Contribution ID : **96** Type : **Oral**

Studying early stage pedogenesis using on-the-fly bimodal tomography

Tuesday, 4 September 2018 09:00 (20)

Urbanization and increasing sealing of the landscape by impervious surfaces lead to fast water runoff in the cities. In urban areas, rain water is often channeled towards swales where it is left to infiltrate through recently engineered soil. As the runoff water is prone to carrying dissolved and colloidal contaminants, it is important to investigate the water infiltration process through soil at swales, estimating the soil's water filtering capabilities. Similarly, green roofs of buildings contain specifically designed engineered soils. It is expected that soil properties are gradually changing during first months and years after plants introduction. This may results in changed water retention capacity, evaporation rates, runoff amount and water filtration. The inner soil surface areas exposed to water flow paths need to be quantified for this purpose. Here it necessary to involve non-invasive imaging techniques because soil is one of the most complex porous media that is known. We have combined neutron and X-Ray tomography (NX) to elucidate the complex water flow through the organic matter rich engineered surface soil in the early stage of pedogenesis. Soils under study involved mixture of 20% topsoil, 50% sand, and 30 % compost as well as green roof growing media based mainly on crushed expanded clay and spongolite stone. One set of samples was prepared by packing of fresh material into aluminum cylinders, while the second set samples was collected from experimental plots after two months of pedogenesis. The complexity of the sample composition requires the information from a second imaging modality to reduce ambiguity in the interpretation. The challenge of the investigation was that the water flow through the sample is relatively high which required on-the-fly acquisition using both modalities. This provided bimodal volume pairs acquired simultaneously at the rate of one per 180s using the NX installation [1] at ICON, Paul Scherrer Institut, [2]. We will illustrate the image processing chain and show results from the preliminary analysis. The reconstruction was performed using our open-source CT reconstruction software [3] and includes correction for scattering correction [4].

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Session Classification : Speaker Sessions and Seminars

Track Classification : Geoscience