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Late Pleistocene loess of the Lower Rhine

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ABSTRACT

From the Lower Rhine a compiled 25.7 m thick Late Pleistocene loess-paleosol sequence is differentiated into five lithostratigraphic units: the Rheingau Member (MIS 5), the Keldach Member (Weichselian Early Pleniglacial, GS-21.1–18, MIS 4), the Ahrgau Member (Weichselian Middle Pleniglacial, MIS 3) and the Hesbaye and Brabant Members (Weichselian Late Pleniglacial, MIS 2). It correlates well with climate fluctuations known from ice cores and deep-sea cores. The sequence was continuously sampled by 335 samples. It cuts through all essential layers and soils of the Late Pleistocene Upper Loess Formation. A continuous coarse silt index (CSI) curve shows a maximum in the Hesbaye Member (31–24 ka b2k) indicating the strongest wind conditions during the early Late Pleistocene. Further CSI highs lie in the Keldach and early Brabant Members. CSI lows are found the early and middle Rheingau Member (GI-25 –?GI-22), the Jackerath-Spenrath Soils within the deeper Keldach Member (?GI-20–19), the early Ahrgau Member (GI-17–GI-12) and finally in the Elfgen Soil (GI-2) at the base of the Brabant Member. The organic carbon culminates in the Titz Humus Zone, presumably at the end of GI-21, indicating scanty oxidation during the following cold Lower Weichselian Pleniglacial period. The Garzweiler Solcomplex forming a prevailing period of soil formation between 130 and 78 ka BP (MIS 5e–a) is considered as interglacial complex (Rhine Interglacial Complex) continuing the style of the older interglacial complexes of MIS 7, 9 etc. The Ahr Interstadial Complex (MIS 3) is seen as immature complex of warm phases with fabric of the interglacial complexes. – Author's suggestion: The Rhine Interglacial Complex covers MIS 5e –a and restricts the Weichselian Glacial to MIS 4 through MIS 2. This procedure follows the style of the older interglacial complexes.

1. Introduction

In the area of the Lower Middle Rhine and the Lower Rhine a compiled Pleistocene stack of an up to 55 m thick loess-paleosol sequence shows a distinct subdivision by solcomplexes and by sedimentological discordances (Fig. 1). Therein the Late Pleistocene loess comes up to 25.70 m thickness and exhibits 20 fossil terrestric soils (see inset) and at least 15 gelic gleysols. This Late Pleistocene loess stack, lithologically called Upper Loess Formation, is subdivided by discordances and fossil soils into five members representing the time periods Rhine Interglacial Complex (bracketing Eemian interglacial and Weichselian Early Glacial), Weichselian Early Pleniglacial, Weichselian Middle Pleniglacial, and lower and upper Weichselian Late Pleniglacial. As the most detailed loess record in Germany it gives hints for comparison of local terrestric climate fluctuations with the orbital climatic course (Schirmer, 2000a,b).

The Rhine Interglacial Complex (Schirmer, 2002a:18) encompasses the Eemian interglacial and the following warm climate variations, the MIS 5e–a. The Early Weichselian Pleniglacial corresponds to MIS 4, the Middle Weichselian Ahr Interstadial Complex to MIS 3, the Late Weichselian Pleniglacial to MIS 2.

2. Regional setting

The area encompasses the slopes of the German Middle and Lower Rhine and the German-Dutch-Belgian Rhine-Maas plateau (Fig. 2). Thus, it represents the eastern part of a loess area with a similar stratigraphic loess-paleosol sequence, which extends from northern France (Antoine, 2002) through Belgium (Haesaerts et al., 2011) and the southern Netherlands (Meijs, 2002, 2011) to the German Rhineland. The loess basin of the Lower Rhine and Maas (40–200 m a.s.l.) is surrounded by the raised Rhenish Shield of

Abbreviations: CSI, Coarse Silt Index for the pelite grain size relation 63–20μm/<20 μm; GI, Greenland Interstadial; GS, Greenland Stadial; ka b2k, kilo years before 2000 AD.

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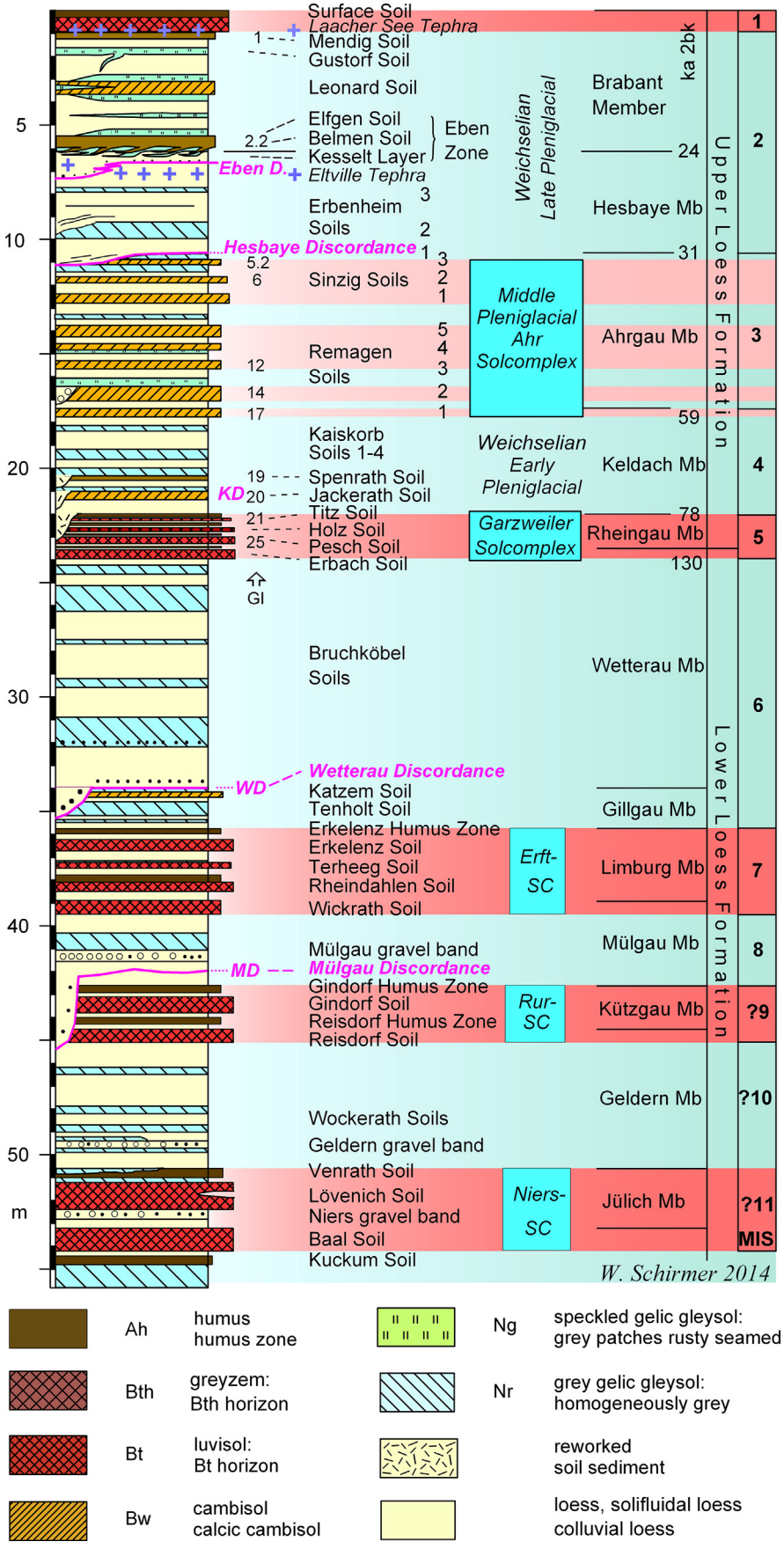

Fig. 1. Rhine loess record. – Eben D. = Eben Discordance, GI = Greenland Interstadial, Igl. = Interglacial, ka 2bk = ka before AD 2000 (ages after Rasmussen et al., 2014). KD = Keldach Discordance. Mb = Member, SC = Solcomplex. Modified after Schirmer (2010).

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