Research outline Lukas Kohl

Identification and preservation of lipophilic biomarkers for elucidating microbial contributions to surface and subsurface organic carbon reservoirs

Lipid geochemistry has helped deciphering the presence and composition of biotic communities in past and present environments (refs). Lipids hold information pertaining to the distribution of all three domains of life and are typically well preserved in many environments. Only recently have lipid biomarkers been analyzed for their isotopic signatures to study variations in carbon cycling and climate in these environments. Isotopic signatures of these molecules can provide carbon source and processing information for organic matter (OM) reservoirs.

Soil OM holds four times the global atmospheric carbon reservoir(refs), its potential vulnerability to climatic changes raised widespread concern regarding its role in climate feedbacks (IPCC 2007). The temperature sensitivity of soil OM is well recognized (refs), however, the large variation in temperature effects on microbial processes and turnover of soil OM (refs) suggests our current understanding is stymied by poor temporal representation. Similarly, deep Earth carbon reservoirs remain poorly understood, but findings suggest a potential role of microorganisms in the generation and processing of these reservoirs (Sherwood Lollar 1988, Ward et. al. 2002). Terrestrial sites of serpentinization are interface zones where fluids from the subsurface act as windows into subsurface biogenic and abiogenic carbon cycling.

My thesis will establish biomarkers to the study of OM reservoir cycling. It aims to apply a geochemical approach to understand (1) the effect of temperature on the composition and turnover of boreal forest soil OM pools, (2) the biotic and abiotic contributions to OM reservoirs at sites of serpentinization and (3) microbial communities in these contrasting environments and how they are linked to OM cycling. Therefore, I will establish a method for the isolation of lipophilic biomarkers (e.g. fatty acids, isopreonoids, n-alkyls, and sterols) and their compound-specific isotopic analysis (d13C, dD, D14C). Exploiting contrasting environments will provide a means to investigate preservation and the relationship between biomarker signatures and OM reservoir source, processing and fate. Lipid biomarkers and their isotopic composition will be used to further estimate the input of microbial 'necromass', the composition of the communities it is derived from, and its residence time in these OM reservoirs.