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Luminescence Chronology of loess palaeosol sequences from the Alsheim section in the Mainz Basin (Germany)

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In the eastern part of the Mainz Basin (Germany) Quaternary sediments about 12 m thick including late Pleistocene loess/palaeosol sequences are exposed at an abandoned brickyard near to the village Alsheim. The loess sequence was investigated by means of sedimentology, pedology, geochronology and palaeomagnetics. An extensive luminescence dating study was carried out to set up a more reliable chronological frame for the loess record in the Mainz basin. These investigations are part of an ongoing study to reconstruct climate and environmental change from Upper Pleistocene aeolian and fluvial sediment archives in the Upper Rhine area. In this study, we present the results from luminescence dating, sedimentological and palaeomagnetic investigations.

Altogether twelve sediment profiles were investigated and described in the field. Loess and alluvial loess samples for IRSL dating were taken from seven profiles. The base of this profile is formed by limestone and marls of the Hydrophobien layer (Miocene). The upper 6 – 8 m of the 12 m thick Quaternary sediments are composed of loess and alluvial loess. They are divided by palaeosols, with the exception of profile VII. A distinct Bt-horizon of fossil luvisols cannot be observed. The oldest parts of the sediments are exposed in profile VI and VII with the oldest humus zone in profile VI. The profile is characterized by intensive channel structures.

The infrared stimulated luminescence (IRSL) method has proven to be a reliable tool for dating Quaternary aeolian sediments up to ages of about 100 ka. The time elapsed since the last exposure to sunlight is determined.

Thirtytwo loess and loess derivates were investigated by the IRSL method. The polymineral fine grain fraction (4 – 11μm) was analysed applying the multiple aliquot

additive dose method (MAAD). All samples were measured by a RISØ TL-DA-15 reader. Uranium, thorium and potassium contents were analysed for annual dose rates by low level gamma spectrometry (EGG & ORTEC, N-Type).

The oldest dated loess samples below the stratigraphic oldest humus zone in Profile VI yielded IRSL age estimates ranging from 107 ± 3 ka to 163 ± 12 ka. In Profile VII the lowermost loess yielded an IRSL age estimate of 167 ± 13 ka. These age estimates are above the dating limit of loess samples in this region and so it is very likely that these results underestimate the true deposition age. A correlation with the penultimate glaciation or any older glaciation is very likely. The IRSL dating results of the other loess and alluvial loess samples from the investigated profiles I, IIa, III, IV, VI and VII are between 16.4 ± 1.5 ka and 109 ± 8 ka and correlate with the Weichselian galciation. Five loess accumulation phases were likely to have been occurred in this region. At the Alsheim site the oldest loess was deposited during the Saalian glaciation. The second one from 110 to130 ka, a third one from 70 to 109 ka, a fourth one from 46 to 70 ka and the youngest loess accumulation period was from 16 to 39 ka. The IRSL age estimates are consistent with the stratigraphical estimates indicating a dynamic sedimentary environment during the last glacial. The luminescence datings provide a very well opportunity for timing the phases of increased dust accumulation.

Furthermore, discrete samples were taken to measure polarity of the earth magnetic field (magnetostratigraphy), susceptibility and various other rock magnetic parameters. No parts with reverse polarity could be detected in the profiles. Due to magnetic enhancement our rock magnetic investigations help to identify distinct soil formation layers (pedogenesis) in the loess profiles.