EGU24-6598, updated on 14 Jan 2025
https://doi.org/10.5194/egusphere-egu24-6598
EGU General Assembly 2024

Why, where, and when are there anoxic microsites in the rhizosphere – a microfluidic approach

Emily Lacroix[1], Giulia Ceriotti[1], Daniel Garrido-Sanz[2], Sergey Borisov[3], Jasmine Berg[1], Christoph Keel[2], Pietro de Anna[4], and Marco Keiluweit[1]

[1]Institute of Earth Surface Dynamics, Université de Lausanne, Switzerland (emily.lacroix@unil.ch)
[2]Department of Fundamental Microbiology, Université de Lausanne, Lausanne, Switzerland
[3]Institute of Analytical Chemistry and Food Chemistry, Graz University of Technology, Graz, Austria
[4]Institute of Earth Sciences, Université de Lausanne, Lausanne, Switzerland

For decades, biogeochemists have speculated that roots are key drivers of anoxic microsites – anomalous volumes of oxygen depletion – in upland soils. Rhizosphere-associated anoxic microsites are hypothesized to regulate plant contaminant uptake, nutrient availability, and the fate of root-derived carbon. However, despite the potential importance of rhizosphere-associated anoxic microsites, it remains unclear why, when, and where anoxic microsites form in the rhizosphere. Here, we pair planar optical oxygen sensors with microfluidic devices mimicking a soil structure to map the distribution of oxygen in a young wheat rhizosphere. We filled microfluidic devices with i) sterile; ii) wheat symbiont-inoculated, and iii) whole-soil community-inoculated nutrient solutions. As a result, we were able to determine root oxygen consumption vs. microbial oxygen consumption over space (i.e., at different root physiological features) and time (i.e., day/night cycles). We will show that i) intense root respiration within the root tip may drive anoxic microsite formation, even in the absence of microbial respiration; ii) microbial colonization of lateral root emergence may drive localized oxygen depletion in older root sections, and iii) overall rhizosphere oxygen depletion has a predictable, diurnal cycle dictated by the plant's photosynthetically active period. Our findings are the first to link root physiology to anoxic microsites, providing a strong basis for future studies of anoxic microsites in field soils.