INVESTIGATION OF A SLOPE FAILURE USING SEISMIC FULL WAVEFORM INVERSION

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Highly plastic, calcareous clays are prevalent throughout Alabama. Slope failures occur fairly frequently in these clays, and experience shows that these clays have very low mobilized shear strengths when they fail. The exact mechanism of these failures is currently unknown, but it is suspected that the clay could potentially be a strain-softening material which would lead to localized zones of softened material. Strain-softening of these soils is expected to lead to a reduction in the in the elastic moduli, which may be visible in a profile of seismic velocities as a low velocity zone in an otherwise stiff clay deposit. Traditional methods for interpreting seismic geophysical data may not be able to detect these localized zones, but full waveform inversion (FWI) offers a potential alternative.

This study evaluates a recent slope failure along County Road 37 in Wilcox County, Alabama. This failure destroyed a section of the roadway and damaged buried utility lines. The slope was located in the Porters Creek Formation which is known to consist primarily of highly plastic clay. As part of the investigation of this slide, two lines of seismic data were acquired, one in the slide area and one outside of the slide area. Electrical resistivity data was also acquired parallel to the seismic lines. Data was also available from four borings performed at the site by the Alabama Department of Transportation (ALDOT). The seismic data was processed using full waveform inversion (FWI). For this method, the elastic wave equation is simulated using SPECFEM2D (Tromp et al. 2008). The 2-D shear wave velocity profile was then updated iteratively in order to minimize the misfit between the observed seismograms and the modeled seismograms. In addition to FWI, the seismic data was processed using the multichannel analysis of surface waves (MASW) technique for comparison purposes. This presentation will offer an interpretation of the FWI results and comparisons to the resistivity, MASW, and borehole data. The feasibility of using FWI for slope failure investigations in highly plastic clay will also be discussed based on the results of this case study.

References:

Tromp, J., Komatitsch, D., and Liu, Q. (2008) Spectral-element and adjoint methods in seismology. *Communications in Computational Physics*, 3(1):1–32, 2008.