

University of Southern Mississippi RESTORE Cooperative Agreement: Investigation of legacy data in Western Mississippi Sound and Northern Chandeleur Sound

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Contents

List of Figures.....	v
List of Tables.....	v
List of Abbreviations and Acronyms	vi
1 Introduction	7
2 Study Area	7
3 Major Tasks	10
4 Results.....	10
4.1 <i>Geophysical Data</i>	10
4.2 <i>Previous MMIS Sediment Core QA/QC</i>	15
4.3 <i>Future Directions and Integration</i>	15
5 Summary	16
6 Literature cited	16

List of Figures

Figure 1. Study area in the Northern Gulf of Mexico	8
Figure 2. Study area polygon for Co-Op#3.....	9
Figure 3. Trackline locations of the 10BIM04 seismic cruise.	11
Figure 4. Example geophysical line 10i02 from cruise 10BIM04.	12
Figure 5. LACOSS VI and Acadiana 87-1 cruise trackline map	13
Figure 6. MSU R/V Sound Surveyor 2018 example.....	14

List of Tables

Table 1. Summary of Geophysical data included in the MMIS submission	15
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List of Abbreviations and Acronyms

BOEM	Bureau of Ocean Energy Management
LUMCON	The Louisiana Universities Marine Consortium
MBRACE	Mississippi Based RESTORE Act Center of Excellence
MBSL	Meters below sea level
MMIS	Marine Minerals Information System
MSU	Mississippi State University
OCS	Outer Continental Shelf
RESTORE	Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States
R/V	Research Vessel
SBDC	Saint Bernard Delta Complex
USGS	United States Geological Survey

1 Introduction

The Northern Gulf of Mexico is among the most at-risk sections of coastline in the United States suffering enhanced vulnerability due to sea-level rise, frequent hurricane impacts, oil spills, and natural/anthropogenic reductions of sediment supply. Restoration projects used to combat these deleterious effects often require large sediment volumes. Therefore, understanding the availability, quality, and location of sediment resources for restoration is imperative for sustainability and coastal resilience of the Northern Gulf of Mexico coast.

Two recent cooperative agreements between BOEM and the University of Southern Mississippi target these needs: “*M16AC00012 Mississippi Offshore Sediment Resources Inventory: Late Quaternary Stratigraphic Evolution of the Inner Shelf (MS Co-Op1)*” and “*M21AC00018-00 Continuing Mississippi Offshore Sediment Resources Inventory: Linking Late Quaternary Stratigraphic Evolution of the Mid Shelf (MS Co-Op2)*”. The overall goal of both studies is to develop an understanding of the geologic evolution of late Quaternary deposits offshore of Mississippi and to delineate and develop volumetric reserve estimates of restoration quality sediment resources located on the OCS. In brief summary, both Co-Ops compile legacy data (geophysics, cores, borings) and collect new data where gaps exist to develop sand-rich polygons and conceptual stratigraphic models. All data are synthesized, compared, interpreted, and presented in a geospatial context.

Based on the areas covered by these Co-Ops, a notable gap exists in the western Mississippi Sound and Northern Chandeleur Sound. This NOAA RESTORE project (MS Co-Op3) sought to support the aforementioned Co-Ops by focusing on an area in Mississippi/Louisiana state waters outside of the primary scope of both previous Co-Ops. Primary goals were to identify legacy data, perform a synthesis of these legacy datasets, and submit a geodatabase to Marine Minerals Information System (MMIS). In total, this project added 3,018 line-kilometers of seismic data to the MMIS.

2 Study Area

A detailed description of the general geologic framework for the Northern Gulf of Mexico can be found in the Co-Op#1 final report (Wallace, 2023). The “*M22AC00017-00 Investigation of legacy data in Western Mississippi Sound and Northern Chandeleur Sound (MS Co-Op 3)*” study area encompassed south of St. Louis Bay, Cat Island, West Ship Island, and the northern part of the Chandeleur Islands (Figures 1 and 2). Legacy geophysical and sediment cores have been taken in this area both by academic, federal, and state entities in the past; but to date, these data have not been connected to a larger database. Analyzing these data collected in state waters will unite our geomorphological understanding of paleo incised valleys and associated interfluves (Wallace, 2023). These fluvial features can be mapped and convergence areas highlighted and identified for future endeavors. Furthermore, a reference literature database was established and cited in this report.

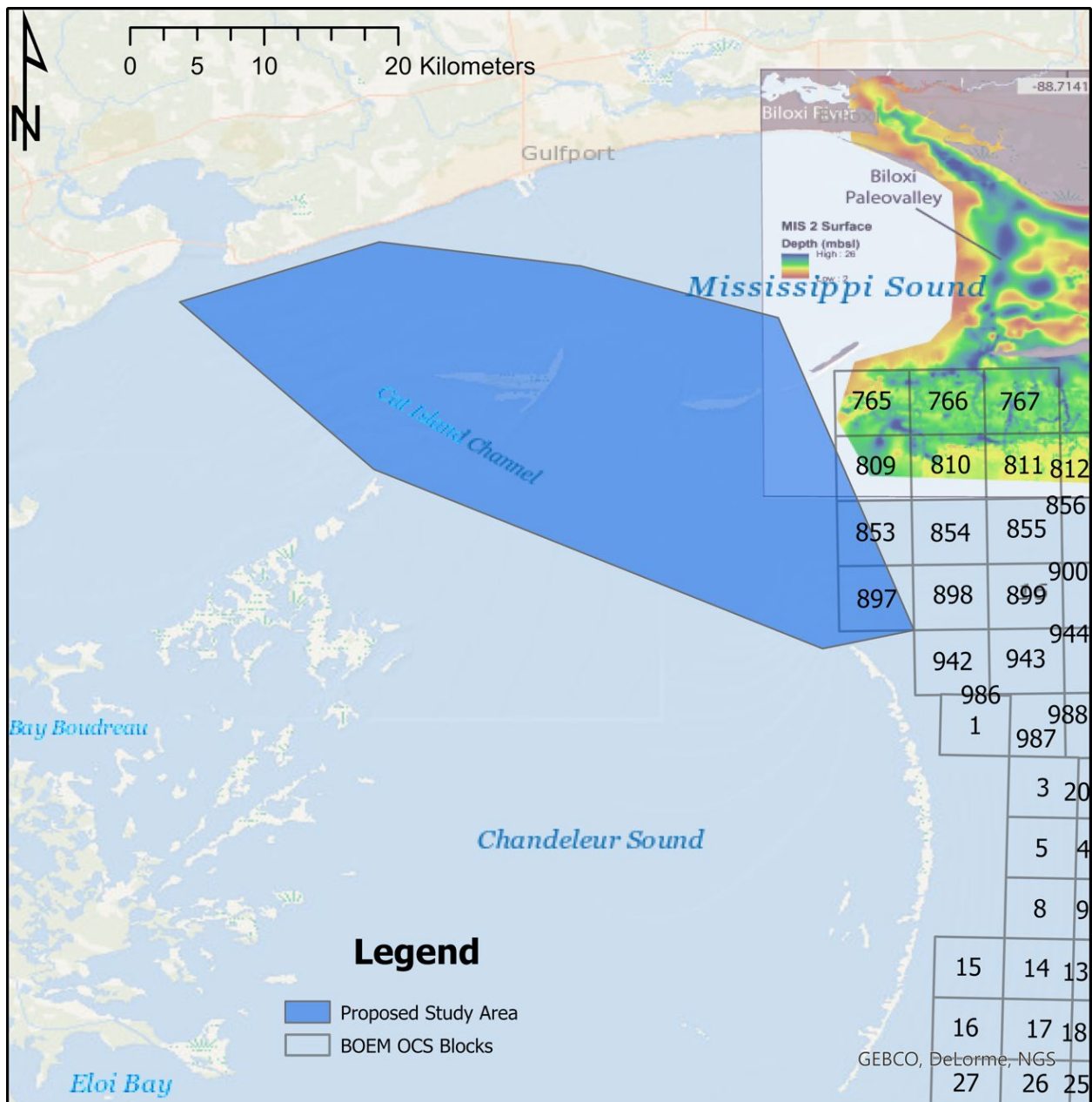


Figure 1. Study area in the Northern Gulf of Mexico.

Original study area polygon. Also shown is the incised valley surface from Co-Op #1 and associated BOEM Outer Continental Shelf (OCS) lease blocks, which represent the western boundary of both Co-Op #1 and #2 study areas. Blue polygon denotes the proposed state legacy data search area.

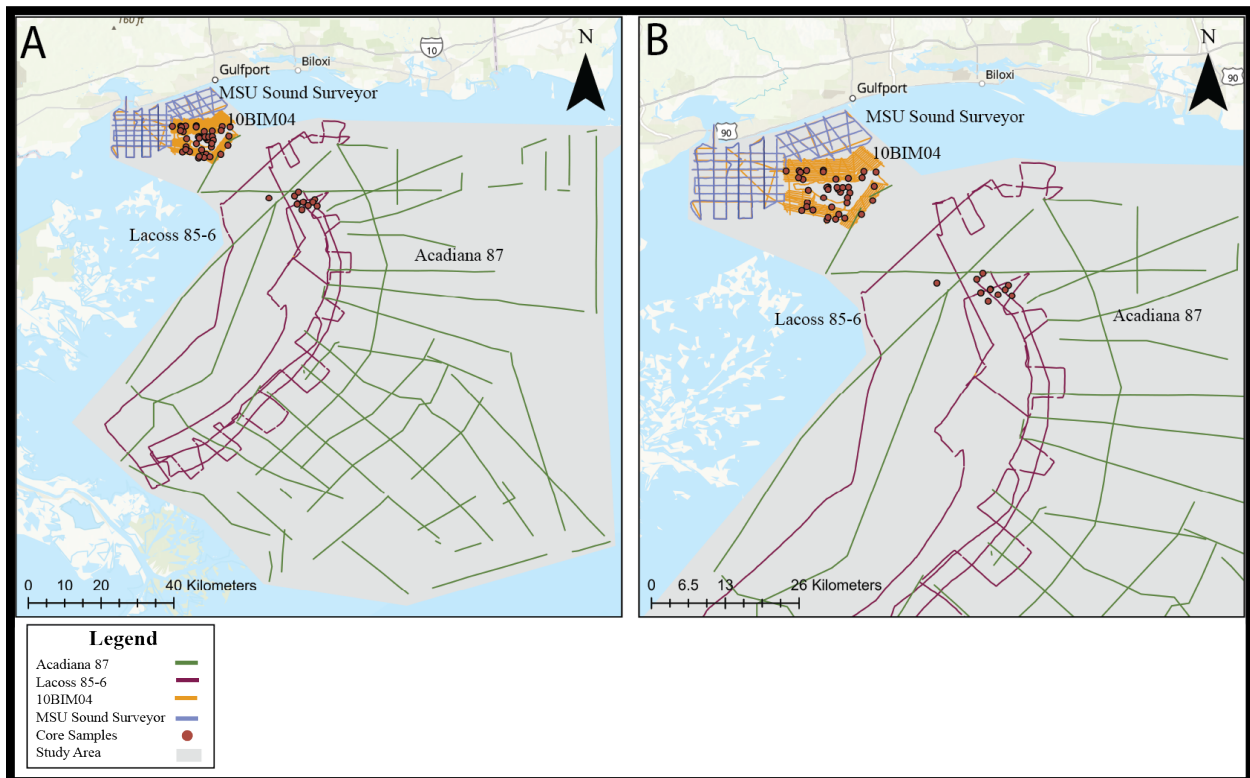


Figure 2. Study area polygon for Co-Op#3.

Geophysical tracklines for cruises added to MMIS for this project at full scale (A) and zoomed scale (B). Also shown are the core locations from cores in MMIS that were QA/QC'ed. The study area shown encapsulates the entirety of the seismic data found within the cruises, instead of parsing the data within the bounds of the original study area.

3 Major Tasks

1. Collect existing geophysical and geological data (digital and analog forms from various sources including USM, BOEM, Mississippi Department of Marine Resources, Mississippi Department of Transportation, Mississippi Department of Environmental Quality, U.S. Army Corps of Engineers, U.S. Geological Survey, etc.) for the study area and compile into a spatial geodatabase using BOEM-specified formatting (including compliant metadata). This will include:
 - a. Digitization of analog data
 - b. Georectification of data for projection in GIS
 - c. Integrating navigation data with geophysical profiles
 - d. Other data specific subtasks necessary to bring data into GIS and other analytical software (e.g. Sonarwiz, Surfer)
2. Literature review, synthesis, and compilation of a reference database of relevant literature. Any spatially relevant products are included in the spatial database compiled under Task 1 (e.g. data points: interpreted locations or isopachs of sand bodies, valley fills, channel fills, etc.).

4 Results

4.1 Geophysical Data

The USGS, 10BIM04 dataset (~500 line-kilometers) was collected in 2010 aboard the USGS's R/V G.K. Gilbert using an Edgetech SB-512i towfish to investigate the subsurface geology around Cat Island, Mississippi (Table 1, Figure 3). These data were analyzed and interpretations outlined in Miselis et al. 2014. The dataset is housed at <https://pubs.usgs.gov/ds/724/> as part of the USGS repository (Forde et al., 2012). The shotpoint navigation lines were downloaded and converted to the ArcGIS MMIS schema. Additionally, the .jpg of each chirp line is housed on the USGS website, and a link was included in the MMIS submission so that end users can easily view these data. These data focused in the immediate area around Cat Island which is 40 km north-west of the Chandeleur Islands and ~9 km south of the Mississippi mainland. An example line is shown in Figure 4.

Early seismic datasets were used to develop large scale stratigraphic relationships within the Mississippi River delta region (Kulp et al., 2002). These datasets include Acadiana 87 and Lacoss VI (Table 1). Acadiana 87-2 was collected in June 1987; paper copies are still stored at the University of New Orleans (UNO) and 1557 line km were digitized in 2017 by the USGS (Bosse et al., 2017). The cruise personnel were John R. Suter, Louisiana Geological Survey; Ron Boyd, Dalhousie University; Jack Kindinger, United States Geological Survey; Ken Parolski, USGS; C.L. Black, LUMCON; and Wayne Simoneaux, LUMCON.

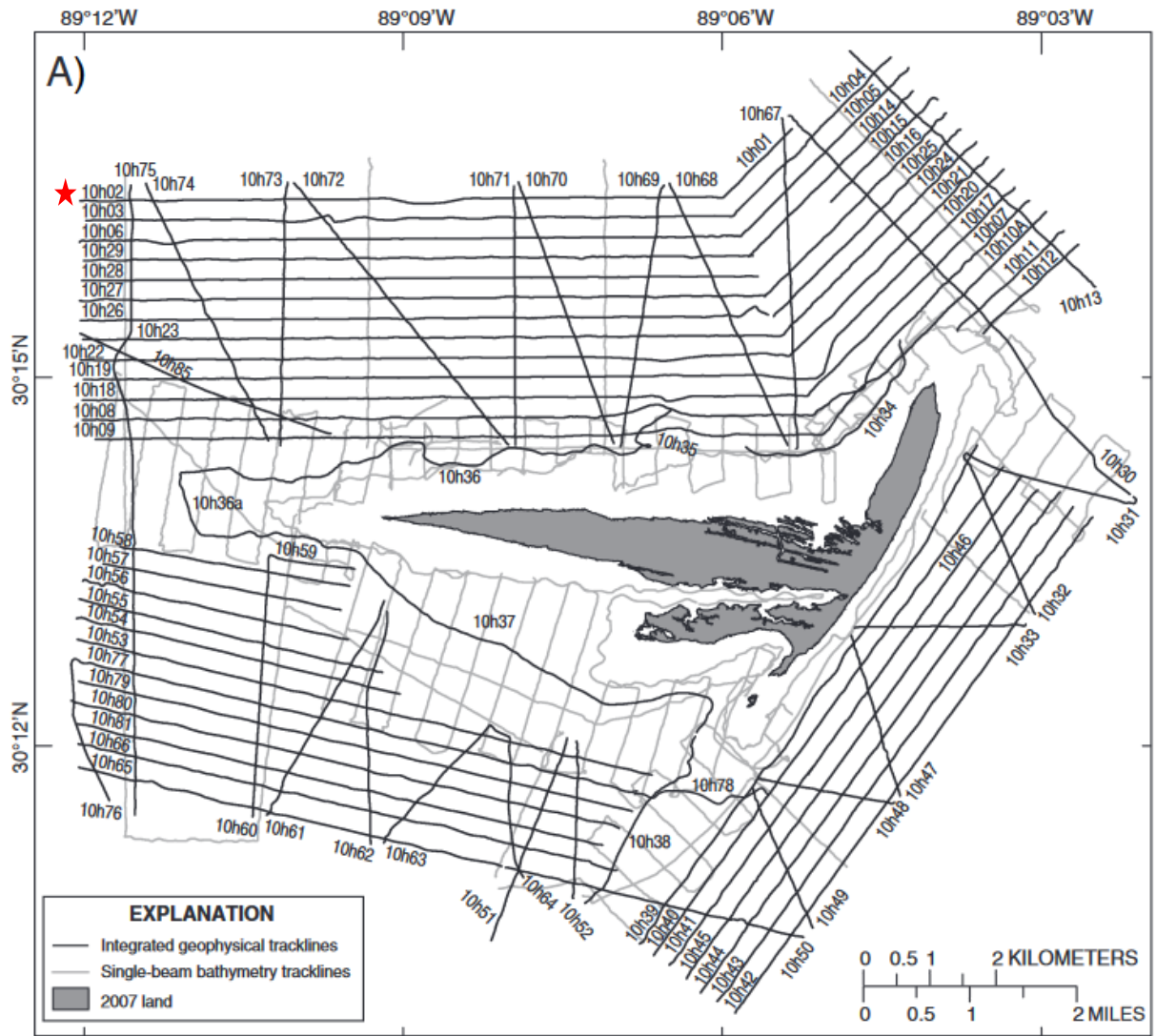


Figure 3. Trackline locations of the 10BIM04 seismic cruise.
 Map from Miselis et al. (2014). Red star indicates beginning of east-west line shown in Figure 4.

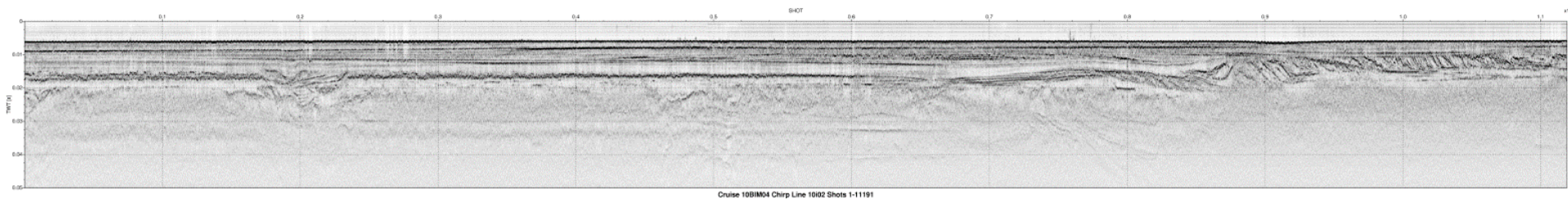


Figure 4. Example geophysical line 10i02 from cruise 10BIM04.
Line location shown in Figure 3.

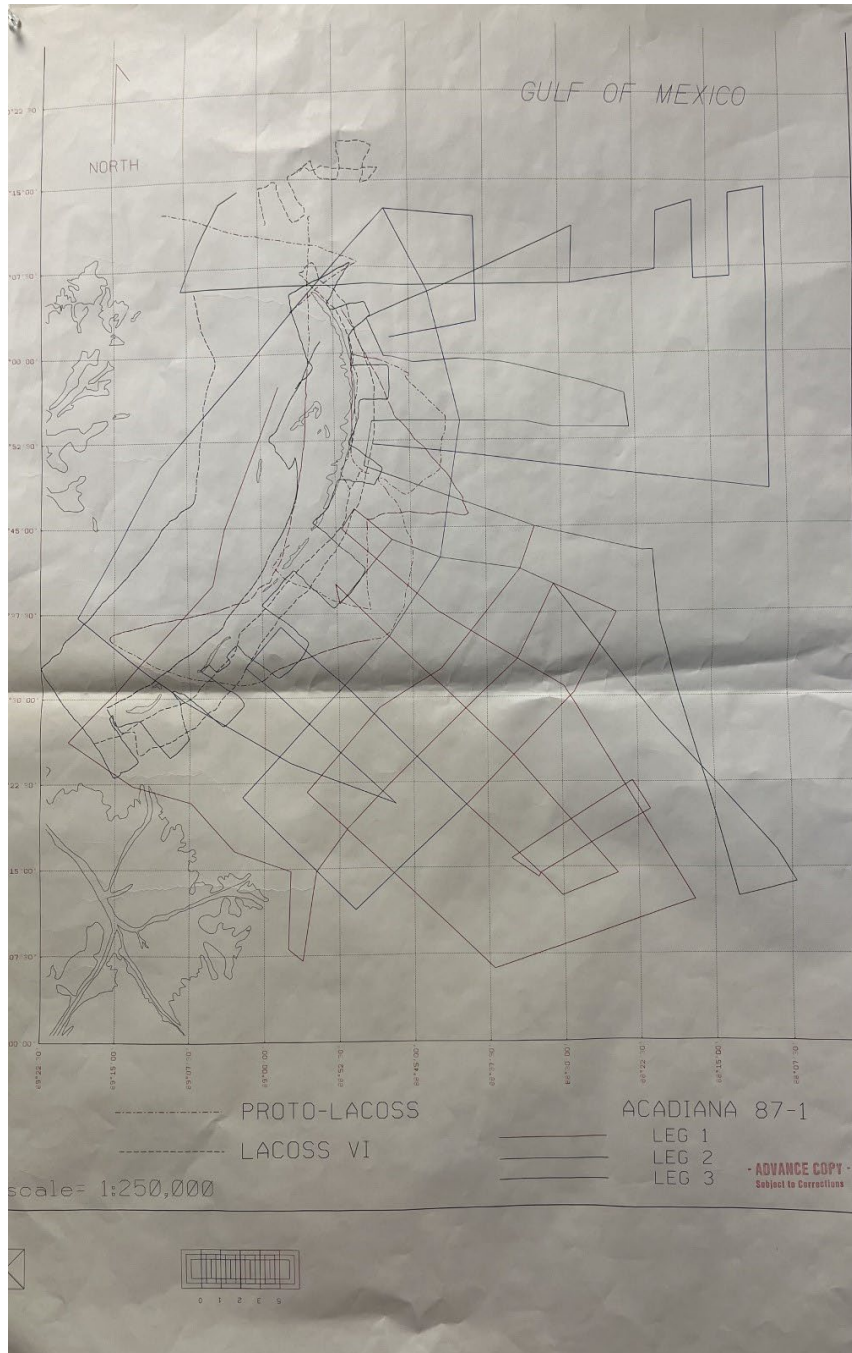


Figure 5. LACOSS VI and Acadiana 87-1 cruise tracklines. Map sourced from Dr. Mark Kulp, University of New Orleans, Framework lab. This is an original hardcopy of the recently digitized data from Bosse et al., 2020.

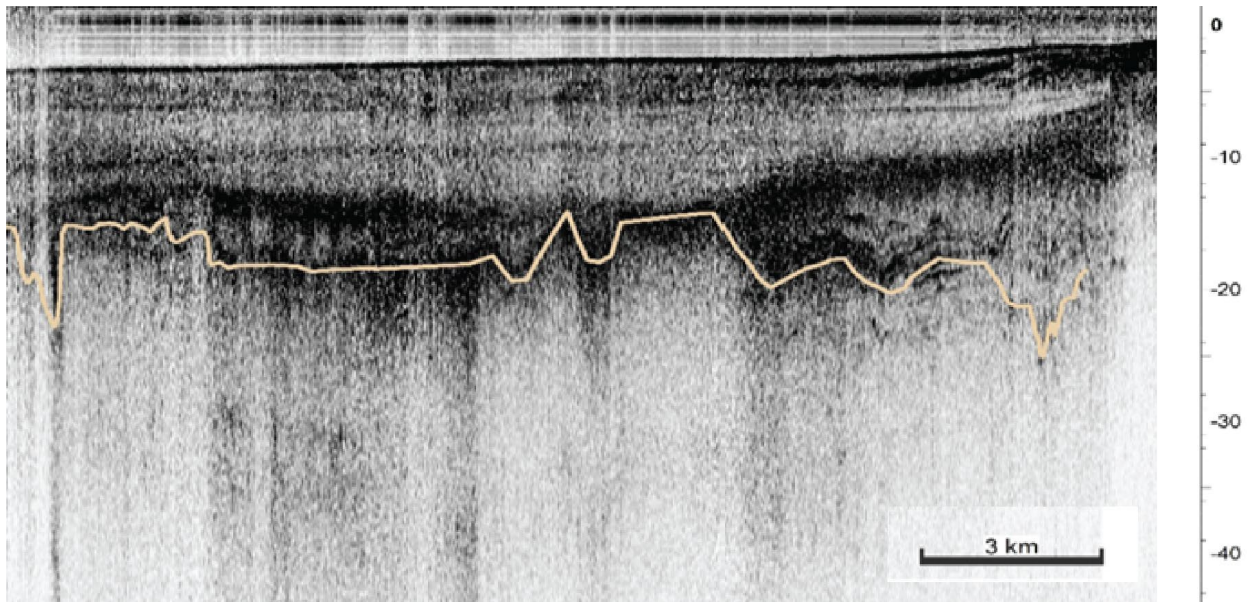


Figure 6. MSU R/V Sound Surveyor 2018 example

Example geophysical line from MSU R/V Sound Surveyor 2018 dataset showing the interpreted MIS2 sequence boundary. Depth axis is in meters. From Adcock, 2019.

Lacoss 85-6 or VI was collected along the Chandeleur Islands from May 15-21, 1985. Paper copies of basemaps including previous geophysical efforts were found at UNO (Figure 5), but only the Acadiana 87-1 and Lacoss VI still exist. The Proto-Lacoss cruise was not able to be located via paper or digital copy. The Lacoss VI dataset includes 706 line km of boomer seismic that were digitized in 2020 by the USGS (Bosse et al., 2020).

The final geophysical dataset explored for this submission is *MSU R/V Sound Surveyor 2018*, which included seismic profiles recording subsurface stratigraphy in the Mississippi Sound (Table 1). ~255 km of seismic was collected with a EdgeTech 3100P sub-bottom profiler and SB-216S towfish chirp system (2-12 kHz) between Point Clear, MS and Gulfport Harbor, MS on the R/V Sound Surveyor (Skarke and Adcock, 2021). These data were collected throughout the following dates: 2018-6-12 to 2018-06-15, 2018-08-16 to 2018-08-18, and 2018-11-07 to 2018-11-08. The project was funded by Mississippi RESTORE Act Center of Excellence MBRACE cycle 1, and the data can be found in the Gulf Research repository: <https://data.gulfresearchinitiative.org/data/MS.x839.000:0030>. The primary goals for the Skarke and Adcock (2021) project were to characterize shallow stratigraphy in the Mississippi Sound and determine how the variability of subsurface geology impacts pollutants, nutrients, and pathogen loads in groundwater discharge. Furthermore, a master's thesis outlining an interpretation of paleochannels was generated (Adcock, D., 2019), and an example line is shown in Figure 6.

Table 1. Summary of Geophysical data included in the MMIS submission.

Cruise ID	Institution Collected or Repository Source	Collection Year	Data Type	Line km
10BIM04	United States Geological Survey (USGS)	2010	Chirp	500
Acadiana 87-2	United States Geological Survey (USGS)	1987	Boomer	1557
Lacoss VI	United States Geological Survey (USGS)	1985	Boomer	706
MSU Sound Surveyor	Mississippi State University (MSU)	2018	Chirp	255

As part of Task 2, this project also searched for any spatially relevant products compiled under Task 1 (e.g. data points: interpreted locations or isopachs of sand bodies, valley fills, channel fills, etc.). However, this information within the bounds of the study area was not discovered.

4.2 Previous MMIS Sediment Core QA/QC

Vibracores associated with this study were previously submitted in “*MI6AC00012 Mississippi Offshore Sediment Resources Inventory: Late Quaternary Stratigraphic Evolution of the Inner Shelf (MS Co-Op1)*” (Figure 2). As part of the Co-Op, we additionally QA/QC’ed the core dataset within the Co-Op 3 polygon (51 cores total). Part of this effort included adding missing subsamples to the MMIS schema and addressing minor inconsistencies from the previous MMIS submission. For the purposes of this MMIS update only, the following partial core series were submitted for minor updates and sediment facies descriptions:

10BIM06 Marine cores; radiocarbon table (Buster, N.A. et al., 2014)

10BIM03 Terrestrial Cores-Cat Island; OSL table (Buster, N.A. et al., 2014)

07SSC (Dreher, C. et al., 2010)

CI-87 (Dreher, C. et al., 2010)

4.3 Future Directions and Integration

While it was beyond the scope of this Co-Op, these datasets provide a very important foundation upon which future studies can build. Previous work (Dike, 2022) has demonstrated that a relatively large lowstand paleovalley existed within St. Louis Bay (outside of study area) associated with the combined Jourdan and Wolf rivers, and that system continued further seaward to our study area. However, it has not been mapped and no relevant spatial products have been extractable to date. Further towards the OCS, the geology becomes significantly more complex, with influence from the SBDC, Biloxi, and Pascagoula incised valley systems. Therefore, fully interpreting the data contained within this study area box, and its connectivity outboard with other previously mapped systems in Co-Op #1 (Fig. 1) will greatly aide in understanding available sediment resources and their sediment characteristics.

5 Summary

Based on the areas covered by previous Co-Ops, a notable gap existed in the western Mississippi Sound. This NOAA RESTORE project identified legacy data, performed a synthesis of these legacy datasets, QA/QC'ed data, and submitted a geodatabase to MMIS. In total, this project added 3,018 line kilometers of seismic data to MMIS. No other spatially relevant products were found that could be added to MMIS.

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