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Coupling fracture facies with in situ permeability measurements to generate stochastic simulations of tight carbonate aquifer properties: example from the Lower Cretaceous aquifer, Northern Provence, SE France

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The relationships between fracture facies and permeability distribution have been explored using a well-constrained 3D implicit structural model of hemipelagic low porosity/low permeability carbonate from the Northern Provence region, SE France. Fracture and permeability facies were determined using an extensive dataset of 99 hydrogeological boreholes wells.

Data processing was undertaken using a step-by-step approach, involving: i) identification of the fracture facies based on well logs detailing structure and stratigraphy ; ii) determination of permeability facies from the a priori correlation between the dimension of the hydraulic radius of influence (deduced from slug test analyses) and the type of reservoir heterogeneity (fissure, fracture, fault zone, etc.); iii) three dimensional plot of fracture and permeability facies in the geological model using a variographic analysis of data. Thirty-three sequential indicator simulations (SIS) were realised on both fracture and permeability facies. Finally, a connectivity algorithm was developed to compute the probability of connection between selected infiltration areas and the major aquifer springs via moderate-to high-permeability geological bodies. Key results are: i) fault zones have a greater role in controlling permeability facies distribution than on fracture facies repartition; ii) there is little correlation between permeability and fracture facies distributions ; iii) connectivity results highlight the compartmentalization of aquifers in the Cadarache area, the extensions of permeable geological bodies being limited by the N130 faults.