Scientists cast doubt on theory of what triggered Antarctic glaciation

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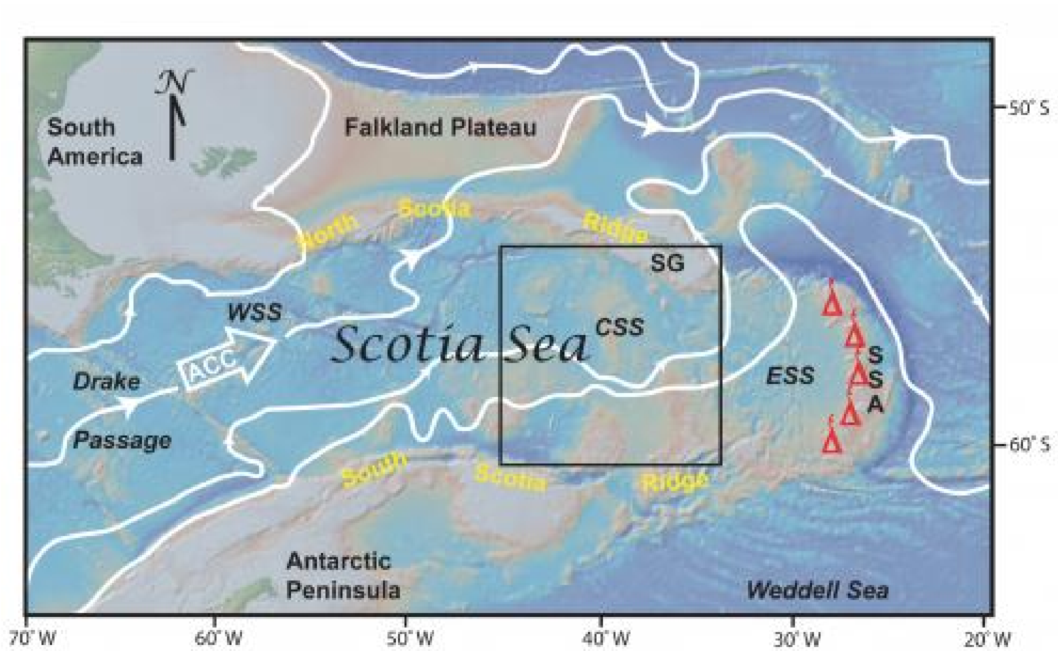


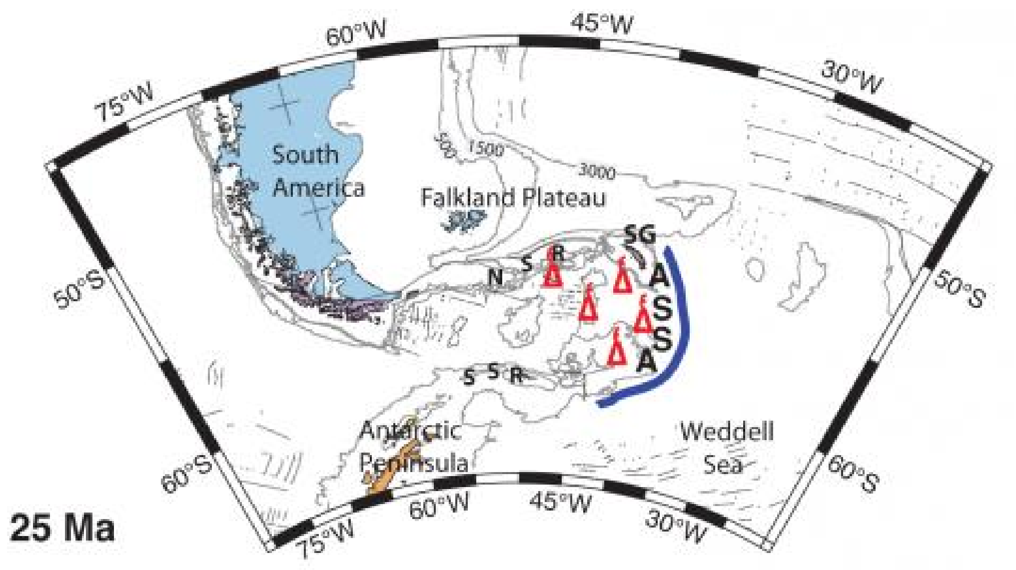
This is a physiographic map of the present-day Scotia Sea, Drake Passage and adjacent land masses. The white arrows show the present path of the several branches of the deep Antarctic Circumpolar Current (ACC) centered on its core. The area of study in the central Scotia Sea (CSS) is shown by the black box to the south of South Georgia island (SG). The volcano symbols mark the active South Sandwich volcanic arc (SSA). (WSS = western Scotia Sea; ESS = eastern Scotia Sea) Credit: University of Texas at Austin

A team of U.S. and U.K. scientists has found geologic evidence that casts doubt on one of the conventional explanations for how Antarctica's ice sheet began forming. Ian Dalziel, research professor at The University of Texas at Austin's Institute for Geophysics and professor in the Jackson School of Geosciences, and his colleagues report the findings today in an online edition of the journal *Geology*.

The Antarctic Circumpolar Current (ACC), an ocean current flowing clockwise around the entire continent, insulates Antarctica from warmer ocean water to the north, helping maintain the ice sheet. For several decades, scientists have surmised that the onset of a complete ACC played a critical role in the initial glaciation of the continent about 34 million years ago.

Now, rock samples from the central Scotia Sea near Antarctica reveal the remnants of a now-submerged volcanic arc that formed sometime before 28 million years ago and might have blocked the formation of the ACC until less than 12 million years ago. Hence, the onset of the ACC may not be related to the initial glaciation of Antarctica, but rather to the subsequent well-documented descent of the planet into a much colder "icehouse" glacial state.

"If you had sailed into the Scotia Sea 25 million years ago, you would have seen a scattering of volcanoes rising above the water," says Dalziel. "They would have looked similar to the modern volcanic arc to the east, the South Sandwich Islands."



This is a reconstruction of the Scotia Sea area 25 million years ago, showing volcanoes of the ancestral South Sandwich arc (ASSA). They are now submerged, but were active at that time and possibly emergent. They may have blocked the onset of the Antarctic Circumpolar Current. (NSR = North Scotia Ridge; SSR = South Scotia Ridge; SG = South Georgia island) Credit: University of Texas at Austin

Using multibeam sonar to map seafloor bathymetry, which is analogous to mapping the topography of the land surface, the team identified seafloor rises in the central Scotia Sea. They dredged the seafloor at various points on the rises and discovered volcanic rocks and sediments created from the weathering of volcanic rocks. These samples are distinct from normal ocean floor lavas and geochemically identical to the presently active South Sandwich Islands volcanic arc to the east of the Scotia Sea that today forms a barrier to the ACC, diverting it northward.

Using a technique known as argon isotopic dating, the researchers found that the samples range in age from about 28 million years to about 12 million years. The team interpreted these results as evidence that an ancient volcanic arc, referred to as the ancestral South Sandwich arc (ASSA), was active in the region during that time and probably much earlier. Because the samples were taken from the current seafloor surface and volcanic material accumulates from the bottom up, the researchers infer that much older volcanic rock lies beneath.

Combined with models of how the seafloor sinks vertically with the passage of time, the team posits that the ASSA originally rose above sea level and would have blocked deep ocean currents such as the ACC.

Two other lines of evidence support the notion that the ACC didn't begin until less than 12 million years ago. First, the northern Antarctic Peninsula and southern Patagonia didn't become glaciated until less than approximately 12 million years ago. And second, certain species of microscopic creatures called dinoflagellates that thrive in cold polar water began appearing in sediments off southwestern Africa around 11.1 million years ago, suggesting colder water began reaching that part of the Atlantic Ocean.

More information: geology.gsapubs.org/content/ea … 10/G34352.1.abstract

Provided by University of Texas at Austin