Abstract

Worldwide, peatlands cover an area of 4.10^6 km^2. Plant primary production dominated over organic matter decomposition and enabled organic matter to accumulate during the last 11 000 years. Peatlands represent a reservoir of atmospheric carbon and they are a useful scientific tool for reconstructions of historical atmospheric pollution. The first part of the thesis focuses on peatlands as a dynamic carbon reservoir under predicted climate change that would influence carbon cycling and emissions of greenhouse gases into the atmosphere. Three methodological approaches were used – a mesocosm laboratory incubation, a transplant experiment and *in situ* gas flux measurements. The laboratory incubation studied the response of peat samples from temperate (Velké Dářko, Czech Republic) and boreal (Stor Åmyran, Sweden) zone to a temperature increase, water table decrease and their combination. Today, the warmer site exhibits ~14 times higher CH_4 production potential than the colder site (28 mg m^{-2} hr^{-1} at VD, and 2 mg m^{-2} hr^{-1} at SA). Both sites respond differently to temperature increases. Changes in methane production were up to 9 fold due to different temperatures. A gradual decrease of water table level from 2 to 14 cm below the peat surface had a much stronger effect, VD exhibited a decrease in methane production potential more than 100 times. Overall, peat samples from the temperate zone responded more strongly to the climate change than samples from the boreal zone.

In situ gas sampling compared methane emissions from an intact peatland and a long-term artificially drained peatland in the Ore Mountains. Long-term drainage could mimic water table decrease under predicted climate change. Drainage led to an invasion of *Carex*, *Molinia Caerulea* and Norway spruce from the edges into the center of the peatland. We focused on seasonal variability in methane fluxes across the two sites and controls on methane emissions. Higher water table fluctuation, higher within-site variability, and, surprisingly, threefold higher methane emission was found at degraded peatland compared to the intact peatland. Temperature and presence of *Carex* were the main controls on methane emissions. A direct effect of the water table level on methane fluxes was insignificant, compared to the indirect effect through changes in vegetation composition following long-term artificial draining.

The second part of the thesis focuses on peatlands as an archives of past atmospheric pollution. Lead concentrations in vertical peat profiles were compared to known historical atmospheric inputs at two sites in the Czech Republic and in the UK. Lead is believed to be immobile in the peat profile but few experiments have been done to test mobility of other trace elements. A transplant experiment between two sites with different geochemical properties was performed to study post-depositional mobility of Pb, Cu, Zn, Fe, Mn and Ti. After 18 months, peat cores from the home site were compared to transplants. Comparison of concentration records in vertical peat profiles lead to separating elements into two groups. The first group of mobile elements (Fe and Mn), converged to the host site patterns, whereas the second group (Pb, Cu, Zn, and Ti) were immobile.

Atmospheric depositions of another toxic element, beryllium (Be), were evaluated across a pollution gradient in the Czech Republic, using remote 10 mountain-top locations. Soluble and insoluble fractions of Be in rime and snow were measured and a comparison of fresh and old snow provided an estimate of vertical wet and dry deposition. Across the sites, 7 times higher concentrations were found in rime compared to snow (6.1 vs. 0.9 $ng.L^{-1}$). On average, 34% of the total beryllium was in soluble (bioavailable) form. Be inputs varied significantly across the country. The highest Be input was found in the northeast of the Czech Republic. Computing of backward trajectories using HYSPLIT model enabled to identify source of pollution – an industrial southern Silesia conurbation.