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Quaternary tectonics from seismic interpretation and its potential relation with deep geothermal fluids in the Marche (Central Italy).

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Knowledge of the structural features is fundamental in evaluating geothermal exchange potential and in modelling geothermal systems. In particular, faults and fractures play an important role for the circulation of fluids in the crust, and structural setting can influence groundwater flow, its regime, chemistry and electrical conductivity.
In this context, data coming from accurate studies of groundwater physical properties in the Marche region (Central Italy), concerning electrical conductivity above all, revealed some anomalies in several localities that could be ascribed to a strong structural control. Data acquisition and interpretation of some SW-NE seismic reflection profiles crossing the Apennine chain to the Adriatic sea and kindly provided by ENI S.p.A, highlight important deep Plio-Quaternary structures connected with minor surface ones and to hydrogeological conditions. Seismic profiles interpretation allowed to reconstruct the structural setting and to identify the recent evolution of the Apennine Marche sector in more detail with respect to what is already known. In fact, some high angle structures affecting the whole sedimentary sequence and routing at high depth were labelled. These are NW-SE sub-parallel transpressive structures bounded by SW and NE-dipping high-angle reverse faults reaching > 10 km depth (positive flower structures), and probably involving the upper crust basement. Three main alignments were identified from W to the coast line. In some cases, flower nucleation gives rise to the lifting and counter-clockwise rotation of the Pre-Pliocene substratum blocks, with the upwelling and outcropping of Upper Miocene (Messinian) evaporite deposits along the axial zone of the transpressive structural highs. Noting the analyses of groundwater properties coming from wells placed in proximity of these structures or located along the analysed seismic profiles, anomalies in electrical conductivity are relevant. The activity of the deep rooting structures observed in the seismic profiles and the high degree of fracturing that accompanies these complex and recent fault systems can facilitate the exchange between deep and superficial fluids. In other cases, like in coastal structural high, it can have a role in preventing the sea water ingression. This significant consideration can be supported also by the direct relation of electrical conductivity with the amount of rainfall revealed from studied piezometers along the carbonate Marche ridge. It should be explained through a specific behaviour (typical of carbonate aquifers, known as the "piston-flow phase") which implies an increase of groundwater mineralization as a result of transmission of the hydraulic pressure from the saturated zone, through fractures as important way for fluids circulation.
Ultimately, we suggest that the structural control could be an important factor in influencing both the surface and the groundwater flow behaviours, and then convective component of the heat transport in the studied area.