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A composite geochemical record based on X-ray fluorescence scanning and radiocarbon dating for the Upper Palaeolithic site Kammern-Grubgraben (Austria)

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The Kammern-Grubgraben site is among the few early Epigravettian sites in Central Europe. It is located in a vineyard in Lower Austria, 12 km north-east of the town of Krems. The main archaeological horizons, AH 1 and AH 2, of Kammern-Grubgraben occur in loess-palaeosol sequences and have been dated to 22.6-22.3 ka cal BP (AH 1) and 23.3-22.4 ka cal BP (AH 2), respectively, with several radiocarbon dates from bone collagen. Previous luminescence dating provided additional but rather imprecise data for sediment above and below the archaeological horizons.

As part of an interdisciplinary German-Austrian research project, we tested the possibility of matching archaeological profiles and adjacent drill cores using semi-quantitative element data obtained by X-ray fluorescence (XRF) core scanning. In addition, different materials were tested for radiocarbon dating depending on their availability. However, only charcoal and gastropods provided reliable results, whereas rhizoconcretions and humic acids were unsuitable for dating. The overall aim of this part of the project was to produce a well-dated composite profile, where the archaeological horizons are embedded in a wider palaeoclimatic context.

Eight loess profiles (total length: 13 m) were sampled with steel U-profiles. Since the loess sequences in the excavation area are truncated by sediment removal for terracing due to viticulture, two percussion cores (6.5 and 7.5 m long) were drilled approximately 30 m northwest of the archaeological excavation site, in a higher terrace where sediment was accumulated onto the former surface. The element counts from XRF scanning of all records were standardized using the centred log-ratio transformation to reconcile the geochemical records. Prior to this, only those elements with reproducible results were selected, i.e. Si, K, Ca, Ti and Fe. Wiggle matching of geochemical records was supported by archaeological tie points and seven additional radiocarbon dates from gastropods and charcoal. The Ca content is considered as the most significant indicator of palaeoclimatic changes, with the lowest (highest) values during interstadial (stadial) conditions due to more (less) weathering and leaching. Overall, our study documents that XRF scanning data are useful for aligning loess-palaeosol records in an archaeological context.

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