Charcoal as tracer of local tree taxa in the Pleistocene loess field of Central Europe. Which relationship with flora, vegetation, landscape or climate?

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***Summary**: Charcoal and pollen records are implemented in order to trace the vegetation and climatic changes from Eastern Europe during the time window 36-26 kyr BP. The present discussion makes comparison between 2 well dated loess sequences with humic horizons that provided pollen and charcoal remains. Some 7 positive climatic oscillations were recorded in this time window which may be correlated with the Greenland ice sequence between GIS 9 and 5b. No significant floristic changes did occur by trees during this period but landscape modifications happened by shifts in the vegetation structure.*

***Key-words**: charcoal, pollen, Pleistocene, loess, central Europe*

INTRODUCTION

Charcoal preserved in loess deposits is regarded accurate testimony of the past presence of tree and shrub taxa in the area of natural deposition or archaeological sites. This assertion is valid in certain favorable sites only if some conditions are fulfilled such as the thorough approach of the site stratigraphy, sampling methodology, laboratory treatment of charcoal, identification of the charcoal fragments and careful selection of fragments for radiocarbon dating. Of course the results must be in agreement with a coherent sequence in stratigraphy and chronology. However this assertion may be tempered by various disturbing factors like bioturbation, colluviation, solifluction, reworking, or intrusion by water transport. Only a precise methodology from the field work to the analyses in the laboratory may vouch for the accuracy of the results in chronology and environment. (Damblon *et al.*, 1996; Damblon and Haesaerts, 2002; Haesaerts *et al.*, 2010). Finally the coherence of each assemblage with other stratigraphic and environmental data must be controlled, an evidence which is not always achieved.

The following contribution aims at demonstrating the efficiency of combined stratigraphy, pollen and charcoal investigations with the aim at tracing vegetation changes and climatic oscillations in eastern Europe during the Upper Pleistocene, especially the time window 36-26 kyr BP, well framed by accurate radiocarbon dates on charcoal.

This time span is chosen because it corresponds to a key period that has known the turn from middle to late pleniglacial and the expansion of the Anatomically Modern Humans (AMH) throughout east and central Europe. Although a lot of pollen records come from this area, their chronology is not always accurate and precise. Moreover long well dated sequences mainly originate from the Mediterranean area and their connection with the loess field often remains puzzling.

Here, after a selection of two accurate pedostratigraphic and palaeobotanical records in loess, sequences from Czechia and Ukraine are discussed with the aim to detect the succession of climatic events between 36 and 26 kyr BP and evaluate their extent and impact on the plant environment. The investigation was focused on the archaeological sites of Dolni Vestonice (Czechia, Moravia) and Molodova (Ukraine) which have produced safe pollen records (Pashkevich, 1987; Svobodova, 1991) and were rich in charcoal material well positioned in stratigraphy. Moreover, some parts of the deposits also include pollen and charcoal in natural conditions.

RESULTS

The sequences of Dolni Vestonice and Molodova may be compared owing to their radiocarbon, charcoal and pollen data. The pedostratigraphic succession combined with the radiocarbon dates allow comparing the time slices 28-26 kyr BP in Dolni Vestonice and 33-23 kyr BP in Molodova. Taken together, these sequences include five palaeosols and humiferous horizons which correspond to episodes of climatic improvements that had induced the end of sand or loess input, the stabilization of the ground surface and the formation of humiferous horizons in loess deposits and peaty deposits in bottom valleys.

The low diversity of tree taxa with predominance of boreal conifers such as *Larix*, *Picea* and *Pinus* all along the time window 36-26 kyr BP is attested by charcoal preserved in archaeological sites as well as in natural conditions. *Abies* was also found in Dolni Vestonice (Beresford-Jones *et al.*, 2011). Only pioneer malacophylls like *Salix*, *Betula* and *Alnus* may be ascertained as local or regional trees. On the contrary, temperate angiosperm tree taxa detected in the pollen records and by single charcoal fragments have to be considered intrusive.

The two pollen sequences in the two regions from Moravia and Ukraine point to open landscapes with

predominant steppe vegetation on dry grounds and sedge-grass meadows in wetter depression or along the rivers. Such marshes may have been at the origin of the tundra signal in diverse pollen records in central and east Europe. Comparing the charcoal and pollen records from west to east Europe puts some gradient in evidence with damper edaphic conditions to the west and drier ones to the east where charcoal data show boreal conifer trees really favored in central and east Europe. These botanical records also suggest continuity in the vegetation type throughout the 36-26 kyr BP window (MIS 3 - beginning MIS 2) given that pollen and charcoal preserved in tundra-gleys at the end of the middle pleniglacial and the beginning of the late pleniglacial attest the persistence of conifers in a wide steppe context during this transition phase.

CONCLUSION

Finally, it is assumed that the climatic oscillations which characterize the MIS 3 and 2 glacial stages were too short (around one millennium) for allowing revolution of the landscape. The palaeobotanical records rather suggest some local or regional minor changes in a steppe environment with limited expansions of boreal trees that had subsisted in sheltered biotopes linked to the valleys, especially to the east of Europe. Some patches of tundra-like vegetation might have developed as a result of local higher water table.

The above discussed results confirm the lack of temperate malacophyll and sclerophyll temperate tree taxa in the loess area of middle Europe during the stadial and interstadial episodes of the last glaciation. Such temperate taxa were standing in sheltered biotopes of the Mediterranean area and south of 45° N as assumed by recent palaeobotanical syntheses (Fletcher *et al.*, 2010; González-Sampériz *et al*., 2010; Müller *et al*., 2011).

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