DELTA SCIENCE FELLOW 2017

Delta Stewardship Council
Delta Science Program

Sea Grant California

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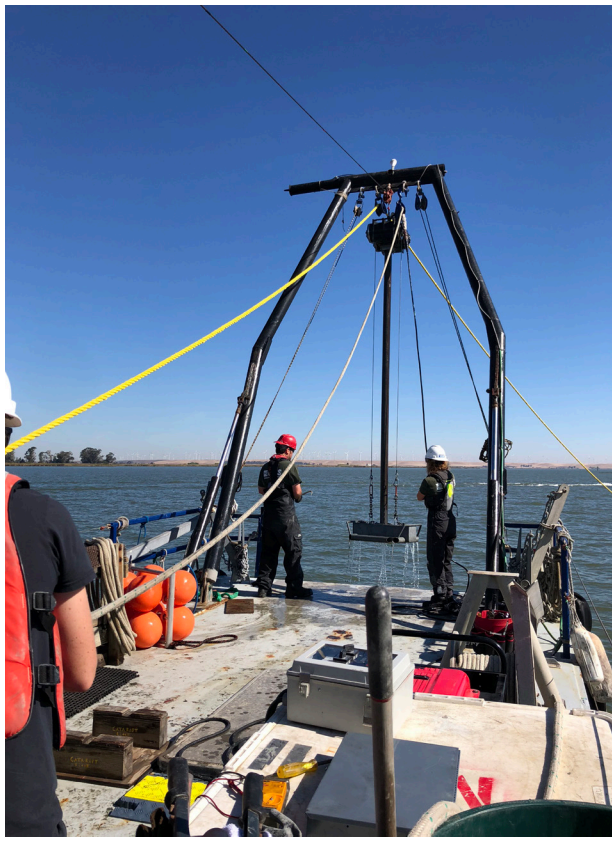
WHY THIS RESEARCH MATTERS

A major earthquake in the Sacramento-San Joaquin Delta region could have serious consequences for California's water supply, as well as the ecology of the delta. The levees that protect the delta islands and tracts from flooding could be easily breached in an earthquake, and as sea level rises, the threats of flooding and saltwater intrusion become more serious.

While the faults under the San Francisco Bay Area are relatively well understood, the seismic regime of the nearby delta is poorly characterized. In order to build infrastructure that could withstand future earthquakes, the region needs better understanding of the area's geology and seismic hazards.

Image: *Charles Jaworski*

Defining the architecture and recurrence interval for faults in the Sacramento-San Joaquin Delta: Assessing potential geohazards



LEFT: USGS marine technicians Jenny White and Pete Dal Ferro, with the help of SDSU professor Dr. Jillian Maloney, recover the vibracore on board the Retriever, while collecting sediment cores in the Sacramento River. *Shannon Klotsko.* ABOVE: Delta Science Fellow Shannon Klotsko with a Chirp, a high-resolution seismic reflection instrument used to image the layers below the water bottom (seafloor, river floor, etc.). *Amy Gusick*

PROJECT

This project aimed to create a detailed fault map for the Sacramento-San Joaquin Delta by mapping the faults throughout the Delta waterways. The project began with a review of existing data and reports, then a high-resolution seismic reflection and sidescan sonar survey, and finally, collection/analysis, including radiocarbon dating, of sediment cores to create the first detailed fault maps for the Delta waterways. The project worked to constrain the significant rupture histories of the Kirby Hills and Midland Faults, which is important for understanding the potential of future earthquakes.

RESULTS

During the first year of the project, SDSU postdoc Shannon Klotsko completed a seismic reflection survey of the Sacramento-San Joaquin Delta. Using these data, she was able to image stratigraphy and deformation associated with faults. In the second year, she worked with colleagues from the U.S. Geological Survey (USGS) to acquire sediment cores near the major faults. Preliminary data suggests that the Midland Fault, a blind fault that has no known surface expression, is an active fault. Seismic reflection data from the San Joaquin River imaged shallow deformation associated with the fault, which runs across Brannon and Twitchell islands, suggesting recent activity. Knowledge that the Midland Fault is likely an active feature is an important finding to be incorporated into future seismic hazard assessments for the delta and for delta management decisions.

Dr. Jillian Maloney and Dr. Shannon Klotsko of San Diego State University on the fantail of the *Retriever* after a day of collecting vibracores in the Sacramento-San Joaquin Delta. *Courtesy photo*

MANAGEMENT APPLICATIONS

Accurate and detailed mapping of fault locations is necessary to make models of earthquake history and hazards and the threats they pose to levees. The USGS is using results of this project to better understand the risk of earthquakes in the Sacramento-San Joaquin Delta. The new datasets are helping to refine locations of delta faults, some of which have been mapped for the first time.

This information, along with evidence of timing of seismic events, is pertinent to understanding seismic risk to the delta and will contribute to future hazard assessments. In addition to usefulness in seismic hazard assessments, mapping and dating of delta geology will also be helpful in management decisions related to impacts of future sea-level rise. Mapping the subsurface geology will also aid in liquefaction modeling. The seismic reflection and sidescan sonar datasets will be made publicly available via the USGS online data archive when manuscripts are published.

SELECT PUBLICATIONS AND PRESENTATIONS

Klotsko, S., Maloney, J., and Watt, J., 2019. Shallow fault mapping in the Sacramento-San Joaquin Delta. *USGS Northern California Seismic Hazards Workshop*. Menlo Park, CA, May 2019.

Klotsko, S., Maloney, J., and Watt, J., 2018. Shallow fault mapping in the Sacramento-San Joaquin Delta. *Southern California Earthquake Center Annual Meeting 2018*. Palm Springs, CA, September 2018.

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