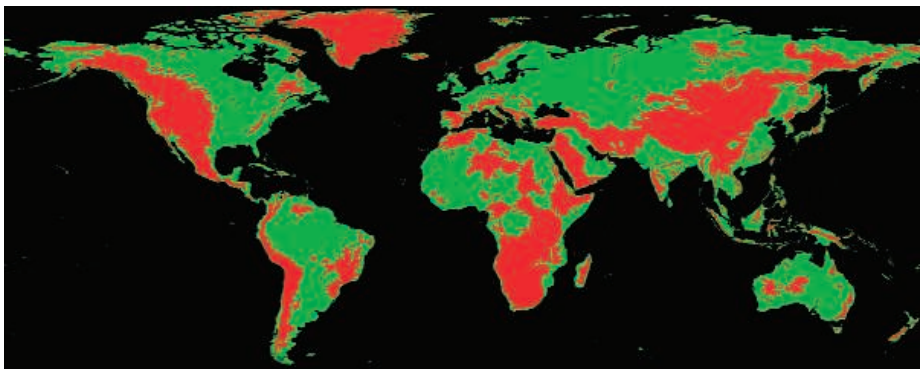
GEOCHEMISTRY

Gasping for Air in Permian Hard Times

Life late in the Permian period certainly sounds unhealthy. More than 250 million years ago, the world was overheating under a growing greenhouse. The great Siberian Traps eruptions were spewing acid haze. Within the seas, noxious gases were building as oxygen dwindled. And something was about to trigger the worst mass extinction in the history of life. How could conditions have been any worse?

On page 398, researchers count some of the ways, from the standpoint of evolutionary biology. On land, atmospheric oxygen was sliding from a heady 30% toward a lung-sapping 15% or below. Low atmospheric oxygen would have squeezed land animals into smaller, more fragmented areas at low altitudes, inducing extinctions while driving down diversity. The hypothesis "adds another dimension" to the role of oxygen in evolution, says biologist Robert Dudley of the University of California, Berkeley. It also complicates the question of how the end-Permian extinction took place.



Too high. If the low atmospheric oxygen levels of the late Permian period prevailed today, few vertebrate animals could live much above an altitude of 500 meters (red).

CREDIT: R. HUEY *ET AL.*

Geochemists can gauge past oxygen levels by taking account of organic matter and reduced sulfur compounds stored in sediments—in effect, the byproducts of oxygen generation. In 2002, geochemist Robert Berner of Yale University calculated that during the past 600 million years, atmospheric concentrations of oxygen were stable near present-day levels of 20% until about 400 million years ago, rose sharply to a peak above 30% about 300 million years ago, and then dove to 12% by 240 million years ago.

Paleontologist Gregory Retallack of the University of Oregon, Eugene, and colleagues suggested in 2003 that such a precipitous decline could have determined winners and losers at the end of the Permian. One of the few large animals to survive the end-Permian extinction, a dog-sized burrowing creature called *Lystrosaurus*, appears to have been well-adapted already for breathing oxygen-poor air, says Retallack. Like humans adapted to living at high altitudes, *Lystrosaurus* had developed a barrel chest for deeper breathing, among other adaptations, apparently in order to "breathe its own breath" more easily in its underground lairs (*Science*, 29 August 2003, p. 1168).

On less well prepared animals, losing more than half of the normal oxygen supply would have had far-reaching effects, say evolutionary physiologist Raymond Huey and paleontologist Peter Ward of the University of Washington, Seattle. Every animal has its own minimum oxygen requirement, they note. That's why each species has a particular altitude beyond which it doesn't live. For example, humans live and reproduce no higher than 5.1 kilometers, in the Peruvian Andes. So, "if oxygen is 12%, sea level would be like living at 5.3 kilometers," says Huey.

With oxygen at the mid-Permian's peak of 30%, animals probably could have breathed easily at any altitude on Earth, says Huey. But as oxygen levels dropped, animals capable of living at 6.0 kilometers in the mid-Permian would have been driven down to 300 meters. Perhaps half of the Permian land area would have been denied to animals. Species specialized to live in upland habitats would have perished, assuming they couldn't adapt their relatively unsophisticated breathing systems. Survivors would have been squeezed down into smaller, more isolated areas, where overcrowding and habitat fragmentation would have driven up extinctions and diminished the number of species the land could support. "We can explain some big part of land extinction with this," says Ward.

Extinction by crowding into lowlands "is a very interesting idea," says Dudley, but "it's pretty hypothetical. None of the assumptions is yet testable." Further studies of breathing physiology and geographical patterns in the fossil record should help size up just how bad life might have been. **–RICHARD A. KERR**

ScienceScope

Zerhouni Hopes to Revise Stock Limits

Two months after announcing new conflict-of-interest rules, National Institutes of Health (NIH) Director Elias Zerhouni is rethinking the strict limits on owning biomedical stock.

The ethics rules were imposed after revelations that some NIH researchers had received hefty consulting payments from industry. But the stock limits are deterring some from joining NIH and persuading others to leave, including James Battey, director of the National Institute on Deafness and Other Communication Disorders, Zerhouni told a Senate subcommittee last week (see p. 334). He explained that the stock rule was imposed by the Department of Health and Human Services (HHS) and Office of Government Ethics, which felt that NIH should be treated like a regulatory agency. "We need to reevaluate" the stock provision "quickly," Zerhouni said.

Last week, a group of senior NIH scientists asked the U.S. Court of Appeals for the District of Columbia to review the rules in part because HHS didn't collect comments first. **–JOCELYN KAISER**

Hungarian Faculty Face Layoffs

Already squeezed by cuts to the national granting agency (*Science*, 26 November 2004, p. 1455), hundreds of Hungary's scientists now face layoffs stemming from a $21 million shortfall across higher education. A government-mandated 7.5% pay raise for faculty went into effect on 1 January this year, but funding increases for universities, which are overwhelmingly government-supported, have not kept pace. Science classes are more expensive than are the humanities, notes George Kampis of Eötvös Loránd University in Budapest, whose department of history and philosophy of science is under the gun. **–GRETCHEN VOGEL**

Trying Again on ITER

TOKYO—Japan and the European Union last week set an early July deadline to resolve the 15-month stalemate over which one will host the $5 billion International Thermonuclear Experimental Reactor (ITER). Japan's Education, Culture, Sports, Science, and Technology Minister Nariaki Nakayama and European Commissioner for Science and Research Janez Potočnik discussed how to iron out the main sticking point, that is, what to give the loser in exchange for not hosting the reactor. An agreement on how to split responsibilities for the mammoth project will hopefully set the stage for a unanimous selection of either the French or Japanese site. **–DENNIS NORMILE**

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