Comparison of Salt Withdrawn Basin on the Louisiana Continental Shelf, Northern Gulf of Mexico

Megan Jackson and Dr. Leslie Sautter
College of Charleston, Charleston, SC USA

COLLEGE of CHARLESTON
DEPARTMENT OF GEOLOGY AND ENVIRONMENTAL GEOSCIENCES

Introduction

The continental margin off the coast of Louisiana is a part of the passive margin in the Gulf of Mexico. The geomorphology of the area is dominated by salt diapirs (or salt domes) and salt withdrawal depocenters termed mini basins or salt withdrawn basins (Sumner et al., 1991). These basins are small in size and grow and form as salt is withdrawn from denser sediments moving downward and less dense salt moving upward (Hamiter et al., 1997; Peel, 2014). Sedimentation of these basins includes gravity-driven high energy turbidity currents (Hamiter et al., 1997).

This study compares the effect of depth to the basin's geometry and hardness of the bottom of several identified basins. Within this study area are basins ranging in depth from 820 meters to 1472 meters.

Abstract

Multibeam sonar data of submarine basins were analyzed along the continental shelf in the Northern Gulf of Mexico, an area known for its numerous salt domes (diapirs). The sonar data were collected in 2014 using a Kongsberg EM302 abroad the NOAA Ship *Okeanos Explorer*. Three areas of the region off the Louisiana coast were studied and consisted of diapirs and several small basins, referred to as salt withdrawn basins. Depths of these basins were measured along with each basin's short and long axes. A comparison of the axis ratios to basin depths showed depth does not affect the basin shape. Several of the basins measured were nearly perfect circles with varying depths. Backscatter intensity analysis was performed on three basins of varying depths and showed no relationship between basin bottom hardness and basin depth.

Methods

- Data for this research were collected aboard the NOAA Ship *Okeanos Explorer* on Cruises Ex1402L1 and Ex140L2.
- Multibeam data were downloaded from the NOAA NGDC website and post processed in CARIS HIPS 8.1
- X,Y,Z measurements were made from cross-sectional profiles.
- Backscatter mosaics were created using CARIS HIPS & SIPS 8.1.

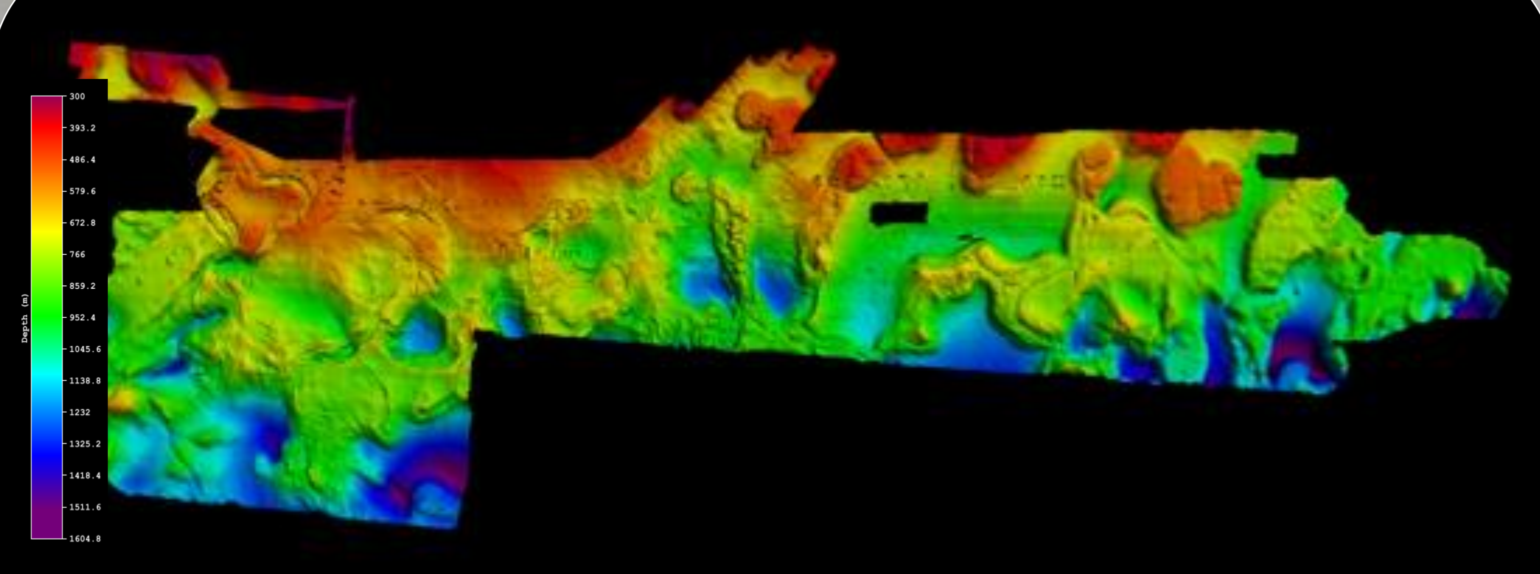


Figure 3. 3D view of BASE surface (VE=10x).

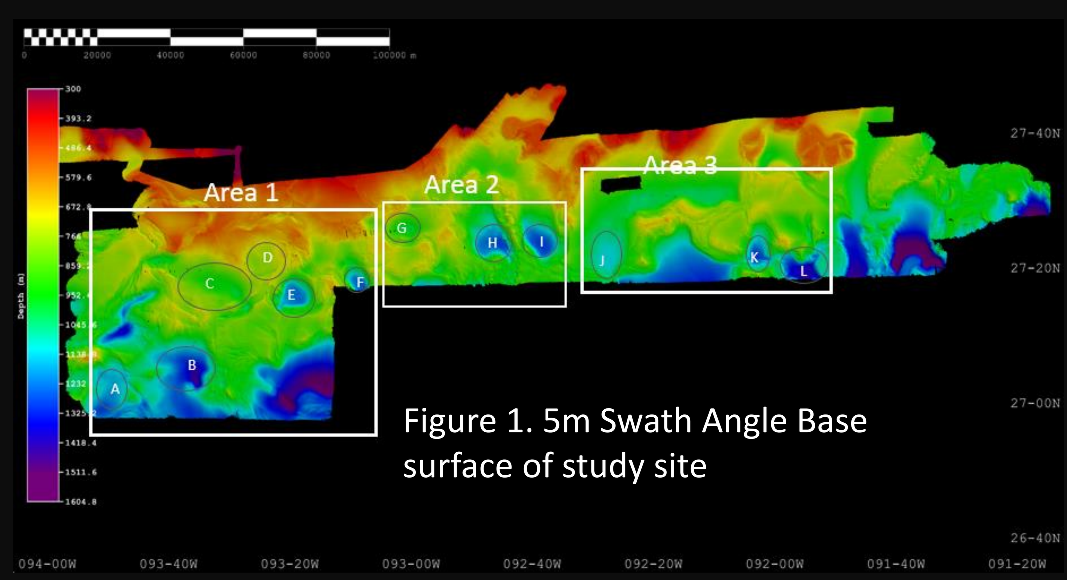


Figure 1. 5m Swath Angle Base surface of study site

Location of Study Site

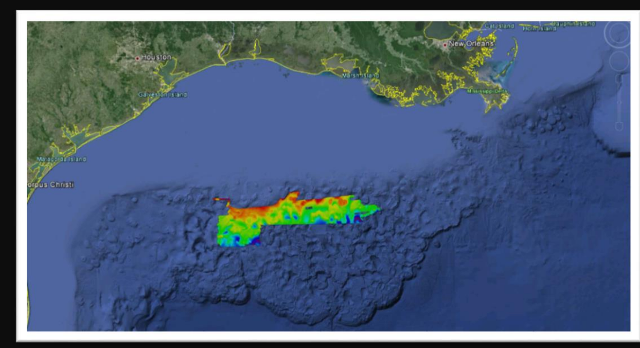


Figure 2. Google Earth image showing study site in the Gulf of Mexico

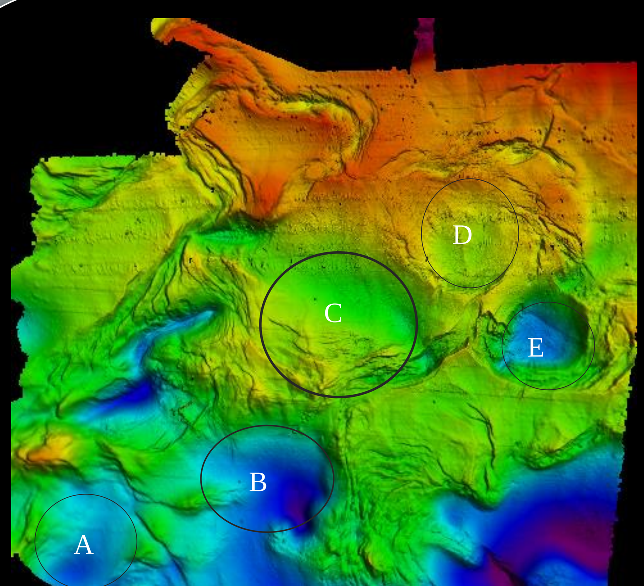


Figure 4. 3D view of Area 1 (VE=10x).

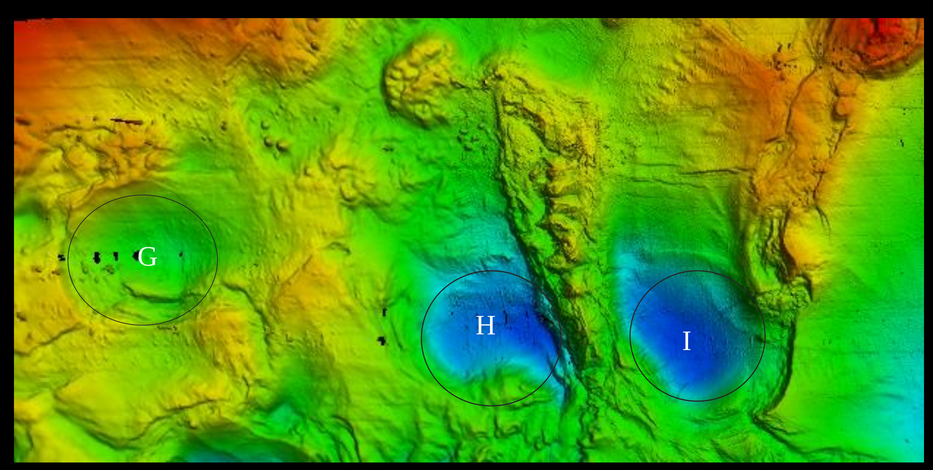


Figure 5. 3D view of Area 2 (VE=10x).

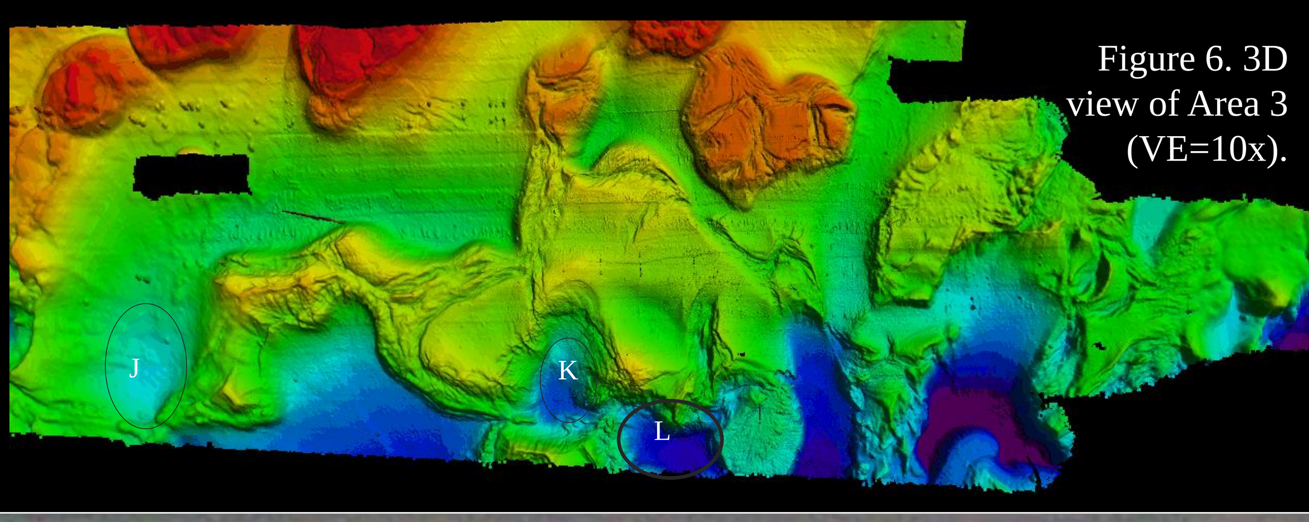
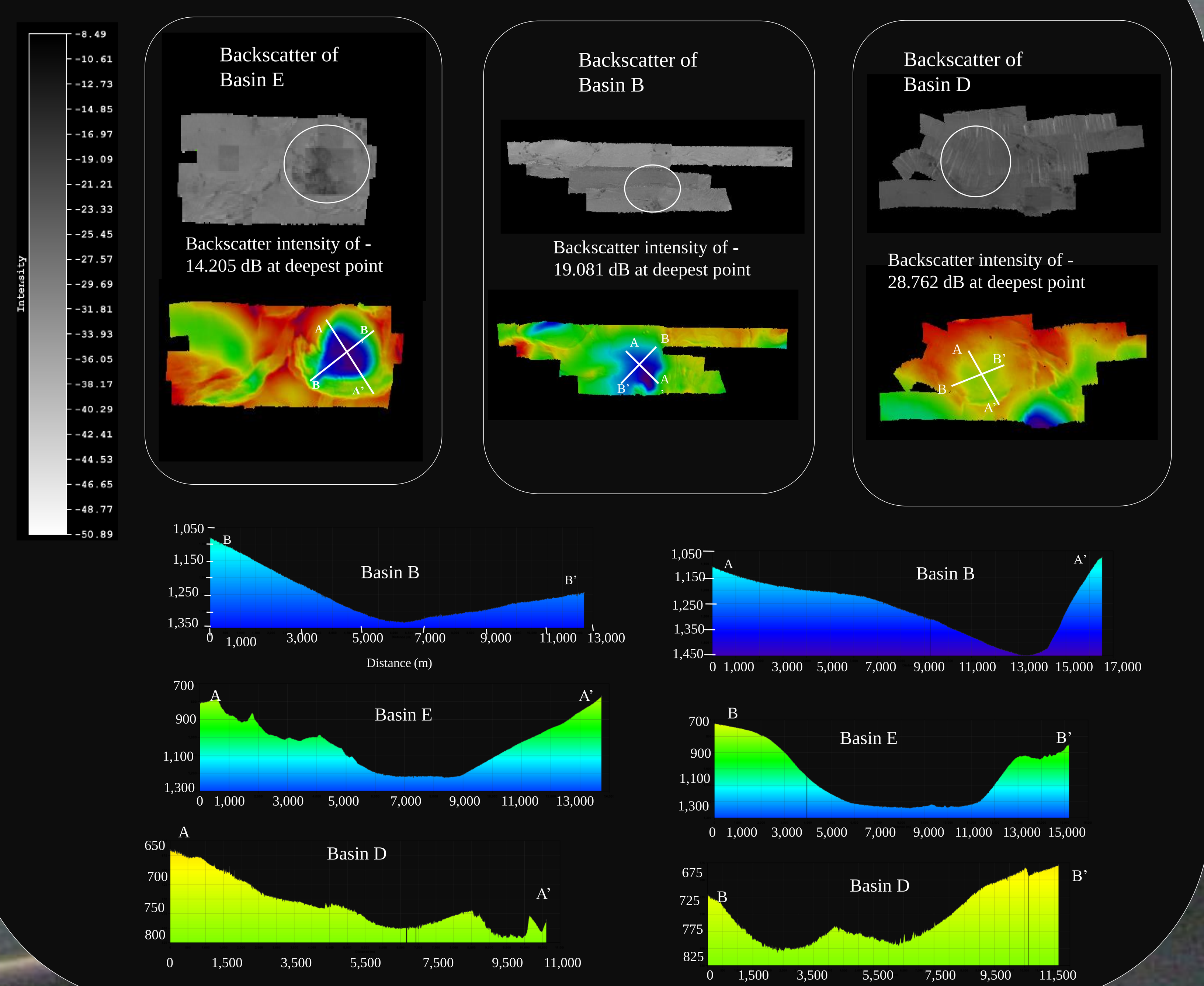
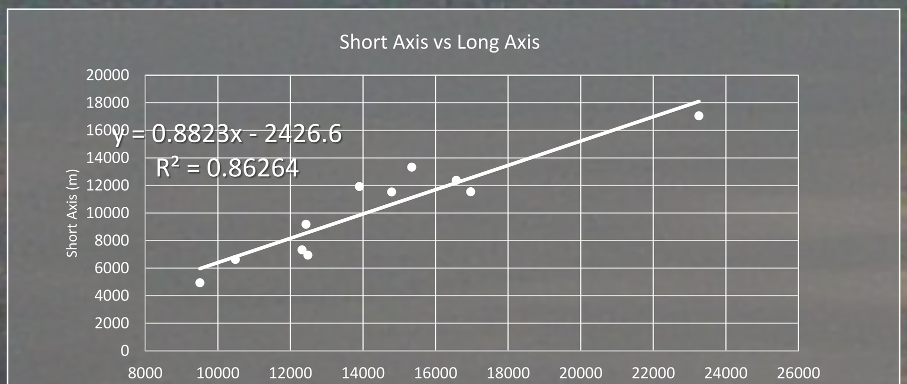


Figure 6. 3D view of Area 3 (VE=10x).

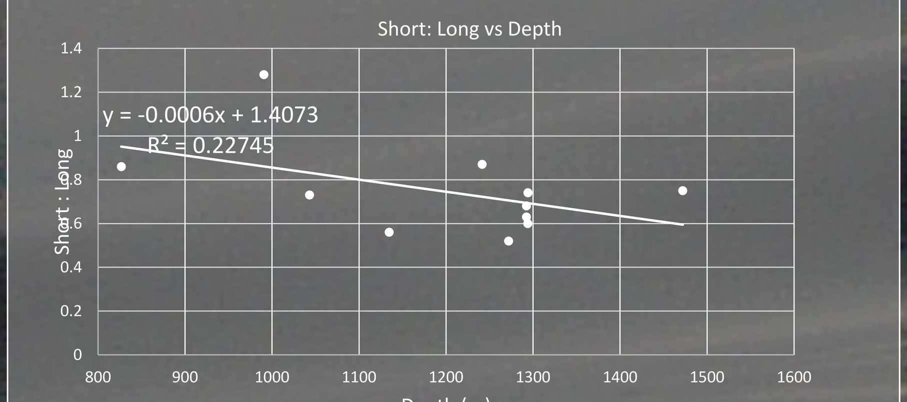
Backscatter

Figure 7 Backscatter Mosaics





Graph 1. Relationship between the short and long axis of each basin. See Table 1.



Graph 2. Relationship between depth and axes ratios (Table 1).

Results

- The short and long axis of the basins were identified visually and measured.
- Basins in Area A (Fig. 1) all had similar short/long axis ratios close to 1 indicating a circular shape.
- Basins in Area 3 (Fig. 1) had the smallest short/long ratios closer to 0.5 indicating a noncircular shape.
- Graph 1 shows a high positive correlation between the basins in all three areas.
- Graph 2 shows a low negative correlation between the depth of the basin and its ratio.
- Backscatter mosaics showed no relationship between depth and hardness of the basin's bottom.

Table 1. Observed measurements of basins

Basin	Short Axis (m)	Long Axis (m)	Deepest Depth (m)	Short Axis: Long Axis
A	11,539.76	16969.91	1292.37	0.68
B	12,373.21	16568.32	1472.03	0.75
C	17,056.28	23257.63	1043.03	0.73
D	11,922.11	13,897.63	826.81	0.86
E	13,323.10	15,343.40	1241.47	0.87
F	4,936.83	9506.19	1271.81	0.52
G	11,529.70	14789.73	990.60	1.28
H	9,176.61	12430.92	1294.08	0.74
I	7,323.24	12317.87	1294.01	0.60
J	6,941.22	12479.13	1134.66	0.56
K	6,633.05	10484.94	1292.48	0.63

Discussion

Three areas of submarine basin were analyzed in the Northern Gulf of Mexico along the Louisiana coast (Fig. 1). The depths of these basins range from 826 to 1472 m. The basins were identified as salt withdrawn basins. When salt is withdrawn it creates a basin, which then fills with sediments. In map view (Fig. 1) these basins are circular in shape and are composed of thick sequences of sediment (Sumner et al. 1991). Collapse of the basin is the result of gravity spread once the salt below is depleted (Pell, 2007). Further study is needed to determine if these basins are still spreading and expanding in size. Within the Northern Gulf of Mexico, there is much variation in geomorphology, however sediment-filled mini basins represent the dominant structural style (Diegel et al. 1995), just as they dominate this study area. This type of sea floor morphology is the result of the exchange between sediment loading and salt movement (Twichell et al. 2000).

This study showed that there is weak negative correlation (Graph 2) between the depths of the basins and the ratio of their size, meaning that with changing depth the ratio of the size of the basin changes only slightly. However the smaller more circular basins did have greater depths than the much larger basins. The backscatter analysis (Fig. 7) on three basins of varying depths revealed that the hardness of the basin bottom is not affect by depth, and that increasing depth does not result in a harder bottom. Further backscatter analysis is required to make a stronger evaluation of the correlation between depth and hardness.

Work Cited

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