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Four dimensional microtectonics: quantifying complex deformation paths through time in natural shear zones deformed by general shear

Reporting

Project Information

4D-UTECTONICS

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Final Activity Report Summary - 4D-UTECTONICS (Four dimensional microtectonics: quantifying complex deformation paths through time in natural shear zones deformed by general shear)

Movement of the Earth's plates is typically accommodated in zones of localised deformation, and movement along these faults is the main cause of earthquakes. As displacement in brittle faults near the earth's surface is linked to ductile flow in shear zones at depth, it is critical to understand the evolution of ductile, deep-crustal shear zones in both space and time. Yet, the mechanisms behind partitioning of deformation into structures that accommodate different types of displacement are not well understood.

Recent work has shown that the tools used for studying shear zones are inadequate in a very common, complex type of shear zone deformation (transpression). In this study, we have tested a new micro-kinematic approach that helps to track the three-dimensional evolution of faults and shear zones through time (i.e. 4D micro-tectonics). This was done on rock samples from Cap de Creus, Spain, using the orientation of quartz grains, which change their shape and orientation during this deformation in a very specific way.

The orientation was obtained using the electron backscatter diffraction technique (EBSD) on a scanning electron microscope (SEM). The results confirm that we have an independent means of establishing the kinematic rotation axis (vorticity vector) of rock samples. This means we can now better test theoretical models of how rocks deform in the middle crust (in general shear). This also aids us in understanding the evolution of mountain belts in general, and fault behaviour in particular.

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