



Towards a multiscale geophysical approach for the evaluation of the geothermal energy potential of the Eastern Po Plain (Italy)

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To contribute to a secure and low energy carbon future, the InGEO project (*Innovation in GEOthermal resources and reserves potential assessment for the decarbonization of power/thermal sectors*) seeks to develop an innovative exploration workflow for combining multi-parameter datasets that will help reduce the risks associated with geothermal energy exploitation. The chosen area for the application is the Northern Apennine buried - structures belonging to the Romagna and Ferrara Folds (RFF), Eastern Po Plain (Italy). There, a mapped thermal anomaly was interpreted to be the effect of deep fluids circulation within the deep-seated Mesozoic carbonate sequences (e.g., Pasquale et al., 2013). As part of the workflow, we first developed a consistent geological/geophysical model of the RFF region. The model integrated data from over 200 seismic surveys from the VIDEPI database (www.videpi.com), 700 deep (>1500 m) boreholes (CNR database, www.geothopica.igg.cnr.it), 160 sonic and lithological logs (Livani et al. 2023), recent seismic tomography models (e.g., Brazus et al. 2025; Kästle et al., 2025), and new density models, obtained from the inversion of the the first pan-Alpine surface-gravity database (Zahorec et al., 2021). The Kingdom Suite was used to interpret the 2D seismic lines and well log data, while clustering algorithms (K-means and Fuzzy c-means) were chosen to classify the seismic tomography and density dataset. The results consist of a 3D architecture of shallow and deep geological features of the study region. Shallow features (up to a depth of ~15 km) included eight horizons, ranging in age from the Quaternary to the Permian. Deep features (between ~15 and 50 km depth) included the basement, the upper crust and the Moho depths. The geological/geophysical model was further validated by utilizing thermo-physical measurements on rocks, also obtained as part of the InGEO project (Sulpski, 2025), high temperature and pressure laboratory data on rocks, compiled from the literature (Burke and Fountain, 1990; Christensen and Mooney, 1995), and sonic log data, obtained from oil and gas wells, drilled in the RFF region (Livani et al. 2023). Furthermore, a comparison with the temperature data on wells provided a preliminary evaluation of the resource potential of the RFF region. The workflow will further entail a more rigorous assessment of the geothermal energy potential of the region, by implementing a numerical simulation, which uses as main input the consistent geological/geophysical model. The workflow of InGEO project will be also used as a decision support system for developing future geothermal projects in Italy.

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References

- Braszus, et al., 2025. JGR, 130(10), p.e2025JB031877, <https://doi.org/10.1029/2025JB031877>.
- Burke and Fountain, 1990. Tectonophysics, 182(1-2), 119-146, [https://doi.org/10.1016/0040-1951\(90\)90346-A](https://doi.org/10.1016/0040-1951(90)90346-A).
- Christensen and Mooney, 1995. JGR, 100(B6), 9761-9788, <https://doi.org/10.1029/95JB00259>.
- Kästle et al., 2025. JGR, 130(2), p.e2024JB030101, <https://doi.org/10.1029/2024JB030101>.
- Livani M. et al., 2023. Earth Syst. Sci. Data, 15, 4261–4293, <https://doi.org/10.5194/essd-15-4261-2023>.
- Pasquale et al., 2013. Tectonophysics, 594, 1-12. <https://doi.org/10.1016/j.tecto.2013.03.011>.
- Slupski et al., 2025. 43° National Conference GNGTS, Bologna, 11-14 February 2025.
- Zahorec et al., 2021. Earth Syst. Sci. Data, 13, 2165–2209, <https://doi.org/10.5194/essd-13-2165-2021>.