SCIENCE NEWS of the week

Paleoclimate Theories Left in Cold?

It may be difficult to predict even tomorrow's weather, but scientists drilling deep into the ocean floor have discovered what the climate was like above the Arctic Circle millions of years ago. What they have found may surprise those who study the earth's very ancient history. The new data cast a scientific shadow of doubt on the generally accepted date for the onset of major glacier buildup in that area of North America, as well as on an established theory of global climate cycles.

Using the drillship *JOIDES Resolution,* participants in the Ocean Drilling Program (ODP), headquartered at Texas A&M University in College Station, drilled at two locations in the Labrador Sea and one in Baffin Bay (see map). The Baffin Bay site was at the highest latitude ever tested by drilling. Battling icebergs and arctic storms, the international group collected more than a mile of sediment samples from as deep as 3,500 feet beneath the seafloor.

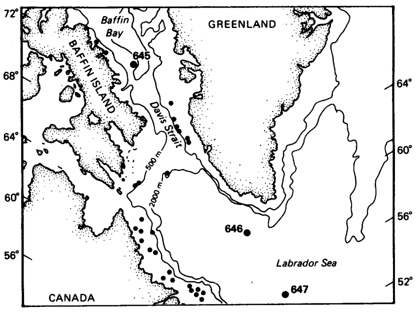
Evaluation of core samples from the two-month mission, completed Oct. 27, will take up to two years. But preliminary conclusions, based on examinations of rocks and fossils of microscopic organisms from different sediment layers, shed new light on old crustal movement (plate tectonics) and long-ago climatic changes. According to ODP scientists, some results apparently shake the scientific bases for certain theories, while others lend support to previous work. For example, the data have confirmed findings from a previous ODP cruise suggesting that Greenland, Canada and Western Europe were one large landmass until they began separating about 85 million years ago. Thirty million years later, Europe left Greenland behind, requiring a major reorganization of the way nearby seas were opening up.

"That [55 million years ago] is the magical age when everything happened," says Mike Arthur of the University of Rhode Island in Narragansett, co-chief scientist for the voyage. "We've linked the tectonic histories of the Labrador Sea and Baffin Bay. Now we think we know that Baffin Bay really started opening up at 55 million years ago." He says sediment profiles also show "something happened" at 36 million years ago, and Baffin Bay stopped expanding. (Earlier studies by others had shown the same dates for the Labrador Sea's formation.) By that time, the once-subtropical temperatures of the region had already started cooling.

With the formation of Baffin Bay and the Labrador Sea, cold water from the Arctic Ocean could flow into the Atlantic Ocean, dramatically changing the climate. ODP evaluation of Labrador Sea "drop stones" – debris released from melting icebergs floating free from glaciers – confirms major ice sheets existed in the western North Atlantic region 2.5 million years ago – the date generally recognized by scientists as the beginning of the area's major ice buildup.

But additional ODP conclusions using Baffin Bay data "will be very controversial," says Arthur. "We put the major dropstone event at 2.5 million years, but we think we have evidence for a much earlier time for the beginning of major glaciation." Rock analyses, he says, suggest a "tentative" date of 3.5 million years ago and an "extremely tentative" date of 8 million years ago for glacial onset.

Marine geologist Ali Aksu of the Memorial University of Newfoundland in St. John's has studied Baffin Bay sediments since 1975. A member of the ODP cruise, he says, "I don't doubt for one minute the data [indicating earlier glaciation]. It looks like there is something funny going on." The disparate dates, Aksu suggests, may be related to technical differences in data – one set based on fossils, another on magnetic field changes.



ODP

Paleoclimatology work by the ODP team will also raise questions about the Milankovitch theory (SN: 10/19/85, p. 251), a long-accepted view of climatic cycles, says Arthur. The theory links global climate over millions of years to the way solar energy is received, changed by slight fluctuations in the tilt of the earth and its mean distance from the sun. Under the theory, tilt is the most important factor in high latitudes. But Arthur reports Baffin Bay data indicate tilt "is not the dominant signal," for reasons not yet understood. "What we got was a regional story," he cautions. "We're trying to incorporate that into a global look."

– D.D. Edwards

Galactic distance by triangulation

Triangulation is a common method of measuring distances on the face of the earth. Now it has been used for the first time in determining the distance from earth to a faraway galaxy. The achievement introduces a method that may in the long run prove more certain than other methods now in use. It also gives Hubble's constant, the number that measures the rate of expansion of the universe.

The triangulation method depends on radio and optical observations of a supernova in a distant galaxy, specifically a supernova that exploded in 1979 in the galaxy M100 located in the Virgo cluster. A supernova is a stellar explosion. It starts from virtually zero diameter and produces an expanding ball of debris.

Optical observation can give the linear speed of expansion, in this instance up to 12,000 kilometers per second. From this the diameter of the ball at any time can be calculated. Radio observation can measure the angle that the diameter makes, as viewed from the earth. From these two data a triangle can be set up that gives the distance to the galaxy, in this case 19 megaparsecs. Essential to the procedure is precise, very-long-baseline interferometry, the combining of simultaneous observations by radiotelescopes located across the earth. Participants in the observation are Norbert Bartel of the Harvard-Smithsonian Center for Astrophysics (CFA) in Cambridge, Mass., A.E.E. Rogers of the Haystack Observatory in Westford, Mass., Irwin I. Shapiro, Marc V. Gorenstein and C.R. Gwinn of the CFA, J.M. Marcaide of the Max Planck Institute for Radioastronomy in Bonn, West Germany, and K.W. Weiler of the National Science Foundation in Washington, D.C. They reported their findings in the Nov. 7 NATURE.

The value of the Hubble constant determined is 65 kilometers per second per megaparsec with uncertainties of plus 35 and minus 25 km/sec/Mpc. The large uncertainties arise because a long string of assumptions had to be made about the geometric development of a supernova – whether it expands evenly and spherically, whether it is a thin shell or a filled sphere, etc. Further observations of supernovas in general and of this one in particular ought to lessen some of the uncertainties. The value of the Hubble constant lies between the two earlier "standard" ones, 50 and 100, but the uncertainties do not allow it to distinguish between them. Such a distinction, settling on a single value for the constant, is the ultimate goal.

– D.E. Thomsen