Selection of a prospect for CO_2 storage - possibilites and pitfalls in the case of screening in the Eastern part of Drava Basin, Croatia

Iva Kolenković Močilac[1], Marko Cvetković[1]*, Marija Pejić[1], Bruno Saftić[1]
[1]* marko.cvetkovic@rgn.hr, University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Zagreb, Croatia

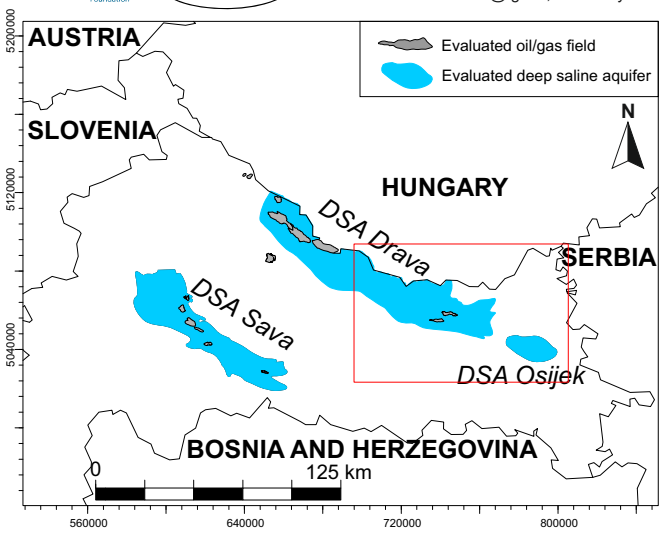

Figure 1: Location of the storage sites described in prevoius studies (Geocapacity project, 2009; Vulin et al., 2023). Red square represents the outline of the Figure 2

Introduction

One of the major challenges in establishing CO_2 management infrastructure lies in advancing the evaluation and development of CO_2 storage resources. This is largely related to „climbing the CO_2 storage capacity assessment pyramid". That served as the motivation behind reevaluating the previous CO_2 storage assessments by conducting the site screening within the study area.

Previous regional assessments have established:
Two deep saline aquifers (DSA's) - Drava and Osijek were defined in Drava subbasin and assessed within the EU Geocapacity project (2009), based on regional subsurface interpretations and DSA Osijek subsequently characterized by Brezovac (2021) (Figure 1).

Reservoirs of altogether eight nearly depleted hydrocarbon fields were identified as potential storage objects in Drava subbasin, but only two of the oil and gas fields - Beničanci and Bokšić are situated within the study area. Their total storage potential was estimated to 22.4 Mt (Vulin et al., 2023). While Bokšić oil and gas field was expected to be pronounced depleted and decommissioned in 2021, it is still in production, while the Beničanci oil and gas field is expected to be in production until 2035 (Vulin et al., 2023).

Site screening

The process of site screening involved interpretation of seismic data in areas of 49 research wells (Figure 2) in order to identify the potential storage objects. In the first step only the depth criteria was taken into account, meaning that data from all the wells was converted to two-way time (2T) domain, which enabled identification of relevant intervals on seismic sections, situated between 750 m and 2500 m of relative depth.
Surprisingly, only few of the wells were situated in the favorable settings and could be candidates for further characterization.

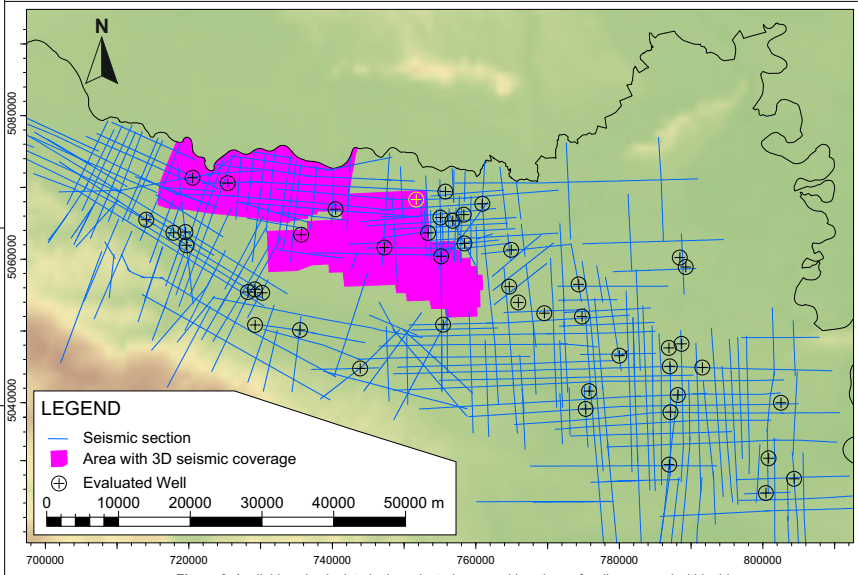

Figure 2: Available seismic data in the selected area and locations of wells screened within this study. Chosen well location is in bright yellow.

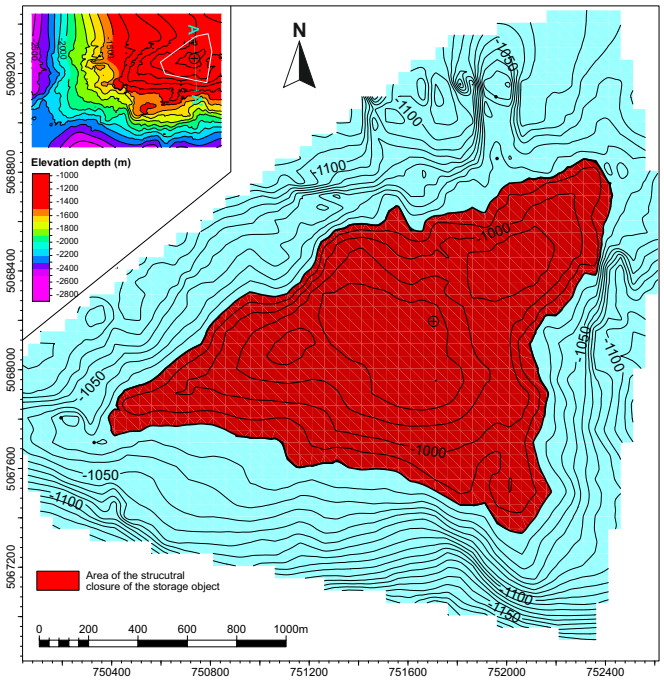

Figure 3: Depth map representing the top of the selected storage object (Reservoir top on Figure 4)

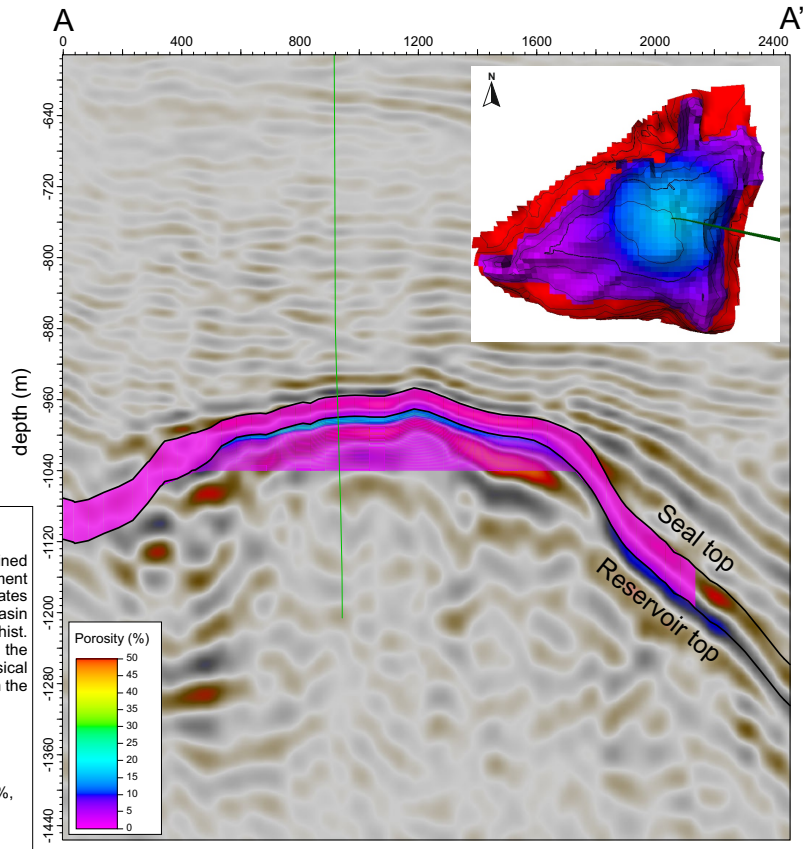

Figure 4: Crossection of the selected storage object with upscaled porosity values. Upper right insert figure represents the porosity distribution beneath the reservoir top surface.

Site selection

The well that drilled through the most promising storage object is marked in yellow in Figure 2. It is a combined structural-stratigraphic trap situated within the fractured Neogene Basement and above the Top Basement unconformity. Reservoir rocks above the unconformity are polymictic poorly sorted breccia-conglomerates consisting of rock fragments (quartz, feldspar and schist fragments) obviously derived from the basin Basement complex. Reservoir beneath the Top Basement unconformity consists of fractured quartz schist. Structure was interpreted within the 3D sesmic. Structural closure was defined at -1200 m when the interpreted Reservoir top surface was converted from 2T to depth in meters domain (Figure 3). Petrophysical properties (porosity) was upscaled from petrophysical measurements and well log interpretations within the reservoir for volume calculation (Figure 4).

Why the presented trap was selected as a potential CO_2 storage site:
- It is situated in the right depth interval (between 750 and 2500 m) (Figures 3 and 4).
- Rather large vertical closure (when compared to other potential traps in the study area).
- Favorable petrophysical properties of reservoir rocks on core samples (porosity between 15 and 22%, both vertical and horizontal permeability exceeding 200 mD)

Weaknesses of the storage site:
- Insecurity of interpretation – Cap rock lateral continuity is not proved by other wells, since all wells in vicinity are either too far or too shallow.
- Relative permeability of cap rocks for CO_2 is not assessed, so they are not proved to be isolators for CO_2.
- There are smaller faults on the structure that were not interpreted and characterized and it has not established whether they allow fluid flow or act as seals.

Acknowledgements

This work has been financially supported by Croatian Science Foundation under the project GEOlogical characterization of the Eastern part of the Drava depression subsurface intended for the evaluation of Energy Potentials (GEODEP), UIP-2019-04-3846.

References

Brezovac, I. (2021): Definiranje dubokog slanog vodonosnika Osijek u Osječkim pješčenjacima istočnog dijela Dravske depresije i procjena perspektivnosti za geološko skladištenje ugljičnog dioksida, diplomski rad [Defining of the deep saline aquifer Osijek in the Osijek sandstones of the eastern part of the Drava depression and evaluation of the potential for geological storage of carbon dioxide, Master's Thesis], University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Zagreb, 35 p.

EU GEOCAPACITY, Assessing European Capacity for Geological Storage of Carbon Dioxide (2009) Technical reports, FP-518318.: EU GeoCapacity. Storage Capacities. WP2.3 D12.

Vulin, D., Močilac, I. K., Jukić, L., Arnaut, M., Vodopić, F., Saftić, B., Sedlar, D. K., & Cvetković, M. (2023): Development of CCUS clusters in Croatia. International Journal of Greenhouse Gas Control, 124, 103857.