



## Soil archives of mardel deposits: the impact of Late Holocene vegetation development, climatic oscillations and historical land use on soil erosion in Luxembourg

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### Mardel genesis.

Mardels are small scale circular to elongated closed depressions ( $\varnothing > 50$  m). They occur in Luxembourg on the Lias plateau in the Gutland, but also in other regions with landscapes, developed on Keuper and Lias deposits (as Lorraine). We can distinguish geogenetic and anthropogenic mardels.

There are two types of genetic mardels, sink holes (controlled by diaclases in the Luxembourgian sandstone and 'true mardels' or subsidence basins (controlled by dissolved gypsum lenses in marls of the Keuper deposits). These mardels developed during the Holocene. The age of the mardel sediments is Subatlantic; the sediments have been deposited on a palaeosol.

Anthropogenic mardels are the result of historic clay excavation (Roman Time or younger). The age of these mardels is Subatlantic. The age of the sediments is also Subatlantic; the sediments have been deposited on a truncated soil in excavations.

In all the genetic types of mardels, the sediments can consist of peat, peaty loam, or colluvic clayloam and the mardel sediments contain always valuable soil archives for the reconstruction of the impact of vegetation development, climatic oscillations and land use on soil erosion and deposition.

### Comparison of mardel deposits and valley deposits.

- Pre-Holocene mardels have been eroded during the Weichselian. Geogenetic mardels have been developed during the Holocene, anthropogenic mardels have been excavated since Roman Time. The age of the clastic (colluvic) deposits in mardels is Subatlantic

- In the Late Glacial, valley bottoms were rather broad and covered with a gravelly bed load. Till the Subboreal river incision was active in primary valleys and peat accumulation took place on broad valley bottoms of secondary valleys. Since Celtic/Roman Time deforestation and extension of agriculture. During the Subatlantic colluvic/alluvic sedimentation took place on all the valley bottoms. The Subatlantic is a period of accelerated sedimentation of clastic sediments in closed depressions and (open) valleys

This was the impact of two factors.

### 1. Impact of natural forest evolution on soil erosivity.

Fagus arrived in the area, jostled Tilia in the Subboreal and extended in the Subatlantic. The understory and humus forms changed, the erosivity of the surface increased and the consequence was accelerating soil erosion. Stable mardels changed in sediment traps, river valleys got constipated with colluvic/alluvic sediments.

### 2. Anthropogenic deforestation and extension of agriculture since Roman Time.

### Conclusions.

1. In a lot of studies, deforestation was considered as the responsible factor for soil erosion.
2. Impact of natural forest evolution (the appearance of Fagus) was not recognized
3. The impact of the Little Ice Age on Subatlantic soil erosion was not recognized
4. Three factors controlled Subatlantic soil erosion and mardel and valley deposition
  - The (natural) jostle of mixed oak forest by beech forest promoted soil erosivity and erosion
  - The (anthropogenic) deforestation and expansion of agriculture promoted soil erosion
  - The temporally move from pasture to arable land during the Little Ice Age promoted soil erosivity

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