NASA Keeps Its Fingers Crossed While Magellan Shines

Faced with the erratic behavior of its Magellan spacecraft in orbit around Venus, the National Aeronautics and Space Administration has put itself in an unusual position. It is going on with the radar mapping of the planet's surface without correcting a mission-threatening problem in the electronics of Magellan. It may have little choice: NASA does not even know what the problem is.

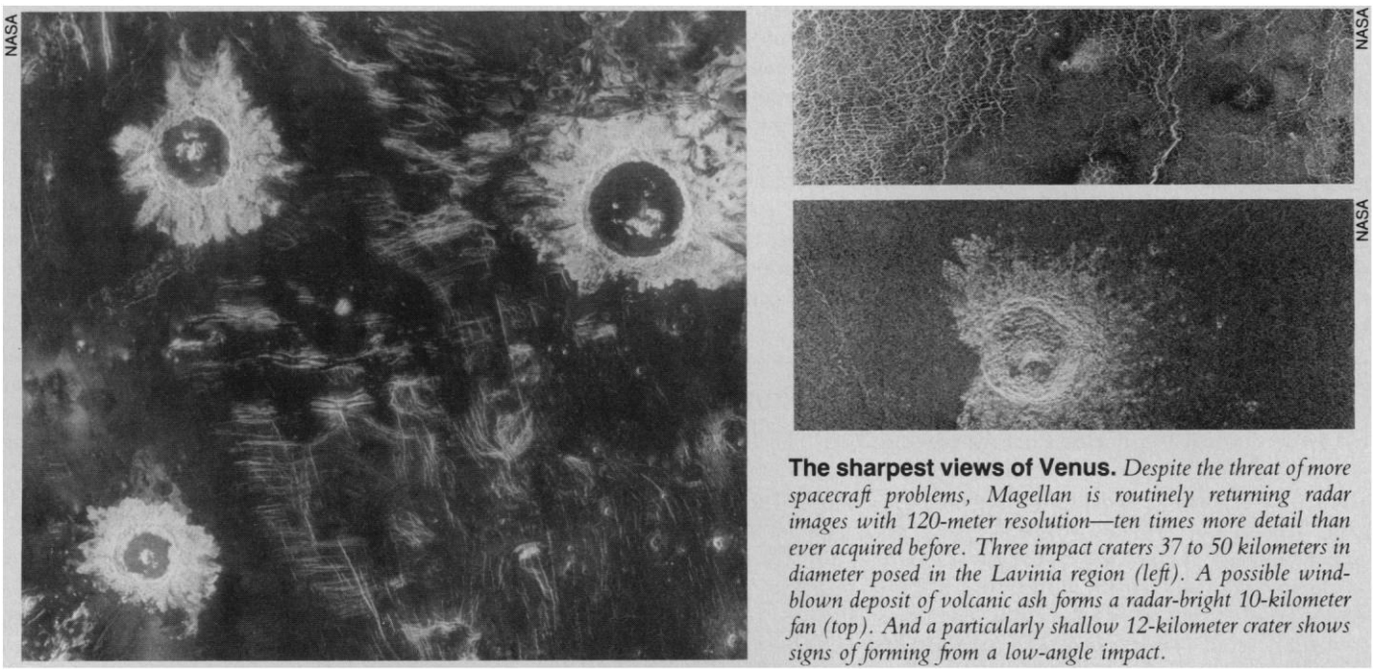
So far, the decision to push ahead has turned out well. There has been no repeat of the bizarre behavior that threatened the entire mission shortly after the spacecraft went into orbit around Venus on 10 August, and the spacecraft has been sending back stunning images of the planet's surface. But mission controllers can't shake the feeling that they may be living on borrowed time.

"The spacecraft has been very, very well behaved," said spacecraft systems engineer John Slonski of the Jet Propulsion Laboratory at a late September press conference. "We have experienced nearly flawless operation." That was the best news from the engineers since mid-August, when Magellan turned itself away from Earth, breaking its radio link and rolling away into its own private world. Through sheer luck, the spacecraft regained contact with Earth 13 hours later (*Science*, 31 August, p. 977). A week after that, Magellan again took it upon itself to change its orientation. On that occasion, controllers on the ground had to intervene after 21 hours of radio silence.

"It may happen again," said Slonski. "The data has not shown us what the root cause was. It has eliminated some possibilities. Right now there are at least two to three models being pursued." All of them involve some as yet unidentified change in the spacecraft's electronics when the rocket motor that put Magellan in orbit separated from the spacecraft. Engineers are focusing on electronic noise that interferes intermittently with normal computer operations.

Slonski conceded that NASA may never learn what Magellan's problem is, and even if the malfunction is identified, there's no guarantee that it can be fixed. In lieu of an immediate cure, spacecraft controllers have applied lots of bandages. "We're putting into place procedures for rapid recovery and minimal data loss" should Magellan act up again, said Slonski. And engineers have made changes in the spacecraft's computer software that are designed to protect against some unplanned events. These software fixes have already proved their worth: The noise came back once and prompted the computer to attempt an "illegal operation" that was thwarted.

While the engineers are scratching their heads, planetary scientists are crowing about the radar images Magellan is returning now that routine mapping is under way. "The general kind of things we're seeing do occur on Earth," noted radar team member James Head of Brown University. But Earth's terrain is "water-damaged"—even as mountain building, faulting, or volcanic activity leave their mark on Earth's surface, flowing water begins to erase them. "To me the big news is that we're looking at pristine things" on Venus, Head told *Science*. "When you look at some of the Venus terrain, it's all there. You have a record of things that are very difficult to sort out on Earth. We will be able to see the whole process."



The sharpest views of Venus. *Despite the threat of more spacecraft problems, Magellan is routinely returning radar images with 120-meter resolution—ten times more detail than ever acquired before. Three impact craters 37 to 50 kilometers in diameter posed in the Lavinia region (left). A possible wind-blown deposit of volcanic ash forms a radar-bright 10-kilometer fan (top). And a particularly shallow 12-kilometer crater shows signs of forming from a low-angle impact.*

With only 1.5% of the planet mapped so far, scientists have not even begun to address the big geologic questions—such as, what are the ultimate sources of the forces that shape the surface—but Magellan's far sharper view is providing lots of exciting details to ponder. A channel that once held a river of lava wanders more than 200 kilometers across the planet. A flat-topped dome like "an upside-down cereal bowl" may mark a subterranean intrusion of magma. Domes 3 to 10 kilometers across that look like shield volcanoes dot the plains that they may have helped form. A volcano trails a bright fan that may be wind-blown ash. Ridges rise where the crust has become wrinkled.

"We've seen a tremendous amount of pervasive tectonic activity," says Head, "but that does not necessarily mean Venus is a more active planet than Earth." A valid comparison will take time, and Magellan's acquiescence. ■ **Richard A. Kerr**