LUNAR SAMPLES

The most exciting business

Rarely in history has so little dirt and rock been scrutinized as thoroughly or treated as gingerly by thousands of scientists as the lunar samples brought back to earth by the Apollo 11 and 12 astronauts. It has been more than a year since scientists first received their Apollo 12 samples, but the 600 who gathered at the Apollo 12 Lunar Science Conference this week in Houston have not lost their enthusiasm. As Dr. Gary Latham of the Lamont-Doherty Geological Observatory says, "Nothing has changed my mind since our last meeting (a year ago). This is the most exciting business in the world to be in."

It is also a rare occasion when scientists agree, but this year's conference has emerged with an emphatic theme: The moon holds the key to that part of the solar system's history obliterated on the earth—the first billion and a half years. They also agree that no more Apollo flights should be lost from the four remaining in the Apollo schedule (three Apollo flights have been previously dropped).

This assembly of all the lunar scientists is only the second of its kind, but the conclave this year includes the results from the only moon soil returned to earth in 1970—that from Luna 16 as presented by Academician Alexander Vinogradov, vice president of the Soviet Academy of Sciences.

Many views about the moon's history have been disproved over the last year and a half. Some have been upheld. But the basic theories of the origin and history of the moon, and therefore of the solar system, are still in a state of flux. The scientists await data to be returned from Apollos 14, 15, 16 and 17. This information, they feel, is essential in piecing the rest of the story together.

Before Apollos 11 and 12 the scientists thought the moon's seas or maria were probably very young areas and perhaps still evolving. They were not sure of the chemical composition. Now they know that two of the areas, the Sea of Tranquility (Apollo 11) and the Ocean of Storms (Apollo 12) are 3.65 billion and 3.45 billion years old and filled with basaltic material. They earlier thought that the iron content of the moon's igneous rocks would be much lower than the earth's. They now know that it is much higher. At one time they thought that the younger craters, such as Tycho, whose rays are still bright and not covered with debris, could be as young as a million or so years old. They now believe that these craters must surely be much older.

The moon's southern highlands are thought to be the oldest structures on the moon's near side because of their high crater density. After the first billion years of the moon's history scientists believe that dramatic events occurred which dug out the large circular basins on the moon such as Mare Imbrium and that scattered debris to form other hilly areas such as the Fra Mauro region, the site for Apollo 14. Following these dramatic events the maria were then filled with a thin layer of material. Later the youngest craters on the moon were formed.

This chronology of lunar history is still pretty much intact. The evidence from the Apollo 12 samples presented this week was turning up many similarities and filling in some historical gaps. For example, says Dr. Paul W. Gast of National Aeronautics and Space Administration's Manned Spacecraft Center, last year the scientists were at loose ends to reconcile the differences between the ages of the maria and the age of rocks such as rock 13, about 4.5 billion years old. Now they understand, he says, that the chemical and physical differences between the exotic rocks and the local bedrock are greater than they previously thought. Rock 13, for example, has dark spots that contain the same material found in rock fragments called norites. The scientists have dubbed the norite fragments KREEP, an acronym derived from their high content of potassium, rare earth elements and phosphorus. The norites, agrees Dr. J. A. Wood of the Smithsonian Astrophysical Observatory in Cambridge, Mass., probably represent the near surface material of the ancient lunar crust. The coarser-grain material called anorthosite is from even deeper in the moon. This is the material the scientists hope to find excavated from Mare Imbrium in the Fra Mauro region.

Except for quakes when the moon is closest to the earth each month and possible outgassing (SN: 11/28, p. 414), the moon so far seems to be quite inactive. Its energy release per unit volume, for example, is eight orders of magnitude less than that of the earth. But erosion processes do occur, from the constant rain of meteoroids.

To an observer, the slow unravelling of lunar history, most of the time very controversial, may not appear to be progressing very rapidly. But, say the scientists, trying to reconstruct what happened 4.6 billion years ago from materials from only three lunar sites is similar to landing at three isolated sites on the earth and trying to understand its history. In a month they hope to have material from a fourth lunar site. Thus the drama goes on. □

SCIENTIFIC DRILLING

Undersea reentry

The depth to which oceanographers can drill into the ocean floor has until now been limited by the durability of the drill bit. Once a bit wore out, a drill hole had to be abandoned because of the technological impossibility of finding and reentering a tiny hole under thousands of feet of water after the drill string had been withdrawn and the bit changed.

Scientists on the Deep Sea Drilling Project had continually been frustrated by this problem. But last June, the Glomar Challenger made a special voyage into the Atlantic to test a new core-hole reentry system. The test was a success (SN: 6/20, p. 597).

Now on Leg 15 of the project, the reentry system has been successfully used operationally for the first time. The first reentry was made in water 13,000 feet deep in the Caribbean—near a site north of Venezuela where previous drilling had to be aborted because of layers of hard rock.

On reaching the site, the scientists attached a funnel-like apparatus, consisting of a 160-foot casing topped by a large inverted cone, to the lower end of the drill stem. The entire assembly was then lowered to the ocean floor. The casing was pressed into the sediment, leaving the cone at the sea floor, and drilling was carried out as usual through the cone and casing.

At a depth of 2,300 feet below the ocean floor, the tungsten-carbide bit finally wore out and was withdrawn to the ship to be changed. When the new bit was installed, the drill string was lowered to within 30 feet of the ocean floor. A transducer at the lower end of the stem emitted high-frequency sounds which were reflected back to it by three acoustic reflectors mounted on the rim of the cone. By monitoring the reflected signals, the researchers determined the relative positions of the cone and drill string, maneuvered the ship to a spot directly above the cone and lowered the drill stem into it. The stem missed the cone on the first try, but the second attempt was dead center.

The scientists were able to drill an additional 200 feet and recover samples of flint-like chert, hard limestone and crystalline rocks, all of which were heretofore unobtainable. The sedimentary rocks encountered by the second phase of drilling provided an unprecedented insight into Caribbean history, the scientists say. They hope the new reentry technique will supply valuable information about this complex sea, concerning whose geological history many questions remain (SN: 1/9, p. 31). □