EARTH SCIENCES

From our reporter at the meeting of the American Geophysical Union in Washington

Dry oil well becomes scientific success

An exploratory oil well which failed to find oil has provided a six-university scientific team a chance to study the earth's crust in the Michigan basin, a region in which the crust dates from ancient Precambrian times to the recent Ice Age period. According to B.C. Haimson of the University of Wisconsin at Madison, the 5,325-meter (17,470-foot) well, located in Gratiot County near Ithaca, Mich., is the deepest manmade hole in the northern United States.

"In addition to the extraction of some 60 feet of core for further rock mechanical, geological and geophysical studies," Haimson says, "measurements of heat flow, stresses, gravity and sonic velocities were conducted in the well." The stress tests, using hydrofractionation, yielded minimum stresses ranging from 295 bars in the Devonian Amherstburg formation at a depth of 1,230 meters to 950 bars in a late Precambrian red silty shale 5,110 meters down. At the deepest level attempted, 5,320 meters, the tests reached the 1,000-bar safety threshold of the well pipe without hydrofracturing the local gabbro zone. The stress required at the shallowest level tried, says Haimson, was "considerably higher" than expected from projecting the linear curve that fits the deeper values, perhaps due in part to a Devonian-Silurian discontinuity 5 to 10 million years ago or to stress relaxation in and above the shallower Salina salt layers.

How storms cool the sea

Just 12 hours before powerful Hurricane Eloise struck the Florida panhandle last September, it passed over a heavily instrumented buoy known as EB10, placed in the north-central Gulf of Mexico by the National Oceanic and Atmospheric Administration. As a result, EB10 has provided a detailed picture of local sea-surface response to a hurricane.

Crossing at about 18 miles per hour, Eloise produced internal inertial waves in the ocean beneath, increasing the depth of the vertical mixing layer from 20 to about 60 meters. This was the major factor in lowering the sea-surface temperature by about 1.5°C, although upwelling sustained a 0.5°C drop for two days after the storm's passing. The internal waves reached a peak amplitude of about 65 meters, 500 meters below the surface, eight days after Eloise was gone, says James F. Price of the University of Miami.

Groundwater is geothermal guide

Chemical analysis of groundwater can be a valid guide to areas with potential as geothermal energy sources, according to two New Mexico State University researchers. This also suggests that the large existing body of hydrologic data can offer ready clues in the search for sites for commercial geothermal development.

Chandler A. Swanberg and Charles H. Stoyer studied relative concentrations of silica, sodium, potassium and calcium, as well as actual water temperature and total dissolved solids, from 150 new sets of groundwater measurements and from more than 10,000 earlier analyses dating back as far as 1917. Applied to geologic maps, their results indicated the same geothermal hotspots as had previously been determined by other workers using different methods. In addition, the NMSU scientists were able to identify several previously unknown sites, many of them along the boundary between the Colorado Plateau and the Basin and Range region that includes southern and western Arizona and other large areas of the western United States.

PHYSICAL SCIENCES

The great pinball machine in the sky

I. The Dreigroschen quasar opera

Detailed radioastronomical studies of a number of quasars indicate that each of those objects is composed of several components that appear to be moving swiftly apart from each other. In some cases the apparent velocities are greater than that of light.

In order to save modern physics from such forbidden speeds some very ingenious models have been devised, such as the Christmas tree effect, which says that the apparent motions are really a series of well-timed blinks of a string of stationary components. One can also conclude that quasars are not as far away as their redshifts would make them. But that throws a spanner into the works of many a cosmological theory.

Adopting a model that is both more ingenuous and more ingenious, four theorists apply the geometrical formulations of general relativity in an attempt to solve the problem (C. Behr of the University of Mainz, E. L. Schucking and W. Wallace of New York University and C. V. Vishveshwara of the University of Pittsburgh in the ASTRONOMICAL JOURNAL 81:147).

The model assumes that the motions are real; that is, that quasars from time to time emit radio sources that fly away with velocities near to but not in excess of that of light. It also assumes that the quasars are as far away as their redshifts would indicate. Applying the geometry of the Friedmann universe, one of general relativity's models for the configuration of the cosmos, these theorists find that if such objects are emitted within a fairly narrow angle around the line of sight from the earth to the quasar, their motion will look superluminal even if it is not.

It is, of course, highly improbable that quasars should emit such objects only in the line of sight. They should spit them in all directions. We see only a few of them because their speeds cause a decline in apparent intensity that makes the rest inconspicuous. The theorists put it in the words of Kurt Weill and Bertold Brecht:

Therefore, some are in darkness;
Some are in the light, and these
You may see, but all those others
In the darkness no one sees.

II. Fast-flying pulsars

Studies of the motions of 12 pulsars done at the Five College Radio Astronomy Observatory indicate that at least some of them are moving fast enough to escape the gravity of the galaxy and fly off into intergalactic space. G. Richard Huguenin of the University of Massachusetts reports velocities between 30 miles per second and 350 miles per second.

A theoretical explanation for such speeds is that pulsars are "photon rockets." That is, the light and radio waves they emit propel them by reaction just as the gas molecules that a rocket emits propel it by reaction. In principle, velocities up to 1,000 miles per second could be produced in that way, theorists say.

III. Another blinking X-ray source

The X-ray source Circinus X-1 changes its intensity over a period of about 16.59 days. L. J. Kaluzienski, S. S. Holt and P. J. Serlemitsos of the Goddard Space Flight Center report in International Astronomical Union Circular 2939 that they have recorded 10 of these periods since October 1975. The blinking may be caused by eclipse of the X-ray source by a binary companion, the observers suggest.