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Late Quaternary paleoenvironmental records from the Chatanika River valley near Fairbanks (Alaska)

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ABSTRACT

Perennially-frozen deposits are considered as excellent paleoenvironmental archives similar to lacustrine, deep marine, and glacier records because of the long-term and good preservation of fossil records under stable permafrost conditions. A permafrost tunnel in the Vault Creek Valley (Chatanika River Valley, near Fairbanks) exposes a sequence of frozen deposits and ground ice that provides a comprehensive set of proxies to reconstruct the late Quaternary environmental history of Interior Alaska. The multi-proxy approach includes different dating techniques (radiocarbon-accelerator mass spectrometry [AMS ^{14}C], optically stimulated luminescence [OSL], thorium/uranium radioisotope disequilibria [^{230}Th/U]), as well as methods of sedimentology, paleoecology, hydrochemistry, and stable isotope geochemistry of ground ice.

The studied sequence consists of 36-m-thick late Quaternary deposits above schistose bedrock. Main portions of the sequence accumulated during the early and middle Wisconsin periods. The lowermost unit A consists of about 9-m-thick ice-bonded fluvial gravels with sand and peat lenses. A late Sangamon (MIS 5a) age of unit A is assumed. Spruce forest with birch, larch, and some shrubby alder dominated the vegetation. High presence of *Sphagnum* spores and Cyperaceae pollen points to mires in the Vault Creek Valley. The overlying unit B consists of 10-m-thick alternating fluvial gravels, loess-like silt, and sand layers, penetrated by small ice wedges. OSL dates support a stadial early Wisconsin (MIS 4) age of unit B. Pollen and plant macrofossil data point to spruce forests with some birch interspersed with wetlands around the site. The following unit C is composed of 15-m-thick ice-rich loess-like and organic-rich silt with fossil bones and large ice wedges. Unit C formed during the interstadial mid-Wisconsin (MIS 3) and stadial late Wisconsin (MIS 2) as indicated by radiocarbon ages. Post-depositional slope processes significantly deformed both, ground ice and sediments of unit C. Pollen data show that spruce forests and wetlands dominated the area. The macrofossil remains of *Picea*, *Larix*, and *Alnus incana* ssp. *tenuifolia* also prove the existence of boreal coniferous forests during the mid-Wisconsin interstadial, which were replaced by treeless tundra-steppe vegetation during the late Wisconsin stadial. Unit C is discordantly overlain by the 2-m-thick late Holocene deposits of unit D. The pollen record of unit D indicates boreal forest vegetation similar to the modern one.

The permafrost record from the Vault Creek tunnel reflects more than 90 ka of periglacial landscape dynamics triggered by fluvial and eolian accumulation, and formation of ice-wedge polygons and post-depositional deformation by slope processes. The record represents a typical Wisconsin valley-bottom facies in Central Alaska.

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