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Spatial and temporal changes of soil organic carbon content since time of reclamation of mine soils in a semi-arid environment of Australia

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Quantifying carbon fluxes in reclaimed mining environments informs about the success of rehabilitation. Increasing soil organic matter (SOM) improves crucial functional properties of soil; thus, it is highly desirable to promote SOM accumulation in rehabilitated mine soils. The carbon content is often used as a surrogate to describe the status of soil health. Organic carbon in soils contributes to nutrient storage and exchange for plant growth, but also improves water storage capacity and microbial activity. Particularly for poor quality soil substrates with low clay contents, like many spoils from open-cut mining, elevating the carbon concentration is an ideal means to improve the soil quality.
The objective of the study was to investigate the change of SOC of re-established soils in mining dependent on the length of time since reclamation under different types of vegetation communities in a semi-arid environment of Central Queensland, Australia.
Deviating from standard sampling programs, the SOC of the soil profile was determined in small depth sampling increments from the surface following the assumption, that fresh (green) organic matter will be highest close to the surface and that in semi-arid environments, the dislocation of organic matter to depth by precipitation and microbial activity will be limited. The investigations showed that the most recently rehabilitated sites (>3 years post rehabilitation) show a high organic carbon (OC) gradient decreasing from the surface downwards into the soil. The highest concentration of OC was generally found in the first cm from the surface. Below a depth of 5cm no increase of OC with time since reclamation (max. 25 years) could be determined. An increase of OC with time could be determined, although it appears that even after more than 20 years since reclamation the concentration and depth distribution of OC of an unmined soil could not be rebuilt. Thus, it may be inferred that introducing support practices of rehabilitation management that e.g. optimize root distribution down the soil profile may increase green carbon content at such locations. Appropriate management practices may relate to the types of plants (and therefore litter) favoured or the promotion of soil conditions conducive to plant root growth at depth and further increase OC content across the soil profile.