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Real-time monitoring of a salt solution mining cavern: view from microseismic and levelling monitoring

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In 2004, in order to better understand processes involved in large-scale mine collapse, an instrumentation was settled in the surrounding of a salt cavern located at a depth of 180 m in NE France. The cavern was mined by solution mining until the large-scale ground failure occurred. A high resolution multi-parameter monitoring system was deployed in the framework of the GISOS (Scientific Interest Group on the Impact and Safety of Underground Structures formed by INERIS, BRGM, INPL and ENSG). Instrumentation, installed by INERIS, consisted of a microseismic network, coupled to automatic-measurement system for levelling (Tacheometer and RTK GPS). Quasi real time transmission of the data to INERIS, at Nancy, enabled rock mass activity of the site to be monitored on a few hours basis. Also, the various recorded observations, in the beginning of spring 2008, led the operator to cause the collapse in February 2009. This was done by intensive extraction of the brine contained in the cavern, which was considered to be at limit equilibrium. On the second day of pumping sudden increase in microseismic activity indicated the start of collapse, followed by manifestation of a surface crater about 35 hours later. All the data and information collected during this experiment are now being processed and back-analysed aimed at ensuring high quality of interpretation. In particular, the space-time distribution of the failures and the evolution of the waveforms enlighten the changing conditions in the geological overburden. When correlated with the measurements of the movement and the known geology, the microseismic data enable a precise description of the failure mechanism(s), and especially of the complex and major role of the overlying bedrock. Similarly, feedback from this experience should lead to practical recommendations concerning collapse phenomena monitoring in such a mining context. While the preliminary results already indicate the exceptional quality of this data set, microseismic monitoring appears to be the most discriminating in terms of earliness, resolution and accuracy compared to levelling measurements.