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Late Pleistocene to Holocene soil development and environments in the Long Gang Volcanic Field area, Jilin Province, NE China

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Late Pleistocene to Holocene shifts of climate and vegetation in the Long Gang Volcanic Field in NE China have been reconstructed, e. g. by Steblich et al. (2009), based on Maar lake sediment cores. In this study, we investigated soil development during the Late Pleistocene and Holocene and linked it to the climate and vegetation reported in the literature.

Three pedons were described and analyzed on a crater wall surrounding a maar. The lower part of the slope is covered by basic pyroclastics that are obviously younger than the maar itself. Pedon 1 is located on the upper slope, where the younger pyroclastics are not present; thus it developed over the entire Holocene and part of the Late Pleistocene. Pedon 2 is on the toe slope and developed from the young basic pyroclastics. Vegetation remains, charred by fire that was caused by the volcanic ash fall, were found in the lowermost part of the pyroclastics layer, on top of a paleosol. Charcoal fragments were dated to 18950-18830 cal BP (using INTCAL 09). Thus, pedon 2 developed since around 18.9 ka BP, whereas the development of the paleosol that was buried under the pyroclastics (pedon 3), was stopped at this time. Pedons 1 and 2 are Vitric Andosols, developed mainly from basic pyroclastics, as evidenced by the composition of rock fragments in the soils, comprising 78 / 81 mass % lapilli and 22 / 19 mass % gneiss fragments, respectively. Pedon 3 is a Cutanic Luvisol (Chromic) that developed entirely from gneiss fragments produced by the maar explosion. Lab data suggest increasing intensity of pedogenesis in the direction: Pedon 3 (paleosol) < Pedon 2 < Pedon 1, reflected e. g. in increasing Fed/Fet ratios, decreasing molar ratios of (Ca+K+Na)/Al, and decreasing pH. However, it needs to be considered that lapilli are more readily weatherable than gneiss fragments. The profile morphology of the paleosol, characterized by reddish-brown color (7.5YR), strong angular blocky structure and well-expressed illuvial clay coatings, rather indicates that it developed over a longer time-span and/or warmer climate than the two yellowish-brown surface soils. Since the morphology of the paleosol clearly reflects interglacial climatic conditions and forest cover, it most likely started developing during the Eemian.

Steblich et al. (2009) reconstructed for the period 16.7-14.45 ka BP steppe with Betula (and minor proportions of Larix, Alnus, Picea and Salix). We assume a similar environment for the time of the deposition of the pyroclastics (18.9 ka BP) in the toe slope profile. The character of the steppe was probably more open at this time, but the presence of at least few scattered trees over the steppe is evidenced by a charred tree trunk that was found in the profile. During Holocene, vegetation consisted mainly of deciduous forest, until anthropogenic influence increased from around 1850 AD on.

Reference:

Steblich, M., Mingram, J., Han, J., Liu, Y. (2009): Late Pleistocene spread of (cool-)temperate forests in Northeast China and climate changes synchronous with the North Atlantic region. Global and Planetary Change, 65, 56-70.