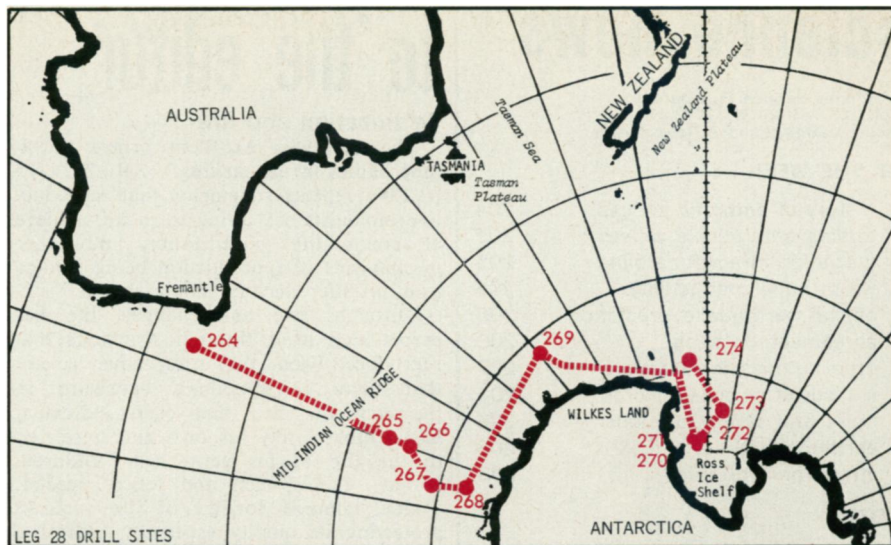


Antarctica's ice cap: Older than believed



Deep Sea Drilling Project

Leg 28's drilling sites: A sedimentary record of a more extensive glacial past.

The deep-sea drilling ship *Glomar Challenger* has penetrated into the sea-floor history of the ocean waters off Antarctica and returned with cores that show the continent has been covered with ice much longer than previously believed.

The results of the first deep drilling ever conducted in the waters near Antarctica also reveal that the Ross Ice Shelf once extended 200 to 300 miles farther than now, that a great increase in glaciation began about 5 million years ago, and that there are traces of natural gas in sediments at three drilling sites. They also confirm other evidence that Australia broke off from Antarctica about 50 million years ago and has been moving northward about two to three inches a year ever since.

The first Antarctic voyage of the Deep Sea Drilling Project, Leg 28, drilled 16 holes in the sea floor and retrieved 4,650 feet of cores. One hole was drilled 50 miles from the edge of the Ross Ice Shelf—less than 900 miles from the South Pole. The results of the 70-day voyage were announced in New York last week by Dennis E. Hayes of Columbia University. He and Lawrence A. Frakes of Florida State University were co-chief scientists on the voyage. The *Glomar Challenger's* second Antarctic voyage, now in progress, is scheduled to end April 19. Two more Antarctic legs will be conducted after the Southern Hemisphere winter, and a fifth is planned later.

The big achievement of Leg 28 is the finding that Antarctica has been glaciated for the last 20 million years. This is in contrast to the view held by most scientists that the glaciation began 5 million to 7 million years ago, although one reference book says that dates of surface rocks that overlie glaciated material "show that glaciers in Antarctica existed at least 10 million

years before the present."

Hayes is certain from the new evidence that Antarctic glaciation began 20 million years ago. "The new chronology of events that we've discovered in Antarctica is, I think, going to alter all the theories" of the relationship between Antarctic and Northern Hemisphere glaciation, Hayes said.

The main clue to the early glacial history is the presence in the sediment cores of pebbles, stones and other material that are too heavy to have been carried out to sea by ocean currents. But they are carried to sea in large quantities by icebergs, and their presence in sediments is a classic indicator of continental glaciation. The glacial pebbles are absent in the portion of cores older (deeper) than 20 million years. At the 20-million-year level they begin accumulating. They are found in about the same amounts up to the 5-million-year level, when their abundance increases greatly, then returns

back to the previous quantities.

Another indicator of this climatic scenario is the presence in the cores beginning about 20 million years ago of the types of fossil organisms that thrive in cold water.

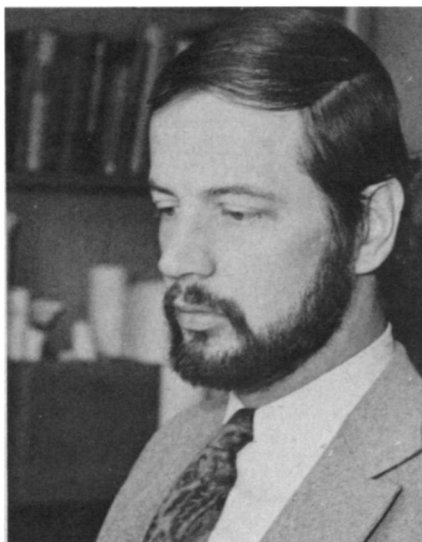
To Hayes and his colleagues this all indicates gradual buildup of ice on the continent and shelf areas beginning about 20 million years ago, followed by "a glacial pulse" 5 million years ago—"a major and abrupt change in the extent of glaciation." Hayes believes this large increase in glaciation at that time is what earlier investigators mistook to be the onset of Antarctic glaciation. "It's going to change all the ideas."

At holes drilled in the Ross Sea, the cores reveal that the tilted sediments had been sheared off by an ice sheet that once rested on the bottom. The Leg 29 scientists infer that the Ross Ice Shelf extended 200 to 300 miles farther out to sea at the time of maximum glaciation 5 million years ago.

After the Antarctic ice reached its maximum extent, the sedimentary evidence indicates that the ice cap underwent a rapid melting and retreat to a position similar to that of today.

The glaciation and melting may have been related to the circulation of polar waters caused by the separation and movement of Australia from Antarctica. But sorting out the causes of glacial events on earth is extremely complex, and there is little scientific consensus on the subject.

What is known is that the Antarctic ice cap has major influences on climate and ocean circulation. The new evidence from the *Glomar Challenger* will undoubtedly, as Hayes predicts, cause considerable reevaluation of ideas and evidence about other known climatic events on earth.



Columbia Univ.

Hayes: Alters all previous theories.

The finding of trace amounts of natural gas—methane and ethane—at three of the four sites in the Ross Sea is causing some uneasiness to the scientists. They caution that the finding does not necessarily mean there are any economically important gas deposits. Hayes notes only that “there will be more interest in that area now than there would otherwise have been.” As at other sites where the Glomar Challenger has found traces of gas, the holes were sealed with cement to prevent any possible pollution.

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The Soviet Union has agreed to join and help finance the Deep Sea Drilling Project. The new U.S.-Soviet Joint Commission on Scientific and Technical Cooperation (see p. 207) gave final approval last week to a plan to have the Institute of Oceanology of the U.S.S.R. Academy of Sciences become a member of JOIDES (Joint Oceanographic Institutions for Deep Earth Sampling), the advisory body for the project. Until now, all five members of JOIDES have been U.S. institutions. The Soviet Union will contribute \$1 million a year, about a tenth of the costs, to the project. The National Science Foundation provides the U.S. funds. □

Drilling into the dry valleys of Antarctica

While the Glomar Challenger was drilling the first deep holes into the ocean bottom near Antarctica, a group of international scientists was completing the first phase of a project to drill into the Antarctic continent itself.

Scientists with the Dry Valley Drilling Project (DVDP) spent from early January to early March in Antarctica doing preliminary drilling. The purpose of the just-completed trip, according to project leader Lyle McGinnis, a Northern Illinois University geophysicist, was to get the team members accustomed to the drilling apparatus and to working in the zero-to-30-degree temperatures.

“We now have our procedures established for the next two years,” McGinnis says. “We could easily drill 30 meters a day with ideal conditions.”

The next phase of the drilling is scheduled for September 1973 through January 1974. Drilling is expected to take place at 10 sites before the project's completion in 1975. The project, supported by the National Science Foundation and science groups from Japan and New Zealand, should produce abundant new information about the geologic, climatic and glacial history of Antarctica.

When glaciers scoured North Carolina's peaks

Throughout Canada and much of the northern United States, the glaciers of millennia ago have left their signs, and in the western half of the continent the sheared mountains and trough-like canyons run down to southern California and northern New Mexico.

In the Eastern states, however, the mighty glaciers have seemed conspicuously absent from the lower latitudes. There are obvious signs in the Catskill Mountains of New York and near-glacial traces in Pennsylvania, but virtually no reports of unambiguous traces farther south. This has not been treated as any Great Mystery—the Gulf of Mexico, perhaps, and the Gulf Stream current could have exerted their warming influence northward, melting down the icy monoliths until they were just trickles crossing the future Mason-Dixon line. Charts in textbooks have complacently showed glaciation as dipping southward into southern Illinois and Indiana in the Midwest, and farther to towering peaks in the Far West, but with the southeast corner of the country untouched.

This week, two geologists at Appalachian State University in Boone, N.C., announced a “100 percent incontrovertible” discovery that could put the southern United States back on the glacial map.

It was rather like the story of the Emperor's New Clothes. The researchers, James O. Berkland and Loren A. Raymond, had both studied geology at the University of California at Davis and thus shared the western notion that mountain glaciation in the South was nothing out of the ordinary. They lacked, says Berkland, a mental set to tell them that one couldn't find such things in the Southeast.

“A year ago this May,” says Berkland, “when I came out here for the first time, it struck me that the area looked as if it had been glaciated in the higher peaks. It has the rather bald, scoured hills, the lack of soil, and . . . the elevations above 4,000 feet seemed

to be adequate. Having come from the West, where 1,500 miles south of the continental ice sheet the various peaks were glaciated down as far as Los Angeles, it seemed very natural that out here in the Appalachians the same thing should be true.”

Thus on Feb. 24, Berkland and the Raymonds drove up to North Carolina's Grandfather Mountain for a look at a promising cirque, a valley with a semi-circular wall piled up like the effect created by swinging one's leg forward into the edge of a snowbank. “It was just about sunset,” Berkland says. “We were about to turn around when we got to this last outcrop, and sure enough there they were.”

“They” were marks—30 to 40 grooves in the rock perhaps an inch wide and half an inch deep, crescent-shaped “chatter marks” and smoothly polished areas of the rock surface. The marks were on a knobby ledge, about 300 feet above the present floor of the cirque (which has been largely filled in with soil and loose rock in the 14,000 years since the glaciation is believed to have taken place) and perhaps 700 feet below the rim of the cirque's west wall, making it unlikely that the grooves were due to other causes such as rocks or strata sliding along the valley floor.

“We knew at once we had found it,” says Berkland, and like the breaking of the four-minute mile, the discovery was soon followed by others, the most recent being the finding last Friday of half a dozen other striated areas, some as low in elevation as 3,200 feet. The finds have been on the predominantly shaded sides of their respective peaks, where snow and ice would be more likely to build up and remain.

A scientific report on the findings is now being evaluated by the journal *SCIENCE*, and there may be more startling finds to come. Berkland and Raymond have recently found promising indications of glaciation on a topographic map of northern Georgia. □



J. O. Berkland

Grooved rock on North Carolina's Grandfather Mountain may be glacial sign.