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Visualizing the impact of living roots on rhizosphere soil structure using X-ray microtomography

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The rhizosphere is an interface between bulk soil and plant root and plays a critical role in root water and nutrient uptake. In this study, we used X-ray Computerized Microtomography (microCT) to visualize soil structure around living roots non-destructively and with high spatial resolution. Four different plant species (Helianthus annuus, Lupinus hartwegii, Vigna radiata and Phaseolus lunatus), grown in four different porous materials (glass beads, medium and coarse sand, loam aggregates), were scanned with 10 µm spatial resolution, using the microtomography beamline 8.3.2 at the Advanced Light Source, Lawrence Berkeley National Laboratory, Berkeley, CA. Sample cross section images clearly show contacts between roots and soil particles, connecting water films, air-water interfaces as well as some cellular features of the plants taproots. We found with a simulation experiment, inflating a cylindrical micro-balloon in a pack of air-dry loam aggregates, that soil fracturing rather than compaction might occur around a taproot growing in dry soil. Form these preliminary experiments, we concluded that microCT has potential as a tool for a more process-based understanding of the role of rhizosphere soil structure on soil fertility, plant growth and the water balance at the earth-atmosphere interface.