Hydrocarbons prospecting using integrated geophysical methods (magnetotelluric soundings, gravity and magnetics) in the external flysch zone (Eastern Carpathians, northern Moldavia)

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A programe of complex geological and geophysical investigations has been conducted in the external flysch zone of the Eastern Carpathians. Magnetotelluric soundings, gravity and magnetics surveys have been applied with success in the prediction of potential hydrocarbon targets in order to evaluate the hydrocarbon perspectives at dephts of 1000-5000m and more. The non-seismic methods approach has proved to show its advantages in complicated areas with challenging topography and unfavorable geological situations.

The case study indicate that these techniques can provide guiding for seismic survey design, and present information about deep structures to effectively detect hydrocarbon reservoir and remarkably improve drilling successes.

The feasibility of magnetotelluric soundings method was based mainly upon the resistivity contrast between different geological formations of the flysch units, the sedimentary cover of the platform and the crystalline basement. We used the magnetotelluric, gravity and magnetic data to obtain several 2D models from solutions of inverse problems. There has been direct comparison of spatial elements of potential-field anomalies with the distribution of favorable structures for hydrocarbon deposits.

A very strong resistivity contrast appears at 1500-3500m depths (and more), between the sedimentary cover and the crystalline basement or ante-Upper Paleozoic deposits of the platform. Gravity and magnetic maps show the presence of longitudinal anomalies, generated by the contrasts between the various geological formations, large scale anomalies reflecting the structure of the crystalline basement, while local anomalies delineate the intricate geology of the flysch and molasse deposits.

The horizontal gravity/magnetic gradient emphasize contacts between formations with different densities/susceptibility. The elongated highs in gravity are usually associated with fault lines, thus making the map an useful tool in understanding the perimeters tectonic evolution.

The geological interpretation of combined data allowed us to point out several directional faults crossing NNW-SSE the area, as well as some transverse strike-slip faults, oriented NNE-SSW.

These faults have been reactivated several times from the Neogene until present, also affecting partly the Moldavidian Nappes. The presence of this complex fault system at the level of the underthrust platform result in an intricate crystalline basement morphology.

By using a multidisciplinary and team based approach to a specific geological situation we greatly improve the accuracy and reliability of our final interpretation. The integration of the geophysical methods (magnetotelluric soundings, gravity, magnetics) with the geological studies can solve complicated problems and outline interesting geological zones for hydrocarbon accumulations, obtaining a higher-precision on their detection.