Loper's group suggests that a layer of hot mantle material close to the core periodically becomes unstable, releasing mobile plumes of hot mantle material that rise to the surface and feed volcanoes. The researchers argue that the release of the plumes also leads to field reversals. The loss of material, they say, thins the layer, allowing more energy to escape from the core. This enables the heat engine in the core to drive the geodynamo harder, and as the flux of energy to the geodynamo increases, the reversal rate increases as well. In a rough, preliminary calculation, Loper estimates that the layer becomes unstable about every 22 Myr.

Loper's group is conducting laboratory experiments to learn more about the behavior of the lower mantle layer, which seismologists have dubbed the D″ layer. The researchers place a layer of dyed water, representing the mobile D″ layer, under viscous corn syrup representing the colder overlying mantle. "We get what looks like episodic behavior" in the rising plumes of water, notes Loper.

Neither Loper nor Pal and Creer are the first to suggest and model links between these different periodic processes. But what *is* relatively new, say several observers, is that the findings of periodicity in a number of records are enjoying a resurgence of respectability. When all these hunts for periodicity resumed several years ago, says one scientist, "I thought it would be just a flash in the pan. But the idea has grown and periodicity is spreading waves throughout geologic thought." — *S. Weisburd*

Pacific's CO_2 levels: Cause for concern?

One of the greatest concerns associated with the world's burning of some 5 billion tons of fossil fuels annually is the large amount of carbon dioxide (CO_2) it generates. Right now, only about half of that combustion-generated CO_2 stays in the atmosphere. Much of the rest, it is generally believed, is taken up by the oceans. But new research indicates that the ocean might not remain as robust a sink for CO_2 as it has been. That would leave even more of the gas to accumulate in the atmosphere, potentially triggering a more rapid and devastating global warming from the so-called "greenhouse effect."

Researchers from the University of South Florida in St. Petersburg have been studying the calcium carbonate shells of pteropods (planktonic mollusks) in the north Pacific (SN: 12/15/84, p. 376). Not only have their shells incorporated some of the carbon that entered the water as CO_2, but the creatures are also a mechanism by which a portion of that carbon is eventually removed from upper ocean waters; as the creatures die, their shells fall toward the ocean bottom, carrying the carbon along. If a shell falls a long way before dissolving, it carries the carbon far from the surface, potentially making it easier for more CO_2 to enter, helping to reduce atmospheric CO_2 levels. This is usually the case, since high acid levels, which help dissolve the pteropod shells, are normally present only at great depths.

But Robert Byrne and his colleagues have identified regions in the north Pacific where the pteropod shells begin to dissolve at depths of only 170 meters — well within the top 10 percent of the ocean depth — and in far shallower water than generally expected. Since CO_2 is one source of water acidity, Byrne notes, the regions of shallow acidity they've identified may be an indication of higher CO_2 levels beginning to accumulate in the surface waters.

If true, this suggests a couple of causes for concern, he says. First, the more acidic water is, the less CO_2 it will absorb. So a trend toward more acidic surface waters could spell a long-term decline in the amount of CO_2 the ocean will accept from the atmosphere. Moreover, if shell dissolving begins too high in the water column, there is a risk that the shells will be less effective at removing carbon from surface waters. That could exacerbate the acidity problem and the potential inability of the ocean surface to accept as much atmospheric CO_2. — *J. Raloff*

EPA suspends permit

Because a tree does not a greenhouse make, Advanced Genetic Sciences, Inc. (AGS) has at least temporarily lost its permit to conduct field tests of its genetically engineered bacteria. The Environmental Protection Agency (EPA) this week charged AGS with violating regulations when it injected "Frostban" bacteria into about 50 trees on its Oakland, Calif., rooftop (SN: 3/8/86, p. 148). The agency also charged that the company "knowingly falsified" data by describing its tests as greenhouse experiments and failing to inform EPA of cankers that developed on the bark of several trees after the injections. The EPA adds, however, that it has concluded that the bacteria are not pathogenic. The agency is levying a $20,000 fine.

AGS has said that it believed the bacteria were always contained during the rooftop tests, first within syringes and then within the trees. According to EPA, the company plans to repeat the tests in its greenhouse in the next two months; after review, the EPA will decide whether to reinstate the permit. □

Antibody cocktail to fight bacteria

A mixture of seven human antibodies, produced by a new laboratory procedure, is proposed as an effective protectant against a deadly bacterium. The bacterium, called *Pseudomonas aeruginosa,* is the most lethal of the microorganisms that patients commonly acquire while hospitalized. Mark E. Lostrom and his colleagues at Genetic Systems Corp. in Seattle focused on this bacterium in devising a new strategy to develop prophylactic "cocktails" made of human antibodies.

The bacterium *P. aeruginosa* comes in at least 17 varieties, each having a characteristic surface molecule. The Genetic Systems scientists decided to work only with the seven varieties that are responsible for 90 percent of hospital infections, Lostrom said last week in Washington, D.C., at the American Society for Microbiology Conference on Biotechnology.

Invading bacteria expose many surface components to a host's immune system. Some of these components are shared by all bacteria of a species, whereas others provide the means of distinguishing the varieties, called serotypes. Using standard methods for producing large amounts of specific mouse antibodies (monoclonal antibodies), Lostrom and his colleagues employed a laboratory model of an immune system attack directed at each of the different surface components of *P. aeruginosa.* The serotype-specific antibodies, only one of which attacks a given bacterium, were the most efficient at triggering destruction of the bacteria. The antibodies against components found on all the serotypes were not effective.

The serotype-specific antibodies were also effective at protecting live mice against a bacterial attack. The mice given antibody prophylactically, before a large dose of the bacterium of the same serotype, all survived and showed few symptoms. Mice not given the antibody were killed in 1 to 3 days by the same dose of bacteria.

Antibodies against one shared bacterial product did confer some protection. *P. aeruginosa* makes a potent toxin; a monoclonal antibody that binds this toxin protected mice against a toxin dose that kills unprotected mice within a day. Lostrom says the toxin's role in human disease is unclear.

Lostrom proposes that a preparation of seven or eight monoclonal antibodies — one for each of the seven important serotypes and perhaps one for the toxin — should protect patients against most hospital infections.

Because administration of mouse antibodies to patients may create an undesirable immune response, the next

step was to make "equivalent human monoclonal antibodies with those same marching orders," Lostrom says. The technique they used, called cell-driven viral transformation, is the "newest advance" in antibody production, according to Lostrom.

This surprising technique avoids the cell fusion step of most other methods to create antibody-producing cells that survive indefinitely in the laboratory. Instead of merging a cell making the appropriate antibody and a cancer cell to create a cell called a hybridoma, the new technique mixes normal blood cells, called B lymphocytes, from patients likely to have hospital-acquired bacterial infections, with other cells infected with the cancer-causing Epstein-Barr virus. The virus moves into the blood cells, and with some biochemical sleight-of-hand the scientists destroy the cells originally infected with Epstein-Barr virus. The scientists then choose from among the transformed cells the ones producing an antibody of interest.

The number of "immortal" cells that result from this procedure is far greater than those from other methods. Lostrom estimates that 1 in 50 of the B lymphocytes present is transformed, whereas with the cell-merging technique only 1 human cell in 10 million is transformed.

"Cell-driven viral transformation gives us the broadest view of the antibody repertoire," Lostrom says.

Animal trials examining the protective effect of the human monoclonal antibodies gave results so clear-cut that Lostrom admits being self-conscious about showing the graphs. All 10 mice given the human monoclonal antibody survived a high dose of bacterium. But the unprotected mice all died the first day.

The research at Genetic Systems was performed under contract to Cutter Laboratories of Emeryville, Calif. Cutter is now moving toward the product development stage, Lostrom says.

Lostrom suggests that the strategy used to develop the antibodies against *P. aeruginosa* can be used for fighting other bacteria. But other cases may be more complicated. For example, *Escherichia coli,* another major cause of hospital-acquired infections, has more than 150 serotypes, among which 14 are responsible for about 80 percent of human *E. coli* disease.

Hospital-acquired infections are an increasing problem, Lostrom says. He estimates that they strike about 5 percent of U.S. hospital patients, adding more than $1 billion annually to medical costs. As bacterial resistance to antibiotics increases, the fatality rates for the infections also are increasing.

"The best hope [against hospital-acquired infections] is prophylaxis," Lostrom says. "It is a very viable alternative to antibiotic therapy." – *J.A. Miller*

Spots in the air: A comet controversy

For nearly half a decade, Louis Frank has been seeing spots. And if their cause is what Frank and his colleagues at the University of Iowa in Iowa City think it is, says the editor of the journal that is about to publish the observations and their interpretation for the first time, "its influence in several fields of science will be profound."

In fact, says GEOPHYSICAL RESEARCH LETTERS (GRL) Editor Alexander Dessler, head of the Space Science Laboratory at NASA's Marshall Space Flight Center in Huntsville, Ala., "I think it is one of the more interesting papers GRL has ever published."

It is also controversial. "Both referees firmly disagree with the interpretation," says Dessler, referring to scientific journals' custom of asking researchers in related fields to evaluate, or referee, articles submitted for publication. More than one scientist has even urged Frank to withdraw the "interpretation" section altogether, arguing that his credibility could suffer, while a similar concern about GRL has been expressed to Dessler.

At the heart of the matter is a series of dark spots that have been appearing in ultraviolet images of earth's atmosphere taken by the Dynamics Explorer 1 satellite (DE-1) ever since the craft was launched in 1981. Several of the spots show up in virtually every one of the more than 10,000 images so far amassed by Frank and colleagues John Sigwarth and John Craven. Each lasts about two to three minutes and covers an area that the authors estimate to be about 2,000 to 3,000 square kilometers.

The furor arises from Frank *et al.*'s proffered explanation: that the spots represent reductions in the atmosphere's ultraviolet brightness, triggered by the water from vast numbers of small, previously unsuspected comets (SN: 12/21&28/85, p. 391) – so many that their mass would add up to the equivalent, in water, of earth's entire atmosphere every 5 million years.

The implications of so many infalling comets' worth of water – about 20 per minute, globally, each averaging about 40 feet in diameter according to the authors' calculations – would be far-reaching. Or, as the authors put it in a term seldom found in scientific journals, "startling."

Researchers have long wondered, for example, if Venus once had an earthlike ocean that has since disappeared, a hypothesis bolstered in recent years by spacecraft measurements of the Venusian atmosphere's deuterium-to-hydrogen ratio (SN: 12/12/81, p. 372). But if the tiny amount of water now detected in the atmosphere has been arriving over billions of years as a succession of comet nuclei, says Frank, "probably there never was an ocean on Venus."

Closer to home is the question of whether numerous prehistoric species on earth were wiped out by the impact of a large asteroid or comet whose debris cut down the incoming sunlight until it triggered an ice age. If the myriad mini-comets are periodically brought in from the solar system's outer reaches by the system's passage through the spiral arms of the Milky Way, writes Frank's group, "fluctuations in the rate of mass accretion may be large enough for rapid climatic fluctuations sufficiently severe to account for the massive extinction of species in lieu of a catastrophic infall of a single large object."

In a more subtle example, "the occasional bursts of gases observed on the moon may be the direct signature of the impact of these small comets rather than impulsive ejection of gases from the moon's interior."

Yet another case, notes Frank, could be the numerous apparently water-formed channels on the surface of Mars (though many researchers are actively studying the view that water in the Martian past came the "conventional" way – from the planet's interior). Other possibilities posed by the group range from the relatively smooth-looking icy surfaces on some of the moons of the outer planets to the strange "spokes" on the widest of Saturn's rings.

The main problem raised by a number of researchers is that of all the water that so many comets would be bringing to earth. Much of it is broken down into hydrogen and oxygen by ultraviolet radiation from the sun, with the hydrogen atoms escaping into space from the top of the atmosphere, or exosphere. But the exospheric "escape rate," notes Thomas Donahue of the University of Michigan in Ann Arbor, would account for about 1,000 times less water than the proposed comet flux is said to be bringing in. Donahue, who has revealed that he was one of the GRL article's referees (their identities are usually kept secret), finds the idea "absurd."

He also admits, however, like most of the other scientists who find Frank's hypothesis uncomfortably exotic, that Frank has "really been careful" to examine the DE-1 data for instrumental problems, statistical errors and other misleading possibilities. Says Edward Smith of Jet Propulsion Laboratory in Pasadena, Calif., "I'd be very, very, very surprised if [the spots] are artifacts in the data."

So what are they? – *J. Eberhart*

News of the week continued on p. 207