Geophysical Research Abstracts
Vol. 18, EGU2016-3624, 2016
EGU General Assembly 2016
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Fault-related structural permeability: Qualitative insights of the damage-zone from micro-CT analysis.

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Fault zones and their related structural permeability play a leading role in the migration of fluids through the continental crust. A first approximation to understanding the structural permeability conditions, and the estimation of its hydraulic properties (i.e. palaeopermeability and fracture porosity conditions) of the fault-related fracture mesh is the 2D analysis of its veinlets, usually made in thin-section. Those estimations are based in the geometrical parameters of the veinlets, such as average fracture density, length and aperture, which can be statistically modelled assuming penny-shaped fractures of constant radius and aperture within an anisotropic fracture system. Thus, this model is related to fracture connectivity, its length and to the cube of the fracture apertures. In this way, the estimated values presents their own inaccuracies owing to the method used. Therefore, the study of the real spatial distribution of the veinlets of the fault-related fracture mesh (3D), feasible with the use of micro-CT analyses, is a first order factor to unravel both, the real structural permeability conditions of a fault-zone, together with the validation of previous estimations made in 2D analyses in thin-sections.

This early contribution shows the preliminary results of a fault-related fracture mesh and its 3D spatial distribution in the damage zone of the Jorgillo Fault (JF), an ancient subvertical left-lateral strike-slip fault exposed in the Atacama Fault System in northern Chile. The JF is a ca. 20 km long NNW-striking strike-slip fault with sinistral displacement of ca. 4 km. The methodology consisted of the drilling of vertically oriented plugs of 5 mm in diameter located at different distances from the JF core – damage zone boundary. Each specimen was, then, scanned with an x-ray micro-CT scanner (ProCon X-Ray CTalpha) in order to assess the fracture mesh. X-rays were generated in a transmission target x-ray tube with acceleration voltages ranging from 90-120 kV and target currents from 40-60 μA. The focal spot size on the diamond/tungsten target was about 5 μm. The x-ray beam was filtered using a 1 mm Aluminum plate before passing the sample. 1200 x-ray images were taken during a full rotation of the sample using an amorphous silicon flat panel detector with 1516x1900 pixels. This resulted in a voxel resolution of about 8 μm in the 3D data reconstructed from the images. Future work will be aimed in the images segmentation of the fault-related fracture mesh followed by the estimation of its hydraulic properties at the time of fracture sealing.

Acknowledgements: This work is a contribution to the CONICYT- BMBF International Scientific Collaborative Research Program Project PCCI130025/FKZ01DN14033 and the FONDAP-CONICYT Project 15090013.