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Pyrogenic carbon in temperate forests - long-lasting impact of historical charcoal production on soils and ecosystems

Alexander Bonhage¹, Thomas Raab¹, Anna Schneider¹, Alexandra Raab¹, Shaghayegh Ramezany¹, and William Ouimet²

¹BTU-Cottbus-Senftenberg, Geopedology and Landscape Development, Germany (alexander.bonhage@b-tu.de)

²University of Connecticut, Geosciences/Geography, United States of America

Pre- and early industrial charcoal production has left a striking legacy effect on today's soil landscapes in many forests of Central Europe and the North Eastern USA. Charcoaling in upright standing hearths (also called kilns) resulted in distinct circular micro relief structures, easily identifiable today in the field and on high resolution LiDAR-based digital elevation maps. Soils on these sites are characterized by one or multiple layers of decimetre thick charcoal rich substrate, which makes them Spolic Technosols according to the WRB soil classification. The focus of research on these sites increasingly deals with the difference of their soil physical and chemical properties in relation to unaffected forest soils and the potential implications for changes in vegetation and faunal growth. The controlling factor thereby is the soils large content of charcoal in various particle sizes, ranging from fine dust to large chunks. Studies have repeatedly shown the soils significant increase in total organic- and pyrogenic carbon content. The increase in total carbon stocks is thereby not only caused by pyrogenic carbon, but also by an apparently increased accumulation of non-pyrogenic organic matter. Here we present the latest findings regarding the carbon contents of centennially old charcoal rich technogenic substrates, sampled as part of multiple research projects in Brandenburg, Germany and the Litchfield hills in North-western Connecticut, USA. A focus will be the determination of highly aromatic carbon by the molecular marker Benzene-polycarboxylic acid (BPCA) and its prediction by FTIR-MIR chemometric methods. We discuss the results on forest soil carbon stocks on a site specific to a landscape and regional scale. Furthermore, the potential to use these sites to study the long term effects of charcoal admixture to soils by wildfires or biochar application will be discussed.