

Contract No.: B2532533
Technology: Vertical Seismic Profiling (VSP)
Contractor: LM Gochioco & Associates

Summary of technology:

The VSP method uses hydrophone receivers that are lowered down a water-filled borehole and a seismic source that is applied to the ground surface. To successfully detect old mine workings, the VSP method relies on good quality data acquisition (high signal-to-noise ratio) in order to identify the “first breaks” from the data record. The first breaks are the first recorded seismic wave arrivals that reflect off the edge of the mine workings and travel back to the hydrophones. For this project, the seismic source was created by a “seisgun,” which consisted of a pipe with a 12-gauge shotgun shell attached at one end. The loaded end of the gun was lowered into a 10 to 12 inch deep hole. A rod was then inserted through the pipe to contact the shotgun shell. The other end of the rod extended above the top of the pipe. The shot was fired by sharply striking the end of the rod with a hammer. The seismic response data was recorded with a Geometrics Geode system and a laptop computer.

Stated limitations of technology:

When the data quality is poor (low signal-to-noise ratio), the data can be dominated by tubewaves which propagate up and down the water-filled borehole. Tubewaves can sometimes be filtered out during data processing, however, when the tubewave velocity is similar to the primary compression wave (P-wave) velocity reflecting from the old mine works the first wave arrivals may be impossible to identify.

Field demonstration results:

Field Demonstration Conditions	Goal of Demonstration	Results of Demonstration
Borehole No. 1 in level agricultural field, coal seam depth of 150 feet, 42 inch mining height	Locate old mine entries filled with water approximately 80 feet away from borehole	Unsuccessful. Data was dominated by tubewaves. Contractor was unable to interpret first arrivals.
Borehole No. 2 in level agricultural field, coal seam depth of 260 feet, 42 inch mining height	Locate old mine entries filled with water approximately 50 feet away from borehole	Unsuccessful. Data was dominated by tubewaves, unable to interpret first arrivals.