Synthesis of Fault Traces in South East Louisiana Relative to Infrastructure

Highlight | Feb. 2018

Project No. 17GTLSU12

PI: Dr. Nancye Dawers (TU), Dr. Mark Kulp (UNO), Dr. Rui Zhang (ULL)

POP: June 2017 – November 2018

Forming a knowledge base of surface fault locations relating to critical infrastructure in the coastal zone of southeastern Louisiana

Geological faulting has been known to contribute to subsidence, coastal land-loss, and submergence of marshlands in southern Louisiana south of the Lake Pontchartrain basin. Fault motion, either by slow creep or more sudden slip, can cause deformation of engineered structures. In addition, the compaction of thicker soils and Holocene sediments on the down-dropped sides of faults contributes to land subsidence that can result in increased infrastructure maintenance and repair costs. This project will synthesize current fault mapping and produce fault trace maps relative to critical infrastructure in areas underlain by existing 3D seismic surveys, and in other areas having a high density of wells and 2D seismic data.

Problem Statement

The impact of surface faulting on critical infrastructure is insufficiently documented in southeastern Louisiana. Accurate mapping of surface faults and an increased knowledge base of the pattern and extent of faults will aid in the design and placement of infrastructure, as well as in determining mitigation methods. Louisiana has vast amounts of subsurface data that to date have been underutilized for near-surface engineering applications outside of the energy sector. The proposed work is unique in the Louisiana coastal zone south of the relatively well-known Tepetate-Baton Rouge fault zone. With the exception of the Houston area, active fault systems in coastal zones of the Gulf Coast region have received little attention in infrastructure planning. There is a need to synthesize fault mapping in a geographic information system (GIS) and produce fault trace maps relative to critical infrastructure in areas underlain by existing three-dimensional (3D) seismic surveys, and in other areas having a high density of wells and two-dimensional (2D) seismic data.

Summary

The study area, outlined in black in Figure 1, extends from north of Baton Rouge eastward to the Mississippi state line, and southward encompassing all of the onshore areas through the Mississippi River's mouth and westward to just west of Houma. Any gaps in precise seismic data coverage will then be determined and investigated for high densities of other data types. By utilizing agreements already in place with energy companies, data owners, and seismic brokers, we will synthesize and refine our fault plane mapping and produce fault trace maps for faults that intersect or are present in the near-surface (ca. upper 1000 meters) and integrate these with other available datasets. Surface fault traces will be ranked using criteria such as: (a) the presence of surface scarps (i.e., as seen based on field investigation, or imaged on LIDAR topography); (b) mapping surface fault traces using high-resolution 2D seismic, 2D deep industry seismic, and industry 3D seismic data; (c) faults correlated or drilled through in wells; and/or (d) age dates in wells and sediment borings.

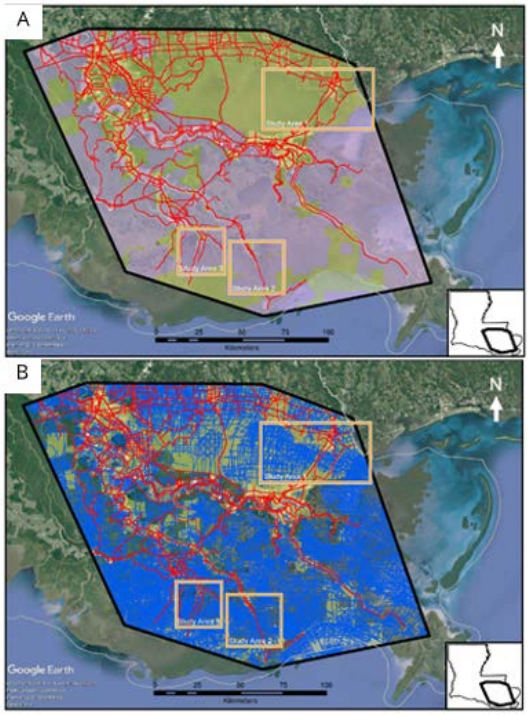

Figure 1. Google Earth satellite image of study area outlined in black in southeastern Louisiana. Roads and highways are colored red areas containing 3D seismic data are shaded pink. Areas with no 3D data available are shaded yellow (3D data gap).

Findings

Figure 1A depicts the study area outlined in black with Louisiana's Department of Transportation and Development (LADOTD) managed roads and highways. Commercially available 3D seismic data is shown in pink and 3D data gap areas in pale yellow. The 3D seismic data layer is a composite of 285 existing 3D surveys from SEI, SEITEL, and Schlumberger. Almost 60% of the study area is covered by 3D, and in the west and south, fully 75% of the study area affected by the most active regional fault zones has 3D coverage.

The three university-led projects using academically-licensed 3D data [Golden Meadow-Leeville (University of Louisiana at Lafayette, Montegut/Chauvin (Tulane University), Lake Borgne (University of New Orleans)] are areas of special focus. In these areas, some funding is available for an appraisal of fault effects that can be used as a protocol for future work in south Louisiana. The process includes 1) identification of key infrastructure likely to be affected by active faulting, 2) identification and interpretation of 3D and/or 2D seismic data as available, 3) acquisition of appropriately placed sediment borings for near-surface sediment characterization, 4) radiometric dating of correlative horizons so that rates of differential movement across the faults can be calculated.

The ongoing tasks of this project are projecting fault traces in the main study areas, followed by the acquisition of high-resolution seismic in the field and collection of sediment cores. Key transportation infrastructure locations in these focused study areas include LA1 and the New Orleans land bridge area including I-10, US Highway 11 and Highway 90 in New Orleans East and Slidell. Figure 1B shows the 3D data gap area and available 2D seismic lines. As one might expect due to the source, 2D data density is greatest where 3D data is also available in the western and southern parts of the study area due to the concentration of oil & gas development in these areas. Where the 2D seismic is the only deep imaging seismic available, blue lines are super imposed on a yellow background. It is apparent that 2D data will be especially important to verify faulting in Lake Pontchartrain, in the New Orleans land bridge and Rigolets area between New Orleans East and Slidell, and along the Mississippi River near the proposed Mid-Barataria Sediment Diversion and LA 23.

Impacts

Documenting where the faults are, and how they might interact with important transportation infrastructure can be greatly improved when 2D and 3D seismic data interpretation is included as a preliminary step for further geotechnical work. It is expected that this synthesis of the state of knowledge of fault locations in southeast Louisiana will be a useful tool to quickly determine whether transportation infrastructure is likely to be impacted by active faulting.

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Mr. Christopher Melson (Tran-SET Program Manager) directly at transet@lsu.edu.