

Deep fossil carbon - spatial and temporal variability of organic matter pools in permafrost

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The estimation of the carbon pool stored in arctic permafrost and its biogeochemical characteristics are essential topics in today's permafrost research. While the uppermost cryosol horizons are well-studied and already recorded in the Northern Circumpolar Soil Carbon Database (NCSCD) there are still large uncertainties concerning the quality and distribution of deep (i.e. up to decameters) organic carbon stocks.

Well-exposed permafrost sections along the arctic sea coast and river banks in northern Yakutia are excellent objects to study permafrost organic carbon characteristics in connection with cryolithology, cryostratigraphy and past periglacial landscape dynamics.

Organic carbon occurs in permafrost as large tree trunks, peat inclusions, twigs and root fragments, other solid plant remains, and finely distributed plant detritus, but also as fossil mammal remains, insects, aquatic zooplankton and -benthos, and soil microorganisms, and finally its decomposition and metabolic products in terms of particulate and dissolved organic matter. These different kinds of fossil organic matter were formed, deposited, frozen, thawed and partly degraded, and sometimes refrozen, under different paleoclimatic and paleogeographical conditions of the Quaternary past. Therefore, the deep permafrost organic carbon pool is far from homogeneous and strongly linked to depositional and permafrost dynamics as well as the ecological and climatic history. The archive of specific biogeochemical and cryolithological features of frozen ground is recorded in permafrost sequences of about the last 200.000 years in northern Yakutia. We present the variabilites of the spatial distribution of organic carbon and organic matter qualities between different stratigraphical units, between correlated stratigraphical units of several sites, and even within stratigraphic units at the same site.

Especially the coverage and composition of the widely distributed late Pleistocene Yedoma horizons and its thermokarst-affected derivatives in alas depressions are of interest to climate modeling, microbiology or biochemistry. There are significant differences to former estimates of the area, thickness of the relevant frozen deposits, ground ice content and finally in organic carbon content that lead to a reassessment of the deep permafrost carbon pools of the northern high latitude Yedoma region.