HIGH RESOLUTION WAVEFORM TOMOGRAPHY AT A GROUND WATER CONTAMINATION SITE

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Shallow (< 20m) high resolution seismic compressional velocity models have been constructed at a ground water contamination site at Hill Air Force Base (HAFB) to identify the base of a paleo-channel in a clay aquitard buried beneath alluvium, using data recorded by 630 PASSCAL instruments. The dataset has useful energy between ~10Hz and ~250-350Hz. Waveform tomography has been applied to a VSP-2D surface dataset and a 3D surface reflection dataset (Fig. 1, left). The velocity model from the former application (Gao et al., 2005) reveals surprisingly large vertical and lateral velocity heterogeneities, which may compromise some conventional seismic imaging tools (Fig. 1, top right). The vertical velocity gradient is ~80m/s/m in the paleo-channel. Lateral heterogeneities in velocity as large as 200 m/s occurring over ~1.5 m are recovered in the model. The structural details in the model correlate well with two lithologic logs and a post-stack depth-migrated image, using the 2D data recorded at the surface between the two VSP boreholes.

Waveform tomography applied to the 3D surface reflection dataset yields 45 2D velocity models for profiles sorted out from the 3D dataset. The locations of the 45 2D seismic profiles are the 45 geophone lines shown as black lines in Fig. 1 (left). From each of the 45 waveform tomography models, the cross-sectional geometry of the buried paleo-channel can be identified by following the velocity contour of 800m/s. The combination of the 45 cross-sectional images gives the 3D geometry of the paleo-channel bottom (Fig. 1, bottom right). The 3D geometry reconstructs the structural host for the polluted ground water. Since the pollutant DNAPLs are heavier than water, they are believed to pond at the deepest points of the paleo-channel. The reconstructed geometry can be used for placement of extraction wells at the site to aid remediation efforts.