Earth Sciences

Dino-death: Flash broil or slow steam

The dinosaurs didn't stand a chance of surviving the postulated asteroid impact 66 million years ago, according to two new theories. One researcher reports evidence that the impact generated a moist greenhouse effect, transforming savannas into rain forests and drastically upsetting the environment. Other scientists suggest the impact turned the atmosphere into a broiler that sparked wildfires worldwide.

Whether or not these scenarios did occur, they demonstrate how far researchers have traveled from the simple impact hypothesis, proposed in 1979 after scientists detected evidence that a meteorite or comet hit the Earth long ago. The original theory held that an impact created a global dust cloud that blocked out sunlight, cooled the planet and arrested photosynthesis, killing a significant number of species.

While he has found evidence supporting the "impact winter" idea, Jack A. Wolfe, a paleobotanist with the U.S. Geological Survey in Denver, has also discovered signs that a moist greenhouse followed the cold times. Wolfe compared the shapes of modern leaves from different environments to leaf fossils found in sediments before and after the time of the proposed impact. The abrupt transition from small, rounded leaves to large, pointed ones suggests precipitation quadrupled and mean annual temperatures soared by 10°C in the interior of North America, he reports in the Jan. 11 NATURE. If the cold didn't kill off vulnerable species, the warm, moist conditions would have finished the job, Wolfe says.

H. Jay Melosh of the University of Arizona in Tucson and his colleagues used theoretical calculations to come up with a different scenario. Melosh proposes that material from the impact body and the impact site should have flown up past Earth's atmosphere and then fallen back down in tiny pieces that moved much faster than scientists had estimated. Speeding through the atmosphere, the billions of glowing bits would heat Earth's surface enough to ignite wildfires, the group suggests in the Jan. 18 NATURE. They would also cause extremely acidic rain, which would kill off many ocean organisms, Melosh says. Some researchers have reported evidence of massive fires from that time, but Wolfe says he sees no such signs in sediments he has examined.

Shifting slope faces shaky situation

Ground motion near Mount Etna's Valle del Bove caldera has destabilized the caldera's western rim, report geologists who monitor movements of the Sicilian volcano. Further shifts in the caldera — a depression created centuries ago by a collapse in the mountain's eastern slope — could lead to rockslides, mudslides or even a full-scale eruption, warns British geologist William McGuire of the West London Institute. Since 1981, McGuire and his colleagues have been collecting what he calls the first numerical measurements of ground motion at Mount Etna.

Minor eruptions in 1983 and 1985 drove molten rock upward with enough force to create vertical fissures, or dykes, under the caldera's western rim. The dykes shifted a 1-by-0.5-kilometer block of the rim 2.8 meters to the east, the group reports in the Jan. 25 NATURE. After 1985, the area essentially held its ground until last October, when another dyke moved the same block 1 meter farther to the east, triggering two small rockslides.

The researchers check for ground deformations twice a year, using geodetic stations on Mount Etna. Similar but more frequent monitoring of Mount St. Helen's led geologists to predict that volcano's May 1980 eruption, notes Tom Pierson of the U.S. Geological Survey in Vancouver, Wash. Predicting a landslide or eruption at Mount Etna would require daily monitoring — an impossibly ambitious goal under the project's current funding, McGuire says.

Environment

Most asbestos poses little human risk

Since 1972, EPA has taken a number of steps to limit nonoccupational exposures to asbestos, a family of carcinogenic minerals. These regulations treat all members of the family equally. However, asbestos toxicologist Brooke T. Mossman asserts, human studies published by several researchers in the past two years suggest chrysotile asbestos poses no hazard at levels encountered outside the workplace — and perhaps not even in the workplace these days. Chrysotile has been the type most commonly used in the United States.

Mossman, of the University of Vermont in Burlington, and her colleagues measured mean levels of asbestos in U.S. schools and other buildings. In the Jan. 19 SCIENCE, they report that these exposures are quite low — on a par with outdoor levels — even where asbestos-containing materials appear severely damaged. The researchers recommend that policymakers reevaluate the wisdom of equating chrysotile risks with those of other asbestos fibers and reassess the need to remove it from buildings. Indeed, Mossman says, "our data suggest that if chrysotile is handled properly in the workplace, it does not present a risk to human health."

Chrysotile's curly shape distinguishes it from other asbestos fibers, called amphiboles, which sport a needle-like structure. The serpentine shape may make chrysotile less likely to penetrate lung tissue and more likely to be cleared from tissue. In the past, researchers have cited this as a possible explanation for epidemiologic observations that workers in the chrysotile industry, compared with other asbestos workers, have a lower incidence of life-threatening lung ailments — in particular lung cancer and mesothelioma, a fatal cancer that strikes only those who have inhaled asbestos or another, similar fiber. But more recent studies suggest chrysotile exposure may have induced few if any such cancers, Mossman says. They reveal that the workers who developed these cancers were also exposed to other carcinogens, most notably cigarette smoke and several of the amphiboles.

Chrysotile fibers are more toxic to cells than are amphiboles, Mossman's work indicates. However, she says, the extra toxicity may actually benefit exposed animals by killing damaged cells before they can multiply to spawn a malignancy.

EPA has "yet to reach a definitive decision about one type of asbestos being less harmful," says Tom Tillman of EPA's Office of Toxic Substances. He adds that the agency has officially begun a technical analysis of the new SCIENCE report.

A promising alternative to CFC-113

CFC-113, or trichlorotrifluoroethane, is a solvent commonly used for degreasing and cleaning, especially in the electronics industry. As part of the Montreal Protocol (SN: 6/10/89, p.367), the United States and several other nations are phasing out production of this chlorofluorocarbon, the culprit behind an estimated 4 percent of the human-generated chlorine now damaging Earth's protective ozone layer. And that's why U.S. firms that reported emitting a ton or more of this pollutant annually (in EPA's first Toxic Release Inventory, published earlier this month) express excitement about new test data on Genesolv 2010, the trade name for a mix of HCFC-123 and HCFC-141b. Last month, EPA announced that a panel of 230 industrial and government researchers identified this experimental degreaser as the first potential CFC-113 substitute that performs as well or better but poses less environmental threat.

Like CFC-113, the hydrofluorocarbons in Genesolv 2010 would release chlorine. But because they would remain in the stratosphere for far shorter periods, "the amount they contribute would be minuscule compared to CFC-113," comments atmospheric chemist Michael Prather at NASA's Goddard Institute for Space Studies in New York City.

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