Study of Earthquake Forecasting

COLLEGE— Accurate earthquake forecasting is still years away, but Seismologist Eduard Berg at the University of Alaska's Geophysical Institute has taken the first step toward that goal with a $200,000 research project sponsored by the U.S. Air Force Office of Scientific Research and the Atomic Energy Commission.

Earthquakes don't just happen, Dr. Berg asserts. "It takes months and sometimes years for the earth's crust to store up the tremendous amount of energy released in an instant as an earthquake."

Berg likens the earth's crust to taffy, building up stress and strains as it is continually twisted, turned, stretched, and compressed by the little-understood process of crustal deformation.

"Eventually the crust, like the taffy, reaches the limit of its elasticity and fractures (pulls apart), liberating the energy that has deformed it as an earthquake, and then springing back."

In the new research project, Dr. Berg and his associates, Dr. Hans Pulpan, Larry Gedney, John Davies, and Bill Feetham, at the Geophysical Institute's seismological observatory will implant borehole seismometers 30 feet into bedrock at NASA's Gilmore Creek tracking station north of Fairbanks, at Paxson in the center of the Alaska Range, and at Mt. McKinley National Park.

The 12-foot pencil-shaped instrument packages will augment UA's existing seismic net—already the most wide-spread of any university-operated system in the U.S.

Seismic telemetry units will transmit earthquake shock wave information back to the observatory at the Geophysical Institute, enabling researchers to pinpoint epicenters by triangulating data supplied by instruments located throughout the Interior and southern coastal region of the state.

The new addition to the system will also provide UA seismologists with a more accurate means of determining earthquake depths in central Alaska.

Sensitive tilt meters in the lower half of the borehole units will play a key role in developing forecasting techniques.

In many instances, crustal deformations of the earth's crust, which are believed to cause many earthquakes, can be observed and even measured over a long period of time, alerting seismologists that an earthquake may be generated.

Seismologists vociferously assert that measuring minute shifts and deformations over an area encompassing thousands of square miles on the crust's surface cannot be construed as forecasting, but they just as readily explain that rudimentary forecasting may result from long term studies such as Dr. Berg's which correlate observed straining and tilting to earthquakes.

Dr. Berg believes Californians will have earthquake warnings sooner than Alaskans, "Because their fault systems are more orderly and much better known than Alaska's, and there are many more scientists concentrating on the quake problems associated with slippage along California's San Andreas fault."

Crustal deformation, Berg explains, can take two forms, either tensional or compressional straining within the crust, or slippage along a fault as evidenced in California.

"Sections of the crust adjacent to the San Andreas fault are moving in opposite directions," Berg says, "So long as there is slippage (a few inches per year) the crust is relieving its stresses and earthquake danger is low, but if the fault locks and slippage stops, the crust deforms and earthquake danger increases."

Alaska's geology, Berg points out, is much more complex than California's, bringing to the fore such un-Californian complications as active volcanoes (which can trigger earthquakes), convoluted in interlocking faults that snake through the curst, and a growing chain of mountains dominated by the continent's highest peak.

Discounting the geological differences between Alaska and California, Dr. Berg believes that he and his California counterparts are confronted by a common problem, the solution of which could well be the crux of the forecasting dilemma.

"Right now the biggest problem is determining when deformation rates become high enough to trigger a catastrophic failure (an earthquake) in the crust," he says. "Just saying that the crust is being deformed, or even how much, isn't as important as saying that the crust will fail next week or next month."

"It is clear," he said, "that we must study the data from the borehole packages, correlating it with our other sources of seismic information, in order to establish a repetitive pattern of deformation and failure, strain and earthquake."

To do so will keep Dr. Berg and his associates busy for several years, even though earthquakes happen with regularity in Alaska—records indicate that Alaska (including the Aleutian chain) has a magnitude eight, or greater every ten years, a quake comparable to the ones which leveled San Francisco in 1906 and portions of Anchorage in 1964.

Research on the long term project will involve interpreting the daily yeild from the seismic net as well as conducting laboratory experiments.

"Long before an earthquake occurs," Dr. Berg explains, "the rock which is being deformed develops small fractures (microfractures) which are roughly comparable to faults in the earth's crust, but they are measured in meters rather than miles."

Laboratory experiments with rocks representative of the earth's crustal materials will enable researchers to ascertain strain tolerances of various rock types before total failure. Outside the Geophysical Institute's labs, researchers will be analyzing failures on a larger scale—the earthquake shock waves that appear daily on UA's seismic records.

By correlating lab data on rock strength and seismic records linking crustal deformations and tilts to earthquakes, the UA research team headed by Dr. Berg is working toward the day when they'll actually be able to alert Alaskans to an impending earthquake, but as yet, they won't predict the date of their first prediction.