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A Field-, GIS- and FTIR based approach to assess the distribution and development of soils affected by historical charcoal production in western Connecticut, USA

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The effects of historical charcoal production on forest soil properties are increasingly well studied on sites in Europe and the northern USA. The most obvious effect of this past forest use practice is the addition of large quantities of charcoal into the soil at sites of former charcoal production. These so called relict charcoal hearth (RCH) sites are mapped in expansive numbers due to the rising availability of high-resolution LiDAR data. However, studies determining the impact of RCHs on more than a field plot scale are rare, so far. To transform results from specific RCH sites to a landscape scale, we sampled and measured 52 RCH sites on a 0.7 km² area in the Litchfield Hills in western Connecticut, USA.

In this study we combine field based measurements of RCH site stratigraphy and geometry, GIS-based spatial analysis of site locations, laboratory determination of soil organic and pyrogenic carbon and FTIR-based analysis of soil carbon. We aim at assessing the soil distribution and soil development in an RCH affected landscape, i.e. the distribution of three typical soils commonly found in these landscapes: natural forest soils, technogenic soils of RCH platforms and soils buried below technogenic soils. Furthermore, we determine the distribution of organic and pyrogenic carbon in these soils and specifically the variation of carbon contents within the technogenic RCH soil stratigraphy.

Preliminary results suggest that RCH site occurrence does not depend on relief position, i.e. RCH site abundance is not correlated with slopes, plateau or flatland positions. However, RCHs with multiple layers of technogenic substrates are more abundant on slope positions. RCH soils have a significantly increased content in total carbon compared to unaffected forest soils. Multi-layered RCHs have a heterogeneous vertical distribution of pyrogenic carbon and a possibly modern enrichment of organic matter in the surface soil. Wet chemical digestion of RCH soil samples coupled with FTIR analysis shows an increased presence of aromatic compounds and therefore pyrogenic carbon. However, the majority of carbon in RCH soils seems to be of non-pyrogenic origin. As of now it is unclear, whether the content of pyrogenic carbon is underestimated by

analytical uncertainties or if pedogenic processes are responsible for an enrichment of labile- and semi-labile organic carbon in the charcoal-rich RCH soil.