

## **Imaging a Shallow Aquitard with Seismic Reflection Data in Memphis, Tennessee**

**Jiandang Ge<sup>1</sup>, Maria Magnani<sup>1</sup>, and Brian Waldron<sup>2</sup>**

*<sup>1</sup>Center for Earthquake Research and Information, The University of Memphis*

*<sup>2</sup>Dept. of Civil Engineering, The University of Memphis*

Two walk-away tests were conducted at two sites in Memphis, TN. One site is representative of an urban setting (road median) while the other represents a rural setting (metropolitan park). Three P-wave sources, a 7.5 kg sledgehammer, a 20 kg weight-drop, and a 12-gauge shotgun, were tested. Analysis of the data collected indicates that the shotgun produced the strongest recorded energy, the highest dominant frequency, the broadest frequency band, and generated the least amount of ground roll energy. The source repeatability was also studied by observing the first cycle of each seismic source, showing that the shotgun can generate the most repeatable source wavelets. None of the sources tested produced significant seismic energy above 100 Hz due to seismic wave attenuation. The loess in the rural site exacerbated the attenuation and resulted in a much lower peak frequency (43.7 Hz), which is nearly half of the peak frequency recorded at the urban site (85.3 Hz). Since attenuation can be a big factor in shallow reflection surveying, we recommend that site attenuation be considered before a reflection survey is performed in the Memphis area and a reflection survey be conducted outside of the loess blanketed area when possible.

Based on results of the walk-away tests, A 1-km-long reflection line was acquired across depressions of the water table that have been interpreted to reflect a breach in the aquitard. Although raw data are dominated by surface waves, after frequency filtering, shot static correction, and F-K filtering, consistent reflections can be observed. Integration of constant velocity analysis (CVS) and super gather semblance analysis was used to determine the RMS velocity field. The stack section shows a set of shallow reflectors interpreted to correspond to the top and bottom of the confining unit. The aquitard thins by about half from the north end to the south end along the reflection line. The continuity of the top and bottom of the aquitard was disrupted by few faults interpreted along the line. None of these faults juxtapose the surficial aquifer against the Memphis aquifer, but it is possible that the faults themselves may act as a hydraulic connection between the surficial aquifer and the Memphis aquifer and thus serve as pathways for a potential leakage. The refraction tomography technique was applied to the first arrival data and it revealed three depressions that are interpreted as paleochannels on the upper part of the confining unit, which is consistent with the background geology of the area. These inferred paleochannels may suggest that ancient river channel erosion may contribute to the process responsible for the formation of aquitard breaches in this area.