BOEM Cooperative Agreement Number M22AC00008

University of Texas Institute for Geophysics

Reconciling Core Databases and Detailed Analysis of Recent Acoustic Reflection Data on the Texas Shelf

Cooperative Agreement Interim Report on Core Reconciliation Effort

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Overview

Objectives and Methods

As part of a previous BOEM cooperative agreement (M16AC00020), the University of Texas Institute for Geophysics (UTIG) compiled a database of core locations in the nearshore and offshore areas to facilitate sediment resource management. The database was submitted as a packaged folder structure including an ESRI geodatabase with core locations and attributes, associated core logs/maps/etc., and the georeferenced images used to derive the majority of the core locations. This database was intended to be incorporated into the MMIS and made available to the public. However, during BOEM's review of this submission it was determined that approximately 250 of the cores in this database were coincident (same core ID) with those published and available for download from Texas GLO's TxSed database in October 2021. These common cores had location discrepancies on the order of 10s to 1000s of meters. In some instances, these discrepancies appeared to be systematic and possibly due to differences in methods of georeferencing. In others, the spatial discrepancies were erratic, suggesting possible differences in source data.

The location discrepancies were documented by BOEM and brought to the attention of UTIG and the Texas GLO in hopes of finding a solution to reconcile them prior to incorporation into the BOEM MMIS to ensure consistency between publicly available datasets. The locations of many of the cores incorporated into the original TxSed database were derived from georeferenced imagery and likely have considerable error. The original TxSed database, compiled by CPE, largely consisted of historical cores taken offshore of Galveston County, TX. The source data and methods used to compile this dataset are well described in the associated metadata, where it is noted that "cores without exact coordinates provided were then extracted from the maps and are estimated to have up to 5000 feet error, and thus, should be used with caution and for reference only".

Horizontal error is inherent in methods that derive point locations from georeferenced maps of variable quality and resolution, and the potential errors are acknowledged in both the UTIG core database and TxSed. As a result, it may not be possible or prudent to fully reconcile these databases without compromising the integrity of each database and the associated methods used for construction. However, it is important to assess, document, and understand the source of the discrepancies between these two databases to (1) determine if major errors are present, if these can be corrected, and/or if improvements can be made, and (2) reduce or eliminate inconsistencies between similar publicly available datasets. To accomplish these goals, we reexamined supporting documentation, refined and revalidated georeferenced imagery, and revised core locations based on the reanalysis and, where possible, available log records.

Results

The accompanying spreadsheet ("Core_DB_discrepancies.xlsx") provides full details on the discrepancies found between UTIG and TxSed databases, analysis of causes, and recommended and final courses of actions. These results are organized by core series – that is, sets of cores collected on single field campaigns and designated with the same core prefix. Typically, each core series was located from the same geo-referenced map image. Overall, there were four different courses of action taken:

1) *Change coordinates in the UTIG database from the georeferenced map values to those recorded in available core logs (62 cores)*. In all cases of discrepancies, the logged values, where they are available, are considered to be more accurate. The most significant case of a map error was found for core series SB-93 (22) and SB-96 (7) over Sabine Bank, which were georeferenced by UTIG from map published in Rodriguez et al. (2004). These same cores in the TxSed database had locations that were derived from

logged values that were available in the Rice University database and were systematically offset by ~1-2 km to the ENE. Reexamination of UTIG's georeferencing of the Rodriguez et al. (2004) map found no errors, but it was subsequently discerned that the graticules on the Rodriguez et al. (2004) map were misplaced, which caused the offset from the actual positions (Figure 1). Other core series where this action was applied include GB (1), OGV-91 (2), OHi-90 (11), TV93 (8), TV99 (3), and WB-12-99 (8; all but one of these remained unchanged).

2) *Refine georeferenced image using known locations of either logged cores or trackline vertices, and then reposition core locations (81 cores)*. On several georeferenced maps, there were a handful of cores with logged locations or other known points that could be used to improve the accuracy of the georeferenced image, and thereby the locations of cores digitized from that image. This action was applied to core series BRFTD (20), CB-96 (3), GB (1), OBP-90 (24), OGV-91 (27), and SP (6).

3) *TxSed to revise their locations to values based on UTIG values (89 cores)*. Some of these sets included some of the largest discrepancies (of order kilometers) and where the UTIG georeferencing was deemed to be accurate whereas the TxSed locations were clearly erroneous. Series 09CCT02 was a special case, where TxSed had a duplicate set with different IDs, one of which was consistent with the UTIG positions, and one was not. In this case, TxSed is being asked to remove the inconsistent set. This action was applied to core series 09CCT02 (25), HB-93 (8), OBP (19), OGV (29), and OGV-93 (8).

4) *Add cores from UTIG database to MMIS as they are and simply note in comments that these locations differ from those in TxSed due to differences in georeferencing methods used to derive core locations (21 cores)*. These discrepancies were mostly less than 100 m. The decision to use UTIG database locations was made because the image used for georeferencing is available. This action was applied to core series GS-B (5), GS-C (6), GS-E (6), and GS-G (4).

In addition to reconciling core locations, a number of database editorial fixes were made to labeling, figures, and core depths values, as noted in the spreadsheet. See Attachment 1 of this report for a complete list of references from which maps were derived and georeferenced as part of this effort.

Conclusions

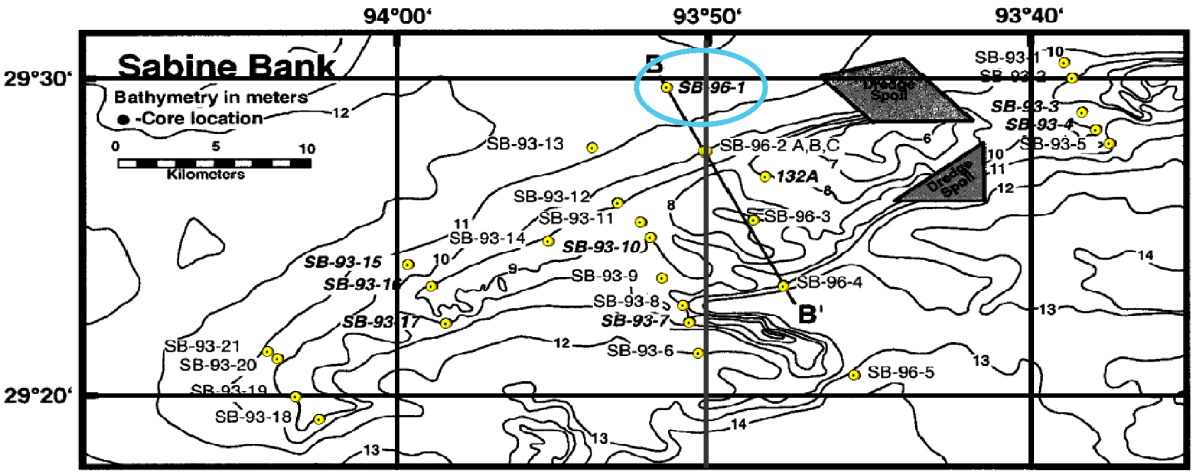
The discrepancies between the overlapping core records in the UTIG and TxSed databases highlight the uncertainties associated with archiving core locations based on georeferenced maps from published papers, dissertations, and other reports. Such maps are inherently imprecise, owing to finite line widths used to represent graticules and other identifying geographic features, symbol sizes and shapes used to identify core locations, and map scale. Additional uncertainty is present if the map projection is unknown. Furthermore, such maps are occasionally subject to plotting errors, as we discerned for the Rodriguez et al. (2004) map of Sabine and Heald Bank cores. This reconciliation effort was highly valuable in identifying some best practices for incorporating archival data into core databases:

1) Preserving logged locations and utilizing those values over georeferenced values whenever they are available

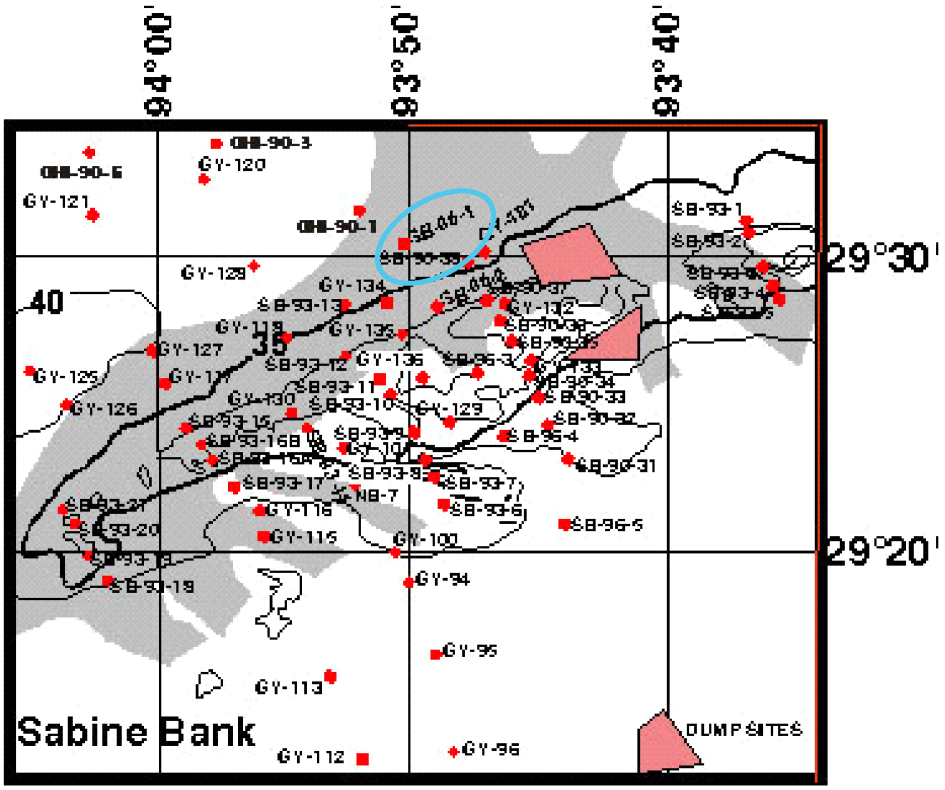
2) Archiving georeferenced maps within the database so that locations can be checked against other sources of location records

3) Verifying the accuracy of georeferenced maps against independent sources of location data, such as coastlines or logged cores.

4) Incorporating as many geographic control points as possible into georeferencing a map image.



Rodriguez et al. (2004)



Rice University Core Data Base

Figure1. Example of discrepancies between UTIG and TxSed databases
Core locations over Sabine Bank as plotted on the map by Rodriguez et al. (2004) (top) and the Rice University core database (bottom). Yellow dots on the Rodriguez et al. (2004) map represent the UTIG database locations digitized from the georeferenced map, and plot directly on the core symbols from which they were determined. The misplaced graticules on this image are well illustrated by core SB-96-1, which is highlighted in both maps with blue ovals. On the Rodriguez et al. (2004) map, this core is south of the 29°30'N graticule and ~2 km west of the 93°50'W graticule. In contrast, on the Rice University core database map, that core is north of the 29°30'N graticule, and almost directly on the 93°50'W graticule.

Cooperative Agreement Outputs and Deliverables for Core Reconciliation Effort

The primary deliverable for the core reconciliation effort is an updated version of the UTIG core database that was previously delivered as part of Cooperative Agreement M16AC00020. These samples span the western and central Gulf of Mexico (Figure 2) and represent a significant advancement over currently available sample databases in both the breadth and types of data now available for analysis and integration with ongoing studies.

The geological database was formatted according to the provided BOEM spatial data template, and all ArcGIS files and corresponding core pdf images are contained within a single geodatabase. The database can be queried by year of acquisition, depth of penetration, author, data type, and numerous other categories and the original scanned core descriptions brought up within ArcGIS on the fly (Figure 3). This updated database has been provided to MMIS and will be made publicly available through their web site.

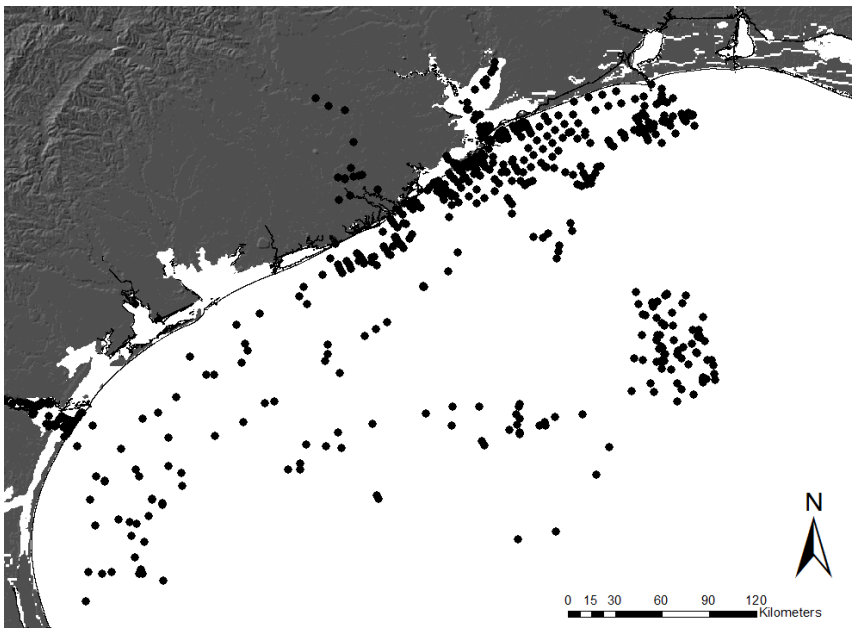


Figure 2. Map of the core geodatabase
Image displays all archived cores and platform borings across the western and central Gulf of Mexico.

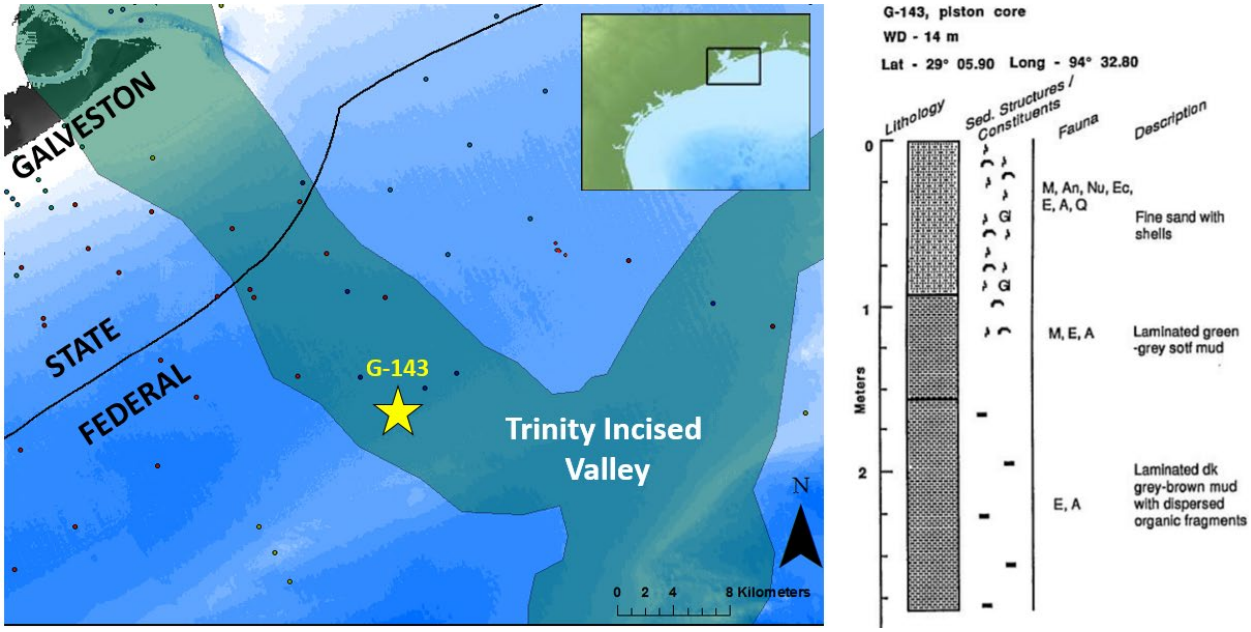


Figure 3. Example of digitized core description in the geodatabase
Core G-143, digitized from a Rice University PhD thesis, samples the upper valley fill of the Trinity Incised Valley.

Attachment 1: References for source maps and information

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