

Comparison of Submarine Canyon Morphology off the U.S. East Coast

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Abstract

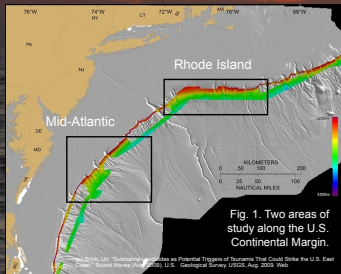
Using multibeam sonar data collected in 2009 by the U.S. Geological Survey from the NOAA Ship *Ronald H. Brown*, submarine canyon morphologies from several parts of the Mid-Atlantic and northern East coast of the United States have been studied and compared. Bathymetric data was processed using the software CARIS HIPS and SIPS 7.1. Canyons have been classified based on different characteristics, ranging from degree of sinuosity, relief, general shape, and orientation of the canyon. The amount of incision and depth of each canyon has been analyzed and could potentially be used to indicate the ages of the canyons relative to one another. These characteristics have been used to define different canyon morphologies, allowing them to be compared to each other as well as other canyons in the area that are not a part of the 2009 data.

Background

The purpose of this study is to classify and compare different submarine canyon morphologies along the continental margin of the Eastern United States. In 2009, a 15-day bathymetric survey was conducted to map a 1,200 km stretch of the continental shelf from the Mid-Atlantic (off the DelMarVa Peninsula) to Rhode Island (Figs. 1, 2, 3). Based on these data, classifications and comparisons will be used for future submarine canyon comparison based on canyon sinuosity, depth, width, overall shape, and other characteristics (Table 1). Erosion and deposition patterns as well as slump and landslide events can also be studied.

Methods

- Data acquired on the NOAA Ship *Ronald H. Brown*, May 11-25, 2009
- Dr. Uri Ten Brink (USGS Woods Hole) and his colleagues conducted this project and provided the multibeam sonar data.
- Sensor: hull-mounted SeaBeam 2112
- Software: Caris HIPS and SIPS 7.1
- Morphologic characteristics of 30 canyons were observed and 7 were measured to classify canyon types within the study areas (Table 1).



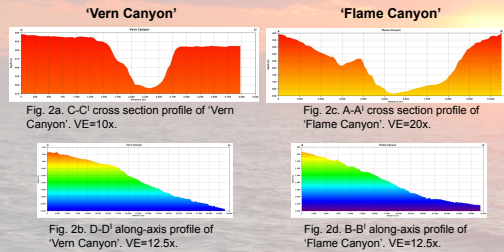
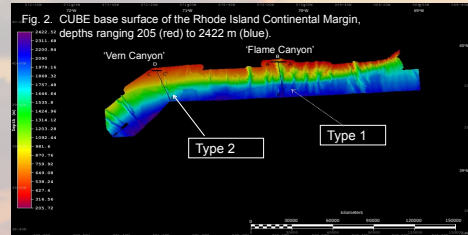
Results

The classic passive margin morphology is exhibited with the continental shelf, slope, and rise of the Eastern coast of the US. Ranging from 200-2000 m, the continental slope is the steepest part of the continental margin and has a large number of unevenly spaced canyons (Twitchell et al., 2009). Canyon morphologies are not specific to certain areas within the study sites, as seen from the occurrence of Type 1 canyons in both Rhode Island and Mid-Atlantic areas. Table 1 shows the data we collected to make these comparisons and classify the canyons.

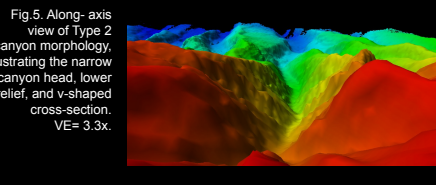
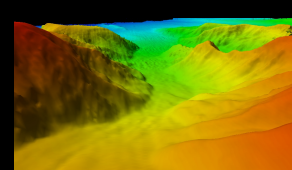
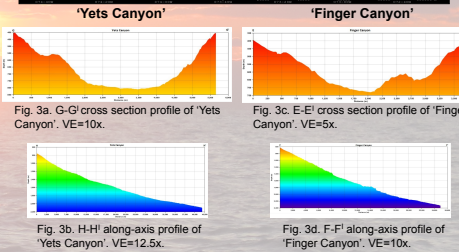
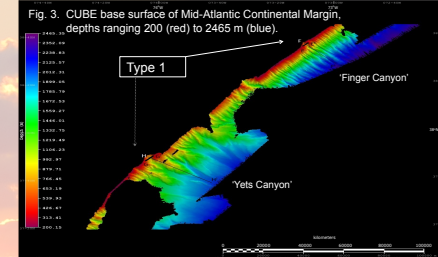
Table 1. Classification of canyon types.

Canyon Name	Sinuosity	Depth Canyon Head (m)	Relief at Head (m)	Width Canyon Head (m)	Ratio of Width at 1,500m depth	Canyon Shape	Type	Orientation
Finger Canyon	0.95	725	320	3550	0.090	2070	U-Shaped	1 N45W
Yets Canyon	1.04	800	405	5150	0.079	6733	U-Shaped	1 N60W
Vern Canyon	1.4	560	115	1200	0.096	1137	V-Shaped	2 N18W
Flame Canyon	0.9	840	390	8550	0.046	6291	U-Shaped	1 N11W
Finger Canyon 2	1.02	505	105	900	0.117	2185	V-Shaped	2 N48W
Finger Canyon 3	1.03	520	120	1500	0.080	1473	U-Shaped	2 N52W
Finger Canyon 4	1.01	478	60	1000	0.060	1685	U-Shaped	2 N52W

Rhode Island Continental Margin

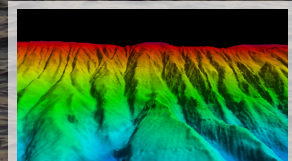
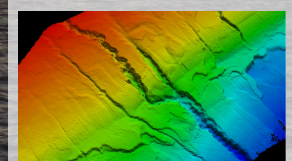
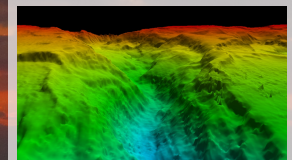
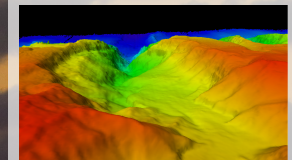


Mid-Atlantic Continental Margin



Discussion

After analyzing the 2009 data of the Rhode Island and Mid-Atlantic study areas, two main morphological types of canyons were classified. The canyon types were classified based on the overall shape of the canyon, the width at the head and middle of the canyons (~400 and ~1500 m), the sinuosity, orientation, and the number of tributaries at the head of the canyons (Table 1). **Type 1 Canyons** occur in both the Rhode Island and Mid-Atlantic areas, totaling 13 canyons, and their morphology is characterized by deep and wide canyon heads, wide at the middle, high relief, with a u-shaped cross-section. **Type 2 Canyons** were found in the southern portion of the Mid-Atlantic as well as the Eastern portion of Rhode Island, with a total of 17 canyons. Type 2 morphologies are characterized by narrow width at the head and middle of the canyons, low relief and shallow depth at the heads, and are both u and v-shaped. The sinuosity of the canyons was calculated and they were determined to be non-sinuosity based on the classification of canyon sinuosity by Wynn et al. (2007). The ratio of Type 1 to Type 2 canyons in the Mid-Atlantic study area is approximately 1:3 and in Rhode Island, 4:1. Type 1 canyons with their deep and wide morphology and high relief are caused by larger and faster turbidity currents. The wideness of the canyons is due to the incision, erosion, and slumping of the canyon walls caused by these high energy turbidity currents. Type 2 canyons are narrow and shallow with low relief. This morphology is caused by smaller, less turbid gravity currents. Because of this lower energy Type 2 canyons do not typically breach the shelf.



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