

Contract No.: B2532533
Technology: In-seam Seismic Reflection
Contractor: LM Gochioco & Associates

Summary of technology:

In-seam seismic reflection tests were conducted at five different mine sites. The method uses geophone receivers and seismic sources deployed inside the mine. Geophone receivers are installed at equally spaced intervals along the coal face/rib. The geophones were installed by drilling a small hole into the rib and pushing the spike of the geophone into the hole until a snug fit was obtained. Seismic sources were created by either detonating a single blasting cap in holes drilled into the rib, or by striking the rib with a sledgehammer. The seismic response data was recorded with a Geometrics Geode system and a laptop computer. The data was then analyzed and the mine voids were located based on measuring the P-wave velocity in the coal and identifying the arrival time of the wave that is reflected off the edge of the mine workings. Based on their experience, the contractor claims that they can usually tell whether a void is air-filled or water-filled by the difference in frequency of the reflected channel wave.

Stated limitations of technology:

The contractor claims that the results are most accurate in cases where the old mine workings are nearly parallel to the test setup barrier/coal face. When the two are not parallel and have considerable "angle" between them, then the margin of error increases as the reflection points are not directly in front of the geophone, but could come from either side of the geophone. To correct this problem, a more sophisticated algorithm called "migration" may be applied to the data set. Migration is an inversion process that rearranges the seismic data elements so that reflections and diffractions are re-plotted to their true subsurface locations. The contractor claims that they did not have the resources to develop the migration algorithm for this demonstration project. Therefore, they indicate that some of the results from the project have reflection points located outside or beyond the old mine works in situations where the orientation of the test barrier and old mine works were not parallel.

Field demonstration results:

Field Demonstration Conditions	Goal of Demonstration	Results of Demonstration
Site No. 1, inside coal mine, 38 to 40 inch mining height, blasting caps used as seismic source	Locate old mine entries filled with water approximately 600 feet away	Detected entries; several reflections (voids) found outside of actual old mine works boundary. Contractor indicates that erroneous reflection locations are because "migration" not applied. Confirmed by drilling.
Site No. 2, inside coal mine, 36-inch mining height, sledgehammer used as seismic source	Locate old mine entries filled with water approximately 1200 feet away	Did not detect intended entries; but accurately detected entries from a shallower coal seam 45 feet above and about 900 feet away. Drilling confirmed boundary of shallower old mine works.
Site No. 3, inside coal mine, 48-inch mining height, blasting caps used as seismic source	Locate old mine entries filled with water approximately 1000 feet away	Detected entries, but the distance to the old works was not verified due to changes in mining plan.
Site No. 3, inside coal mine, 48-inch mining height, blasting caps used as seismic source	Locate old mine entries filled with water approximately 600 to 800 feet away	Detected entries; but several reflections (voids) found outside of old mine works boundary. Contractor says those erroneous reflection locations are due to lack of applying migration to data.
Site No. 4, inside coal mine, 48-inch mining height, blasting caps used as seismic source	Locate old mine entries filled with water approximately 500 to 600 feet away	Detected entries but the results were not accurate. Lack of applying migration played a role in the results. Actual void location known from accurate survey.
Site No. 5, inside coal mine, 78-inch mining height, sledgehammer used as seismic source	Locate old mine entries (air-filled) approximately 200 to 260 feet away	Detected entries with a high degree of accuracy. Void location known from previous drilling.

