Reservoir Rock Typing of the Late Jurassic Reef Complex in Support of Geothermal Exploration in the Greater Geneva Basin (Switzerland and France)

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ABSTRACT

A first reservoir assessment was performed in the Greater Geneva Basin (GGB) to develop low to medium enthalpy resources in the area. A specific rock typing workflow was designed, simultaneously with a review of the stratigraphical frame for the sake of data homogenization and correlations at regional scale, as well as a detail structural analysis of the basin. The reservoir assessment consisted of describing depositional and petrophysical characteristics of the sedimentary units ranging from the Permo-Carboniferous to the Lower Cretaceous using well, core and outcrop material. Methods applied encompassed (1) microfacies and cathodoluminescence analyses (2) porosity, permeability and grain density measurements integrated with similar data available from well reports (3) modal mineralogy using QEMSCAN technology (4) P and S wave velocity measurements (5) further investigation of the pore network with SEM images. Rock types were then defined to propagate and predict reservoir properties through 3D geological models. An integrated approach was developed, combining depositional, diagenetic, petrophysical and electrical properties with pore network characteristics. Petrophysical investigations revealed that the Kimmeridgian-Tithonian Reef Complex unit is the most promising target for geothermal prospects (porosity range 10-20%; permeability to 1mD). Best reservoir properties were measured in pure carbonate sediments formed in reef depositional environments, surrounded by synchronous tight lagoonal deposits. Associated porous dolomitized intervals located in the western part of the basin also promote enhanced reservoir qualities. Accordingly, reservoir bodies display complex geometries and a scattered distribution. To propagate these heterogeneous reservoir properties, rock types were defined, and are currently integrated into 3D geological models based on 2D seismic data. Additionally, the detail structural characterization of the basin using available 2D seismic dataset confirmed the existence of several wrench fault zones and conjugate fault systems across the basin, which could act as hydraulic corridor, and play a key role in connecting the most productive reservoir facies. These integrated studies allowed to understand better the distribution and properties of productive reservoir facies and hydraulic connectivity zones within the study area to assure the successful development of geothermal energy in the GGB.