Structural Characterization of the Greater Geneva Basin (Switzerland and France) for Geothermal Ressource Exploration

Nicolas Clerc[1], Elme Rusillon[1], Luca Cardello[1], Andrea Moscariello[1], and Philippe Renard[2]

[1]Earth and Environmental Sciences, University of Geneva, Geneva, Switzerland.
[2]Center for Hydrogeology and Geothermics, University of Neuchâtel, Neuchâtel, Switzerland.

ABSTRACT

The GEothermie 2020 Geneva State program aims at investigating and developing the geothermal energy potential of the Geneva Basin, Switzerland. In this purpose, subsurface characterization studies are carried out at University of Geneva, including reservoir rock typing analysis, detailed stratigraphy harmonization, assessment of fault hydraulic conductivity, evaluation of diagenetic imprint on reservoir facies, 3D structural modeling and fault mapping from 2D seismic data. The Greater Geneva Basin (GGB) forms the transnational (Swiss-French) southwestern extremity of the North Alpine foreland Molasse Basin. It is limited in the northwest by the Jura fold-and-thrust belt and in the southeast by the Alps. The basinal sedimentary cover consists of a thick series of Mesozoic carbonate and marls overlain by Cenozoic Molasse siliciclastic deposits. At regional scale, the Meso-Cenozoic sedimentary cover is detached from its substratum on a decollement layer occurring in the Triassic evaporites. The substratum is composed of a crystalline Variscan basement locally affected by paleo-graben or half-graben structures filled with siliciclastic Permo-Carboniferous sediments. Recently enriched, c.a. 500 km of 2D seismic data form the most ever complete dataset available over the GGB, thus allowing to refine knowledge on its structural frame. In addition to the Vuache Fault, a major NNW-striking left-lateral tranpressive fault mostly formed during the early Miocene and well known from its surface expression, 2 main sets of smaller-scale subvertical strike-slip faults NNW- and WNW-striking occur in the basin. Whereas a large amount of the shortening related to the Alpine orogeny is absorbed by intra-basinal thrusted antiforms rooting on the triassic decollement layer (i.e., Salève & Gros-Foug reliefs), smaller-scale thrusts and back-thrusts are recognised on 2D seismic within the basin, mostly affecting the Upper-Jurassic and Lower Cretaceous carbonates while the underlying Lower Jurassic marly units respond in a more ductile manner. A clear mapping of the fault network plays a key role in the selection of future drilling location for geothermal production. Understanding timing and kinematics also helps in predicting the occurence of subseismic faults and fracture-related enhanced permeability zones, potentially acting as hydraulic conduits connecting the most productive reservoir facies.