



Maguelone (Languedoc coastline, France) : a shallow experimental site for CO₂ storage hydrogeophysical monitoring methods.

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The Maguelone experimental site is located along the Mediterranean lido of the Gulf of Lions passive margin, 10 km south from Montpellier. Limited to the north by a coastal lagoon and to the south by the Mediterranean sea, this site offers a natural laboratory to study porous coastal reservoirs in a clastic and clay-rich context saturated with mostly saline fluids. Drilled and cored in 2003 for sedimentological purpose, the Maguelone site crosses from surface to 9 m depth a thin Holocene sequence constituted with lagoonal sediments made mostly of dark green clays. This sequence forms an impermeable seal overlying unconformably a Pliocene sequence consisting mainly of relatively homogeneous fine grained continental deposits (clays, silts, and clayey silts). The clayey fraction is relatively high all along, making those deposits poorly permeable. In this sequence, a single remarkable depositional unit located from 14 to 17 m, consists of porous and permeable conglomerates and sands interpreted as fluvial deposits. Sedimentary and geophysical measurements suggest a high permeability for this 3 m-thick reservoir. Hydrogen sulphite (H₂S) (possibly resulting from lagoonal organic matter decomposition and compaction) encountered during coring operations near 15 m depth confirmed the presence of a small reservoir at this depth.

As part of the ALIANCE EC project (FP5), a new downhole resistivity observatory prototype was constructed and set-up in 2004, tested in a dipole-dipole mode, and calibrated against induction resistivity logs. From this, time lapse measurements were emplaced and made automatic showing gradual changes over time in electrical resistivity. Taking advantage of this shallow and thin reservoir embedded in clays and silts, a new shallow experimental site is to be developed in the context of MUSTANG EC project (FP7). In particular, the downhole technology jointly developed by "Géosciences Montpellier" and "imaGeau" is to be adapted to resist the aggressive conditions encountered in CO₂ underground storage, and pressure conditions down to 1500 m depth.

The SIMEx ("Shallow Integrated Monitoring Experiment") monitoring experiment is consequently to be deployed at Maguelone by mid 2010. It is a unique opportunity to test in an integrated manner a full suite of coordinated monitoring techniques, either from surface or downhole. While gas injection will be restricted to the reservoir located from about 14 to 17 m, all new holes will be drilled down to 25 m and instrumented over their entire length. The field spread includes, along with the existing holes (MAG4 resistivity observatory and MAG1), a new injection hole perforated only over the 3 meter long interval corresponding to the conglomeratic reservoir, additional downhole electrical observatories (DEO's) placed at variable distance from the injection point, a downhole hydrodynamic observatory (DHO) based on a pore fluid sampling completion from WestBay (SWS), a downhole seismic observatory (DSO) in order to complete the electrical strategy and study how the two methods might be combined for a more efficient description of the saturation/desaturation process associated with the injection (to be installed in MAG1), surface electrical observatory (SEO) and seismic observatory (SSO) with permanent flutes during the injection period, in order to study how surface and downhole monitoring strategies shall complete each other, looking at different volumes, with possible surface/downhole tomographic approaches.