A rock from the moon's early days

Taking its last shot at the prize, the Apollo program came through. A major goal of the scientists examining samples brought back from the lunar surface was to find a rock virtually as old as the moon itself, a relic more than 4.5 billion years old that might reveal traces of materials as they were immediately following the formation of the solar system. After five visits to the moon, the last-ditch effort, Apollo 17, finally paid off.

Among the 110 pounds of rocks collected by astronauts Eugene Cernan and Harrison Schmitt was a blue-gray breccia labeled "Boulder No. 2." Embedded in the boulder were five fragments which, says A. L. Albee of California Institute of Technology, seem to be "a product of primary lunar differentiation."

After several refinements in dating procedures, Albee and his colleagues under Gerald Wasserburg have concluded that the material, containing a greenish mineral called dunite, is about 4.6 billion years old. "The Wasserburg group's theory," according to a NASA geologist at the Johnson Space Center in Houston, "dictates a short accretion time for the solar system," which, he says, means that the prized fragments are within a mere 1,500 years of being as old as the moon itself.

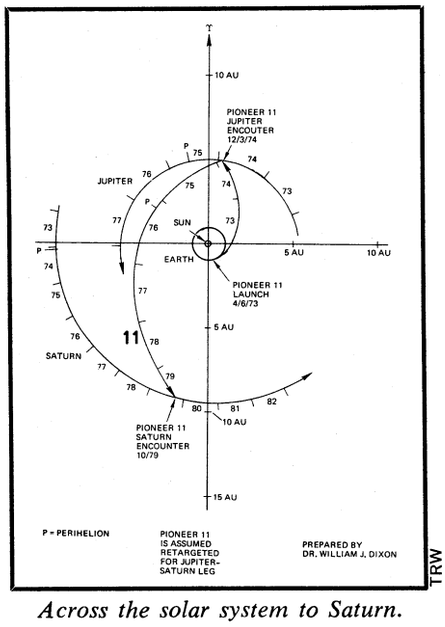
Boulder No. 2 includes a wide variety of minerals and crystal forms, many of which have undergone some geologic alteration, such as by shock and heat. However, says Albee, "despite the complex history, rubidium and strontium [the elements whose isotopes were used in dating the material] appear to have remained undisturbed. . . . As there is no evidence for contamination from either petrographic or trace-element data, we tentatively conclude that this rock must represent a very early differentiate derived from the upper lunar mantle."

The oldest known rocks on earth are only about 3.7 billion years old, because erosion and other factors have simply wiped out the traces of the planet's formative years. The ancient lunar fragments, therefore, may by analogy provide information that is obtainable in no other way about the youthful earth. □

Pioneer 11 to be sent to Saturn

It's official. Pioneer 11 is going to Saturn.

The long-discussed possibility began to seem likely last Dec. 3, when its predecessor, Pioneer 10, survived a suspenseful trip through the intense radiation belts of Jupiter. Pioneer 11 will have to run the same gauntlet, since it too is going to Jupiter and must use the giant planet's gravity to swing it around toward Saturn.



Across the solar system to Saturn.

This gravity-powered slingshot technique was used last month for the first time, when Venus was used to bend the path of Mariner 10 towards Mercury, but the Pioneer maneuver will be a much more radical one. Mariner 10 flew "behind" Venus, which slowed the spacecraft down and altered its path by about 90 degrees. Pioneer 11 will fly under Jupiter's southern hemisphere and be accelerated up and over the top in an almost complete turnaround that will send it all the way back past the sun to meet Saturn on the far side of the solar system. The giant heave could send the probe as much as 15 degrees above the plane of the ecliptic.

As it goes behind Jupiter, the spacecraft will pass about 26,000 miles from the surface, less than one-third the distance of Pioneer 10's flyby. When it goes through the radiation belts, however, it will be about 85,000 miles out, and project officials predict that the cumulative radiation exposure will be only about one fourth as great as Pioneer 10's, due both to the steeper passage through the belts and to the additional speed provided by the slingshot maneuver.

Pioneer 11 will reach Jupiter about Dec. 5. By the time it gets to Saturn, in early September of 1979, it will have flown more than 1.5 billion miles and been in space for more than six and a half years. "This is well beyond the spacecraft's design lifetime," admits a NASA official, "but there is a fair possibility that it will be at least partially operational and able to return data."

The spacecraft has already survived its first major potential hazard, the asteroid belt between the orbits of Mars and Jupiter, just as did Pioneer 10. Both probes encountered only dust-sized particles—and not many of them. The larger asteroids are apparently fewer and farther between than had been anticipated.

Pioneer 11's precise path past Saturn need not be selected for months or years. It will be chosen with an eye toward complementing future missions such as the Mariner Jupiter-Saturn flights to be launched in 1977. One possibility, which may not be covered by the Mariner missions, is a dramatic pass between Sautrn's surface and the innermost of its rings. □

Submerging offshore oil rigs

At the same time that final governmental hurdles to increase offshore oil drilling are being surmounted, industry has come up with a new way of extending the possible range of such wells to the edge of the continental shelf. Beginning next year, companies engaged in offshore drilling will be able to replace limited height platforms with completely submersible units called Subsea Work Enclosures (SWE) that will automatically route oil and gas through pipelines to shore or to a waiting tanker overhead.

The current limit of platform-based pumping operations is about 600 feet, half the depth of the outer edge of America's oil-rich continental shelf. The SWE's now being tested in the Gulf of Mexico and off the coast of Africa will be able to operate in depths below 1,500 feet, enough to extend the productive range of American wells some 300 miles offshore. The devices may prove even more important in opening up fields in the North Sea, where Great Britain now puts its hopes for petroleum independence. Unencumbered at their great depth by frequent storms overhead, SWE's should help meet the need for multiple, widely spaced wells in the North Sea area.

The SWE and its auxiliary equipment were developed by the Subsea Equipment Associates, Ltd. (SEAL) a joint venture of several major oil and aerospace companies. SEAL's projects have been specifically designed to use the talents of redeployed space scientists. A special diving bell that allows personnel to couple with the SWE and work on its apparatus at atmospheric pressure is a direct outgrowth of space