A plan to probe into the continent

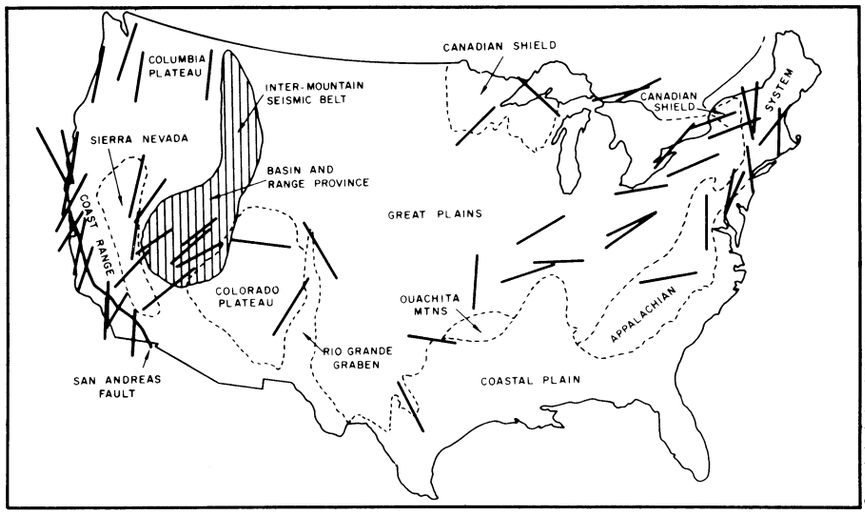
Geophysics, being the science it is, has gotten much of its information out of holes in the ground. The record goes back at least to the silver miners of ancient Greece, who observed that the deeper they went the hotter it got. From the silver mines of Laurion in Attica to the petroleum wells of Oklahoma's Anadarko Basin, the information for dry-land geophysics has usually come from holes drilled for commercial purposes. Now a group of distinguished American geophysicists, whose deliberations of the subject were financed by the Carnegie Institution of Washington, proposes a change: deep dry-land holes specifically for geophysics.

The proposed Continental Drilling Project is a conscious imitation of the highly successful scientific program of undersea deep drilling that has been going on for the past seven years. If dry-land geophysics piggybacked on mineral exploitation, the reverse has been true under water. There the successes of the scientific program have stimulated commercial interest.

The holes proposed would be the deepest ever yet drilled, though not spectacularly deeper than the deepest now existing. Nine kilometers is the maximum for the proposed holes, compared to seven or eight in the Anadarko Basin and the Kola Peninsula in the Soviet Union. The drilling would thus be within the capabilities of present techniques except for some proposed hot-rock drilling that might require the new melting and boring techniques under development at the Los Alamos Scientific Laboratory.

The scientific objectives are several, basic and specific. They encompass the nature of earthquake mechanisms and possible avenues to their control or mitigation, investigations of geothermal deposits and possible penetration of a molten magma chamber, study of lateral stresses in the North American continental plate in an attempt to elucidate details of the forces that move it, and probes of the basement rock—the deepest part of the crust, what might be called the foundation garment of the continental plate.

The San Andreas is North America's best known earthquake fault and probably its most dangerous with regard to activity and location near population centers, and it is the target of the earthquake probing. The technique is to drill a hole alongside the fault zone and to "whipstock," bore off laterally, through the fault zone. The object is to study the relationship of lubrication to the release of stress (see p. 402) and why different portions of the fault release stress at different rates. It may turn out that artificial interference can promote gradual release in place of catastrophic quakes. The location would probably be the Bear Valley about 100 miles south of San Francisco.



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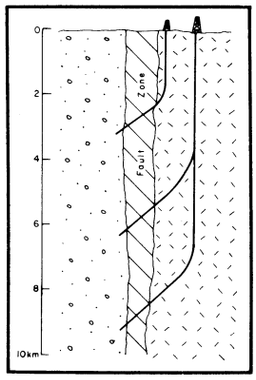

Map of lateral stress trajectories shows large data gap in the high plains region. "Whipstocking" is the technique proposed for probing the San Andreas fault (left).

The geothermal questions involve the differences between the two kinds of geothermal wells, those that spew mostly hot water and those concerned with dry steam and where the water comes from. The flow rate indicates there must be water sources deep underground not connected with the surface water cycle. Another objective is to obtain a sample of the molten magma that serves as a heat source.

Commercial holes have given a good deal of information about lateral stresses in the continental plate. The technique is to pump in high-pressure liquids and to observe in what direction the surrounding rocks crack. But commercial holes are drilled only where there is hope of oil or gas so there are no data for a large part of the middle of the continent.

The basement rock comes to the surface in northern Canada, but it is buried through most of the United States. The questions include how far out to sea it extends and whether it undergirds the whole of the dry land (in the Pacific Northwest it may not), and its general structure and composition.

Each of the principal projects would take between four and seven years. Each would take $20 million to $30 million, bringing the total to upwards of $150 million. The different projects could be done separately. The geophysicists envision funding from various government agencies that ought to be interested.

To justify support there is a promise of practical results. Earthquake control could conceivably save thousands of lives and billions of dollars, says Eugene F. Shoemaker, of the California Institute of Technology, one of the two conveners of the panel. "If we don't do something about the earthquake danger in California, we're headed for a major disaster." Energy-crisis types should be interested in the geothermal phenomena. And then there is always the gnomic serendipity of digging into the earth. E. F. Osborn of the U.S. Bureau of Mines relates that the Polish government, prospecting for gas to decrease its dependence on Russia for fluid hydrocarbons, hit a deposit of high-grade copper. Poland has gone from being a copper importer to a copper exporter as a result of the one discovery. □

The argon on Mars: Portents, puzzles

On March 12, 1974, a Soviet spacecraft called Mars 6 reached the surface of its namesake planet. Apparently it crashed—its transmissions ceased just as it was to have touched down—but one of its instruments, a mass spectrometer intended to measure the gases in the Martian atmosphere, managed to get out a brief signal. It didn't measure anything; it just signaled that it was getting ready to go. But that short message has stirred new and old concerns ranging from improved chances of life on Mars to a reappraisal of the genesis of earth.

The signal came from the spectrometer's ion pump, a device which was to clear gases out of the instrument. It showed that the current in the pump seemed to be sporadically rising, a possible indication that the pump was having to work harder than expected. One interpretation of the rising current is that a