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Optical luminescence dating for timing of palaeoseismological activity at the Viersen Fault, Lower Rhine Area (Germany)

A. Techmer (1), K. Skupin (2), R. Pelzing (2), G. Schollmeyer (2), M. Frechen (1), J. Klostermann (2)

(1) Leibniz Institute for Applied Geosciences (GGA), Hannover, Germany,(2) Geological Survey Nordrhein-Westfalen, Krefeld, Germany

(techmer@gga-hannover.de / Fax 0511/ 643-3665 / Phone 0511/ 643-2540)

In the context of paleoseismological investigations in the Lower Rhine Area an exploratory excavation in Holthausen crossing the Viersen fault was carried out. This fault shows a clear disturbance through the Holocene sequence up to the surface. There are distinct offsets of 15 – 50 cm in the underlying Pleistocene and Tertiary beds. The upper layers, of clayey- silty loess and the lower colluvial sediments were investigated to setup a more reliable chronological framework for timing of the palaeoseismic activity in this region. The deposition of the sediments under studying is either caused by palaeoseismic events or by running water. In the latter case the dating represents a minimum age and in the other case a maximunm age with respect to the seismic activity.

The optical stimulated luminescence method is a reliable tool for dating quaternary sediments up to ages of about 100 ka. The method is based on the light emitted from minerals like quartz and feldspar that are produced by a natural or artificial dose of radiation. During fluvial or aeolian transport this acquired geological signal is reset and again the geological clock starts. The stored signal is proportional to the time since deposition.

Eighteen sediments (VIE 1 – VIE 7, VIE 9, and VIE 20 – VIE 27) were investigated by the infrared stimulated luminescence method (IRSL). The polymineral fine grain fraction (4-11μm) of fifteen samples was analyzed applying the multiple aliquot additive

dose method (MAAD). Additionally, three coarse grain potassium feldspar (VIE 8 – VIE 10) samples were studied by the multiple aliquot additive dose (infrared MAAD) and the single aliquot regeneration dose (SAR) following the protocol described by Wallinga et al. (2000) for coarse grain (100 – 150 μm) feldspar. All samples were measured by a RISO TL-DA-15 reader. U, Th- and K-contents were determined for annual dose rates by low level gamma spectrometry (EG&G ORTEC, N-Type).

Three different layers were identified. In this trench the clayey silty sediment (Layer I) should be the best bleached sediment during transportation. The IRSL- age estimates from polymineral fine grain fraction of this horizon range from 7.1 ka $\pm$ 1.0 ka up to 20.2 ka $\pm$ 3.9 ka. The weighted mean luminescence age is 10.8 ka $\pm$ 0.5 ka ($\chi^y = \mathrm{x4u9sg} = \mathrm{xzpug}$he sediments were deposited after the palaeoseismic event. In terms of the seismic activity, these datings represent minimum ages.

The Layer II and III are not well bleached prior to deposition. The IRSL age estimates range from 182.8 ka $\pm$ 19.4 ka to 43.8 ka $\pm$ 3.3 ka.

There are three coarse grain feldspar results. Layer I shows an agreement to all three dating methods (MAAD- polymineral, MAAD- feldspar, SAR- feldspar). If there is any underestimation because of anomalous fading, it should be seen from the quartz dating. These investigations are still in progress.

The IRSL- age estimates of the fine grain fraction from Layer II (43.8 ka $\pm$ 3.3 ka) displays no correlation with the feldspar results. Moreover the feldspar measuring with the SAR- method is lower (79.1 ka $\pm$ 7.5 ka) than the dating received with the multiple aliquot method (118.1 ka $\pm$ 11.8 ka). Also Layer III shows a lower SAR- feldspar IRSL- age estimate with 169.4 ka $\pm$ 20.5 ka compared to the MAAD- feldspar dating, 182.8 ka $\pm$ 19.4 ka. This is part of an ongoing study of palaeoseismic activity in the Lower Rhine Area.

Wallinga, J. et al. (2000): The single aliquot regeneration dose (SAR) protocol applied to coarse-grain feldspar. Radiation Measurements, 32: 529-533.