Antarctic sea ice may herald ice age

Climate has long been an AAAS favorite, and this year was no exception. While most debate still centers around CO_2 and whether its relatively short-term effects will accelerate or stall the coming ice age, James D. Hays and colleagues at Columbia University's Lamont-Doherty Geological Observatory have found what Hays thinks may be "an early warning system" for the oncoming glaciation.

An accepted part of ice age theories is that northern hemisphere glaciation occurs first and drives climate changes in the southern hemisphere. However, Hays's recent, and as yet unpublished, data show that the southern hemisphere, and Antarctica in particular, is much more sensitive to climatic changes and shows ice age-like conditions several thousand years before the northern hemisphere.

In earlier work, Hays and co-workers found that subtle, predictable changes in the geometry of the earth's orbit — the distance to the sun, the tilt of the earth's axis and the shape of the orbit — produce the regular swings from ice ages to warmer climates (SN: 12/4/76, p. 356). But those changes are quite small. What amplifies them and produces the dramatic swings in climate? According to Hays, the amplifier is the change in the amount of sea ice surrounding Antarctica.

Hays and his team examined piston cores of sediments taken near Antarctica in the southern Indian Ocean. Where researchers found sediments enriched with the remains of diatoms, they knew open ocean once existed; where sediments were mostly clay, ice must have covered the seas, preventing the growth of diatoms. The seasonal growth and retreat of the sea ice, therefore, could be found by marking and dating the line between clay sediments and diatomaceous sediments. For example, based on the dividing line found in 20,000-year-old sections of cores, the researchers estimate that during the Antarctic summer at that time, ice covered 20 million square kilometers, 10 times the area covered during a current Antarctic summer. During the winter 20,000 years ago, ice covered about 40 million km^2, twice the area of present-day winter sea ice. More significant, the researchers found, the change between the extensive ice cover and today's conditions was quite abrupt — occurring within 300 years. Similarly, the build-up of sea ice just before the last glacial period took only a few centuries, even though glaciation did not occur in the northern hemisphere for several thousand more years. It is this evidence that leads Hays to call Antarctica an ice age early warning system.

The complete story as read from the cores goes as follows. Small changes in the earth's orbit alter the global distribution of the sun's radiation and change the seasons. Between 3,000 and 8,000 years later, the sea ice surrounding Antarctica builds abruptly. Sub-Antarctic sea surface temperatures drop. Several thousand years later, ice begins to build in the northern hemisphere. It is likely, Hays says, that the increase of sea ice changes the albedo, or reflectivity, of the globe, reducing the absorption of the sun's energy and cooling the climate. It is also possible, he told SCIENCE NEWS, that the lower sea surface temperatures may cause changes in ocean circulation. When the colder oceans hit the warm Atlantic waters, evaporation increases, leading to increased condensation and snowfall which in turn build northern hemispheric ice.

Another glacial period is expected to begin in the next few thousand years; Hays suggests that satellite monitoring of sea ice could provide clues to future climatic changes. At present, he said, there is no sign of a build-up of sea ice, though sub-Antarctic sea surface temperatures have slowly declined during the last 9,000 years. □

Panel poses planetary plan

It's called COMPLEX, and the name fits the job — laying out strategy for the study of the entire solar system. The National Aeronautics and Space Administration gets input both from its own scientists and from outside researchers to whom it has assigned similar responsibilities. But the COMmittee on PLanetary and Lunar EXploration of the National Research Council's Space Science Board has been described as the only independent, external body formally charged with advising NASA on the key scientific questions to be addressed in the agency's probings of other worlds.

In 1975, COMPLEX proposed a strategy for the outer solar system — Jupiter and beyond — covering the years through 1985: an intensive look at Jupiter, reconnaissance of Saturn and a first close look at Uranus. The two-spacecraft Voyager mission and the planned early-1980s Galileo mission with its direct probe of the Jovian atmosphere embody NASA's response. Now the panel has turned its attention to the inner planets — Mercury, Venus, the moon and Mars — a group that also significantly includes the earth.

The members of COMPLEX maintain, however, that the group is not in business to recommend specific missions. That's NASA's department. Instead, the panel stresses scientific goals, independent of the spacecraft that may address them. One reason is that such goals remain despite the annual ups and downs of NASA's budget. Perhaps more important, however, is the feeling that it is better to ask questions first, with missions assigned to seek the answers, than to let predetermined mission designs limit the questions that can even be asked.

The COMPLEX report on inner-planet strategy, which covers the period through 1987, recommends that the major focus should go to "the triad of terrestrial planets" — earth, Mars and Venus. Comparative planetology is the name of the game here, and "a key," says the report, "to the understanding of the formation of the earth, its atmosphere and oceans, and the physical and chemical conditions that lead to the origin and evolution of life."

- Mars: NASA is now studying the possibility of bringing back a sample of the planet, and from some accounts one gets the impression that this is viewed as the climactic Mars mission, with the only question being whether to first send a separate mission with "rovers" to explore the surface. COMPLEX asserts that such studies are complementary — "each of the components is separately necessary" — but that although a specific sequence is desirable, it is not necessary. A piece of Mars in an earthly laboratory can be subjected to painstaking isotopic, trace-element and other analyses impossible within the constraints of a spacecraft. Other questions, however, may be better answered on Mars itself: Some depend on atmospheric interactions, some on changes with time, some on the ability to conduct similar investigations at differing sites. Sample-return, the panel says, is "a major technique" but not a "terminal" goal, and the scientific questions raised by the group — chronology of surface-forming processes, distribution of water and other volatiles, etc. — could evoke a suite of devices from multi-sensor orbiters to dropped "penetrators" to long-range roving vehicles.

A planet to ponder: Myriad mesas and isolated hills dot the Martian surface south of the crater Lyot.

- Venus: The COMPLEX report was drawn up before the Pioneer Venus mission had been to the planet, and some of the group's major recommendations (such as atmospheric composition measurements) were in part addressed by the Pioneer probes. Only two photos and