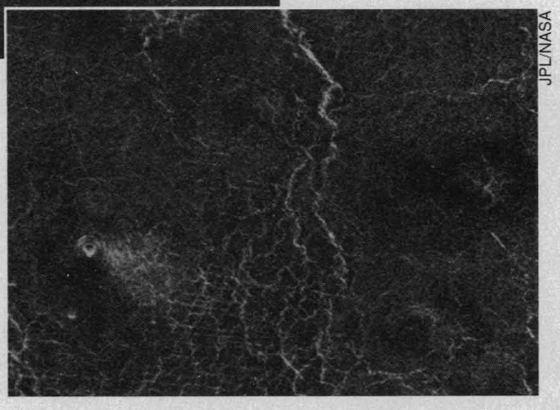
Breakfast time. *"Pancake" volcanism oozed thick lava onto Venus' surface.*

An explosion? *A windblown fan could mark a past violent eruption.*



JPL/NASA

new features. It's found a novel type of volcanism in which thick lava oozing onto a flat surface forms 25-kilometer-wide pancake-like puddles (above). And the volcano with a fan-shaped feature extending downwind is an obvious candidate for the site of ash-laden explosive eruptions (right).

Other Venusian features are proving more enigmatic. Even at the high resolution of the Magellan images, it is not immediately obvious how the Danu Montes mountain belt formed. Was it squeezed upward or is it a crumpled pile of crust that slid off a broad bulge? The origins of the tessera terrains (below), so called because of their mosaic-like appearance at low resolution, are even more obscure.

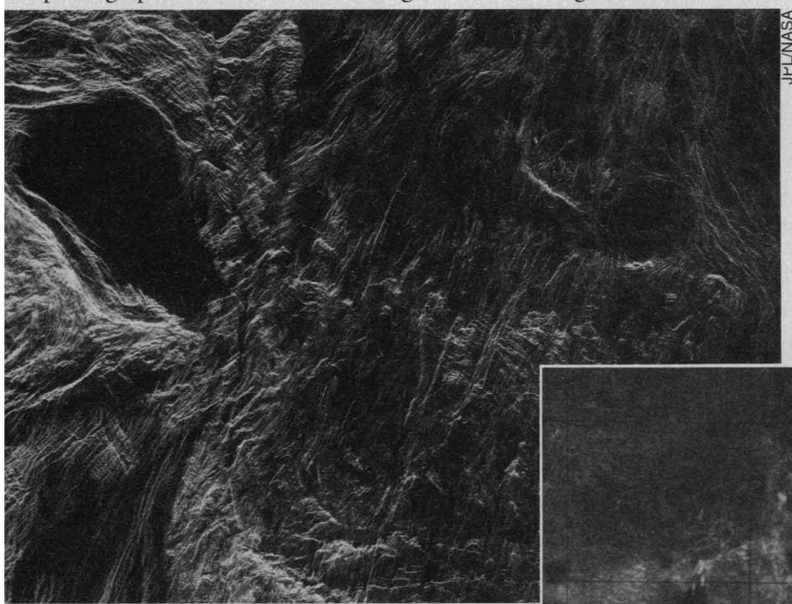
Magellan team members hope that additional circuits of Venus will enable them to resolve some of these enigmas. For example, more circuits will allow Magellan scientists to tinker with the radar so they can get new information from its images. The results will be something like what happens when a photographer who has been taking unimaginative black-and-white photos of a subject switches to color photos taken from different angles and under varying lighting conditions. The new pictures should reveal previously unseen aspects of the subject.

And there could be plenty of aspects of the Venusian surface that haven't yet been seen. One reason is that although Magellan radar images resemble aerial photographs, they are not. The difference is due largely to the kind of "light" Magellan uses. Magellan radar illuminates the Venusian surface using electromagnetic radiation with a wavelength of 12.6 centimeters—in the microwave range—instead of the submicrometer wavelengths of visible light.

That's an advantage, because microwaves, unlike visible light, can penetrate Venus' clouds. But it may lead to confusion, because visible light and microwave radiation will interact very differently with the geological features on the planet's surface. In particular, the images obtained by radar mapping are much more influenced by the angle at which the radiation strikes the surface. At the low angle that the Venera radar illuminated the Venusian surface, for example, microwaves can glint off a ridge slope that is facing the radar the way sunlight sparkles on the sea, making the ridge a prominent radar feature (below right). But the same ridge might nearly fade from view when imaged at the higher angles of the ground-based Arecibo radar (below left). Using different angles to remap some areas during Magellan's extended mission may thus reveal features missed in the first round of mapping.

Other work planned for the extension of the mission includes the mapping of subtle gravity variations around the planet. These are induced by such subsurface features as the rising plumes that feed lava to volcanic hot spots. The gravity variations cause the spacecraft to bob up and down ever so slightly, motions that can be detected because they produce a Doppler shift in the radio signal being beamed back at Earth. But the gravity measurements require that Magellan's big dish antenna be pointed at Earth rather than at the surface of Venus, so they can't be done while mapping.

With the spacecraft's problems under control for the time being, Magellan scientists and engineers can worry about the vagaries of funding. Although NASA is authorizing mission extensions one 8-month circuit at a time, Magellan scientists figure they're in a strong position. Unlike some other NASA missions, this one seems to be working just the way the scientists said it would. ■ RICHARD A. KERR



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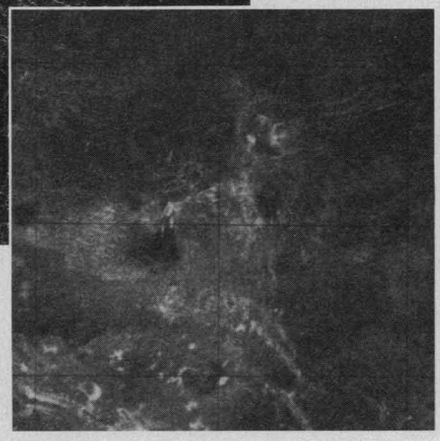
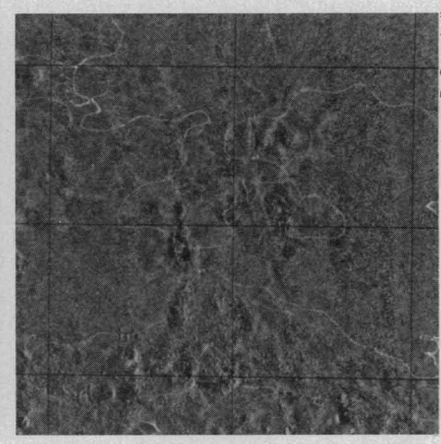
The tessera enigma. *Clotho's intersecting ridges and valleys remain a mystery.*





D. Campbell

One scene, two views. *With radar, what you see depends on how you look.*