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.

Results

The classic passive margin morphology is characterized with the continental shelf slope, and rise of the Eastern coast of the U.S. Ranging from 200-2000 m, the continental slope is the steepest part of the continental margin and has a large number of unvegetated canyons (Twichell 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 was collected to make these comparisons and classify the canyons.

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 canyon, relief, sinuosity, 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 both u and v-shaped. The sinuosity of the canyons was calculated and they were determined to be non-sinusoidal 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, 1:1.

Type 1 canyons with their deep and wide morphology and high relief are caused by larger and faster turbidity currents. The widthlessness of the canyons is due to the incision, erosion, and slashing of the canyon heads caused by these high-energy turbidity currents. Type 2 canyons are narrow and shallow with low relief. This morphology is caused by smaller, less turbulent currents. Because of this lower energy Type 2 canyons do not typically breach the shelf.

Table 1. Classification of canyon types.

<table>
<thead>
<tr>
<th>Canyon Name</th>
<th>Sinuosity</th>
<th>Depth (m)</th>
<th>Relief at Head (m)</th>
<th>Width of Canyon Head (m)</th>
<th>Width of canyon (m)</th>
<th>Canyon Shape</th>
<th>Type</th>
<th>Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger Canyon</td>
<td>1.01</td>
<td>120</td>
<td>73</td>
<td>180</td>
<td>1800</td>
<td>U-shaped</td>
<td>1</td>
<td>N1W</td>
</tr>
<tr>
<td>Vets Canyon</td>
<td>1.03</td>
<td>120</td>
<td>73</td>
<td>180</td>
<td>1800</td>
<td>U-shaped</td>
<td>1</td>
<td>N1W</td>
</tr>
<tr>
<td>Vern Canyon</td>
<td>1.05</td>
<td>120</td>
<td>73</td>
<td>180</td>
<td>1800</td>
<td>U-shaped</td>
<td>1</td>
<td>N1W</td>
</tr>
<tr>
<td>Flame Canyon</td>
<td>1.0</td>
<td>120</td>
<td>73</td>
<td>180</td>
<td>1800</td>
<td>U-shaped</td>
<td>1</td>
<td>N1W</td>
</tr>
</tbody>
</table>

References


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