

# LITHOSTRATIGRAPHY OF PLIOCENE DEPOSITS IN THE LIEFKENSHOEKTUNNEL CONSTRUCTION WORKS NEAR KALLO (NW BELGIUM)

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The lithostratigraphy of Pliocene deposits recently exposed in a temporary section near Kallo (province of Oost-Vlaanderen, NW Belgium) is described. In the section exposed the Merksem Sand Member, the Kruisschans Sand Member and the Oorderen Sand Member of the Lillo Formation (Pliocene) could be recognised. Previously described sections are briefly commented upon.

Key words — Lithostratigraphy, Pliocene, Kallo, NW Belgium.

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## INTRODUCTION

A section exposing Pliocene deposits that was accessible in a construction pit in the Antwerp harbour area near Kallo from 1986 to 1989 was studied and sampled by the authors with the intention of identifying the lithostratigraphical units as defined by de Meuter & Laga (1976). The section was found to be highly fossiliferous, which is why numerous samples were taken; for study these will remain in the authors' private collections for the time being.

The lithostratigraphical description presented herein is intended to serve as a reference for a number of papers describing the faunas collected, which are currently in preparation. These papers

will especially focus on the ill-known faunas of the Kruisschans Sand Member (Lillo Formation).

For an overview of previous papers dealing with the stratigraphy of the Pliocene in the Antwerp harbour area, the reader is referred to the brief historical review presented by Nuyts (1990, pp. 17-19).

## LOCALITY

The section studied was exposed some five kilometres west of the village of Kallo (municipality of Beveren; topographical map of Belgium 1:25,000, sheet 7/5-6, co-ordinates  $x = 139.611,250$ ,  $y = 219.504,250$ ), on the left bank of the River Scheldt near Antwerp (Fig. 1). Here a construction pit (measuring 400 by 280 metres) was dug to put in place components of the Liefkenshoektunnel at the site where the Verrebroekdok is planned. The construction pit was situated along the Waasland Canal in line with the Doeldok and is now flooded.

## LITHOLOGY AND LITHOSTRATIGRAPHY

The section exposed in the construction pit was accessible between the summers of 1986 and 1989.

During this period it was recorded several times, extensively sampled and documented by photographs. The section described herein was recorded in the northeastern part of the pit; no changes in the lithostratigraphy in the various parts of the pit were observed. The stratigraphical sequence had a total thickness of about 15 metres the uppermost 5 metres of which consisted of recently displaced sands; the remainder of the section was undisturbed. The absolute height of the top of the pit was at +6,30 m, the bottom at -8,80 m (data courtesy of the Belgian Ministry of Public Works).

A description of the section measured is given in the caption of Fig. 2 with depths indicated in metres below surface. The term 'shells' signifies molluscs, fragments of such and shell grit.

The uppermost 5 metres consist of recently displaced sands. The continental deposits found below these sands reach a thickness of 2,60 m. The top of these deposits could not be properly studied as it had been disturbed during the excavation works. The first marine deposit encountered is the Merkssem Sand Member with a thickness of 1,40 m and consisting mainly of dark green clayey sand with small shells and much shell grit. Lithologically, this member comprises essentially sand with clay particles and as such it differs from the underlying Kruisschans Sand Member, which consists essentially of clay. The latter member is 2,85 m thick, and comprises dark brown clay with many bands and lenses of coarse light brown sand occurring throughout. This is a typical feature of a high-energy environment. A few shell layers were observed (layers 11, 13, 15 and 17 in Fig. 2). This part of the section is referred to the Kruisschans Sand Member rather than to the Oorderen Sand Member on the following grounds:

- the sediment consists of clay rather than of clayey sand or sand;
- both members are clearly separated by a thin layer of shells; below this layer is found sand, above it is found clay.

As we shall demonstrate in subsequent papers, the Kruisschans Sand Member also yields a distinctive teleost fauna, which in particular the large-sized otoliths of *Melanogrammus conjunctus* Gaemers & Schwarzchans, 1973 and bones of *Platax woodwardii* Agassiz, 1843 (Hoedemakers, in prep.). From this member a distinctive molluscan fauna was collected, comprising a species of gastropod typical of more temperate (boreal) areas, *Admete viridula* (Fabricius, 1780) and other characteristic Kruisschans

species such as the bivalve *Laevicardium parkinsoni* (J. Sowerby, 1818) and the gastropod *Lunatia cate-noides* (Wood, 1842). The first known *in situ* occurrence of the bivalve *Panomya trapezoidis* Strauch, 1972 should also be noted (Marquet, in prep.).

The lowermost 3,30 m exposed are assigned to the Oorderen Sand Member on account of the occurrence, occasionally in large numbers, of the bivalve *Angulus benedeni benedeni* (Nyst & Westendorp, 1839) in a sandy sediment. A few shell layers were observed as well; the base of the member was not reached in the construction pit.

All Pliocene deposits were found to be highly fossiliferous, but it is beyond the scope of this paper to present detailed descriptions of the faunas of the various members recognised in the pit. The authors intend to discuss the most interesting faunal elements in forthcoming papers.

#### COMPARISON WITH PREVIOUSLY DESCRIBED SECTIONS

During the past two decades a number of sections in the Antwerp harbour area west of the River Scheldt that exposed deposits comparable to the ones described herein have been published: Gaemers & Janssen (1972) and Herman (1974) described the section exposed at the sea lock, Janssen (1974) the one accessible during the tunnel works at the First Canal Dock, while Nuyts (1990) provided an account of the section of the Fourth Harbour Dock (see Fig. 1 for locations). In all of these sections the Oorderen Sand Member of the Lillo Formation was recognised, but the Kruisschans Sand Member was recorded only from the tunnel works at the First Canal Dock, but it may have been present at the sea lock as well.

At the sea lock the Kruisschans Sand Member was not recognised with certainty by Gaemers & Janssen (1972, p. 27), who indicated that some fossiliferous layers might belong to that member, but no confirmation is given. At the same site, Herman (1974, p. 18, fig. 2) recorded only the Oorderen Sand Member, or Sables de Kallo, as the unit was then called. In the tunnel works at the First Canal Dock, the Kruisschans Sand Member reached a thickness of 2,85 m. At this locality a slope in stratification was observed in this member. This was not seen in the Liefkenshoeektunnel construction pit, but we did note in the pit that the Kruisschans Sand Member thinned out towards the south. In the Fourth Harbour Dock exposure the Kruisschans Sand Member was not recorded, although the

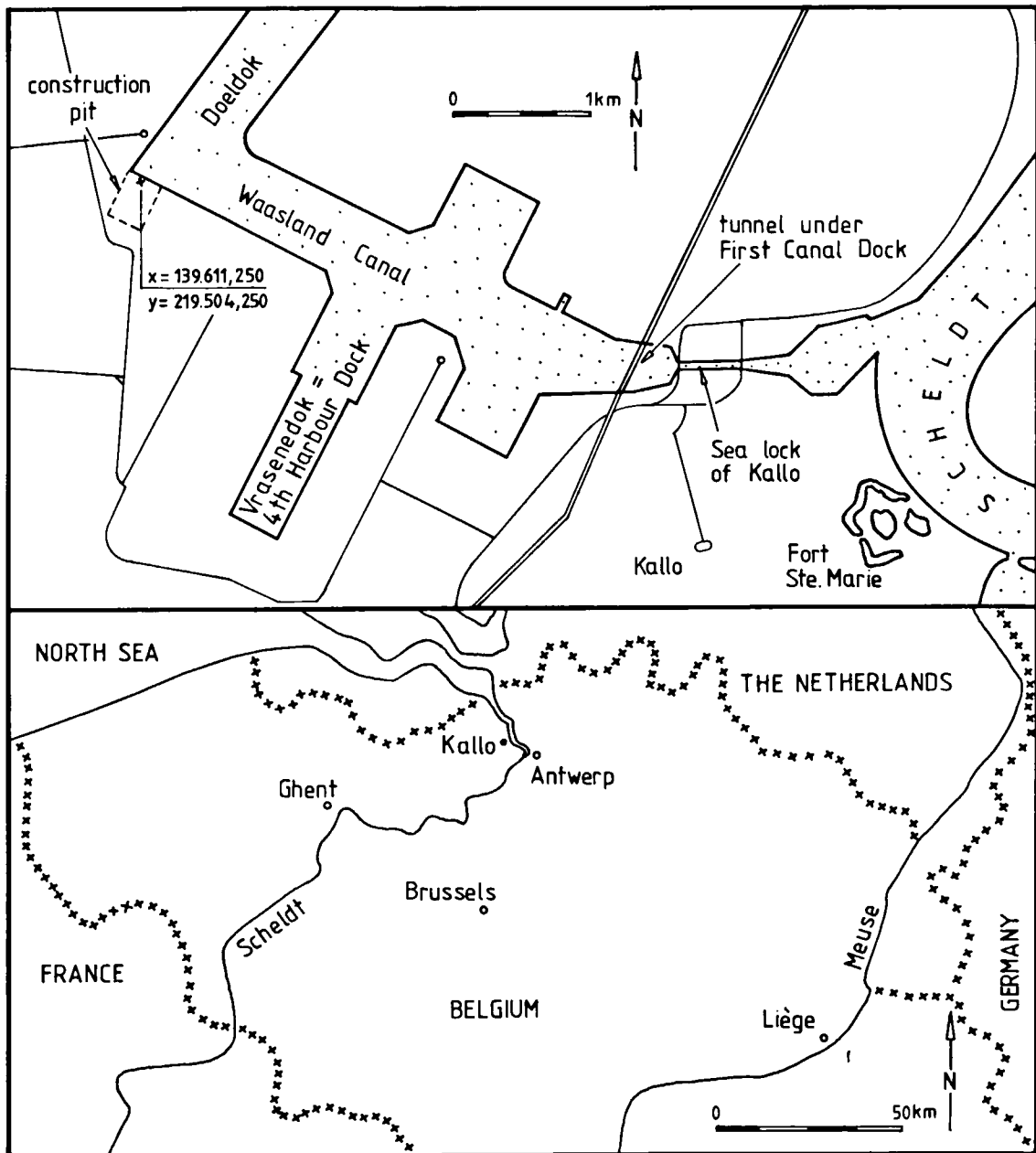


Fig. 1. Location of the temporary exposure in the Liefkenshoektunnel construction pit, and other exposures in the area described previously to which reference is made in the text.

lithology of the upper part of the Oorderen Sand Member as recognised there [between 3,60 m and 5,60 m below surface; see Nuyts (1990, p. 19)] closely resembles that of the Kruisschans Sand Member as seen in the present exposure. This leads us to assume that this member was indeed present at the Fourth Harbour Dock exposure, but was incorrectly included in the Oorderen Sand Member. These members can easily be distinguished, as noted above. However, it is very difficult to cor-

rectly assign sections merely on the basis of lithological logs in previously published descriptions.

The Oorderen Sand Member as recorded herein finds a good match in sections published previously from the sea lock and from the First Canal Dock tunnel works, and corresponds with the lower part of the Oorderen Sand Member (down from 5,60 m below surface) as published for the Fourth Harbour Dock.

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Fig. 2. Stratigraphy of Late Cainozoic deposits at the Liefkenshoektunnel construction works. Section measured September 4, 1987 with additions recorded May 18, 1989.

- 1: light rusty brown fine sand with *Atrina* sp. in life position and many crustacean burrows (not indurated) (14,70-15,10 m)
- 2: cross-bedded bands of light brown fine sand with many shells (14,60-14,70 m)
- 3: light brown fine sand with many shells, characterised by *Atrina* sp. in horizontal position (14,20-14,60 m)
- 4: light brown fine sand with scattered shells (13,70-14,20 m)
- 5: shell layer in light brown fine sand, locally oxidised and indurated, with many molluscs [especially the bivalve *Pygocardia rustica rustica* (J. Sowerby, 1818)] (13,50-13,70 m)
- 6: dark brown rather coarse sand with scattered shells [many *Cultellus cultellatus* (Wood in Sowerby, 1844) and some *Angulus benedeni benedeni*] (12,90-13,50 m)
- 7: undulating shell layer in dark brown rather coarse clayey sand (12,60-12,90 m)
- 8: as 6, with scattered shells (12,10-12,60 m)
- 9: shell layer in dark brown rather coarse sand, many bivalves (especially *A. benedeni benedeni*) preserved articulated (12,00-12,10 m)
- 10: as 6, with scattered shells [especially *A. benedeni benedeni*], bivalves disarticulated (11,85-12,00 m)
- 11: shell layer in light brown coarse sand, occasionally clayey (11,80-11,85 m)
- 12: dark brown sandy clay with lenses of brown coarse sand and with scattered shells (11,35-11,80 m)
- 13: shell layer (characterised by *Panomya trapezoidis*) in light brown coarse sand (11,30-11,35 m)
- 14: as 12 (10,70-11,30 m)
- 15: shell layer in light brown coarse sand, many vertebrate remains; locally up to 0.25 m thick and occasionally with a lens of light brown coarse sand with small shells only at the top [e.g. the bivalve *Corbula (Varicorbula) gibba gibba* (Olivi, 1792), the gastropods *Hinia reticosa* (J. Sowerby, 1812) and Turridae] and vertebrate remains (10,60-10,70 m)
- 16: as 12 (10,30-10,60 m)
- 17: shell layer in light brown coarse sand, also with many vertebrate remains (10,25-10,30 m)
- 18: dark brown sandy clay with lenses of brown coarse sand, many shells occurring throughout, at the top many oxidised crustacean burrows (9,25-10,25 m)
- 19: light brown sand with shells and clay nodules (9,00-9,25 m)
- 20: bands of dark green fine clayey sand with shells in alternation with bands of light to dark brown fine sand (7,60-9,00 m)
- 21: light grey to white fine sand, with bands of dark brown fine sand (7,10-7,60 m)
- 22: black peat (6,10-7,10 m)
- 23: light brown to light grey sand, with darker parts and rusty spots, scattered shells, more concentrated at the base (5,00-6,10 m)
- 24: recent filling up (0-5,00 m).

