would be the deepest samples from within the moon yet to be brought back. They could extend all the way through the regolith to the bedrock.

Worden, in orbit around the moon, was also wiping out theories by his observations of some 14 areas. A particularly surprising observation was cinder cones in the area around Littrow (a crater in an area thought to be the youngest mare area on the moon). He said, ". . . in the area where we noticed darker deposits, there are a whole series of small, almost irregular shaped cones. . . . It looks like a whole field of small cinder cones." If photographs bear out his visual observations, scientists say that the presence of these volcanic remnants in one of the youngest areas of the moon would extend the period during which the moon was hot by one billion years. Originally scientists thought this period lasted only from 4.6 billion to 3 billion years ago. But the new finding would mean that it extended to 2 billion years ago.

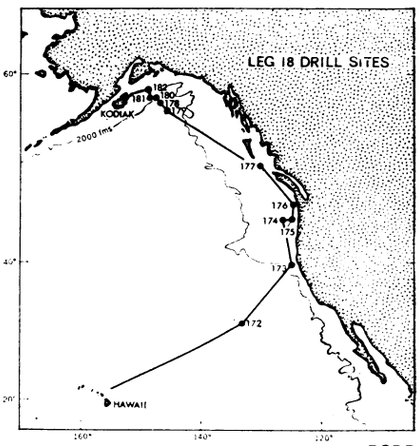
Another interesting observation Worden made was of layering in the central peak which protrudes up from the center of the crater Tsiolkovsky on the far side of the moon. This means that the peak was formed by pushing up from a depth rather than by piling up on the outside. The instruments operated in orbit are already giving scientists the mineral composition of 20 percent of the moon's surface and constituents found in the trace atmosphere around the moon.

Seismic data obtained from impacting of the Saturn 4-B stage and the ascent stage of the lunar module support theories that the structure of the moon is hard, brittle and crystalline, to a depth of 300 to 400 kilometers. Dr. Gary Latham of the Lamont-Doherty Geological Observatory had said, "If we see seismic waves 1,100 kilometers to the south at the Apollo 12 and 14 sites as well as from the Apollo 15 station, then our theory that the structure 300 to 400 kilometers deep is hard, brittle, crystalline material in which seismic waves would propagate well, is true." All three stations reported the signal.

Minor problems plagued the men, putting them behind schedule almost every mile of the way—from having to mop up 25 pounds of water to having to use tape to repair some of their equipment. But if all continued to proceed without major problems, the crew was expected to splashdown at 4:46 p.m., EDT, Aug. 7, setting in all accounts a new moon record and bringing back 175 to 180 net pounds of lunar rock and soil. Worden summed up the week pretty well: "I think we're going to give lots of people lots of things to do for a long time." □

DEEP-SEA DRILLING

Where plate meets plate



Leg 18: Drilling crustal borders.

At deep-sea trenches, where one crustal plate is being jammed underneath another, geophysicists believe that sediments that have accumulated on the underthrusting oceanic basin are scraped off and pile up against the edge of the overriding plate. The exact nature of this sedimentary deformation, however, has not been observed in active trenches. Up to now oceanographic instruments have been unable to show clearly the complex folded and faulted structures thought to be present.

Now scientists on Leg 18 of the Deep Sea Drilling Project, which ended July 19 at Kodiak, Alaska, have recovered cores showing sedimentary deformation from several sites along the Aleutian trench off Alaska, where oceanic crust is being thrust under the continent at a rate of more than two inches per year. At one site, number 180, the researchers, led by Drs. LaVerne D. Kulm of Oregon State University and Roland von Huene of the U.S. Geological Survey's Office of Marine Geology, drilled directly along the axis of the trench. A more productive site, however, was site 181 on the landward wall of the trench, where they drilled to a depth of 369 meters. The sediment layers there, says Dr. Kulm, appear to be quite jumbled up. The top 100 meters of the core were composed of softer sediments. Below were hard mudstones, with thin, highly deformed laminations.

At another site, off California's Cape Mendocino, the researchers recovered a spectacularly complete sedimentary record spanning the past 26 million years. Fossilized microscopic marine organisms in the core, such as diatoms and radiolaria, record periods of oceanic upwelling and of varying biological productivity. Evidence from marine-plant fossils in the sediments of the coastal mountain ranges of California and Oregon has offered a much less complete record than that now obtained by the scientists on the Glomar Challenger.

The character and type of marine organisms living in the surface waters of the oceans is highly sensitive to the temperature of these waters. Fossil remains from sediments thus give an indication of ocean surface temperatures—and therefore climate—that existed at the time the organisms were alive. The Leg 18 scientists found evidence in the sedimentary record of the climatic oscillations over the past 2 million years.

Over the years, the Columbia River, which divides Oregon and Washington, has washed tons of continental materials from the land and deposited them in the Pacific Ocean. In this way, an extensive fan-shaped sediment deposit, called the Astoria Fan, has developed at the foot of the continental slope off Oregon and Washington. Spores and pollen from trees, shrubs and grasses that are entombed in these sediments carry a record of land temperatures. Cores recovered from the Astoria Fan by the Deep Sea Drilling Project researchers show that the Pacific Northwest, over the past 2 million years, has never been warmer than it is now.

Evidence from the Astoria Fan also shows that during the ice ages, sediments were carried downriver much more rapidly than the average rate at which sediments are being deposited in the deep ocean today. The high rates of sediment accumulation, the scientists believe, indicate that glacial erosion of the continents was more vigorous than previously thought.

The Leg 18 scientists drilled at a total of 11 sites along the continental margin between Oregon and Alaska. By delineating geological structures at plate borders they hope to determine the rate and direction of large shifts in the earth's crust. The 56-day cruise began May 28 at Honolulu. □

ENERGY INDUSTRIES

Making synthetic fuel gas

Critics of the United States energy industry often allege that shortages of fuels and power result from increasing monopolistic control of the industry and influence over the policies of the Interior Department. In a press conference this week, Interior Secretary Rogers C. B. Morton denied some of these allegations. He may be correct, but it is hard for the public to judge since the companies are often as secretive about their activities as Balkan diplomats.

Whichever side may be correct, Morton this week signed a contract that appears, at least, to indicate that energy

industry competition is still alive and that the public and the environment will probably benefit from this competition.

The contract is between the Interior Department and the American Gas Association. It calls for an expenditure of about $300 million over the next eight years to develop a commercial process for making synthetic fuel gas from coal. To begin, two-thirds of the money will come from Interior ($20 million in fiscal 1972) but the ratio could be changed toward a larger industry contribution if processes to be developed at three pilot plants look good. Gas is a virtually nonpolluting fuel for power plants and other uses. The coal gas is needed, says Morton, because of a growing shortage of natural gas.

But oil company statements have shown pessimism about commercial coal gasification before 1985 and have consistently suggested that higher natural gas prices would stimulate exploration and discovery of new gas fields. Even with the higher prices, natural gas would beat out coal gas in the marketplace, the companies claim. But coal advocates, including officials of Interior's Office of Coal Research, claim that if coal gas were commercially available today it would be highly competitive with natural gas in populous Eastern markets even at current prices.

Those who charge that monopoly control of energy sources is stifling competition—including a Ralph Nader team—claim coal, oil and gas company interests are virtually identical because of interlocks created by mergers. They claim also that oil company claims of natural gas shortages are really a "natural gas strike" aimed at artificially boosting prices. If the two assertions are both correct, it seems unlikely the large-scale coal gasification program would be getting under way.

On the other hand, there are many techniques other than coal gasification for using coal in nonpolluting ways, and these techniques are still getting short shrift.

For instance Hydrocarbon Research Co. and OCR have discussed building a pilot plant at OCR's existing Cresap, W.Va., facility to test HRC's H-coal process for liquefaction of coal into a low-sulfur fuel oil for power plants. The talks foundered when the Office of Management and Budget insisted on a one-third industry contribution to the project. The logical contributors, the oil companies, aren't interested, they have told officials. Asked about the Cresap project, Morton referred the question to OCR's George Fumich, who would only say negotiations are too "delicate" to discuss. □

CHEMICAL ACCIDENTS

Fighting fire with a computer

A propane tank car exploded in Illinois several months ago, causing a train wreck of considerable proportions. Vinyl chloride burned rapidly producing a by-product that railway personnel believed was the dreaded mustard gas of World War I. About a thousand persons, whose homes were near the wreck were evacuated. Although the by-product of vinyl chloride turned out not to be mustard gas, and no lives were lost, the railroad ended up paying the town's citizens thousands of dollars to cover the inconvenience of the evacuation, rather than have these people bring suits against the railroad for negligence.

This is only one example of explosions and accidents that can take place while chemicals are being transported, usually by railroad. Deaths, illnesses, damage and public inconvenience might be prevented if railroad employes, fire departments and physicians arriving on the scene knew what to do. They usually do not because there is no communications center to call to find out exactly what chemicals have exploded, and what countermeasures should be taken.

In response to this need, the Railroad Systems and Management Association has devised information systems to help people know. The simplest is a pocket index to be carried by the man on the scene that lists over 200 chemicals and tells what first-aid measures to take for each and what not to do. For use in railroad control centers they have devised a manual that picks up where the index stops. It lists procedures to be followed from the time a carrier's control center receives word of an accident through clean-up of the area.

The manual gives several thousand names for some 400 chemicals. For each it estimates the severity of risk and the hazards to life. It details methods of fire control and waste disposal and it describes first-aid and medical supportive procedures for physicians on the scene.

With the help of the RCA Corp., the RSMA has developed a computer which would make all this information available through print-outs in four languages at various computer outlets around the country, or via special phones hooked up to the central computer bank. The index and manual are already being used by eight railroads, some fire departments and several industries other than railroads. Bringing the computer into use, RSMA officials believe, is a project for the U.S. Department of Transportation.

The computer was demonstrated before DOT officials last April, but RSMA spokesmen say that DOT has made no definitive response about financing implementation of the computer, possibly because the department is waiting for the passage of an appropriations bill to fatten the Federal Railroad Safety Act of last December.

ICRR

It might have been mustard gas.

Quentin Bank, assistant chief of hazardous materials at DOT, however, says DOT is hesitating about the computer for several reasons: Few large chemical companies have been willing to provide RSMA with information about their products. RSMA indicates it would like to run the computer system for DOT, but DOT is having trouble generally in delegating its authority to industry. Anyway "the idea is good," Bank says. "RSMA or somebody will eventually get the job to do."

In any event, Ted Leviton of RSMA, who demonstrated the index, manual and computer at the 23rd International Congress of Pure and Applied Chemistry, held in Boston last week, believes that waiting is a pity when millions of dollars and not a few lives are at stake.

The question is, will Government now pay the tab to make the chemical explosions communications computer available? Regardless of DOT action, Grant Cvietsch, president of RSMA, says another Government agency has promised to get the computer implementation going within six weeks. □