Hydromechanical modelling of the hydraulic stimulation PX2-1 in Pohang (South Korea)

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Between January 2016 and September 2017, a sequence of five hydraulic stimulations were carried out in the two wells of the Pohang EGS project. In the well PX2, the first stimulation campaign was done by injecting cyclically during about two weeks a total volume of about 1970 m^3 with flow rates of up to 47 l/s and with very high well head pressures of up to 90 MPa (900 bar). The equivalent downhole pressure at the injection interval below the casing shoe (4208 m) is about 132 MPa, which is higher than both the vertical principle stress (rock overburden, ~109 MPa) and the minimum horizontal stress, which is smaller than the vertical principle stress if a strike-slip stress regime is assumed. Analysis of the micro-seismicity during the injections shows that the seismic events during the stimulation fall on a plane at several hundreds of meters away from the injection interval. This plane could be part of the fault system of the M5.4 earthquake.

We present first results from an ongoing modelling work to investigate the hydromechanical impact of the high pressures applied in PX2 on the observed plane of seismicity assuming that there is no direct highly conductive pathway connecting the inflow point and the supposed rupture plane. We use the numerical code CODE_BRIGHT, developed at UPC, to account for poroelastic hydromechanical effects in a 2-D vertical plane containing the supposed low permeable rupture plane (RP; Figure 1) and the source fault (SF) where water is injected in the PX2 well below 4208 m. For simplicity and because we have no data on the orientation of the different rock materials discerned by well logging along PX2, we assume that the different materials and also the source fault extend parallel to the rupture plane. We argue that these simplified assumptions are justifiable because many structures of fault zones found in the literature are highly anisotropic with alternating high conductivity disturbed zones and low permeable fault gouge zones parallel to the fault planes. Finally, we want to investigate a case with a direct high conductive pathway from the injection point into the assumed rupture plane.

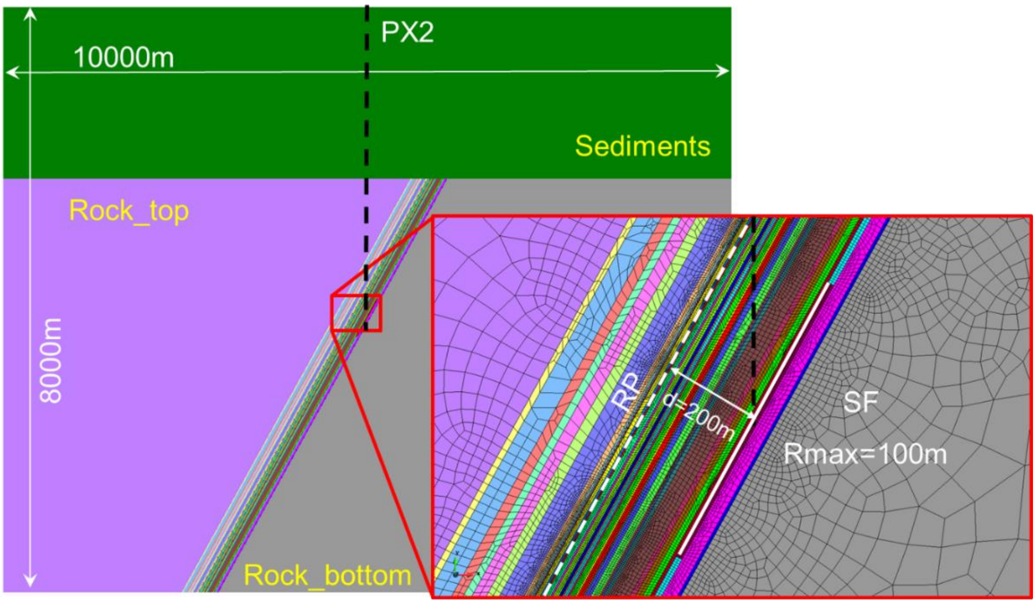

Fig. 1 2D vertical domain for poroelastic hydromechanical modelling of the first stimulation in the PX2 well. RP denotes the supposed rupture plane where micro-seismicity has been observed with assumed hydromechanical properties of a fault core zone, water is injected into the source fault SF within the open borehole section of PX2. The hydromechanical parameters of the different fault sections are derived from well logging data.