Natural Resources Canada | Ressources naturelles Canada
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GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

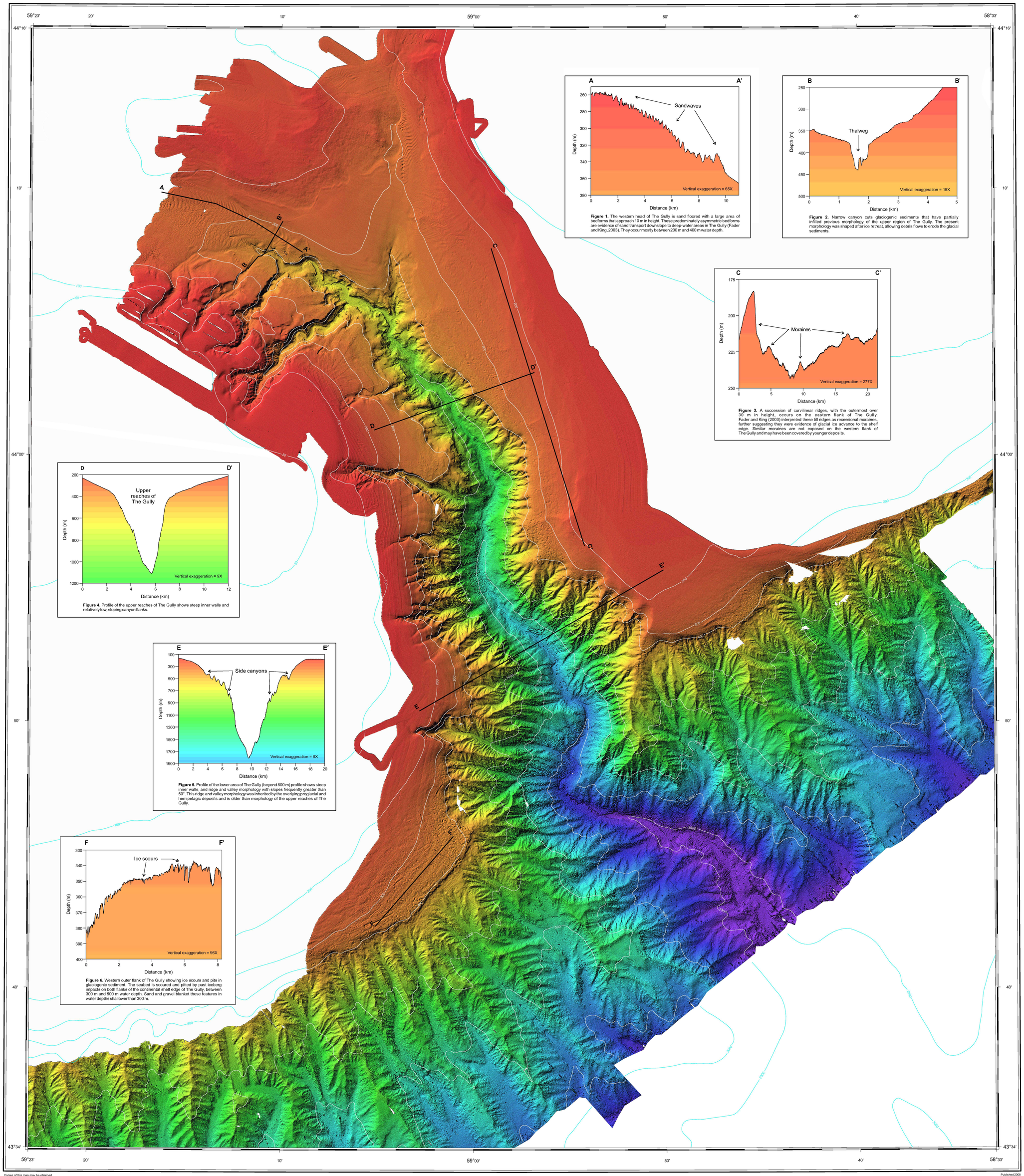

Figure 1. The western head of The Gully is sand floored with a large area of bedforms that approach 10 m in height. These predominately asymmetric bedforms are evidence of sand transport downslope to deep-water areas in The Gully (Fader and King, 2003). They occur mostly between 200 m and 400 m water depth.

Figure 2. Narrow canyon cuts glaciogenic sediments that have partially infilled previous morphology of the upper region of The Gully. The present morphology was shaped after ice retreat, allowing debris flows to erode the glacial sediments.

Figure 3. A succession of curvilinear ridges, with the outermost over 30 m in height, occurs on the eastern flank of The Gully. Fader and King (2003) interpreted these till ridges as recessional moraines, further suggesting they were evidence of glacial ice advance to the shelf edge. Similar moraines are not exposed on the western flank of The Gully and may have been covered by younger deposits.

Figure 4. Profile of the upper reaches of The Gully shows steep inner walls and relatively low, sloping canyon flanks.

Figure 5. Profile of the lower area of The Gully (beyond 800 m) profile shows steep inner walls, and ridge and valley morphology with slopes frequently greater than 50°. This ridge and valley morphology was inherited by the overlying proglacial and hemipelagic deposits and is older than morphology of the upper reaches of The Gully.

Figure 6. Western outer flank of The Gully showing ice scours and pits in glaciogenic sediment. The seabed is scoured and pitted by past iceberg impacts on both flanks of the continental shelf edge of The Gully, between 300 m and 500 m water depth. Sand and gravel blanket these features in water depths shallower than 300 m.

DESCRIPTIVE NOTES

INTRODUCTION

This colour-coded, multibeam sonar shaded-relief seafloor map is part of a three-map series of The Gully at a scale of 1:100 000. The series also includes a surficial geology map (Cameron et al., 2008) and a colour-coded, shaded seafloor-slope analysis map (Cameron and King, 2008).

MULTIBEAM BATHYMETRIC DATA COLLECTION

Multibeam surveys were co-ordinated by the Geological Survey of Canada (Atlantic) in 1996, 1997, and 1998 and by the Canadian Hydrographic Service in 2000 within The Gully Marine Protected Area. Surveys were conducted in collaboration with several industry partners and the Department of Fisheries and Oceans. The survey utilized a Simrad EM1000 multibeam sonar with operational depths from 10 m to 4500 m. The system produces 135 beams over a maximum arc of 150°. During this survey, the swath coverage was up to seven times the water depth, with survey speeds of 10–12 knots. A Differential Global Positioning System provided positioning accuracy of approximately 3 m.

Figures 1–6 are bathymetric profiles derived using ArcMap™. They illustrate a variety of features found in The Gully.

DATA DISPLAY

Shaded seafloor relief was produced by processing multibeam data at both 10 m and 20 m gridding interval. This elevation model has been displayed using sun illumination from 315° and at 45° above the horizon. Bathymetric values are colour-coded shades of blue and red for depths from deep to shallow, respectively. The vertical exaggeration is 10X.

Linear acoustic artifacts oriented parallel to the survey direction are due to refraction errors. Horizontal resolution decreases with increasing water depth because of an increase in the acoustic footprint and beam spacing. This results in a smoothing effect with a local underestimation of steep slopes and an inability to resolve small features.

MORPHOLOGY

Introduction

Positioned between Sable Island Bank and Banquereau, The Gully is the largest submarine canyon on the outer southeastern Canadian continental margin. It appears morphologically similar to many other canyons on the Scotian Slope; however, it indents the continental shelf much deeper than other canyons, connecting the middle shelf to the continental slope.

Mechanisms of formation

It is generally recognized that The Gully formed by fluvial, glacial, and meltwater erosion (Fader et al., 1998) that cut deeply into Cenozoic mudstone and sandstone units. It was excavated over the past million years as successive continental glaciations lowered sea level, exposing the shelf and allowing rivers to erode and deposit sediments near the top of the continental slope. The Gully was partially eroded by turbidity currents that flowed down the canyon at times of glacial maxima.

Upper part of The Gully

The upper part of The Gully was partially infilled by subglacial and proglacial sediments. A meandering main thalweg, large feeder channels, and retrogressive slumped canyon walls with terraces characterize morphology of the upper part of The Gully (shallower than 800 m). This morphology was shaped after ice retreat, allowing debris flows to erode the glacial sediments. Easily eroded glacial marine sediment infilling the upper western flanks of The Gully has contributed to the growth of major side canyons. Till on the eastern flank has prevented large side canyons from forming.

Lower part of The Gully

With slopes frequently greater than 50°, the lower part of The Gully (beyond 800 m) is characterized by ridge and valley morphology formed by submarine erosion. This ridge and valley morphology may have been inherited by the overlying proglacial and hemipelagic deposits and is older than the morphology of the upper part of The Gully.

Feeder canyons

Nine major feeder canyons or channels and many smaller channels occur on the western flank of the upper part of The Gully. Large feeder canyons do not occur on the eastern flank of The Gully. All feeder canyons have sand-filled catchment basins at their heads that give way to bedrock-controlled sidewalls in deeper water. Ledges, terraces, steep slopes of exposed sandstone and mudstone, and minor gullies characterize the feeder canyons (Fader and Strang, 2002).

The thalweg

The Gully thalweg (channel) has a uniform sand-covered surface, sloping at approximately 2° seaward from its head. Only at 2700 m water depth does the slope of the thalweg begin to decrease slightly. Overdeepening of the present thalweg channel floor does not occur, suggesting minimal glacial erosional effects in the deep channel and uniform processes of sediment deposition in recent time.

The canyon head

The head of The Gully is sand floored and bifurcated into two channels, a minor one that extends to the north and a major channel extending to the northwest. The major channel floor consists of rippled sand with accumulated organic flocculent in the troughs of the bedforms. The sediment at the canyon head is similar in texture and lithology to fine-grained sand found on Sable Island Bank. A large megaflute occurs on the seafloor to the northwest of The Gully, which suggests formation by strong and likely episodic bottom currents.

The canyon flanks

The seabed is scoured and pitted by past iceberg impacts on both flanks of the continental shelf edge of The Gully, between 300 m and 500 m water depth. Sand and gravel blanket these features in water depths shallower than 300 m.

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Cameron, G.D.M., Campbell, D.C., and King, E.L.
2008: Surficial geology and sun-illuminated seafloor topography, The Gully, Scotian Shelf, offshore eastern Canada; Geological Survey of Canada, Map 2123A, scale 1:100 000.

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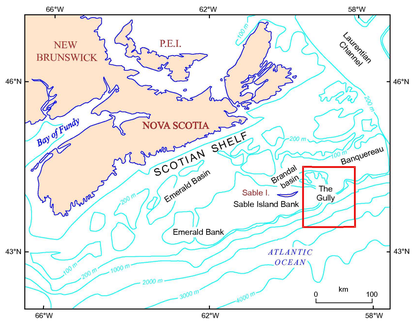


Copies of this map may be obtained
from the Geological Survey of Canada:
601 Booth Street, Ottawa, Ontario K1A 0E8
3303-33rd Street, N.W., Calgary, Alberta T2L 2A7
625 Robson Street, Vancouver, B.C. V6B 5J3
490, rue de la Couronne, Québec, Québec G1K 9A9
1 Challenger Drive, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2

LOCATION MAP

Authors: G.D.M. Cameron and E.L. King

Multibeam bathymetric data collected by M.Z. Li, and D.C. Campbell, Geological Survey of Canada (1996 – 1998); Canadian Hydrographic Services (2000) and C&C Technologies

Multibeam bathymetric data compiled by J. Strang, 2005

Digital cartography by G. Grant, GSC (Atlantic)

Any revisions or additional information known to the user would be welcomed by the Geological Survey of Canada

MAP 2122A

SUN-ILLUMINATED SEAFLOOR TOPOGRAPHY

THE GULLY

SCOTIAN SHELF, OFFSHORE EASTERN CANADA

Scale 1:100 000/Échelle 1/100 000

kilometres 2 0 2 4 6 8 kilometres

Universal Transverse Mercator Projection
North American Datum 1983

This map is not to be used for navigational purposes

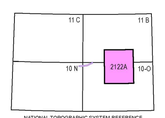
Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983

Cette carte ne droit pas être utilisée aux fins de navagation

Digital bathymetric contours in metres supplied by the Canadian Hydrographic Service and GSC (Atlantic)

Mean magnetic declination 2008, 18°55'W, decreasing 9.3' annually. Readings vary from 18°49'W in the SW corner to 19°01' in the NE corner of the map

Depth in metres below sea level



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE

Published 2008

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2008: Sun-illuminated seafloor topography, The Gully, Scotian Shelf, offshore eastern Canada; Geological Survey of Canada, Map 2122A, scale 1:100 000.