Abstract

Biogeochemical cycle of chlorine, particularly the formation of organically bound chlorine is still not well understood. In continental ecosystems chlorides act as source of chlorine, and also as a stress factor. Chlorides originate from precipitation of marine cloud masses. Organically bound chlorine in the environment is formed naturally by biotical and abiotical way. The biotical factors are microorganisms, plants, soil enzymes and animals. Volatile chlorinated hydrocarbons (VOCl) represent one group of organically bound chlorines. Several volatile chlorinated hydrocarbons reacts with atmospheric ozone, consequently causing depletion of the ozone layer. The most important known terrestrial source of volatile chlorinated hydrocarbons is the spruce forest ecosystem. Chlorine in the soil can be transformed by microorganisms into organically bound chlorine or translocated by transpiration stream in plants, where they are also transformed enzymatically into organically bound chlorine, and both of them can be emitted into the atmosphere. Too large amounts of chloride can affect the physiological functions of plants.

In this thesis experiments were designed for measuring the natural emissions of volatile halogenated hydrocarbons from plants and fungi, with various periods of incubation, and also to confirm the influence of addition of chloride to the halogenation processes. At first the suitability of analytical method was verified on standards of volatile halogenated hydrocarbons. It was found that for preconcentration of samples the most suitable SPME fiber is coated with carboxen/polydimethylsiloxane coating. For determination gas chromatography with mass spectrometric detection (GC-MS) was subsequently used.

Natural formation of volatile halogenated hydrocarbons by plants and fungi was confirmed experimentally. Both chlorinated and brominated volatile hydrocarbons were found to be emitted by the samples. The most frequently emitted compound was chloroform, which was emitted in the concentration range 2-28 ppm for fungi and 3-151 ppb for plants, followed by (E)-1,3-dichloropropene, tetrachloromethane, bromodichloromethane and 1,2-dibromoethane. The amount of emission depended on the incubation time, physiological condition of analyzed plants and fungi and was also influenced by the concentrations of added sodium chloride. According to my measurements low concentrations of sodium chloride in soil water (0,06 M) affected the halogenation processes in plants, thereby increasing the emissions of volatile halogenated hydrocarbons into the atmosphere. Higher concentrations of sodium chloride (0,12 M) can slow down or stop halogenation processes and kill the whole plant. It has been proved that addition of sodium chloride affects the natural halogenation processes of plants, thereby changing the amount of volatile halogenated hydrocarbons emitted into the atmosphere.

Key words: chlorinated volatile hydrocarbons, natural resources, bryophytes, ferns, fungi, salt stress, SPME, GC-MS