

Volcanoes and ice ages: A link?

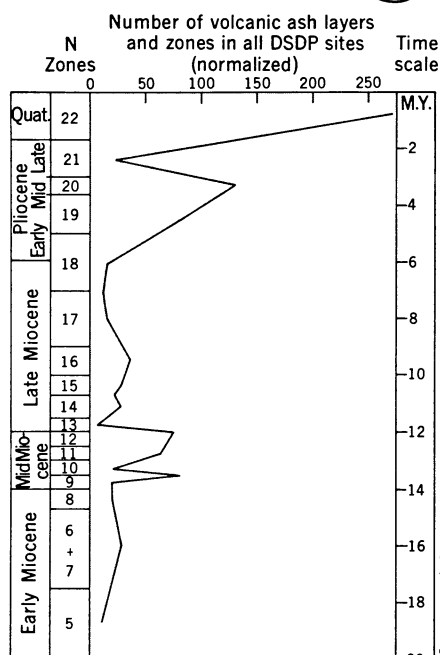
The longstanding but unproven hypothesis that there may be some cause-and-effect relationship between the great ice ages and periods of increased volcanic activity has been given strong new support. The evidence comes from analysis of deep-sea cores that indicate very high rates of explosive global volcanic activity during the past two million years. This time period, the Quaternary, is marked by major and rapid fluctuations of Northern Hemisphere ice sheets, global climates and sea level.

The idea that dust from periods of global volcanic activity might screen out enough solar radiation to bring on glaciation is hardly new. Benjamin Franklin was one of its early proponents. But hard evidence has been difficult to obtain. The record on land of patterns of volcanism over large areas is often obscured by younger volcanic sequences. In his textbook on physical geology published in 1965, Arthur Holmes stated that geologically no correlation had yet been demonstrated between times of glaciation and periods of prolonged or exceptionally intense volcanism.

The new evidence that contradicts this view is the result of the first attempt to evaluate global volcanic history by using the distribution of volcanic ash in deep-drilled core sequences obtained by the Deep Sea Drilling Project. University of Rhode Island oceanography professor James P. Kennett and graduate student Robert C. Thunell used the detailed descriptions published in the initial reports of 27 legs of the DSDP and the less detailed descriptions in the preliminary reports of 6 other legs to evaluate 320 deep-sea sections. The cores come from all oceans except the Arctic. The core sections span the last 20 million years.

The cores clearly show, Kennett and Thunell report in the Feb. 14 *SCIENCE*, a peak in Quaternary volcanism approximately four times higher than the average over the 20-million-year period and about twice as high as a peak in the Middle Pliocene, 12 to 14 million years ago. They grouped the sites into eight geographical areas, and all eight showed pronounced rates of volcanic activity during the past two million years.

"Our work shows that greatly increased volcanism during the last two million years closely coincides with that interval of earth history marked



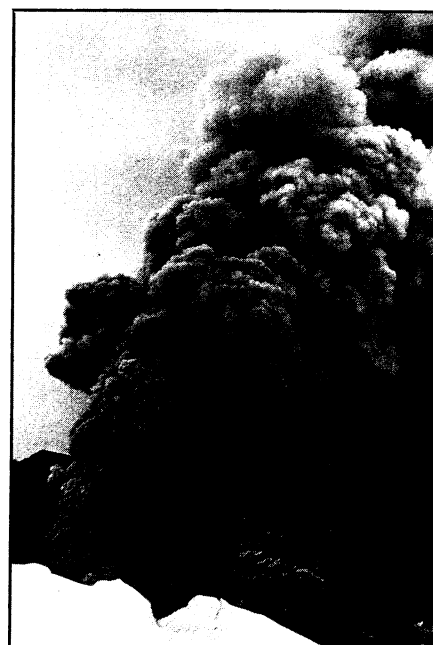
Last 2 million years: High volcanism.

by major and rapidly oscillating climatic conditions related to glacial-interglacial cycles in the Northern Hemisphere," the investigators say. Kennett and N. J. Shackleton have dated the initiation of continental glaciation at 2.4 million years ago.

"This general synchronism is almost certainly not coincidental," Kennett and Thunell say. But they emphasize that the data are too general to discriminate between any of the possible cause-and-effect relationships that have been suggested. Published calculations indicate that explosive volcanicity may need to be increased at least 40 percent within a period of a few thousand years for glaciation to be initiated by dust veil effects. Kennett and Thunell note that their data show a general increase in volcanism much greater than this. But their data are not fine enough to deal with small variations in volcanism.

The findings are probably the strongest evidence yet for an association between glaciation and global volcanism. But what is cause and what is effect is not distinguishable. They do not prove that volcanism played a role in triggering the ice ages, although they suggest that that may be the case.

Indeed the opposite might also be true. Kennett and Thunell refer to a hypothesis of R. K. Mathews, concerning a way in which climatic change could trigger global volcanism. There were large and relatively rapid changes



U.S. Geological Survey

in sea level during the past two million years as water was successively locked up in and then liberated from continental ice sheets. The changing volume of the oceans would have caused the ocean basins to adjust to the loading and unloading. This might have created periodic large-scale movements within the mantle, causing stress release and increased volcanism. □

Task force to study ozone problem

Aerosol propellants have fallen from the status of "modern miracle" to "possible environmental menace" following reports that they may be breaking down the earth's protective ozone layer. A large research effort is under way to confirm and quantify the effect; the National Academy of Sciences is officially studying the problem, and a consumer law firm has asked the Consumer Product Safety Commission to ban aerosol products. Several Government agencies, all of which have some jurisdiction over the potential problem, have been under increasing Congressional and public pressure to do something. But what, how, when and by whom?

In an attempt to answer these questions, and with unusual speed and coordination, an *ad hoc* Federal interagency task force has been orga-

nized. The task force will be directed by the Council on Environmental Quality and the Federal Council for Science and Technology, and will include representatives from the Environmental Protection Agency, the National Science Foundation, the Food and Drug Administration, the Consumer Product Safety Commission (CPSC), the National Aeronautics and Space Administration, the Energy Research and Development Agency, the Interdepartmental Committee for Atmospheric Sciences and the Departments of Commerce, Justice, Agriculture, Defense and Transportation.

Concern mounted quickly after atmospheric chemists last fall proposed a theoretical mechanism for fluorochlorohydrocarbon behavior in the stratosphere (SN: 9/21/74, p. 180; 10/5/74, p. 212). The inert propellants float 9 to 12 miles above the earth's surface unchanged, they theorize, and are there broken down by ultraviolet light. Liberated chlorine atoms in turn may break down ozone (O₃) molecules, which are needed to shield the earth from the damaging wavelengths of ultraviolet light. If the sources of ozone destruction are not removed soon, they postulate, the ozone layer could be depleted by as much as 35 percent within the next 20 years.

Although research has not been completed, several of the participating agencies such as EPA, FDA and CPSC would be involved in regulation if the theories are confirmed. One important task force function will be to untangle the legal question of which agency would handle which aspect of the regulation. The Justice Department has been given this assignment.

The task force will also consider atmospheric, medical, ecological and economic impacts of the problem as well as industry and Government alternatives.

Fears have been voiced by some scientists that the traditional regulatory channels will move too slowly to squelch the problem in time. But, says co-chairman Carroll L. Pegler of the National Science Foundation's Science and Technology Policy Office: "I think it is a good sign that action has started early this time, and the regulatory problems haven't become too complicated before the Government agencies organized themselves. This task force provides a way to quantify the uncertainties and provide decisive action if it becomes necessary." A report will be issued in June, she says.

Thomas Stoel, a lawyer with the consumer law firm that initiated the suit with the CPSC, says the task force may be "an elephant trying to kill a mouse." A large slow-moving body is probably not needed, he says, but at least the regulatory ball is rolling. □

Mineral supplies: Shortages ahead

The United States may not have as much untapped fuel as the Government seems to think, a report by the National Academy of Sciences concludes. In its report, the Committee on Mineral Resources and the Environment says the chances of America achieving energy independence based on new discoveries of oil and gas are slim, and that even if more mineral reserves are found, new technological achievements probably won't meet demand. Production may cost more than the mineral is worth. Even gloomier is the group's statement that "there are no standardized techniques for making long-term demand forecasts," and that "projections of demand for energy to the year 2000 contain conceptual errors and questionable assumptions."

Committee head Brian John Skinner, chairman of the department of geology and geophysics at Yale, says 200 billion barrels of oil will probably remain in the ground indefinitely, since there is no known way of extracting it. "If Project Independence depends on increasing oil production, then it's on shaky ground," he says. The time lag involved in discovering and pumping new oil fields after current supplies are exhausted would make oil production increases almost impossible. Skinner says that although he doesn't think the Interior Department is intentionally deceiving the public, "The U.S. Geological Survey estimates are unrealistically high," in guessing the United States' undiscovered oil and natural gas reserves.

The report confirms the findings of an earlier academy study compiled for President Kennedy under the chairmanship of M. King Hubbert, who ever since has been warning about impending materials shortages (SN: 4/27/74, p. 277).

Minerals already in short supply, including copper, nickel, gold and tin, probably won't be replaced by substitutes, the group says. This means conservation and recycling may be the only alternatives to increasing mineral production. While world supplies of copper are large (at least enough for the next 25 years), conserving what has already been mined while developing new technology is the group's chief suggestion. A recycling efficiency of 90 percent, though rarely attainable, would mean about a tenfold reduction in the rate at which fresh material would need to be mined.

Manganese and copper nodules scraped off the ocean floor may provide new sources of raw materials, but devising equipment to gather them without disrupting marine life de-

serves study, the group says. Another mining innovation, called situ leaching, involves soaking ore deposits in acid, thereby dissolving or leaching out the desired constituents, which are subsequently collected from the run-off stream. But the environmental effects of chemical runoff and the hazards of explosive ore shattering can't be ignored. The group suggests refining current beneficiation systems (separating mineral grains from waste rock).

Financing the Government's proposed needs may be America's biggest crisis, the group says. For example, tripling coal production by 1980, as has been suggested, would imply at least tripling the investment in coal-mining machinery unless there is a dramatic improvement in productivity caused by the development of new techniques. These kinds of innovations would be implemented by private companies, many of which simply can't afford to gamble with current demands. A manpower shortage coupled with new pollution standards and health hazard restrictions involved in mining coal make capital investments risky. □

Largest ecology award

Most environmental projects, it seems, are labors of love. But last week limnologist Ruth Patrick received \$150,000 for her ecological studies of polluted streams. The John and Alice Tyler Ecology Award, \$150,000 tax free, is the largest award ever given to a single scientist, surpassing even the Nobel Prize (\$31,000 to \$72,000).

To win the prize, given only twice so far, requires 10 years of scientific research on a project, then practical application of the results, distributed worldwide. Patrick, 67, helped shape the United States' clean water act. Now current chairman of Philadelphia's Academy of Natural Sciences, she says of the honor, "I still can't believe it." Patrick was selected from among scientists of 15 countries.

The award is administered by California's Pepperdine University. The benefactor, John C. Tyler, co-founder of the Farmers Insurance Co., left a total of \$5 million for the annual award, but died before its inception. His widow, Alice Tyler, says of the fund, "The unfortunate thing, for the moment at least, is that ecological solutions would seem to conflict with business, industry and economy. But of course, this isn't a real conflict. I mean, after all, we all want to live, don't we?" □