A clay sample from Tangen brickwork

BY

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With 3 text-figures.

A clay sample with a beautiful specimen of a *Ophiura,* probably *O. alba* Forbes, was sent in to Norges geologiske undersøkelse (Geological survey of Norway) by H. A. Sand, Fredrikstad. It had been collected by E. Kvernstrøm in the clay pit of Tangen brickwork near Fredrikstad on the east side of the entrance to the Oslofjord, Norway. The deposit is situated 200 m east of the eastern border of the river Glomma. The surface of the deposit lies approximately 20 m above sea level, and the sample was taken 8 m below the surface.

The grain size distribution of this clay sample was analysed by John W. Wilhelmsen of Norges geologiske undersøkelse, and the cumulative curve, given in figure 1, indicates a normal- to well-sorted sediment, $So = \log \frac{Q_{75}}{Q_{25}} = 0.80$. It is extraordinary fine-grained, its median particle size being 0.001 mm and 68 per cent by weight consisting of particles less than 0.002 mm. Plotted in the Md-So diagram (Selmer-Olsen, 1954) it falls within the area of fine-grained marine sediments but close to the transition between this area and that of lacustrine clays.

In order to find out the mineral composition of our clay sample, a part of it was submitted to X-ray analysis at the Roentgen laboratory of the Mineralogisk-Geologisk museum, University of Oslo.

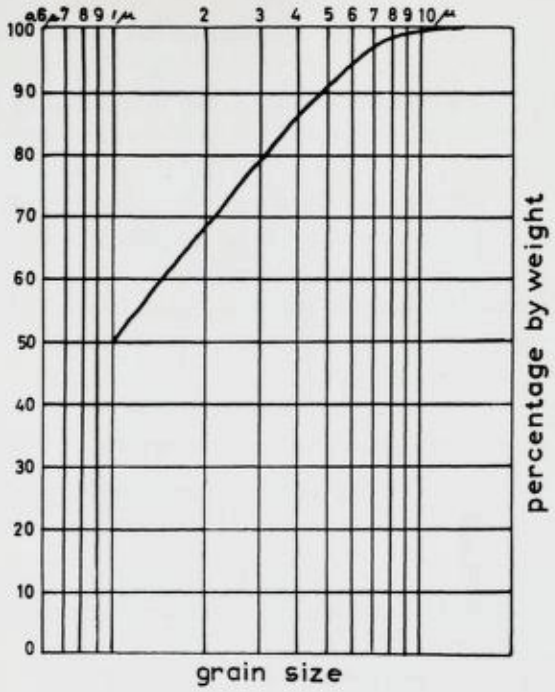

Fig. 1. Grain size distribution; Q_{25} estimated.
Kornfordelingskurve.

This investigation was carried out by Per Chr. Sæbø who used a powder camera with 9 cm radius and Fe-radiation. Two films, No. 6931 from the total substance and No. 7277 from the particle fraction less than 0.002 mm, were exposed during 20 hours. They showed no principle differences. No. 6931 is reproduced in figure 2 together with the X-ray powder patterns of ordinary muscovite and of ordinary chlorite. The chief mineral of our sample is an ordinary muscovite. Quartz is present in small amounts and, furthermore, there is a distinct reflection at 7.05 Å whereas no reflection can be traced at approx 14.00 Å (see Brindley 1951). This would indicate the presence of some mineral of the kaoline group. As, however, kaoline is very rare in Norwegian clay deposits, the above-mentioned reflection wold more probably indicate the presence of a mineral of the chlorites rich in iron, because chlorites rich in iron will give no, or only very faint, reflection of (001) at 14.00 Å when present in moderate quantities. No other mineral was identified in the X-ray patterns. There exists, however, the possibility that the relatively large amount of unaltered muscovite obliterates a possible

occurence of hydrous mica (illite) in the patterns. Biotite may also be present.

The results of the X-ray investigation have been confirmed by a differential thermal analysis carried out at Norges geologiske undersøkelse by John W. Wilhelmsen; the diagram is given in figure 3. The DTA demonstrates the presence of chlorite, but neither kaoline nor hydrous mica could be found. Small amounts of quartz, sulfides and carbonates are present, and the diagram also shows the characteristic exothermic reaction of the Cambro-Silurian shales of the Oslo region with a maximum at approximately 500°C due to their content of organic carbon.

According to these investigations our clay sample from Tangen at Fredrikstad is, semi-quantitatively, made up of:

40—50 per cent unaltered muscovite
10—20 » » chlorite rich in iron
5—10 » » quartz

and, additionally, sulfides, carbonates and some organic material.

A high content of muscovite is furthermore supported by extraordinary high value of the ratio Potassium/Sodium of our clay, K/Na = 5.50/1.42 (Analyst Brynjolf Bruun of Norges geologiske undersøkelse).

One of the factors constituting the conditions under which this clay has been preserved, is revealed by examination of the included microfossils. This was carried out by Rolf W. Feyling-Hanssen of Norges geologiske undersøkelse, and showed a poor fauna of fossil Foraminifera and some Ostracoda. The species *Streblus beccarii* Linné dominates the population accounting for 65 per cent of the foraminiferal fauna. Together with the other species present this places our clay into a late part of the Post Glacial period, probably at he transition between zone F and G of Feyling-Hanssen's stratigraphical division (Feyling-Hanssen, 1957). Our clay sample thus belongs to a young sediment, and there has been little time for mineral changes in it.

As previously mentioned our clay sample was taken 8 m below the surface of the deposit. It has thus escaped alteration processes within the so-called drying crust and has also been protected against weathering phenomena caused by seasonal fluctuations in temperature

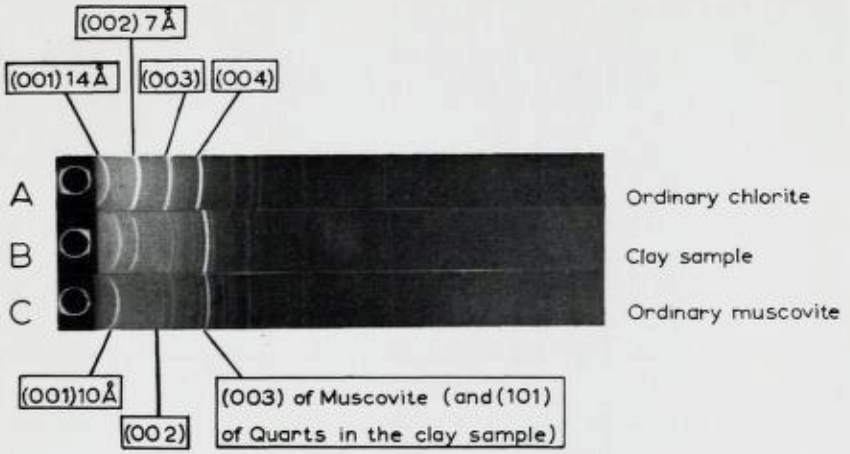

Fig. 2. A: Ordinary chlorite with normal content of Iron (from Støa, Norway. Coll. T. W. F. Barth). Note the intensity of the basal reflections (001) at approx. 14Å and (002) at approx. 7Å. B: The clay from Tangen. Only (002) of the chlorite can be seen, (001) and (003) are not recorded. C: Unaltered muscovite from Big Ridge Mica Mine, North Carolina. The extraordinary strong (003) line in the clay pattern (B) is caused by coinsidence with the (101) reflection og quartz.

Photo: B. Mauritz.

Røntgendiagrammer: A, vanlig kloritt; B, leirprøven fra Tangen; C, vanlig muskovitt.

Fig. 3. Differential thermal analysis. The exothermic reaction between 320 and 520°C indicates the presence of organic carbon.

Differensialtermisk analyse.

(see Moum og Rosenqvist, 1955). Furthermore the extraordinarily low permeability of these fine-grained clay has certainly to a great extent prevented hydrous solutions from penetrating into it and reacting with it.

The fauna of fossil Foraminifera indicates that our clay was deposited in shallow water of rather low salinity, probably brachyhaline water. This is in good accordance with its position in the Md-So diagram being close to the area of lacustrine deposits. In order to explain the sedimentation of such a fine-grained clay i shallow water, we suppose that some kind of quiet, lagoonal condition existed during the deposition. The microscopic examination also revealed the presence of plant remains, these too contributing to the amount of organic carbon in our clay.

Sammendrag.

En leirprøve fra Tangen teglverk.

En leirprøve fra Tangen teglverk nær Fredrikstad, samlet av E. Kvernstrøm og innsendt til Norges geologiske undersøkelse av H. A. Sand, ble underkastet røntgenundersøkelse (Per Chr. Sæbø), kornstørrelsesfordeling og differensialtermisk analyse (John W. Wilhelmsen) samt mikropaleontologisk analyse (Rolf W. Feyling-Hanssen). Den viste seg å være en meget finkornig gruntvannsleire, 68 % av materialet hadde partikkelstørrelser mindre enn 0.002 mm. 40—50 % av mineralinnholdet besto av uomvandlet glimmer (muskovitt), dessuten fantes 10—20 % jernrik kloritt og 5—10 % kvarts, små mengder sulfider, karbonater og organisk kullstoff var også til stede. Leirprøven viste et vakkert avtrykk av en slangestjerne, *Ophiura*.

References:

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