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Isotopic evidence for the formation of unusually humus-rich soils in the Baltic region

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Arable mineral soils in the Pleistocene landscape of Northern Germany usually contain about 4 to 8 kg of organic C (Corg) per m2, most of which is visually recognizable concentrated in the tilled topsoil horizon. Some unusually humus-rich (10 to 20 kg Corg m-2), and deeply (> 70 cm) dark-colored soils in coastal regions with mollic properties have been classified as Chernozems. Their location far away from the middle German and Central European Chernozem regions, absence of steppe vegetation and semi-arid climate conditions make classical pedogenetic theories doubtful. However, non-targeted mass spectrometric analyses of soil organic matter (SOM) composition revealed great similarities with typical Chernozems worldwide (Thiele-Bruhn et al., 2014) and made alternative (e.g. waterlogged) pathways of SOM accumulation unlikely. Subsequent detailed multi-method SOM analyses down the soil profiles revealed relative enrichments in cyclic ("black carbon") and heterocyclic organic compounds in the deeper, bioturbated horizons. These were plausibly explained by the input of combustion residues, likely originating from anthropogenic activities because spots of these soils coincided with archeological artifacts of early settlements (Acksel et al., 2016). However, these finding could not completely explain the genesis of Chernozems in the Baltic region. Therefore, we actually explored isotope analyses (12/13C, 13/14C, 14/15N, 32/34S) to find out the origin of these unusual SOM enrichments and the time period in which it occurred. The results will be compiled to a consistent hypothesis on the formation of these soils in the Baltic and other Northern European regions.

References

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