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Hydroacoustic monitoring of a salt cavity: analysis of precursory events of the collapse

François Lebert (1), Séverine Bernardie (1), and Guénolé Mainsant (2)

(1) BRGM, 3 avenue Claude-Guillemin, BP 36009, 45060 Orléans, cedex 2, France, (2) LGIT - BP 53, 38041 Grenoble, CEDEX 9, France

One of the main purposes in "post mining" research is related to the available methods and means for monitoring mine-degradation processes that may, as a consequence, directly threaten surface infrastructures.
GISOS, a French scientific interest group concerned with the impact and the safety of the underground works in the field of the post-mining, aims amongst other at developing techniques for monitoring underground growing cavities due to salt dissolution, leading to collapse. One method for monitoring the stability of a salt cavity is to record microseismic-precursor signals that indicate the onset of rock failure. In particular, in this study, it has to identify and evaluate the capacity of hydroacoustic technique for monitoring salt cavities. More specifically, the purpose is to be able to determine the criteria of the behaviour change and the state of the rock likely to occur as a precursory sign before the collapse of the salt cavity.
More precisely, three types of signal were recorded in a salt mine, in Lorraine (France), during the monitoring of the collapse of a salt cavity of about 800.000 m3 at 120 m depth.

- The RMS (Root Mean Square) levels, with the time recordings of the RMS power in four frequency-bands (total signal; 30 Hz – 3 kHz; 3 kHz – 30 kHz; 30 kHz – 180 kHz).
- The low frequency monitoring, which records the events from cracking to block falls, in the 30 Hz - 3 kHz frequency-band?
- The high frequency monitoring, which deals with the recordings of events occurring in the 30 kHz - 180 kHz frequency-band?

The hydroacoustic data highlight some interesting precursory signals before the collapse of the cavity. Indeed, the cumulative energy evolution of both low and high frequency events seems to be a good indicator of the mechanical state of the cavity. Moreover, the analysis of the recordings shows a new type of family events, which occurs a few hours before the failure phase. Finally, correlations have been performed between hydroacoustic recordings and other measurements acquired at the same time on the site, including strain measurements, and hydrostatic pressure of the brine, permitting to validate the hydroacoustic technique as a method adapted to monitor the mechanical instability of an underground cavity.