Fracturing a fault … potential solution of CO_2 leakage event?

In an unlikely event that CO_2 is leaking from a storage site, action is needed to prevent CO_2 coming to the surface. Various corrective measures can be considered in the event of undesired migration of CO_2 injected in the deep subsurface reservoirs. One possible corrective measures is diversion of the injected CO_2 from a leaky compartment to an adjacent compartment, separated by a sealing fault. This measure requires creating a pathway for fluid migration between two originally non-connected reservoirs, which can be achieved, for example, by hydraulic fracturing across the fault.

After last week biggest anti-fracking demonstration in US history hydraulic fracturing becomes more and more a sensitive term. However in the research performed in the MiReCOL project the purpose of these fractures is quite different. In the U.S.A. fractures are used for unconventional gas and oil development, while in MiReCOL fractures are used to avoid further leaking of CO_2 from the storage reservoir.

In this study we investigate the effect of a hydraulic fracture through a sealing fault between two differently pressured neighboring compartments. The creation of such a fracture will cause a pressure equilibration between the two compartments. The speed of the pressure equilibration depends primarily on the pressure difference between the compartments and the conductivity of the new fracture.

Currently we are preforming a synthetic study for understanding the most important factors of the system. Later in the project a more realistic case will be modelled. The synthetic case consists of two depleted, adjacent reservoir compartments separated by a sealing fault (Figure 1). CO_2 is injected in one of the compartments. At some point during injection, CO_2 starts leaking from the storage reservoir. After leak detection, it is decided to divert CO_2 into the adjacent compartment with a lower pressure. A long horizontal well is drilled parallel to the sealing fault, which separates the two reservoirs. Then, multi-stage hydraulic fracturing is performed to create pathways for fluid migration across the fault, from the storage compartment into the neighboring compartment. We assume the fractures to be identical and equidistant. This reduces the model to a single slice with one fracture.

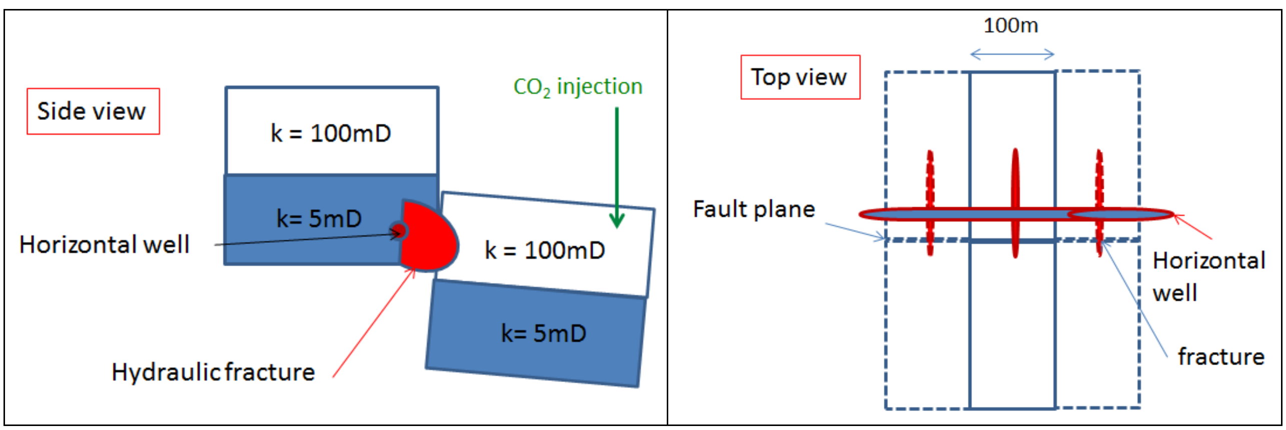

Figure 1. Schematic overview of the case setup: side and top view. In the side view, permeability k is indicated. In the top view, the lines indicate symmetry elements. A single slice delineated by solid lines is simulated.

A first appetizer of the results is presented in Figure 2. The pressure development due to the leakage is given by the red solid line, which shows a slow pressure decrease over time. The red dashed line shows the pressure in the storage reservoir; the blue dashed curve represents the pressure in the adjacent reservoir. The results show that, in this particular case, the pressure in the two compartments is equalized within a year and leakage stopped.

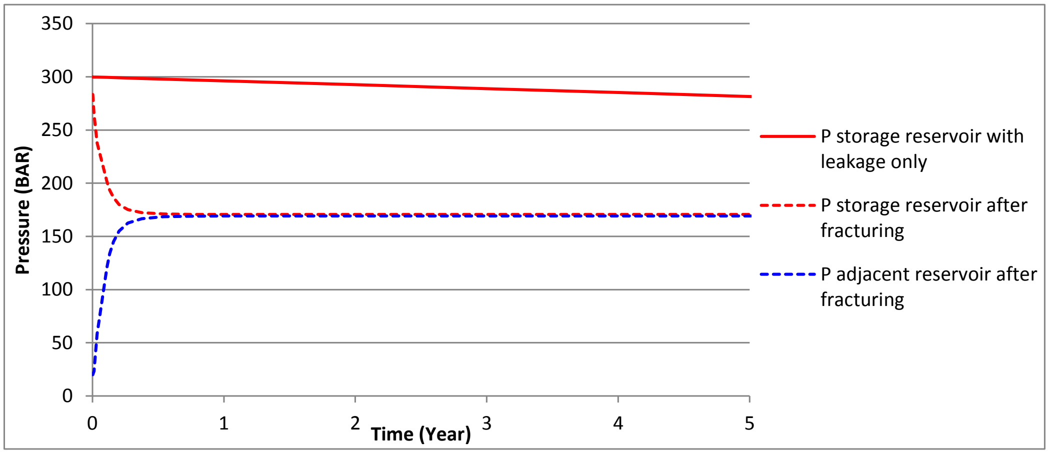

Figure 2. Pressure development versus time in two adjacent reservoir compartments connected by a single hydraulic fracture.

This first result is promising and a positive answer can be expected on the question stated in the title of this blog. But some puzzling questions remain , like how safe is it to create a fracture trough a fault? How to avoid fault re-activation? Many questions have yet to be answered in the MiReCOL project … to be continued.

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