EARTH SCIENCES

Cheryl Simon reports from Philadelphia at the spring meeting of the American Geophysical Union

Light-show on the shuttle

Astronauts looking directly out the windows of the space shuttle on its third and most recent flight could not see the glow of light surrounding the vehicle. But screens on specialized televisions showed an aurora-like glow around the shuttle's edge, facing into the spacecraft's orbit. The light effect is known to occur around satellites in the earth's ionosphere. Still photographs taken by the astronauts as part of the Vehicle Charging and Potential Experiment, though, are the first to show it in clear detail. The project was conducted by Peter Banks of Utah State University and Stanford University, and colleagues.

The photos show that the glow begins a few centimeters from the shuttle's surface, and decays within a meter. Scientists think the glow occurs when atomic oxygen in the upper atmosphere recombines on the spacecraft's surface, giving rise to excited oxygen molecules that radiate as they leave the vehicle. Another possible explanation is that the atomic oxygen combines with organic contaminants adhering to the shuttle's surface. Then, as the contaminants float away, they give off photons. For the next shuttle flight, scheduled for launch June 27, researchers will attach a special grating to one of the cameras, enabling them to measure the light wavelengths and learn what process produces the glow. They are eager to understand the phenomenon because the emission may interfere with performance of optical equipment vital to experiments conducted during shuttle missions. The scientific aspects of the glow are not so surprising, says Roger Williamson, also of Utah State and Stanford, but adds, "It is a dramatic description of something that has been ignored but cannot be in future space shuttle flights." Williamson says that light flashes generated by thrusters that fire sporadically to adjust the attitude of the vehicle may be even more active in skewing research results.

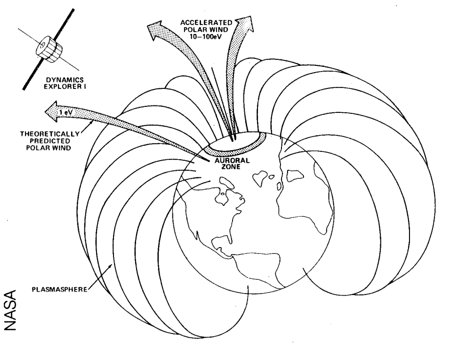
Drilling to bedrock in Greenland

It took them seven and a half months drilling time, but participants in the Greenland Ice Sheet Program (GISP) finally achieved their goal: a continuous core from the top of the ice sheet down 2,037 meters to bedrock. The core, 10 centimeters in diameter, marks the third time bedrock has been reached through a continent-sized ice sheet. Previous cores were obtained from Greenland in 1966 (1,385 meters) and Antarctica in 1968 (2,164 meters). "This is the best quality unfractured core ever recovered," says Chester Langway of the State University of New York in Buffalo. He was co-principal investigator of the project along with Willi Dansgaard of the University of Copenhagen and Hans Oeschger of the University of Bern. The United States, Denmark, and Switzerland were the main participants in the international research effort. The National Science Foundation contributed $7 million.

Scientists are studying the core to learn how an ice sheet forms, grows and decays over time. As a product of atmospheric processes, it provides an invaluable record of high-frequency changes, Langway says. A meter of snow is added to the ice surface each year, he says, compared to the centimeter of sediment that builds up per thousand years on the Atlantic seafloor. The information frozen into the ice layers will supplement records preserved in tree rings, peat bogs and sediments.

The core spans 120,000 to 130,000 years. It was extracted in pieces 2.2 meters long by a battery-powered drill designed over a three-year period by researchers at the University of Copenhagen. Most analysis of the ice core was conducted on-site from 1979 through 1981. Volcanic activity, which may exert a powerful effect on temperature, and shifts in ratios of stable isotopes are reflected in the ice. The isotope ratios are sensitive indicators of temperature change.

First reading of the polar wind



NASA

A specially designed instrument aboard the Dynamics Explorer 1 has measured for the first time a flow of particles from the earth's ionosphere into the magnetosphere, the uppermost portion of the earth's atmosphere. This flow of charged particles is called the "polar wind." Its existence was predicted theoretically 14 years ago, but lack of proper instrumentation prevented its detection. The DE-1 carries three Retarding Ion Mass Spectrometers (RIMS), which sample low energy gas (0-50 electron-volts). Because of their arrangement on the satellite, the RIMS are able to sample gas as it travels up the earth's magnetic field lines. The RIMS saw charged particles (plasma) of hydrogen and helium flowing up the open field lines that emanate from the earth's polar regions. "We've seen what looks like a wind that corresponds to the original prediction: wind with low temperatures and low velocity," says Julian Johnson of NASA's Marshall Space Flight Center in Huntsville, Ala. The particles are flowing at about 10 kilometers per second. "But we also see at other times a flow from the polar cap of ions with higher temperatures and higher velocity." The second "wind" moves as fast as 50 km per second; the phenomenon is still unexplained. Peter Banks of Utah State University and Stanford, and C. R. Chappell of Marshall Space Flight Center are co-investigators on the project. DE-1 follows a high-altitude elliptical orbit over the earth's poles. It works with a companion satellite, DE-2, which orbits the earth at lower altitudes. The RIMS also detected nitrogen for the first time in the magnetosphere. This is the first discovery of a new element there since oxygen ions were found in the early 1970s. Ten percent of the plasma previously thought to be oxygen may in fact be nitrogen, scientists say.

Rifting and ancient plate margins

When geophysicists in the 1960s were finally able to embrace the idea that the earth is composed of crustal plates that move as they are pushed apart at spreading centers in the ocean, answers to ancient problems in earth science seemed imminent. But 20 years later, many questions persist. For instance, when lines connecting points of equal age — isochrons — are lined up, why don't the edges of pre-rift continents match? In 1977, Richard Hey and colleagues at Scripps Institution of Oceanography proposed that because rifts propagate — occur a little at a time rather than all at once — continental margins are not isochrons. Now, Gregory Vink of Princeton University has applied Hey's model in reconstructing ancient land masses. The standard method for reconstruction, he says, is to "define the contours at the continental edges, rotate the land masses, minimize the gaps, and call the result Pangea." The result is not accurate, he says, because the rigors of rifting distort the plates, stretching the edges as the rift cuts through crustal material. Hey believes that as a rift propagates, crust may be compressed rather than extended, as it wrinkles and folds in response to the force of moving plates. Despite slightly differing views about the mechanics and side-effects of rifting, the researchers agree that any effort to reconstruct ancient continents must consider the possibility that rifting has changed the contours of the continental margins, and that the margins are not isochrons.