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Fault anatomy, porosity and pore connectivity: The La Sarraz-Mormont Fault System

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The La Sarraz-Mormont Fault system is composed of two parallel hectometre-scale subvertical strike-slip faults, with dextral movement and striking NW-SE. This strike-slip system is conjugated to the kilometric-scale Pontarlier Fault System, with left-lateral movement and striking N-S. Fieldwork was conducted in the Eclépens Quarry, located in between the two parallel subvertical branches of the La Sarraz-Mormont Fault System. This study focused on understanding fault architecture, porosity and criticality. The outstanding outcrop quality in Eclépens Quarry allowed us to obtain abundant information on faults and striations. The major and minor faults in the Eclépens Quarry were studied in detail. The damage zone of the outcropping faults were mapped and 50 samples were collected. The samples were analysed with optical microscopy, cathodoluminescence, scanning electron microscopy, stable isotopes and x-ray powder diffraction. A µ-CT scan was used to determine the porosity of the samples, which was scanned, reconstructed and segmented. A permeability modelling was simulated in the 3D skeletonised samples. The paleostress results indicate that the faults in the Eclépens Quarry are under a strike-slip regime with subhorizontal NW-SE compression, subhorizontal NE-SW extension and vertical σ_2, corresponding to the lithostatic pressure (S_V). A paragenetic sequence was suggested by combining the analysed microscopic results from the samples of the fault damage zones. We identified a typical Barremian marine environment of deposition. The micro deformation features observed in the studied samples indicate faulting in a brittle deformation mode and the fault movement was influenced by hydrothermal fluids ($\delta^{18}O$= -16‰ to -14‰). The study of porosity using µ-CT scan analysis indicated that the damage zone of the Mormont Fault and Quarry fault presented an average porosity between 2.99% and 6.44%. The aforementioned fieldwork and laboratory results were combined into a 2D fracture network fluid modelling. The modelling focused on understanding the parameters controlling faults slip tendency. 72 simulations were obtained by varying the fluid pressure, the fracture setup and aquifer depth. The results indicate that the slip tendency on strike-slip faults is controlled by the orientation of the regional stress field, as well as, the fluid pressure applied in the injection well. The increase of fluid pressure critically stressed optimally oriented faults from 500 to 1000 m from the injection well. In conclusion, the results here presented points out the La Sarraz-Mormont Fault System as a favourable site to host a geothermal doublet for heat use.

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