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Characterisation and monitoring of the Excavation Disturbed Zone (EDZ) in fractured gneisses of the Roselend underground laboratory: permeability measurements, transport property changes and related radon bursts

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The Roselend tunnel was drilled in the fifties by blasting in the micashists, granites and gneisses of the Méraillet massif (French Alps). It is situated on the shore of the Roselend reservoir Lake near its dam. Several tectonic shear fractures related to the Alpine orogeny intersect the dead end tunnel (with length of 128 m and section about 2 m), indeed the fracture density varies from 0.45 to 1 fracture per meter along the tunnel (Dezayes and Villemin 2002). Some fractures are partially or totally filled with secondary minerals. The flow rates of percolating water through the fractured medium are seasonal dependent. Large fractures drain a large fluid volume unlike small ones that drain limited fluid volume (Patriarche et al. 2007). The Roselend underground laboratory allows the study of the geochemical and geophysical responses of a fractured rock mass to periodic sollicitations due to water level variations of the nearby Roselend reservoir Lake. The tunnel was instrumented in the nineties to understand the relationship between radon (Rn-222) concentration and water level variations of the Roselend reservoir Lake (Trique et al. 1999). In order to characterize the geometry and the extent of the EDZ, core drilling and permeability measurements through pneumatic testing are performed along the Roselend tunnel. Drilled core analysis consists of direct observations at a macroscopic scale of fractures (density of fractures from EDZ) and also at a microscopic scale via thin sections. Method of pressure build-up in wells (Jakubick and Franz 1993, Bossart et al. 2002) is used to determine permeability profile along each borehole and hence to precise the extent and geometry of the EDZ. A strong correlation is observed between permeability profiles and the density of fractures estimated from core analysis. The extent of the EDZ appears to be about one tunnel radius i.e. one meter around the tunnel corridor.
Another experiment consisting of continuous differential pressure measurements between an obturated borehole and the tunnel is conducted to monitor the possible modifications of the transport properties of the EDZ due to hydraulical and/or mechanical sollicitations of the nearby Roselend reservoir lake. As radon level is controlled by emanation and transport path through the medium. The observed bursts of radon should be due to changes of the radon transport properties (Trique et al. 1999) of the EDZ. A correlation between the differential pressure variations and radon bursts is clearly observed. Radon bursts seem to be related to overpressure events that take place in the instrumented borehole. Which external sollicitations, hydraulical or mechanical, or both, induce such a behaviour?

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