# Structural modeling of the Geneva Basin for geothermal ressource assessment

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In late 2015, 62 km 2D reflexion seismic data were acquired over the Geneva canton as part of the GEothermie 2020 Geneva State programm, which aims at investigate and develop the deep geothermal potential of the Geneva basin (Moscariello, 2016).These newly acquired data complements the existing 2D seismic dataset partly recently reprocessed available over the the Swiss-French Geneva basin.

In the light of this most ever complete Swiss-French 2D seismic dataset (>500 km), the structural scheme of the Geneva basin, already depicted by various authors at either basin- or local-scale can be further refined. In this sense, the main left-lateral strike-slip fault zones known across the basin are confirmed, but detailed delineation of individual seismic faults geometries and extensions reveals a more complex structuration of these main fault zones, along with the presence of smaller-scale associated or conjugated fault systems. Despite this improved seismic data coverage, the connections, extensions and orientations of certain fault objects remain however uncertain in some areas. Indeed, some areas suffer from non-unique possible interpretation of fault traces between 2D seismic profiles. This issue, as well as the proposed refined structural scheme of the Geneva basin in its whole, is temptatively validated by observed surface fault expressions and fault-kinematics analysis from nearby outcrop observations (Cardello et al., 2016), in the context of the tectonic structuration history of the greater Geneva region.

This enriched 2D seismic dataset also provides better controll on the 3D geometries of the main Mesozoic stratigraphic units across the basin. Their respective seismic signature, coherent with their main lithological contents, is identified from the deep well Humilly-2 along a reference seismic line running through it. Petrophysical measurements on core and outcrop samples, coupled with well-log response analysis reveal that the Kimmeridgian – Tithonian *Reef Complex* and underlying *Calcaires de Tabalcon* units display the most encouraging geothermal reservoir properties within the Mesozoic sedimentary cover (Rusillon et al., 2016). For this reason, despite its limited thickness at seismic scale and some difficulty to track it with good precision within the seismically monotonous calcareous-prone Upper Malm interval, special emphasis is given in the 3D mapping of the Kimmeridgian unit in order to highlight its depth and thickness variations across the Geneva basin. Moreover, specific dome-shape structure patterns with irregular to chaotic internal reflexions, surrounded by onlapping reflectors can be repetively identified on certain seismic profiles. The stratigraphic position, thicknesses and lateral

extension of these seismic objects is coherent with the Kimmeridgian *Reef-Complex* buildups observed in nearby outcrops. They are temptatively interpreted as such, while keeping in mind that the presence of numerous (subseismic) unit-bounded diffused fault discontinuities, commonly observed within the massive limestones of the Upper Malm and Cretaceous intervals, can also generate similar seismic artifacts. In both cases, whereas it is of depositional (*Reef Complex* buildups) or structural (increased fault density) origine, these perticular zones likely correspond to enhance reservoir properties regions that deserve special mapping attention in the quest of geothermal reservoirs.

A clear mapping of the fault network and Kimmeridgian reservoir unit across the Geneva basin will play a kee role in the selection of future drilling location for deep geothermal heat production. Understanding the development of the fault network in terms of fault relationships and kinematics within the basin stress field evolution through time and present-day situation should also help to predict the development and preferential orientation of smaller-scale fault and fracture-related enhanced permeability zones, potentially acting as hydraulic conduits connecting most productive reservoir facies.

## REFERENCES

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