Amber yields samples of ancient air

Air bubbles trapped in 80-million-year-old amber are giving scientists an unprecedented opportunity to sample and analyze the atmosphere from the earth's Cretaceous period, when dinosaurs roamed the planet. And the preliminary results are suggesting that these creatures breathed an air far different from the atmosphere of today.

"We were able to recalculate the original concentration of oxygen," says Robert A. Berner of Yale University, who has analyzed the samples along with Gary P. Landis of the U.S. Geological Survey in Denver. "The oxygen level appeared to be around 30 percent [of the atmosphere] as opposed to 21 percent today," Berner said last week at the Geological Society of America's annual meeting in Phoenix.

Previously, the oldest samples of the atmosphere came from ice buried deep in the glacial cap of the Antarctic, dating back only 160,000 years—a tiny portion of the earth's 4.5-billion-year history. Scientists have therefore had to rely on indirect methods for studying atmospheric evolution.

The rock and fossil records show that oxygen first appeared in the atmosphere around 2 billion years ago and continued to increase in concentration over time. But this record reveals little about the last half billion years, when plants and animals left the seas, evolving into the complex forms of today.

Air samples from amber might help fill in this important gap, says Harvard University's Heinrich Holland, who has studied the evolution of the atmosphere and oceans. "It's very exciting because it potentially gives us the first real handle on variations of oxygen over the time scale of millions of years."

Amber is fossilized tree resin or sap. As sap oozes out of a tree it often encases air, insects and even frogs (SN: 9/26/87, p. 205). Landis and Berner crushed their amber samples in a vacuum and analyzed the escaping gas with a quadrupole mass spectrometer.

In addition to the Cretaceous amber, which came from north-central Canada, the researchers also analyzed 40-million-year-old amber from the Baltic Sea and 25-million-year-old amber from the Dominican Republic. They found that oxygen in the Baltic amber equaled today's level, but the air from the younger Dominican amber contained less oxygen. However, Berner stresses that he and Landis completed these measurements only a week before the conference: "These are all very preliminary results. They need much further testing."

Holland and others had previously thought of analyzing the air in amber, but they abandoned the idea, believing that the amber might have contaminated the trapped air over millions of years. Berner says the results show that the amber was relatively inert. Instead, the trapped air seems to contain some contamination — in the form of suspiciously high values of carbon dioxide — from the respiration of trapped microbes.

The carbon dioxide concentration in the atmosphere has never risen above a few tenths of a percent, says Berner. But the high levels in the amber lead him to believe that microbe respiration converted oxygen to carbon dioxide. Because this process is a simple one-to-one conversion, he was able to recalculate the original oxygen in the trapped air.

Berner's results appear to mesh with the notions of modelers of the ocean-atmosphere system, who have predicted that oxygen levels might have been higher during the Cretaceous period. These modelers believe that the concentration of atmospheric oxygen represents a balance between two pervasive processes on the earth: weathering of rocks and burial of organic matter. While weathering consumes oxygen, the burial of plants and animal material in the oceans causes oxygen levels to rise.

"It's a very complicated interplay, which we are just starting to understand," says Holland. "But I think [the amber finding] fits beautifully into what we know about the burial of organic matter during the Cretaceous."

Some researchers had suggested that oxygen concentrations could never rise much above the 20 percent mark because high oxygen levels would support worldwide forest fires. Since there is no record of such burning, says Berner, these fire estimates may need revision.

William Berry, a paleontologist at the University of California at Berkeley, believes the new oxygen measurements might help explain how the largest dinosaurs — some of which stood five stories tall — could have developed and flourished. "You begin to think about big animals having a little bit easier time," he told SCIENCE NEWS. *— R. Monastersky*

Type A and coronary artery disease

Researchers may have added another piece to the puzzle concerning type A behavior's relationship with coronary artery disease.

Type A behavior is characterized by impatience and anger. During stressful situations, it increases blood pressure and heart rate and stimulates some chemical messengers in the nervous system. And it is thought these factors may lead to coronary artery disease. But scientists have not understood exactly how this happens.

The answer may be related to receptors on the outside of muscle cells lining coronary arteries, because they control arterial blood flow, according to Columbia University researchers in the Oct. 24 LANCET. Alpha receptors trigger the cells to constrict coronary arteries, and the beta receptors have an opposing effect. In severe type A individuals, chronic alpha-receptor stimulation is predominant, the researchers report. In the calmer, type B individuals, the proportions are reversed.

The recent finding, they suggest, may help scientists understand the mechanism of coronary artery disease. It also could change treatment programs, perhaps by incorporating the monitoring of a patient's ratio of alpha- to beta-receptor stimulation or by developing medications that act on receptor sites.

In the study, Jeffrey P. Kahn and his colleagues used 17 men ranging in age from 22 to 32. All had a family history of coronary artery disease. This was a criterion, Kahn says, because the volunteers would be at higher risk for the disease and also because of the closer correlation between type A behavior and blood-pressure rise as a response to stress among people with a family history.

The researchers assessed each volunteer's level of type A behavior with an extensive, structured interview. Each volunteer was ranked from 1 (severe type B behavior) to 5 (severe type A behavior).

The researchers then collected blood samples and determined the density of alpha receptors on platelets, which are essential for blood coagulation, and the density of beta receptors on lymphocytes, a type of white blood cell. Those receptors were chosen because scientists believe they correlate closely with receptor densities in coronary arteries, which were not accessible.

The findings indicate that as type A ranking increases, the ratio of beta to alpha receptors increases, suggesting alpha receptors are preferentially stimulated in type A individuals, Kahn told SCIENCE NEWS. This occurs because as alpha receptors are stimulated, their number decreases; this phenomenon, Kahn says, is not fully understood.

Kahn says he is not sure whether type A behavior stimulates alpha receptors, whether alpha-receptor stimulation causes type A behavior, or whether something else causes both reactions. He also is not sure whether hostility, a key component of type A behavior, according to some researchers, is associated with chronic alpha-receptor stimulation. *— S. Eisenberg*