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Weichselian Upper Pleniglacial environmental variability in north-western Europe reconstructed from terrestrial mollusc faunas and its relationship with the presence/absence of human settlements

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ABSTRACT

During the Weichselian glaciation, millennial timescale climatic changes are a major cause of environmental variability, which influence the composition of large mammal fauna and the geographical distribution of human prehistoric populations. Nevertheless, precise environmental contexts of archaeological artefacts may remain unknown due to an unclear stratigraphy and/or to the bad preservation of paleoenvironmental proxies. As pollen is badly preserved in glacial loess deposits, a compilation of age constrained high resolution molluscan records is used to initiate the establishment of a canvas of millennial timescale spatial and temporal environmental changes in the European Loess Belt during the Weichselian Upper Pleniglacial (ca. 37–20 ka) to look for relationships with spatial distribution of human settlements.

In this study, new terrestrial mollusc assemblages have been added to the database previously established for north-western Europe. They strengthen the position of the limit between the two molluscan-based biogeographical domains initially highlighted for north-western Europe: a flat and poorly vegetated western domain extending around the Channel and in Belgium, and a hilly domain with more diversified vegetation to the east. The analysis of molluscan data shows the persistence of these two domains throughout alternations of loess deposition phases (interstadial–stadial transitions and stadial phases) with phases of development and degradation of tundra gley horizon (stadial-interstadial transitions and interstadial phases).

The interpretation of malacofauna from both domains combined with associated pedological and sedimentological features, climate modelling and comparisons with present tundra environments reveals a significant effect of both seasonality and snow cover along a longitudinal gradient between both domains, but also between phases of loess deposition and phases of tundra gley development. During interstadial phases, the intense functioning of the active layer and the degradation of permafrost in north-western Europe led to more homogeneous environments, which were less favourable for the diversity of both vegetation and terrestrial mollusc fauna.

Presently, uncertainties of numerical ages still preclude precise correlations of loess units and tundra gley horizons between different sites and with nonlocal prehistoric occupations. However, a first raw comparison of the molluscan data with spatial distributions of Aurignacian, Gravettian and Solutrean-Upper Magdalenian lithic cultures reveals that the northern limit of the first two ones fits well with the south-eastern border of the poorly vegetated western domain also characterised by well-developed ice-wedge networks during phases of permafrost installation. Later, an important southward shift of human populations in western Europe resulted from the extreme aridity of the Last Glacial Maximum.

1. Introduction

The reconstruction of glacial palaeoenvironments in continental Europe is of primary interest for understanding of prehistoric occupation by human beings. During the last glaciation (Weichselian), northern limits of cultural expansions and human presence

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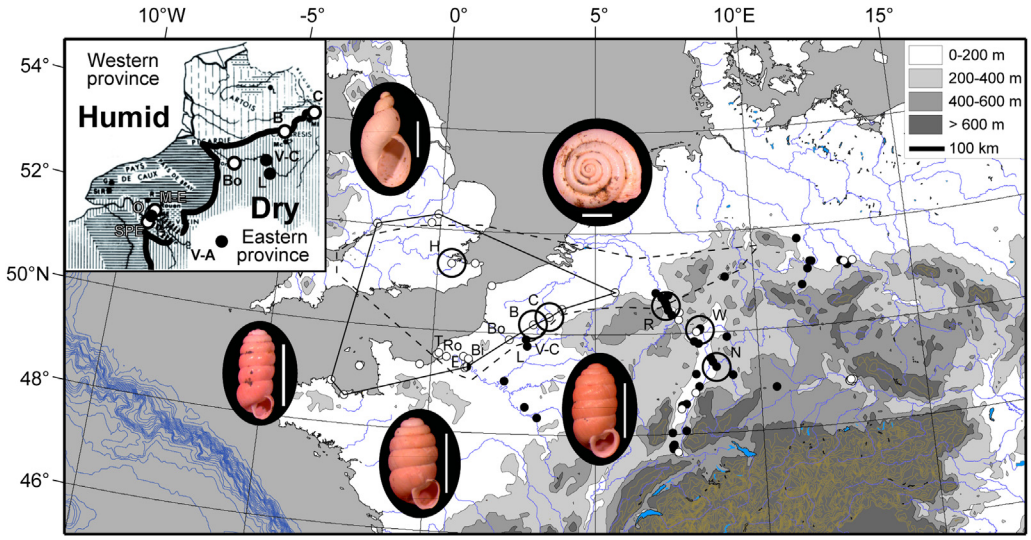

Fig. 1. Distribution map of sites that yielded age-checked Weichselian Upper Pleniglacial molluscan records. Newly added samples to the database come from Tancarville (T), Epouville (E), Roumare (Ro), Bihorel (Bi), Saint-Pierre-lès-Elbeuf (SPE), Oissel (O), Mesnil-Esnard (M-E), Boves (Bo), Bourlon (B), Curgies (C) and Remagen (R). Circles point continuous records used in factorial correspondence analyses, i.e. Halling (H), Bourlon (B), Curgies (C), Remagen (R), Wiesbaden Hainerberg and Gräselberg (W) and Nussloch (N). Plain line borders the western domain and dotted line the area of LGM (probably not only according to absolute and relative age uncertainties) high ice-wedge cast and ice-wedge cast networks density according to data of Van Vliet-Lanoë and Hallégouët (1998) for France and Karte (1987) for Benelux and Germany. See Moine (2008) for a full map of sites. Inserted map shows the limit between both sedimentological loess domains defined by Lautridou and Sommé (1974). Note the good fit of the south-eastern border of western domain with the border of sedimentological loess domain (inserted map) and with the south-eastern border of the area of high ice-wedge cast density (main map). Only on these maps, we located Languevoisin (L) (Moine, unpublished) and Villers-Carbonnel (V-C) (Huguenard, unpublished), which both strengthen the position of the south-eastern border of western domain. From top and clockwise are shell pictures (scale = 2 mm) of *Succinella oblonga*, *Trochulus hispidus*, *Pupilla muscorum*, *Pupilla alpicola* and *Columella columella*, which are the five main taxa of the western domain, two others being *Oxyloma elegans* and slugs. White circles: sites where the malacofauna is made of all or part of these seven taxa; black circles: composed sites where other species are additionally present.

were located in the European Great Plain (van Andel et al., 2003). Around the transition between Weichselian Middle Pleniglacial (WMP) and the Weichselian Upper Pleniglacial (WUP), this area was the scene of Neanderthal disappearance and its replacement by Anatomically Modern Humans (AMH) (Djindjian et al., 1999). Then, not less than three lithic technologies, Aurignacian, Gravettian and Magdalenian, succeeded during the WUP after the arrival of AMH in north-western Europe.

Whatever the approach used to study the geographical dynamics of Upper Palaeolithic human populations in Europe through dispersion of lithic technologies, palaeoenvironmental reconstructions are essential to evaluate any eventual forcing from both climate and environment. In the European Great Plain, loess is an aeolian sediment that accumulated in many regions during glaciations (Grahmann, 1932; Catt, 1985; Haesaerts, 1985; Haase et al., 2007), and particularly during the WUP between ca. 37 and 16 ka (Frechen et al., 2003). In the western half of the European Great Plain, continuous high resolution WUP pollen records are exceptions (Woillard, 1978; Müller et al., 2003). Besides, pollen is poorly preserved in loess and provides only a vague insight of

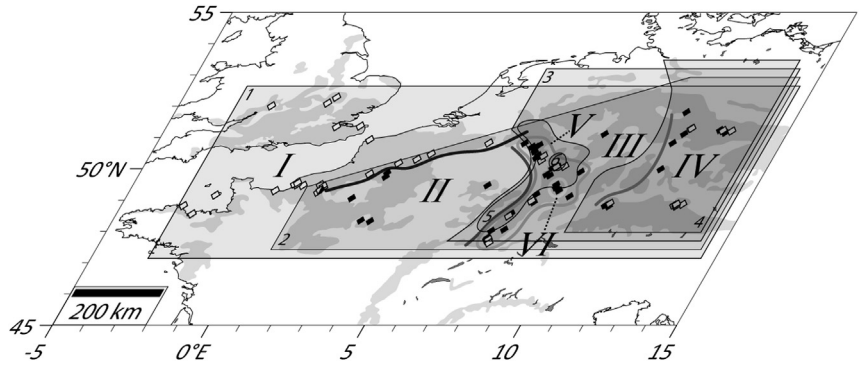

Fig. 2. Molluscan biogeography. Roman numbers refer to malaco-biogeographical domains, whose limits are drawn in the background. Arabic numbers refer to taxa distribution patterns represented as superimposed layers. Group 1: taxa spread all over the studied area (*Pupilla muscorum*, *Succinella oblonga*, *Trochulus hispidus*, *Columella columella* and slugs); Group 2: taxa spread all over the area except in the westernmost area around the Channel (*V. pulchella*, *V. pygmaeum*, *A. arbustorum*, *C. lubrica*, *P. loessica* and *V. costata*); Group 3: taxa spread east of the Rhine Valley (*Pupilla sterri*, *Helicopsis striata* and *Vertigo parcedentata*); Group 4: taxon spread around Ore Mountains, Bohemian Massif and Alps, east of 10°E (*Vallonia tenuilabris*); Group 5: taxa spread only in the Rhine Valley (*Clausilia rugosa parvula* and *Punctum pygmaeum*); Group 6: taxa only spread in the Rhine-Neckar confluence area (*Neostyriaca corynodes*, *Trochulus striolatus*, *Vitrea crystallina*, *Orcula dolium*, *V. genesii*, *Clausilia dubia*, *Abida secale*, *Helicella* sp. and *Succinella*/*Oxyloma*). Other taxa only occur in a few distant sites. Consequently, only affinities (Aff.) with six previous groups are proposed. Aff. 1: *Pupilla alpicola* and *Oxyloma elegans* spread in the middle of the European loess belt; Aff. 2: *Aegopinella nitidula* only occurs in the southern part of the Rhine Valley near Basel; Aff. 3: *Eucobresia diaphana*, *Euconulus fulvus*, and *Discus rotundatus*, occur in the Rhine Valley and around Ore Mountains (first two) and Alps (third one), all east of 10°E; Aff. 4: *Trochulus sericeus*, *Columella edentula* and *Nesovitrea hammonis*/*petronella* complex, occur around Alps (first two) and Ore Mountains (third one), all east of 10°E; Aff. 5: taxon "large species" is present only near Strasbourg, and *Jaminia quadridens* and *Pupilla triplicata*, are both present between Cologne and Koblenz; Aff. 5 and 6: *Bradybaena fruticum* is present in the Rhine-Neckar area and near Strasbourg, and *Chondrula tridens* is present near Frankfurt. Sites that yielded only Group 1 and Aff. 1 taxa are represented by empty diamonds, others by full diamonds.