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Multi-method luminescence and electron spin resonance dating of eastern European key loess section at Stayky in Ukraine

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Here we provide a robust luminescence chronology for Stayky (Ukraine), a reference profile in European Late Pleistocene loess stratigraphy, based on optically stimulated luminescence (OSL) dating on quartz (4-11 μm, 63-90 μm) and post infrared-infrared stimulated luminescence (pIR-IRSL)) on polymineral fine grains. For the Bug loess unit, the equivalent of Marine Isotope Stage (MIS 2), results agree between methods, demonstrating the suite of embryonic soils previously interpreted as reflecting climate variability similar to Greenland interstadials (GI), actually date to ∼29/27-15 ka, with most emplaced around or after 20 ka. This temporal span is further confirmed by age-depth modelling of available data. Apart from GI-2, no interstadial- type climate events are recorded in Greenland ice core data for that time interval. As short-term pedogenetic phases are also documented in records from central-western Europe, there is a need for more research into European mid-latitude terrestrial environment responses to hydroclimate variability during MIS 2.

The dating of Vytachiv paleosol, previously equivocally linked to various GI events within MIS 3, resulted in ages of ∼40±4 ka and ∼53±4 ka at the lower transition, and ∼26±2 ka to ∼30±2 ka in the overlying loess.

The pIR-IRSL290 dating of the loams immediately underneath Pryluky unit are in the range of ∼120 ka to ∼168 ka, and of the Pryluky mollisol from ∼90 ka to 126 ka. These results confirm the correspondence of this unit with MIS 5, although poor dose recovery results suggest further testing into the degree these ages provide overestimated results may be necessary. Quartz data severely underestimate the pIR-IRSL290 ages for these samples.

The application of pIR-IRSL290 dating for the underlying Dnieper till previously linked to the Saalian glaciation resulted in natural signals at the level of laboratory saturation, yielding minimum ages of c.700 ka. This was confirmed by electron spin resonance dating using Al-hole and Ti-Li signals that resulted in ages of 1100±200 ka and 845±400 ka, respectively. For the same sample, the natural SAR-OSL signals for 4-11 μm quartz were found significantly below laboratory saturation level, resulting in finite ages of ∼250-270 ka. These are interpreted here as underestimates, while coarse quartz (63-90 μm) signals reached about 85% of the laboratory saturation level. These data suggest extreme caution must be taken when dating such old samples using quartz OSL.