Peterie, S. L., Miller, R. D., Ivanov, J., Schwenk, J. T., Bailey, B. L., Schwarzer, J., and Markiewicz, R. D., 2012, Multi-method determination of continuous 2D velocity profiles from the surface to 1 km [Abs.]: 2012 AGU Fall Meeting, San Francisco, California, December 3-7.

Compressional and shear reflection data provide critical measurements of velocity and attenuation that are necessary for numerical simulations of site response from earthquake energy and seismic investigations to lithologic and pore characterizations. Imperative for accurate site response models is a seismic velocity model extending from the surface to the depth of interest that is representative of the true subsurface. In general, no seismic method can be used to characterize the shallowest (< 30 m) and deepest (30 m to 1 km) portions of the subsurface in a single pass with a consistent set of equipment and acquisition parameters. With four unique seismic surveys targeting different portions of the subsurface and different components of the seismic wavefield, we were able to build a comprehensive dataset that facilitated continuous 2D velocity profiles. The upper kilometer underlying our study site consists of Lake Bonneville lucustrine sediments and post-Bonneville alluvium and colluvium from the nearby Wasatch Front in north central Utah (Eardley, 1938; Hintze, 2005). Four unique seismic surveys were acquired along each of two 1.5 km lines located approximately 3 km apart. Data for tomography and multi-channel analysis of surface waves (MASW) were acquired with a bungee accelerated weight drop and 4.5 Hz compressional geophones. P-wave and S-wave reflection data were acquired with an IVI minivib 1 and 28 Hz compressional and 14 Hz SH geophones, respectively. P-wave and S-wave velocities from the surface to 30 m were determined using tomography and MASW, respectively. Stacking velocities of reflections on common midpoint gathers from the vibroseis data were used to determine Vp and Vs from approximately 30 m to nearly 1 km below ground surface. Each Vp and Vs dataset were merged to generate continuous interval and average velocity profiles. The sutured velocity cross-sections were produced for both P- and S-waves in a fashion not previously described in the literature. To confirm the validity of the velocity results, the surveys were simulated using an elastic seismic model developed from the reported velocity models. Synthetic records produced from this model were processed consistent with the real data, and synthetic results were quantitatively compared with real results. Seismic velocities and Vp/Vs ratios are largely suggestive of relatively compacted, unlithified sediments. An abrupt increase in Vp indicates the top of the saturated zone. Although lines 1 and 2 are located only about 3 km apart, shallow data suggest completely different hydrologic settings. Several shallow anomalous zones on both Vp and Vs profiles are indicative of both geologic and anthropogenic heterogeneities that are of interest from a material response perspective. Quantitative comparison of synthetic versus real results gives credence to the methodologies that culminated in the sutured velocity cross-sections, thereby opening opportunities for use in future studies.