Late Pleistocene millennial scale cycles of aeolian sedimentation in the Dunaszekcső loess record, south Hungary: preliminary data and interpretations

Gábor Újvári[1], János Kovács[2,3], György Varga[4], Mihály Molnár[5] and Ágnes Novothny[6]

[1] Geodetic and Geophysical Institute, MTA Research Centre for Astronomy and Earth Sciences, Csatkai E. u. 6-8., 9400 Sopron, Hungary, Email: ujvari.gabor@csfk.mta.hu

[2] Department of Geology and Meteorology, University of Pécs, Ifjúság u. 6., 7624 Pécs, Hungary

[3] Environmental Analytical and Geoanalytical Research Group, Szentágothai Research Centre, University of Pécs, Ifjúság útja 20., 7624 Pécs, Hungary

[4] Geographical Institute, MTA Research Centre for Astronomy and Earth Sciences, Budaörsi út 45, 1112 Budapest, Hungary

[5] Hertelendy Laboratory of Environmental Studies, MTA Institute of Nuclear Research, Bem tér 18/C, H-4026 Debrecen, Hungary

[6] Department of Physical Geography, Eötvös Loránd University, Pázmány Péter sétány 1/C, H-1117 Budapest, Hungary

Millennial scale warm-cold oscillations in air temperature over Greenland and rapid sea surface temperature changes were recorded in ice cores and North Atlantic sediments for the last glaciation. These events must have been associated with profound environmental changes in Europe, and indeed, millennial scale oscillations in grain size records have been found in loess deposits of Europe and Asia. Unfortunately, the timing of these events are still unresolved due to chronological uncertainties on the order of thousands of years. Major problems are the low precision of luminescence ages and the general lack of materials that can reliably be dated using ^{14}C.

As demonstrated by 24 OSL/IRSL ages, the Dunaszekcső loess-palaeosol sequence is an archive of climate and environmental changes of the last glacial-interglacial cycles. For the upper part of the section (<33 cal yr BP), the chronology is further refined based on charcoal and mollusc shell radiocarbon ages. Here we show that AMS ^{14}C ages of some mollusc species having small shells (<10 mm) seem to yield reliable ages in a comparison with charcoal ^{14}C ages. These radiocarbon ages are consistent, have low variability and define age-depth models with sufficient precision to examine the timing of paleoenvironmental changes in the context of North Atlantic climatic variations.

Bayesian age-depth modeling was performed using Bacon for a depth of 865-500 cm and a time span of 33-25 kyr based on 16 radiocarbon ages. Mean confidence ranges are 674 yr with a minimum of 416 yr at 630 cm and a maximum of 917 yr at 865 cm. Such a sub-millennial scale age model precision has formerly been unprecedented for loess profiles. Sedimentation rates calculated from the Bayesian age-depth model vary between 0.3 and 1.1 mm year^{-1} (=m kyr^{-1}) with the maximum at 27.390±230 cal yr BP. Estimated bulk dust flux for the studied site and the given time span range from 493 to 1666 g m^{-2} yr^{-1}, calculating with a dry density of loess of 1500

kg m^{-3}. Both the sedimentation rate and dust flux show millennial scale variations, together with the median grain size (Md) of bulk loess that is considered an integrated proxy of wind strength, dust source distance and source aridity. The Md proxy reveals sub-millennial scale variations, too, but the interpretation of such oscillations is far from straightforward. Nevertheless, the millennial scale variations in the Aeolian sedimentation imply strong and rapid changes in the frequency (and magnitude?) of dust storm events for the period of 33-25 kyr. Further preliminary observations are that grain size (Md) maxima lag behind the NGRIP dust peaks (Ca^{2+}) by ca. 300-500 years and grain size minima closely follows Ca^{2+} and $\delta^{18}O$ minima (GI-4 and 3). It must be noted, however, that the 300-500 years lags are within age model uncertainties.

Acknowledgements

This work was supported by the Hungarian Scientific Research Fund through post doc projects to GÚ (OTKA PD-108639), GV (OTKA PD-108708) and ÁN (OTKA PD-100315).