Biomethylation and biovolatilisation of arsenic in three contaminated soils of Switzerland

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Arsenic (As) is a toxic and ubiquitous pollutant that can exist under a range of different species in the environment. In soils, As can be remobilised and further methylated and volatilised by soil microorganisms. These two mechanisms, which are poorly understood, can change the toxicity and mobility of As by producing different As species. Furthermore, biomethylation and biovolatilisation are influenced by soil organic matter, Eh and pH. In order to better understand the soil processes leading to the methylation, and volatilisation of As in soils, we investigated three As-contaminated soils in Switzerland. Two are former Au/As mining sites (Astano in Canton Ticino and Salanfe in Canton Valais) and one is an agricultural area with high geogenic As (Liesberg in Canton Basel-Landschaft). We incubated fresh soils from the selected sites under flooded conditions with and without organic matter (OM, 2% cow manure). The incubators were fitted with silver nitrate impregnated silica gel traps to measure and identify the volatile As species produced and with rhizon samplers to monitor soil solution throughout the incubation period (total As, As species, DOC, Eh, pH Fe, Mn, and other trace elements were measured). After 10 days of incubation, all the investigated soils produced volatile As and the measured fluxes were between 0.85 and 1.9 µg/kg/yr which agrees with previous studies. The soil solution analysis showed a distinct difference between OM-amended and non-amended soils in terms of the methylation of As. The OM–amended soils produced more methylated As species. The underlying mechanisms leading to the formation of volatile and methylated As species as well as the implications for risk-assessment are also discussed.