ABSTRACT

Soil organic matter dynamics at reclaimed and unreclaimed post-mining sites

The subject of this thesis is to explore soil organic matter sequestration in post-mining soils and its relation to other ecosystem properties. The results of this study are summarized in four manuscripts, which have either been published or submitted for publication in international journals.

On freshly mined-out overburden measurements of respiration revealed that the deep microflora community may substantially contribute to the microbial community in soil heaps, especially during early stages of succession and such influence early stages of pedogenesis. Microscopic observations also indicated massive breakdown of the sediment implying decomposition of fossil organic matter. For study of accumulation of soil organic matter, associated changes and interactions between chemical and biological soil properties over time, data from sets of plots of known different age(chronosequence) amended by data from repeated measurement after an extended period, allowed us to observe actual changes in soil chemistry, the carbon stock and soil properties. By this combination of these methods two separate studies were conducted at post-mining sites near the town of Sokolov in the Czech Republic (1999 and 2010). Soil pH decreased with site age, the decrease being more substantial in the upper soil layer. These changes over the 11 years were negatively correlated with the initial pH at the sites. The amount of soil carbon rose with site age. On the contrary, with site age, the rate of carbon accumulation declined (based on differences between the first and second sampling). The average increases in the carbon stock corresponded well to values determined by the chronosequence and real-time approaches. Changes in soil nitrogen content exhibited a similar pattern as changes in soil carbon content. Chronosequences in combination with repeated measurements are therefore a valuable tool for monitoring pedogenesis and interactions among soil, vegetation and the biota.

The results of recovering post-mining soil also depend on organic matter and associated microbial biomass, which is a basic precondition for successful restoration. The aim was to compare the dynamics of soil carbon fractions and the microbial communities associated with these fractions. Soil properties such as soil carbon, pH, bulk density and the light fraction of particulate organic carbon (POC) and bound in soil aggregates studied. Using bulk soil and POC fractions, the microbial community was examined for intermediate and late succession stages by phospholipid fatty acids analyse (PLFAs). Soil carbon content in both chronosequences increased and pH decreased with plot age. The amount of POC fractions (light, bound) increased with plot age. The light fraction was always greater than the bound fraction in both chronosequences. The higher amount and larger increase in both fractions was more pronounced at reclaimed than at unreclaimed sites. POC fractions affected the microbial community more than plot age. The microbial community of bulk soil in reclaimed plots was more similar to the community of the bound POC fraction. In unreclaimed plots, by contrast, the community was more similar to the light fraction. Observed differences in POC, and thus also the microbial community, correspond with the higher level of bioturbation at reclaimed sites, which promotes faster POC accumulation and brings the microbial community closer to bound POC.