Analysing salt precipitation-damage coupling in limestone with 4D X-ray tomographic imaging

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Keywords: salt precipitation, salt damage, X-ray CT, image segmentation, digital volume correlation

Abstract: An image processing workflow (Figure 1) employing different complementary techniques is presented to quantify the coupling between transport, salt precipitation, deformation and crack formation in a natural porous rock that was imaged with X-ray micro-computed tomography. This coupling plays an important role in the weathering of natural building stones and construction materials. When precipitation occurs within the pore space, stresses build up that can cause damage. Building materials are typically subjected to repeated cycles of precipitation and dissolution of salts, gradually weakening the material's strength and eventually leading to severe deterioration. In the analyzed experiment, one such cycle is studied with dynamic X-ray imaging, comprising the precipitation of NaCl and its subsequent deliquescence. As salt crystals precipitate, localised deformations are observed as well as the formation of cracks that partially close during deliquescence. A better understanding of the transport-precipitation-damage coupling based on in-situ experiments will lead to better prediction models for the durability of building materials, and assist in defining the best-suited prevention or conservation methods.

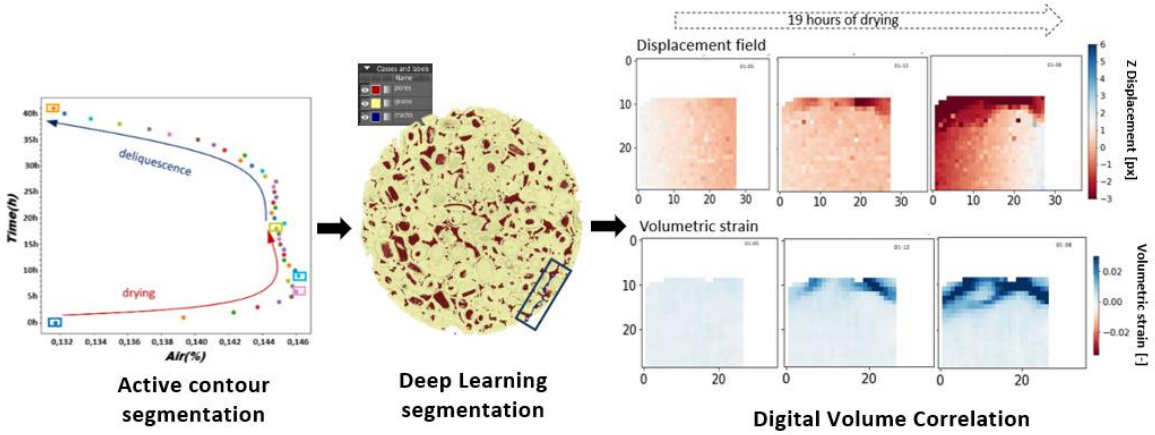

Figure 1: Image processing workflow

The authors acknowledge the support from the Research Foundation – Flanders (FWO grants 1276814N and 1521815N) and from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 850853).