# Rockfest XIX: Getting around

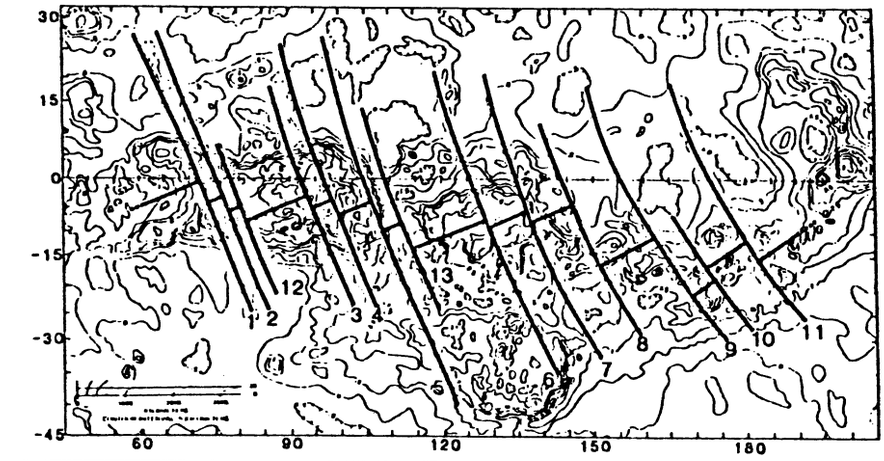
It was 1970 that saw the first "Rockfest," formally known as the Lunar Science Conference, convened at NASA's Johnson Space Center in Houston to present analyses of the pieces of the moon brought to earth by the Apollo astronauts. Held every year since then, its name was changed in 1978 to Lunar *and Planetary*, as other planets, moons, asteroids, comets, meteorites, space dust and more became additional stars of the show.

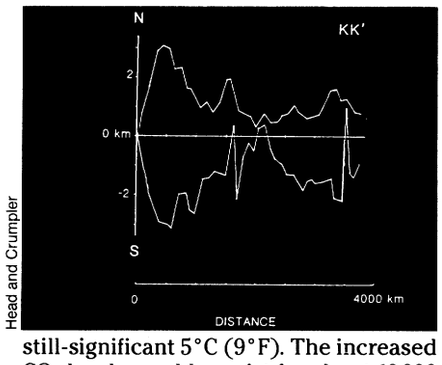
The last astronauts left the moon in 1972, and the United States has not even launched an automatic probe to another world since 1978. Yet the 19th Rockfest last week saw record numbers both of scientists in attendance (about 750, including American, Soviet, European and Japanese) and of scientific papers (678, whose three volumes of extended abstracts yielded a stack nearly 4 inches thick).

One major topic was the earth itself, as researchers continued efforts to piece together the numerous plant and animal species that have become extinct over the planet's history. A much-discussed hypothesis has been that the widespread mass extinctions may have resulted from lowered temperatures due to the blockage of sunlight by the dust of a major meteorite impact. More recently, researchers have suggested that higher temperatures — triggered by the death of certain light-reflecting ocean plankton following an impact — may have been the culprit (SN: 3/12/88, p.165).

Newly raised at the Rockfest, however, was an alternative suggestion, also involving heat, by John D. O'Keefe and Thomas J. Ahrens of Caltech in Pasadena. They suggest that a large impact into carbonate-rich sedimentary rock, such as is found in shallow seas but absent in the deepest places, could have released a great quantity of carbon dioxide into the atmosphere, trapping the sun's heat. O'Keefe and Ahrens base their conclusion on studies of impacts by projectiles into calcite (limestone) at speeds up to 13,500 miles per second, after which they measured the resultant release of carbon dioxide as a function of pressure. "If a comet with a radius of 50 kilometers struck the earth at a 4-kilometer-thick carbonate-rich layer," the authors conclude, "there would be an immediate hundred-fold increase in the amount of $CO_2$ in the atmosphere.

"This would lead to an increase in average temperatures of about 20°C (36°F) within only 10 days due to the greenhouse effect. . . .Even in the case of a smaller impact on a thinner carbonate layer — say, a meteor with a radius of 20 km landing on a 1-km-thick layer — worldwide temperatures would increase by a still-significant 5°C (9°F). The increased $CO_2$ levels would persist for about 10,000 years."




Head and Crumpler

*Radar map of Aphrodite Terra on Venus (above) indicates possible "cross-strike discontinuities" reminiscent of details in earth's ever-evolving crustal plates. Similarities of contours at equal distances north and south of Aphrodite (left) suggest at least the possibility of what happens on earth at the ends of some growing plates.*

Also being studied with earth in mind is Venus, where radar observations by U.S. and Soviet spacecraft have suggested what may be a dramatic range of tectonic processes. For example, radar maps of a vast, near-equatorial highland on Venus called Aphrodite Terra, which extends more than a third of the way around the planet, indicate what James W. Head, Lawrence S. Crumpler and other researchers at Brown University in Providence, R.I., describe as "cross-strike discontinuities," similar in appearance to the spreading rift zones between the plates of earth's crust.

Head and his colleagues do not assert that earth-style plate tectonics are taking place on Venus. "The point," says Head, "is to find out what's going on, not just whether it fits a terrestrial stereotype." But although they would like the radar maps to be sharper (the U.S. Magellan spacecraft, due to be launched to Venus next year from the space shuttle, should make a significant difference), there are already intriguing signs. If crustal plates on Venus are indeed being moved apart due to the emergence of new crust, comparison with the terrestrial example — "the only one we've got," notes Head — suggests that there might be signs of the thickening of the two plates' "outer ends," the portions farthest away from the "spreading center." The crustal plates of Venus may well follow a different set of rules, but diagrams Crumpler presented at the Rockfest at least seem to suggest symmetrical patterns at equal distances north and south of Aphrodite Terra.

Earth's moon, meanwhile, is not being left out of the picture. President Reagan's new space policy includes plans for a permanently inhabited base on the lunar surface. In addition, scientists and NASA planners alike are working to initiate a Lunar Geophysical Orbiter to conduct scientific studies of the moon years before such a base is even begun.

*— J. Eberhart*

# Cajon Pass drilling: Down the tubes?

While other nations are pouring more money than ever into scientific drilling projects that reach deep into the earth's crust, researchers at the deepest scientific drillhole in the United States, located near the San Andreas fault, are packing up their instruments. They are preparing for next week, when funding cuts will force the end of drilling operations there for at least two years, if not permanently. Now at a depth of 3½ kilometers, the hole at Cajon Pass, Calif., is still some 1½ km shy of its original goal, and San Andreas experts are wondering if 3½ km is deep enough to resolve a 20-year-old paradox about the fault.

"The whole purpose of this experiment was to do something definitive, which meant going deep enough," says Stanford University's Mark Zoback, who is chief scientist on the Cajon Pass project.

Although the hole has provided some answers about the earthquake-producing forces along the San Andreas, the researchers have yet to reach the important depths between 5 and 10 km, where great California quakes are born.

Probing these depths would require about $12 million a year over the next two years to finish the project, according to Zoback. But for fiscal year 1988, the project received $4.8 million instead of the $6 million the scientists had expected from the National Science Foundation's Continental Lithosphere Program. And next year, fiscal year 1989, that program will be giving priority to other projects that were not favored this year, and the drillhole will receive significantly less funding. Therefore, if drilling does begin again, it must wait for fiscal 1990.

Zoback and many other project scientists have been working at Cajon Pass to examine the forces that generate the earthquakes along this fault, which is at the boundary of the Pacific and North American plates – two huge sections of the earth's crust that are slowly slipping past each other.

Earthquakes happen because at some spots the rocks on opposite sides of the fault jam. Friction between the rocks causes the fault to lock for years or centuries, until the stress becomes too great and the rocks suddenly slip, generating the seismic waves of an earthquake.

The paradox of the San Andreas revolves around the stress on the rocks of the fault (SN: 1/31/87, p.70). Scientists have traditionally believed that the fault is strong, meaning that stress along the fault is relatively high. Generations of laboratory experiments and theories are based on this supposition.

But evidence in the last 20 years has caused scientists to question the strong-fault theory. A high-stress fault should generate heat. Yet experiments in hundreds of shallow boreholes have not detected the expected high temperatures. Although these tests suggest the fault is weak, scientists could not be sure of the results because the holes were too shallow.

The Cajon Pass project was meant to yield a definitive answer to this question, and, says Zoback, "everything we've found so far is highly indicative of low stress on the fault."

If the fault is weak, then scientists will have to recast their theories about how the San Andreas operates. They will need new laboratory experiments and perhaps future drillholes to determine why the frictional forces along the fault are so low. Pressurized groundwater or a layer of clay filling the fault may be lowering the friction and permitting the fault to move under low stresses.

While this revolution in thinking will not affect ideas about the destructiveness of earthquakes along the San Andreas, "it may be that we're using the wrong kinds of models for earthquake prediction," says Zoback.

But those who study the San Andreas are not sure whether the present hole is deep enough to serve as a basis for firm conclusions about the fault. Because the stress experiments require a stable area, the hole was placed 3½ km east of the fault. Because of this distance from the actual fault, the hole ideally should be dug significantly deeper than 3½ km, according to the researchers, in order to obtain accurate results.

"The impact of whether the fault is weak is so enormous," says Zoback. "Do we undertake this revision in thinking without being 100 percent sure of what we're talking about?"

Zoback and most other scientists on the project want to reach the target depth to be sure. "For the purposes of the heat-flow experiments, it is necessary to get to 16,000 feet [almost 5 km]," says Lee Silver of Caltech in Pasadena, who is investigating temperatures around the fault.

It is unclear, however, what will happen when the lithosphere program again receives enough funds to support the nation's scientific drilling program. The Cajon Pass hole is the first project of the program, and it has received top priority in the last year and a half. When funding returns, the planning committee will have to decide whether to return to Cajon Pass or start other projects that have been put on hold. *– R. Monastersky*

# Graham defends FOIA exemption for federal-lab research

William R. Graham Jr., the President's science adviser, is carrying to Capitol Hill the administration's plea for a broad new exemption to the Freedom of Information Act (FOIA). The 1966 law gives individuals broad rights to search for and acquire nonclassified government information, much of it unpublished, but exempts from disclosure certain data, such as industrial trade secrets, personnel data covered by the Privacy Act and controlled nuclear information. At a Senate judiciary hearing last week, Graham argued for an additional exemption to remove an FOIA "prejudice against government scientists."

The administration included a proposal for just such an exemption in its Superconductivity Competitiveness Act, a bill it sent to Congress on Feb. 23. Aimed at promoting U.S. competitiveness in high technology, this legislation would prohibit FOIA release of any national-laboratory-generated research data that might have commercial value and whose release could "cause harm to the economic competitiveness of the United States."

Graham said at the hearing that government scientists, unlike their colleagues in academia and industry, can be "compelled" to release data, including laboratory notebooks on work in progress – even when doing so jeopardizes the government's ability to protect patent rights, copyrights or control of trade secrets.

The new exemption, he said, would also close an apparent loophole in export-control law. He noted that in 1984, the Department of Defense received an exemption for FOIA requests involving "strategically sensitive but otherwise unclassified" technologies having both civilian and strategic military applications. But Graham said this exemption does not shield from FOIA similar – or even identical – export-controlled information available through other federal agencies. Thus "it appears," he said, "that one could circumvent [export-control] laws using FOIA."

But when Graham was unable to immediately name any scientist harmed by FOIA, several researchers countered that the proposed exemption seems to be the solution to a problem that doesn't exist.

Testifying with Graham last week, IBM Vice-President Dean Eastman argued that there is no need to protect early research findings, such as the rapidly occurring advances in high-temperature superconductivity. The Yorktown Heights, N.Y., scientist said that explains why IBM has been freely sharing its advances in this field with outside researchers. Also testifying at the hearing was Charles W. Gear, a computer scientist at the University of Illinois in Urbana-Champaign and president of the Society of Industrial and Applied Mathematics. He said this sharing of research is essential to validating new findings, avoiding duplication of efforts and exploiting the commercial potential of new ideas.

There is even some concern among policy analysts that the new exemption could be expanded to justify a broader withholding of any government-laboratory research with commercial potential – from agricultural and biotechnology advances to details on the medical effectiveness of new drugs.

A precedent for this already exists, says Mitchel Wallerstein, staff director in Washington, D.C., for the National Academy of Sciences' 1987 Allen report, which assessed export controls' cost to U.S. competitiveness (SN: 1/24/87, p.55). In an interview, Wallerstein noted that the Defense Department cited its 1984 FOIA exemption to justify prohibiting the disclosure at meetings, in discussions with foreign scientists and in print of any nonclassified national-security-related research that might qualify for withholding under FOIA. *– J. Raloff*