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SIMEX at Maguelone (Languedoc coastline, France): a shallow injection experimental site to test CO2 storage monitoring techniques from a multi-method approach.

Philippe Pezard (1), Nataliya Denchik (1), Johanna Lofi (1), Hervé Perroud (1), Omar Jaafar (1), Denis Neyens (2), and Simon Barry ()

(1) Géosciences Montpellier, CNRS, Université Montpellier 2, 34095 Montpellier, France, (2) imaGeau, Cap Omega, Montpellier, France

SIMEx (Shallow Injection Monitoring Experiment) started at Maguelone in early 2010 in order to prepare for injection experiments and relevant geophysical monitoring in 2011 with the development of a new field spread (drilling and completion of downhole observatories) to complete the exiting geological, petrophysical and hydrological description of the site. Initially limited within the MUSTANG FP7 EC project to the shallow testing of a new CO2 downhole electrical monitoring array built by imaGeau, it is now expended to a more complete, multi-method experiment using a full suite of monitoring techniques (electrical, acoustical, hydrodynamic with fluid sampling, time-lapse logging) either from surface or downhole.. Prior to deep deployment below 800 m, this shallow depth (< 25 m) monitoring experiment provides a cost effective test of strategies to be implemented deeper.

The Maguelone experimental site is located along the Mediterranean shore, 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 mostly with saline fluids. Drilled and cored in 2003 for sedimentological purpose, the Maguelone site crosses from surface to 9 m depth Late-Holocene lagoonal sediments (mostly impermeable dark green clays). This forms an impermeable seal overlying homogeneous fine-grained Pliocene continental deposits (clays, silts, and clayey silts). The clayey fraction is relatively high all along, making those deposits poorly permeable. In this sequence, a porous and permeable conglomerates sands interpreted as fluvial deposits is located from 14 to 17 m. Sedimentary facies and geophysical measurements suggest a high permeability for this 3 m-thick reservoir. Hydrogen sulphite (H2S) encountered during coring operations near 15 m depth confirms the presence of a small reservoir at this depth.

Taking advantage of this shallow and thin reservoir embedded in clays and silts, a new shallow experimental site is to be developped in the context of MUSTANG EC project (FP7). In particular, the downhole technology jointly developped by ''Geosciences 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. While gas injection will be restricted in 2011 to the reservoir (14 to 17 m), all new holes have been 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 (MAG8), additional downhole electrical observatories (MAG7 & MAG9) placed at variable distance from the injection point, a downhole hydrodynamic observatory (MAG5) based on a pore fluid sampling completion from WestBay (SWS), a downhole seismic observatory (MAG1) 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. Surface electrical observatories (SEO) and seismic observatories (SSO) made of permanent flutes will be deployed 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.