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Experimental monitoring of a solution-mining Cavern in Salt: Identifying and Analyzing Early-Warning Signals Prior to Collapse

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Abstract

Risk management of underground cavities requires a good working knowledge of accidental phenomena like subsidence or large-scale collapse. This was the context when the opportunity was taken to instrument a large size in use saline cavern, so as to test various auscultation techniques available under controlled conditions. A microseismic monitoring network coupled to a surface measurement system was installed to improve our knowledge of the mechanisms that initiate and govern the evolution of the cavern up to its collapse. After a stationary period combined with partial depressurization tests conducted in 2005 and 2007, the cavern appears to have entered into its final evolution phase, and this probably since early 2008. This results in continuous and highly sustained microseismic activity as well as the occurrence of a number of microseismic episodes localized around the cavern roof. The localization of the microseismic events, for some of these episodes, is closely correlated to the quasi-dynamic brine pressure variations and to the evolutions of the roof depth measured at observation boreholes. The microseismic activity turns out to be more precise when it comes to the evolution affecting the mine cavern than the movement measurements taken on the surface or sub-surface.

Key words: Solution Mining and Salt, Instrumentation and Monitoring, Sinkholes, Subsidence, Instrumentation and Monitoring, Geophysics