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A detailed Holocene glacial-periglacial reconstruction based on multidisciplinary studies of a 60 m permafrost core from central Svalbard

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During summer 2012, a 60 m sedimentary permafrost core was retrieved from the lower part of the Adventdalen Valley, central Svalbard, as part of the Longyearbyen CO_2 project. The core was taken in 3 m long sections, with 20 % core loss, and reached the sedimentary bedrock (Lower Cretaceous). Thus our samples had the potential to represent the entire Quaternary and reflect changes in the sedimentary environments through time. The stratigraphy and sedimentology of the core was first investigated, to establish an overall geological model for the sampling site. The general stratigraphy encompasses a layer of basal till at the bottom of the core. This is overlain by marine sediments documenting a transition from glacial-proximal to open-marine conditions. Subsequently, a thick package of deltaic sediments records the progradation of the local river system. Finally, aeolian sediments, characterizing the modern environment, form the top few meters of the core.

The ice content of the permafrost is generally low. Gravimetric water content generally ranges between 20% and 40%, but is considerably higher in some ice-rich layers. High resolution optically stimulated luminescence dating of the core sediment shows that deposition was very fast and took place primarily during the mid Holocene, with very rapid sedimentation of around 4 m/ka. With the onset of aeolian deposition (around 3-4 ka) the sedimentation rate decreased significantly to 1m/ka.

The microbial diversity and activity of the core are being studied displaying decreasing activity with depth. Microbial community and functional gene numbers indicate variations with depth and geochemistry. Incubation studies have been performed primarily on the upper 30 m, and indicate a potential CO_2 production from all depth intervals being studied.

The potential for using foraminifer studies for both dating and palaeoenvironmental reconstructions are evaluated with the intension of comparison with previous studies of marine sediment cores both from the fjords in the Svalbard area and from the Barents Sea and Fram Strait region.

This multidisciplinary approach is allowing us to build the first detailed palaeoenvironmental reconstruction of the Holocene glacial-periglacial interaction in the lowlands of central Svalbard; this includes a detailed reconstruction of the permafrost conditions.