



## **Natural versus anthropogenic genesis of mardels (closed depressions) on the Gutland plateau (Luxembourg); archaeometrical and palynological evidence of Roman clay excavation from mardels.**

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Mardels, small closed depressions, are distinctive landforms on the Luxembourgish Gutland plateau. In the present landscape most mardels are shallow fens, filled with colluvial sediments. The genesis of mardels has been studied intensively, inside and outside Luxembourg. Some researchers suggested a natural development and consider mardels as subsidence basins due to subsurface solution of gypsum veins, other researchers suggested cultural causes and consider mardels as prehistorical quarries.

In the Gutland, mardels occur on various substrates. Mardels on the Strassen marls (li3) are abandoned quarries, related to clay excavation in Roman Time. Mardels on the Luxembourgish sandstone (li2) are sinkholes, related to joint patterns in the sandstone formation. Mardels on the Keuper marls (km1,3) are originally subsidence basins, related to subsurface dissolutions of gypsum lenses and veins, filled with colluvial clay. The results of pollen analysis and archaeometrical tests demonstrate Roman extraction of clay for the production of ancient ceramics. So, the natural depressions have been enlarged to the present mardels. After excavation, the sedimentation of colluvium restarted in the abandoned quarries.