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Pore morphologies of root induced biopores from single pore to network scale investigated by XRCT

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Biopores are assumed to be an important factor for nutrient acquisition by providing biologically highly active soil-root interfaces to re-colonizing roots and controlling oxygen and water flows at the pedon scale and within the rhizosphere through the formation of branching channel networks which potentially enhance microbial turnover processes. Characteristic differences in pore morphologies are to be expected depending on the genesis of biopores which, for example, can be earthworm-induced or root-induced or subsequently modified by one of the two. Our understanding of biophysical interactions between plants and soil can be significantly improved by quantifying 3D biopore architectures across scales ranging from single biopores to pedon scale pore networks and linking pore morphologies to microscale measurements of transport processes (e.g. oxygen diffusion). While a few studies in the past have investigated biopore networks on a larger scale yet little is known on the micro-morphology of root-induces biopores and their associated rhizosphere. Also little data is available on lateral transport of oxygen through the rhizosphere which will strongly influence microbial turnover processes and consequently control the release and uptake of nutrients.

This paper highlights results gathered within a research unit on nutrient acquisition from the subsoil. Here we focus on X-ray microtomography (XRCT) studies ranging from large soil columns (70 cm length and 20 cm diameter) to individual biopores and its surrounding rhizosphere. Samples were collected from sites with different preceding crops (fescue, chicory, alfalfa) and various cropping durations (1-3 years). We will present an approach for quantitative image analysis combined with micro-sensor measurements of oxygen diffusion and spatial gradients of O_2 partial pressures to relate pore structure with transport functions. Implications of various biopore architectures for the accessibility of nutrient resources in soils and the potential of parameters derived from image analysis to be included in novel spatially explicit modelling approaches will be discussed.