NORTHERN APENNINE BURIED STRUCTURES OBSERVED FROM ANALYSES OF GEOPHYSICAL DATA TO EVALUATE THEIR GEOTHERMAL POTENTIAL

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The geothermal resources are distributed within the crust and thus the characterization of the shallow tectonic structures is crucial for planning exploration and exploitation of the geothermal reservoirs. In the InGEO PRIN 2022 PNRR project (Innovation in GEOthermal resources and reserves potential assessment for the decarbonisation of power/thermal sectors), which has received funding from European Union, Next Generation EU, we develop an innovative exploration workflow, integrating geological/geophysical data, organized to make available a sort of decision support system of geothermal projects.

We focus our study on the Northern Apennine buried structures, belonging to the Romagna and Ferrara Folds (RFF), which show a relatively low geothermal gradients, within the deep carbonate units (~14°C/km), and a significantly higher thermal gradient (~53°C/km) in the overlying impermeable cover. According to these evidences, fluid thermal convection occurrs in the deep-seated carbonate units of Mesozoic age, composing the local geothermal reservoir.

The shallow crust is investigated through a total of 535 deep exploratory wells (VIDEPI database: https://www.videpi.com/videpi/videpi.asp), with depths ranging from 0.5 up to 6.5 km below ground level. They provide essential information, concerning lithostratigraphy, temperatures measured during drilling stops, and geophysical logs, which are used to implement a geological model of the shallow structures in a companion study.

On the other hand, the results of several geophysical investigations, recently carried out in the Alps and Po plain, are used to identify the depth of the main crustal discontinuities, lateral variations of Bouguer anomalies, seismic velocities. The comparison between the Vp and Vs-depth distribution help identify both the main crustal layers and areas of crustal thickening. We observe a good correspondence between the low seismic velocities, characterizing the shallow crust of the RFF, and negative Bouguer anomalies. We also notice that the velocity in the shallow crust is consistent with that obtained from the linear regression between the P-wave sonic velocity and depth for the cemented sand. The Moho depth, reconstructed by estimating the depth of the iso-velocity contour of 4.1 km/s, increases towards the Apennines, from ~27 km to ~48 km, as the velocity in the sub-crustal lithosphere, which is low in the central part of the study area, likely due to a local asthenospheric upwelling.

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