EARTH SCIENCES

Radio signals before quakes?

Six days before the catastrophic Chilean earthquake occurred on May 22, 1960, an unusually large electromagnetic emission was recorded by several widely spaced radio astronomy receivers in the Northern Hemisphere. James Warwick, a radio astronomer now of Radio Physics, Inc. and the University of Colorado in Boulder, concluded in 1963 that the emission might have been produced by a source surrounding the earth or possibly "hanging like a cloud over the observing stations." Now, some 20 years later, re-evaluation of the earlier analysis has led Warwick, with Carol Stoker, also of the University of Colorado, and Thomas R. Meyer of Colmek, Co., Inc. in Boulder, to hypothesize that the radio signal was emitted by stress-induced microfractures in quartz-bearing rocks along the Chilean Fault. That same increase in stress, they say, may have led to the earthquake six days later.

They speculate in an upcoming issue of the JOURNAL OF GEOPHYSICAL RESEARCH that the radio event may have been a precursor of the earthquake, one of the largest in the century, and that broadcast-band radio waves may become a useful tool for earthquake prediction. Under stress, fractures in quartz-bearing rocks become wider and longer, and an electric field forms along microfractures in the rocks. In laboratory tests, the scientists found that all initially unstressed samples of quartz-bearing rocks, when stressed until they fractured, produced detectable electric and magnetic signals. The authors do not know whether every strong earthquake emits similar radio signals but suggest that it would be a "worthwhile gamble" to deploy radio receivers along the San Andreas Fault. Rocks capable of emitting radio signals are present there, although not in the same proportions as along the Chilean Fault.

Research use for suspect gases

The gases chlorofluorocarbon-11 and chlorofluorocarbon-12 most often are mentioned for their possible role in depleting the earth's ozone layer. Scientists now find that the gases can be useful in tracing ocean mixing and circulation. The gases, which are chemically stable at sea level and in the lower atmosphere, have advantages over tritium, a radioactive substance more commonly used as a tracer. Tritium was produced during the bomb tests during the late 1950s and early 1960s. Unlike chlorofluorocarbons, which are closely monitored, the point and rate at which tritium enters the atmosphere cannot be determined. The chlorofluorocarbons also enter the oceans continually through a chemical exchange between air and water, whereas tritium enters the oceans through precipitation, which can be scant over the mid-oceans.

Refinement of the use of chlorofluorocarbons as a tracer is timely because tritium is decaying and in the next decade or so, as its concentrations diminish, it may lose its effectiveness as a tracer. Use of chlorofluorocarbons has two other strong advantages, said Joel Cline of the National Oceanic and Atmospheric Administration in Seattle. First, samples can be analyzed on site, which is much cheaper than analysis of radioactive tracers, which must be done in a laboratory onshore. Second, because the chlorofluorocarbons can be measured so quickly, changes in the research plan can be made as the analysis is completed. The technique was developed and tested in the Pacific in a NOAA-funded research project. Richard Gammon, of the University of Washington in Seattle, participated in the NOAA project and with funding from the National Science Foundation and the Department of Energy is developing techniques in the Atlantic Ocean to incorporate measurements of chlorofluorocarbons into existing procedures. Recent results were presented in San Antonio, Tex., at the meeting of the American Geophysical Union.

ENVIRONMENT

Ozone and crop damage

Between $2 billion and $4.5 billion is lost in the U.S. each year to decreased crop productivity caused by ozone pollution, reports a study by the Office of Technology Assessment. While crop damage by ozone has been recognized for years, the new dollar estimates — representing 5 percent of total annual farm output — are far higher than any previously released. The data were collected by the National Crop Loss Assessment Network for OTA's larger report to be released in June.

The four crops studied — peanuts, soybeans, wheat and corn — span a wide range of ozone sensitivity. Of these crops, peanuts are more sensitive to and corn most tolerant of ozone damage. Because these estimates do not include other pollutants or other crops, total agricultural losses due to air pollution are even higher than the NCLAN figures, Congressman George E. Brown Jr., chairman of an agriculture subcommittee, said. He spoke at a Feb. 18 symposium on air pollution and agriculture, sponsored by the Izaak Walton League.

Ozone, which occurs naturally in low concentrations, is formed at high levels when hydrocarbons and nitrogen oxides — major constituents of automobile exhaust — react in the atmosphere. Other air pollutants also damage crops. But ozone, because it is distributed so widely and so far from its original source, is considered the most serious, according to Jay Jacobson, a plant physiologist with the Boyce Thompson Institute for Plant Research at Cornell University and a participant in the symposium.

Release of the crop damage figures is significant now, says Marni Holbrook of the Izaak Walton League. Congress is currently considering a Clean Air Act amendment, backed by the Reagan administration, that would double automobile nitrogen oxide emission standards. If passed, HR 5252 "can only increase crop damage due to ozone pollution," says Holbrook.

Benefits of saving endangered species

Stressing the potential value to man of all plants and so-called "lower" animals, two scientists spoke up last month for continuation of a strong U.S. endangered species program. In testimony before a House subcommittee considering reauthorization of the Endangered Species Act, Peter Raven, director of the Missouri Botanical Gardens, and Thomas Eisner, of Cornell University, pointed to the accelerating rate of extinctions and emphasized the practical consequences of losing species diversity.

Raven, a botanist, noted that while we may feel "sentimental" about large and "obvious" animals that receive the bulk of government attention now, losing a plant is at least as serious. Because plants are the base of most food chains, extinction of a single plant species potentially drags several animals down with it. In addition, the chief ingredients of 40 percent of today's prescription drugs are compounds derived from plants. Yet some opponents of the Act, which is open for amendments at the same time it is reauthorized, would like to see protection of plants eliminated. Invertebrates could go as well. Eisner, a research biologist specializing in the study of chemical compounds derived from plants and animals, summarized research findings from his laboratory. Discoveries have included an insect repellant from millipedes, a potential heart drug from fireflies and a shark repellant from a marine gastropod. In addition, he cited a recent, still unpublished, identification of an effective antileukemic agent taken from a marine bryozoan. Compared with benefits to mankind from even "insignificant" organisms such as these — the majority of which have not been analyzed for useful chemical compounds — Eisner called the complaints of industry about permit delays "really quite trifling."