Thawing of Arctic soils: control of trace element dynamics by organic matter

Y. AGNAN [1]*, M.A. ALEXIS[1], M. ROUELLE[1], C. ANQUETIL[1], D. OBRIST[2], S. DERENNE[1]

[1]Métis, Sorbonne Universités, Paris, France
(*correspondence: yannick.agnan@biogeochimie.fr)
[2]EEAS, University of Massashussetts, Lowell, MA, USA

The recent increase in temperatures in the arctic regions induces a permafrost thawing, thickening the active layer generally rich in organic matter. This modifies the quality and quantity of organic matter – such as trace elements – which is an important factor for mobilization of chemicals in the drainage basin. Soils and vegetation were sampled from two study sites: Toolik Field Station (Alaska, USA; annual temperature averaged −8 °C, continuous permafrost) and Abisko Scientific Research Station (Sweden; annual temperature averaged −0.8 °C, discontinuous permafrost). These sites are similar in terms of latitude (68°N), ecosystem (tundra and taiga), and distance from the Arctic Ocean (200 km). We can therefore consider Abisko as a climate projection for Toolik in the future.

Our main objective was to study the potential influence of organic matter in trace element mobility in Arctic soils related to the climate change. We analyzed trace elements (As, Cd, Cu, Mn, Pb, Se, Sb, Zn…) concentrations in soil and vegetation by ICP–OES and ICP–MS and characterized organic matter by solid-state ^{13}C NMR. Our first results showed that trace element concentrations were frequently negatively correlated to carbon content, except for Cd and Mn. This illustrates the main lithogenic origin of these elements in such remote environments. Vegetation in the two sites presented similar organic matter composition, showing the absence of influence of fresh organic matter in the arctic soil composition. An important variability, however, was observed for functional groups (*e.g.*, alkyl/O-alkyl ratios) in soils, particularly between the same horizons of different sites (intra-Toolik, intra-Abisko, and Toolik *vs* Abisko). This may be due to either differential decomposition depending on local environmental conditions, or translocation of organic matter by cryoturbation, particularly in polycyclic soils. Trace element concentrations showed variations among sub-sites and horizons, but no significant difference was observed between Toolik and Abisko.