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POLYTECH MONS

Roughness analysis in Chalk fractures

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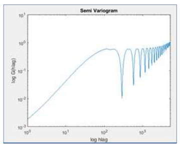
The understanding of fluid flow in fractured chalk is essential in the modelling of **large fractured reservoirs** (oil, water, or gas) where fractures significantly affect flowrate and local pressure regimes. **A complete description of fractures** should include the evaluation of fracture surfaces at various scales, from the rock mass in situ (metric and above) to lab samples (centimetric), potentially at a very small observation range (millimetric and even µm), i.e. down to 'grain scale'. The method presented here involves **characterisation of the chalk fractures on-site within the geological and tectonic context**, coupled to **visual check** of 40x40mm cylindrical samples and lab tests providing **roughness computation** by several means: the empirical **JRC profiles**, the **Z2** (RMS) **statistical parameter**, and two **fractal dimensions**, all very common in the literature. Various textures, natural and artificial fracture surfaces are investigated.

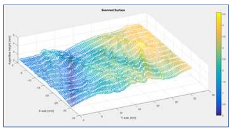
METHOD

On-site observation

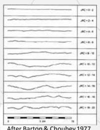


Roughness indices processing

Sample characterisation in the lab



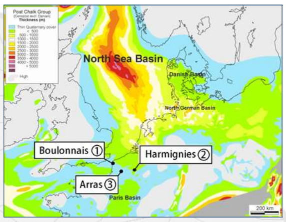
Numeric data acquisition

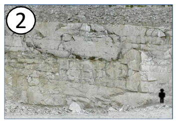


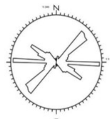
After Barton & Choubey 1977

GEOLOGICAL SITES

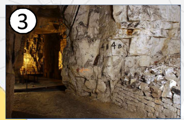
The clay-rich blue Chalk of the Blanc-Nez Formation was collected at Petit Blanc-Nez and Grand Blanc-Nez sites. It comes from the base of the Upper Cretaceous Series.



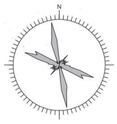




The Upper Cretaceous Campanian Obourg Chalk taken from Harmignies presents a finely grained lithology, is of very white colour, without chert.



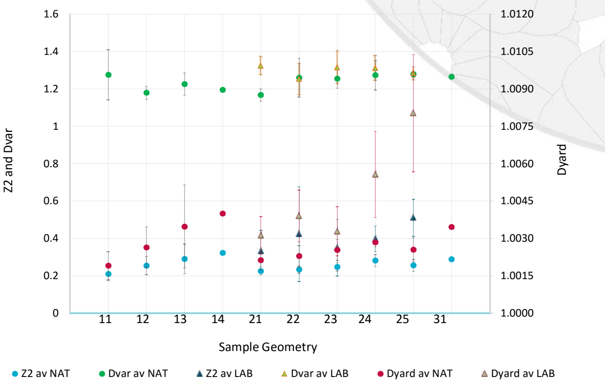
Upper Cretaceous Campanian Chalk taken from underground Arras quarries. Il is a fine grained lithology with regular layers of cherts.



ROUGHNESS INDICES

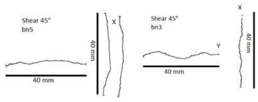
Roughness is also characterised by the average asperities height R_a and the associated standard deviation σ_a but clearer indicators of increasing surface complexity are the RMS 'Z2' factor and a fractal dimension D, here computed via the Yardstick method and via the Semi-variogram method.

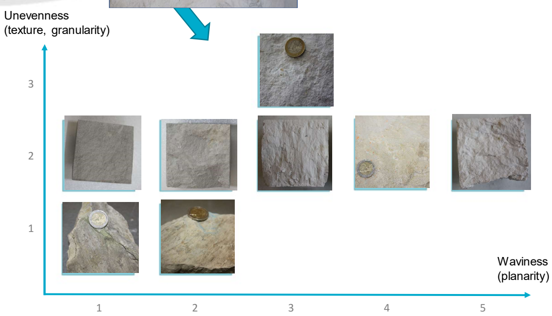
Roughness indices - natural & lab generated fractures



SMALL SCALE OBSERVATIONS

Observation in the lab of natural fractures surfaces (joints and fault planes) can be compared to surfaces obtained from cylindrical samples after tensile failure (Brazilian method), or shear failure produced under controlled loading. JRC profiles are taken using a steel gauge. Samples surfaces are visually compared on basis of their geometrical likeness, according to two parameters: granularity or 'evenness' and planarity or 'waviness'.





CONCLUSIONS

Chalk surface topography can be described by various means, which all depend on the scale at which the observation is made. This process starts from observation of the faults and joints within the rock mass on-site. Chalk from Harmignies (Belgium), Arras and Cap Blanc-Nez (France) was studied. The selected samples carried to the lab bear oriented fractures, that can be linked to the main tectonic systems they belong to. Test cylinders were cored and fractured by Brazilian tensile test or shear test. JRC profiles are drawn from natural fractures and lab-generated fractures then all samples were categorised based on visual observation, and scanned with a high-precision laser. The resulting asperities height measurements are used to compute statistical indices (R_a, σ_a, Z2 and fractal dimensions Dvar and Dyard). All in all, the process characterises chalk fractures from three different sites of the North-West European basin at large (metric) scale down to very small scale (sub-millimetric).

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