Stalking the Mid-Continent Quake

The most awesome earthquakes in U.S. history have occurred not in ever-trembling California, but in the Missouri "bootheel," a small piece of the state that nicks into Tennessee, Arkansas and Kentucky. Between December 1811 and February 1812, three massive shocks, centered near the town of New Madrid, Mo., devastated forests for hundreds of miles, changed the course of the Mississippi River, created new lakes and wiped out old ones.

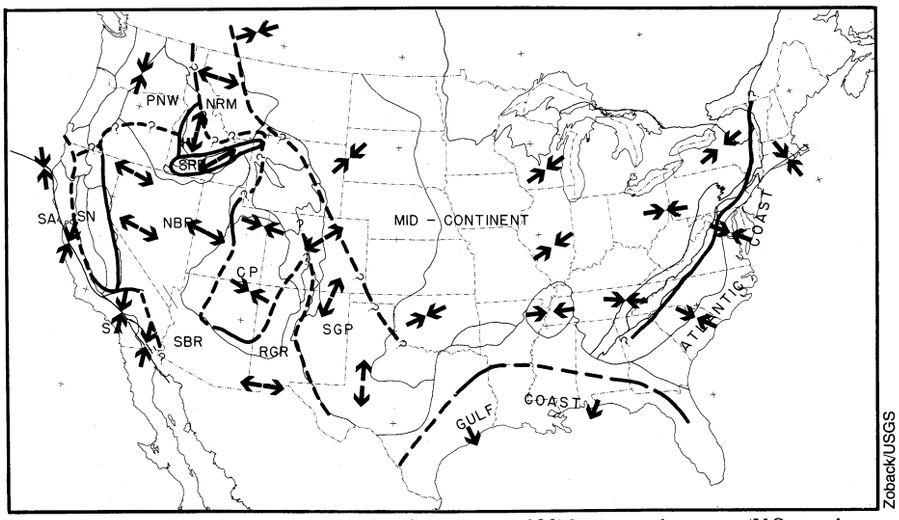
Geologically, these quakes are particularly distressing: Most major earthquakes, such as those in California, occur at well-defined faults where two tectonic plates grind past one another. New Madrid-style quakes, however, occur within a tectonic plate and cannot be neatly explained by obvious faults and plate motions.

But a cohesive explanation is beginning to emerge for "intraplate" quakes such as those in the Midwest and on the East Coast. In particular, recent measurements by Mary Lou Zoback and Mark D. Zoback of the U.S. Geological Survey have uncovered the direction and types of stress that may be responsible for eastern and midwestern quakes — an important step toward determining where and when such quakes may occur.

As Mark Zoback told a recent symposium on earthquake prediction in New Paltz, N.Y., the nascent theory is the fruit of a variety of recent research concentrated primarily in the New Madrid region. A seismic network operated by St. Louis University shows two distinct regions of quake activity in Missouri — one running northwest-southeast from New Madrid into Tennessee and one crossing northeast-southwest from Arkansas into the bootheel. Seismic soundings recently revealed a shallow fault (SN: 11/3/79, p. 310) that coincides with the northeast-southwest zone of activity. Beneath the fault zone, magnetic and gravity surveys uncovered a 50-mile-wide, 200-mile-long rift valley — a region that at one time stretched and collapsed in a process similar to that now splitting Asia and Africa (SN: 1/5/80, p. 9). A deep trench dug across the fault zone showed researchers that in the past 2,000 years, three devastating quakes have occurred in the region.

More recently, the Zobacks have examined the stresses within the crustal rock of the New Madrid region, as well as of the eastern seaboard. The researchers use a technique called hydrofracture, in which a hole is drilled into the ground and water is pumped in under sufficient pressure to cause cracks in the walls of the hole. According to theory, the cracks will form along the direction of maximum stress.

In the interior of the continent, the Zobacks found that the maximum stress is east-west, approximately parallel to the westward drift of the North American plate. The stress, they suggest, is caused by drag on the bottom of the plate as it moves; earthquakes occur in the New Madrid area as drag-stress builds up and the already rifting-weakened crust gives way.



Stress direction measurements may lead to cause of Midwest and eastern U.S. quakes.

In the eastern United States, however, the picture is less clear. The stress field apparently lies perpendicular to the coast and is not consistent with the plate motion. Moreover, only two structures that might be interpreted as faults have been found, one in South Carolina and one in New York, and the relation between them and the stress field is not clear, the Zobacks say.

Particularly in the eastern United States, "We need to look for more structures and somehow get enough stress data," says Mark Zoback. "But it's all very consistent; the picture is coming together well." □

Gene-spliced hormone, interferon do job

Rapid has been the success of biologists in engineering bacteria to make animal materials. But slower has been the task of demonstrating that the new bacterial products can function effectively in animals. Now Nowell Stebbing of the research firm Genentech (SN: 3/29/80, p. 203) reports that two bacterially produced materials — human growth hormone and human interferon — are as active in animals as are their mammal-made counterparts. He was speaking at a recent meeting held by the Food and Drug Administration.

Stebbing's report includes the first announcement that Genentech, in a collaboration with Hoffman-LaRoche Inc., has produced two types of human interferon — fibroblast and leukocyte — through recombinant DNA technology. Earlier this year a Geneva-based company, Biogen, S.A., reported the first bacterial production of the leukocyte form (SN: 1/26/80, p. 52). The yields reported by Biogen were only a few molecules of interferon per bacterial cell. The Genentech procedure, however, yields as many as 100,000 molecules per cell. That amount corresponds to 50 patient doses, Genentech estimates. Interferon is currently being studied both as an anticancer and antiviral agent (SN: 6/7/80, p. 358).

The high yield is due to two factors, according to Genentech vice-president Robert F. Byrnes. The gene, which was copied from human RNA, is attached to a natural bacterial control system. In addition, the connection is a "direct hook-up," so no precursor regions need to be trimmed from the product.

The interferon produced by bacteria at both Genentech and Biogen differs from mammalian interferon in at least one respect. The bacterial material does not contain sugar groups. Stebbing reports preliminary data indicating that despite its sugar deficiency bacterium-produced interferon is active.

Groups of three squirrel monkeys received either bacterial or human cell leukocyte interferon before and after infection with the deadly encephalomyocarditis virus. All animals in both groups survived, but not monkeys that received only natural bacterial proteins.

At the most recent meeting of the federal Recombinant DNA Advisory Commit-