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Passive Seismic Observations at Grand Bayou, Louisiana, USA Associated with the Failure of Oxy Geismar #3 Solution Cavern

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Abstract

Residents in the Bayou Corne area of Louisiana, USA reported feeling earth tremors in April 2012 and in May bubbling was observed in water wells and the nearby bayous, along with continued tremors. In response to the concern in the local community, the United States Geological Survey (USGS) and University of Memphis Center for Earthquake Information (CERI) installed seismic monitoring equipment in the Grand Bayou area on July 12, 2012. Ten days later, up to 1,000 seismic events per day were observed on the seismic stations (Horton, 2012). On August 2, the earthquake activity decreased dramatically and a sinkhole was found the morning of August 3, 2012. Seismicity continues to occur in the area around the sinkhole and cavern, more than a year following the incident.

In response to the seismic activity, a variety of seismic instrumentation has been installed in the area by an assortment of groups including the USGS, Chevron (a storage cavern operator on the dome), and Texas Brine Corporation (TBC). USGS stations were eventually replaced in early 2013 by a TBC network of 5 near-surface seismometers, a three element borehole array to 450 ft located directly over the failed cavern and a two element borehole array to 940 ft located in sediments off the salt dome. In addition to the surface seismic arrays, high-frequency geophone arrays were deployed within the salt in two TBC cavern wells and recorded microseismicity with magnitudes less than 0.

The seismic events recorded at Grand Bayou are typically two primary types of seismic events: high frequency (>50 Hz) “microseismic” events, and Very Long Period (<0.1 Hz) events. The high frequency events were best captured on the borehole geophone arrays located in wells drilled into the caprock and deployed in the salt section of the cavern wells.

The VLP events, with periods on the order of 15-20 seconds, appear to originate at shallow depths to the southwest of the sinkhole as they are recorded with the largest amplitudes and most consistently by a seismic station in that area.

The passive seismic monitoring is used to help assess the stability of the salt, predict sinkhole activity and assess safety for crews working in and around the sinkhole area. Plans for future seismic monitoring include an extensive borehole seismic array with sensors cemented into salt from 1000 to 3000 ft subsea located between Oxy Geismar #3 and #1 solution caverns.

Key words: Caverns for Solution Mining, Cavern Failure, Earthquake, Microearthquake, Very Long Period Seismic Events (VLP), Sinkhole, Seismic Monitoring.