Coastal-Change and Glaciological Maps of the Antarctic Peninsula

In 2000, the Glacier Studies Project (GSP) of the U.S. Geological Survey (USGS) and the Mapping and Geographic Information Centre (MAGIC) of the British Antarctic Survey (BAS) began a formal cooperative 3-year endeavor to prepare three maps of the Antarctic Peninsula region (figs. 1 and 2). The maps will be based on a large variety of cartographic, aerial photograph, satellite image, and ancillary historical datasets archived at each institution. The maps will document dynamic changes on the peninsula during the past 50 years.

The three maps are part of a planned 24-map series (I–2600) being published by the USGS in both paper and digital format (see USGS Fact Sheet FS–050–98 at http://pubs.usgs.gov/factsheet/fs50-98); the maps are of the Trinity Peninsula area (I–2600–A), the Larsen Ice Shelf area (I–2600–B), and the Palmer Land area (I–2600–C). The 1:1,000,000-scale maps will encompass an area 1,800 kilometers (km) long and with an average width of 400 km (range of 200 to 600 km wide); the area is between lats 60° and 76° S. and longs 52° and 80° W. Each of the three maps will include an interpretive booklet that analyzes documented historical changes in the fronts of the ice shelves and termini of the outlet glaciers.

For much of the Antarctic Peninsula, the BAS has used a georeferenced digital image mosaic from Landsat Thematic Mapper images prepared by the Institut für Angewandt Geodäsie (now the Bundesamt für Kartographie und Geodäsie) in Germany as an image-map base (backdrop). Thus, I–2600–A–C will have a different base than the other maps of the series, which will be georeferenced to a digital mosaic of RADARSAT images of Antarctica created by the Byrd Polar Research Center of Ohio State University. All digital cartographic data for I–2600–A–C will be available in the web-accessible USGS Atlas of Antarctic Research, and new coastline information will be incorporated into the Scientific Committee on Antarctic Research Antarctic Digital Database (ADD) (see http://www.nerc-bas.ac.uk/public/magic/add_home.html). The ADD is a multinational project to maintain a digital cartographic database of Antarctica.

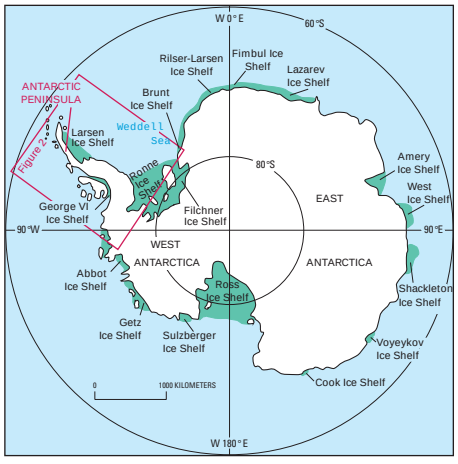

Figure 1. Location of the Antarctic Peninsula and principal ice shelves of Antarctica, areas of dynamic coastal change.

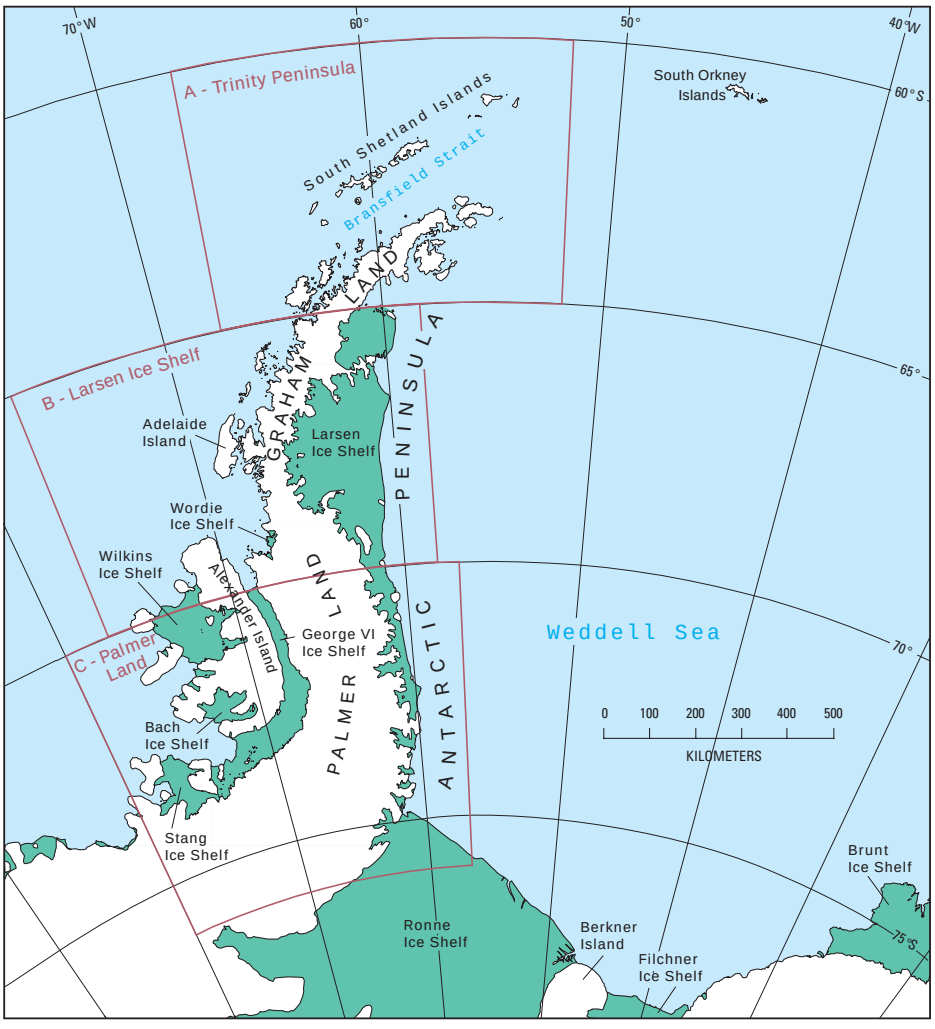

Figure 2. Locations and names of three Antarctic Peninsula areas for which the U.S. Geological Survey and the British Antarctic Survey are preparing coastal-change and glaciological maps (I–2600–A, B, and C, scale 1:1,000,000).

The 24 maps will be valuable tools in studying changes along the cryospheric coast of Antarctica. The plan for the maps grew out of the 11-volume USGS Professional Paper 1386, "Satellite Image Atlas of Glaciers of the World," an internationally authored publication which provides a mid-1970s baseline of the global areal extent of glaciers according to Landsat multispectral scanner (MSS) images (see USGS Fact Sheet FS–133–99 at http://pubs.usgs.gov/factsheet/fs133-99).

The continent of Antarctica (fig. 1) is covered by the larger of the two remaining ice sheets on Earth. The Antarctic ice sheet encompasses an area of 13,949,000 km^2 and a volume of 30,109,800 km^3; only 0.33 percent of the continent has exposed bedrock. Changes in the area and volume of the Antarctic ice sheet, the Greenland ice sheet (1,736,095 km^2, 2,600,000 km^3), ice caps, ice fields, and the Earth's smaller glaciers are related to the global hydrologic cycle. Glaciers represent about 2 percent of the Earth's water in the form of freshwater ice, which, if completely melted, would raise sea level by more than 75 meters (see USGS Fact Sheet FS–02–00 at http://pubs.usgs.gov/factsheet/fs2-00).

Ice fronts, the floating edges of ice shelves and outlet glaciers, are the most dynamic and changeable features in the coastal regions of Antarctica. The Ross Ice Shelf and the Ronne Ice Shelf/Filchner Ice Shelf have experienced major calving events historically, in which tabular icebergs many tens of kilometers long and wide have broken off. Such events, although irregular, are thought to be cyclical. In the Antarctic Peninsula region (fig. 2), however, the calving process of ice shelves during the past 50 years does not appear to be cyclical. Rather, the repeated calving events are resulting in the near-complete disintegration of some ice shelves (for example, Wordie Ice Shelf; figs. 2 and 3) and the breakup of others (Larsen Ice Shelf, figs. 1 and 2). The pronounced glaciological changes occurring in the Antarctic Peninsula region are the probable result of regional climate warming (+2.5°C since meteorological observations were initiated in the 1940s) and may even have global-climate-change implications.

The ice shelves that fringe Antarctica (fig. 1) slow the flow of outlet glaciers. The loss of buttressing ice shelves may cause outlet glaciers to accelerate their flow directly into the surrounding ocean. Any loss (melting) of grounded glacier ice above sea level from the Antarctic (and other glacierized regions on Earth) would cause a global rise in sea level. Even the total melting of the small volume of ice in the Antarctic Peninsula region would raise global sea level by about 0.5 m.

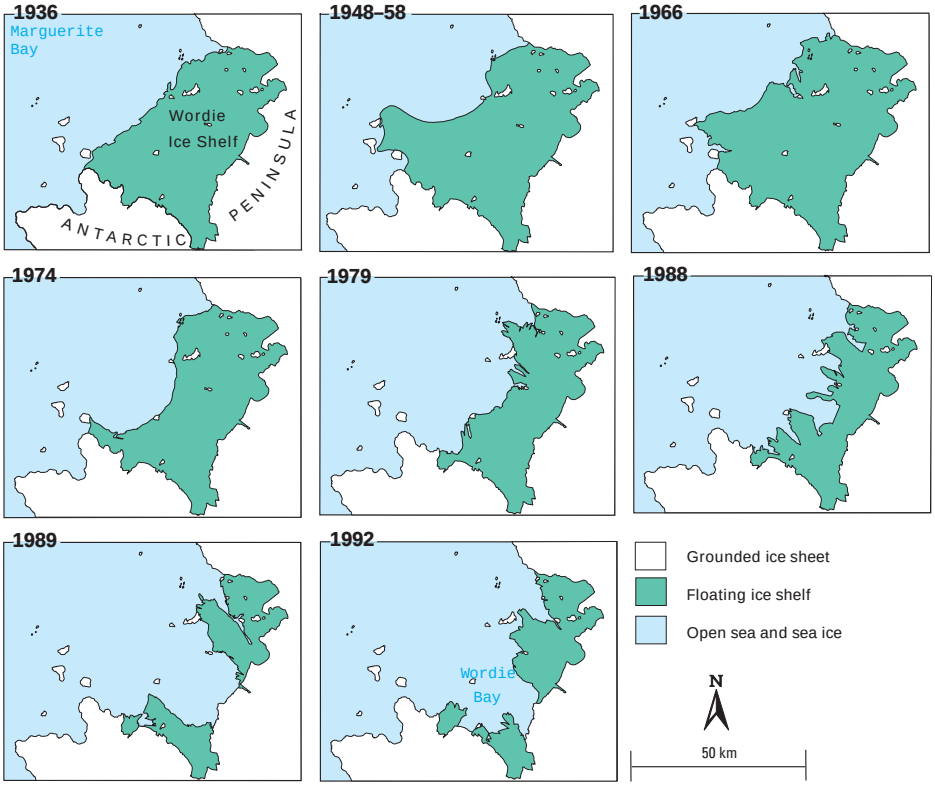

Figure 3. Disintegration of the Wordie Ice Shelf, Antarctic Peninsula, 1936–92. Modified from Natural Environment Research Council, British Antarctic Survey, 1996, Climate change; Ice and ice ages, a copyrighted leaflet. Used with permission.

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