earth sciences

Strata in the Moho

In 1910, the Yugoslav geophysicist Mohorovičic discovered the transition layer between the earth's crust and mantle. The "Moho," as it was named (for Mohorovičic discontinuity), has now revealed some of its secrets to a West German seismologist.

Rudolph Meissner, head of the Institute of Geophysics of Kiel University, has proved that the Moho is not a simple bordering layer—as had been generally assumed—but rather a transition zone several kilometers in thickness. Using special methods of analysis in interpreting artificial earthquakes in the foothills of the Alps, Meissner showed that the transition layer is not homogeneous and uniform. Instead, it consists of varying stratifications of thin layers or thin lens-shaped rock layers of varying sound conductivity. Some of these "lenses" or strata, whose thickness may be 80 to 150 meters, may possibly be in a semi-molten state.

A summary from the German Research Society reports that near Ivrea, Italy, in the southern Alps, there is rock consisting of an uplifted "splinter" that contains the transition zone (the Moho) and shows these lens-shaped rocks as well as a kind of laminated structure.

San Andreas Fault: Forecasting slippage . . .

A group of California scientists report what they call "most encouraging" evidence that observation of water level changes in deep wells can be used to monitor stress changes along active earthquake fault zones.

A 152-meter-deep well was drilled into the San Andreas Fault zone near Hollister, Calif., about 300 yards from the famous Cienega winery building, which is continually being sheared by intermittent fault creep. Creep at the winery site is continually being measured by the Stanford University geophysics department.

Measurements of the water level in the well showed changes that coincide, within hours, with the only creep episodes recorded at the site. In the first instance, water level in the well rose 5.6 centimeters four hours before a movement of 4 millimeters along the fault. In another case, it rose 3.2 centimeters 8 hours before a 2-millimeter movement of the fault. The third level change came 1.5 hours after a movement along the fault.

"The results are most encouraging to the proposition that deeper wells could detect strains and pressure changes deeper in the earth's crust . . . ," say Ansel G. Johnson, Robert L. Kovach and Amos Nur of Stanford and John R. Booker of the University of Washington in the Feb. 10 Journal of Geophysical Research.

. . . estimating the annual movement

In the same issue of JGR, J. C. Savage and R. O. Burford of the National Center for Earthquake Research report a reexamination of geodetic data to estimate the current relative movement between the American and Pacific crustal plates across the San Andreas Fault system. (The American plate is the huge slab of the earth's upper surface on which most of North America, except extreme western California, "rides." Most of the Pacific Ocean crust and the part of California west of the San Andreas Fault ride on the Pacific plate. The plates slip past each other in response to shear stresses that presumably originate from the drag of mantle convection currents along the bottom of the plates.)

The data reexamined consist of repeated surveys of triangulation networks over the period 1907-1962, repeated surveys of the geodimeter network, and direct measurements of fault creep along the 280-kilometer segment of the fault extending southeast from San Francisco. The geophysicists find a remarkable agreement in the data that indicate the average relative lateral motion along the fault for the period from 1907 to 1971 to be 3.2 centimeters a year. They consider the figure accurate to within 0.5 centimeters a year.

Two views on earth's core: The core paradox . . .

In a paper in 1971, George C. Kennedy and Gary H. Higgins of the University of California at Los Angeles noted the possibility that the liquid in the earth's outer core was separated into layers of different temperatures. This stratification, they felt, might inhibit circulation of the outer core fluid of the kind proposed for generation of the earth's magnetic field. Since then, a number of geophysicists have made suggestions for escaping "this seeming paradox."

In the Feb. 10 Journal of Geophysical Research, Kennedy and Higgins say they have examined these suggestions and find that none of them seem likely to provide an escape from the paradox. However, they may have come up with one themselves. They find that the lower one-third of the fluid in the outer core may have a temperature distribution that might allow free circulation. If so, convective circulation in that restricted region could possibly generate the geomagnetic fields.

. . . oscillations of the inner core

Also in the Feb. 10 JGR, I. J. Won and J. T. Kuo examine theoretically the oscillation of the earth's inner core. They find it to be "very probable that the inner core can be excited to a state of oscillation by an external agency such as a large earthquake or a large meteorite impact."

Although the amplitude of the oscillation (its period would be 7.4 hours) turns out to be extremely small, they present calculations showing that the oscillation can generate motions in the outer core of the velocity required by the present geomagnetic dynamo theory. In other words, they propose that the inner-core oscillations are ultimately responsible for producing the earth's magnetic field.

Won and Kuo say the chance of experimentally verifying the oscillation of the inner core by means of an ultrasensitive tidal gravity meter appears promising.

Deformed deeps in the Indian Ocean

Recent cruises of the research vessels Conrad and Vema have revealed a group of unusual linear structural depressions that appear to be the deepest features found so far in the Indian Ocean basin. Depth to the acoustic basement exceeds 7,500 meters in at least one of the deeps, considerably in excess of the regional depth of the rest of the Wharton basin, in the northeast Indian Ocean.

In the Feb. 10 Journal of Geophysical Research, G. Carpenter and John Ewing of Lamont-Doherty Geological Observatory propose two possible explanations for the deeps. They appear to be either disoriented fracture zones associated with an extinct and ill-defined former ridge of seafloor spreading, or they are areas where the crust has become thin and extended.

Whatever the tectonic process responsible for the genesis "of these remarkable features," as Carpenter and Ewing term them, it now seems to be quiescent. They appear to have been in existence since very early in the tectonic history of the basin, perhaps as much as 100 million years ago.