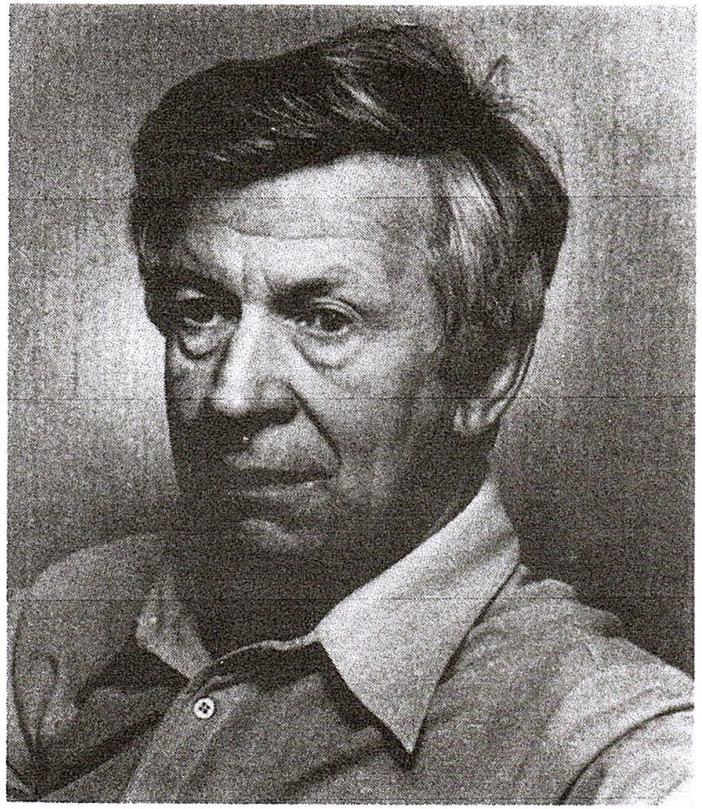
The Tømte Symposium
24. 10. 2022.

Strategies in quick clay mapping.

Tor Løken

Professor Ivan Th. Rosenqvist (UIO) and Dir. Laurits Bjerrum (NGI)
(1916 - 1994) (1918 – 1973)







Fysikalsk-kjemisk-mineralogiske undersøkelser over norske leir-jordarter

Dr. philos. I. Th. Rosenqvist
Norges Geotekniske Institutt

DK 553.61 : 624.131 (481)

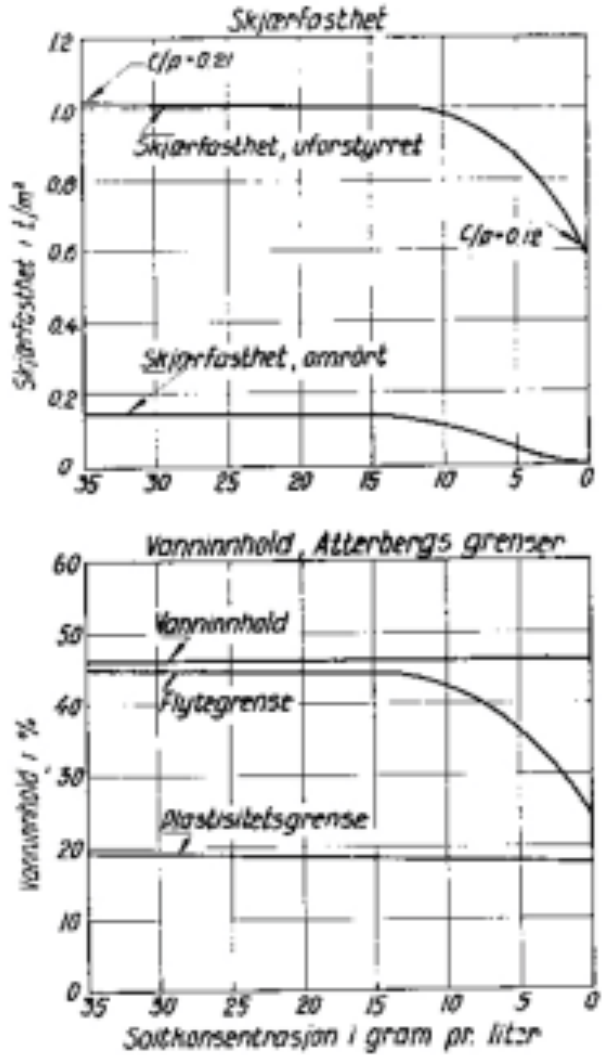


Fig. 18. Sammenhengen mellom mekaniske egenskaper og saltinnholdet i porevannet for østnorske leirer. (Bjerrum 1954.)

Både flytegrense og skjærfasthet avtar drastisk med minkende saltinnhold

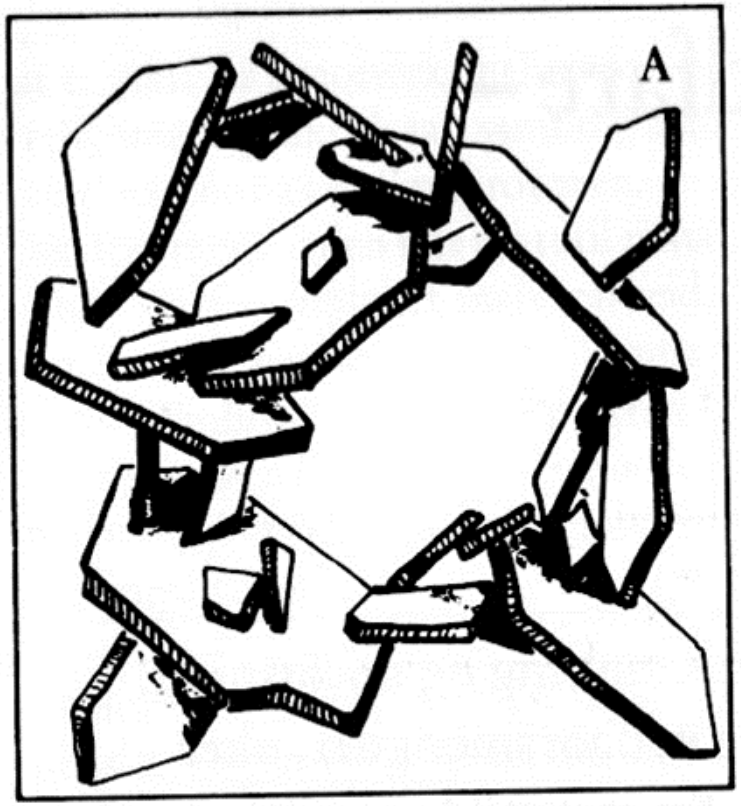
Rosenqvist(1954) TU 1954

Typical grain structures in marine clay.

T. Løken, Forskningsnytt no. 3, 1983.
(grains of sand and silt are excluded in A and B)

Foto: Løken.





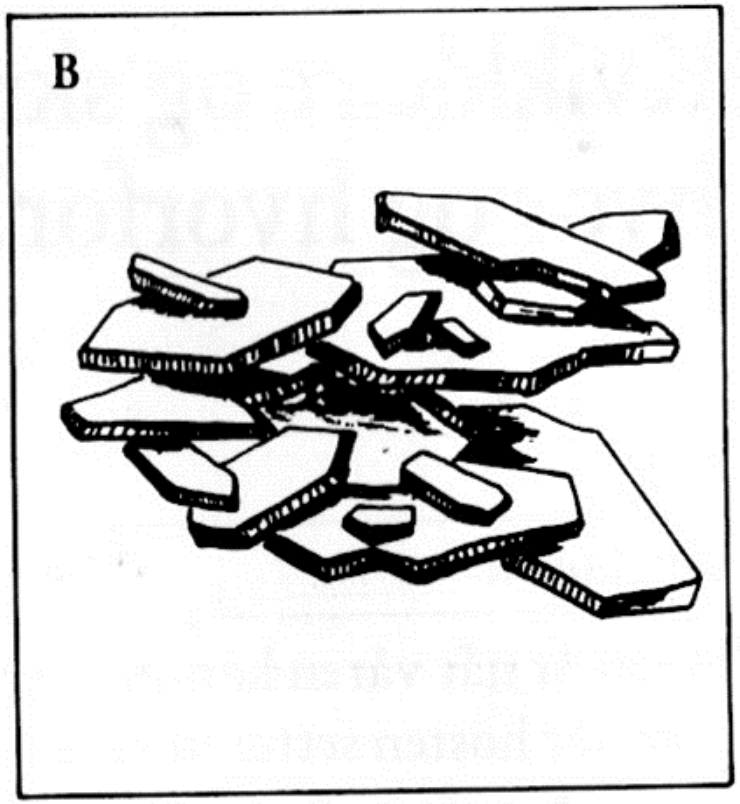
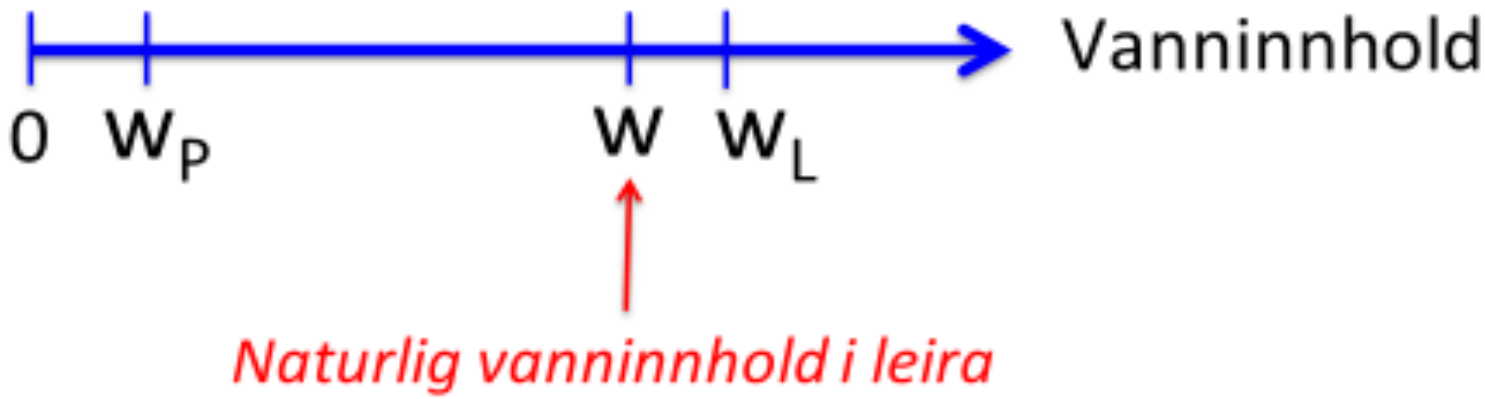


Fig. 1. Typisk kornstruktur i en marin leire fra Romerike. Fotografiet, forstørret 20.000 x, er tatt med elektronmikroskop. Tegningen viser skjematisk kornstrukturen for en kvikkleire A) i naturlig uforstyrret tilstand (tilsvarende fotografiet) og B) slik de samme kornene vil ligge etter at kvikkleira har vært omrørt og resedimentert. Dette viser samtidig at gamle kvikkleire-skredmasser har en meget tett struktur, og slike masser kan aldri mer bli kvikke.

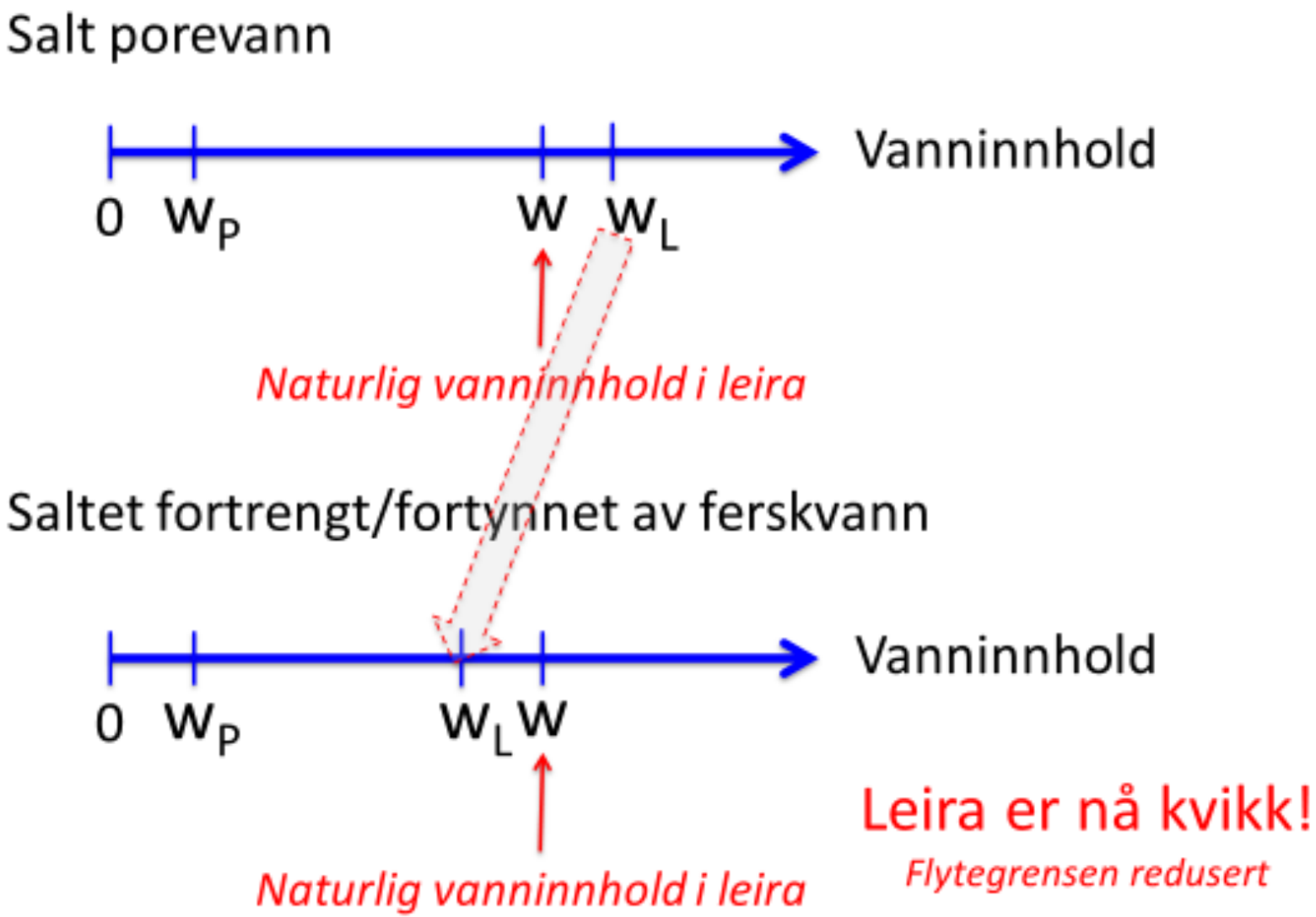
Leire og vann

Kan illustreres slikt:

$$I_P = w_L - w_P$$



Kvikkleiredannelse



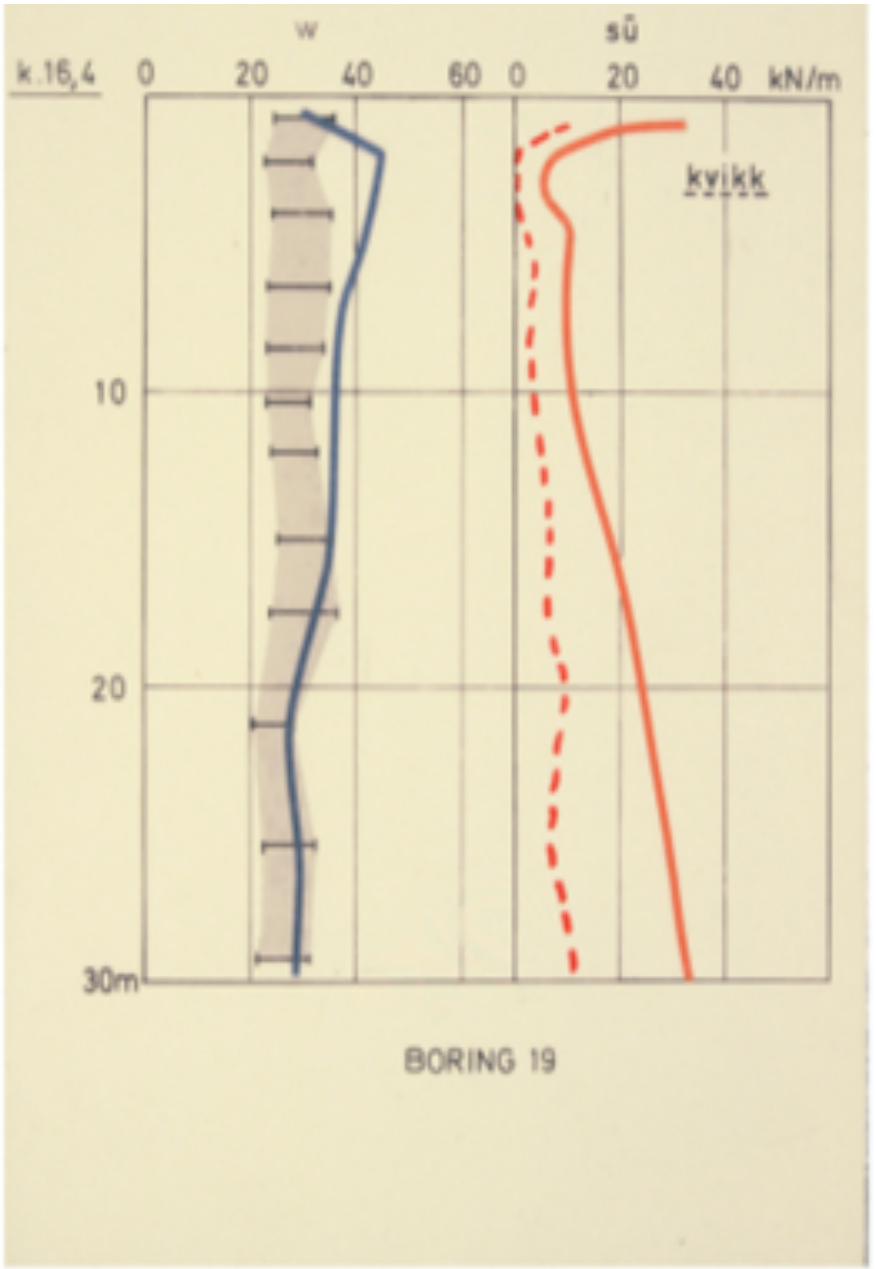
Example of soil investigation of quick clay

Rissa site.

NGI profile No. 19.

1. Natural watercontent
2. Atterbergs limits
3. Shear strength

   (Undisturbed and remoulded)



Tor Løken (1983)

Recent research at NGI conserning the influence oh chemical additions on quick clay.

Tor Løken

(Geologiska Föreningen i Stockholm Förhandlingar. Vol. 92. part 2, 1970).

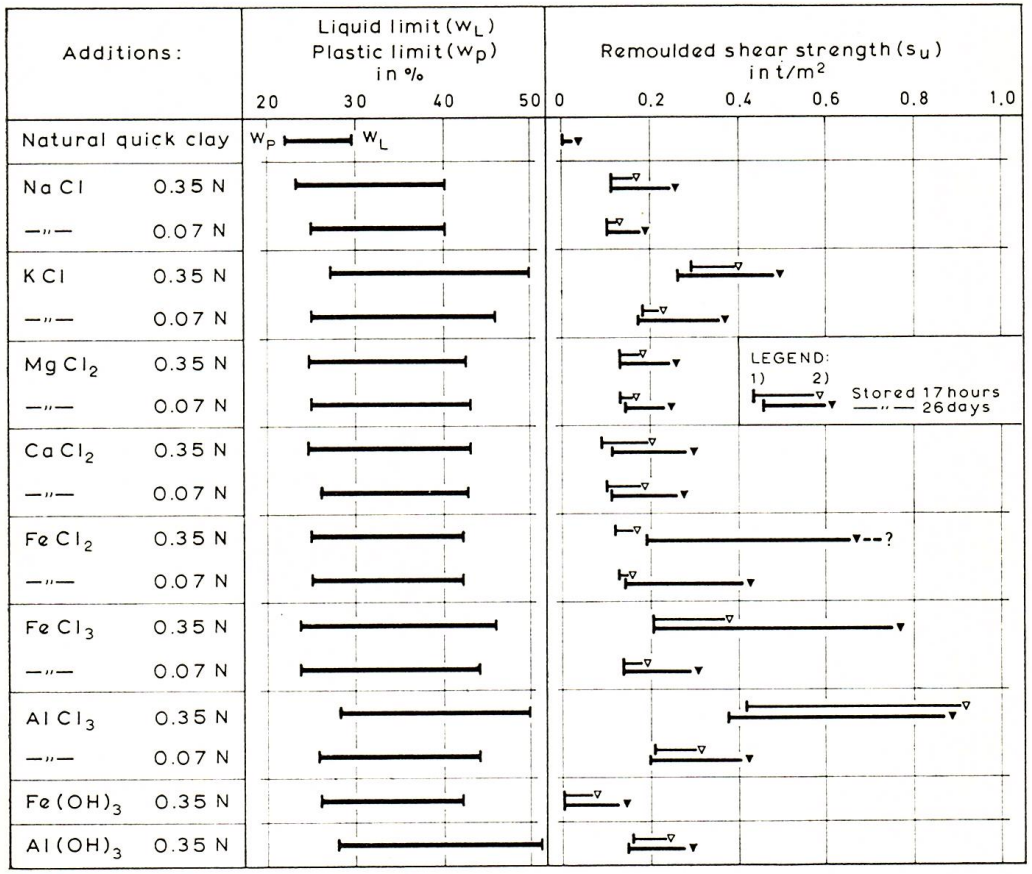


Fig. 1. Atterberg limits and shear strength for different salt additions with water content constant 44 % during 26 days. 1) Freshly remoulded. 2) Thixotropic regain.

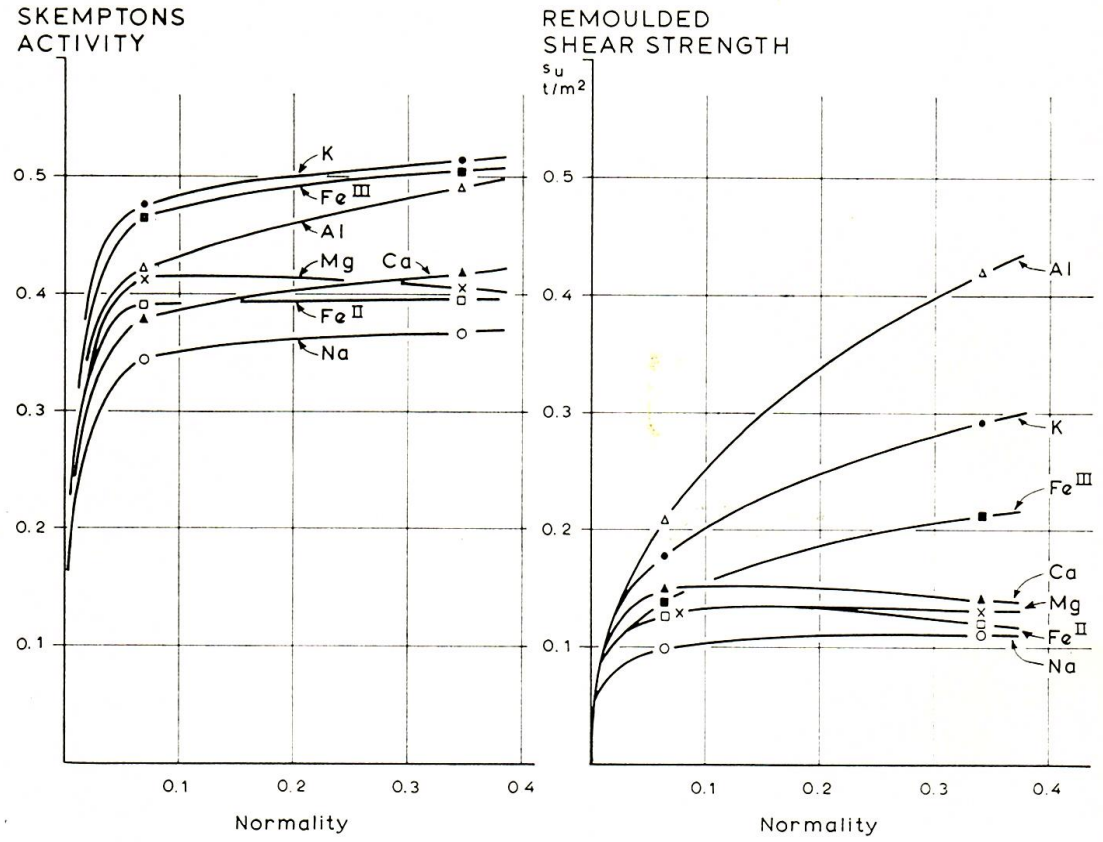


Fig. 2. Effects of different salts as chlorides on a) Skemptons activity and b) remoulded shear strength. Normality = $\frac{\text{Motarity}}{\text{Valence of cation}}$ of salt in pore water.

The Ullensaker quick clay slide at Borgen, 1953



Soli investigation of the stable slope opposite the quick clay slide at Ullensaker 1953

Tor Løken, 1968
NGI publ. No. 75.

Shear strength undisturbed and remoulded by vane tests.

Combined with measurements of relative resistans in ohms (blue).

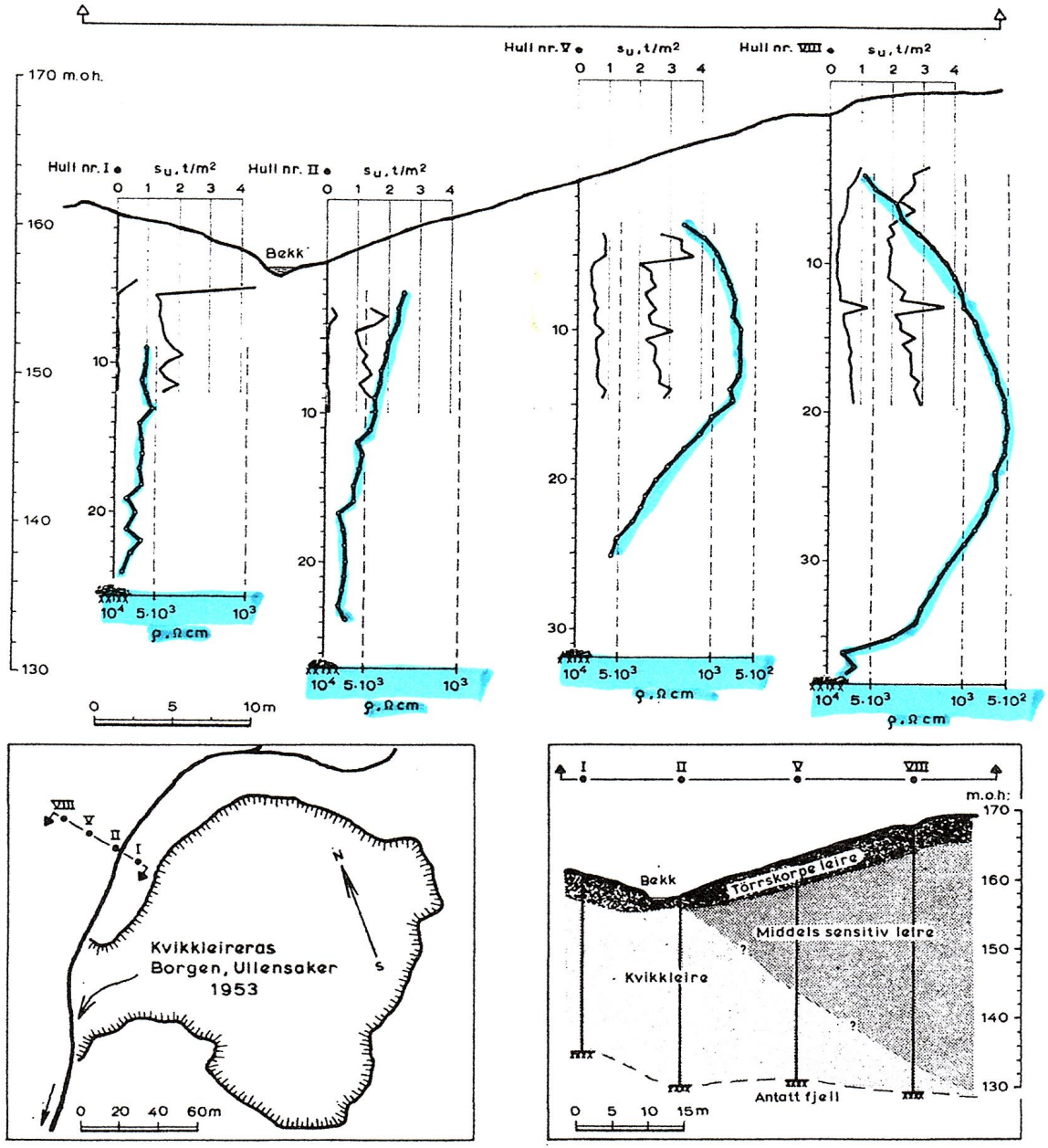


Fig. 3. Profil av en stabil leirskråning vis-á-vis kvikkleireskredet på Borgen i Ullensaker som viser vingeborskjærfasthet (s_u) og spesifikk elektrisk motstand (ϱ).

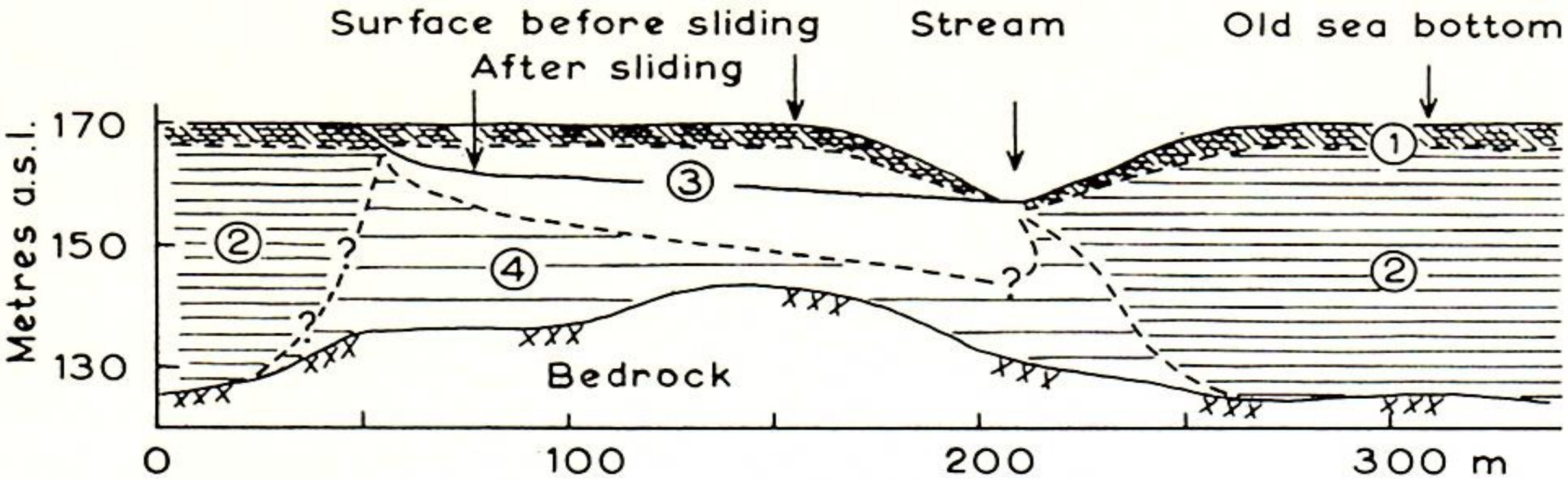
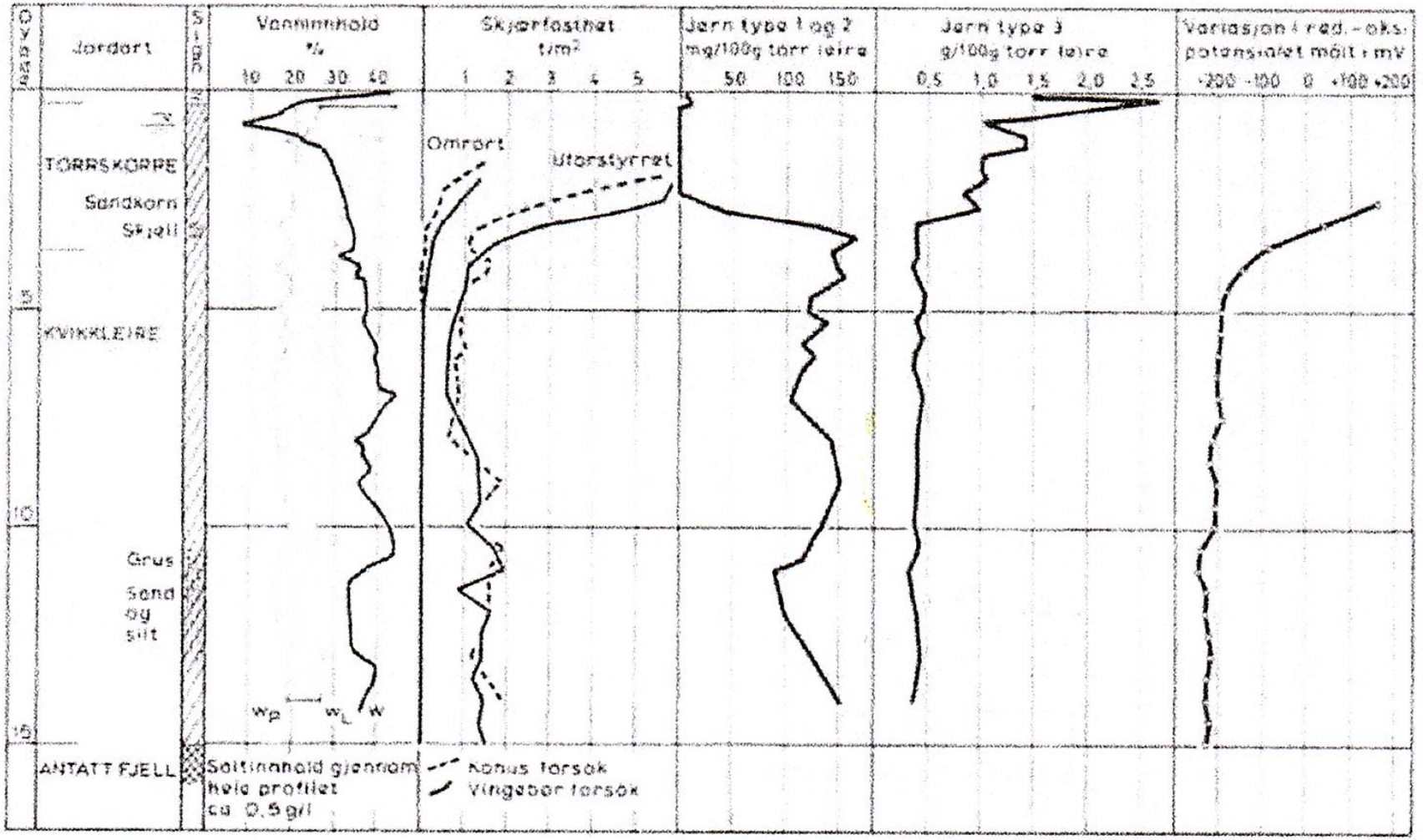


Fig. 6. Schematic cross section through the Ullensaker quick clay slide, 1953.

1. Weathered crust
2. Marine clay
3. Marine clay, leached until quick
4. Marine clay, leached until quick, then weathered.

A profile in quick clay from Manglerud, Oslo, clearly showing a correlation between mechanical properties and iron content and an increase of reduction-oxidation potential at top.

Tor Løken, 1968, NGI publ. No. 75



Tinghuset, Drammen

J. Moum, T. Løken and K. Torrance (1971 and 1972), Geotechnique **21**, No. 4 and **22**, No. 3.

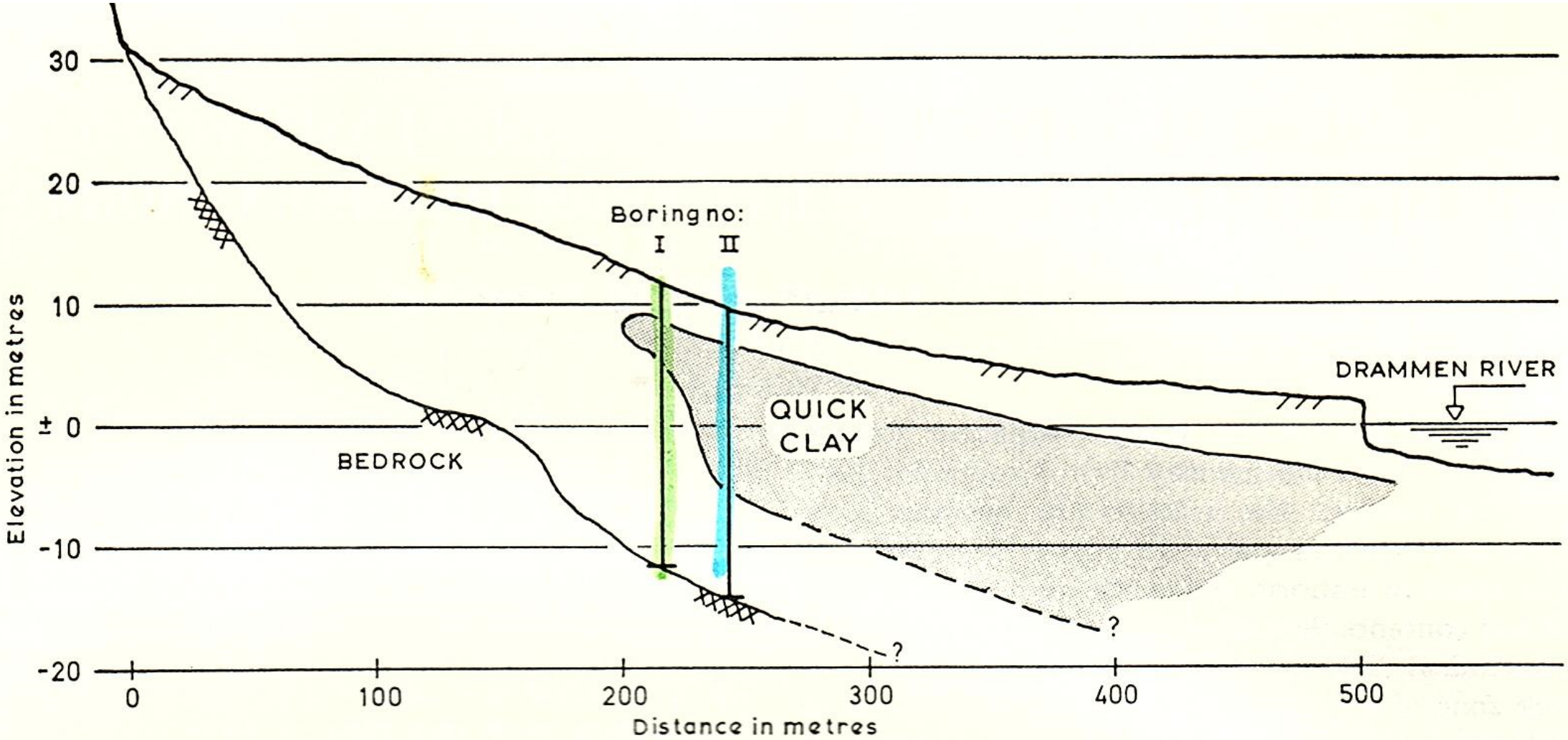


Fig. 1. Geological conditions at Drammen

Tinghuset, Drammen

A geochemical investigation of the sensitivity of a normally consolidated clay.
J. Moum, T. Løken and J.K. Torrance (1971) Geotechnique 21.

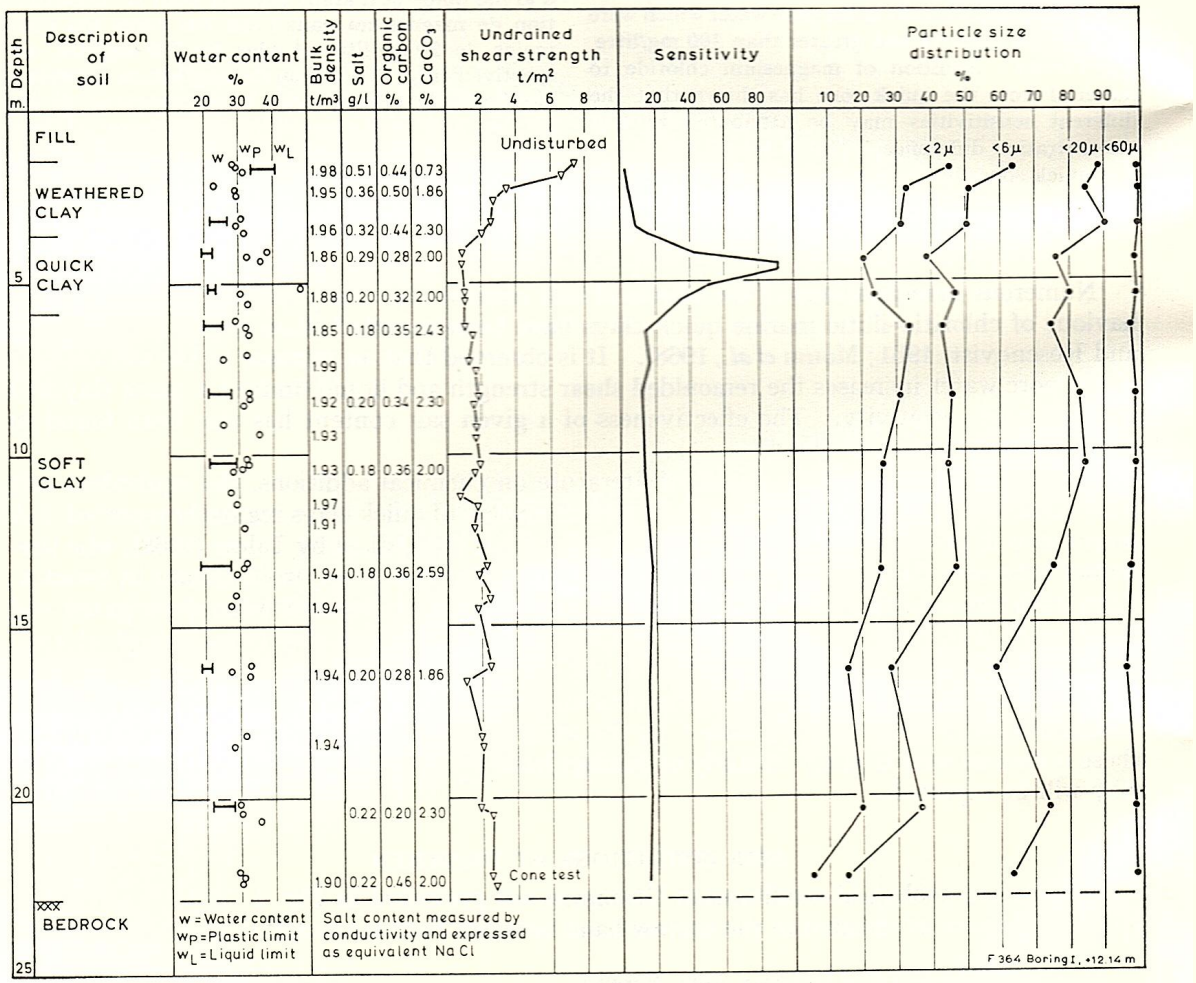


Fig. 2. Geotechnical data for boring I

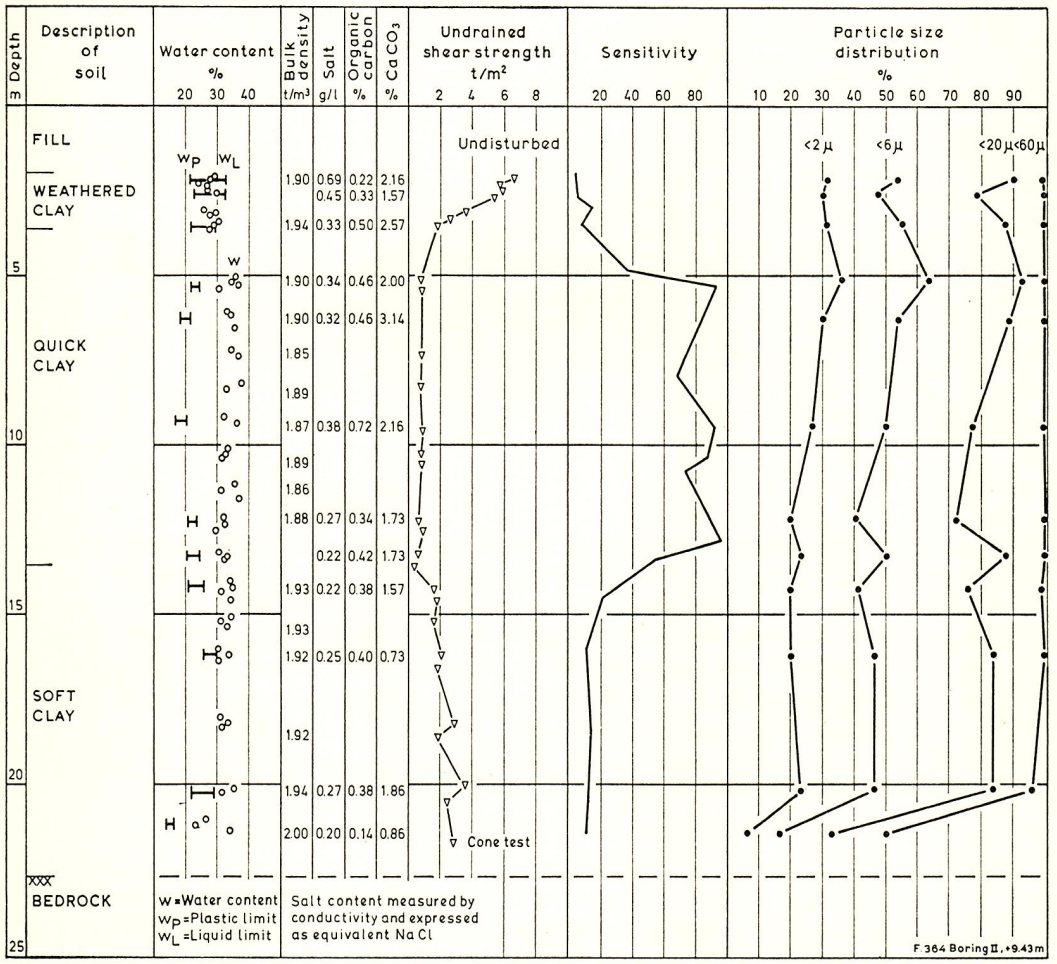


Fig. 3. Geotechnical data for boring II

Tinghuset, Drammen.

Comparison of cations consentrations solved in porewater.
Geotechnique (1972) No. **22**, 3.

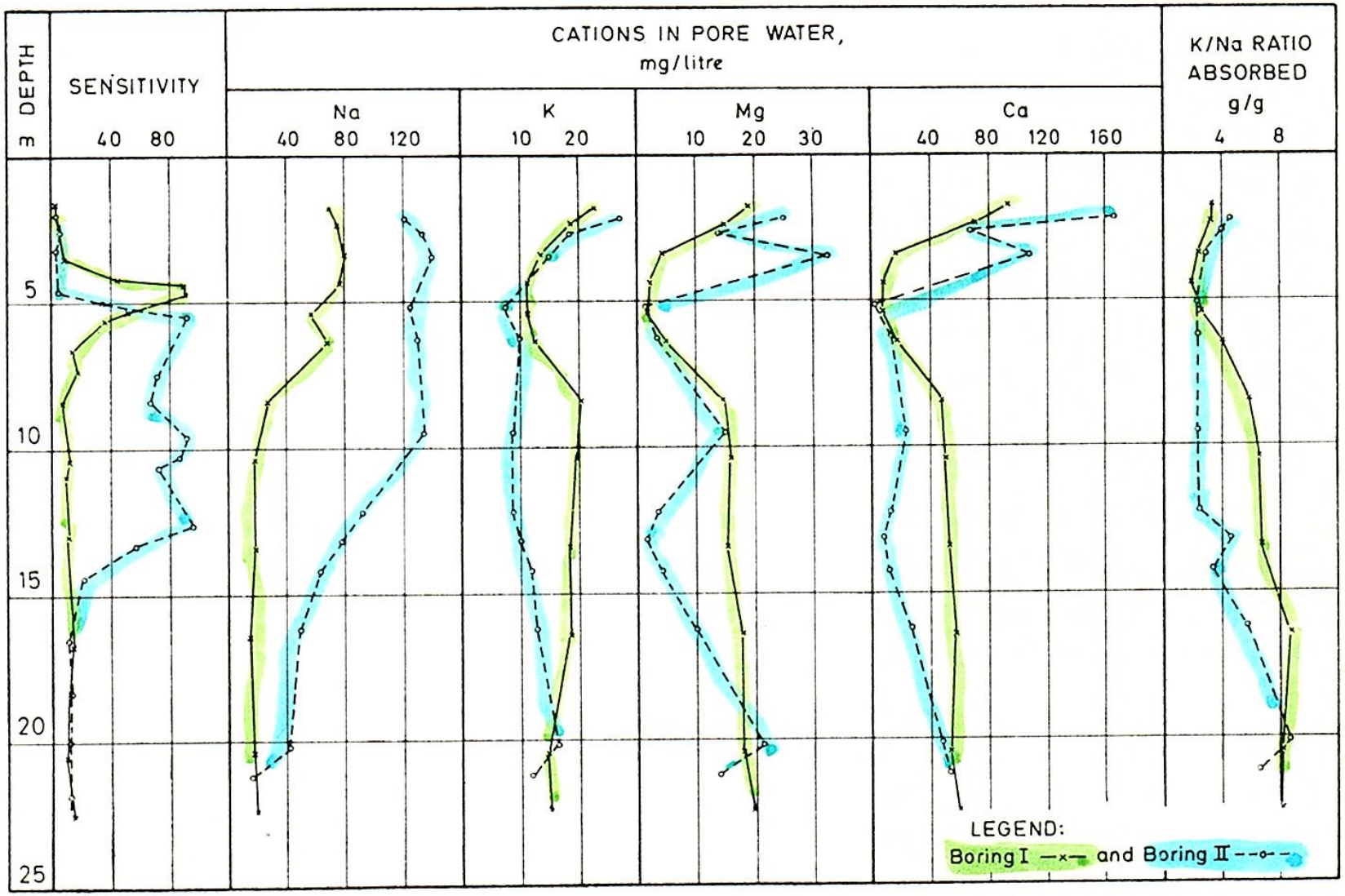
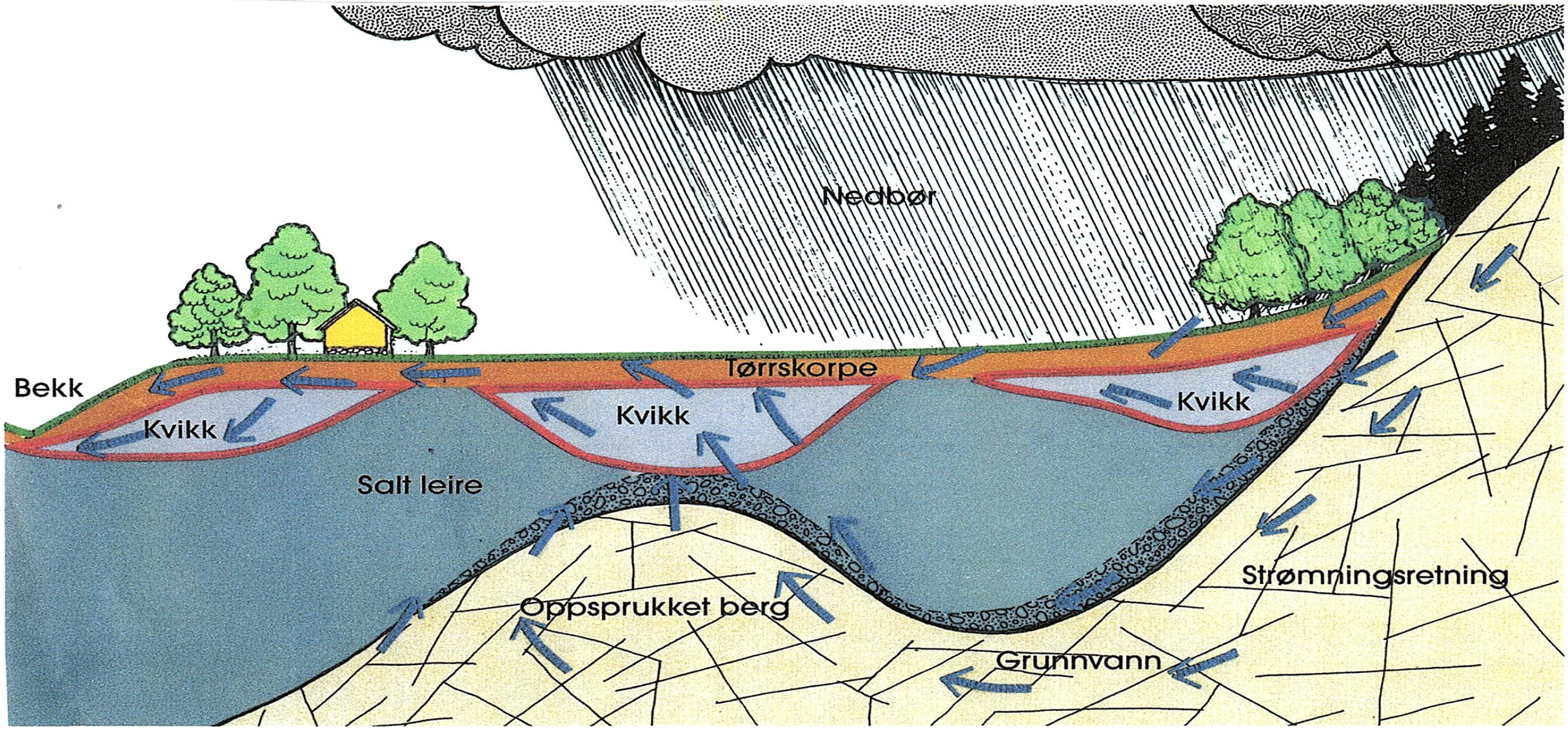


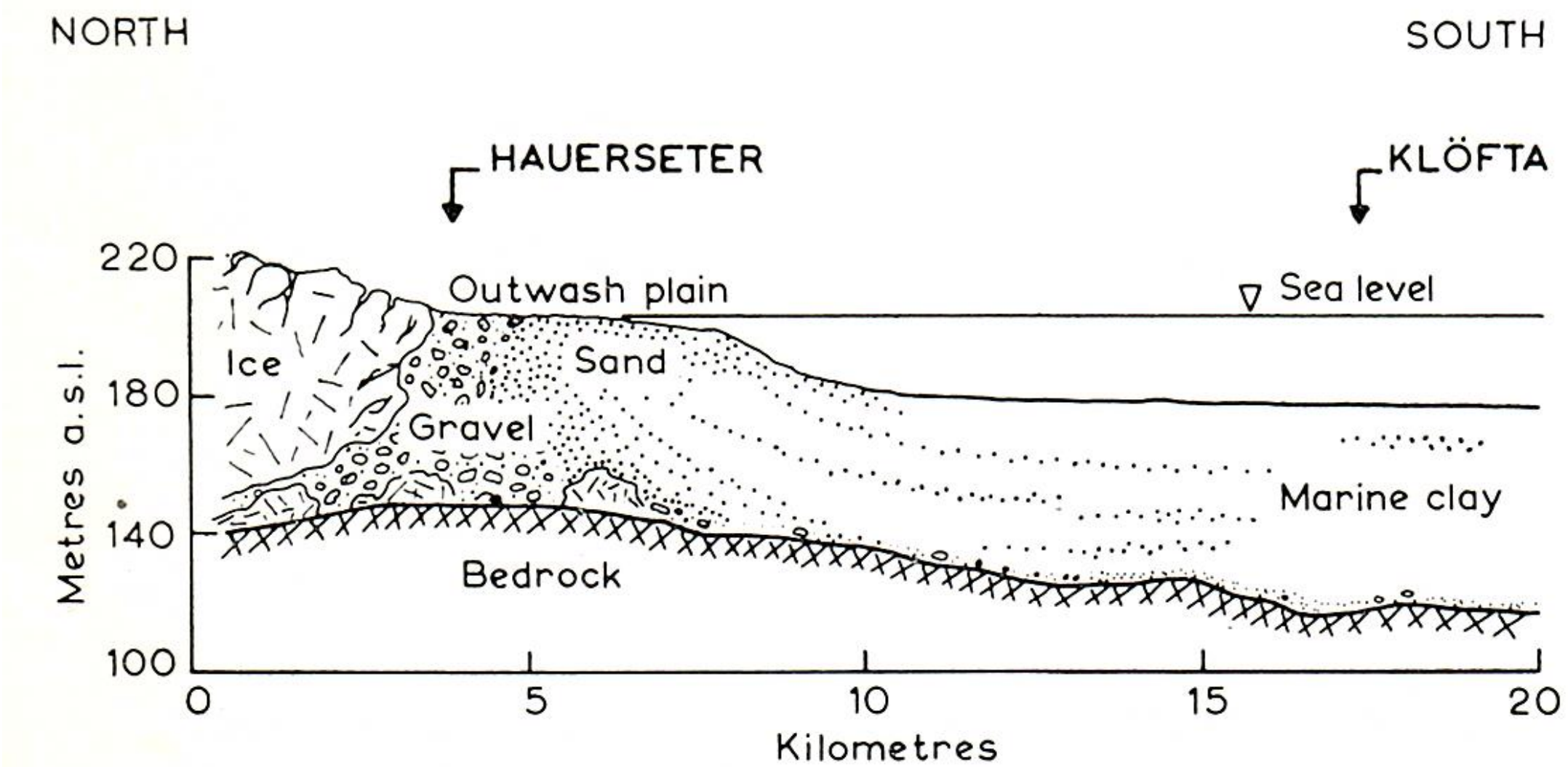
Fig. 1. Sensitivity, porewater chemistry and K/Na ratio (absorbed): corrected values

Fresh water leaching of marine clay.

Tor Løken. Forskningsnytt No.3/193



Geological section illustrating the glacifluvial depositon of Gardermoen and sedimentation of marine clay and silt in front about 9800 years ago. This illustrate also «the old seabotton».



Example of stream erosion in old seabottom plain.

L. Bjerrum, T. Løken and S. Heiberg, NGI and R. Foster, The City University, London

NGI Publ. No. 85, 1969



Airphoto (Fjellanger Widerøe) Nannestad area to wards South



A field study of factors responsible for quick clay slides.

L. Bjerrum, T. Løken and S. Heiberg, NGI.
R. Foster, The City University, London, UK.

In The Seventh Intern. Conf. on Soil Mech. and Foundation Engineering, Mexico 1969.
(Also: NGI pub. No. 85, 1969)

Ullensaker area just east of Kløfta.

1. Eksposed bedrock
2. Old seabottom plain
3. Old quick clay slides scars
4. Redeposited quick clay slide masses
5. Rock exposures in rivers
6. «Front of aggression»

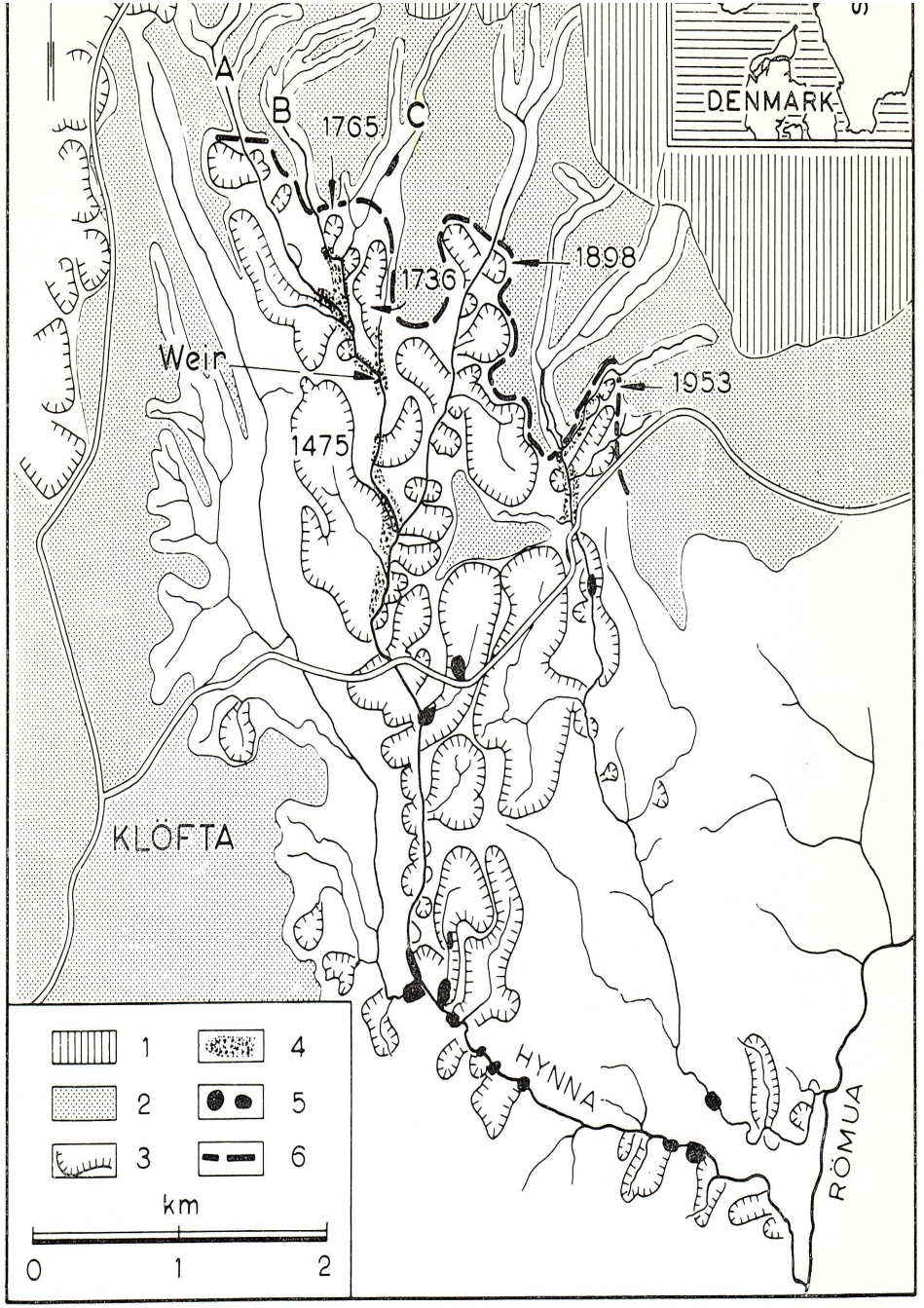


Fig. 2. Map showing the research area.
1. Bedrock area, 2. Old sea bottom plain, 3. Quick clay slide scars, 4. Redeposited quick clay slide masses, 5. Rock exposures, 6. "Front of aggression".

Longitudinal profiles of the main stream Hynna with tributaries.

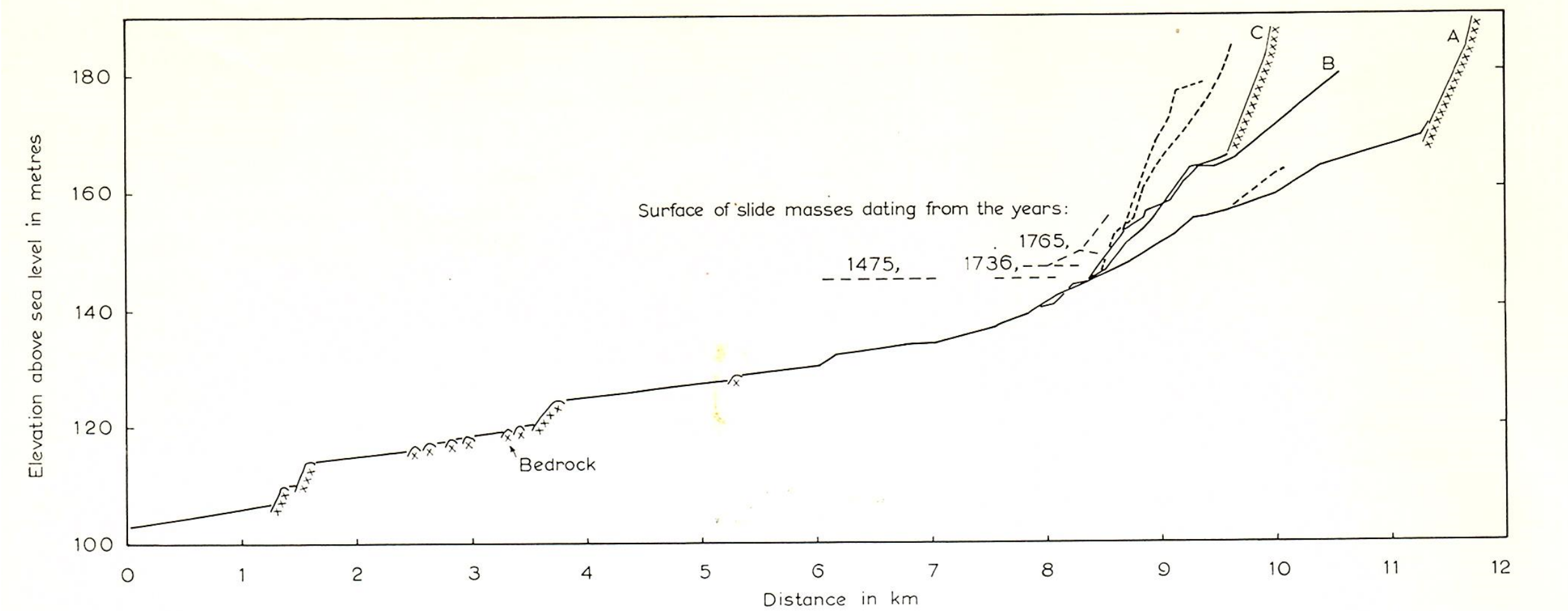
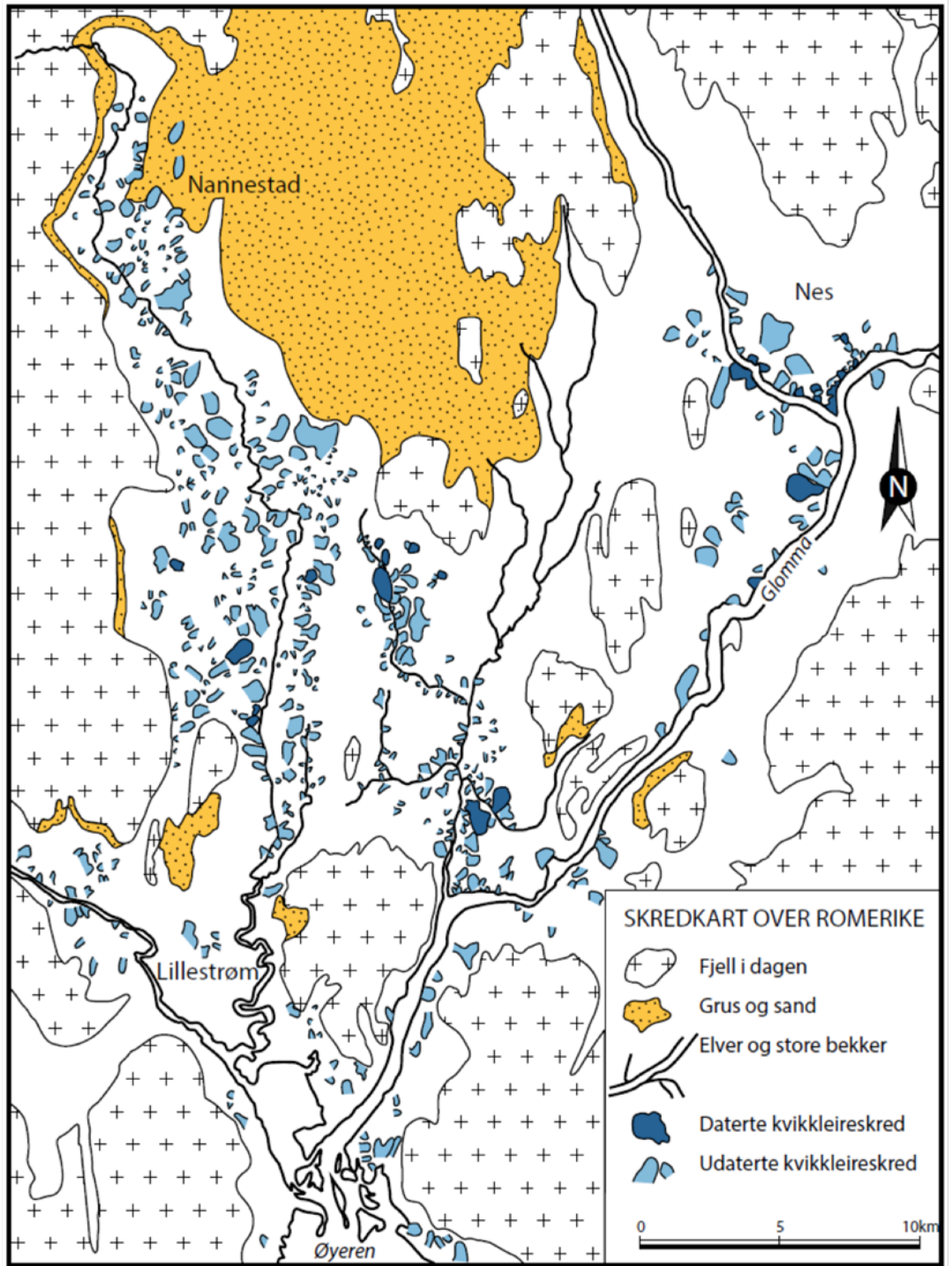


Fig. 7. Longitudinal profiles of the main stream Hynna, "lower reach", "intermediate reach" and "upper reach".

Romerike med gamle og historiske leirskred

Sand og grusavsetningene på Gardermoen med leirområdene i Nannestad, Ullensaker og Nes.

Løken, Jørstad and Heiberg (1970)



Mapping of «potential areas of quick cklay sliding». An cooperation of NGU and NGI

(NGI drawing 1983)

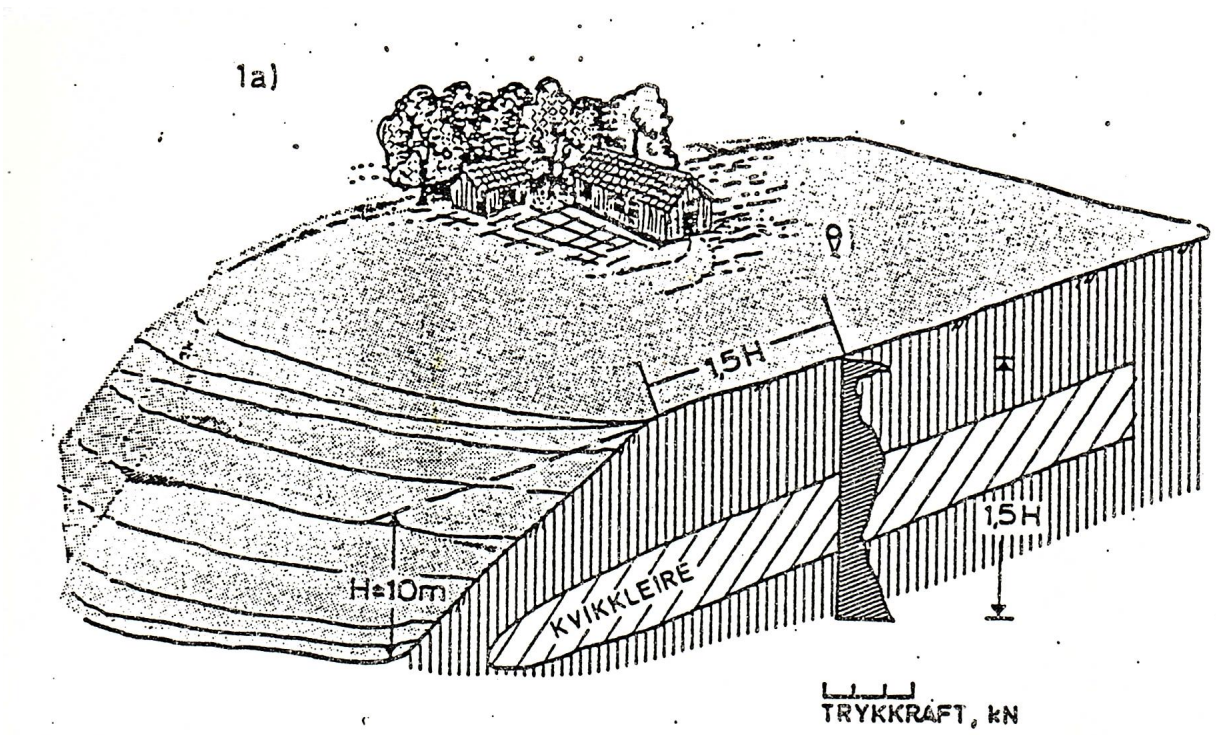


Fig. 1 a. Perspektivskisse av platåterreng

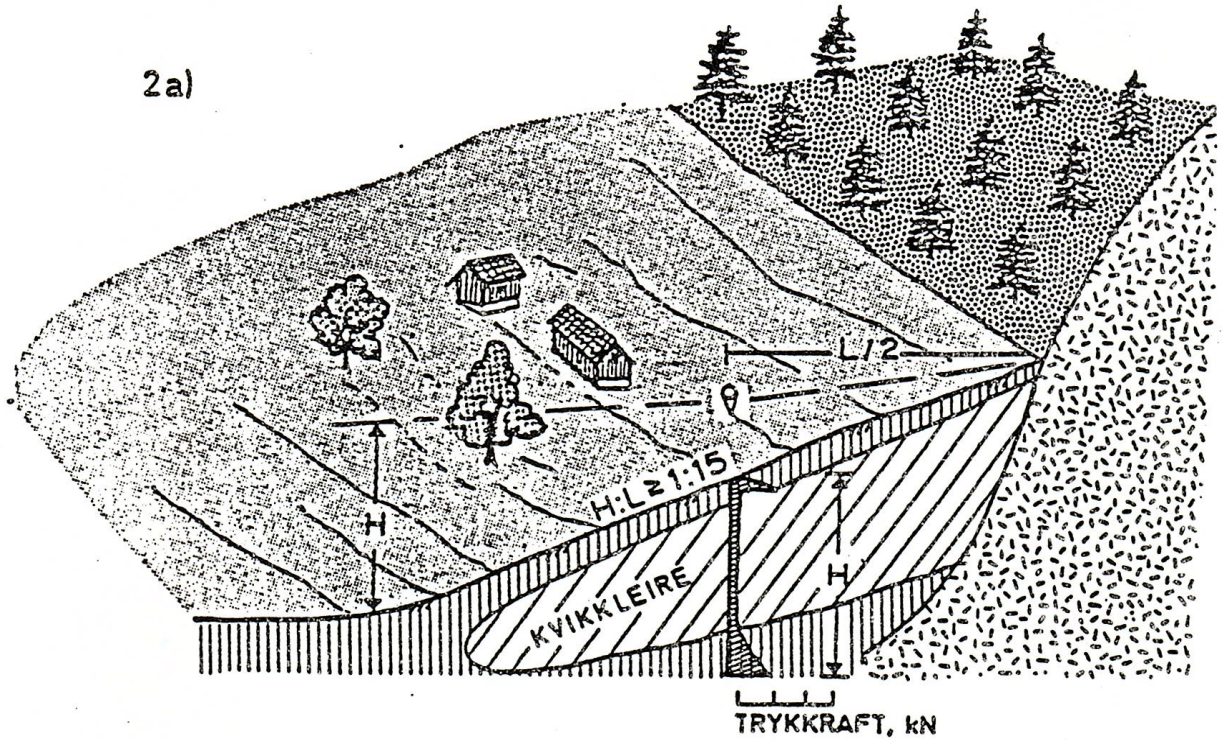
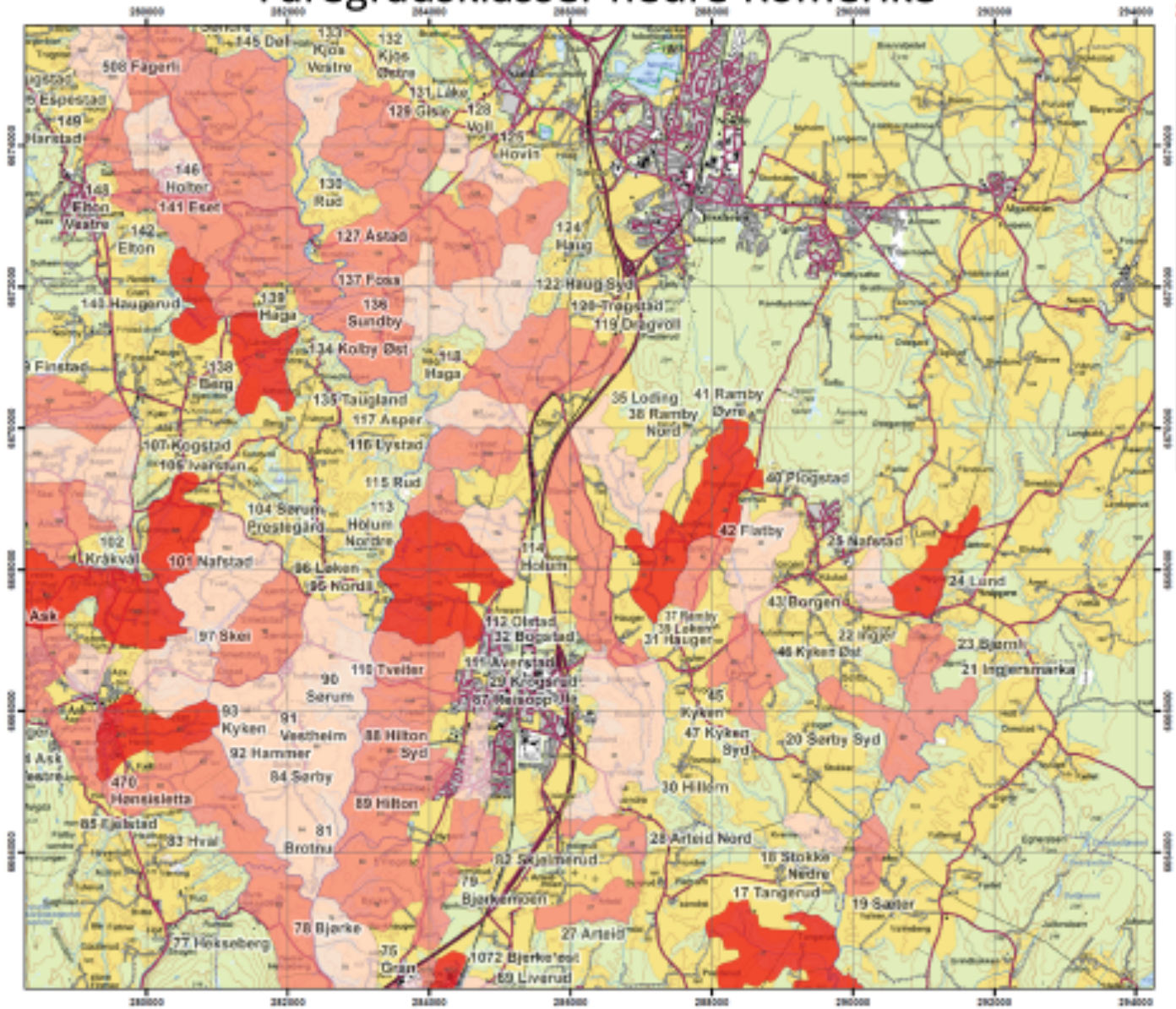
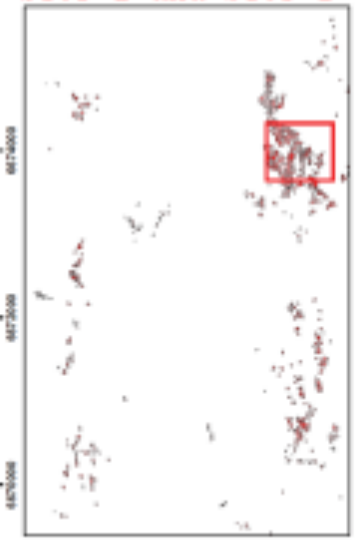


Fig. 2 a. Perspektivskisse av naturlig hellende terreng

Faregradsklasser nedre Romerike



STOP 1 and STOP 2



Tegnforklaring

Faregradklasse

- Lav
- Middels
- Høy

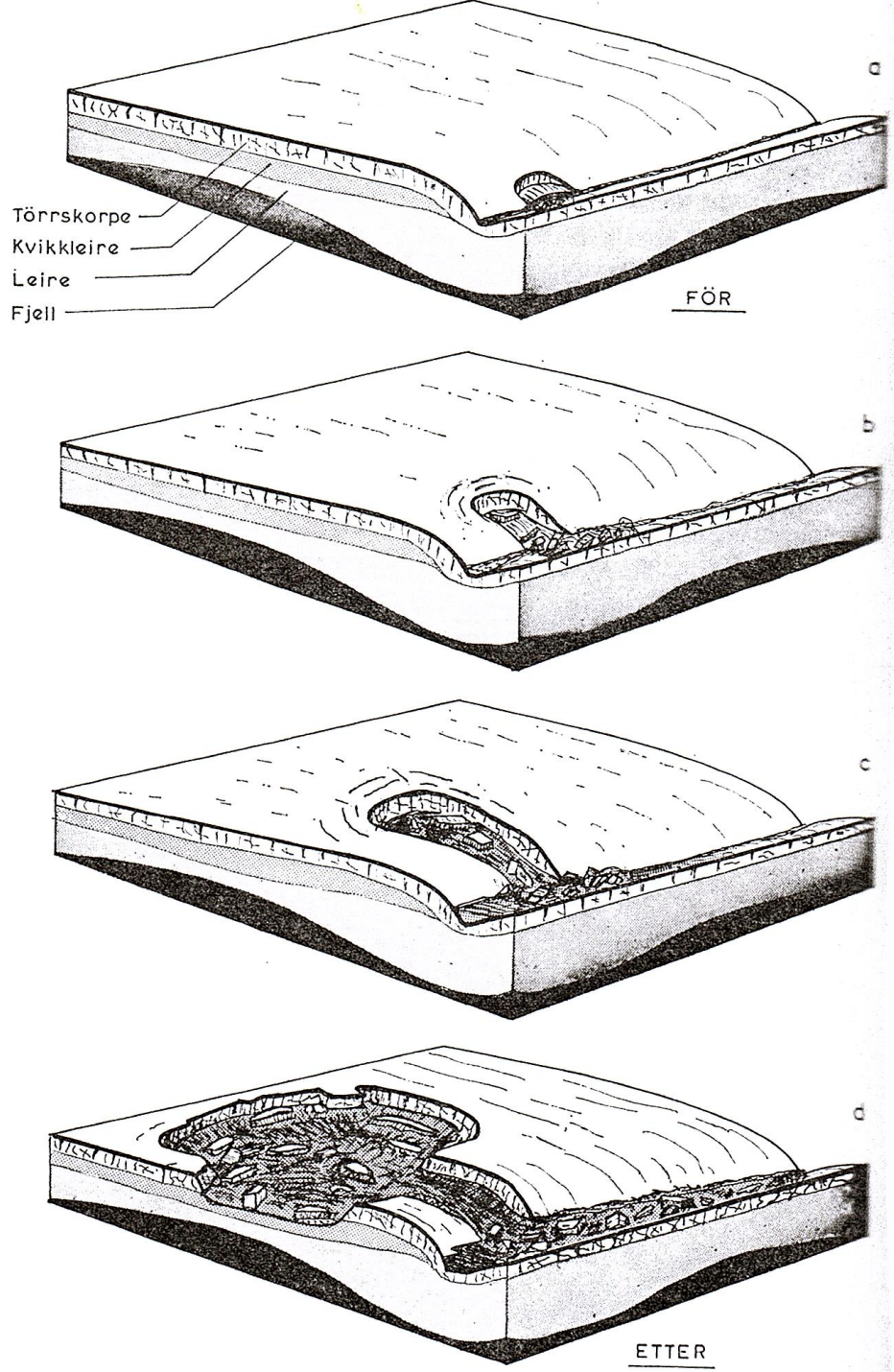
N W E S

Kilometer

0 12.5 25 50

NORGES VASSDRAGS- OG ENERGIDIREKTORAT

NGI


a
Törrskorpe
Kvikkleire
Leire
Fjell
FÖR
b
c
d
ETTER

Rissaskredet
1978

Illustr:
Kjell Karlsrud



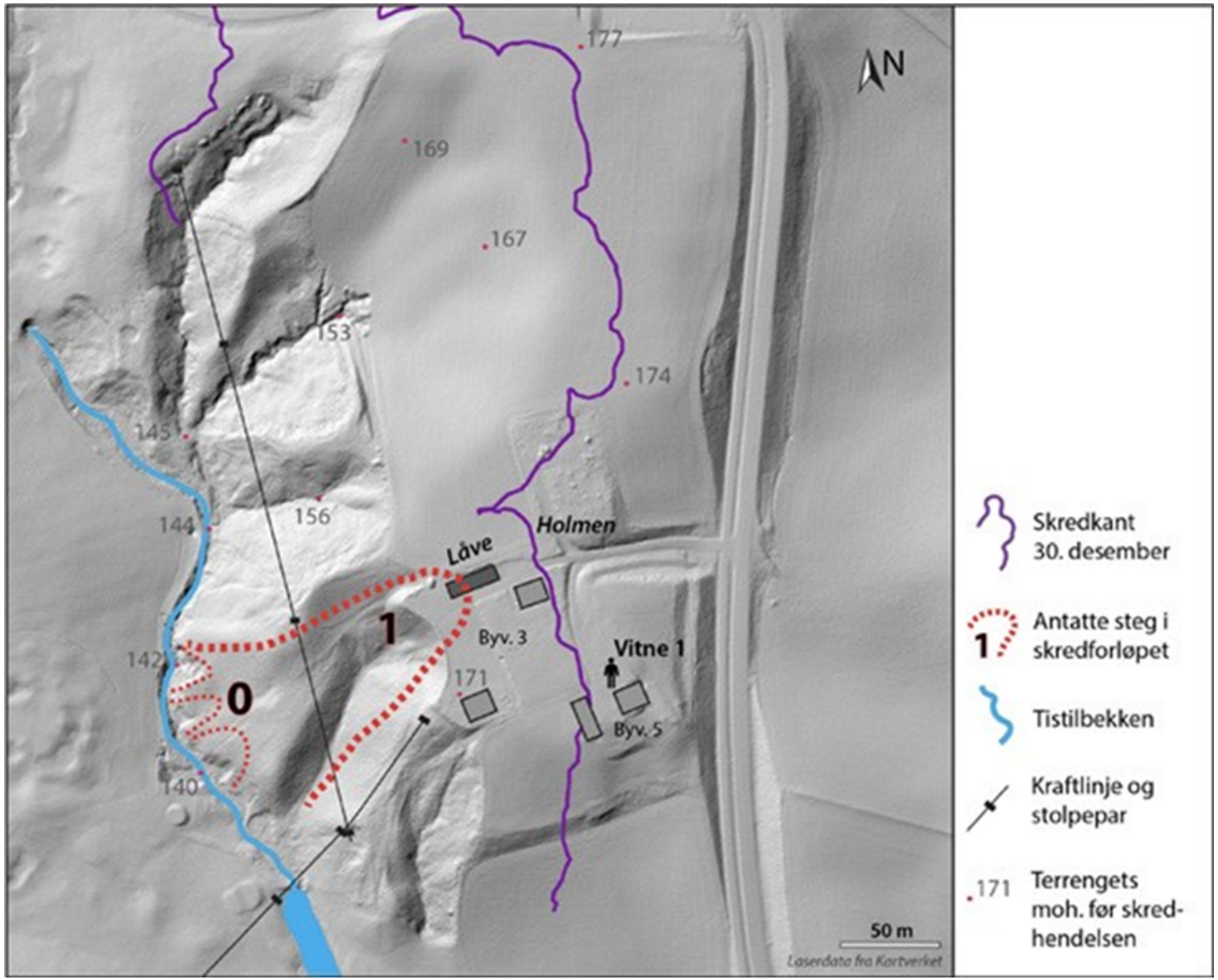
The Gjerdrum quick clay slide, 9.12.2020

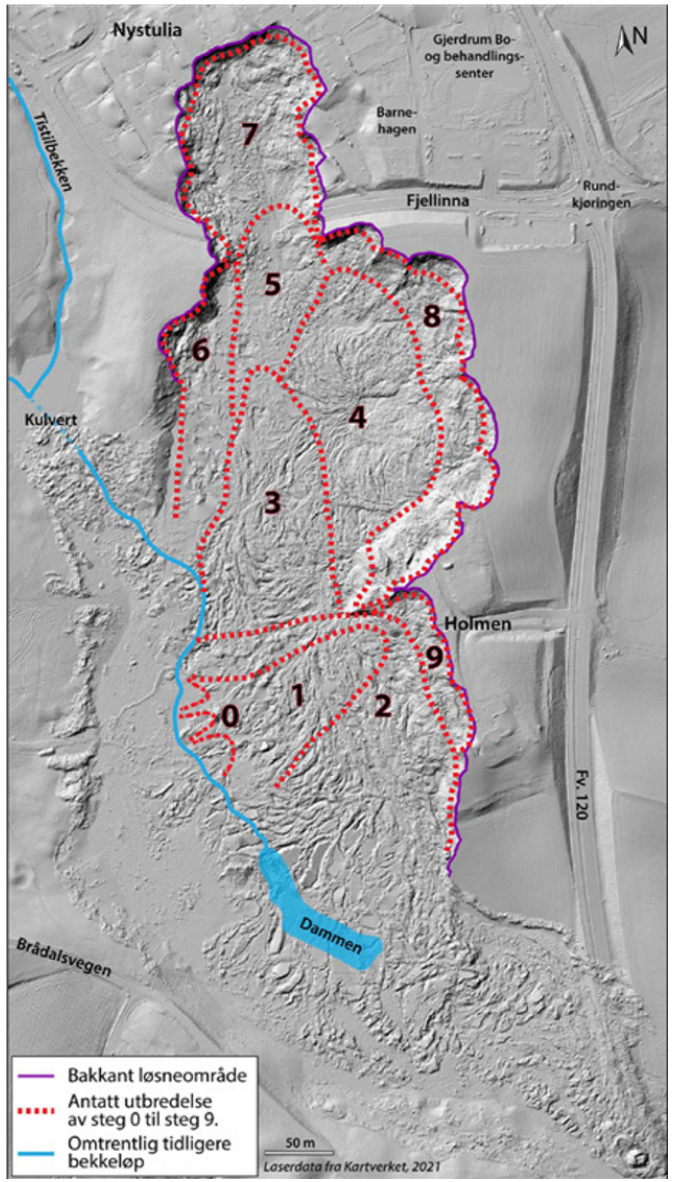
(Repport fra the ekspertutvalget 29.9.2021)



The Gjerdrum quick clay slide,

Rapport fra ekspertutvalg, 29.9.2021





Stabilization of undisturbed quick clay by salt wells.

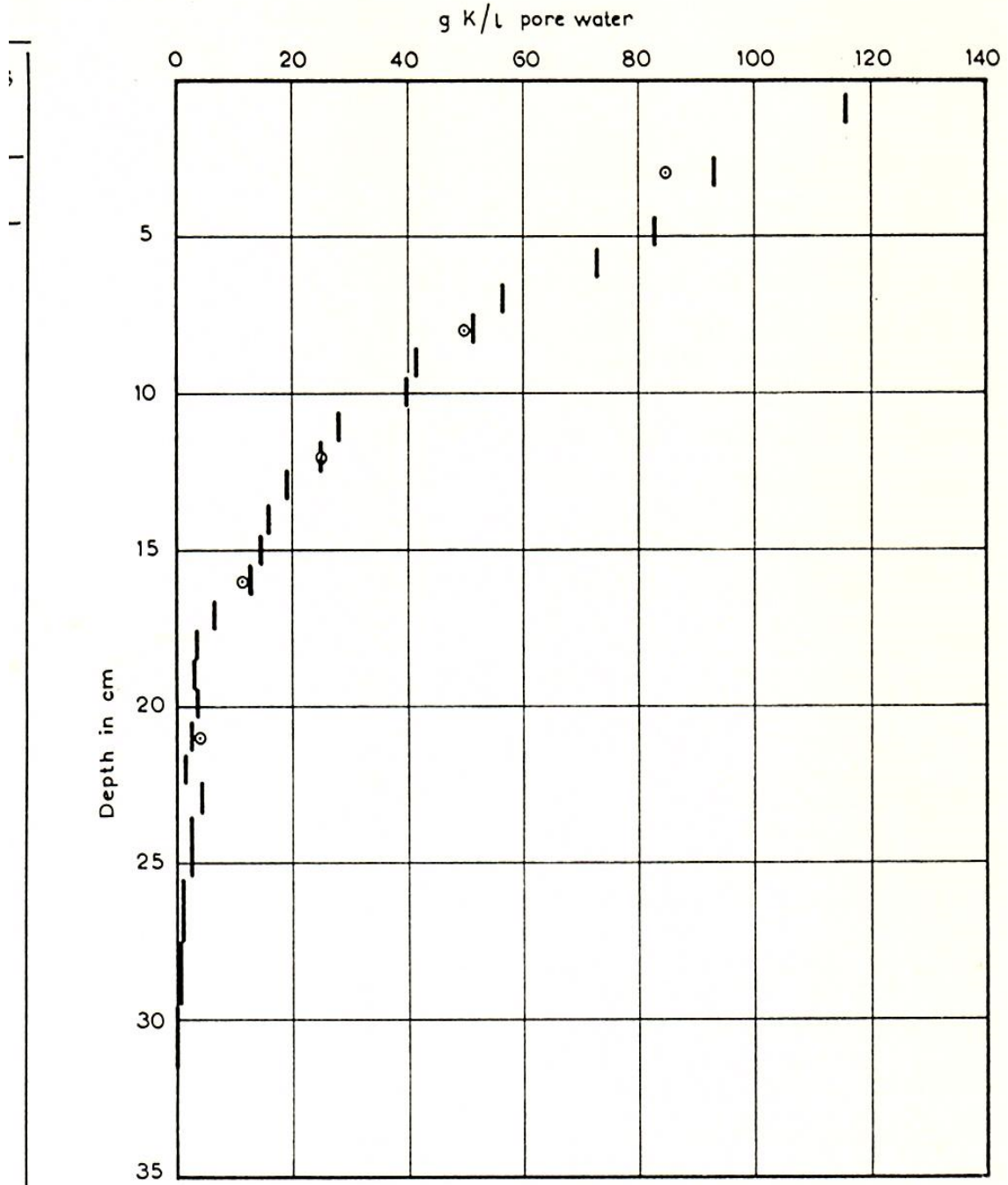
Johan Moum, Olav Ihlen Sopp and Tor Løken.

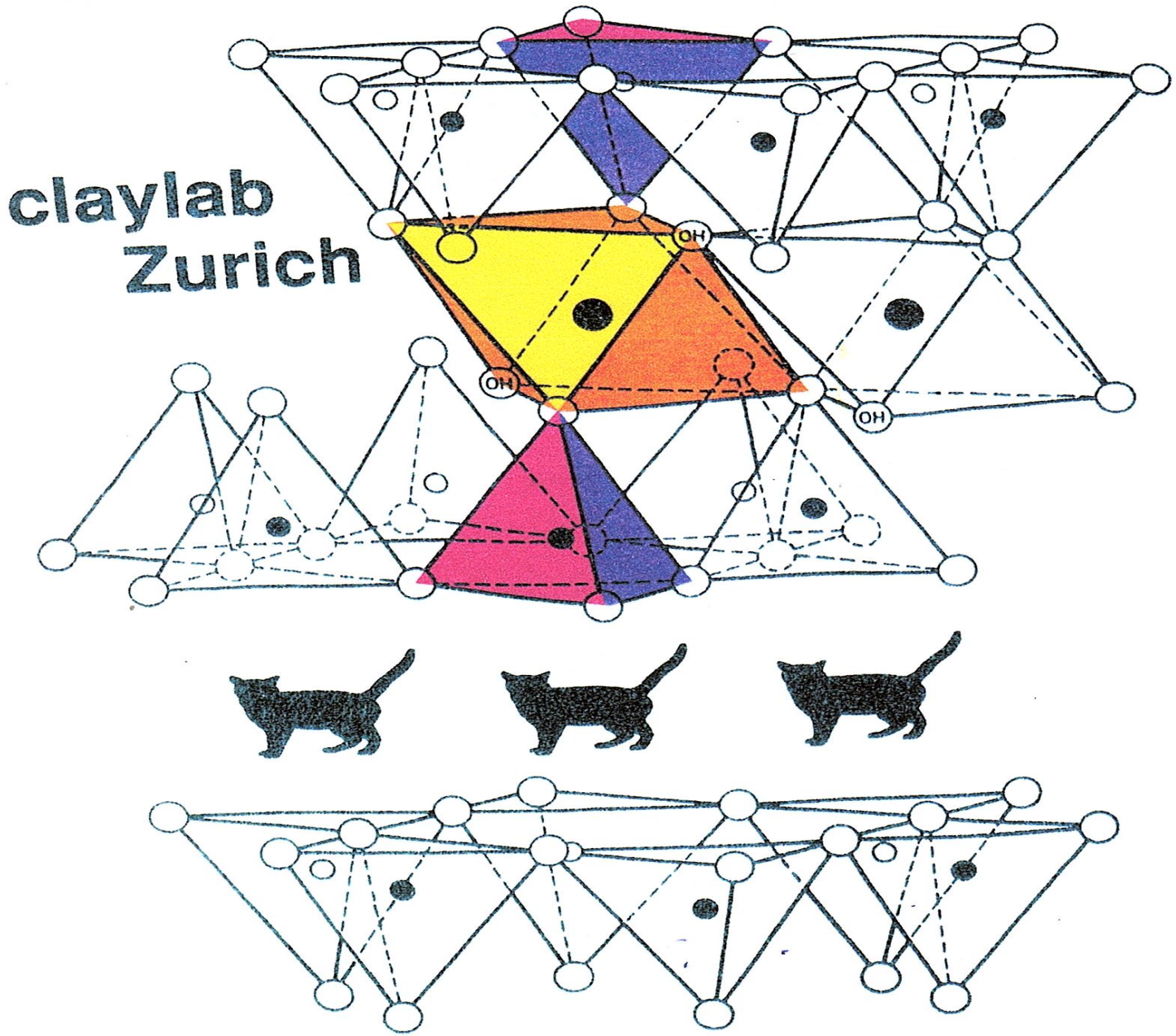
NGI publ. No. 81 , 1968

Diffusion of potassium chloride.

Analyzed potassium concentration against depth.

Encirculated points represent calculated concentrations using D=6.2 10




claylab
Zurich
OH
OH
OH