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Field analysis of a crystalline batholith:

Characterization of a deep crystalline reservoir (the Soultz-sous-Forêts EGS case study)

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At the Soultz-sous-Forêts EGS (Enhanced Geothermal Systems) and in general in other crystalline reservoirs, the fluid flow paths between the injection and the production boreholes are mainly controlled by a set of permeable and non-permeable structures occurring from the hectometric to micrometric scales. The objective of our work is to define the architecture of these paths within the heat exchanger, which is difficult due to the great depth of the hot granite.

Thus we will expose our work organized in two different domains:

The direct investigation of the reservoir consists in some *in situ* geophysical data acquisitions and interpretations. Both logging and seismic methods are used for the multi-scale delineation of the structures intersected by the well, or the faults affecting the sedimentary cover of the reservoir basement. A special attention is paid to VSP (Vertical Seismic Profiling) data after an adapted isotropic processing which reveals the location of permeable faults affecting the reservoir, even several hundreds of meter

away from the acquisition well. Other structures are identified as well, like diffracting faults intersections or strongly attenuating zones. In addition, at well location these VSP results are in full agreement with the local results of structural logging data (UBI, ARI, FMI...).

As the Soultz-sous-Forêts granitic basement is covered by thick sediments (1500 m thick), an indirect characterization is led on an analogue outcropping batholith located north of Barcelona (Catalunya – Spain). This granitic massif indeed presents strong analogies with the geothermal reservoir in Soultz-sous-Forêts: these two hercynian granites presenting very close petrologic compositions and recording very similar tectonic histories (Pyrenean or Alpine compression and Oligocene rifting…). These two granitic massifs currently present similar thermal anomaly, seismic and geothermal (hot springs) activities, and evidences of hydrothermal alteration. The preliminary results of a 3D structural recognition and detailed fracturation analysis will be presented with a special attention to fault zones. In addition, these intragranitic faults are investigated by seismic and radar methods in order to make a link between the geological structures and their geophysical responses, in order to help the interpretation of the Soultz-sous-Forêts VSPs.

Thus, from these two tasks, a comparison is proposed so as to complete the Soultz-sous-Forêts EGS characterization. As the structural data acquired by logging are collected only locally in the wells, the macro-structural pattern of the reservoir deduced by seismic methods can be completed by the analogue field 3D fracturation data. In addition, petrophysical properties of fault zones measured on Soultz-sous-Forêts cores and on the analogue samples are compared.