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Podzol development in S Norway – a soil chronosequence of 31 pedons covering soil ages from 85 to 9650 years

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The Oslofjord region in SE-Norway has undergone steady glacio-isostatic uplift all over the Holocene. Hence, in the coastal areas land surface age continuously increases with elevation, providing suitable conditions for studying soil development with time. A chronosequence of soils on beach sand and sandy terraces of the Lågen River, showing progressive podzolization with soil age, was studied on the western side of the Oslofjord. 31 pedons with soil ages ranging from 85 years (0.25 m a. s. l.) to ca. 9650 years (62 m a. s. l.) were described and are currently analysed. Soil ages were estimated by relating elevations of the sites to a Holocene relative sea level curve based on twelve AMS 14C-dates of gyttja from the isolation contact (marine / fresh water boundary) and six marine macrofossil 14C-dates (Sørensen et al., 2012).

The climate in the study area is comparatively mild, with mean annual temperatures ranging from 5.3°C (Ramnes) to 6.3°C (Sandefjord, Larvik) and a mean annual precipitation of 909 mm (Sandefjord) - 1150 mm (Stokke). The vegetation consists predominantly of mixed forest.

In this soil chronosequence, soil organic matter (SOM) accumulation in the A horizons reaches a steady state in less than 2300 years, while SOM in the B horizons continues to accumulate. Soil pH (in water) drops from pH 6.9 in the recent beach sand to pH 4.6 within about 4500 years and stays constant thereafter, which is attributed to sesquioxide buffering. Base saturation shows an exponential decrease with time. Progressive weathering is reflected by increasing Fed and Ald contents, and proceeding podzolization by increasing amounts of pyrophophate- and oxalate-soluble Fe and Al with soil age. Increases of most Fe and Al fractions can be best described by exponential models.

Micromorphological analysis reveals accumulation of cloudy, iron-rich, reddish fine material in the Bs horizons that proceeds with soil age, leading to chitonic c/f-related distribution in the Bs horizons. The mineralogical composition of the parent material is dominated by quartz and feldspars, whereby the feldspar grains show features of proceeding weathering with time. In addition to podzolisation features, illuvial clay is observed below the Bs horizons. Apparently, the sand is sufficiently buffered during the first millennia of soil formation so that acidification proceeds slowly enough to allow for clay translocation prior to podzolisation.

Reference

Sørensen, R., Høeg, H.I., Henningsmoen, K.E., Skog, G., Labowsky, S.F., Stabell, B. (2012): Utviklingen av det senglasiale og tidlig preboreale landskapet og vegetasjonen omkring steinalderboplassene ved Pauler, Larvik kommune, Vestfold. In: Jaksland, L. (Ed.), E18 Brunlaneprospektet. Varia 79. Kulturhistorisk Museum, University of Oslo.