Geologie en Mijnbouw 64: 333-336 (1985).

The use of heavy mineral suites for loess stratigraphy

Etienne Juvigné
Laboratoire de Géomorphologie et de Géologie du Quaternaire, Place du 20 Août 7, B 4000 Liège, Belgium

Received 8 June 1985; accepted in revised form 8 August 1985

Abstract

Juvigné, E. 1985 The use of heavy mineral suites for loess stratigraphy – Geol. Mijnbouw 64: 333-336.

It is shown that Saalian loess deposits which accumulated in a cut-off meander of the Lesse River at Wanlin, is partly characterized by a mineralogical index similar to that of Weichselian loesses. This is in agreement with a similar observation for loesses of northern France published recently by Balescu & Haesaerts (1984).

1. Introduction

Van Dormael (1945) showed that in Limburg (The Netherlands), the Lower Loesses (these should be pre-Weichselian) contain less green hornblende and garnet, and more zircon and rutile than the Upper Loesses (these should be Weichselian).

Gullentops (1954) demonstrated a similar difference in the loesses at Rocourt (Belgium). He pointed out that the ratio green hornblende/epidote is about 1/3 in the Lower Loesses and 1/1 in the Upper Loesses. The former was attributed to the Saal glaciation and the latter to the Weichsel glaciation.

Juvigné (1978) showed that the above mineralogical difference is true for the whole of middle Belgium. A mineralogical index 'green hornblende + garnet/zircon + rutile'* was introduced to distinguish Weichselian loesses (values from 0.56 to 4.1) from pre-Weichselian ones (values lower than 0.6).

Juvigné (in Thieme et al. 1981) showed that the M.I. varies in the same way for a loess section at Rheindahlen (F.R. Germany).

Mees & Meijs (1984) pointed out a similar variation in a loess profile at Vroenhoven (Belgium).

Balescu & Haesaerts (1984) investigated two loess sections in northern France (Sangatte and Cagny la Garenne) and demonstrated that the loesses with high green hornblende and garnet content which were assumed previously to be restricted to the Weichsel glaciation were also deposited during the Saal glaciation.

In this paper evidence which supports the above conclusion of Balescu & Haesaerts (1984) is provided from a research carried out in a locality of southern Belgium.

2. The locality and its deposits

The section is located at Wanlin, southern Belgium (Fig. 1), in a cut-off meander of the river Lesse identified by Alexandre & Macar (1960).

*Abbreviation M.I. is used in the following text to designate the above defined Mineralogical Index.

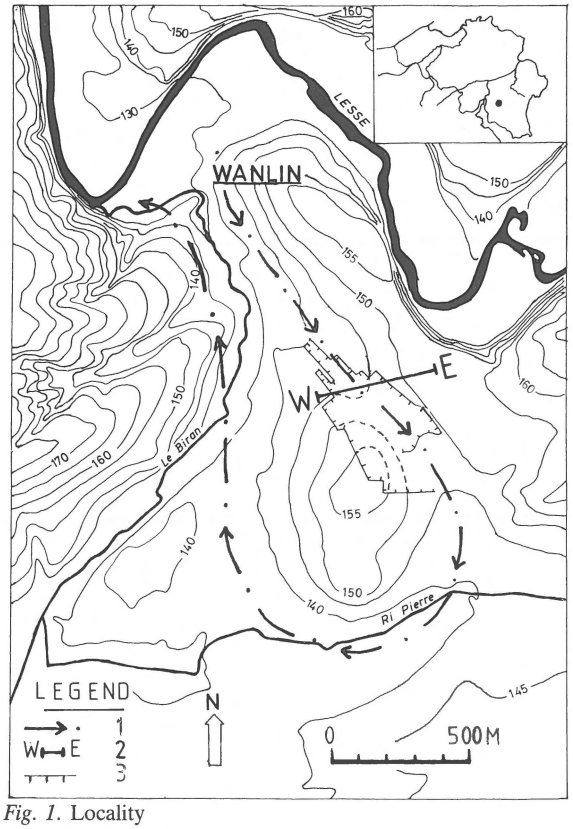

Fig. 1. Locality
1. Cut-off meander
2. Section described in figure 2
3. Limit of the pit at the brickyard

Paepe (1969) published a description, as well as a chronostratigraphical interpretation of the deposits overlying the gravel of the river. These essentially consist of loess and local shale debris. Paepe (o.c.) insisted on the occurrence of two interglacial buried soils within the sequence and he correlated the upper one ('Hour Soil') with the Eem Interglacial and the lower one ('Wanlin Soil') with the Holstein Interglacial.

However, Juvigné (1979) pointed out the occurrence of volcanic minerals of the 'Rocourt tuff' within the 'Hour Soil' which allowed this Soil to be situated within the early-mid Weichselian interstadial. Hence, the 'Wanlin Soil' can be correlated with the Eem interglacial.

The section is shown schematically in Fig. 2. The material consits of loess and shale debris in different mixtures. The shale debris layers are stratified ('grèze litée'). The Holocene soil is developed in the upper 1.5 m. The Eemian soil is preserved on both sides of the pit. On the eastern side the Eemian soil is overlain by residual pavement partly reworked from the terrace of the Lesse at 150 m. The early-mid Weichselian soil, including the volcanic minerals of the 'Rocourt tuff', overlies the Eemian soil only at the eastern side of the section.

The terrace underlying the slope deposits within the cut-off meander is a very low terrace of the Lesse. At the exit of the meander its top is situated 3 to 4 m above the surface of the present flood plain (Juvigné 1979), while the highest Pleistocene terrace of the Lesse crosses the area about 125 m above the flood plain (Seret 1957). Hence the terrace of the meander must have been formed relatively late during the Pleistocene, and the loess body between the Eemian soil and the terrace should not be older than the Saalian glaciation.

3. Mineralogical index of loesses

The transparent heavy minerals were investigated within the grain-size range 30 to 60 μm as done at most sections by the authors mentioned in the Introduction.

The above defined M.I. was calculated for each sample and plotted in Fig. 3 for comparison with the values obtained by Juvigné (1978) and Balescu & Haesaerts (1984). On both M.I. diagrammes of Fig. 2 the vertical lines represent the highest value of the M.I. (0.6) in the pre-Weichselian loesses from middle Belgium (Juvigné 1978).

For the Weichselian loesses of Wanlin, the M.I. ranges between 0.6 and 2. These values correspond to those of the lower half of the range of the Weichselian loesses from middle Belgium. This can be explained because most of the loess from the section of Wanlin was most probably lifted by wind from the periglacial flood plain of the Lesse, as previously demonstrated in the Ourthe valley, south Belgium (Juvigné 1977). In this case we have to take into account that all the rivers flowing from high Belgium were carrying higher amounts of zircon originating from altered primary rocks. This increases the denominator of the M.I.

For the Saalian loesses of Wanlin most of the

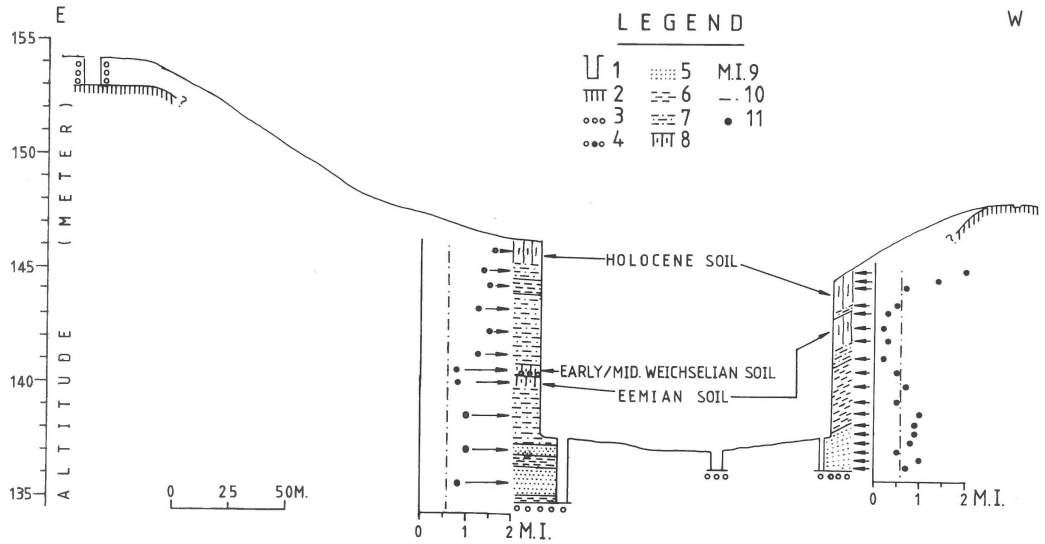

Fig. 2. Section through the pleistocene deposits of the cut-off meander. See location in Fig. 1

1. Excavations or borings
2. Bedrock: shale
3. Terraces of the Lesse
4. Residual pavement
5. Loess dominant and no stratification within the layer
6. Shale debris dominant and stratification within the layer ('grèze litée')
7. Unstratified mixture of almost equal parts of loess and shale debris
8. Uppermost soil and remnants of buried paleosoils
9. Mineralogical index: green hornblende + garnet/zircon + rutile
10. Upper value (0.6) of the M.I. in the pre-Weichselian loesses of middle Belgium
11. Values of the M.I. on each side of the section

M.I. values are above 0.6. This means that the Saalian and Weichselian loesses cannot be distinguished anymore from each other using the M.I. values as defined by Juvigné (1978) in middle Belgium.

This cannot be explained by laboratory methods

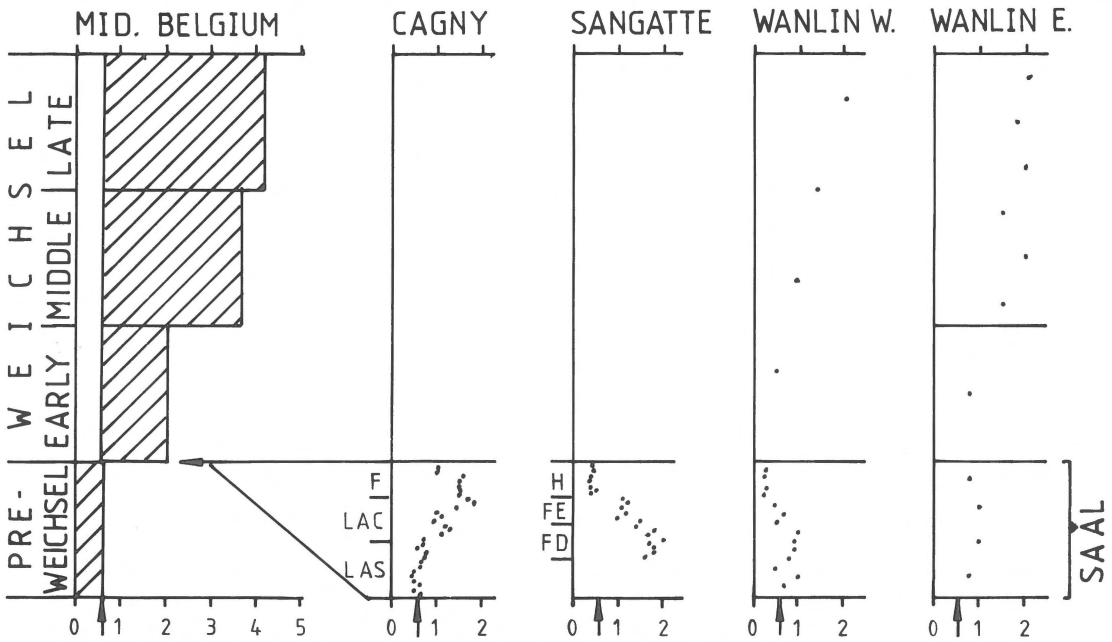

Fig. 3. Comparison of the M.I. values of loesses in different sections of middle Belgium, northern France and Wanlin

or misidentification of minerals because the author is the same in both cases.

If all the loesses of Wanlin with M.I. values higher than 0.6 would be considered as Weichselian, one should accept that the reddish Bt-horizons (in this case the Wanlin Soil) cannot be used anymore as indicator of interglacial climate. Hence the significance of paleopedology would be challenged.

Redeposition of older loesses cannot explain the M.I. values of Saalian loesses of Wanlin because thusfar loesses older than Saalian with M.I. values higher than 0.6 are not known.

Recently Balescu & Haesaerts (1984) found pre-Weichselian loesses with M.I. values higher than 0.6 in northern France. These loesses could be correlated with the Saalian loesses of Wanlin.

Because the M.I. values of the Saalian and the Weichselian loesses overlap, a common provenance for both is likely and this should be the periglacial outwash of the Scandinavian ice cap as suggested by Juvigné in 1978 for Weichselian loesses only.

At Wanlin the only values which are lower than 0.6 correspond to some samples from the Eemian soil. They can be explained by weathering because both zircon and rutile are more resistant than hornblende and garnet.

4. Consequence for loess stratigraphy

The above result implies that the previous stratigraphical conclusions based on mineralogical content of loesses must be partly revised.

It is not possible to determine on the basis of the M.I. whether the Saalian loesses of Wanlin can be correlated with both cold periods (Drenthe and Warthe) of this glaciation, or only with one of them, or even with a part of one.

At Harmignies, Tongrinne, Grand Manil, Rocourt and Ans (Juvigné 1978), Rheindahlen (Thieme et al. 1981) and Vroenhoven (Mees & Meijs 1984), all the pre-Weichselian loesses have M.I. values lower than 0.6 as reported by Juvigné (1978). This implies that in these sections the equivalent of the Saalian loesses of Wanlin and northern France is missing or that its hornblende and garnet were weathered by pedogenetic processes during the Eem interglacial.

5. Conclusion

Based on their high M.I., the Saalian loesses of Sangatte, Cagny la Garenne and Wanlin are comparable to the Weichselian loesses of middle Belgium, but they can be distinguished from the other pre-Saalin loesses.

Saalian loesses with high M.I. are probably missing from most sections described previously in middle Belgium.

Acknowledgment

I am grateful to Dr. Ann Wintle (University of Cambridge) for reviewing the English text.

References

Alexandre J. & Macar P. 1960 Excursion du jeudi 11 juin 1959 Liège- Baraque de Fraiture- Laroche- Rochefort- Liège. Biul. Peryglacjalny 9: 187-197

Balescu S. & Haesaerts P. 1984 The Sangatte raised beach and the age of the opening of the Strait of Dover. Geol. Mijnbouw 63: 355-362

Gullentops F. 1954 Contribution à la chronologie du Pléistocène et des formes du relief en Belgique. Mém. Inst. Géol. Univ. Louvain 18: 125-252

Juvigne E. 1977 Déflation éolienne sur des alluvions de l'Ourthe au Pléistocène. Rev. Belge de Géogr. 101: 175-185

Juvigne E. 1978 Les minéraux denses transparents des loess de Belgique. Z. Geomorph. 22: 68-88

Juvigne E. 1979 Etude stratigraphique des dépôts du méandre recoupé de la Lesse à Wanlin (Famenne). Bull. Soc. Géogr de Liège 15: 65-75

Mees R. & Meijs E. 1984 Note on the presence of pre-Weichselian loess deposits along the Albert Canal near Kesselt and Vroenhoven (Belgian Limbourg). Geol. Mijnbouw 6: 7-11

Paepe R. 1969 Quelques aspects des dépôts quaternaires de la Famenne. Bull. Soc. Géol. Belg. 78: 69-75

Seret G. 1957 Les terrasses et les formes associées dans le bassin de la Lesse inférieure. Ann. Soc. Geol. Belg. 80: 355-378

Thieme H., Brunnacker K & Juvigne E. 1981 Petrographische und urgeschichtliche Untersuchungen im Loessprofil von Rheindahlen. Quartär 31/32: 41-67

Van Doormael J. 1945 Onderzoekingen betreffende de loessgronden van Zuid-Limburg. Dissertatie. Wageningen. Gottmer, Haarlem