

# Bathymetric Study of Four Submarine Canyons on the Southern Edge of Georges Bank

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NOAA Ship *Okeanos Explorer*



## Abstract

Georges Bank is a large submerged plateau, encompassing an area of 42,000 m<sup>2</sup> on the northeastern continental shelf. On its seaward boundary it is incised by several submarine canyons, which play a significant role in the high levels of productivity that have historically characterized the area. Marine organisms thrive in submarine canyons, and recent approaches to protect fish populations have emphasized the importance of these benthic habitats. Raw bathymetric data were acquired with a Kongsberg EM302 multibeam sonar system from aboard the NOAA Ship *Okeanos Explorer* in 2012 during a five-leg survey of the U.S. Atlantic Margin. Four of the submarine canyons surveyed have been processed and analyzed in this study with the CARIS HIPS 7.1 software: Hydrographer Canyon, Oceanographer Canyon, Gilbert Canyon, and Lydonia Canyon. These data have been used to predict coral habitats on the basis of canyon depth, relief of canyon walls, and location of hard substrate. Gaining a clearer insight about the continental shelf and slope morphology of the Georges Bank area will aid in ecosystem management.

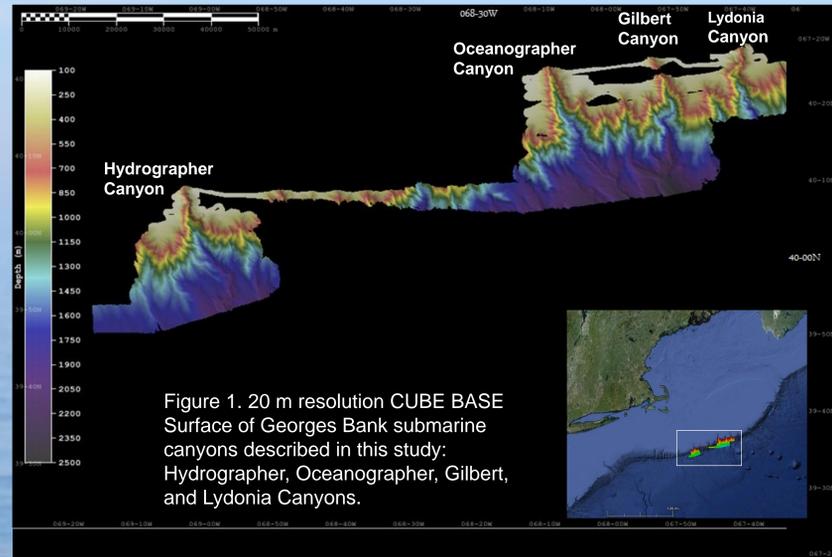
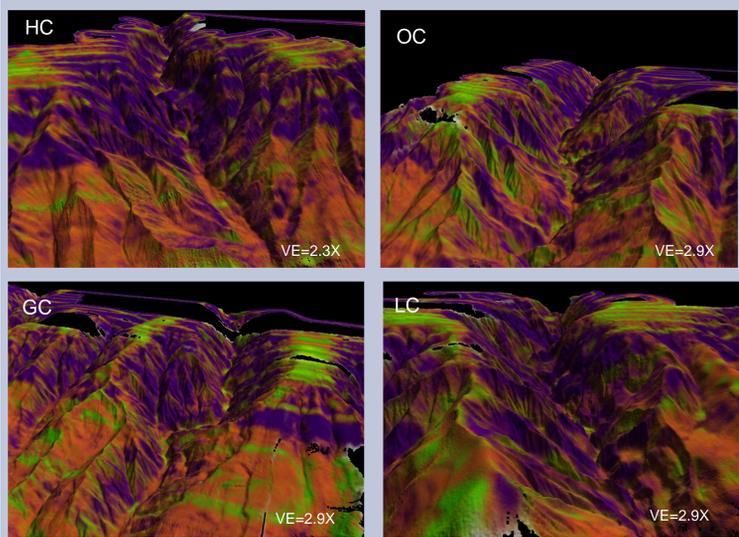
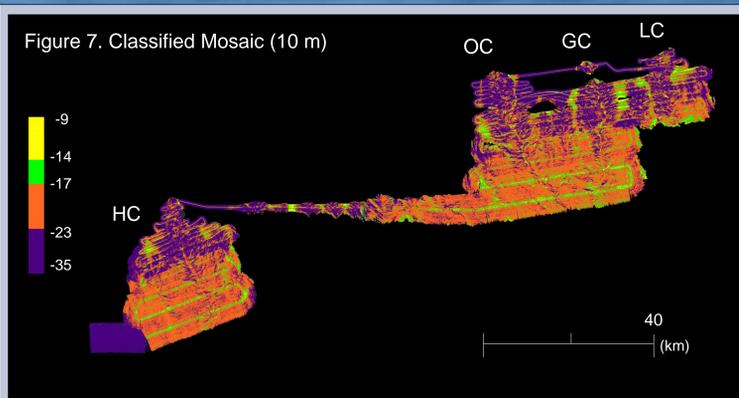


Figure 1. 20 m resolution CUBE BASE Surface of Georges Bank submarine canyons described in this study: Hydrographer, Oceanographer, Gilbert, and Lydonia Canyons.

## Methods

- Multibeam sonar data were collected aboard the NOAA Ship *Okeanos Explorer* in 2012 as a part of the Atlantic Canyons Undersea Mapping Expeditions project.
- Data were acquired utilizing a Kongsberg EM302 multibeam sonar system, with an SIS acquisition program.
- Raw data from Expedition 1204 were processed with CARIS HIPS 7.1 software to generate a 20m resolution CUBE BASE Surface (Fig. 1)
- Along-axis and cross-axis profiles drawn at the mouth of each canyon, gradient of the canyon walls was calculated. (Fig. 6)
- Sediment was analyzed and classified by creating a 10 meter resolution mosaic using Geocoder (Fig. 7)



3D View of classified Mosaic at a resolution of 10 meters draped over the CUBE BASE Surface. Hydrographer Canyon (HC), Oceanographer Canyon (OC), Gilbert Canyon (GC), and Lydonia Canyon (LC).

## Works Cited

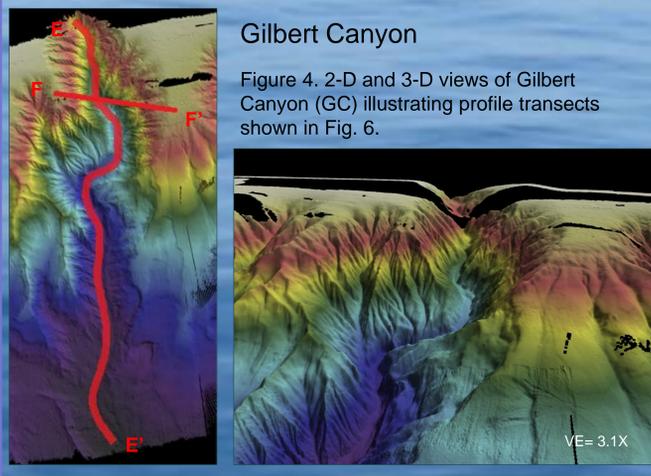
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## Introduction

Georges Bank has long been known to serve as a habitat to many types of marine life, including cod, yellowtail flounder, haddock and scallops. Commercial fishermen from many parts of the world reaped the benefits of the area's productivity until the establishment of the Economic Exclusive Zone (EEZ), which enabled only domestic fleets to harvest the area. However, because of technological advancements in the commercial fishing industry, fish populations were depleted by nearly 50 % by 1960 (Fogarty, 1998). There have been numerous efforts to conserve the fishery over the last fifty years, only some of which have been deemed effective.

Deep sea corals typically attach themselves to hard, rocky substrate. The ecosystem of Georges Bank relies on its benthic habitats to support marine communities, including deep sea corals, which are found along submarine canyon walls. Evaluating the source of the fishery's productivity will aid in the protection and conservation of Georges Bank and other habitats found along the Atlantic Margin.

In June 2012, NOAA's Atlantic Canyons Undersea Mapping Expeditions (ACUMEN) program, in collaboration with the New England Fisheries Science Center (NEFSC), deployed three vessels to gather bathymetric data along the Northeast Atlantic shelf-slope. The objective of the study was to interpret the locations of deep sea corals in order to assess whether management of the area was necessary (Dawicki, 2012). In March 2012, The NEFSC published a document (Cunningham et. al, 2012) that identified several species of corals found along the U.S. Atlantic margin and their locations based on depth and substrate. According to the study done by NEFSC, corals are most likely to be found on submarine canyon walls with a relief greater than or equal to 450 meters. The following study will estimate the presence of corals based on these standards, and also based on the backscatter data, as corals are most often found on rocky substrate.



## Gilbert Canyon

Figure 4. 2-D and 3-D views of Gilbert Canyon (GC) illustrating profile transects shown in Fig. 6.

## Results and Discussion

Georges Bank houses one of the most productive fishing grounds in the world, and its productivity depends on the benthic habitats within the submarine canyons. It is crucial to monitor the condition of the primary and secondary producers in order to evaluate the condition of the entire ecosystem as a whole. In a 2012 report, New England Fisheries Management Council set a threshold relief of 450 m from the canyon rim to the axis as one parameter to infer the presence of corals (Cunningham, 2012). Each of the canyons studied had a relief greater than or equal to 450 m, meeting the threshold relief as classified by NEFMC (Fig. 6). Lydonia Canyon and Oceanographer Canyon had the steepest gradients from canyon rim to the axis.

Backscatter data of the canyons were separated into four classes, ranging from lowest intensity of return to highest (i.e. softest sediment to hardest), illustrated by purple, orange, green, and yellow, respectively (Fig. 7). Backscatter analyses suggest soundings with the highest return were found mainly within the tributary channels that drain into the canyons, as well as along the canyon rims. This was especially significant in Oceanographer Canyon, where the higher intensities of return (i.e. harder substrate), are observed not only along the channel axis but along the channel walls.

Lydonia Canyon and Oceanographer Canyon have both been nominated by NOAA and Mid-Atlantic Fishery Management to be a part of the national system of Marine Protected Areas. Further studies should be conducted to monitor these areas as passive margin canyon morphologies are controlled by erosion and depositional processes. Submarine landslides and other transport processes could be very detrimental to the survival of deep sea corals.

## Hydrographer Canyon

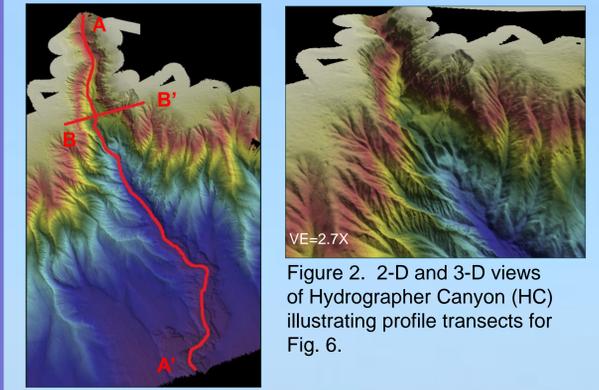


Figure 2. 2-D and 3-D views of Hydrographer Canyon (HC) illustrating profile transects for Fig. 6.

## Oceanographer Canyon

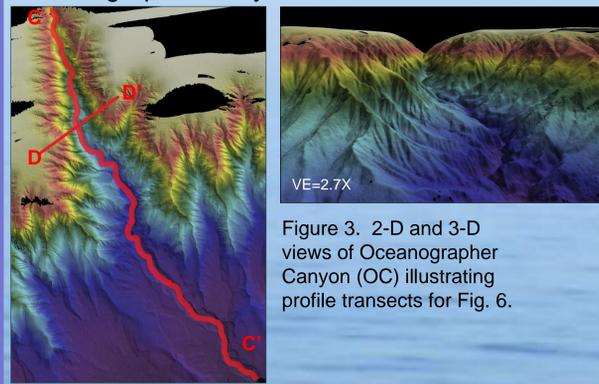


Figure 3. 2-D and 3-D views of Oceanographer Canyon (OC) illustrating profile transects for Fig. 6.

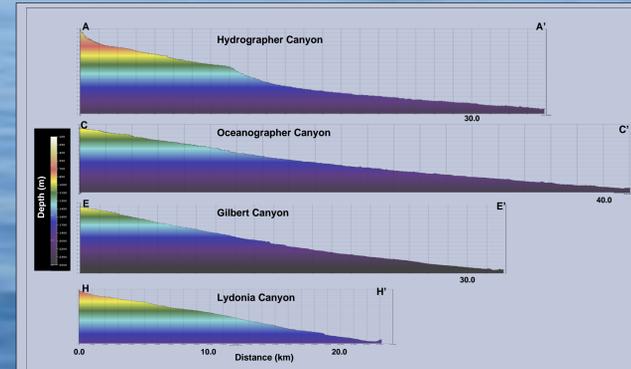
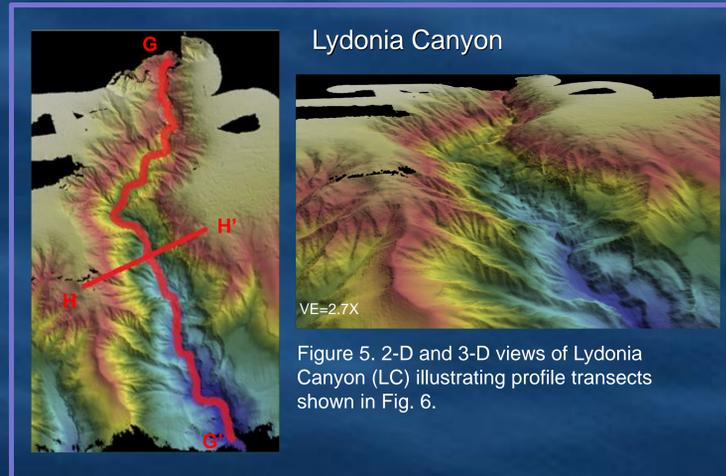
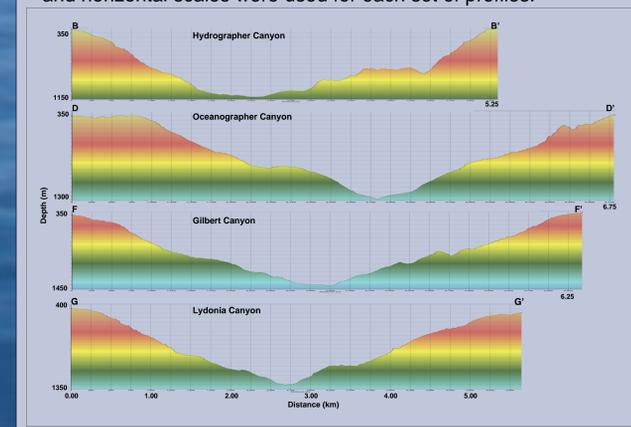


Figure 6. Above: Along-axis profiles of the 4 canyons. Below: Cross-axis profiles of canyon channels. The same vertical and horizontal scales were used for each set of profiles.



## Lydonia Canyon

Figure 5. 2-D and 3-D views of Lydonia Canyon (LC) illustrating profile transects shown in Fig. 6.

## Acknowledgements

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