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Reservoir geology of the Cretaceous-Cenozoic Transition in the context of geothermal exploration in the Geneva Basin and neighbouring France (Switzerland & France)

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As part of the energy transition effort in Switzerland, the 'GEothermies': exploration program carried out in the Geneva Basin and its neighbouring areas (Fig. 1) for direct geothermal heat production and storage is ongoing in the Molasse sedimentary basin. Results from previous hydrocarbon exploration and subsequent geothermal drilling campaigns confirmed the presence of five possible stratigraphic targets for geothermal projects.

This study focuses on the shallowest: the Cretaceous-Cenozoic Transition (CCT), a poorly known stratigraphic interval marked by a sedimentary hiatus related to the tectonic phase and the climate that dominated the area at this period. It displays good geothermal potential for its flow rate due to the occurrence of karstification and open fracture systems in the Lower Cretaceous characterized by low-porosity carbonates. The Alpine orogenesis has subaerially exposed and faulted the Lower Cretaceous generating karsts that were infilled with Eocene and Oligocene coarse sediments: the '*Sidérolithique*', a quartz-rich sandstone facies, and the '*Gompholite*', a polygenic conglomerate facies.

A better understanding of this stratigraphic interval is provided by tackling the following aspects:

- Sedimentological framework and diagenetic history of the Cenozoic sediments based on outcrop data and description of cores, further refined by geochemical and mineralogical analyses aimed at reconstructing their depositional processes and environment,
- Petrophysics, reservoir properties and evaluation of their geothermal reservoirs potential,
- Regional 2D geological model based on outcrops, wells record, 2D and 3D seismic data in order to predict their lateral and vertical distribution.

The CCT is identified in a few outcrops in the Salève, the Vuache and the Jura, in 35 wells (Fig. 1) and in seismic data, with a depth ranging between 31.20 m (well SPM-3) and 1376 m (well Thônex; Fig. 1). The most significant '*Sidérolithique*' deposit of 130 m thickness was recorded at 630 m depth in the geothermal exploration well GEo-02 drilled in 2019. According to cores and outcrops observations, the '*Sidérolithique*' facies have a variable clay content of kaolinite and chlorite as well as a variable abundance of siderite. In the Geo-02 well, a kaolinite-rich content at the bottom

of the 'Sidérolithique' shows a mixed signature of the doline palaeosol with the sandstone fill. Despite the presence of clay and siderite, in the Gex wells, porosity values in the CCT deposits ranges from 0 to 20 % while permeability values can reach up several hundreds of mD (Fig. 2) indicating overall good reservoir potential.

Ultimately, this study aims at improving the predictive capability of the geological model of the Canton of Geneva and neighbouring France and provides new insights on the potential of the CCT deposits as geothermal reservoirs.

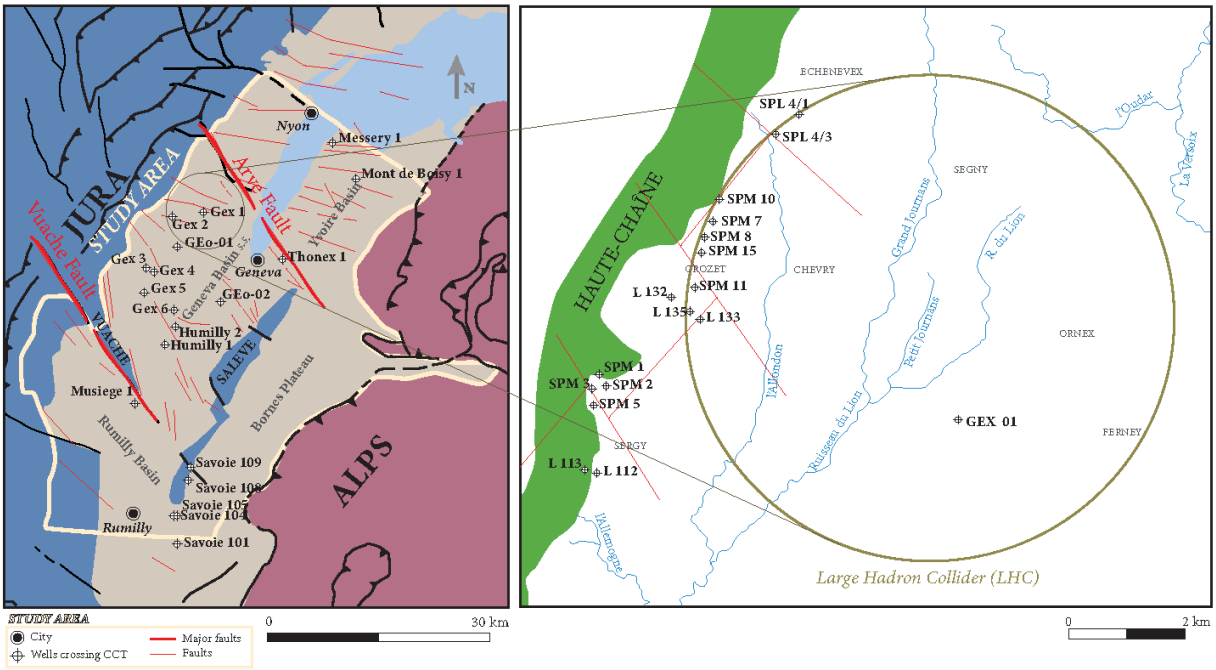

Figure 1. Location of the study area with the 35 wells that recorded the CCT. Two NW-SE major faults are showed in red: the Vuache Fault and the Arve Fault.

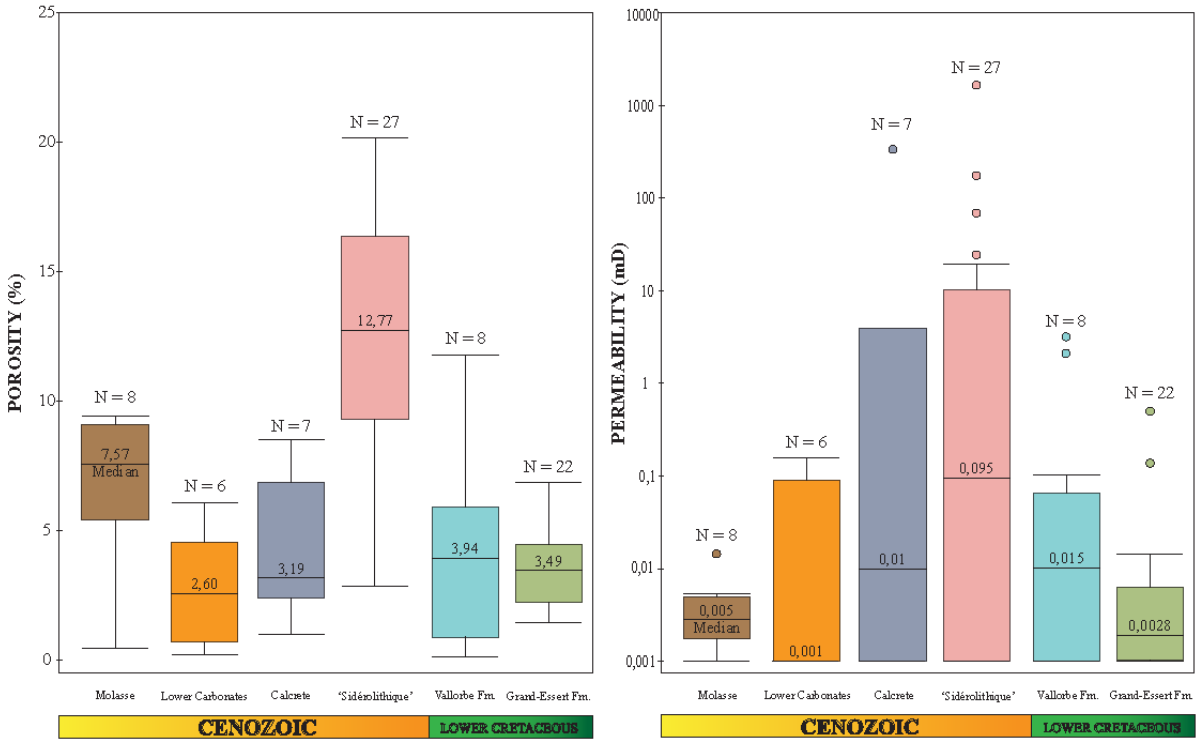

Figure 2. Summary of porosity and permeability values from 86 plugs sorted by facies from the Gex wells including different units in the CCT interval from younger Molasse (left) to older Lower Cretaceous units (right).