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The Late Pleistocene loess-palaeosol sequence of Middle Belgium

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ABSTRACT

In Belgium, two areas show extended Late Pleistocene loess cover: the Hesbaye close to Liège and the Haine Basin around Mons. For decades, correlation between both areas remained problematic. Here we will show how, by way of complementary approaches, the records of the Haine and the Hesbaye could be inserted into a high resolution pedosedimentary sequence encompassing the major part of the Late Pleistocene and reproducible at the scale of the Belgian loess belt. Based on the pedosedimentary and palaeoenvironmental signatures of the Belgian sequence, comparisons are proposed with high resolution loess sequences of Eastern Europe and Central Siberia. They give access to well documented palynological data for the first part of the Late Pleistocene and to a strong climatic record on loess framed between 45 and 10 ka BP by long series of radiocarbon dates on charcoal and wood remains. The conjunction of these complementary loess records has further given way to a consistent proxy-correlation scheme linking a high resolution continental climatic record to the Greenland ice sequence.

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1. Introduction

Middle Belgium is part of a large loess belt which extends from Central Europe to Normandy, via the Middle Rhine and the northern part of the Paris Basin. In Belgium, it covers the central part of the country, north of the Sambre and Meuse valleys. Most of the loess is from Late Pleistocene, reaching locally a thickness of ~15 m in plateau position. The two best documented areas are located in the Hesbaye, and in the Haine Basin around Mons (Fig. 1).

During recent decades, numerous studies have been dedicated to the Belgian loess belt, leading to the building of distinct lithostratigraphic and chronostratigraphic schemes. Differences are found from one team to another, but also for single authors with evolving stratigraphic schemes over time. A brief historiographic overview will be presented in this paper, illustrating the major steps in the construction of the modern sequence (Section 2). After some methodological considerations (Section 3), we will present the up-to-date reference sequence for the Middle Belgium loess belt, focusing on Late Pleistocene (Section 4). The chronostratigraphic framework will then be presented, as well as correlations with other key loess areas in the Eurasian loess belt (Section 5).

2. History of research (SP, PH, PS)

2.1. The scheme of F. Gullentops

In the mid-fifties, Gullentops (1954) established a chronostratigraphic scheme in the Hesbaye that can be considered as the starting point of modern research dedicated to loess in Belgium. Among F. Gullentops' precursors figure the names of J. Ladrière, E. Van den Broeck, V. Commont, A. Rutot, J. Cornet, and R. Tavernier. A synthesis of these studies can be found in Gullentops (1954). F. Gullentops' scheme encompassed three loess bodies (Hainaut, Hesbaye and Brabant) with two intercalated stratigraphic markers named respectively Rocourt Soil and Kesselt Soil (Gullentops, 1954; Fig. 2).

The Rocourt Soil, described in the Gritten sand-pit at Rocourt, close to Liège, occurred as a leached soil, with a reddish brown Bt horizon and a thin E horizon; it was ascribed to the Last Interglacial (Eemian). The thick humic horizon which overlies the Rocourt Soil at the type site was further reported to the final phase of the interglacial. It contains volcanic minerals including enstatite (Gullentops, 1954), later attributed to the Rocourt Tephra (Juvigné, 1977; Pouclet et al., 2008).

The Kesselt Soil was described in the Nelissen brickyard at Kesselt, near Maastricht, as a yellowish ochre leached horizon developed locally on top of the Hesbaye Loess. It was expected to

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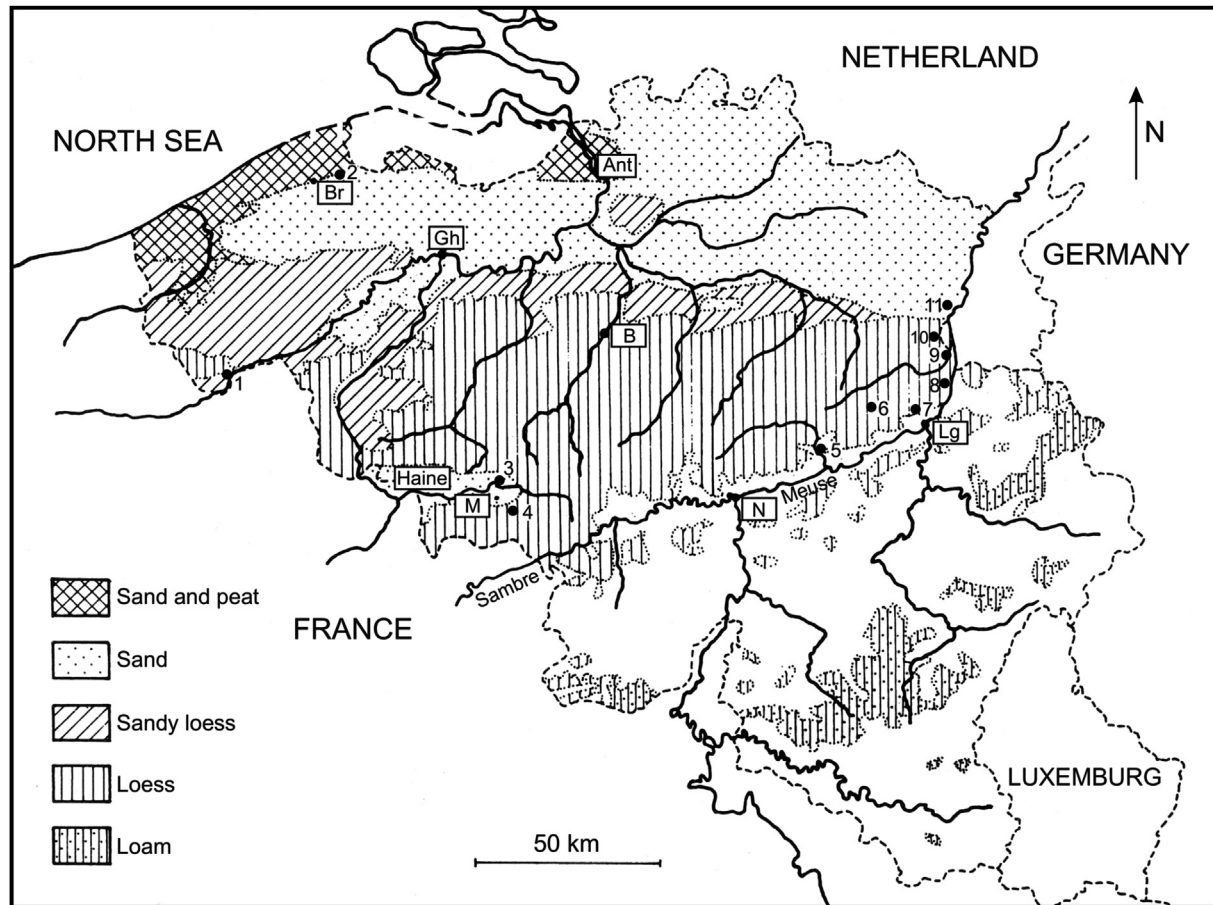


Fig. 1. Location of the sites mentioned in the text. 1: Warneton; 2: Moerkerke; 3: Maisières-Canal; 4: Harmignies and Hélin quarries; 5: Huccorgne; 6: Remicourt; 7: Rocourt; 8: Lixhe; 9: Romont; 10: Kesselt; 11: Opgimbie. Main towns. Br: Bruges; Gh: Ghent; Ant: Antwerp; B: Brussels; M: Mons; N: Namur; Lg: Liège.

record a main interstadial event in contrast with the base of the overlying Brabant Loess marked all over the site by a cryoturbated humic horizon with characteristic tongues (Fig. 2).

2.2. The scheme of R. Paepe

In the 1960s, the stratigraphic scheme of the Hesbaye area was extended to other regions of Belgium by Paepe and Vanhoorne (1967). They established a link between the Rocourt Soil and Eemian fluvial deposits of the Flemish Valley. They also connected the Weichselian Early Glacial peaty deposits of the Warneton region with the humiferous horizon overlying the Rocourt Soil in Rocourt, which was named Warneton Soil. These researchers were the first to introduce radiocarbon dates into the system, linking a cryoturbated peat layer dated 28 200 BP at Zelzate near Ghent (Table 1), with the cryoturbated humic horizon at the base of the Brabant Loess in the Hesbaye area (Paepe and Vanhoorne, 1967). This cryoturbated horizon was further used as a stratigraphic marker for correlation with the loess sequences of Northern France (Sommé et al., 1980).

2.3. The Haine Basin

For almost two decades, the stratigraphic scheme of the Late Pleistocene loess in the Hesbaye area introduced by Gullentops (1954) remained unchanged. At the end of the 1960s, new Late Pleistocene sections were studied in the Haine Basin, leading to the development of a new system focusing on two main sites:

Maisières-Canal, in the Haine Valley close to Mons, and Harmignies to the south of Mons (Haesaerts, 1974; Pirson et al., 2009).

2.3.1. Maisières-Canal

In 1966, the construction of a new canal along the northern side of the Haine Valley between Maisières and Obourg led to the discovery of a Gravettian settlement, 5 m below the present-day alluvial plain (de Heinzelin, 1973). The cultural layer was preserved in a bottom slope position, within a sedimentary succession combining fluvial deposits and humic horizons radiocarbon dated between 30 800 and 28 000 BP. The stratigraphic record at the site was further extended to the deposits exposed along the banks of the canal over several hundreds of meters. Fluvial sedimentation of the Haine was well documented in the south western bank. The upper part of the north eastern bank gave access over a long distance to a complex set of loamy deposits, locally connected to the Gravettian settlement, preserved at the edge of the alluvial plain (Fig. 3). This area covered the upper part of the Weichselian Pleniglacial, from ca 32 000 BP up to the Holocene (Haesaerts, 1974; Haesaerts and de Heinzelin, 1979).

2.3.2. Harmignies

In the early 1970s, stratigraphic survey of the Harmignies quarry allowed to complete the sequence of Maisières-Canal. Long sections were open across the thick loess cover preserved on top of a chalky ridge (cuesta). Detailed records of extended sections over ~750 m provided a 18 m thick Late Pleistocene stratigraphic sequence

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