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Fracture corridors in carbonates

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Among fractures, Fracture Corridors (FC) are anomalous structures made of highly persistent fracture clusters having a strong effect on multi-phase fluid flow in the subsurface. While mechanical and geological conditions for diffuse fracture systems are well constrained, FC genetic conditions remain a matter of questioning. FC can be localized in larger structures such as folds and fault zones but recent studies suggest that a large amount of fractures and FC also arise as distributed in the host rock and formed in tabular layers during burial with early rock mechanical differentiation. In addition, while the mechanical stratigraphy is of prime importance for fracture stratigraphy, it is still unknown which factor prevails on FC genesis among the local versus regional stress-state, the host rock mechanical stratigraphy or the sedimentary facies.

We present a study of fractures in a 400×300 m wide quarry (Calvisson, SE France) dug in homogeneous marly limestones of Hauterivian age. The quarry exhibits diffuse fractures as well as 16 FC.

The aim of this study is to reveal the genetics factor for FC development, their global geometry and internal morphologic variations, but also to clear the impact of fracture corridors on diffuse fracture. For that, we measured >2500 fractures (strike, dip, spacing, filling, aperture, etc.) and studied microstructures in 80 thin sections. We calculated fracture density and acquired LiDAR data with >90 million points with a resolution of 4 to 15mm.

Diffuse fractures are organized as two perpendicular sets, a main set NE-SW-trending and minor set NW-SE-trending. The FC have the same trend, but the NW-SE trend prevail on the NE-SW one. The LiDAR acquisition allows to visualize the 3D lateral continuity with corridors with a minimal extension of 30m. We distinguish 4 internal morphologic types in FC, depending on fracture morphology, occurrence of breccia and number of zones. The types may occur in a single FC with a lateral transition from one type to another.

Fracture density study shows that diffuse fracture increase around FC. FC growth and variability was not dependent on facies variations, as they are inexistent in the quarry. The result of this study allows to interpret geomechanical behaviors and geological history of fractures and fracture corridors in carbonates.