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The Hontomin CO_2 geologic storage site: results from 2D seismic survey

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The Spanish research program on Carbon dioxide Capture and Storage (CCS), leaded by the state-owned foundation CIUDEN, initiated the storage project with the creation of the first Spanish technological laboratory devoted to subsurface storage of carbon dioxide (CO_2) in 2010 near the village of Hontomín (North West of Spain). This research site aims investigating the different phases involved in the CO_2 injection process in underground geologic formations at real scale and monitoring its long-term behavior.

The seismic baseline study consist on five innovative and non-standard seismic experiments including: 1) a 35 km2 of 3D seismic survey, 2) a 2D seismic survey, 3) a Seismovie survey, 4) a 30 passive-seismic network and 5) a Vertical Seismic Profile (VSP) survey programmed for this year. Here we focus on the 2D seismic reflection survey that was acquired with new generation 3-component receivers. A total of 408 receivers with 25 m interval were deployed along 2 orthogonal profiles, orientated ∼NS-EW, centered near the injection point. The seismic source consisted on 4 15-Tn M22 vibroseis trucks with a 16-sec sweep vibrating at each 25 m distance. Data processing included static corrections, spherical divergence correction, airwave muting, predictive deconvolution, stack, time-variant band-pass filtering and time migration.

First analysis of the vertical component data confirm the dome-geometry of the reservoir observed by previous studies and give details on the tectonic structure of the potential injection zone. The data also show two main seismic features corresponding to 1) a loss of the P-wave first arrival amplitudes resulting in a shadow zone at offsets of ∼600-1500 m. and 2) a high-amplitude reflection at the base of the shadow zone. We related the presence of the shadow zone with a ∼750 m-thick layer of low velocity or small velocity-gradient, associated to Early-Middle Cretaceous deposits that globally correspond to variable grain-size siliciclastic continental material of Purbeck, Weald and Utrillas-Escucha formations. The relatively high porosity of these deposits (18-26 %) support their susceptibility to fluid saturation and consequently explain the presence of low P-wave velocity values. On the other hand, the high-amplitude reflection below is related to the Purbeck-Dogger formations contact, resulting from the high impedance contrast between the low-velocity zone and the underlaying Late-Middle Jurassic marine deposits of the Dogger and Lias formations (limestones, marls and blackshales), which are the seal of the system. The main potential reservoir for C02 is located at ∼1400-1500 m depth, in limestones and carniolas deposits (∼30% porosity) of the Early Jurassic Lias formation.