Rapid transformation of P across a podzol chronosequence in Northern Sweden

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Biological activity can accelerate soil processes and can thus have profound effects on weathering and the transformation of phosphorus (P). Here we show that the transformation of P is closely linked to soil development across an about 9000 years old soil chronosequence formed through glacial rebound. Easily weathered forms of P such as apatite are rapidly lost from the surface mineral horizon (within < 500 yrs) and these changes are coinciding with succession changes in the plant and microbial community structure. Long-term changes in P pools are, however, also dependent landscape topography. For instance, across a boreal landscape gradient, P concentrations increased dramatically in the surface soil of toe slope areas and decreased plant and microbial P availability [1, 2]. These differences are probably established already at early stages of soil formation.

Also environmental disturbances, such as wildfires can have profound effects on the distribution of P. In the absence of wildfires organic P will build-up at the surface of the mineral soil whereas regular wildfires rather promote losses of P [3]. Despite large differences in fire frequency (40 to 5, 300 yrs since last fire) only small differences in the distribution of P forms in the surface soil were found in a wildfire chronosequence [3]. Possible adaptations to temporal and spatial variations in the P distribution will be discussed further.

[1] Giesler *et al.* (2002) *Ecosystems* **3**, 300–314. [2] Giesler *et al.* (2004) *Ecosystems* **7**, 208–217. [3] Lagerström *et al.* (2009) *Biogeochemistry* **95**, 199–213.

Changes in microbial community structure and activity during amendment with long-term electron donor sources for bioreduction of groundwater contaminants

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Longer-term maintenance of reduced zones is considered a primary impediment to a biostimulation approach to uranium-contaminated groundwater remediation. Here we present an experiment exploring the use of slow-release substrates (SRS) to achieve longer periods of sustained U bioimmobilization. Objectives included tracking microbial populations as the subsurface manipulation zone transitioned through reduction and re-oxidation phases, correlating microbial and geochemical observations, and thereby improving predictions of the long-term effectiveness of remediation activities. SRS, consisting mainly of emulsified vegetable oil, was injected into a contaminant plume which was sampled for over 12 months. Prokaryotic communities were characterized using 16S rRNA gene pyrosequencing, and functional gene microarray and qPCR analyses.

The subsurface amendment of SRS resulted in sequential reduction of nitrate, Mn (IV), Fe (III), and sulfate over the first 20 d; soluble U concentrations decreased by >80% for up to 4 mo. and remained at <50% of original levels after >365 d. After 4 mo. gradual rebound of soluble sulfate, U, and nitrate in groundwater was observed. Members of the *Anaerosinus* and *Desulforegula* genera were identify as key taxa for performing initial oil degradation (triglyceride hydrolysis and long-chain faty acid-oxidition, respectively) and providing a sustained source of labile electron donors (e.g. propionate, acetate, H_2). Sulfate (*Desulforegula*, *Desulfovibrio*) and iron (*Geobacter*) reducers predominated and presumably acted syntrophically to achieve long-term U reduction. H_2-oxidizing, CO_2-reducing methanogenic archaea flourished after other electron donors and acceptors were largely depleted, suggesting that reduced zones persisted during the overall subsurface re-oxidation.