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Environmental evolutions of the Moselle and Alzette valleys (Luxembourg) since Late Pleistocene : a first comparison

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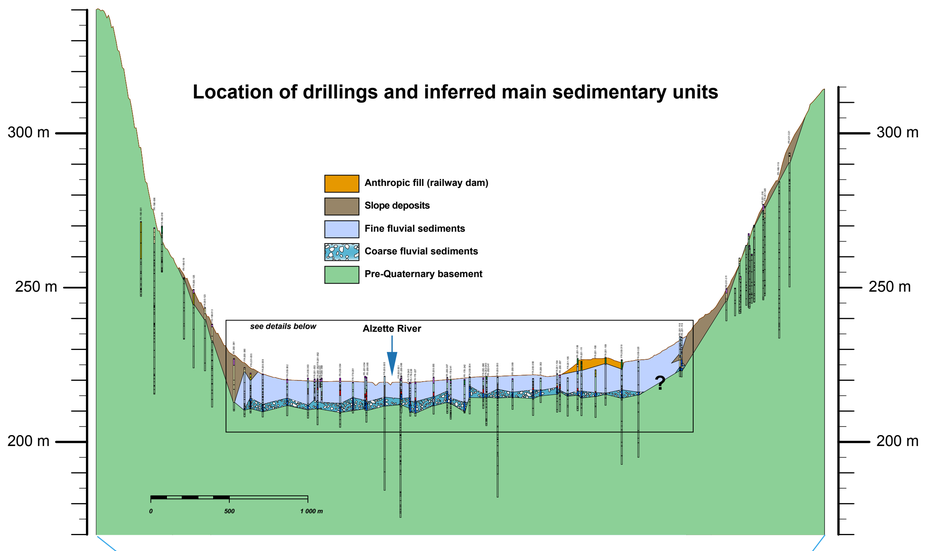
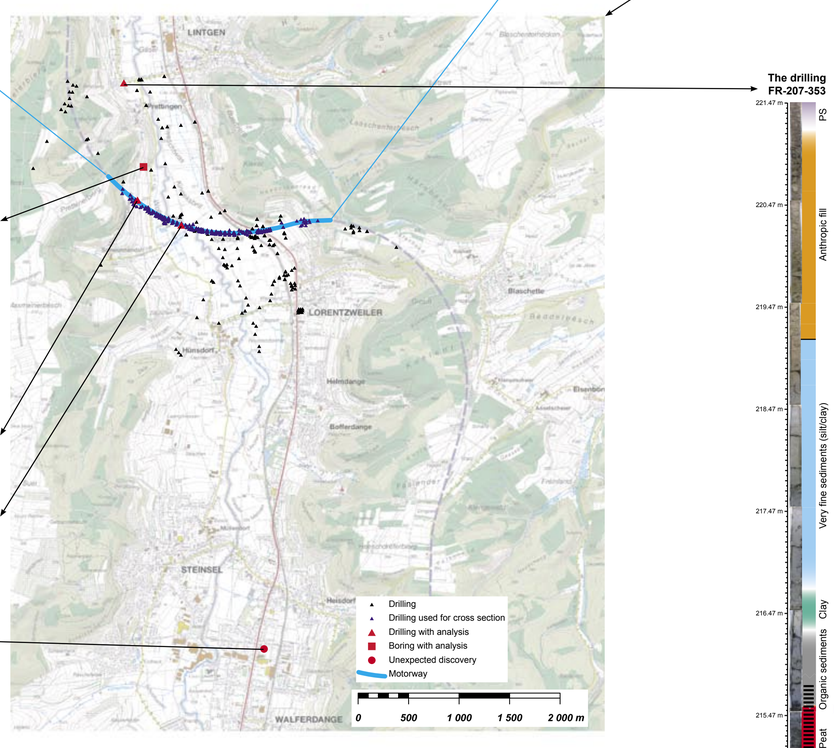
Geoarchaeological research in the Grand-Duchy of Luxembourg especially focused on two main valleys of the country: the Moselle valley (presence of several gravel-pits in the “Wintrange basin”), and the valley of its tributary the Alzette (located in the centre of the Luxembourg), where important road works recently occurred. Preventive archaeological investigations revealed in both areas evidence of human occupation since the Palaeolithic. This poster presents the main results of geoarchaeological research in these two areas, leading to a preliminary comparison between these two sedimentary areas.

Alzette River

The Alzette River rises within France, approximately 4 km south of the French-Luxembourg border, and has a total length of 73 kilometres before joining the Sauer which is a left-bank tributary of the Moselle River.
During the construction of the “Nordstrooss” motorway (going north from Luxembourg city towards Ettelbruck) a viaduct was built that crosses the wide alluvial plain (about 1 km) of the Alzette River valley near Lorentzweiler. A lot of drillings were also made for geotechnical purposes by the Geological survey of Luxembourg (SGL). The drillings were also able to provide informations about the sediments preserved in the Alzette River valley floor. This information has allowed the construction of a cross-profile through the valley showing the stratigraphy of the quaternary deposits, and showing that it was the result of a rather complex evolution (aggradation and incision periods leading to terraces formation, input of slope deposits at the valley margins, possible eolian input, …).
A multidisciplinary research project thus started, aiming to reconstruct the paleoenvironment of the Alzette region during the late Pleistocene and Holocene periods.





Various paleoenvironmental evidences

***Seisselbaach* stream**

Molluscan analysis from a tufaceous holocene deposit by Richard Meyrick: three local mollusc zones are proposed. From the bottom to top:

- PS1: Moist, open conditions predominate but some shade is available: Arctic/Alpine and Boreal elements present (*Vertigo genesii*, *Vertigo geyeri*, *Discus ruderatus*). A radiocarbon age of 9820±120 BP (Beta-181807) was obtained on charcoal fragments too small for identification.
- PS2: Open woodland: base defined by the expansion of *Carychium tridentatum*, Arctic/Alpine elements now lacking, but *Discus ruderatus* characteristic). Comparison of this assemblage with other radiocarbon dated molluscan successions from the Rheinland region suggests an age of about 9700 yr BP.
- PS3: Open woodland: base defined by the expansion of *Discus rotundatus*, *Discus ruderatus* disappears. The “*Discus ruderatus/rotundatus* transition” is a significant biostratigraphical marker in the early-mid Holocene throughout North West and Central Europe As such, it has been observed in several land snail records from the Rheinland Region, where it has been radiocarbon dated to approximately 8400 yr BP (Meyrick, 2001).

Drilling FR-201-055

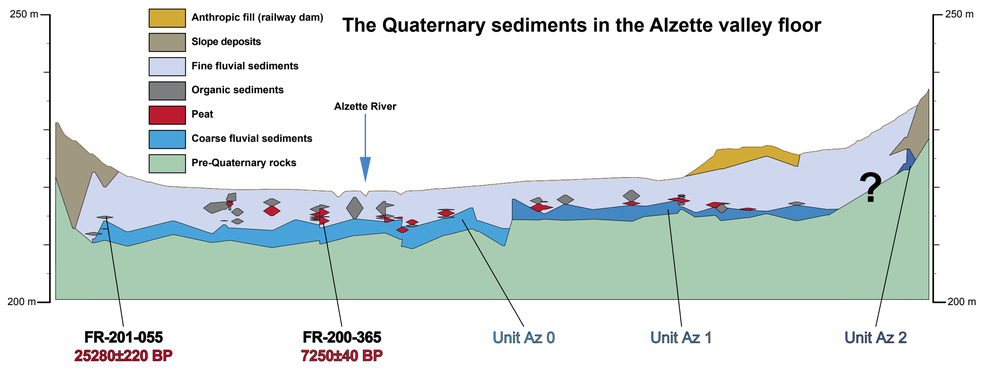
Palynological study from a organic deposit by Pascale Ruffaldi : pollen analysis indicates a dry and cold climat (allocated to Weichselian period) . A radiocarbon age of 25280±220 BP (Beta-182249) was obtained on moss (*bryophyta*) near 215.5 m.

Drilling FR-200-365

A radiocarbon age of 7250±40 BP (Beta-240994) was obtained on peat located near 217 m.

Mammoth tusk

An excavation for a building construction allows the discovery of a mammoth tusk from coarse sediments near 225 m (terrace Az 2).



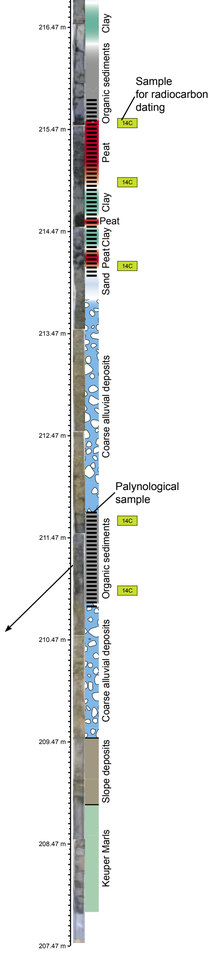
The drilling results make it possible to reconstruct the geometry of the quaternary sedimentary units of the Alzette valley. Three stepped alluvial units are also recognized along the cross profile: the lower one (Az0) corresponds with the maximal incision of the Alzette. It is preserved in the western part of the floodplain, with base being located at about 212 m a.s.l.. In the eastern part of the valley the contact between the fluvial deposits and the substratum is located at about 215 m a.s.l.: these deposits may also be allocated to a lower terrace Az1 (relative height : +3 m). A third alluvial unit Az2 was recognized in two drillings, with a bedrock located at about 224 m a.s.l. (+12 m). The drillings however provide no information about the transition between this upper unit and Az1.

The channel migration in the valley and the assumed meandering dynamics (suggested by the weakness of the longitudinal slope) led to meander downcuttings and to the formation of oxbow lakes.

These former oxbow-lakes are subjected either to a mineral or organic filling, the predominance of this latter leading to the formation of peat bogs. A radiocarbon dating of 7250±40 BP (Beta-240994) was obtained on a peaty level from an ancient drilling (FR-200-365) towards 217 m a.s.l. Taking account of this dating, sequences of peats found in the recent drillings (e.g. FR-207-353, see adjoining), could belong to the first part of the Holocene.

In the FR-207-353 drilling, it is also important to note presence of an organic level within the coarse sediments. It is located at approx. 211 m a.s.l., and contains numerous rests of molluscs shells (see adjoining photo). Further radiocarbon dating and palynological study will consequently be realised for this level.

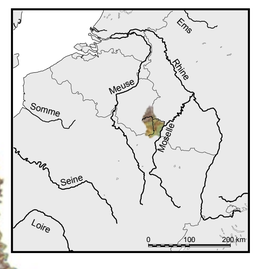
In the drilling FR-201-055 (located at the western part of the valley), the dating of moss remains (bryophyts) preserved in a clayey level gave an age estimate of about 25280±220 BP (Beta-182249). This result is in good agreement with palynological data, suggesting a dry and cold environment. This age has however to be confirmed due, first to a possible reservoir effect (more study of the bryophyts remains is needed), and secondly to the incoherences and heterogeneity of the drilling samples (mix of alluvial and slope deposits).

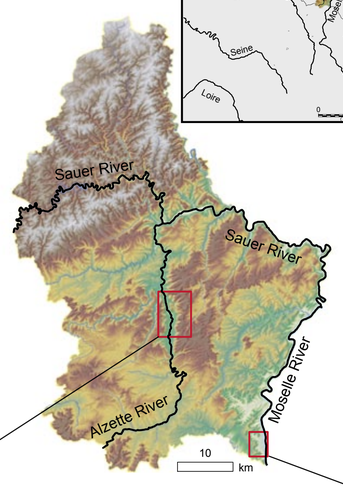


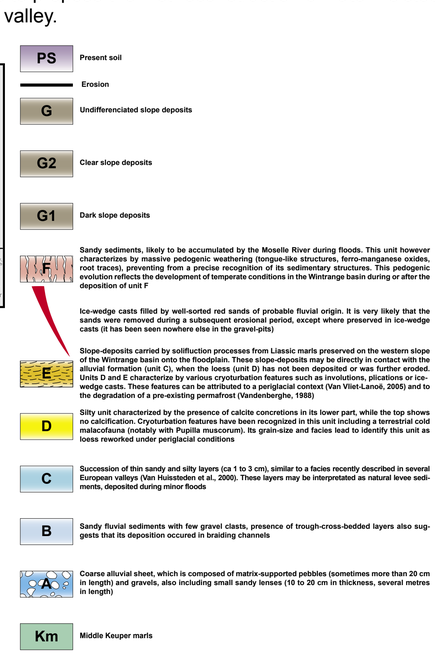
The organic sediments observed in coarse alluvial deposits contain molluscs from the FR-207-353 drilling

Moselle River

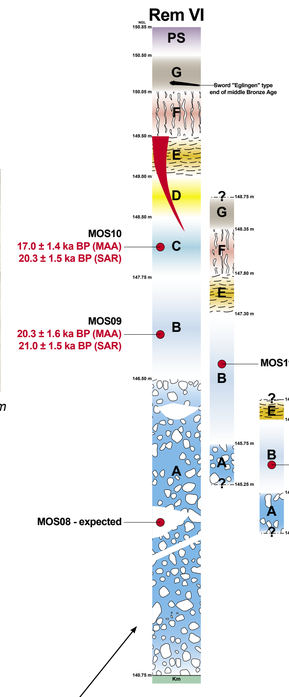
The Moselle River is a left-bank main tributary of the Rhine River; it rises within the Vosges massif and flows through the eastern Paris Basin and the Rhenish massif.
Archaeological research has been carried out for fifteen years in the Luxembourgian Moselle valley, and particularly in the Wintrange basin downstream from the village of Schengen. This research is coordinated by the Survey of Prehistorical Archaeology of the *Musée National d’Histoire et d’Art du Grand-Duché de Luxembourg* (MNHAL) and includes multidisciplinary approaches, like archaeological, morphological, and sedimentological analyses. The research has intensified in the past few years, with the obtention of relative and numerical (AMS and IRSL) dating making it possible to propose the first reconstruction of Late Pleistocene and Holocene palaeoenvironmental evolution of this part of the Luxembourgian Moselle valley.





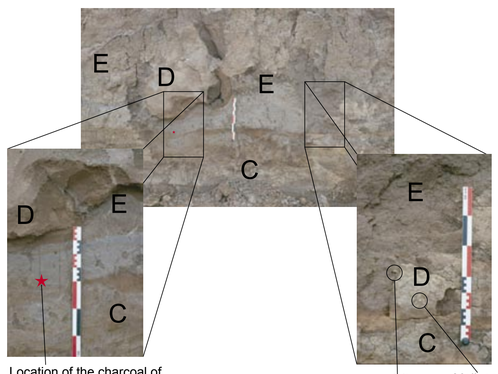


Remerschen VI - *Enner dem Wéntrengerwee*
Position of IRSL samples



Study area 1993-2008

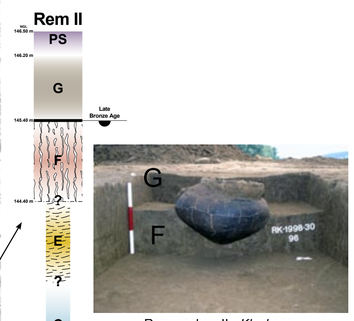
Remerschen IV - *Enner dem Schengenerwee*
Ice wedge cast filled by red sands



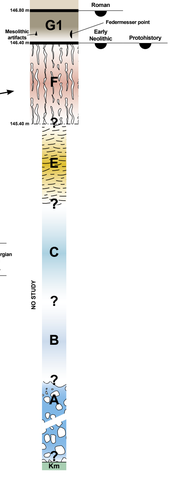
Location of the charcoal of *Juniperus* with date of 30770±300 BP (Beta-182248)

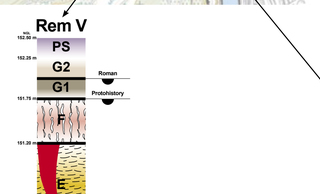
calcite concretions

Molluscs



Remerschen II - *Klosbaam*
Late Bronze Age, incineration





Remerschen V - *Enner dem Raederwee*
Stratigraphical sequency

Palaeoenvironments and human settlements in the Wintrange basin over Late pleistocene

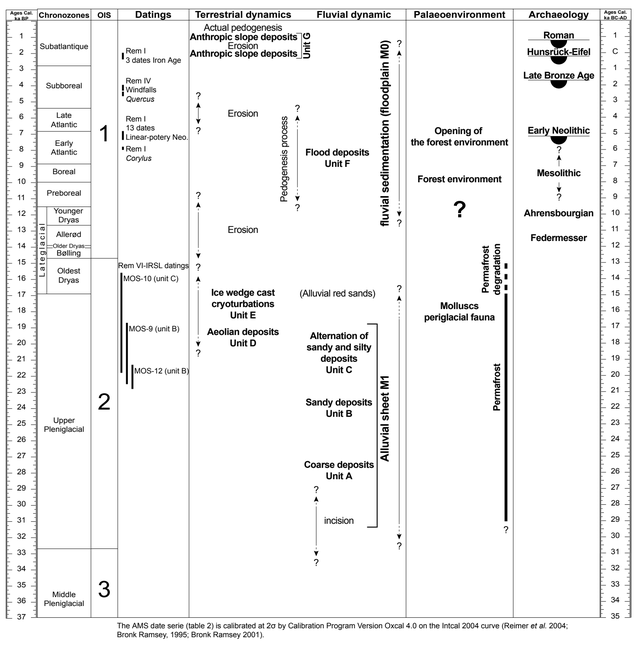
Combining sedimentological, chronological, archaeological and anthracological results has allowed the reconstruction of landscape evolution and human occupation in the Wintrange basin during the Late Pleistocene and Holocene, as summarized in the adjoining table. There is however several remaining questions about the chronology of each event.

The story begins in the Upper Pleniglacial: this cold period corresponded in the Middle Moselle valley to a periglacial environment likely associated to the presence of permafrost. Owing to the morphology of the basin, the Moselle River here developed a braided channel system, associated with the deposition of coarse sediments (unit A). Ice-rafting events are evidenced by the presence of quartzite blocks in this unit.

The second part of Upper Pleniglacial time corresponds to a progressive decrease of the fluvial energy of the river, which deposited mainly sands and silts (units B and C). This decrease is linked to a reduction in precipitation affecting the whole of Western Europe (Frechen et al., 2003). Another consequence of this change could be the deposition of aeolian deposits correlating with unit D, with their cold malacofauna remains.

The end of the Upper Pleniglacial corresponds to a period of increased precipitation, possibly associated with the degradation of the permafrost (Van Huissteden et al., 2000), both generating solifluction deposits (unit E). The cryoturbation features recognized in units D and E, however, point to the persistence of periglacial conditions in the basin. The red sand with an assumed fluvial origin in the core of ice-wedge casts is attributed to increased fluvial activity indicating an aggradation phase.

The upper sediments (units F and G) record the development of more temperate conditions in the basin. This return of interglacial conditions allowed the development of human settlements and activities, as evidenced by the numerous Neolithic to Medieval remains found in the basin. Human occupation has also driven major landscape evolutions, resulting in deforestation and agricultural activities. While the increased forestry started during the Neolithic, in the diversity of forest species, farming generated major soil erosion, evidenced by two main phases of slope deposition (unit G) in the Iron Age and/or Roman period.



The AMS date serie (table 2) is calibrated at 2σ by Calibration Program Version Oxcal 4.0 on the Intcal 2004 curve (Reimer *et al.* 2004; Bronk Ramsey, 1995; Bronk Ramsey 2001).

Conclusion:

The preliminary comparison between the valley evolution of the Moselle and Alzette in Luxembourg made it possible to recognize important similarities : both valley floors actually consist of three alluvial units, the alluvial floodplain and two lower alluvial terraces located at +3 and + 10-12 m, respectively, and locally overlain by slope-deposits.

Despite numerous gaps, the chronological framework also seems in good agreement, which made it possible to identify the passage from a periglacial context to interglacial conditions leading to increase of human activities.

These research has however to be continued and improved : in the Moselle valley, by the acquisition of complementary luminescence age estimates and the possibility to develop research on the alluvial floodplain M0 ; and in the Alzette valley by analyses of the undisturbed sequences observed in the recent drillings, which cover the whole valley-floor (in opposition with the Moselle).

As recognized in the north-western France (Antoine et al., 2003), the upstream course of small river valleys (like the Alzette near Lorentzweiler) offers very convenient conditions to study the end of the glacial period and the beginning of the warmer period in a continental setting. Further results should then lead to improve the global environmental evolution in the Luxembourg area since the last cold period.

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