Periglacial alluvial fan activity over the last 100 ka: insights from a study of the Eerbeek fan (The Netherlands)

Willem Viveen [1], Jeroen M. Schoorl [2], Jakob Wallinga [2,3], Sanne Palstra [4], Johannes Van der Plicht [4]

Introduction

Periglacial fans are common in NW Europe, but in the literature little attention has been given to their formation in relation to climate variations over a full glacial-interglacial cycle. We have reconstructed the evolution of a periglacial alluvial fan in the Netherlands (see Fig. 1) over the past 100 ka by combining the reconstructed 3-D, stratigraphic architecture of the fan with a geochronological framework of age control by 38 samples from two separate sediment cores by means of optically stimulated luminescence (OSL) and radio carbon (advanced ^{14}C) methods.

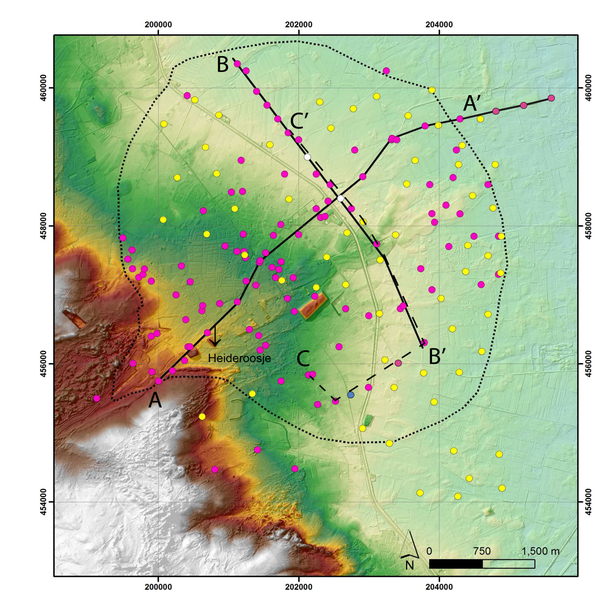

Figure 1. General overview of the Èerbeek alluvial fan. Dots are indicating Core and CPT locations. Transect B cuts straight trough middle the fan area.

Eerbeek alluvial fan

On the basis of 160 geophysical (CPT Cone Penetration Test) and borehole logs (>50 m deep), a reconstruction was made of the subsurface of the Eerbeek fan (Fig. 2). A total of 11 main layers were reconstructed (A to K). The base of our reconstruction is formed by a thick peat layer of Eemian (MIS 5e) age (Unit A) with on top the earliest deposits of the Eerbeek fan (Unit B), followed by alternating deposits of clastic fan material, Aeolian cover sands and peat layers. Interfingering sediments of the Weichselian Rhine were also detected, showing occasional inundation of the distal parts of the Eerbeek fan.

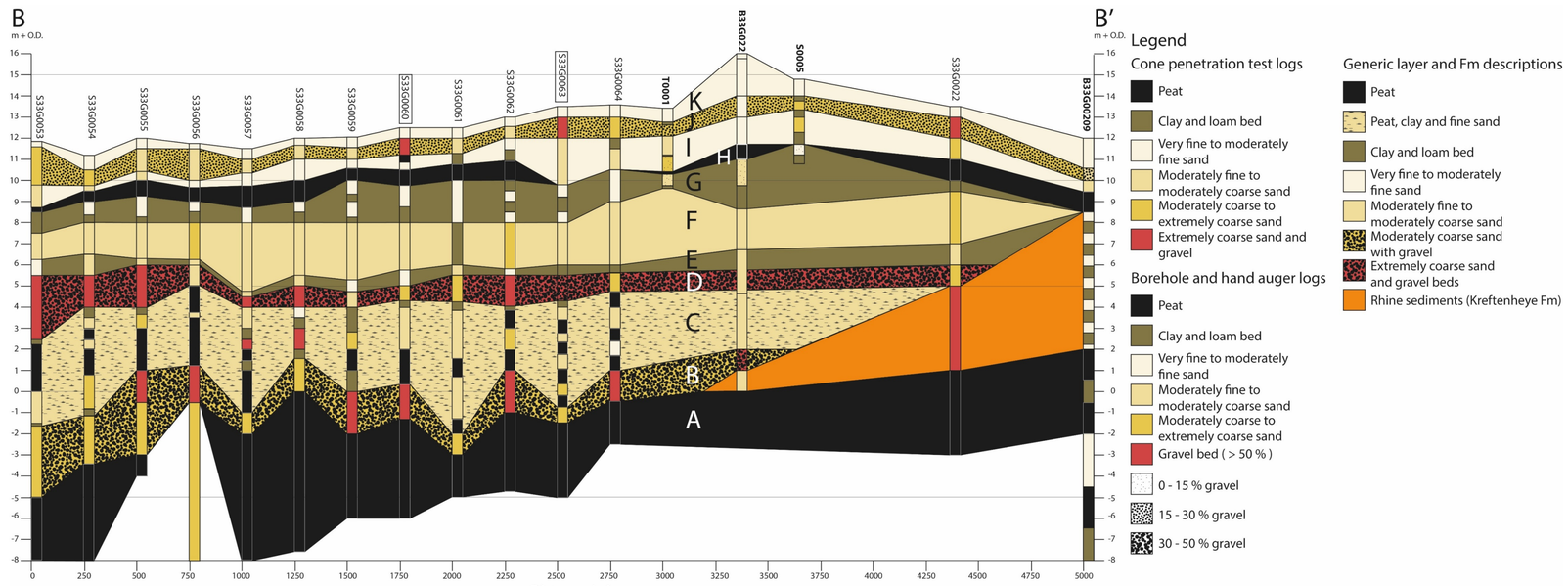

Figure 2. Example of correlations of the most important formations and sediments for cross-section B. Location cross-section indicated in Figure 1. Note repetition of units and formations as indicative for different depositional and process environments related to climatic changes.

OSL and ^{14}C dating of alluvial clastic deposits & peat layers and the resulting sediment volume reconstructions

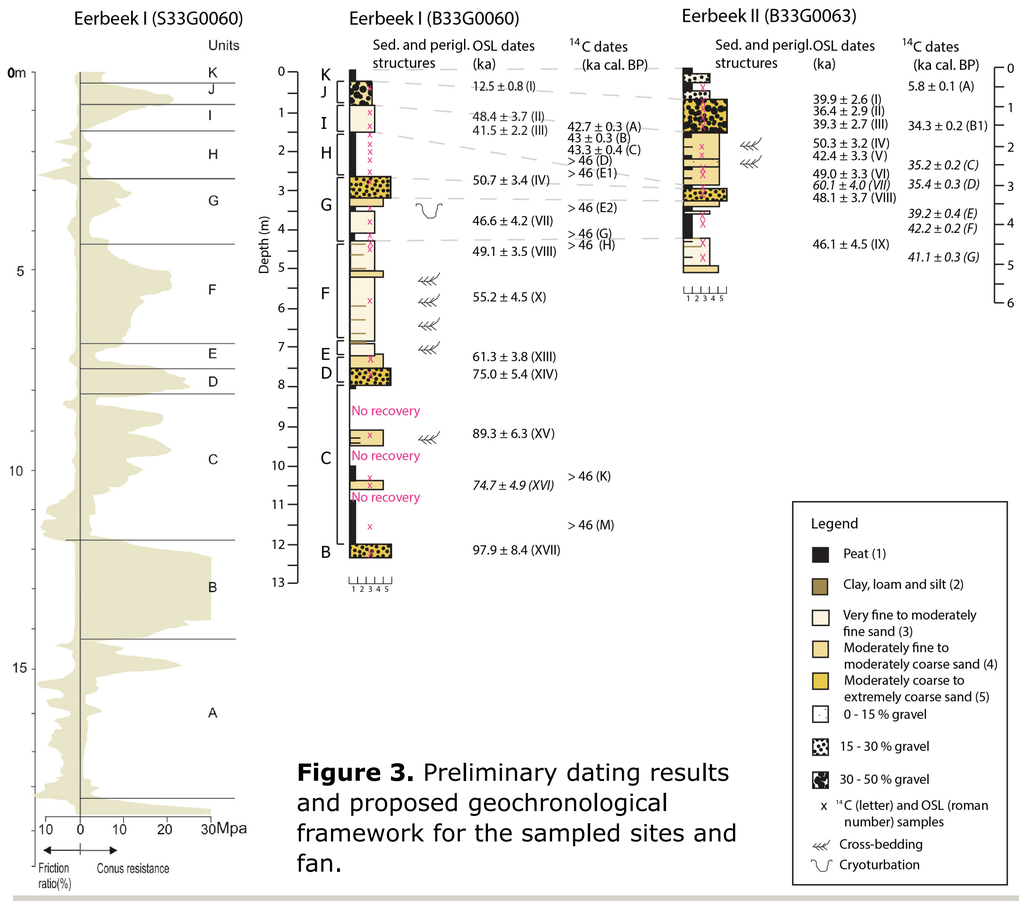

Figure 3. Preliminary dating results and proposed geochronological framework for the sampled sites and fan.

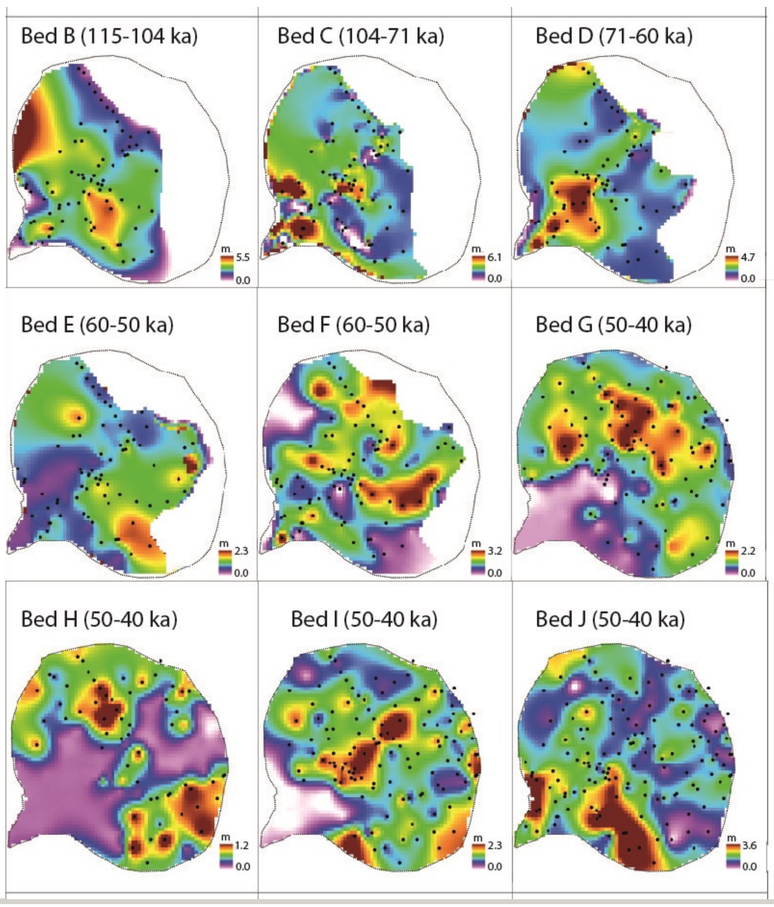

Figure 4. Alluvial fan sediment volumes for reconstructed layers according B to J related to the geochronological framework.

Conclusions

- The age control provides a correlation with major Marine Isotope Stage transitions as well as D/O-events during the last glacial period for the mayor units (A, B, C, etc).
- The depositional centre shifts its position from more proximal to distal locations revealing the complex build-up history of the fan.
- Fan aggradation rate calculations show a general increase from MIS 5d towards MIS 3, after that a decrease towards the Holocene (MIS 1).
- The lower activity during MIS 2 is probably related to further aridification and the limited presence of a seasonally thawing top layer during permafrost conditions.

[1] Grupo de Investigación en Geología Sedimentaria
Especialidad de Ingeniería Geológica
Departamento de Ingeniería
Pontificia Universidad Católica del Perú
Contact: wviveen@pucp.pe
https://www.pucp.edu.pe/

[2] Soil Geography and Landscape group
Wageningen University & Research
P.O. Box 47, NL-6700 AA Wageningen
Contact: Jeroen.Schoorl@wur.nl
T + 31 (0)317 48 20 67
www.wur.eu/sgl

[3] Netherlands Centre for Luminescence dating
Wageningen University & Research
P.O. Box 47, NL-6700 AA Wageningen
http://www.wur.eu/sgl

[4] Faculty of Science and Engineering
Groningen University
Nijenborgh 4, NL-9747 AG Groningen
https://www.rug.nl