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Luminescence age constraints on the Pleistocene-Holocene transition recorded in loess sequences across SE Europe

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The need for a better understanding of past environmental change has led to increasing efforts in improving chronologies for paleoclimate records worldwide. For loess-paleosol sequences (LPS), the issue is more compelling, as in many cases the chronological control is often achieved only by tuning to other records. It is generally assumed that dust deposition is enhanced during glacial times, whereas pedogenetic processes are stronger during warm-wet climates, specific to interglacial periods. Thus, when investigating the transitions recorded in LPS, trends in environmental magnetic susceptibility (MS) are often wiggle matched or tuned to ice records or marine sediments proxies, thus assuming synchronicity of climatic changes between the terrestrial, marine or ice records at glacial-interglacial transitions.
The transition between Late Glacial and Holocene is probably the most easily identifiable and also quantifiable through absolute dating. However, a recent study comparing radiocarbon records over the most recent deglaciation that highlighted differences in the timing of the benthic δ18O change in various marine records, globally (Stern and Lisiecki, 2014). If the synchronicity assumption does not hold even for the most recent glacial/interglacial transition, then the whole approach behind the magnetic and pedostratigraphic timescale tuning must be re-assessed.
Here we investigated at high-resolution the timing of the last glacial loess (L1) - Holocene soil (S0) transition recorded in loess-paleosol sequences from SE Europe (Ukraine, Romania, Serbia) by applying comparative luminescence dating techniques on quartz and feldspars. Equivalent dose measurements were carried out using the single-aliquot regenerative-dose (SAR) OSL technique on silt (4-11 μm) and sand-sized (63-90 μm and coarser fraction when available) quartz and the post IR-IRSL290 technique is applied to 4-11 μm polymineral grains. To constrain precisely the L1/S0 transition, low field magnetic susceptibility (χlf) as well as frequency dependent magnetic susceptibility (χfd) analyses have been performed. SAR-OSL dating of 4-11 μm, 63-90 μm and 90-125 μm quartz provided consistent and reliable ages in three loess-paleosol sites investigated, while the post-IR IRSL290 protocol proved unreliable for accurate dating of such young samples. The threshold in the magnetic susceptibility data has been dated using quartz to 11.9 $\pm$ 0.9 ka in Roxolany (Ukraine), to 12.4 $\pm$ 1.0 ka in Ramnicu Sarat (Romania) and to 10.9 $\pm$ 0.9 ka in Mošorin (Serbia). From the luminescence chronology we derive that in all three sites investigated a decrease in the sediment accumulation rates has been identified at a depth closely matching the magnetic susceptibility threshold. Thus, we interpret the simultaneous changes in magnetic susceptibility and sedimentation rates as reflecting the Pleistocene/ Holocene transition in the investigated sites. The quartz OSL ages obtained for the L1/S0 transition in these three loess sites correspond within error limits with the 11.7 ka age set for the Pleistocene/Holocene boundary in ice cores records.

References

Stern, J.V., Lisiecki, L.E., 2014. Termination 1 timing in radiocarbon-dated regional benthic δ18O stacks. Paleoceanography 29, 1127-1142.

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