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Freeze-thaw weathering: visualizing water and ice distributions on the pore scale

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Freeze-thaw weathering is one of the main contributors to disintegration of mineral building materials. Following the main theories on crystallization in porous media, unfrozen pore water is possibly drawn to sites of ice crystal growth, where crystallization pressure exerts force on the pore walls. Research that concentrates on these processes often use relatively large experimental setups and samples, and focus on proxies, such as length change and temperature of a sample. Therefore, mostly indirect evidence on the acting damaging mechanisms has been gathered over time. *In situ* monitoring of the water redistribution is a first logical step towards a direct assessment of the acting damage mechanisms. X-ray computed micro-tomography (μCT) has proven its value in earlier frost-related research and can be used to locate different phases within the pore space of different mineral materials. A custom-made freezing cell was installed on HECTOR (UGCT) to perform freeze-thaw cycles on a water-saturated porous limestone core. After producing a first μCT scan at a constant temperature of 4 $^{\circ}$C, the sample was cooled and kept at a constant temperature of -8 $^{\circ}$C and a new full μCT scan was taken. This cycle was repeated four times. Through image processing and analysis, it was possible to observe the volumes of water and ice throughout the freeze-thaw cycles. Moreover, by applying differential imaging, we were able to filter out differences between water-ice distributions, enabling us to observe several evolutions. Despite some restrictions and considerations, these observations help to improve the understanding of pore-scale processes.