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Characterisation of fractured media: laboratorial tests and numerical modelling

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Usually the interpretation of dispersion in fractured media starts with some kind of flow modelling. This exercise leads to average properties of the fluid flow namely average velocity. From there transport modelling provides hydrodynamic dispersion coefficients, which combine mechanical dispersion and molecular diffusion. Analysis of lab tracer tests revealed that the average velocity is insufficient to explain the transport of solutes. In the lab we conducted a series of tests in a block of granite. An artificial fracture was created and it was crossed by a set of symmetrical boreholes. This permitted hydraulic and tracer tests. For most of the tracer tests advection dominated the transport of solutes. However the lab results show that under identical hydrodynamic conditions the transport of solute is different for inverse tests between pairs of boreholes. In order to explain transport of solutes, a measure of the dispersion of the fluid velocities is required. Also observed was the fact that some tests showed significant dispersion. As the volume open to fluid flow could be measured it could be compared with the theoretical volume, calculated using the residence time theory. Many of these theoretical values were larger, and a few much larger, than the measured value. To explain the discrepancy between measured and calculated volumes some sort of internal recirculation has to be considered. The temperature of the fluid also has influence in this kind of tests. The finite element numerical model Geocrack (developed at the Kansas State University, USA) was used to simulate numerically the temperature variation in the block of granite.