Characterization and working programme of Hontomín CO_2 injection site (Spain). Monitoring, Hydrogeochemical Characterization and Injection Tests

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INTRODUCTION: THE HONTOMIN TDP

Hontomín (Burgos province, Northern Spain, Fig. 1) is the site for the CO_2 storage Technology Demonstration Plant (TDP) of the Compostilla OXYCFB300 project. This research facility is operated by the Energy City Foundation (CIUDEN) of the Spanish Government. The geological setting of Hontomín consists of a dome-like structure (Fig. 2) located in formations of lower Jurassic age: marls as the upper seal, calcites and dolomites as the storage formation, and anhydrites as lower seal.

The CO_2 will be injected in a dolomitised level located at approximately 1450 m depth. A large number of multidisciplinary experiments are planned, including: site characterization studies and development of new technologies and injection schemes. The research facility for the geological storage of CO_2 will consist of three wells (Fig. 1): an injection well (Hontomín-5), a geophysical monitoring well (Hontomín-6) and a hydrogeochemical sampling well (Hontomín 7).

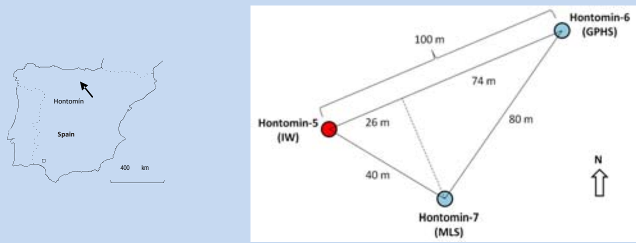

Figure 1: Location and surface topography of the Hontomín site, relative positions of the injection well (IW), the geophysical monitoring well (GPHS) and the multi-level geochemical sampling well (MLS) at the reservoir level.

INSTRUMENTATION AND MONITORING TECHNIQUES

The injection well will be equipped with ERT electrodes, a fiber optic Distributed Temperature Sensing (DTS) system with a heating element, extensometers, and fluid pressure sensors. The geophysical monitoring well will be equipped with the same sensors plus an array of geophones. The multilevel fluid sampling well will be equipped with sampling ports for multiphase fluid sampling, a DTS with heating element, extensometers and fluid pressure sensors.

In order to carry out hydraulic and geochemical tests and to monitor the movement of CO_2, the sampling well (Hontomín-7) is intended as a Multi-Level System (MLS), i.e., a system that will enable to sample at different intervals of the cap-rock and reservoir formations (Fig. 3). The idea is to be able to sample phases that are lighter (supercritical CO_2) and denser (brine with dissolved CO_2) than the resident brine. The geological formations that will be investigated are the cap-rock and the storage reservoir, which is roughly divided into three production zones. Through these geological units we want to sample and measure within 5 intervals.

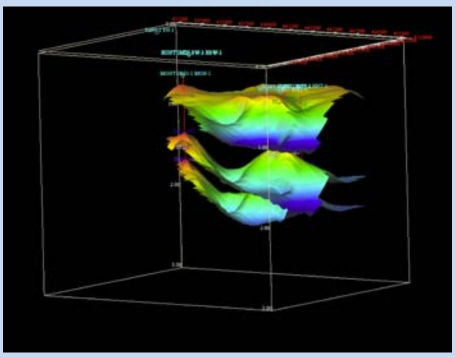

Figure 2: 3-D model of the Hontomín dome. Top of the K-level (post-rift base discordance), top of Keuper and top of Dogger. The storage and primary seal layers of the Hontomín injection are located between the Keuper and Dogger top levels. (Courtesy of Geomodels-University of Barcelona)

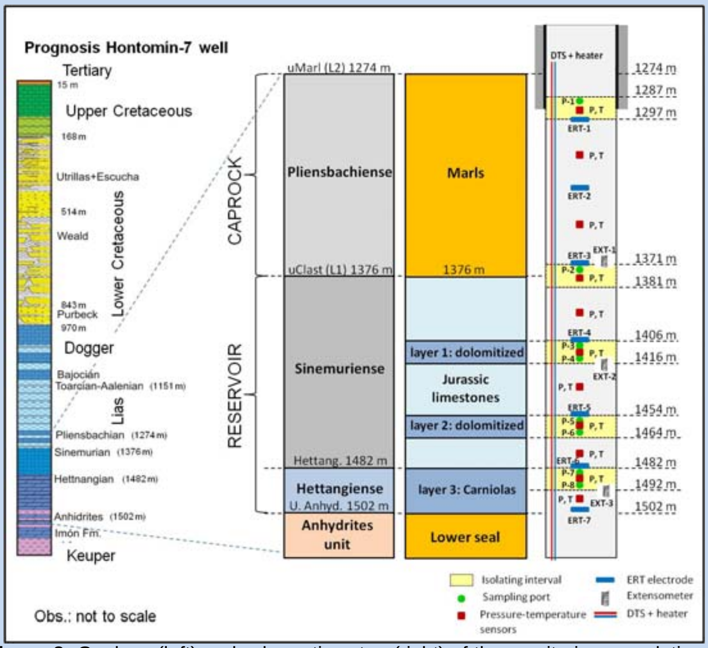

Figure 3: Geology (left) and schematic setup (right) of the monitoring completion of well Hontomín-7.

Distributed Temperature Systems (DTS) will be implemented in the three wells to monitor disturbances in thermal equilibrium over time and detect changes in the temperature profile around the wells. In well Hontomín-5, DTS will allow to know the distribution of different phases through the injection tubing and the occurrence of phase changes as well. We expect that the arrival of the CO_2 plume affects the temperature distribution and thermal conductivity near the monitoring (Hontomín-6) and sampling (Hontomín-7) wells. Therefore, installation of a DTS system and a heating element in these wells will be used to measure the thermal diffusivity by inverse modeling, which will allow to obtain a more accurate detection of CO_2.

To complete the set of instrumentation, extensometers will be incorporated in the sampling well Hontomín-7 and pressure transducers will be distributed through the target formations in the injection and monitoring wells (Hontomín-5, 6 and 7).

HYDROGEOCHEMICAL CHARACTERIZATION TESTS

Planned hydrogeochemical characterization experiments include conventional hydraulic tests and CO_2 storage specific tests. Among these, a mid-term (several days) high pressure, high flow rate, water injection test will be performed to identify potential brine leakage paths and to assess mechanical stability issues. To this end, the site will be heavily instrumented to measure micro-seismicity and mechanical deformation.

Push-pull tests using brine and both reactive and inert tracers will be performed to assess the porosity structure and in situ reactivity of the rock. Supercritical CO_2 (with gaseous tracers) push-pull tests will also be performed to assess retention mechanisms. Tracers will allow identifying chromatographic effects so as to characterize CO_2 dissolution rates.

CO_2 INJECTION STRATEGIES

Regarding the CO_2 injection phase, several injection techniques will be tested to promote CO_2 stabilization. These include continuous and fluctuating injection rates, temperature controlled injection, dissolved CO_2 and prior injection of gases. Before, during and after these tests, fluid sampling, pressure and deformation measurements, geophysical logs, ERT and passive and active seismic monitoring will determine how the storage and seal formations react to the stimulations.

Drilling of the wells will start by the end of 2011, and hydrogeochemical characterization tests will be conducted during the second half of 2012.

ACKNOWLEDGMENTS

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