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Geophysical observations at cavity collapse

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In Lorraine region (France) salt layers at about 200 meters depth are exploited by Solvay using solution mining methodology which consists in extracting the salt by dissolution, collapsing the cavern overburden during the exploitation phase and finally reclaiming the landscape by creating a water area. In this process, one of the main challenges for the exploiting company is to control the initial 120-m diameter collapse so as to minimize possible damages. In order to detect potential precursors and understand processes associated with such collapses, a wide series of monitoring techniques including micro seismics, broad-band seismology, hydro-acoustic, electromagnetism, gas probing, automatic leveling, continuous GPS, continuous gravity and borehole extensometry was set-up in the frame of an in-situ study carried out by the "Research Group for the Impact and Safety of Underground Works" (GISOS, France). Equipments were set-up well before the final collapse, giving a unique opportunity to analyze a great deal of information prior to and during the collapse process which has been successfully achieved on February the 13th, 2009 by controlling the cavity internal pressure. In this work, we present the results of data recorded by a network of 3 broadband seismometers, 2 accelerometers, 2 tilt-meters and a continuously gravity meter. We relate the variations of the brine pumping rate with the evolutions of the induced geophysical signals and finally we propose a first mechanical model for describing the controlled collapse. Beyond the studied case, extrapolation of the results obtained might contribute to the understanding of uncontrolled cavity collapses, such as pit-craters or calderas at volcanoes.