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Elodie Sallet, Zoe Shipton, Christopher Wibberley. The spatial organization of deformation in high porosity sandstones: from outcrop data to prediction of bulk fault zone properties. *Tectono-Mechanics*, Apr 2013, Paris, France. hal-04382827

**HAL Id: hal-04382827**

**<https://hal.science/hal-04382827>**

Submitted on 11 Jan 2024

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April 15<sup>th</sup>-16<sup>th</sup>, 12h30-14h30

## **The spatial organization of deformation in high porosity sandstones: from outcrop data to prediction of bulk fault zone properties**

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Understanding the evolution of fault zone geometrical and hydromechanical properties during fault growth and network development is of major importance in fluid flow prediction in the crust. In porous rocks, faulting produces zones of deformation bands rather than planar fracture surfaces. Cataclastic deformation bands (CDBs) are mm-cm thick brittle shear zones that form through the combined effects of compaction and cataclasis. Porosity and grain size reduction associated with CDB formation causes strain hardening, and the result is the initiation of a new band, adjacent to the first. Continued deformation may possibly result in the development of localized slip planes associated to DB zones. Most commonly CDBs show a reduction of porosity, associated with a reduction of permeability. This permeability decrease is largest for the most evolved and thick zones of CDBs. Conversely, slip planes can potentially have a higher permeability than the host rock. Therefore CDBs in sandstone reservoirs can potentially retard fluid flow circulation and act as barriers to fluids, whereas slip planes could be conduits for flow. Previous studies have examined the effect of connected deformation band systems on flow, but have not considered the effect of "open" slip planes. To predict the effect of such structures on fluid flow we must consider the connectivity of the relatively low permeability CDBs and any high permeability slip planes. To characterize this connectivity we have chosen to undertake detailed mapping of structures affecting deformed sandstones in France (Provence) and USA (Utah). The principal objectives of this mapping were 1) to quantify the geometrical interconnectivity between low permeability CDBs and high permeability slip planes, 2) to quantify the variability of this connectivity at individual sites and 3) to establish if the connectivity and variations in connectivity are controlled by the host rock properties and deformation conditions. The field and laboratory data coming from the Provence and Utah outcrops allow us to identify two different models, corresponding to different geological factors and resulting to an evolution of the deformation process. These two models can be identifying as a single one analogous of the fracturing sandstone reservoir, respectively at low and high burial depth. On the lower burial depth - dominated by poorly cohesive sands - deformation is translate by a high number of CDBs and a small amount of large but simple and no anastomosed faults. On the higher burial depth - dominated by cohesive sandstone with cement - deformation is translate by large, complex and anastomosed faults, associated with CDBs. In such conditions, complex and high burial depth fault zones associated to cross-cutting slip surfaces can have a strong impact on fluid flow circulation at the reservoir scale.