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Paleo-hydrothermal fluid flow: a clue to understand the properties of the geothermal province of Limagne (French Massif Central).

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Geothermal resources are a prime target to the future energy supply. Deciphering the properties of the geothermal area such the structure, the hydrological features, the heat sources as well as the recharge/discharge area are still difficult to describe. Most of geothermal systems are associate with hydrothermal precipitation that records the chemical and conditions that could give some constraints on the processes occurring in different site of a geothermal province.
In this presentation, we propose to estimate the fluid flow direction and velocities from the textures recorded in quartz comb texture in the Limagne basin. Locates in the French Massif Central, this basin is hemi-graben filled by tertiary sedimentary rocks. Characterized by a high thermal gradient and numerous occurrence of CO_2-rich thermo-mineral waters this basin has a potential for high-temperature geothermal energy.
We use the quartz-hydrothermal mineralization in veins to point out the paleo- recharge/discharge area and the associate fluid flow. The asymmetric growing of equivalent crystal faces within the quartz grain allow us to define the sense of the paleo-fluids flow responsible for this quartz vein formation. Coupled with 2D and 3D numerical modeling, by inverse method, we are able to determine the local velocities of this paleo-fluids flow. This methods have been apply on the whole Limagne basin and the recharge/discharge area have been identified. The result shows that the flow is discontinuous over the time and change in velocities and direction. A first downward flow at 10-6,-3 m.s-1 corresponding to the recharge area have been identified close to the thermal anomaly. A second mainly lateral flow at 10-6,-4 m.s-1 have been characterized in all other part of the Limagne basin corresponding to the discharge areas.
In a second time, to better understand the nature of the fluids involved, the fluids inclusion within the quartz grain have been studied. It allows us to propose a method to delimit the areas with high geothermal potential integrating this fluids flow variation.