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Pressure responses of a geothermal doublet system: Field measurements and numerical simulations.

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This study addresses the hydro-thermal conditions of the geothermal research doublet E GrSk03/90 and Gt GrSk04/05 at the drill site Gross Schönebeck (north of Berlin, Germany). The prospected production well Gt GrSk04/05 with a true vertical depth of -4198 m has been finished in 2007, followed by three stimulation treatments to enhance productivity. At the top of the reservoir (-3815 m), the inclination of the production well is 18° and increases progressively to 48° at -4236 m. Therefore, the distance between the two wells increases from 241 to 470 m from top to bottom of the reservoir. The reservoir rocks are classified into two rock units from bottom to top: volcanic rocks (Lower Rotliegend) and siliciclastics (Upper Rotliegend) ranging from conglomerates to fine grained sand-, silt- and mudstones. The first stimulation treatment at the production well Gt GrSk04/05 in 2007 was applied in the low permeable volcanic rocks. During this stimulation a total volume of 13.000 m^3 with maximum flow rates of 150 l/s was injected. The corresponding pressure change at the well head was 586 bars. Simultaneously, the well head pressure at the neighbouring well E GrSk03/90 increases by approx. 1 bar (0.17%). To confirm this direct pressure response, three impulse tests were performed in 2009. During these tests a total volume of 135 m^3 with maximum flow rates of 3.6 l/s was produced from the well E GrSk03/90. The well head pressure decrease was 16 bars and the pressure response in the neighbouring well Gt GrSk04/05 was 0.025 bar (0.16%). Both, the stimulation treatment and the impulse test result in a direct pressure response in the neighbouring well and indicate a hydraulic interaction between both wells. This hydraulic interaction could be due to matrix flow and fluid flow in natural fracture and fault systems. In brittle crystalline or magmatic rocks, critically stressed faults are described as hydraulically transmissive due to a high fracture density in the fault damage zone. In the Gross Schönebeck reservoir, N to NE trending faults are interpreted as highly stressed shear faults exhibiting a high likelihood of reactivation under increased formation pressure (additional fluid pressure). In the volcanic rocks the well Gt GrSk04/05 is close to a NE-trending and W-dipping minor fault being – with respect to the local reservoir stress field - a highly stressed fault. A numerical reservoir simulation was developed including all important fault zones for advanced understanding of the observed field measurements. We will present the results of the field measurements, the model set up and the interpretation of the numerical simulation.