Deformation and hydrothermal alteration insights of a high strain sheared zone in a gneissic basement (Black Forest, Germany). An analogue for fractured geothermal crystalline reservoirs.

Benjamin Avakian*[1,2,3], Béatrice Ledésert[1], Ronan Hebert[1], Philippe Claeys[2], Steven Goderis[2], Ghislain Trullenque[3], and Sébastien Potel[3]

[1]CY Cergy Paris Université – Geosciences Environnement Cergy – France
[2]Vrije Universiteit [Brussel] – Belgique
[3]UniLaSalle – B2R – France

Résumé

Enhanced geothermal systems in basement rocks consist in the exploitation of the hot brines circulating within the fracture network as the main fluid pathway within the reservoir. This is the case at Soultz-sous-Forêts and Rittershoffen (France). The fracture network must be clearly documented before developing a geothermal installation to reduce the risks of targeting low permeability fractures or induced seismicity related to reservoir stimulation. A potential sub-surface analogue to Soultz-sous-Forêts' reservoir is found in a highly strained zone rich in clay minerals in Shauinsland's mine (Black Forest, Germany). The analogue is crosscut by an ore vein that disappears close to the core of the fault zone and reapers on its other side. Petrographical and petrophysical characterizations were done to identify deformation and hydrothermal alteration markers such as grain size reduction, fracturation, illitization process and precipitation of carbonate veins. This was coupled with a geochemical study focusing on the effect of hydrothermal alteration on the chemical composition of the deformed host rock. Micro X-ray fluorescence element maps were gained at thin section scale (3x4 centimeters) to identify fluid circulation features within the host rock. Major element concentrations were quantified using powdered samples taken along the fault zone to identify hydrothermal alteration stages. Porosity, carbonate content and magnetic susceptibility increase towards the fault core and tend to be correlated with clay content. Fe precipitated massively in the core zone and Ca in veins of the damage zone. High fluid flow was channelled in the core zone which is no longer permeable as indicated by the high clay content. Combined with mechanical data and numerical modelling, this may help reduce the risks of "dry well" or generate seismic events during geothermal stimulation.

Mots-Clés: Enhanced geothermal systems, analogue, fault zone, fluid/rock interaction, permeability

*Intervenant