

Monitoring of a Leaching Process on Salt Caverns Using Passive Micro-Seismic Surveillance Geosel Underground Storage

Eric Fortier and Baptiste Gombert Magnitude, France
Patrick Renoux, Geostock, France

Abstract

Geosel underground storage started in Manosque (Southern Alps) in 1968. 10 years later a total of 28 caverns had been created. Each cavern was formed by leaching the salt. Magnitude has been contracted by Géostock since 1992 to perform micro-seismic monitoring. A seismic network of 7 subsurface three-axis geophones is currently used to this end.

During the last five years, two new cavities were under leaching process, and another under second leaching. These operations induced an important micro-seismic activity, with about 10,000 events recorded in five years. 600 of these micro-earthquakes could be located using a 3D-velocity model.

This seismic activity was located within a radius of 100 m around the center of each cavity, showing its association with the leaching process. It also follows the different leaching phases and suggests positions of the insoluble layers, later confirmed by the sonar profiles.

Small scale micro-seismicity is inherent to the leaching of salt caverns. The small range of Richter Magnitude observed, is an indicator of 'normal' micro-seismic activity. The associated source radius below 15 m corroborates the limited size of the geological structures involved.

Focal mechanisms were inferred for strong events, in order to better understand the source origin. The principal result is the similarities of observed mechanisms, presenting a preferential rupture direction with a primarily double-couple mechanism with 'reverse' faulting. This study also confirms the anisotropic nature of the salt formation, with pre-existing fractures in the insoluble layers. The leaching process disturbs the stress field, inducing micro-seismic activity.

Micro-seismic surveillance is a valuable tool for salt leaching monitoring. It provides with a better understanding of induced instabilities, and is a reliable way to check in near real-time the integrity of the underground storage.

Key words: underground storage, saliferous unit, tectonic, leaching, seismic monitoring, micro-seismicity, velocity model, magnitude, source radius, focal mechanism, double-couple, risk assessment