The Mississippi Margin: A Comparison of Continental Margin Geomorphologic Features

Nicholas C. Damm, Robert W. Rivers, and Leslie R. Sautter
Dept. of Geology and Environmental Geosciences
College of Charleston, Charleston, SC USA

Abstract

The Mississippi Margin is located on the continental shelf and slope off the Mississippi and Louisiana coast in the Gulf of Mexico. The two sites for this study consist of a deltaic region located 45 km south of the Mississippi Main Pass and a non-deltaic region located 180 km south of Atchafalaya Bay. The study area located south of the Mississippi Main Pass has a gradual slope, contains various erosional features, salt domes, and sedimentation processes. The study area south of the Atchafalaya Bay includes a large salt dome with various slump deposits and evidence of turbidity currents. Salt dome dimensions, relief, and gradients were unaffected by their location along the margin. However, continental margin relief and gradient in areas where salt domes are not present is much greater in deltaic-regions versus non-deltaic regions, likely due to influx of terrestrial sediments from the Mississippi River into the deltaic region.

Introduction

The Mississippi Margin is a passive continental margin located in the Gulf of Mexico off the coast of Mississippi and Louisiana, United States. A continental margin is the morphologic link between continental crust and oceanic crust (Laughton and Roberts, 1978). This study was designed to evaluate the relief and gradient of the continental margin in the study area. This study is focused on the Mississippi Main Pass and the slope south of Atchafalaya Bay (Fig. 1a). The focus of this study is the non-deltaic region versus the deltaic region along the margin. The deltaic region is located south of the Mississippi Main Pass and is adjacent to the main Mississippi River Delta. The non-deltaic region is located south of Atchafalaya Bay, a large salt dome on the shelf south of Atchafalaya Bay, a large salt dome in the Atchafalaya Bay area. The non-deltaic region features a large salt dome with various slump deposits and evidence of turbidity currents. Salt dome dimensions, relief, and gradients were unaffected by their location along the margin. However, continental margin relief and gradient in areas where salt domes are not present is much greater in deltaic-regions versus non-deltaic regions, likely due to influx of terrestrial sediments from the Mississippi River into the deltaic region.

Figure 1a. South of Atchafalaya Bay. The salt dome is represented by the red square. The white line shows the location of the profile used in Fig. 1b. The orange arrow shows the view direction for 3D images 1c and 1d.

Table 1. The salt dome's (Figs. 1 & 2) dimensions and various aspects of relief.

<table>
<thead>
<tr>
<th>Site</th>
<th>Contiguous Shelf to Deep Ocean (m)</th>
<th>Largest Width of the Salt Dome (m)</th>
<th>Salt Dome</th>
<th>Depth Ocean (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.007</td>
<td>180</td>
<td>360</td>
<td>1080</td>
</tr>
<tr>
<td>B</td>
<td>0.027</td>
<td>12,500</td>
<td>396</td>
<td>1875</td>
</tr>
<tr>
<td>C</td>
<td>0.018</td>
<td>11785.41</td>
<td>396</td>
<td>1875</td>
</tr>
</tbody>
</table>

Table 2. Represents the continental shelf's (Figs. 3 & 4) variations in relief and slope.

<table>
<thead>
<tr>
<th>Site</th>
<th>Mean Relief (m)</th>
<th>Mean Slope (°)</th>
<th>Mean Vertical Relief (m)</th>
<th>Mean Gradient (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.020</td>
<td>0.003</td>
<td>0.005</td>
<td>0.007</td>
</tr>
<tr>
<td>B</td>
<td>0.030</td>
<td>0.006</td>
<td>0.009</td>
<td>0.010</td>
</tr>
<tr>
<td>C</td>
<td>0.020</td>
<td>0.007</td>
<td>0.007</td>
<td>0.008</td>
</tr>
</tbody>
</table>

Methods

- The survey was conducted by the NOAA Ship Okeanos Explorer on cruises EX12012, EX12021, and EX1203 of March and May in 2012, using a Kongsberg EM320 transducer.
- Raw data were downloaded from the NOAA NODC website and post-processed with CARIS HIPS 8.1.
- The relief and gradients of various features of the continental margin were calculated through slope profiles extracted from CARIS HIPS 8.1.

Discussion & Conclusions

- Salt dome dimensions, relief, and gradients are not affected by their region’s location on the continental shelf in the Mississippi Margin. Therefore, the presence of the Mississippi River delta did not affect the processes that shaped the salt domes. This may be due to salt domes of the Gulf of Mexico having similar formation processes, which can be tied to the Jurassic Period. Additionally, the salt domes’ concurrent growth with overlaying layers could allow for the salt dome’s dimensions to remain unaffected by morphologically different regions along the continental margin where sediment input regimes (deltaic versus non-deltaic) and result in similar salt dome morphologies.
- However, differences are observed in deltaic versus non-deltaic regions in the amount of relief and slope (gradient) along the continental margin where salt domes are not present. The total relief of the deltaic region is 737 m greater than the non-deltaic region. Similarly, the slope in the deltaic region is 6.5° steeper. The steeper slope and greater relief in the deltaic region could be attributed to the larger influx of terrestrial sediment supplied to the shelf that is obtained from the influx of terrestrial sediments from the Mississippi River.

Acknowledgements

We thank College of Charleston BAYMAC Program; CARIS for the support in training; Highlandsoft for software license support; Dept. of Geology and Environmental Geosciences; School of Sciences and Mathematics; Crew of the NOAA Ship Okeanos Explorer.

References

Martinez, D., 1991, Salt Domes , Carlsbad, NM, 650 m

Figure 1a. South of Atchafalaya Bay. The salt dome is represented by the red square. The white line shows the location of the profile used in Fig. 1b. The orange arrow shows the view direction for 3D images 1c and 1d.

Figure 1b. Profile of the Mississippi Main Pass salt dome. The dimensions are similar to salt dome in Site A and it has the same slope of 0.027.

Figure 1c. 3D view of salt deposits adjacent to the salt dome, located south of Atchafalaya Bay (9x V.E.). The red box represents the featured salt dome. The shelf is represented by the raised region in the background.

Figure 1d. 3-D representation of the southeast portion of the Atchafalaya Bay salt dome viewed looking northwest, shown by the orange arrow on Figure 1a (9x V.E.).

Figure 2a. Salt dome (red box) in the deltaic region south of the Mississippi River on the Mississippi Main Pass. The white line represents the profile in Fig. 2b. The orange arrow shows the view direction of Fig. 2c.

Figure 2b. Profile of the Mississippi Main Pass salt dome. The dimensions are similar to salt dome in Site A and it has the same slope of 0.027.

Figure 2c. 3-D offshore view from the deep ocean (10x V.E.). The red box represents the featured salt dome. The shelf is represented by the raised region in the background.

Figure 2d. 3-D bird's eye view representation of the Mississippi Main Pass featured salt dome. (10x V.E.)

Figure 3a. The passive continental margin's shelf and slope south of Atchafalaya Bay with a slope of 0.0028.

Figure 3b. Profile of the continental margin's shelf and slope south of Atchafalaya Bay with a slope of 0.0028.

Figure 3c. 3-D bird's eye view of the continental shelf and salt dome south of Atchafalaya Bay (9x V.E.). There is a large slump that is represented by the erosional feature on the shelf edge.

Figure 4a. The continental shelf and slope on the Mississippi Main Pass. The white line shows the profile line (Fig. 4b), and the orange arrow shows the view direction of Fig. 4c.

Figure 4b. Profile shows 6.5x greater gradient than exhibited in the non-deltic region.

Figure 4c. 3-D view of the continental margin south of the Main Pass (20x V.E.) showing various morphological features caused by sediment accretions and erosion. The main sediment accretion is on the shelf and is represented by the shallow regions. Erosional features occur where the shelf slope to the continental slope. Turbidity currents and dumping are responsible for the areas heavy in erosion.