3D dynamic imaging of pore scale processes in geomaterials

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Fluid flow and mass transport, dissolution and precipitation of minerals and the propagation of micro-fractures are all phenomena that take place on the pore scale in geomaterials. To fully comprehend the impact of these processes on large geological entities, a good understanding of the underlying pore scale dynamics is vital. In this context, 4D (3D + time) pore-scale imaging not only offers new and exciting insights, but such datasets are also useful to complement modeling studies at this scale, both to identify the phenomena to be included in the model as for validation purposes. The availability of high quality laboratory-based X-ray micro-CT scanners has enabled many researchers to image and analyze a geo-material's pore space in 3D [1]. However, a number of important challenges in both the acquisition and the analysis of 3D pore space information persists. Since the understanding of the dynamics of pore-scale processes requires fast in-situ, time-resolved imaging, a dedicated dynamic lab-based Environmental micro-CT scanner (EMCT) was developed at Ghent University's Centre for X-Ray Tomography (UGCT) [2]. The EMCT is designed for continuous scanning of objects which are difficult to mount on a rotation stage, for example because they are physically connected to external experimental hardware. Therefore, the source-detector assembly rotates around the sample, similar to gantry-based medical or small-animal scanners, but with the added advantage of a variable magnification. We will demonstrate the possibilities this set-up offers and illustrate some dynamic processes in geomaterials acquired in-situ in a lab environment.

[1] Cnudde & Boone (2013). *Earth-Science Reviews* 133 [2] Dierick et al. (2014). NIMB 324: 35-40.