Subsurface imaging using reflected ground roll

Robert R. Stewart* and Craig Hyslop†

ABSTRACT

Reflection of surface waves from lateral changes can be used to produce subsurface images. Surface waves that reflect or backscatter from lateral heterogeneities provide information about the location, depth, and the amount of subsurface variation. We first confirm the validity of forward modeling reflectivity from surface-wave phase-velocities by comparing it with a known method of determining reflectivity from shear-wave velocities. The forward model forms the basis for our method of extracting reflectivity. We use VSP-type processing as well as the undoing of dispersive effects to uncover the reflected wave. Deconvolution of the reflected wave results in reflectivity which characterizes the properties of the reflector. Mapping the corresponding wavelengths for the amplitude spectrum of reflectivity for all traces creates a lateral-reflectivity image as function of depth. The lateral-reflectivity image properly locates and determines depth to buried faults for two synthetic examples. In addition, the reflectivity image processed from the Hockley Fault system near Houston, Texas correctly highlights a major fault (Figure 1). With the correctly determined amount of change across a particular lateral location, as defined by reflectivity, an iterative inversion scheme can be used to update the surface-wave phase-velocity model. Iterative inversion improves lateral resolution of the phase-velocity model and resultant shear-wave velocity models for both synthetic and field data.

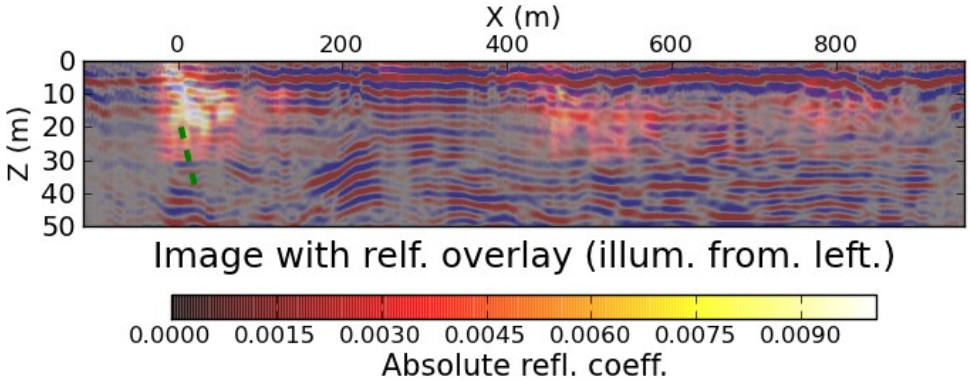

Figure 1. Seismic reflection section from the Hockley Fault System near Houston, Texas. The color overlay indicated the reflected ground roll amplitude.

* University of Calgary, University of Houston
† University of Houston