earth sciences

Another crack in the crust

The parallel bands of reversed and normal magnetization in the ocean crust are broken and offset in many places, revealing fractures in the sea floor.

George Peter and Omar E. DeWald of the National Oceanic and Atmospheric Administration's Miami laboratories have found, from magnetic lineations, a previously unsuspected fracture off the coasts of Oregon and Washington. Adding the results of recent NOAA magnetic surveys to previous ones, they obtained a magnetic map of the northeast Pacific that extends farther westward than previous maps.

Moving westward from the Gorda Ridge, off the coast of Oregon, the magnetic anomaly pattern is continuous (for about 220 kilometers). But west of the Juan de Fuca Ridge several of the anomalies disappear. The disappearance of these anomalies occurs along a northwest line which correlates with a sharp change in the relief of the sea floor, from very rough topography in the east to a smooth abyssal plain in the west. This line, they suggest in the Aug. 2 NATURE PHYSICAL SCIENCE, represents a fracture zone, which they name the Juan de Fuca.

This fracture, and the present scattered locations of three ridge fragments that had once been connected, is probably the result of crustal deformation. The deformation was in turn caused by compression of the crust.

It's long been cold up there

The climatic history of ocean basins can be inferred from studies of microscopic fauna preserved in deep-sea sediments and from the ratio between isotopes of oxygen (SN: 11/7/70, p. 369).

Dr. Yvonne Herman and Caroline Hooper of Washington State University and Dr. C. Vergnaud Grazzini of the University of Paris applied both methods to sediments from the Arctic Ocean north of Alaska.

The longest core recovered spans the last 3.3 million years. In the Aug. 13 NATURE the researchers report that the surface and deep water underwent periodic fluctuations and that the average surface water temperatures have varied between about minus 2 degrees and plus 0.5 degree C. Salinities ranged from 29 to 36 parts per thousand. Present-day surface water temperature varies between minus 1.6 degrees and 0 degree C. Salinity ranges from 29 to 33 parts per thousand.

Throughout the cores are debris that show evidence of having been transported by drifting ice. This indicates that high latitude glaciation began before 3.3 million years ago, the scientists conclude.

Filling in climatic gaps

Genuine understanding of climatic trends requires a complete record of past climate on a global scale. Climatic information for the past 30,000 years in the southern hemisphere has lagged behind that for the northern hemisphere. Lakes in southeast Australia are being studied to help fill this gap.

In the July 30 NATURE, Drs. J. M. Bowler of the Australian National University and Tatsuji Hamada of Japan's Institute of Physical and Chemical Research report preliminary results from Lake Keilambete, which occupies a volcanic crater in the Victoria province. The lake level is sensitive to changes in precipitation or evaporation, so that lake sediments reveal past climate.

The lake was full from about 30,000 to 18,000 years ago. Sometime in the next 3,000 years it dried up and the water level did not begin to rise again until about 10,000 years ago, reflecting an increase in precipitation or a decrease in temperature, the scientists conclude. Since then, the lake level has fluctuated, and in 1969 reached its lowest point in 1,900 years. A postglacial temperature maximum from 5,500 to 3,100 years ago is represented by a slow fall in water level. The data suggest conditions similar to those of today.

A slice of crust

Up to now, geophysical investigations of the sea floor have been somewhat piecemeal, concentrating on selected isolated locations. The Trans-Atlantic Geotraverse is aimed at establishing what project chief scientist Dr. Peter A. Rona calls "the first standard crustal section across an ocean basin." Conducted by the National Oceanic and Atmospheric Administration, the study is part of the International Decade of Ocean Exploration.

The crustal section, 200 miles wide and 3,500 miles long, is calculated to be as close as possible to the track left by North America and Africa as they drifted apart. Data will include topography, magnetic intensities, gravity readings, rock ages and crustal structure to a depth of 10 kilometers.

The research ship Discoverer has already made three tracks along the section, studied foothills on the Mid-Atlantic Ridge and sampled the ocean floor from the ridge to the African continental shelf. Dr. Rona reports that they have found very heavy encrustations of manganese ore exposed on sea-floor fractures.

Studying underground waste storage

For centuries man has been dumping his garbage over the surface of the earth. More recently, the practice of injecting fluid wastes into the earth's interior has been growing.

Such injections, often carried out with little knowledge of the area's underground geological plumbing, may adversely affect subsurface water supplies and even geologic structure. The U.S. Geological Survey is conducting a major study of the effects of underground waste storage. "For many years now," says Joseph T. Callahan, chief of USGS's branch of ground water, "unwanted, and sometimes noxious wastes, have been poured into the ground with relatively non-uniform regulations based upon fragmented knowledge." The major aim of the study, he says, is to develop enough knowledge to assess levels of risk and predict the effects of disposal schemes.

The program includes a number of separate projects, such as seismic monitoring of an experimental disposal well at Tuscaloosa, Ala.; assessment of problems of subsurface waste storage in the Ohio River Basin; studies of geologic and hydrologic factors controlling fluid movement in the Floridan aquifer (a water-bearing formation); and studies of the amount, quality and reactivity of organic substances in ground waters.