NSF, to perform work supervised by JOIDES.

The *Glomar Challenger*'s discoveries into the origin and history of the ocean floors have been among the most important ever made in oceanographic research, and officials were understandably upset at any possible taint of CIA association.

Scripps Director William A. Nierenberg told SCIENCE NEWS it would have been "literally impossible" for the CIA to have used the *Glomar Challenger*. The Soviet Union, he points out, is a member of JOIDES and thus has access to all the ship's logs. Since the ship was commissioned there has been no "dead period" in which extra-scientific work could have been carried out. Like Maxwell, he recalls with some chagrin the *Pueblo* affair, saying that legitimate ocean researchers were "quite annoyed" that it had been labeled an oceanographic vessel. Nevertheless, he does not foresee too much disruption of current scientific cooperation, at least as far as the Soviet Union is concerned, since the Soviets are well aware that bona fide researchers were not involved. Nierenberg does fear, however, that developing nations may be less cooperative. He says the *Glomar Challenger* will continue to invite local scientists to participate in any research conducted in the territorial waters of other nations, in order to dispel any lingering doubts. Should these countries refuse access to their waters, they would only "hurt themselves economically," he concludes.

After a week of undistinguished reporting, it was hard to tell just what had been accomplished by the *Explorer*'s salvage operation. According to various reports, the Russian sub had been found intact (or in pieces), was partially (or completely) recovered, including 10 (or 70) of its crewmen. Two nuclear warheads (or none, or all) had been salvaged, together with (or without) the code machine, making the project a "major intelligence victory" (or a "waste of the taxpayer's money"). □

'Rock Fest' VI: A megaview of the moon

On July 20, 1969, the first human footprint appeared on the moon. Less than six months later, on Jan. 5, 1970, almost 1,500 eager scientists met at the Manned Spacecraft Center in Houston to discuss the exciting potential of the first samples of another world. But the samples were still coming in. By the time Apollo 17 splashed down in the Pacific on Dec. 19, 1972, 844.1 pounds of lunar material had been transported to the earth.

It is often said of interplanetary missions that "the data will keep researchers going for years," and Apollo proves the point in spades. Last week in Houston, the sixth consecutive Lunar Science Conference was attended by nearly 600 scientists. And some of the potentially most important samples have not even been opened yet. In fact, says Stewart Nagle, ranking analyst of Apollo's core-tube samples at the Johnson Space Center, it may be five years before all of the eligible lunar material has been opened for study.

But at this year's conference, there was a difference. "For the first few years," says William Phinney, chief of the JSC planetary division's Geology and Geoscience Branch, "everybody would sit on the edge of their seats, waiting to hear the age of a rock. . . . Even up until last year we were trying to get out data on individual missions. But now I think we're beginning to see a trend towards less emphasis on the data . . . and more an attempt to put these kinds of data from the different missions together again. . . ."

The approach used to be, according to one attendee, "pulling some numbers off a 10-milligram sample and seeing if they'd tell you where the moon came from." The tendency now is more in the direction of seeking unifying implications from a growing body of broader information.

One of the favorite arguments at past "rock festivals" (as the researchers call their gatherings) has been over whether today's moon is hot or cold inside. But efforts toward an overview have led to at least a seeming consensus. "One of the important results of this meeting is verifying that the moon is hot," says JSC's Don Anderson. "The electrical conductivity data requires, and seismic and heat-flow data are consistent with, a hot moon."

The most popular public question about the moon—where did it come from?—still has almost as many answers as it ever did, but they are being refined. "All of the classical theories of lunar origin are still with us—capture, fission and dual-planet accretion," says Anderson, "[but] in variants quite different from those initially proposed." The capture of a fully-formed moon now seems "extremely improbable," according to Anderson's summary view of the conference, "both dynamically and [for] other considerations." Two UCLA researchers, however, A. W. Harris and W. M. Kaula, separately suggested the possibility that the moon was literally knocked together by colliding fragments, or planetesimals, arriving from the vicinity of Jupiter.

The fission theory—that the moon was somehow wrenched, blasted or otherwise severed from the earth—also has its updated versions. A. E. Ringwood of the Australian National University suggests that planetesimals falling onto the newly formed earth were chemically reduced by a primitive hydrogen atmosphere that had been delivered by the solar wind, and which, he says, could help to account for the moon's comparative shortages of iron and certain volatile elements. As the surface temperature of the earth rose due to heat buildup in the forming core, 2 to 3 percent of the mantle evaporated, creating a "silicate atmosphere" that spun out into a disk shape. The disk in turn captured additional planetesimals from their sun-circling orbits, leading to a ring of particles about three earth-radii distant, which ultimately coagulated into the moon.

Proponents of the idea that the two bodies formed separately from the primordial nebula that was to become the solar system have had their own problems rationalizing differences in chemistry. Oxygen-isotope data are on the side of this theory, and scientists at this year's conference were considering the possibility that outgassing of the earth's atmosphere somehow triggered the condensation of the moon. This could mean that the earth was as much as 60 percent formed when the moon began, thus perhaps accounting for its differing composition.

One consequence of being able to take the broad view of the moon is that the conference seemed to show a trend toward comparative planetology, particularly in view of Mercury's remarkably moonlike exterior as revealed by Mariner 10. Mercury's higher gravity, according to Donald Gault of NASA's Ames Research Center in California, produces smaller craters for a given amount of kinetic energy than on the moon, but the faster-falling ejecta cause far more secondary craters in close to the rims of the big primary ones.

M. H. Toksöz of Massachusetts Institute of Technology and his colleagues dealt at the meeting with the differing thermal "regimes" of the moon (possibly part molten below about 700 kilometers with a fully molten core), Mars (partial melting about 200 kilometers down), Venus partially molten even in its upper mantle) and Mercury (nearly solid, with only slight melting, even in the core).

Next year, suggests James Arnold of the University of California at San Diego, even more emphasis should be placed on unifying Apollo's scattered contributions. The "mega-regolith," he calls it—a way of looking at the lunar surface that takes the same approach followed by the GATE researchers in the tropical Atlantic: Bridging the gap from small-scale data to large-scale conclusions. □