SHORT COMMUNICATIONS

FROST CRACKS OF SAALIAN AGE NEAR LUNTEREN (THE NETHERLANDS)[1]

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INTRODUCTION

Near Lunteren, where the ice-pushed ridges of Ede and Oud-Reemst meet, sand and gravel is exploited in two large pits. These pits are situated on top of the Goudsberg, the culmination of the ice-pushed ridges. Although exploitation occurred originally in two separate pits, they nowadays form one more or less continuous pit. We will here discuss some features observed during geomorphological fieldwork in this area by the second author. The main results of his studies will be dealt with in his M.Sc. thesis.

When studying the western pit several frost cracks were observed. We will here shortly describe the stratigraphy of this pit and the observed frost cracks and their implication.

LITHOLOGY

For the location of the sandpit see figure 1; the section was surveyed in the southwestern part of the pit.

The section (Fig. 2) is built up of a lower steep face, a gradually rising slope and an upper steep face. The total height was about 14 m (situation August 1980). Five units could be distinguished, A-E from bottom to top.

Unit A

The basal unit consists of a grey parallel-bedded sandy deposit. As a result of ice-pushing from the north the layers are found in an inclined position. Possibly a later pushing from the southwest influenced these deposits again, together with the overlying units B, C and possibly D. Unit A is interpreted as an ice-pushed river deposit. The upper boundary of this unit shows deformation structures with fault planes dipping east-southeast (pers. comm. M. Rappol, 1980).

Unit B

This unit has a thickness of about 50 cm and can be divided into three subunits. In the lowest part of the sandpit a clay-rich, laminated (varve-like) layer is present. It is sandwiched between two sandy-gravelly, horizontally bedded (lense-like) deposits. Within the varve-like deposit ice-needle casts have

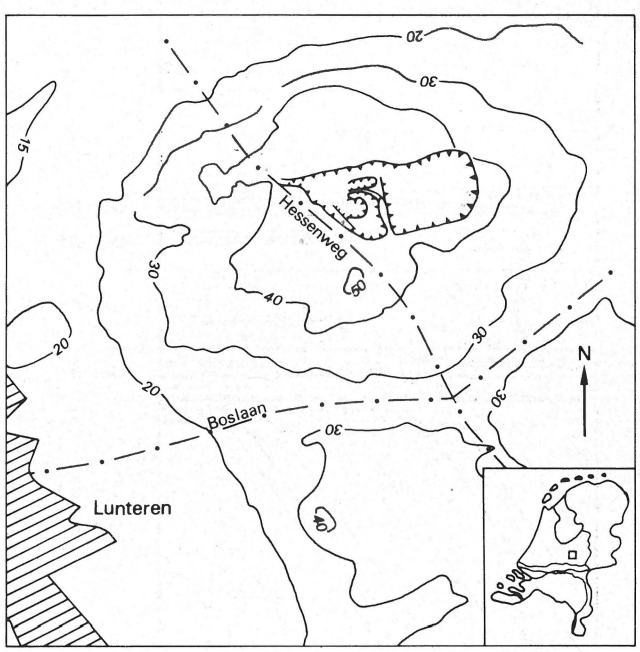

Fig. 1
Location of the sand pit near Lunteren.

[1] Manuscript received: 1981-02-05.
Revised manuscript received and accepted: 1981-03-11.
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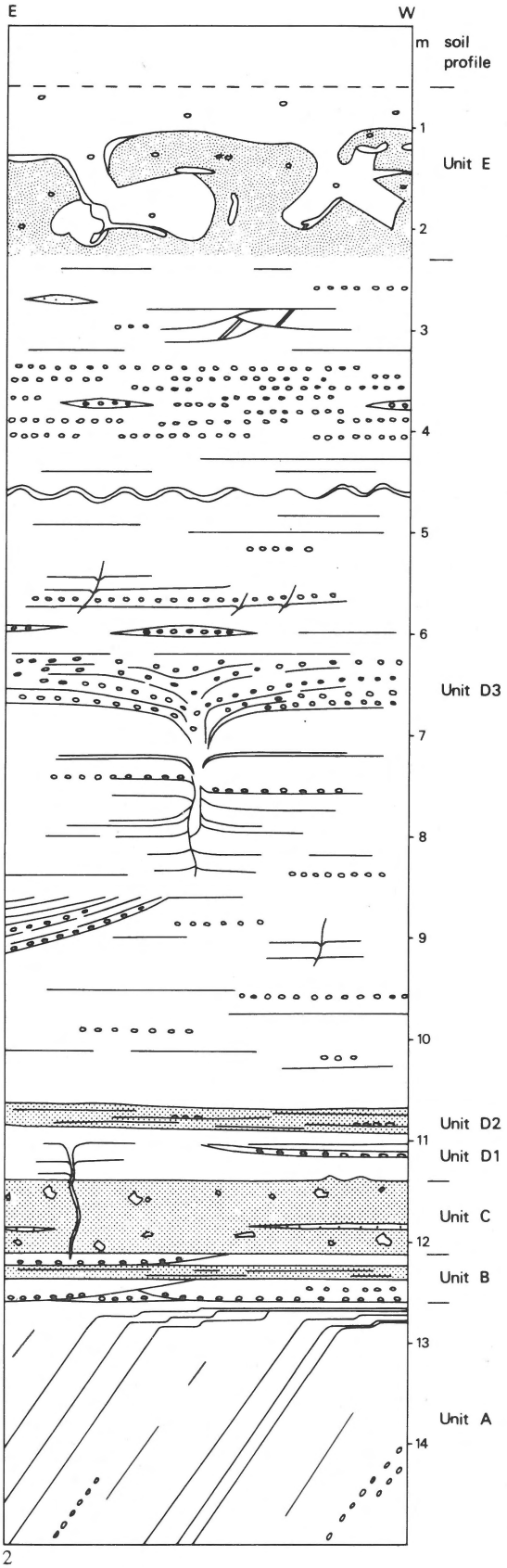

Fig. 2
Recorded section in the sand pit near Lunteren.

been regularly observed. Unit B is interpreted as a lacustrine deposit.

Unit C

Consisting of two different tills, this unit overlies unit B with a non-erosive contact. The lower brown till has a basin-like extension in the sandpit; this might be due to a later (second) phase of ice-pushing. The till is laterally and vertically rather homogeneous in composition, structure and thickness (ca. 1 m). In the lower half of the unit sand lenses and parallel laminated clay lenses were found (thickness 1-7 cm and maximum length 5 m). Throughout the till small clay pebbles (0.5-2 cm) were observed. Locally the till surface seems to be fluted.

A red till, which is less consistent than the brown till, and which contains many angular boulders, is lying on top of the brown till. It is only found in the eastern part of this pit. The nature of these two tills is still studied (in collaboration with M. Rappol).

Unit D

This unit has a thickness of about 9 m. From bottom to top several subunits can be observed. The basal subunit (D 1) with a thickness of about 50 cm consists of alternating horizontally laminated and bedded, coarse and fine layers. Subunit D 2 is a clayey laminated subunit, made up of silt and clay laminae, with intercalated sand lenses and gravel strings. Its thickness is only about 25 cm.

The thickest subunit is D 3, with a thickness of about 8.25 m. It also consists of alternating coarse and fine horizontally laminated or bedded layers. In the lower part of this subunit we found some big channels (maximum exposed width 20 m, height 1 m). Higher up several smaller channels (maximum width 1 m) were observed. Here also a layer was visible, which is interpreted as a load-cast structure.

Unit D is interpreted as the infilling of a small basin, by lacustrine deposits alternating with coarser fluvioglacial deposits.

The frostcracks were observed about 5.30 m below the surface halfway unit D 3 and in unit D 1 cutting through unit C.

Unit E

This last unit follows via a gradual transition. It has a thickness of about 2 m and consists of brown, grey and yellow deposits which locally show convolute bedding. The grey deposits are made up of fine sand and silt, and are found between two sandy and gravelly layers. In the upper 60 cm a soil profile is developed. The main part of this unit is interpreted as a cryoturbated layer, the cryoturbation dating from the Weichselian.

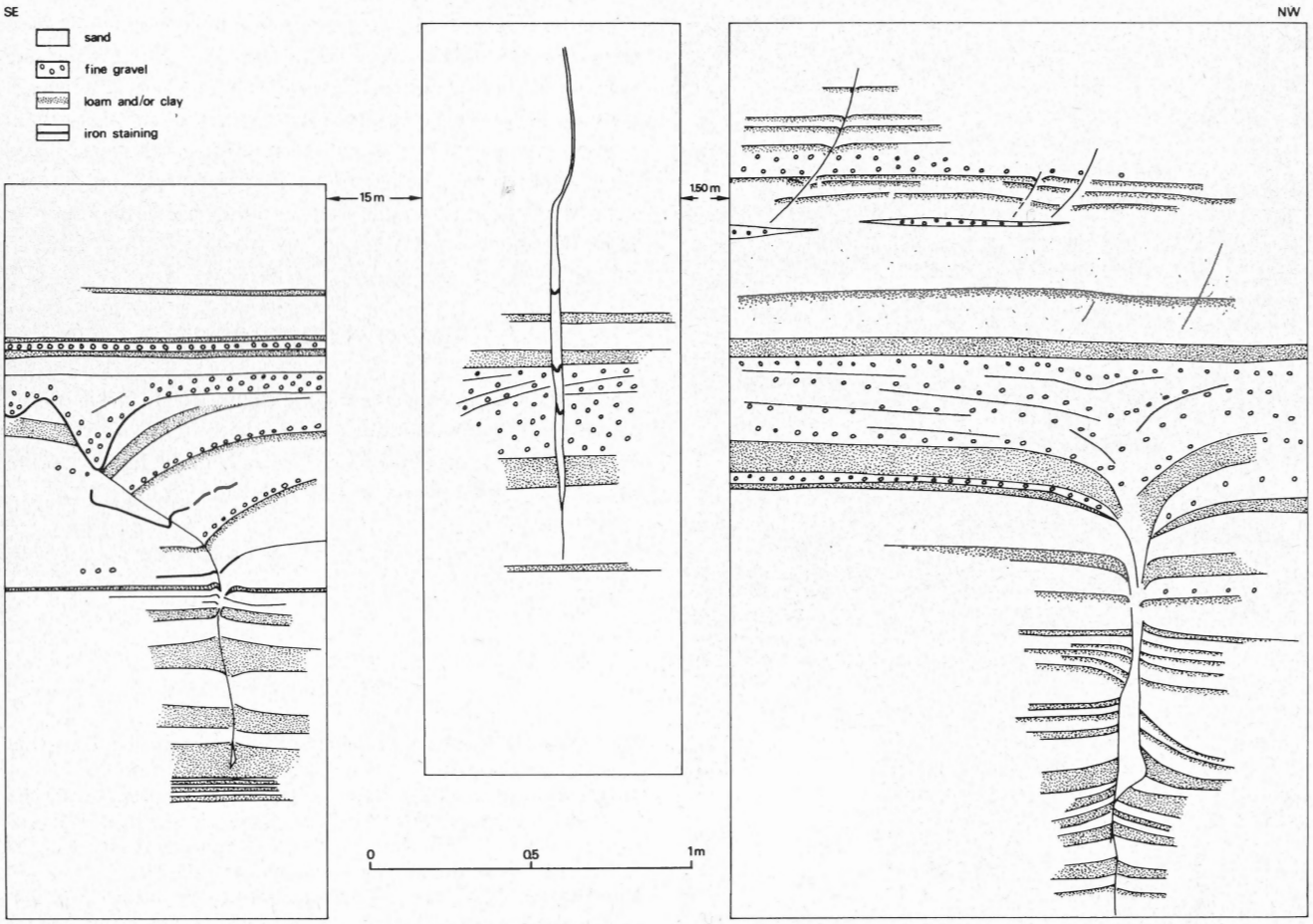

Fig. 3
Some frost cracks of the upper set.

DESCRIPTION OF THE FROST CRACKS

In the middle and in the lower part of unit D several sets of cracks were found. In the lowest sets the cracks continue into the underlying till (unit C). The main cracks in unit D 3 cut through the host in a more or less vertical way. One curved frost crack was observed. The length of the cracks is about 1½ metre, and their width varies from less than 1 cm to about 10 cm.

Offset of the host is clearly visible along most of the cracks. Up- and downturned beds occur both, also along the same crack (Figs. 3 and 4; see also VAN STRAATEN, 1956). But also beds without offset have been observed.

The filling of the cracks consists of the same sand as the host and that is probably the reason why the outline of the wedges is not always very distinct. Sometimes the outline of the cracks is accentuated by iron staining. Erosion of the top of the cracks was not observed.

About 1 metre above the right-hand wedge in figure 3 another set of cracks was observed. These cracks are much smaller, with a length of only about 25 cm. Only one crack with a length of about 60 cm was observed. The width of these small cracks is always less than 1 cm. All the cracks in this set are curved and some of them show slight, but distinct downturning of the host. The strikes of some of the cracks in the lower set were measured and their variation between N 130 S and N 270 S points to a polygonal network.

INTERPRETATION

The characteristics of the cracks as described above and their occurrence in fluvioglacial deposits of a sandy nature, both point to an origin as frost cracks. In this material and environment one would not expect desiccation or shrinkage cracks to be formed. This goes for all sets of cracks. The occurrence of frost cracks of this size does not necessarily imply permafrost. It does imply severe winters with abrupt changes of temperature and little or no snowfall (DYLIK & MAARLEVELD, 1967). Cracks and fissures of post-Alleröd age (Late Dryas time) from The Netherlands as described by VAN DER TAK-SCHNEIDER (1968) are similar in every aspect to the frost cracks described here. Because the cracks are found at a depth of at least 5 m below the surface and frost cracks are

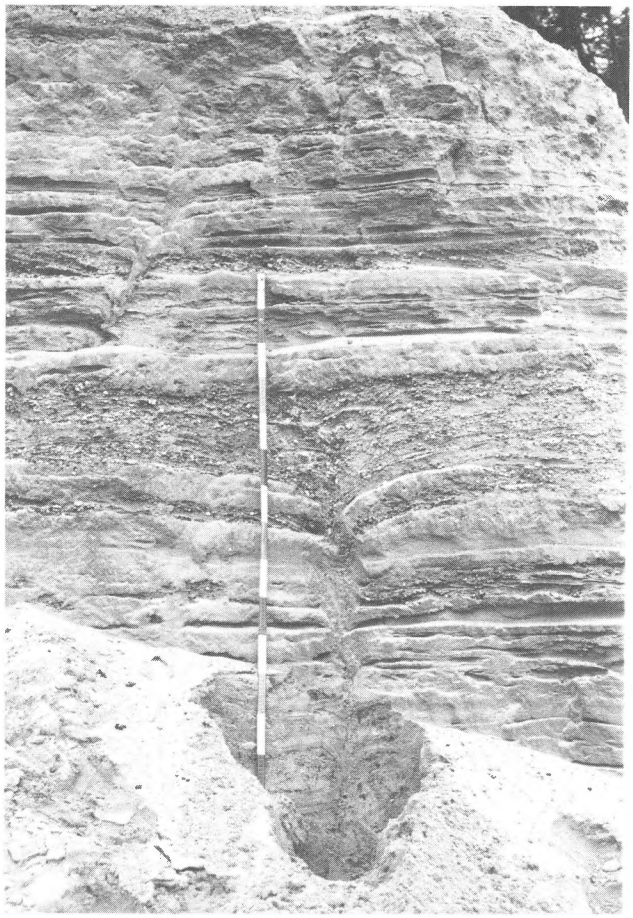

Fig. 4
One of the longer cracks of the upper set. A small crack of the uppermost set is visible left of the tape.

formed at the surface, the cracks must have the same age as the deposits in which they occur. Because the surrounding sediments are fluvioglacial deposits (Unit D 3) of Saalian age (RUEGG, 1977), the cracks must date from the end of the main Saalian advance. Frost cracks of pre-Weichselian age from The Netherlands have been mentioned before (a.o. MAARLEVELD, 1960), but this is the first time they are being reported from this time.

ACKNOWLEDGEMENTS

The authors wish to express their thanks to Prof. Dr. G. C. Maarleveld for commenting on the first draft of this paper; to Mrs. O. M. Bergmeijer-de Vré for drawing the figures and to Mrs. M. C. G. Keijzer-v.d. Lubbe for the typing.

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