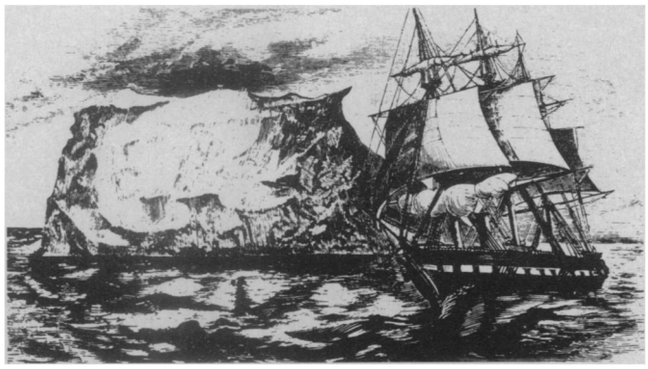
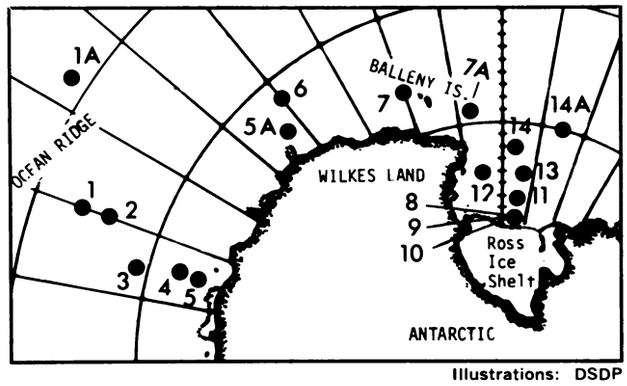


The first Challenger in Antarctic waters, 1874.



Illustrations: DSDP

Leg 28 drill sites: Toward a clearer Antarctic picture.

Antarctic leg: Drilling among the icebergs

by Louise A. Purrett

For a little over four years the research ship Glomar Challenger has been cruising the world oceans while scientists on board probed the sediments below. The ship has covered over 100,000 miles and drilled at 265 sites. But so far one area has been neglected. Now, for the first time, the Challenger will venture into Antarctic waters.

On Dec. 22, the Glomar Challenger was to depart Fremantle, Australia, to begin Leg 28 of the Deep Sea Drilling Project. The date has additional significance: It will have been exactly 100 years and one day since the original Challenger left England on its 3.5-year expedition.

About 14 drill holes are planned for the Ross Sea and Antarctic waters directly south of Australia. The expedition, headed by Dennis E. Hayes of Lamont-Doherty Geological Observatory and Lawrence A. Frakes of Florida State University, will end Feb. 28, 1973, at Christchurch, New Zealand.

A thick ice sheet and the hazards of severe weather have contributed to keeping Antarctica the least-known of the continents. In fact, during the 50-month life of the project, only two of the DSDP's drill sites have been located south of latitude 35 degrees S. Both were on Leg 26, in the Indian Ocean.

Among the basic goals of the voyage are: to determine the glacial and climatic history of Antarctica and its effects on global climate; to detail the chronology of separation of the supercontinent Gondwanaland, which broke apart 150 million to 200 million years ago into the present-day southern continents; to study the distribution and fossil content of sediments; to define oceanic circulation patterns around Antarctica, and to outline the history of movements of crustal plates bordering the continent.

More specifically, there are several puzzles about Antarctica that the Leg 28 scientists hope to solve. Antarctica, according to Hayes and Frakes, is taken as the hub of all reconstructions of predrift Gondwanaland. In these reconstructions Antarctica is assumed to have remained relatively stationary while the other fragments of Gondwanaland drifted away. "The south pole continent was thus left passively in the wake of the northward migration, in sequence, of the various Gondwanaland components." Indeed, paleomagnetic data from Antarctica, in which the magnetic orientations frozen into ancient rocks are determined, confirm that the continent has occupied a high-latitude position for at least the last 250 million to 300 million years.

Recently, however, field explorations on the continent have been uncovering remains of amphibians, insects, plants and spores between 20 million and 200 million years old that point to the conclusion that a milder climate once prevailed on the continent. It is assumed, says Hayes, that a high-latitude position for Antarctica necessitates a cold climate. "But *was* it cold? Or are we mistaken in the belief that Antarctica has been in high latitude?" The drilling planned on both sides of the mid-Indian Ocean ridge may uncover enough of the history of sea-floor spreading there to enable scientists to pinpoint past Antarctic positions.

Determining when Antarctica first acquired its ice blanket might also shed light on the problem. "The time of onset of continental glaciation is still a controversial issue," say Hayes and Frakes. "However, there is very strong evidence to indicate the presence of major glacial effects through the continent as long as four million to seven million years ago and perhaps much longer for more restricted areas." The scientists would be able to identify any drastic change in climate on the continent by a change in the nature of the fossils. Discovery of glacially transported materials, such as sand grains bearing tell-tale scratches, would also mark the onset of glaciation.

Sediment cores recovered from the North Atlantic, Caribbean and parts of the Pacific Ocean on previous Challenger voyages have had one peculiar characteristic in common—a gap in the sediment record in which sediments between 40 million and 50 million years old were missing. The time interval missing is not exactly the same at all locations but the Leg 28 scientists believe that some relationship between them is likely and that changing circulation or climate at Antarctica may well have had global effects that account for the gap.

The cold bottom water occupying the depths of most of the ocean basins in the world is formed around the periphery of Antarctica, particularly in the Ross and Weddell Seas. Seawater around the world is not uniform in character, and Antarctic water can be identified by salinity, temperature, oxygen properties and mineral content. But though deep-basin water is known to originate in the Antarctic, says Hayes, "there is a lot of uncertainty as to how and where it forms and how it moves around." The circulation of this bottom water controls sedimentation, erosion and circulation of the deep water of the world oceans.

Some change in bottom-water circulation, perhaps caused by the onset of glaciation on the continent, may account for the widespread gap in the sediment record.

Deep Sea Drilling voyages seldom accomplish everything they set out to do, but in waters as unknown as the Antarctic it's a safe bet Leg 28 researchers will come up with something new, and maybe even something unexpected. □