

***Interactive comment on “Natural versus anthropogenic genesis of mardels (closed depressions) on the Gutland plateau (Luxembourg); archaeometrical and palynological evidence of Roman clay excavation from mardels” by J. M. van Mourik et al.***

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**Synopsis**

Authors try to demonstrate an anthropogenic origin for several closed depressions (mardels) on the Luxembourg Gutland Plateau that are formed in sedimentary rock. Specifically, they propose that some of these mardels are the vestiges of Roman quarries that were used for clay extraction, primarily in the production of ceramics. Data

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set includes sediments collected by bucket auger and a peat core for pollen analysis from fens within three newly studied mardels (Medernach, Brasert2, and Michelbouch) and one mardel (Dauwelsmuer) whose pollen sequence was previously documented by Schwenninger (1989) ; new macrobotanical analysis is also performed for Dauwelsmuer. The pollen data are supplemented by particle size, pH, and geochemical analysis (XRF) analysis on five sediment samples from the mardels, five sediment samples from nearby soils, and four ceramics obtained from nearby Michelbouch. Chronometry for the deposits filling the mardels is based solely on pollen evidence except for one (Dauwelsmuer) whose fill was previously dated with  $^{14}\text{C}$  (peat deposits) by Schwenninger. If I'm reading this correctly, the ages for the other mardels are correlative ages where pollen spectra are correlated to the dated sequence at Daulwelsmuer (Table 1). The authors provide a Holocene paleoenvironmental reconstruction for the area and argue that the fills post-date Roman occupation and have a similar clay mineralogy to the analyzed ceramics. They conclude that some of these mardels are natural depressions formed through dissolution and collapse of underlying substrates whereas others are indeed Roman clay quarries.

## General Comments

The main contribution of this study is the analysis of pollen from fens formed in these mardels that provide insight into local/regional Holocene vegetation changes due to climate and/or land use changes. The chronology is not very robust, limited to correlation to a previously dated pollen sequence at Daulwelsmuer, but at a minimum provides evidence for post-glacial environmental changes through time.

Unfortunately, the paper is poorly written and difficult to follow in places; it requires heavy copy editing. However, the main problem is that insufficient data are presented to support the conclusion of an anthropogenic origin for any of the mardels. Not enough contextual information is provided to explain the sampling strategy and location of the various samples in relation to one another. There are no large scale maps of the individual mardels showing size, depth, etc.; no locations of sediment cores within the

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mardels; no locations of the soil and ceramic samples in relation to the mardels; and no stratigraphic columns with detailed sedimentological/pedogenic descriptions of the mardel fill deposits (this is especially problematic given that the paper is submitted to SOILD). There is virtually no information on the origin and nature of the ceramics (e.g., find locations, thin sections, stylistic features, etc.).

Numerical ages based on palynological correlation are not well explained. More information is needed on the palynochronological markers common to this region, preferably in the background section prior to Results and Discussion. And despite claimed problems with  $^{14}\text{C}$  dating organic matter in mardels (p. 8), the  $^{14}\text{C}$  chronology from Daulwelsmuer is claimed to be "reliable". How do we know that? Much rests on the accuracy of the age estimates but little is presented explaining the chronology and stratigraphy of the reference mardel.

Another problem is that results and interpretations are mixed throughout the document. Results should review the pollen spectra of the four mardels, the correlated ages, and the archaeometric results. Later, in the Discussion (or Interpretation) section, inferences can be made regarding climate, land use, and vegetation changes on the plateau, and possible provenance of the clay used in the Roman ceramics.

Unfortunately, the weakest part of the study is the "archaeometric" analysis which seems like an afterthought. One sediment sample from each mardel is unlikely to be representative.....likewise, with the adjacent soils. The limited sample size and contextual information for mardel fill, soils, and ceramics precludes the ability to determine provenance with the given geochemical results and statistical analyses. Without better definition of the sample universe, it is not possible to determine a reliable match.

Finally, given that the provenance of the clay in the Roman ceramics is not demonstrated, and that the chronology of the newly studied mardel deposits is tenuous, the conclusion that some of the mardels were used by Romans as clay sources is not supported by the data at hand.

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Due to these concerns, I cannot recommend that this paper be published, even with major revisions. The authors need to review the international literature on ceramic provenance studies and think about how best to devise a robust sampling strategy that will result in an adequate data set that can support interpretations of Roman clay quarrying in these interesting landscape features. Such a study might have a better chance of being published in an archaeometry journal.

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