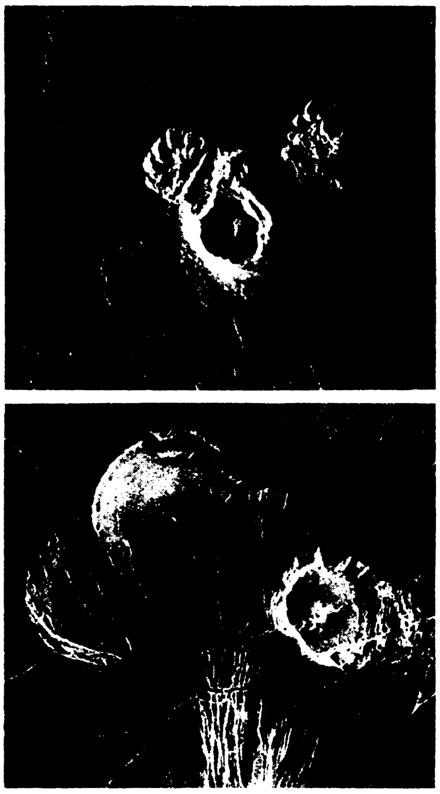
Magellan captures landslides on Venus


NASA

Top: The northwest and northeast flanks of this small volcano on Venus have collapsed, spilling rubble onto the plain. Bottom: Multiple landslides formed the bottlecap-shaped edges of three larger volcanoes, but scientists suspect that later eruptions covered the resulting debris with lava.

Scientists didn't catch these rolling stones in action, but they do have pictures of the show after it went down.

This week, NASA released the first radar images clearly showing evidence of landslides on Venus. The Magellan spacecraft snapped the pictures while orbiting the planet. Although researchers don't know exactly when the landslides occurred, they believe the activity took place thousands or even millions of years ago. "Clearly it was sometime in the past – probably even deep in the geologic past. We didn't catch a landslide in the act," says Jeffrey Plaut, a member of the Magellan team at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif.

Two Magellan images released last fall showed what scientists initially thought were before-and-after shots of a plateau on Venus undergoing a landslide (SN: 9/7/91, p.149). These pictures appeared to provide the first visible evidence of current geologic activity on a planet other than Earth. After further analysis, however, the researchers discovered they had mistaken image distortion for geologic destruction and withdrew the claim (SN: 10/26/91, p.269).

The landslides in the new images formed on volcanoes. JPL scientists propose three basic theories to explain what caused the avalanches. It's possible that a buildup of cooled lava on the steep slopes succumbed to gravity and broke loose. Or, as with Mount St. Helens in 1980, an eruption could have sheared off the side of a mountain. Finally, a "Venusquake" may have shaken loose tons of unstable debris.

Spotting landslides by satellite, says Plaut, is an exercise in "photogeology." Viewed from overhead, most landslides have a distinct, recognizable geologic footprint. In the Venus images, "you see a gouged-out area on the hillside, and downslope from there you see a big pile of rubble," says Plaut. "It's very similar to what you'd see if you flew Magellan over some of the large landslides on Earth."

Magellan coordinator R. Stephen Saunders suggests that since Venus has no rainfall to cause erosion, landslides probably helped sculpt much of the mountainous terrain on the planet.

Studying ancient landslides on planets such as Mars and Venus helps piece together "the big geological picture" of their evolution, says Plaut. "We are trying to understand the history of other worlds, and what it comes down to is geology."

– M. Stroh

Shaping ceramics with electrochemistry

Taking a cue from how carmakers paint autos, British scientists have developed a simple way to shape ceramic materials electrochemically. Car painting involves lowering the alkalinity of the car surface so that polymers settle and coat the car, where they are cured to form a permanent paint.

"It suddenly struck me that if we can generate a base at an electrode, then we could precipitate [ceramic] materials from solution," recalls Philip J. Mitchell, an electrochemist at Loughborough (England) University of Technology. In the June 4 NATURE, he and Loughborough University materials scientist Geoffrey D. Wilcox describe an electrochemical process that creates such a basic environment. They report that they have used this approach to make a variety of ceramic films in different shapes, including hair-width ceramic tubes.

"It gives us a very good method of forming a coating on a metal substrate *in situ,*" says Wilcox. Moreover, the technique does not require the high temperatures typically used for ceramic processing, he says.

Mitchell and Wilcox begin by placing electrodes into a water solution containing metallic salts. When the researchers set up an electric field between the electrodes, they cause the water molecules near one electrode to split into charged hydrogen (H) and hydroxyl (OH) components. The hydroxyl components make the electrode basic, so the metallic salts deposit as metal hydroxides.

The researchers first tried electrodes made of platinum wire but found that the ceramic deposited unevenly. The water's liberated hydrogen bubbled off the electrode surface, destroying the integrity of the ceramic film. So they turned to palladium electrodes, which soak up the hydrogen as it forms. The researchers are now experimenting with using steel and other less expensive materials as electrodes. They hope that electrochemistry will enable them to modify these materials to resist wear and corrosion better.

The ceramic forms a gel on the electrode, says Mitchell. Should engineers want to coat a part, such as an engine piston, with ceramic, then they could use that part as the electrode and cure the ceramic as part of the electrode.

"But what's novel is you can take it off the substrate," says Mitchell. For example, he and Wilcox can slide the gel off a wire electrode to make a hollow ceramic tube potentially useful as a superconductor or semiconductor.

The technique also seems versatile. By using different mixtures of salts, the scientists can vary the final composition of the ceramic. In one experiment, they allowed a thin aluminum oxide film to build up on an electrode, then moved that electrode to a different solution, where magnesium oxide deposited on top. In this way, they created a two-layer ceramic tube. Strong electric fields speed deposition and yield dense films, while weak electric fields yield porous material.

Mitchell and Wilcox suggest that one can make complex shapes by first putting an insulating mask on the electrode. "The ceramic only precipitates on the unmasked parts," Mitchell says.

"It looks to be a fairly novel way to make preshaped ceramic bodies," comments James H. Adair, a materials scientist at the University of Florida in Gainesville. "It could really have an impact on how we make complex ceramics." First, however, scientists need to demonstrate that this electrochemical pottery yields ceramic materials with the desired reproducible properties, he notes.

– E. Pennisi