Geological reconstruction of the Romagna and Ferrara folds area to evaluate its geothermal potential

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The PRIN PNRR project '**InGEO - Innovation in geothermal resources and reserves potential assessment for the decarbonization of power/thermal sectors**', financed by the European Union through the NextGenerationEU funds, supports the objective of increasing the share of energy produced from **renewable sources in Italy**, through an acceleration of the development of geothermal energy. InGEO responds to the need to improve **knowledge** on **geothermal resources**, addressing several technological challenges: 1. developing an effective assessment of deep geothermal resources, 2. taking into account local geological conditions regime and heat exchange capacity, 3. defining operational solutions for energy production and heat storage in the underground, optimizing the thermal performance, 4. validation with a real case study the approaches that are developed on a regional scale. The reconstruction of crustal and sub-crustal structures and the temperature distribution of the buried folds of the **Po Valley** sector will be the input for the calculation of geothermal potential, considering various applications (power generation district heating process heat and combination) and technologies for underground energy exchange (open and closed circuits).

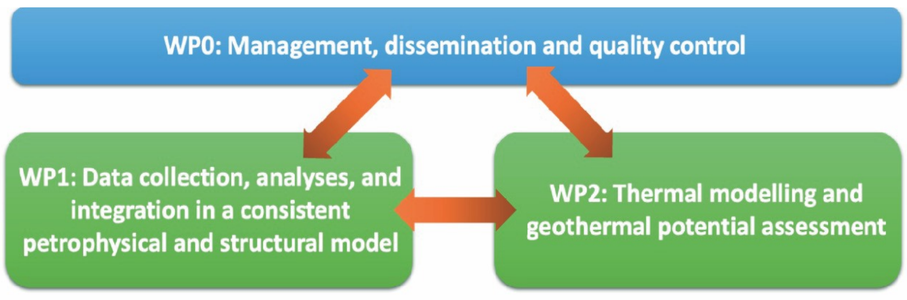

Fig. 1: Thematic Work Package and workflow of the InGEO project

The project aims to create a **database of petrophysical parameters** of the rocks, a **3D model of the shallow lithospheric structures** of the study area - based on the integration of collected data acquired, analyzed and interpreted in the project - to use as input for the evaluation of the geothermal potential. **Open-source software** will also be produced - accessible through a **web-GIS** application - to calculate the deep geothermal potential, with variable heat extraction modes and production rates.

Study Area

The pilot area is the **Romagna and Ferrara folds**, where a t**hermal anomaly** has been identified and attributed to the thermal convection in deep-seated Mesozoic carbonate units (Pasquale et al., 2013; Pasquale et al., 2014). The Romagna and Ferrara folds represent the outer deformation front of the Northern Apennines thrust and fold belt. They are partly buried under thin Plio-Pleistocene terrigenous deposits of the Po plain.

Here we present the ongoing work on the **analyses of the geological data** (e.g., seismic lines, stratigraphic columns, well reports and logs, borehole tests and measurements, gravity anomalies) collected from VIDEPI (https://www.videpi.com/videpi/videpi.asp) and GEOTHOPICA (https://geothopica.igg.cnr.it/index.php/it/) database, in terms of the depth of the main geological units.

These results will be compared with those already published in previous studies (Livani et al., 2023), in order to implement a consistent **geological model of the study area**. The last one will be further supplemented with interpretations from **thermophysical experiments on rock samples**. The geological model will contribute to the development of an open-source and web-based GIS tool and will be the main input for calculating the area's geothermal potential, improving business planning for the exploitation of **deep geothermal resources in Italy**.

Fig. 2: Location of the study area (limited by red rectangle) in a satellite image of Italy.

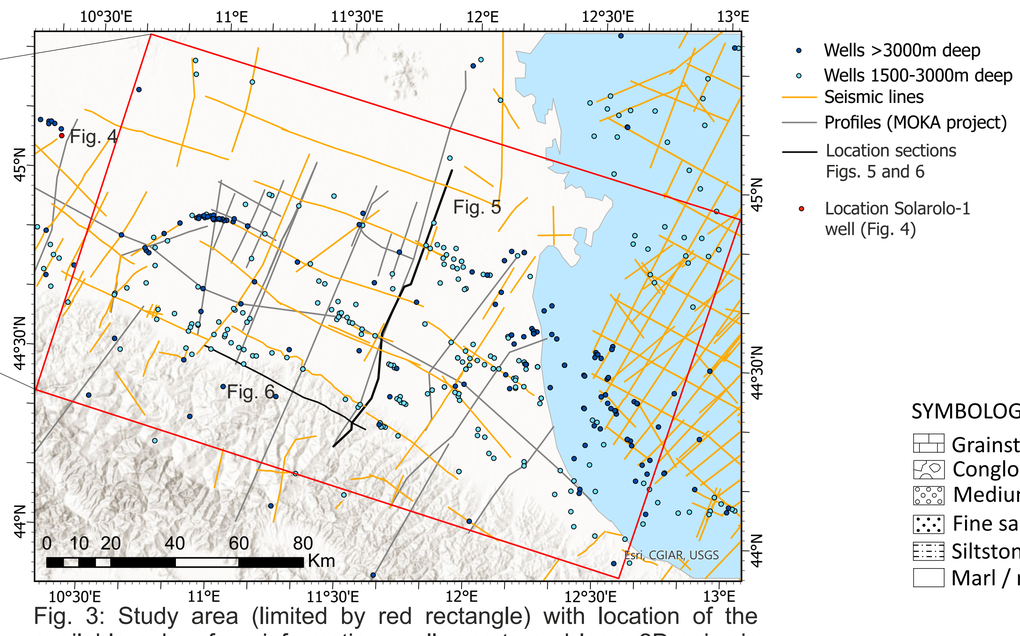

Fig. 3: Study area (limited by red rectangle) with location of the available subsurface information: well reports and logs, 2D seismic lines, and interpreted sections.

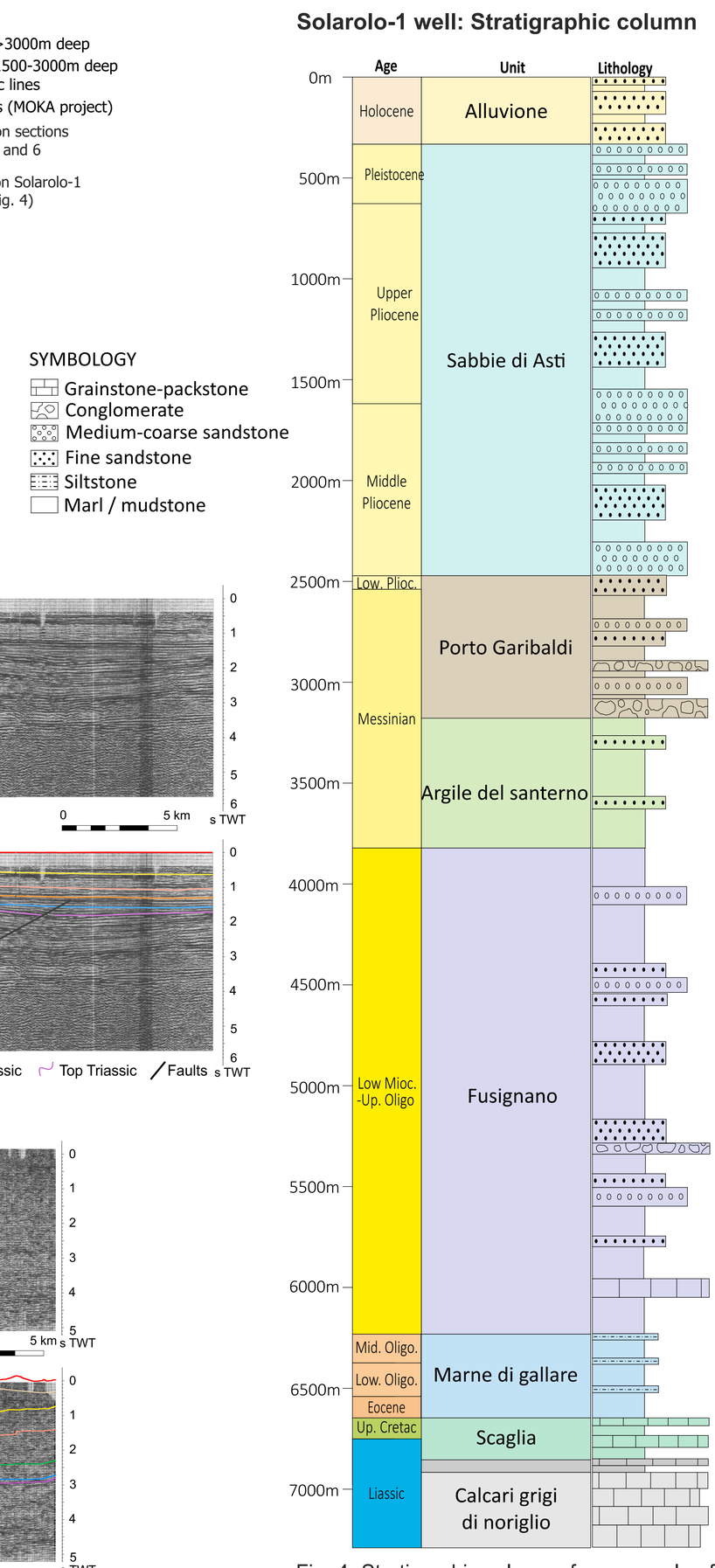

Fig. 4: Stratigraphic column of an example of deep well in the Po basin, based on the reports of the Videpi database. (See location in Fig.3).

Seismic interpretation: on-going work

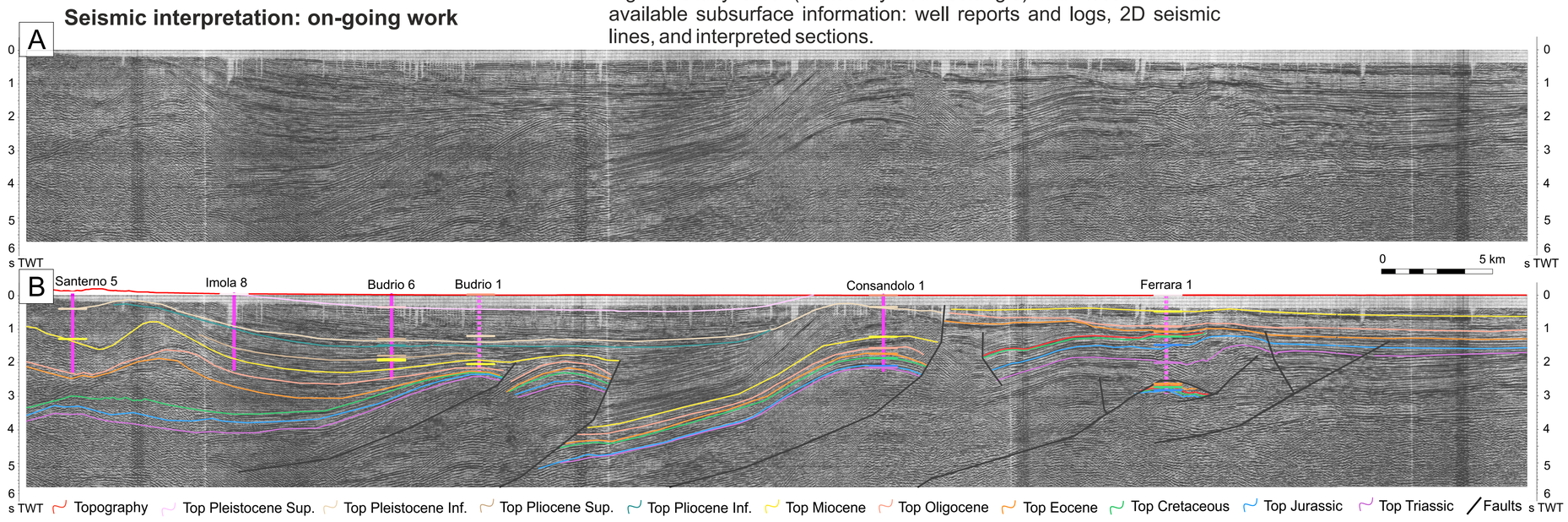

Fig. 5: 2D seismic profile Apenninico-Orient-3 (See location in Fig. 3). A) Seismic line. B) Interpreted seismic line with nearby wells plotted.

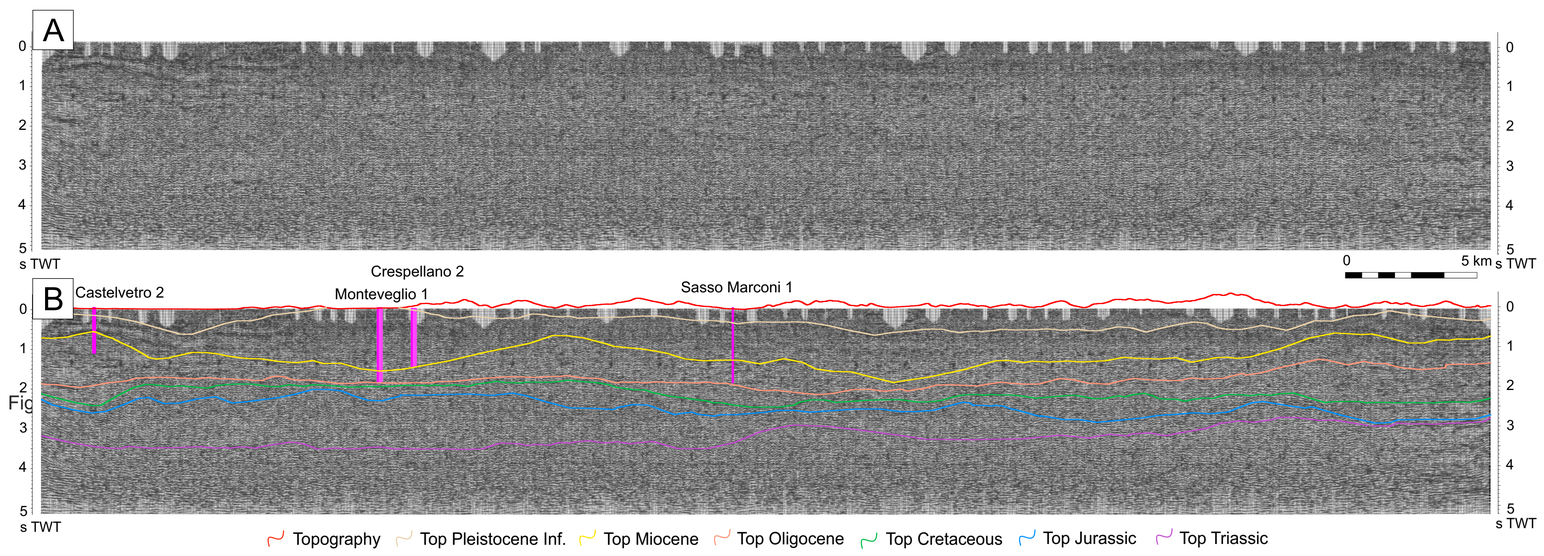

Fig. 6: 2D seismic profile BO-376-83 (See location in Fig. 3). A) Seismic line. B) Interpreted seismic line with nearby wells plotted.

Depth of the main geological boundaries from the model of Livani et al. (2023)

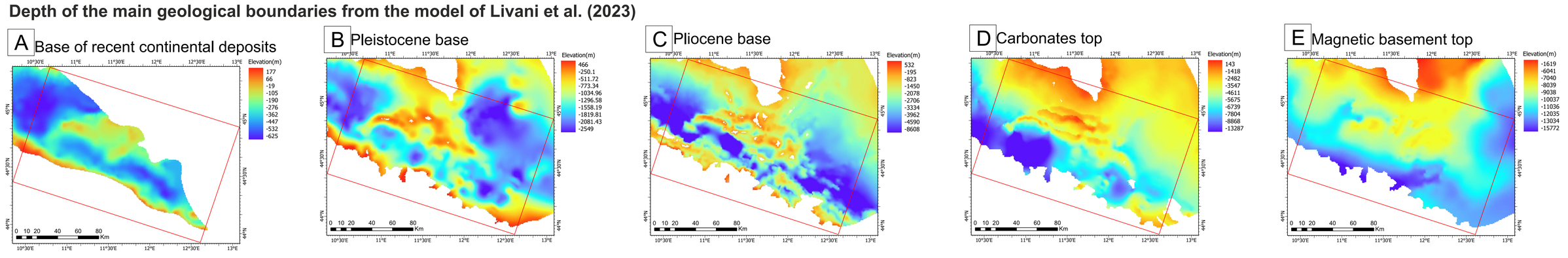

Fig. 7: Depth maps of the main geological units modified from Livani et al. (2003)

References

- Livani M. et al. (2023) - Subsurface geological and geophysical data from the Po Plain and the northern Adriatic Sea (north Italy), Earth Syst. Sci. Data, 15, 4261-4293, https://doi.org/10.5194/essd-15-4261-2023
- https://www.videpi.com/videpi/videpi.asp

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