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GEOLOGICAL MODELLING OF THE LOPÍN CO_2 STORAGE SITE, SPAIN

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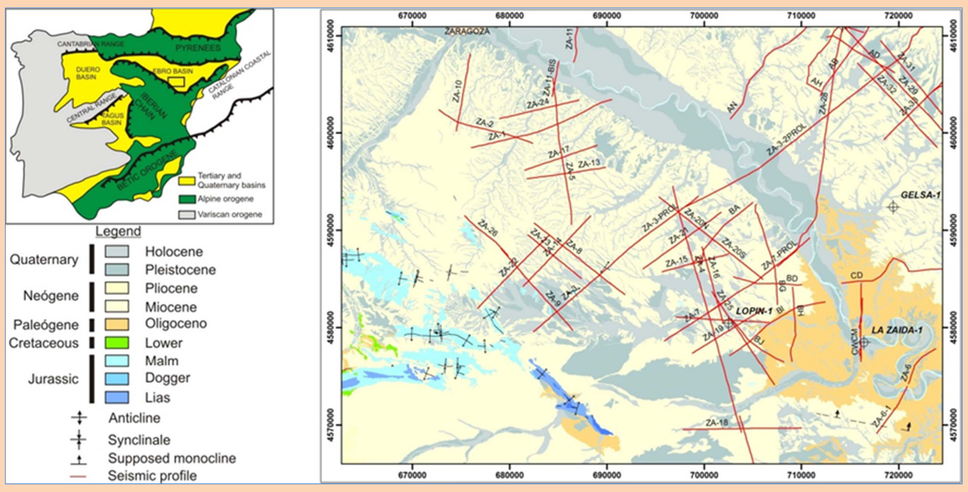
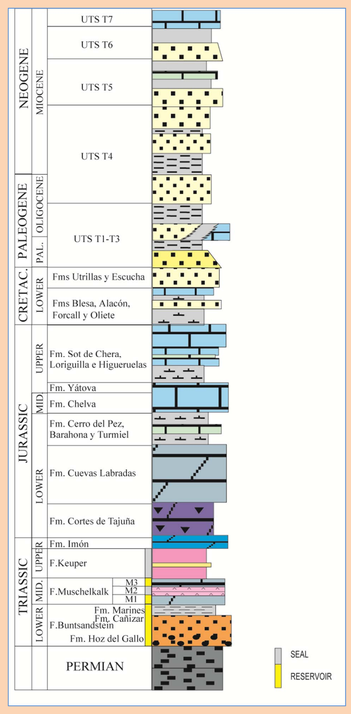
INTRODUCTION

The IGME (Geological and Mining Institute of Spain) is currently developing a program of Subsurface Geology and CO_2 Geological Storage site screening and characterization. The aim of the program is to increase the knowledge of the subsurface structure of the country and to select and characterize a number of suitable areas for CO_2 storage. In the first phase of the program (ALGECO2) 70 areas were chosen and studied. Contour maps of potential storage formations were built from geological cross-sections and seismic lines (García Lobón et al., 2011). In this phase the Lopín structure was selected and studied obtaining contour maps for the Buntsandstein formation (IGME, 2010). Currently, the IGME is developing the second phase of the program. The Lopín structure has been selected to be revisited because of its proximity to a significant CO_2 emission centre.
The aim of this work is to better characterize of the Lopín CO_2 storage site, using all available seismic profile and well-log data. The final goal is to integrate all information in a 3D structural model of the Lopín subsurface, including the geometry and detailed distribution of the main geological units and faults, as derived from a throughout seismic interpretation. This model will provide new structural and stratigraphic knowledge of the Lopín structure within its regional geodynamic frame



The Lopín structure is located in the Ebro Tertiary Basin in the transition between this domain and the northern part of the Aragonian branch in the Iberian Range. The structure is unconformably overlain by subhorizontal Neogene materials. At the southern part of the studied area Jurassic and Paleocene units crop out in the Belchite anticline.
Stratigraphically, the Mesozoic succession starts with Triassic clastic sediments (Buntsandstein facies) overlying the Palaeozoic basement. On top of these materials, middle-upper Triassic dolomites, evaporites and marls (Muschelkalk and Keuper facies) were deposited. The Jurassic series is constituted by a sequence of shallow marine carbonate and hemipelagic ramp sediments which are unconformably overlain by clastic series of Early Cretaceous ages.
The analysis of seismic sequences shows that Cenozoic rocks (Paleocene and Neogene) unconformably overlie the Cretaceous and Jurassic units (Cortés-Gracia, 2004).

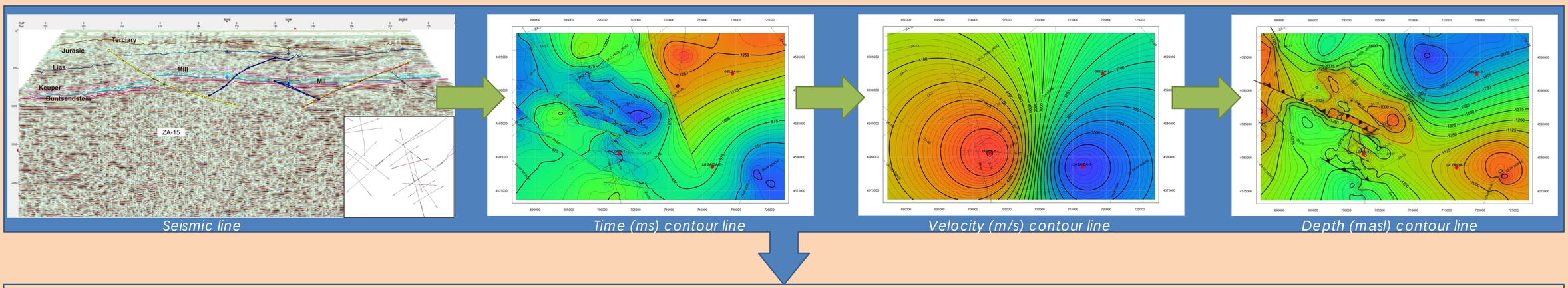
The modelling process consists of creating horizons and faults, contours maps, upscaling well data, and layering, in order to generate a grid. Finally, a 3D model is created from the surfaces for the reservoir volume estimation.



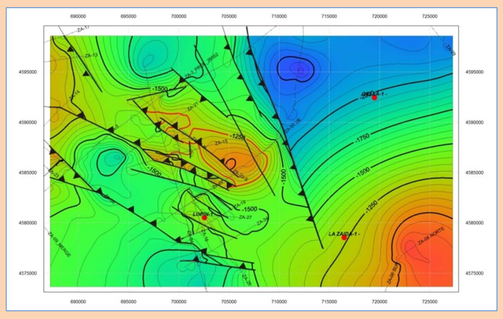
SEISMIC INTERPRETATION

Seismic surveys from the 70s were reinterpreted, taking into account the Lopín, La Zaida and Gelsa well data together with the surface information (geological map).
In the seismic interpretation we distinguished eight horizons, although only six of them have been considered to build surfaces for the 3D model of the Lopín structure: Buntsandstein Top, Muschelkalk II Top, Muschelkalk III Top, Keuper Top, Lias Top and Cenozoic Bottom.

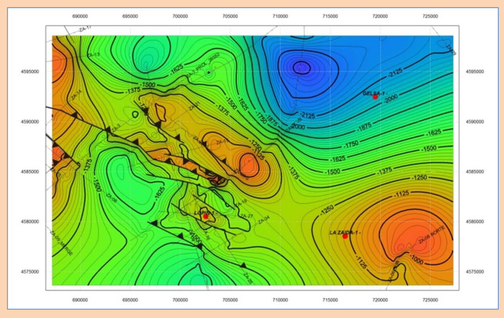
GeoGraphix (© LMKR)



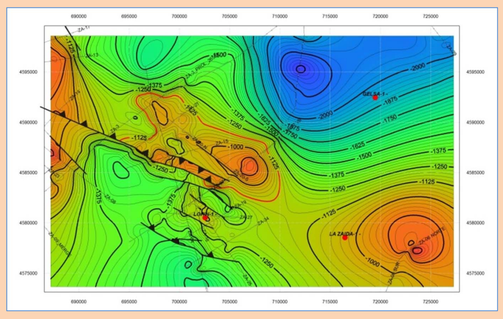
Seismic line — *Time (ms) contour line* — *Velocity (m/s) contour line* — *Depth (masl) contour line*



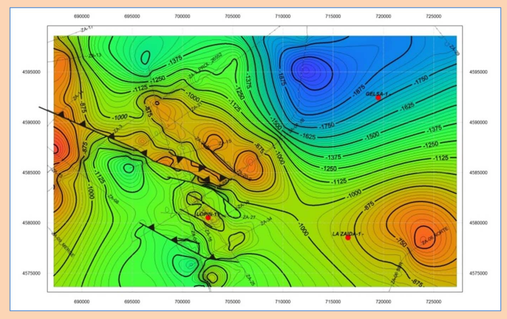
Depth (masl) contour lines of Buntsandstein top with spill-contour marked in red



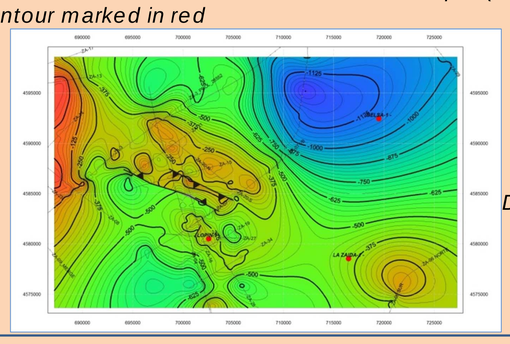
Depth (masl) contour lines of MII top



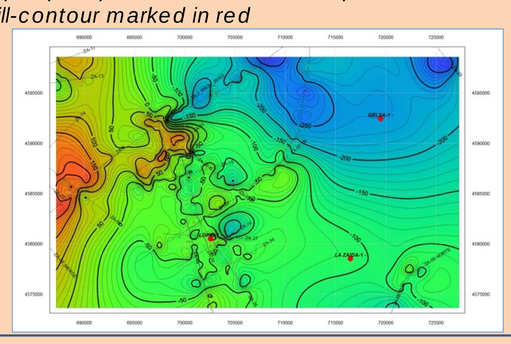
Depth (masl) contour lines of MIII top with spill-contour marked in red



Depth (masl) contour lines of Keuper top



Depth (masl) contour lines of Lias top

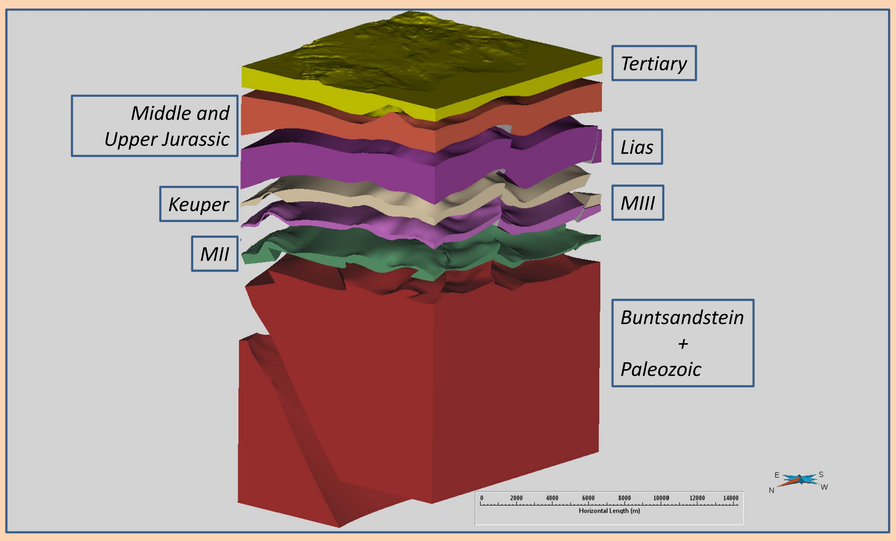


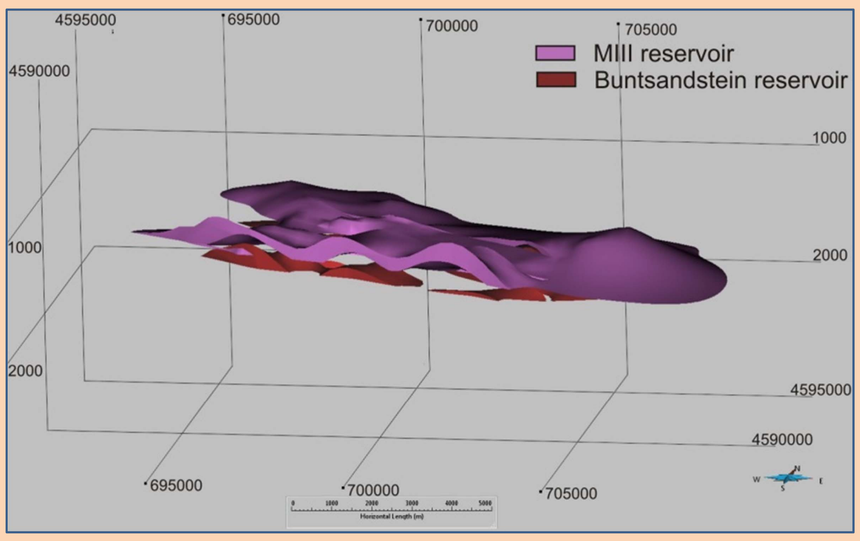
Depth (masl) contour lines of Tertiary bottom

3D STATIC MODEL

The reservoir and seal formations were selected following available information; porosity, salinity and depth data, from well logs. These formations are Triassic and in the Lopín area are affected by a NW-SE-trending anticline several tenths of kilometres long Alpine deformation involving the Variscan basement and Mesozoic cover consists of NW-SE and NNW-SSE-striking reverse faults, subparallel to dominant structures in the Iberian Chain.

gOcad (© Paradigm).





Two target reservoirs were considered: Buntsandstein and Muschelkalk (MIII) facies. The available seismic data indicate that the Buntsandstein facies top is at approximately 1000 m depth and hosts a deep saline aquifer. The target reservoir series include the Hoz del Gallo and Cañizar formations with average thickness of 150-200 m and 5% of porosity. The seal comprises the evaporite facies (MII) with an average thickness of 100 m. Additionally, the Muschelkalk (MIII) facies are suitable as reservoir, they are located at 825 m depth with a thickness of 100 m and 2% porosity. The seal is formed by evaporites and marls of Keuper Facies with an average thickness of 350 m.
The volumes of structures were calculated based on the -1250 masl for the Buntsandstein top and -1125 masl for the MIII top deepest closed contour lines. The estimated volumes are 3300 Mm^3 and 6100 Mm^3, respectively.

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References: Final Reports of the Second Phase of the Project "Plan de selección y caracterización de áreas y estructuras favorables para el almacenamiento geológico de CO2 en España (PLAN ALGECO2).CORTÉS-GRACIA A.L. (2004): Geometría del subsuelo de la Cuenca del Ebro en el Campo de Belchite (Zaragoza). *Geotemas*, 6(3), 225-228. GARCÍA LOBÓN, J.L., REGUERA GARCÍA, M.I., MARTÍN LEÓN, J., REY MORAL, C. & BERREZUETA ALVARADO, E.R. (2011) - *Plan de selección y caracterización de áreas y estructuras favorables para el almacenamiento geológico de CO2 en España, Resumen ejecutivo*, Fondo documental del IGME. Documento nº 64.055 (72 pp).
IGME (2010) - Plan de Almacenamiento geológico de CO2 del IGME – Plan ALGECO2, Volumen II Pirineo–Ebro. *Geología*. Fondo Documental del IGME