

#### Test 1: The water injection test

A deep abandoned natural gas well (depth of 6059 m), was available to perform a water injection test. The well penetrates the strata of the Middle Jurassic System ( $J_2$ ) and Lower Jurassic System ( $J_1$ ) to the Upper Permian System ( $P_2^{11}$ ). The injection test was conducted in the stratum of the Lower Shaximiao Formation of the Middle Jurassic System ( $J_2s^1$ ) at a depth of 1732 m-2654 m. The Lower Shaximiao Formation stratum ( $J_2s^1$ ) comprises mainly purplish red mudstone and sandy mudstone with fine sandstone and siltstone. The water was injected under high pressure into the aquifer, which is located between the depths of 2103.9 m and 2174.0 m and has a thickness of 70.1 m. An aquifuge with a height of  $> 100$  m is situated above and below the aquifer. Packers were set in the aquifuge region so that fresh water was only injected into the aquifer. The test was done during 112 h 40 min at a constant flow rate of  $2.2 \text{ m}^3/\text{h}$  through a high-pressure injection system. A total of  $247.87 \text{ m}^3$  of fresh water was injected.

The *time* from the dataset was the cumulative time of trial. The *injection pressure* from the dataset was the pressure from the sensor at the aquifer.

#### Test 2: The experiment based on Darcy's law

The apparatus was similar to the apparatus which Darcy used. The liquid we use was solution. The plastic column in the set was filled with silica sand with a mean diameter of  $1.12 \times 10^{-4}$  m. The height of the sand in column is 0.2 m. The inner diameter of the cross-section is 0.14m.

The *Molality* from the dataset was the molality of the mixed solution. The *flow rate* and hydraulic gradient from the dataset were same as Darcy's law.