

Preliminary analysis of hydraulic shear stimulations in the Bredretto Lab: The link with natural fractures.

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Three stimulation treatments were performed in the Bedretto Lab during 2020 by Geo-Energie Suisse. The locations of microseismic events as well as image logs taken before and after were analyzed to characterize the results of these stimulations.

Millimetric, permanent displacements were identified in pre-existing, natural fractures after stimulation treatments. The measured displacement vectors are consistent between different structures. The deformation can be measured weeks after the end of the stimulation indicating the permanent character of shear displacements.

Micro-seismicity clouds were analyzed to find links with the previously established structural model. Simple linear fitting methods were used to find planes formed by seismicity clusters. The search for planes was carried out using 3 different methods: 1) A “brute force” method was used to find statistically dominant orientations, 2) A semi-manual method fitting one plane to events grouped by clusters or stimulation intervals and, 3) A fully-manual method, fitting planes to lineaments identified by visual inspection of the clouds.

In general, a dominant orientation approximately perpendicular to the boreholes was found in all clouds across all three methods. This direction is present in the lab, especially near the bottom of long boreholes. The orientations found in this analysis represent general trends and alignments at the scale of the whole cloud. Individual events might be associated with different orientations.

The observations described here show the effectiveness of a multistage stimulation protocol to reactivate pre-existing structures