

Master/Bachelor Thesis: Preferential flows in soils: a hot spot for trace element mobility and methylation?

Background and research question: Trace elements are usually found in soils at background (trace) levels but can also be found in very high levels in some areas and can thus represent an environmental issue threatening the health of the soil but also of the whole environment. These high levels can be anthropogenic (man-made) or geogenic (natural accumulation). These compounds are grouped under the name “Potentially Toxic Trace Elements” or PTTEs. In soils, some PTTEs undergo biomethylation, a mechanism by which their mobility and toxicity is enhanced and this mechanism is taking place under water saturated conditions. A prime example is mercury which transforms to the potent neurotoxic methylmercury when the soils are flooded. Soils are not homogenous and paths where the water infiltrates exists due to burrowing animals, root holes or cracks. It is not known if such preferential flow paths in soils could be hotspot of methylation due to the fact that they are more often water-saturated which leads to the following research question:

Are PTTEs more methylated and/or remobilised along preferential flows?

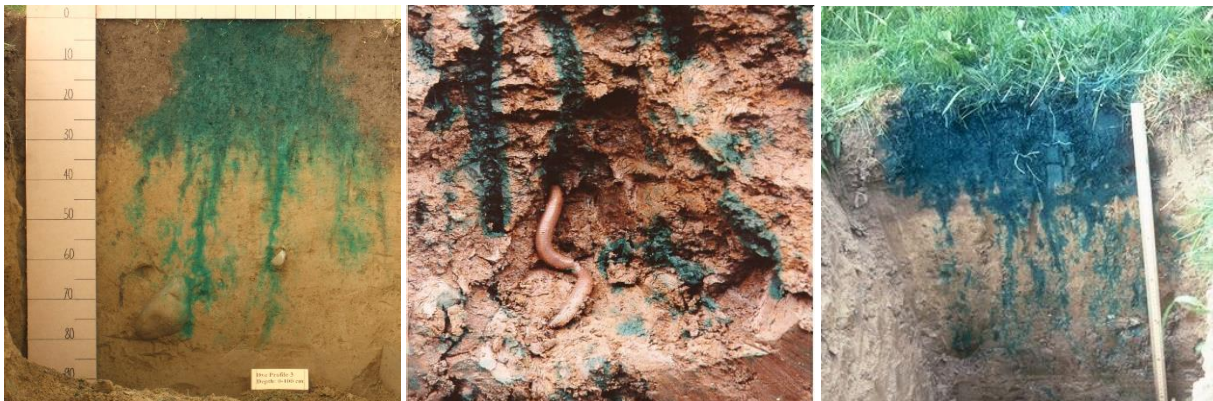
Project: The student will sample anthropogenically or geogenically contaminated agricultural soils situated in the Hg polluted floodplain situated between Visp and Raron (VS), in a shooting range polluted with antimony and lead (BE) and in an As contaminated corn field (BL). The sampling will use the traditional dyeing tracer method (see pictures below) to highlight where the preferential flows are. The student will sample dyed and undyed soils. The soil samples will be analyzed for trace elements and their methylated species using state-of-the-art techniques. Soil pH, CNS, %OM, grain size will also be analyzed. The student will compare the results for dyed and undyed soil. Depending on the student’s own interests and level of studies, the project scope will be adjusted. Starting date: flexible but sampling should start in spring.

Aims: Determine the trace element levels and speciation in soils situated around preferential flows and in bulk soils.

Learning goals: The candidate will learn laboratory and sampling techniques (trace element extraction and analyses). She/he will learn how to manage her/his own Thesis project (laboratory work, data analysis, interpretation, writing and presenting).

Prerequisite: For GIUB students, the candidate will have attended the course “Introductory laboratory techniques in physical geography” at the bachelor level. Candidates that have attended either Soil Biogeochemistry, Seminar in Soil Science, Lab course in Soil Biogeochemistry and Advanced Lab Methods in Physical geography I or II will be preferred.

Supervision and contact for more info: Prof. Adrien Mestrot adrien.mestrot@giub.unibe.ch



Preferential flow paths in soils indicated by blue dye (Landcare Research and Cornell University). Earthworm is often called the “pore generator” called