Earth Science

Ancient lead emissions polluted Arctic

Researchers have discovered lead emissions from ancient Roman and Greek smelters buried in British peat and Swedish lake sediments (SN: 3/26/94, p.198). But a new study shows that ancient airborne pollutants traveled even farther and contaminated the lower atmosphere of the lower Arctic.

"This . . . marks the oldest large-scale hemispheric pollution ever reported," Sungmin Hong of Domaine University in Grenoble, France, and his colleagues assert in the Sept. 23 SCIENCE.

The team analyzed cores drilled by the European Greenland Ice Core Project in central Greenland. Lead production increased during a period of Roman cultural expansion 2,500 to 1,700 years ago. Lead concentrations reached a high of about 2 picograms per gram (pg/g) of ice during the 800-year span. This is nearly four times the amount found in ice dating to before people began working lead.

At its peak, lead production in ancient Rome totaled about 80,000 metric tons per year, rivaling the output during the Industrial Revolution, the Hong group calculates. Roughly 400 tons of lead accumulated in the Greenland ice cap between 500 B.C. and A.D. 300. In comparison, some 2,670 tons of lead have fallen on Greenland over the past 60 years, mostly due to the use of lead additives in gasoline, the team reports.

Lead concentrations in ice cores fell between A.D. 300 and A.D. 500, following the depletion of the Roman lead mines, the team finds. But the concentrations later increased because of lead and silver mining in Central Europe, reaching almost 4 pg/g in ice samples from 1,000 to 500 years ago.

Lead concentrations in core samples from when Greek civilization flourished over 2,500 years ago rival those found in segments from Roman times. But since the Greeks made less lead, either lead production estimates are incorrect or lead emissions traveled more readily to Greenland from the Greek production sites, the team speculates.

Flora changes as the Arctic warms

The Arctic's ecosystem fell prey to global warming earlier than previously thought, a research team now argues.

For thousands of years, the patterns of plant life in Arctic ponds changed very little and only very gradually. But in the 1800s, these patterns shifted dramatically, probably as a result of warming temperatures, a study of frozen sediment cores from Arctic ponds reveals.

Marianne S.V. Douglas of the University of Massachusetts at Amherst and her colleagues analyzed the fossilized remains of diatoms, a type of algae, from three ponds on Ellesmere Island in the Canadian Arctic, they report in the Oct. 21 SCIENCE. Their core samples dated back as much as 8,000 years.

One genus of diatom dominated two of the ponds until the 19th century, the team says. Then, in one of those ponds, a diatom that lives on moss swelled from 10 percent of the diatom population to 90 percent of it, the team reports.

At the other pond, the flora shifted completely, to a relatively diverse mixture of six diatoms, the scientists find. The third pond's recent sediments reveal "dramatic increases" in the relative frequency of one genus of diatom, they discovered.

The authors ruled out airborne pollution, changes in ultraviolet radiation, or activities of local inhabitants as possible causes for the shifts in the abundance of the single-celled organisms. The culprit, they suspect, is global warming. Even a slight increase in temperatures would extend the growing season and allow for changes in diatom communities.

Other researchers have also found signs of Arctic temperature increases, but "our data indicate an earlier (by over a century) start for these changes," Douglas and her colleagues say. Some scientists, however, believe that the Arctic shows no signs of warming (SN: 1/30/93, p.70).

Environment

Sunlamp use linked to melanoma

Heavy use of sunlamps appears to increase an individual's risk of melanoma, the most virulent form of skin cancer, a new study reports. However, its findings indicate that the tie is strongest in people under 30 and applies only to cancers that first show up on the chest, abdomen, or back.

Researchers at University Hospital in Lund, Sweden, questioned 400 melanoma patients and 640 demographically matched, healthy volunteers on their use of tanning lamps. Sweden represents a good area for study, note Johan Westerdahl and his colleagues in the Oct. 15 AMERICAN JOURNAL OF EPIDEMIOLOGY, because its northern latitude makes true suntans hard to achieve much of the year.

Even accounting for such predisposing risks as blond hair, summer sunbathing, and raised nevi (pigmented birthmarks), their data showed that anyone who had ever used sunlamps or sunbeds faced a 30 percent greater risk of melanoma than those who had never used such devices.

But when the researchers restricted their analysis to persons under 30, those who had ever used tanning devices proved almost three times as likely to develop melanoma as those who never had. People in this younger group who used tanning lamps more than 10 times a year faced nearly eight times the melanoma risk of those who shunned such devices.

Young tanners are more likely to have used the newer sunlamps — those whose rays fall mainly in the A, or longwave, ultraviolet (UV) spectrum. And a number of studies, including one published just last month (SN: 10/15/94, p.255), indicate that UV-A has the potential to cause skin cancer. Why sunlamp use was linked only to cancers on the trunk of the body remains unclear. However, speculates Westerdahl's group, "skin of the trunk may be less adapted to UV radiation than the skin of, for instance, the face and arms."

Enzymes help office paper recycling

Beside most office copying machines and laser printers these days stands a recycling container into which people dutifully toss their bad copies and printouts.

Yet ironically, much of that paper still ends up in landfills. The reason, says Thomas W. Jeffries, a microbiologist at the University of Wisconsin-Madison, has to do with toner, the plasticlike ink used in office copiers and printers.

"Toners are not like regular inks," he says. "A toner uses a thermal nylon polymer that physically fuses with the paper fibers. If you run your finger over a copied page, you can feel little bumps from the letters." Thus, ordinary de-inking processes in paper recycling fail to get the toner out. To make matters worse, he adds, "mixing waste office paper with tonerfree paper, like computer printouts, devalues the pulp."

Exploring this problem, Jeffries and his colleagues have found that treating the office paper pulp with simple enzymes helps remove the toner. The researchers tested seven kinds of enzymes, each one a type of cellulase or xylanase.

Using recovered paper stock from office copiers and laser printers, they observed that as little as 200 to 400 milliliters of enzyme per metric ton of pulp helped get the toner off the paper fibers. Nearly all enzyme trials "were more efficient than the chemical treatment for ink removal," they report.

In fact, the enzymes removed up to 96 percent of the toner in laboratory tests and 94 percent in an industrial test.

The researchers are not quite sure why the enzymes work. They "might release toner from the paper surface," the scientists speculate. Or they might facilitate washing and water removal from the pulp.

Either way, this process may prove a boon for recycling. "The enzymes are very cheap," Jeffries says. "They cost less than $10 per kilogram. And they're benign and biodegradable."