Earth Sciences

Climate clues glued to rocks

Rock varnish is a black, paper-thin coating that forms slowly over tens of thousands of years as clays, trace elements, organic matter and whatever other particulates happen to fall out of the air are cemented to rock surfaces by iron and manganese oxides. "It's just astounding," says Ronald I. Dorn at the University of California at Los Angeles (UCLA). "There are entire mountain ranges in the Sinai Peninsula, as in the western United States, that are completely coated with varnish — top to bottom."

Because varnishes are found worldwide — especially in deserts, where they can remain chemically stable for 100,000 years and more — Dorn and a number of other researchers think they could be useful in understanding the environmental conditions of the past. Dorn has published a few papers showing how rock varnishes record the alkalinity of past environments, as well as how varnishes can be used to date geologic and archaeological objects. Now, in the March 22 SCIENCE, he and Michael J. De Niro, also at UCLA, describe a method for estimating past aridity by measuring the ratio of carbon-13 to carbon-12 contained in varnish organic matter.

The researchers believe that the ratio in the varnish reflects that of plants that lived nearby. They also expect that different kinds of plants will have different ratios: So-called C_3 vegetation — plants that produce acids containing three carbon atoms during the first step of photosynthesis — would have a lower ratio than C_4 plants that make acids with four carbons. And because C_3 plants tend to live in cool, humid places while C_4 and another type of plant prefer hot, arid locales, the ratio in the varnish reveals how arid or humid a region was.

At present, Dorn must scrape off a lot of varnish from rocks in order to get enough organic material for conventional isotope measurements. So, at best, the reseachers' view of past climates is limited to general trends that persisted over a minimum of 100,000 years. In the future, however, Dorn hopes to improve the sensitivity of the technique by using an accelerator, which requires much less organic matter to measure the carbon isotope composition.

Meteors and MASS NMR: It's a hit!

A bit of stishovite found at a site where scientists are trying to prove that an asteroid once smacked into the earth would do wonders for their case. The silica mineral has been found in nature only where meteors have hit and created a large impulse of pressure. But testing for stishovite has not been an easy process. The mineral typically comes in such small quantities that it must be concentrated with chemical techniques that often destroy the crystals. And when X-ray diffraction is done on the sample, the stishovite signal is easily obscured by other elements.

In an upcoming issue of METEORITICS, John F. McHone and co-workers at the University of Illinois in Urbana discuss another technique for hunting stishovite: magic-angle sample-spinning nuclear magnetic resonance (MASS NMR), in which the NMR device, normally used in the study of liquids, is "fooled" into treating a spinning sample of ground-up solid material as a liquid. With this method, the researchers clearly detected stishovite in a sandstone rock from a crater in Arizona. "We were able to take a rock right off the ground, grind it up, stick it in the NMR and *voilà!* Out came a spectrum," says McHone.

Unfortunately, the technique cannot be used with magnetic minerals, which are common in meteorites and are also found in the clays of the Cretaceous-Tertiary (K/T) boundary that has attracted so much debate over whether an asteroid caused mass extinctions 65 million years ago (SN: 6/2/79, p. 356). McHone, however, believes that this problem may be solved in the near future. He also says that no stishovite was detected in a K/T sample, but it may have been destroyed by the present preparation method.

Environment

Federal carcinogenesis review

The White House Office of Science and Technology Policy has just completed a review of chemical carcinogenesis. Developed to standardize the way this science is used throughout the federal government, the report describes mechanisms of cancer causation, points to emerging science areas that have the potential to affect federal regulations and gives advice for interpreting new research findings. Aimed at federal agencies charged with assessing cancer risks from chemicals, the 71-page review appears in the March 14 Federal Register.

Mapping gaps in environmental data

There is a general consensus among environmental experts that data from networks monitoring U.S. environmental quality are "not very good," according to Richard M. Dowd, a Washington-based consultant and former Environmental Protection Agency assistant administrator. Analyzing how to remedy deficiencies in data on the health of the environment — and challenges to that health — was the primary goal of a new study on long-term research needs conducted by the President's Council on Environmental Quality (CEQ), in which Dowd participated.

At a news briefing last week to unveil the study's findings, CEQ chairman A. Alan Hill pledged he would work with other federal agencies to see that the report's long list of recommendations is implemented. These recommendations were distilled from discussions among four expert panels on human health impacts, geochemical and hydrological processes, ecosystems and environmental monitoring and assessment.

Dowd identified several of the panels' common concerns, such as monitoring. The study found that for many environmental indicators there exist little or no monitoring data — "and often not even baselines against which to measure current conditions." Panelists also worry that most data come from short-term experiments that probably do not reflect the real and complex biochemical and physical ways an ecosystem would respond to stress. A related issue is how the majority of environmental research, which has focused on a single pollutant in just one medium — air, land or water — distorts understanding of possible relationships that occur as mixtures of contaminants move between media (SN: 2/23/85, p. 124).

Included in the study's report are recommendations to: inventory all federal environmental monitoring programs; use federal hazardous-waste cleanup operations as field laboratories to study the chemistry of pollutants in soil; identify specially sensitive species — such as bees, worms or fungi — as early-warning sentinels of hazards; and conduct continental and global baseline studies for at least 10 years on the most important atmospheric pollutants — such as ozone, methane and oxides of nitrogen and sulfur.

Relief for refuge's selenium problem

Upon learning on March 14 that the Interior Department's Bureau of Reclamation (BOR) might be in violation of the Migratory Bird Treaty Act, Interior Sec. Donald Hodel announced he would halt BOR's delivery of irrigation water to — and acceptance of selenium-contaminated salty drainage from — 42,000 acres of farmland in California's San Joaquin Valley.

Selenium, leached from the soil by irrigation, has been accumulating in BOR's drainage ponds in the Kesterson National Wildlife Refuge, poisoning waterfowl and other animals there (SN: 11/10/84, p. 299). Hodel said that following BOR's permanent shutdown of the San Luis (irrigation water) Drain, efforts to clean up Kesterson's selenium buildup would begin. Farmers who need the drainage to prevent a saline waterlogging of their soils have petitioned Interior for relief.