earth sciences

Earthquakes and explosions

Much of the opposition to underground nuclear tests is based on the fear that they may set off damaging earthquakes (SN: 5/22/71, p. 350).

Some scientists, such as Dr. M. Nafi Toksöz and Harold H. Kehrer of the Massachusetts Institute of Technology, believe that such explosions may also be a useful tool for earthquake control. The two examined the seismic waves generated by a number of underground nuclear explosions. They found that the Pile Driver and Hardhat explosions in 1966 and 1962 at the Nevada Test Site released accumulated strain energy more than 10 times greater than their own.

The amount of strain released depends on the type of rock and on the amount of pent-up energy in the vicinity. Explosions in hard media, such as granite, release more strain than do explosions in softer rock, the scientists report in the July 16 SCIENCE.

Explosions could be used to deactivate a seismically active site before construction of projects such as nuclear plants, the researchers suggest. However, they caution, it is not yet known how soon strain would build up again, and further, explosions seem to affect only small areas.

On the other hand, the geophysicists warn, nuclear testing in areas of high stress might have serious consequences. A 10-megaton explosion releasing proportionally as much energy as Hardhat could generate energy equal to a 7.2-magnitude quake.

Mexico slides seaward

Mexican and United States scientists participating in the International Decade of Ocean Exploration have found evidence that the eastern part of Mexico has been sliding slowly into the Gulf of Mexico during the past two million years.

In the Gulf of Mexico, they report, there are enormous folds of rock and sediment "that resemble somewhat the folds of a wrinkled rug." These earth layers are crumpled in much the same way that rocks and sediments are deformed at the base of many large slides on land.

The area involved is a huge slab of the earth's crust of about 75,000 square miles east of the Sierra Madre Oriental extending from just below the Texas border to south of Mexico City. "Comparison with the unusual—and perhaps unique—geologic conditions off eastern Mexico," says Dr. George W. Moore of the U.S. Geological Survey, "will help us to evaluate other areas where earthquakes, subsidence and slow rock deformation may affect engineering structures in the offshore zone."

Opening of the Labrador Sea

The directions of sea-floor fractures and magnetic anomalies are the two main clues to past motions of crustal plates. These clues are well defined in some areas of the ocean, but in others, such as the Labrador Sea, they are more obscure.

After painstaking seismic, magnetic and gravity surveys, supplemented by cores, dredges and photographs of the sea bottom, Drs. Xavier Le Pichon and Guy Pautot of France's Centre Océanologique de Bretagne and Dr. Roy D. Hyndman of Dalhousie University in Nova Scotia have reconstructed the opening of the Labrador Sea.

There were two main phases of opening, they report in the July 10 JOURNAL OF GEOPHYSICAL RESEARCH. During the first phase, which began about 80 million years ago, the rate of sea-floor spreading was about 0.8 centimeters per year. This episode would have been accompanied by rapid subsidence of the sea's margins, along which thick sediments were deposited. The second phase was slower—about 0.5 centimeters per year—and the direction of spreading had changed slightly. The researchers believe that the second episode was followed by progressive slowing of the rate of spread, though the Labrador Sea is probably still opening very slowly.

Another ancient pole position

Establishing the past positions of the earth's magnetic poles entails determining the direction of magnetization of rocks of different ages and locations. At present, there is little data from any part of the world for pole positions during the period from 345 million to 600 million years ago. What data there are come from sedimentary rocks, which cannot be accurately dated.

Drs. Edwin E. Larson of the University of Colorado and Felix E. Mutschler of Eastern Washington State College studied igneous rocks from central Colorado. The magnetization of igneous rocks is generally more reliable for determining ancient pole positions. The magnetization is usually acquired instantaneously, and the rock can be accurately dated.

The Colorado samples, the geologists report in the June GEOLOGICAL SOCIETY OF AMERICA BULLETIN, indicate that about 500 million years ago the pole was at the same position that it was 250 million years later. The researchers conclude that either the magnetic pole was relatively stable during this period, or if the pole did wander, it returned to its earlier position.

Little drops make more rain

Unusually high rates of rainfall development have been observed in certain clouds. The reason, according to three University of Manchester (England) physicists, may be that formation of smaller satellite drops by collisions between larger raindrops increases rainfall intensity.

In the laboratory, Drs. P. R. Brazier-Smith, S. G. Jennings and John Latham made streams of uniformly sized drops of water of different radii collide in midair at different velocities. Photographs of the collisions show that for low-velocity collisions the drops coalesced permanently, but for collisions at higher velocities, the drops coalesced temporarily and then rotated and separated, forming one to eight smaller drops. Satellites were produced most readily when the ratio of the radii of the colliding drops was between two and three.

If raindrops falling through clouds suffer similar collisions, they suggest in the July 9 NATURE, the rate of transformation of cloud water to rainwater will be increased. Further calculations showed that satellites are particularly important to this transformation in clouds of high liquid water content.