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Machine Learning-Based Joint Interpretation of Geophysical data for the geothermal potential assessment in the Romagna and Ferrara Folds (Italy)

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Geothermal energy, a clean, continuously available and sustainable energy source, will help boost the current renewable energy supply and, simultaneously, reduce the dominant contribution of fossil fuels to the total energy supply in Italy [1]. Efficient exploitation of this resource, however, requires a characterization of the subsurface region, through integration of multi-parameter datasets, to mitigate the risks of drilling unsuccessful geothermal wells.

The InGEO project (*Innovation in GEOthermal resources and reserves potential assessment for the decarbonization of power/thermal sectors*, www.ingeo.cnr.it) seeks to develop an innovative exploration workflow integrating geological, geophysical and petrophysical datasets. It focuses on the northern sector of the Northern Apennine buried-structures belonging to the Romagna and Ferrara Folds (RFF), where a thermal anomaly attributable to deep fluid circulation within the deep-seated Mesozoic carbonate sequences, was identified [2].

With an ongoing study focusing on the reconstruction of a 3D geological model of the RFF region [3], this study develops the research by jointly interpreting previous geophysical datasets [4-5] geographically constrained within the RFF region. The novelty consists on the application of a machine learning algorithm for jointly re-interpreting geophysical datasets. The similarities among the geophysical datasets within the RFF are classified by applying the Fuzzy c-means method, which uses the Euclidean distance measure. The findings include the 3D spatial distribution of derived classes and are validated with the 3D geological model of the RFF [3] and laboratory data obtained on rock samples analyses [6].

The resulting 3D geophysical model contributes to the delineation and constraint of shallow and deep structural features within the RFF. This information will be used as input parameters for the development of a thermal model and the implementation of an open-source and web-based GIS tool that will assess the deep geothermal resource potential for both hydrothermal resources and closed-loop deep heat exchangers solutions in Italy, but with potential to extend the approach in different geological contexts. The workflow of InGEO project will be used as a decision support

system for developing geothermal projects in Italy.

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References

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