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Seismic and electrical methods applied to the evaluation of subsidence risk derived from mining works

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The subsidence processes represent an important hazard to property and human safety, especially when an underground structure (like a cave) collapses. The identification of these structures is critical to reduce the hazard. In this way, the geophysical methods improve the probability of detecting and delineating these subsoil features with respect to boreholes and can be used to reduce the cost and time invested.

In this study a multitechnique mapping has been used to identify zones with potential risk of subsidence associated to old mining works. The geophysical methods selected were seis-mic refraction, multichannel analysis of surface waves (MASW) and electrical resistivity tomography (ERT).

The study area is situated in the so-called Cantabrian zone of the Variscan Massif in northwest Spain, 30 km north of Oviedo. During years, mining works were focused in the exploitation of Silurian ferruginous sandstones by underground galleries. Nowadays the mine is abandoned, but the effects of subsidence related to the collapse of galleries are evident affecting all kind of infrastructures like roads or houses.

The objective of this work is to compare and evaluate the data from several geophysical methods applied to the detection of mining galleries. To do it, a geophysical survey was planned in a line of 120 m along which seismic refraction, MASW and ERT data were acquired. The geophysical models were compared with direct geological data from boreholes allowing a complete characterization of the subsoil. In a first step, the geophysical data were interpreted individually permitting the evaluation of the advantages and limitations of each geophysical method to be examined separately. In the second step, all the data were integrated in a final model to determine accurately which area was susceptible of collapse.

Through seismic and electrical methods separately was possible to create a geological model of the subsoil area and identify the disrupted zone from the mining activity, which was confirmed later with borehole data. However, in our conclusions, joint interpretation provides several advantages when compared to traditionally separate approaches, which can be beneficial in this kind of studies. It makes the interpretation of geophysical data easier, improves the spatial resolution of single method and allows to compare the uncertainty in the depth of interpreted data. Also, through joint interpretation we have differentiated areas with high reliability where all the geophysical data agree and areas of more doubtful information, which could afterwards be drilling targets.