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Thesis Abstracts

Thesis title: Die Infrarot-Stimulierte-Lumineszenz als Datierungsmethode für holozäne Lössderivate. Ein Beitrag zur Chronometrie kolluvialer, alluvialer und limnischer Sedimente in Südwestdeutschland.

Awarded by: Ruprecht-Karls-Universität Heidelberg
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Degree: Dr. rer. nat.

Abstract

In the Middle European loess regions the insufficient amount of accurate age data is one of the limiting factors for a process-orientated reconstruction of landscape development.
This study proofs the applicability of IRSL-techniques for dating sedimentary reworking processes of Holocene age. This is accomplished through empirical dating-tests, methodological investigations, and by correlative analysis of sedimentological and physical properties of the sediments.
Samples for which independent age control was available were taken from aeolian, fluvial, limnic, and colluvial sediments from SW Germany. The investigations of the polymineral fine-grain fraction led to following results:
All IRSL-measurements were highly reproducible.
An outdoor bleaching-experiment on a rainy winter day showed that even under conditions of low light intensity, the IRSL-signal of a loess sample was reduced to zero after 30 min of exposure. This is confirmed by the ED-plateau-tests which hint to sufficient bleaching for colluvial and limnic sediments during the depositional process.
Results further indicate, that an ED-plateau is necessary for dating fine-grained sediments, but is not a sufficient indicator for datability.
Fading was detected only when a broad wavelength band was used. By using a narrow wavelength window around 410 nm, the influnence of fading on the dating results was eliminated.
With the exception of very young samples ED was determined within a statistical error margin of only ± 3 %.
The application of four independent methods to determine the dose rate allowed a presicion of up to ± 6,5 % in samples with radioactive equilibrium.
The study shows that a multiple method approach is necessary to achieve an acceptable level of reliability.
Based on the origin of the sediments investigated, it can be concluded that not only aeolian, but also colluvial and limnic sediments can be accurately dated by IRSL. The results are especially remarkable in the case of colluvial sediments, because transport distances did not exceed 100 m.
By using IRSL with colluvial sediments, it was possible to define four distinct phases of intense soil erosion in the Kraichgau Hills that correlate in age with the human settlement periods of Bandkeramik, Michelsberg, Celtic and Middle Age cultures.
Results obtained may be valid only for the Middle European loess regions because specific mineral compositions and details of the depositional process vary regionally.

Thesis title: The Use Of An Imaging Photon Detector For Luminescence Dating

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Abstract

The individual luminescence (TL and OSL) sensitivities of hundreds of individual feldspar and quartz grains have been measured. Measurements on individual grains were possible by using an imaging photon detector (IPD) which enables the low photon flux from each grain to be resolved and measured. In addition, the imaging capability of the IPD allowed many grains to be measured simultaneously, which is important since without such a facility the measurements would be extremely time consuming. Initially, the resolution of the optics was too poor for imaging and consequently a new optical system was developed which provided sufficient resolution to allow imaging of coarse grains (90-180μm in size).

It was found that a few grains has a high TL sensitivity, that is they exhibited both high natural TL and high second glow TL (measured after administering a laboratory beta dose). Other grains were found to have a high equivalent dose (ED), that is they exhibited only high natural TL and therfore high natural/second glow ratios. Examination of the grains using optical microscopy and SEM was undertaken in an attempt to explain the observed differences in natural and second glow TL. Grains which had both a high natural and a high second glow TL were not correlated with any of the

observed physical features from each grain and hence, differences in the trap and luminescence centre concentrations in each grain (which could not be measured directly) were thought to be the primary cause of the observed differences in TL sensitivities. Grains which had only high natural TL were considered to have been insufficiently bleached prior to deposition.

The infra-red stimulated luminescence (IRSL) from many quartz grains was measured and the origins of the IRSL, whether from indicidual quartz grains or from feldspar inclusions within the grains, was investigated. Finally, the IPD was used to obtain TL images of pottery, rocks and mineral slices and it was established that such images could be routinely used in laboratory to identify areas of luminescence inhomogeneity.