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Mathematisch-Naturwissen-
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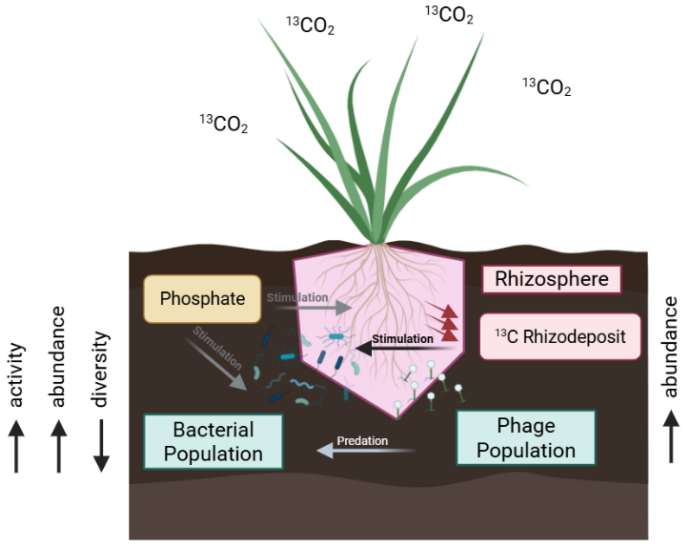
Fachbereich Geowissenschaften

MSc thesis project:

Piggyback or kill the winner? Reproductive strategies of phages in the rhizosphere and their role in phosphorus cycling

In most ecosystems, P is a growth-limiting nutrient for both plants and microbes. Soil microbes drive P transformations, making it more bioavailable to plants. The rhizosphere – the narrow soil zone shaped by plant roots – is a hotspot of microbial activity and nutrient cycling. In this environment, phages shape bacterial communities by inducing cell lysis, modulating metabolism, and supporting microbial diversity. Yet their role in rhizosphere phosphorus (P) mineralization remains elusive and may depend on their reproductive strategies.

Phages replicate in two ways: virulent phages kill their host and release new virus particles, while temperate phages can integrate into the host genome as "prophages" and replicate passively. The two strategies could influence soil P availability in different ways—either by releasing nutrients through cell lysis or by altering the metabolism of infected cells and their P acquisition.



This project will explore whether and how phage reproductive strategies shift in rhizosphere and bulk soil in response to organic P addition (focusing on the "Piggyback-the-Winner" or "Kill-the-Winner" strategies). We hypothesize that organic P addition will favor the virulent strategy by increasing the growth rates and abundance of phage hosts.

This project will quantify viral and microbial abundances, phosphatase enzyme activities, and the frequency of inducible prophages (via Mitomycin C assays) in rhizosphere and bulk soils with and without organic P supplementation. Students will gain hands-on experience in microbial ecology (DNA, virus and bacterial extraction, flow cytometry), soil biochemistry (enzyme activity measurements), and molecular biology (prophage induction assay).

Candidates should have knowledge of biology, biogeochemistry and/or environmental sciences. Self-motivation and independent work skills are essential. Working language is English. Students will be hosted in the Soil Microbial Interactions group in the Department of Geosciences (GUZ). For enquiries, please contact Jun.-Prof. Kyle Mason-Jones at k.mason-jones@uni-tuebingen.de.