High resolution seismic methods applied to subsidence evaluation and solution mine design

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Introduction

The AKZO NOBEL Brinefield in the concession "Twente Rijn" (Eastern Netherlands) is intensively mined with over four hundred production wells having been drilled. At some locations no surface effects are apparent, while at others gradual and slow subsidence occurred. More recently a ground collapse occurred in the mining area. Questions still not satisfactorily answered are: why does subsidence occur on one location and not on the other, and what are the lateral variations that cause such different behaviour?

The point we want to illustrate in this paper is how high resolution seismic can be used in relation to these questions and thus to mine design. It is exemplified by a high resolution seismic survey that we carried out. We will look to technical aspects of the seismic as applied and to the interpretation of the final results in terms of mine design.

Subsidence causes unsafe situations, environmental risks and damage to all kinds of civil works as buildings, pipes and cables. Solution mined cavities can result in sinkhole formation or ground collapse.

Obviously subsidence prediction improves safety and reduces environmental risk of existing solution mines. Improved mine design, that is: avoiding hazardous areas, would be of great interest. Evaluation and prediction of subsidence, especially sinkhole formation and ground collapse, is hampered by insufficient knowledge of the local geology and of the subsidence mechanisms.

The objective of the survey was to see whether the seismic can inform us where subsidence will occur. If lateral variations in the formations are related to subsidence occurrence, the seismic might detect these variations and thus helping us in designing our mine.

More generally the aims of the seismic survey are:

- mapping of formation boundaries
- detect lateral variations in these formations (an important issue here are faults that might be related to subsidence)
- mapping cavities (the lateral dimensions of the cavities is about 100 to 200 m).

The target depth range is from about 60 to 600 meters.

If the 2D results would be promising, a 3D survey might be carried out. The decision to carry on with the 3D survey depended mainly on the quality of the 2D results.