

## **Solution Mining and Abandonment of Very Deep Salt Caverns near Vauvert, France**

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### **Abstract**

Since 1973 rock salt has been solution mined at the Parrapon concession near Vauvert in the South–East of France. The salt formation of Vauvert is found at a depth of between 1900 and 3000 m and the mine is considered as one of the deepest salt mines in the world.

The salt field is located on the NW margin of the Camargue basin and results from Oligo-Aquitainian rifting. The salt formation consists of approximately 50 per cent salt rock (halite) and 50 per cent insoluble material (anhydrite and clay).

The structural interpretation suggests that the salt formation is part of an abnormal superposition of three halite series which results from halo tectonic gravity trusting along two slip planes (D1 & D2)

The production is based on a solution mining technique, which in Vauvert consists of dissolving the salt by circulating water through fractures between two wells (a doublet system). Solution mining creates cylindrical cavities of circa 500 m height and 40 m of diameter along both wells.

The brine production is sent by pipe-line to chlorine-alkali facilities at Lavera and Fos-sur-Mer. The total production has meanwhile reached over 30 million tons of salt.

The extreme mining depth has some implications because of the high differential pressure between the brine-filled caverns and the surrounding salt rock and because of the high geostatic temperature at these depths. Very substantial salt creep under these circumstances tends to significantly reduce the size of the caverns and simultaneously induces land subsidence. The subsidence rate is about 2.5 cm per year at the centre of the bowl, and the size of the area involved is 4 km wide by 8 km long.

Pressure tests and comprehensive modelling based on observed micro-seismic events indicate that most of the caverns are in hydraulic communication at the level of an upper slip plane in the salt formation. Consequently, this situation should be seriously taken into account in view of a final abandonment of the caverns and wells.

WEP has recently invented and elaborated a novel mining and abandonment concept which potentially makes cavern abandonment more economically viable by revitalising the caverns at deeper levels and bringing them in a steady–state mining condition, while at the same time reducing the remaining free brine volume in the old upper caverns. This paper introduces the new concept.

**Key words:** Halo tectonic gravity trust, doublet mining, micro-seismic events, very high salt creep, novel cavern abandonment concept.