

RADIOCARBON AGES AND VALLEY FLOOR EVOLUTION IN SOUTH BELGIUM

by

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SUMMARY: Cored drillings executed through a travertine dam in a V-shaped valley revealed the existence of several peat layers, also in gravel deposits at the very bottom of this valley. Peat within the gravel revealed to be both Allerød and Bølling in age; peat in the travertine dam yielded Preboreal and Boreal ages. Gravel deposition took place at a rate of 0.6 mm/year. Travertine growth varies from approximately 0,1 cm/year at the beginning to 1 cm/year at the end of the dam building. Incision of the V-shaped valley took place at the beginning of the Late Glacial while incision of the travertine dam occurred at the Atlanticum.

Introduction

Eleven drillings were made by the Geological Survey of Belgium in 1969 in fluvial deposits of a valley floor in South Belgium (see fig. 1 for location). These drillings were concentrated on a selected spot where a travertine dam is responsible for a step of about 10 m high in the longitudinal profile. All drillings were carried out till bedrock was reached. At least one metre of it was cored beneath the fluvial deposits. Numerous peat patches and peat layers were found within the alluvial sequence.

Thirteen radiocarbon dates executed by the "Natuurkundig Laboratorium der Rijks-Universiteit" in Groningen (The Netherlands) and by the "Niedersächsisches Landesamt für Bodenforschung" in Hannover (West Germany) were obtained from these peats. They enable us, not only to reconstruct the detailed Late to Post-glacial history of the valley but also, thanks to suitable conditions, to throw some lights on the problem of rates of erosion and deposition on a valley floor.

Location and general geology

The valley of Williers, where this study has been undertaken, is located in South Belgium along the French border (see fig. 1). This valley is to a depth of say 100 metres incised into a plateau consisting of subhorizontal to gently dipping (5° south) limy sandstones.

The plateau is at an elevation of 300 m; it is largely covered with a deciduous temperate forest. No tributaries exist in the lower part of the valley where the travertine dam is located. Steep slopes (25°) and a flat bottom are characteristics of the local topography.

The drillings (nr 9, 10 and 11 in fig. 2) were made at the foot of the travertine dam on a transverse line in the valley floor. They reached, beneath the alluvial deposits, limy sandstones and sand layers which characterize the bedrock but also an impervious thin clay layer (50 cm thick) locally present within the sandstones. This clay layer which appears directly under the alluvial deposits or beneath two metres of limy sandstones, is responsible for valley bottom springs and emergence of the underflow. This water of high hydrocarbonate

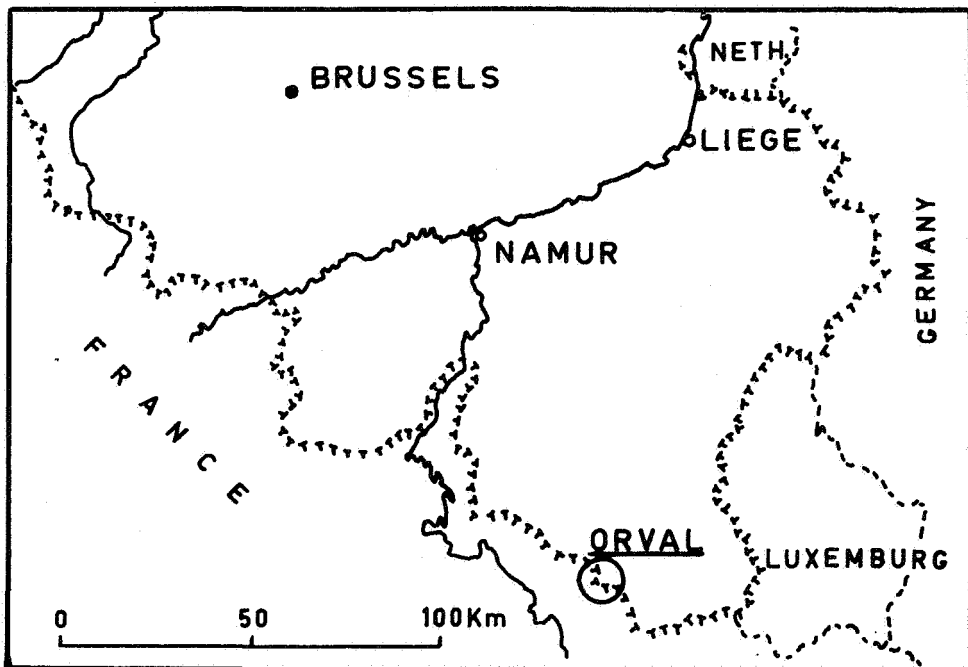


Fig. 1: Location of the studied site, nearby Orval in the Lorraine region (Paris Basin).

content, if saturated, will favor limestone precipitation and travertine formation by loss of carbon dioxide at the ground surface and by mosses and algae activity. The location of the travertine dam in the valley floor is thus intimately connected with the presence of the thin gray-blue clay layer in the bedrock.

Another transverse line of drillings (nr 1, 2 and 3 in fig. 2) was made at the top of the dam just above the step and five others (from 4 to 8) upwards along the longitudinal axis of the valley floor.

The deposits of the valley floor

In all cores examined an alluvial pebbly layer was found (unit A) directly above the bedrock. This layer with a maximum of 3 to 4 metres thickness, fills a V-shaped channel whose geometrical properties are such that the entire valley has to be considered as a V subsequently buried at the bottom by the deposits of the valley floor. This basal pebbly layer can

be further subdivided into two different units, A_1 and A_2 , separated locally by a peat layer 10 centimetres thick (fig. 3).

Above the pebbles, at the level of the dam and upwards, a second unit (B) consists of about two and a half metres thick silty, granular, homogeneous travertine containing thin peat layers and shell debris, which become more numerous in the upward cores.

A very pure travertine 2 metres thick forms the third unit (C) and is covered by about 5 metres of silt, silty travertine and peat (unit D). At the foot of the step, in a downward direction, two metres of silt and peat rest directly above the basal pebbles (unit E).

Radiocarbon dates and evolution of the valley floor.

The radiocarbon ages obtained from the peats have not been transformed into true ages because, if correction factors can easily be found for the last six millenia, the question is

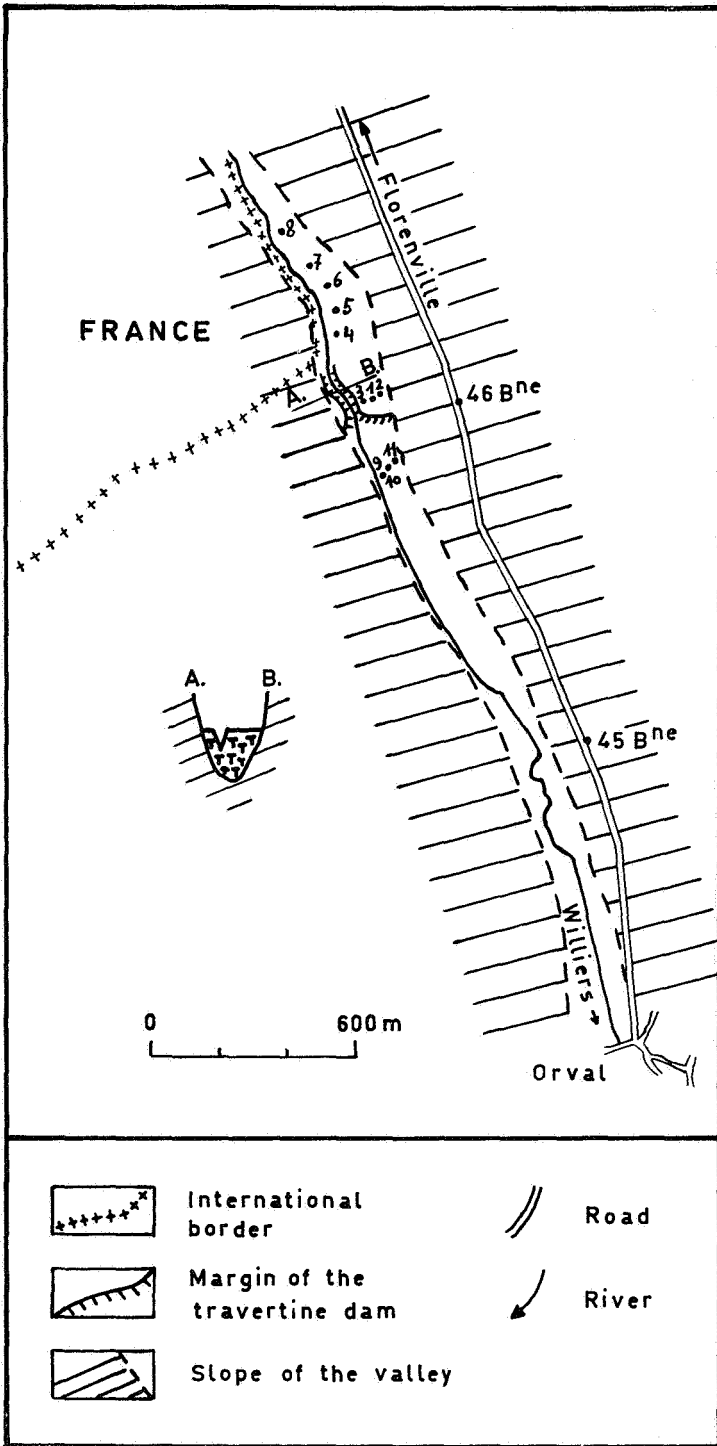


Fig. 2: Detail of the Williers Valley nearby Orval, with location of the borings and cross section A-B, through this valley at the travertine dam site.

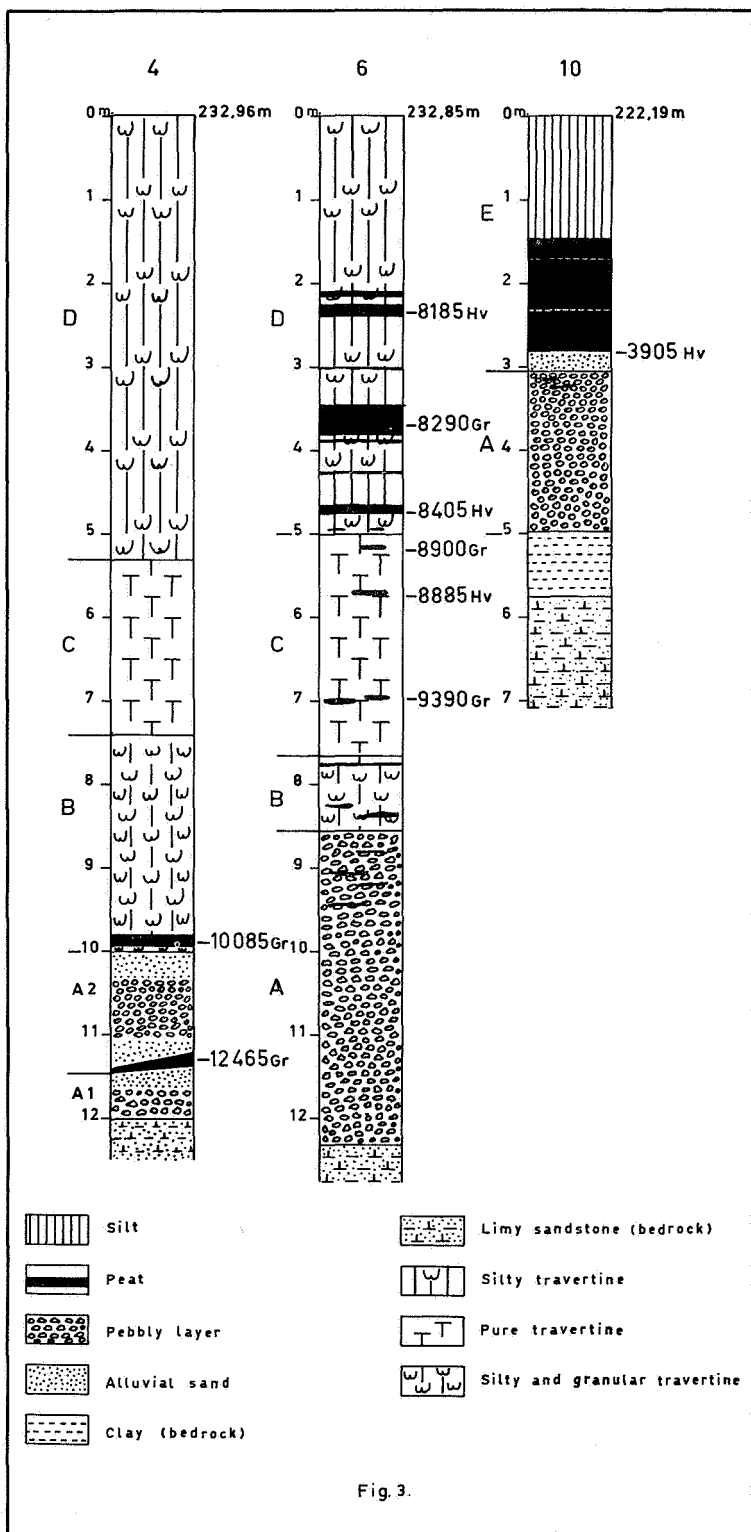


Fig. 3.

Fig. 3: Lithological profiles of borings nr. 4, 6 and 10, with C-14-datings (Gr.: Groningen; Hv: Hannover).

now practically unsolved with respect to ages of 8.000 to 10.000 BP which are nearly all the dates obtained so far in the site studied.

Therefore it seems preferable to use the radiocarbon years to determine the rates of erosion and deposition even if we know that there is an unknown factor to correct the radiocarbon ages into true ages. For this reason also, the rates obtained are to be considered only as orders of magnitude rather than precise values.

For the basal alluvial pebbly layer A, five radiocarbon dates have been obtained. The peat layer between A₁ and A₂ gives in drilling nr 4, 12.465 ± 10 y.BP (GrN-6159) and in drilling nr 3, 10.790 ± 60 y.BP (GrN-6012). Sedimentation during the Old Dryas seems not to have occurred in the valley since the first age is characteristic for the Alleröd and the second for the Bölling interstadial. The peat above the pebbles yields 9.900 ± 80 y.BP (GrN-6011) in drilling 3, 10.085 ± 60 y.BP (GrN-6013) in drilling 4 and 9.965 ± 140 y.BP (Hv-3440) in drilling 8. The basal pebbly layer can thus be considered as pre-Holocene in age.

The two dates in drilling nr 4 indicate a mean rate of pebble deposition of about 0.6 mm per year (1m 53 in 2380 years). Since only half a metre exists in drilling nr 4 between the oldest dated peat and the bedrock at the very bottom of the valley and no pleniglacial, Weichselian deposits cover the valley floor, it can be further assumed that the entire pebbly sequence is from the beginning of the Late-glacial period. This means that downcutting of the valley occurred during the late weichselian period which is responsible for the V buried by the postglacial sediments.

Several radiocarbon dates have been ob-

tained from the peats within the travertine deposits. Depending on their position they extend in time from 9.390 ± 55 y.BP (GrN-6162) 8.900 ± 50 y.BP (GrN-6161) and 8.885 ± 190 y.BP (Hv-3438) in drilling 6 to 8.440 ± 90 y.BP (Hv-3439) in drilling 7 and 8.405 ± 80 y.BP (Hv-3437) 8.290 ± 50 y.BP (GrN-6160) and 8.185 ± 230 y.BP (Hv-3436) in drilling 6. These dates indicate that the travertine deposit was built during the Preboreal and Boreal since the more recent age, for a peat only 2.64 m under the surface, is 8.185 ± 230 y.BP (Hv-3436). Thanks to several dates on the same vertical (drilling nr 6), rates of travertine and peat deposition can be determined: for nearly pure travertine, 0.1 to 0.4 cm per year (2 m between 9.390 and 8.900 BP and 55 cm between 8.900 and 8.405 BP). For more recent deposition with layers of peat interbedded with the travertine sequence the rates increase to approximately 1 cm per year (1.06 m between 8.405 and 8.290 BP and 1 m between 8.290 and 8.185 BP). These rates are of course to be considered as mean values without being able to tell if more rapid deposition occurred.

After 8.185 ± 230 y.BP (Hv-3436) the travertine dam has been incised by the river prior to the deposition of the peat located at the foot of the step just above the basal pebbles (drilling nr 9, 10 and 11). In drilling nr 10 the basal layer of peat has been dated: 3.905 ± 135 y.BP (Hv.3441). The incision of the river into the travertine dam occurred thus during the Atlantic and Subboreal with a mean rate of downcutting of about 0.3 cm per year.

For several reasons, the different rates given are only orders of magnitude but it is hoped that they may serve for more precise investigation of valley floor evolution.

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