Geophysical Research Abstracts
Vol. 19, EGU2017-9074, 2017
EGU General Assembly 2017
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Geothermal prospection in the Greater Geneva Basin (Switzerland and France): Structural and reservoir quality assessment

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A reservoir assessment was performed in the Greater Geneva Basin to evaluate the geothermal resources potential of low to medium enthalpy (Moscariello, 2016). For this purpose, a detail structural analysis of the basin was performed (Clerc et al., 2016) simultaneously with a reservoir appraisal study including petrophysical properties assessment in a consistent sedimentological and stratigraphical frame (Brentini et al., 2017).

This multi-disciplinary study was organised in 4 steps: (1) investigation of the surrounding outcrops to understand the stratigraphy and lateral facies distribution of the sedimentary sequence from Permo-Carboniferous to Lower Cretaceous units; (2) development of 3D geological models derived from 2D seismic and well data focusing on the structural scheme of the basin to constrain better the tectonic influence on facies distribution and to assess potential hydraulic connectivity through faults between reservoir units ; (3) evaluation of the distribution, geometry, sedimentology and petrophysical properties of potential reservoir units from well data; (4) identification and selection of the most promising reservoir units for in-depth rock type characterization and 3D modeling.

Petrophysical investigations revealed that the Kimmeridgian-Tithonian Reef Complex and the underlying Calcaires de Tabalcon units are the most promising geothermal reservoir targets (porosity range 10-20%; permeability to 1mD). Best reservoir properties are measured in patch reefs and high-energy peri-reefal depositional environments, which are surrounded by synchronous tight lagoonal deposits. Associated highly porous dolomitized intervals reported in the western part of the basin also provide enhanced reservoir quality. The distribution and geometry of best reservoir bodies is complex and constrained by (1) palaeotopography, which can be affected by synsedimentary fault activity during Mesozoic times, (2) sedimentary factors such as hydrodynamics, sea level variations, or sedimentation rates and (3) diagenetic history (Makhloufi et al., 2017).

A detail structural characterization of the basin using 2D seismic data reveals the existence of several wrench fault zones and intra-basinal thrusts across the basin, which could act as hydraulic conduits and play a key role in connecting the most productive reservoir facies. To understand the propagation of these heterogeneous reservoirs, rock types are currently defined and will be integrated into 3D geological models.

This integrated study allows us to understand better the distribution and properties of productive reservoir facies as well as hydraulic connectivity zones within the study area. This provides consistent knowledge for future geothermal exploration steps toward the successful development of this sustainable energy resource in the Greater Geneva Basin.

Brentini et al. 2017 : Geothermal prospection in the Greater Geneva Basin: integration of geological data in the new Information System. Abstract, EGU General Assembly 2017, Vienna, Austria
Clerc et al. 2016 : Structural Modeling of the Geneva Basin for Geothermal Ressource Assessment. Abstract, 14th Swiss Geoscience Meeting, Geneva, Switzerland
Makhloufi et al. 2017 : Geothermal prospection in the Greater Geneva Basin (Switzerland and France) : impact of diagenesis on reservoir properties of the Upper Jurassic carbonate sediments. Abstract, EGU General Assembly 2017, Vienna, Austria
Moscariello, A. 2016 : Geothermal exploration in SW Switzerland, Proceeding , European Geotermal Congress 2016, Strasbourg, France