Combination of computed X-ray tomography and triaxial geomechanical tests as a tool for fracture propagation prediction

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Abstract. Nowadays combination of various lab techniques in core analysis is a way to successful and detailed complex rock interpretation. One of the imaging techniques, computed X-ray tomography, nCT, is a tool for 3D pore geometry modelling in rocks. Using these techniques is possible to identify pores and fractures, their location, size, angle and aperture. Geomechanical test can simulate the stress-strain in in situ conditions.

Computed X-ray tomography was carried out in three steps: before, during and after triaxial compression test. Firstly, sample was scanned reflecting the natural pores and microcracks geometrical system. This CT results were treated as a reference image. The second CT measurements, during the geomechanical test, reflects the geometrical system in a stage of linear stress-strain relation. At that stage we suspect elastic relations, what means that pores and cracks probably were going back to the previous positions after geomechnical test. The third CT scan, after triaxial compression test, were analyzed from the point of cracks propagation and changes in pore space development. Images combinations before and after geomechanical test give the answer about the specimen reaction on stresses, so naturally on possible hydraulic fracturing during the reservoir exploitation. Qualitative and quantitative interpretation was based on diameters, angles, azimuths, directions, volume comparison of pores and cracks before and after the test. It appeared that the tested samples were prone to fractured in defined directions. As a tested data set were used samples of different lithological types: sandstones, shales and carbonates.

As a result of a novel combination of laboratory results, 3D image of different lithological samples before, at the stage of linear relation and after the stress-strain test was obtained. Changes, crack propagation and fracture directions were analyzed. Conducted analyses contributed to better recognition of rock pore and fracture system properties and more accurate planning of the fracturing process for unconventional hydrocarbon extraction.