1 A geological profile along the Belgian coast

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INTRODUCTION

The drilling of three new wells along the Belgian coast by the Geological Survey was certainly not because a good geometrical lithoframe for the area would have been lacking. HALET (1921) and GULINCK (1970) produced well known sections along the coast. The data available to these authors however were provided by samples from older water flush wells and hence precise and detailed lithological descriptions were rare as were the samples suitable for modern biostratigraphical analyses. Besides geotechnical-, exploration- and research activities offshore the Belgian coast would benefit from more modern geological and geophysical reference data along the coast. Three well sites were selected, at Den Haan (22W/276), Knokke (11E/138) and Oostduinkerke (35E/142). The three wells are drilled till the Caledonian basement of the Brabant Massif. The Knokke well has been entirely cored ; both other wells were flushwells. All three wells had a classical well log program (resistivity, spontaneous potential, natural radioactivity and caliper) ; additionally in the Knokke well density and acoustic transit time measurements were done.

THE MAIN RESULTS FROM THE THREE INDIVIDUAL WELLS

a. The Knokke well

A full report about the Knokke well is available (LAGA and VANDENBERGHE, in press) with contributions dealing with lithology, mineralogy, biostratigraphy and well geophysical data.

The Knokke well section starts at the top with 30 m mainly sandy Pleistocene, estuarine tidal deposits belonging to the Flemish Valley river system.

Between 30 and 71.50 m depth the top of the Tertiary is made up by the lower two clay units of the Kallo Formation. The lower one with a glauconitic rich base being the Asse clay ; both clay units are separated by the first sandy layer of the Kallo Formation complex.

A thin fine sand unit between 71.5 and 74 m contains *Nummulites wemmelensis* and is therefore identified as the Wemmel sands. The 74-79 m section is badly cored because of the alternation of fine sands and cemented calcareous sandstones. At 73 m *Callista proxima*, diagnostic for the Brussels sands is present together with numerous rounded *Nummulites laevigatus*. Therefore underlying the Wemmel sands are probably the Brussels sands and not the Lede sands as regional geological knowledge would expect. However the idea of a widespread sheet of Brussels sands almost completely eroded before the deposition of Lede and Wemmel sands was put forward already in 1954 by GULINCK and HACQUAERT while a more recent study in the nearby Zeebrugge harbour area by DEPRET and WILLEMS (1983) confirmed the lack of the Lede sediments and the presence of *Nummulites laevigatus* which according to these authors could belong to sediments comparable either to the Den Hoorn (Upper Panisel) or to the Brussels sands.

The 79 m - 105 m interval of fine clayey glauconitic sands with numerous shells and calcareous sandstones corresponds to the Upper Panisel facies. Between this typical Upper Panisel facies and the clayey Lower

Panisel facies between 124 and 133 m a glauconitic sand with stone layers occurs. The basal Panisel clay (Merelbeke clay) is only two metres thick between 133 and 135 m.

The Ieper Formation extends from 144 m down to 288 m. The overlying interval 135-144 m is a laminated clay with fine sand horizons and even cemented sandstones and is now called the Egem Formation. The Ieper Formation consists of homogeneous greengrey heavy clay with some rare silty spots or thin silt laminae. Several horizons of brecciated Ieper clay exist. Although some of the fragments have some rounding, most of the breccia fragments are still angular and have barely moved. At least in some instances brecciation is associated with small faults, probably indicating gliding. The angular shape of the clay fragments and the fact that the fragments have not been compressed suggests brecciation at an already well compacted stage, at least some tens of metres burial depth or even more.

The breccia are related to observations by HENRIET and MARECHAL (1982) who have interpreted, from sparkerseismic surveys, diapirs and other deformations in the Ieper clay offshore. It is suggested that this common occurrence of Ieper clay deformation in the Belgian North Sea in contrast to almost undeformed Ieper clay on land is due to unloading as the Channel was eroded.

Practically the whole Landen Formation between 288-311 m has to be associated with continental Upper Landen facies. The upper 11 m are quartz sands with peat debris. The 297-308 m interval with silts, fine sands, heavy clay and shells has a typical Sparnacien type appearance. The lower part of the Landen Formation consists of coloured sands.

The Upper Cretaceous chalk sequence is very homogeneous. It is a fine grained white chalk, containing mollusc fragments. Several indurated horizons occur and the chalk as a whole becomes more endurated towards the base. Calcareous nannofossils show the sequence to be mainly Campanian to Lower Maastrichtian at the very top. The base of the Upper Cretaceous is more differentiated. It contains small black phosphatic pebbles, cemented glauconite sandstone and fish remnants. Its age is Santonian.

The top of the Brabant Massif is reached at 432 m and consists of a moderately dipping jointed slate of the Lower Revinium Oisquercq slates (LEGRAND, 1968).

b. The Den Haan and Oostduinkerke wells

The Tertiary in both wells only consists of Ieper clays and the Landen Formation.

The detailed lithological variations within the Ieper clays can be correlated through the natural radioactivity logs. Based mainly on resistivity, the Landen Formation in the two wells can be divided into an upper continental facies with a variable mainly sandy lithology and a lower marine facies with a rather homogeneous fine grained lithology.

The Landen Formation in the Den Haan well occurs between 193 and 223 m and in the Oostduinkerke well between 138.5 and 180 m.

The chalk mass in Oostduinkerke between 180 and 264.45 m is apparently less permeable than the chalk in Den Haan between 223 and 297 m, based on the separation between long and short spaced resistivity readings.

The biostratigraphic work by LOUWYE (in LAGA and VANDENBERGHE, op.cit.) based on *Dinophyceae* attributes the almost entire section to the Lower Campanian except for the 295-299 m part which is attributed to the Santonian. The main chalk mass in the Oostduinkerke well is associated with the Upper and Lower Turonian. The lower two metres (262.4 m - 264.45 m) is a pale conglomerate with Caledonian fragments in a limy and glauconitic cement, and containing fossil fragments. It is thought to be equivalent with the Cenomanian base conglomerate (Serrasin de Bellignies of MARLIERE 1954, p. 422-425).

The top of the Brabant Massif in the Den Haan well at 297 m is a Revinian quartzic slate, the top of which is altered to a reddish clay. Total depth at Den Haan is 321 m. The top of the Brabant Massif in the Oostduinkerke well consists of slightly altered quartz slates, with red clay fillings and a tectonic breccia.

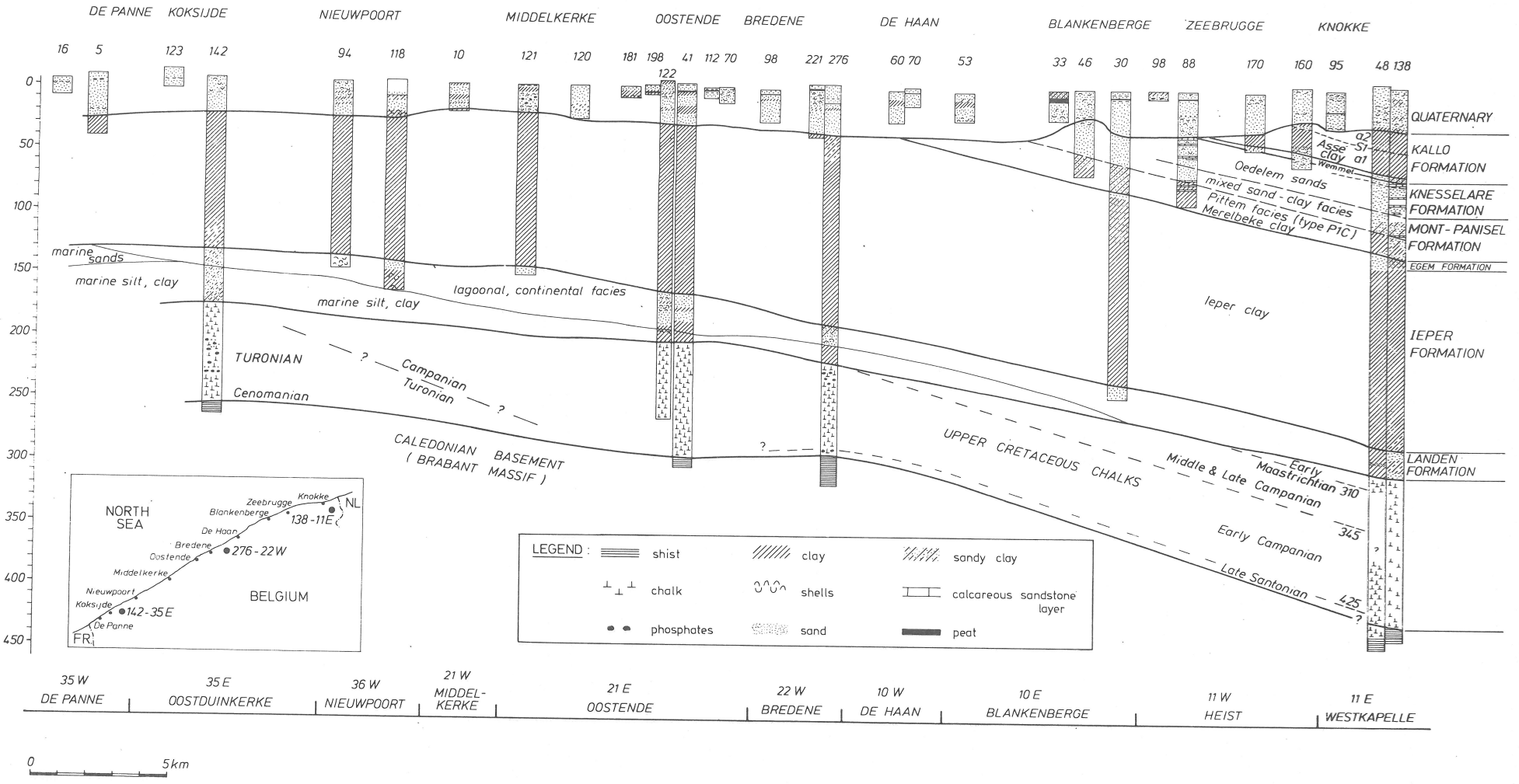

Figure 1 Cross section along the Belgian coast.

According to LEGRAND (1968) these rocks should belong to the Salmian. Total depth at Oostduinkerke is 270.3 m.

THE CORRELATION OF THE THREE WELLS AND A CROSS SECTION ALONG THE COAST

The profile represented on figure 1 incorporates the three wells discussed above together with other well data available in the files of the Geological Survey.

The boundaries of the Tertiary formations and facies and also the top of the Brabant Massif can be traced without too much difficulty.

Within the Upper Cretaceous, the Turonian of the west coast (Oostduinkerke) has to wedge out under the Santonian-Campanian probably between Den Haan and Oostende (see also LEGRAND, 1968). The northern limit of the Turonian sea was formed by a relative high in the Brabant Massif (MARLIERE, 1954, p. 420). After the Turonian the area north of Den Haan has started to subside relative to the southern area where Turonian had been deposited before.

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