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Geological characterization of potencial reservoirs and seal formations for CO2 storage in the basins of Iberian Peninsula based on Well Logging

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Abstract

The research is focused on the application of logging tools to the study and characterization of the subsurface to evaluate potential reservoirs and seal formations in shallow holes for underground CO2 storage in the Iberian Peninsula. From televiewer acoustic images and televiewer optical images, full wave sonic log, spectral gamma ray logs and hydrochemical logs of the fluid in the borehole, we have managed to characterize the formations of interest in the subsurface, obtaining very diverse and accurate information to carry the opportune petrophysical interpretations.

The Geological Survey of Spain (IGME) within the framework of a large Plan of evaluation and characterization of Spanish areas for CO2 storage, established general criteria for selection of favourable formations for CO2 storage at regional scale, and thereafter, a shortlist of large sedimentary basins in the Spanish territory. Our study is carried out in two of the four selected areas of the Iberian Peninsula; Pyrenees and Ebro Basin, and Betic-Guadalquivir Basin selected by specific tectonic setting, sedimentary fill thickness characteristic reservoir-seal relationships. To characterize these areas the subsurface data available from former seismic surveys and deep oil exploration boreholes were analyzed. In these areas a large number of shallow holes were drilled by IGME, cores and geophysical logs were obtained.

A specific methodology focused on the characterization of the subsurface for geological storage of carbon dioxide (CO2) is being developed, both for log data acquisition and for processing and interpretation of logs and image, integrated with core and sample data. Simultaneously to the development of new methodologies, the characterization of formations as potential underground reservoirs and their seals is performed. Accurate characterization of the subsurface is a key contribution to studies of underground CO2 storage, seals, reservoir rocks and fluids and ongoing modelling.

The results presented in this contribution correspond to five selected research holes; borehole SE-3 (Orrit-Lérida) and borehole SE-4 (Arbolí-Tarragona), both located in the Pyrenees and Ebro Basin, and borehole SB-1 (Alcaraz-Albacete), borehole SB-3 (Cantillana-Sevilla) and SB-4 (Bacarot-Alicante), located in Betic-Guadalquivir Basin, respectively. The logs were processed and analyzed. Lithological, structural and sedimentary interpretation performed on geophysical logs and on images to obtain a complete characterization of the formations of interest. Full wave sonic logs were also included in the interpretation for compositional, petrophysical and geomechanical characterization. Simultaneously, all these logs also have been correlated with older oil exploration logs, using common petrophysical, structural and stratigraphic properties, to define the extension and continuity in the study areas. As a result of this research we provide relevant data to characterize the storage formation and the seal formation (such as porosity, permeability, salinity, etc.), and check if they are suitable for permanent geological storage of carbon dioxide. This work will continue on with well logging acquisitions in new depth

boreholes of future areas determined by IGME.

Keywords: CO2 storage, logs, geophysics, petrophysics, logging interpretation, characterization.