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Effects of historic charcoal burning on soil properties

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In Northeastern Germany the production of ironware between the 16th and 19th century left behind a remarkable amount of charcoal kiln remains. At the study site in the forests north of Cottbus, Rubic Brunic Arenosols are developed on Weichselian glaciofluvial deposits. Remote sensing surveys, underpinned by archaeological studies, show that charcoal was gained from several thousand kilns. The round charcoal kiln remains with inner diameters up to 20 m are smooth platforms elevated a few decimeters higher than the surrounding area. The remaining mounds consist of an about 40 cm thick sheet containing residuals of the charcoal production process such as charcoal fragments, ash but also organic material covering the Rubic Brunic Arenosols. The charcoal kiln remains are distanced only up to 100 m from each other. For the 32 square kilometers large study site, the ground area covered by such charcoal production residuals is about 0.5 square kilometer, i.e. 1.5% of the study area. The charcoal kiln sites are a remarkable carbon accumulator on the sandy parent material. Against this background, we aim to characterize the effects of pyrolysis and the enrichment of carbon, induced by the charcoal production, on soil properties. Field work was done during archaeological rescue excavations on three charcoal kiln relicts having diameters of about 15 m. We applied 150 l of Brilliant Blue solution on six 1 square meter plots (three inside, three outside of the charcoal kiln mound) and afterwards trenched horizontal and vertical profiles for recording the staining patterns. Undisturbed soil samples to study soil micromorphology and further undisturbed samples for characterizing soil physical and hydraulic properties were taken.
Outside of the charcoal kiln remain the Brilliant Blue solution drained within less than 10 minutes, whereas on the charcoal kiln remains the draining took between 20 and 40 minutes. Preliminary laboratory analyses underline the findings from the field and indicate that the carbon rich kiln residuals have a higher field capacity than the surrounding Arenosols. The matrix potential of the carbon rich kiln substrate is high and water drop penetration time tests show high water repellency. Our findings suggest that although the charcoal production led to an enrichment of carbon in the landscape, the hydraulic properties of the remaining ash layers can have negative effects on the water supply for plants.