



Malacological and palynological evidence of the Lower Pleistocene cold phase at the Carpathian Foothills (Southern Poland)

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ARTICLE INFO

Article history:

Received 7 July 2011

Available online 23 March 2012

Keywords:

Lower Pleistocene

Cold phase

Land snails

Pollen analysis

Carpathian Foothills

ABSTRACT

Early Pleistocene sediments bearing gastropod shells and pollen flora were found during coring at Jawornik (South Poland) at a depth interval of 54.30–39.00 m, beneath the oldest till of the Carpathians. Thirteen land-snail taxa identified in 55 samples of the core formed two molluscan assemblages. In the bottom part, typical cold-loving snails were found (e.g. *Vallonia tenuilabris*, *Pupilla loessica*, *Vertigo genesii*, *Columella columella*), whereas in the upper part only *Semilimax kotulae* was present. The succession of molluscan assemblages may suggest that at the site of deposition, after a phase of tundra, steppe-tundra or forest-steppe landscape with patches of wet habitats in cold climate, the climate became slightly milder but still cool, favourable to the spreading of boreal (coniferous) woodlands. Pollen analysis was performed only for the upper part of the profile. The pollen spectra, besides the Tertiary (Miocene) elements, contained sporomorphs common to the Tertiary and Quaternary floras. Among them, the highest percentages were noted for *Pinus haploxylon* t., *P. diploxylon* t., *Picea*, *Quercus*, *Ericaceae*, *Betula*, and *Ulmus*. The fact that the sediments with organic remains underlie the oldest Scandinavian till suggests that they are older than the oldest glacial unit of the South-Polish Complex (Narevian = Menapian, ~1.2 Ma).

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Introduction

Mollusc- and flora-bearing organic sediments were found during coring for the Detailed Geological Map of Poland, 1:50000 Strzyżów sheet (Malata, 2009), at Jawornik (21°47'E, 49°52'N) (Figs. 1 and 2). Gastropod shells and pollen flora were located at the depth interval of 54.50–39.00 m, underlying the oldest Scandinavian glaciation till deposit in the Carpathians. The age of this till has been a matter of dispute from quite a long time. Actually, there are four glaciations within the South-Polish Complex containing the oldest Pleistocene glaciations in Poland – Narevian, Nidanian, Sanian 1 and Sanian 2 (Ber, 2005; Ber et al., 2007; Lindner and Marks, 2008). Until recently the Sanian 1 (~0.65 Ma) glaciation was considered the only which invaded the Carpathians Mts. According the newest paleomagnetic data from Kończyce profile located at the Carpathians border the oldest till should be associated with the Narevian (= Manepian, ~1.2 Ma) glaciation (Wójcik et al., 2004; Foltyn et al., 2010).

The present paper reconstructs local paleoenvironment changes during the Lower Pleistocene in the Carpathian Foothills based on mollusc assemblages and vegetation from the Jawornik core.

Mollusc assemblages indicative of cold or cool climatic condition are very common in the late Pleistocene deposits of central Europe, but data from the older Pleistocene sections are comparatively scarce. The oldest locality bearing some cold-loving species comes from the upper Pliocene at Stranzendorf in Austria (Frank, 2006), and a few early Pleistocene localities were noted from Krems and Radlbrunn in Austria, from Červený kopec (former Czechoslovakia) (Ložek, 1964) and from several sites in Germany (Mania, 1973). In Hungary, some of the cold-tolerant species are known only starting with the middle Pleistocene (*V. tenuilabris*, *V. alpestris*), but they are mainly recorded from late Pleistocene sediments (Krolopp and Sümegei, 1993; Füköh et al., 1995).

In Poland, the oldest (loess) sediments bearing cold-loving species such as *Vallonia tenuilabris*, *Columella columella* and *Vertigo parcedentata* have been recorded from the Świętokrzyskie Mts. (Poliński, 1927) (Fig. 2) and correlated to the Sanian 1 glaciation (~0.65 Ma) (= Sanian; Skompski, 1996). Much more information has been provided by early Pleistocene interglacial deposits from Kielniki 3A (Stworzewicz, 1981), dated as Lower Biharian (1.4–1.5 Ma) in mammal stratigraphy (Nadachowski, 1990) and containing numerous species of warm-humid, deciduous or mixed forest snails, including some Tertiary taxa which survived up to the early Pleistocene.

Lower Pleistocene (pre-glacial) pollen records from the territory of Poland are rather scarce and fragmentary. Most of them come from central Poland (Mamakowa, 2003). In the Carpathians, only one locality with lacustrine sediments has been analyzed for pollen

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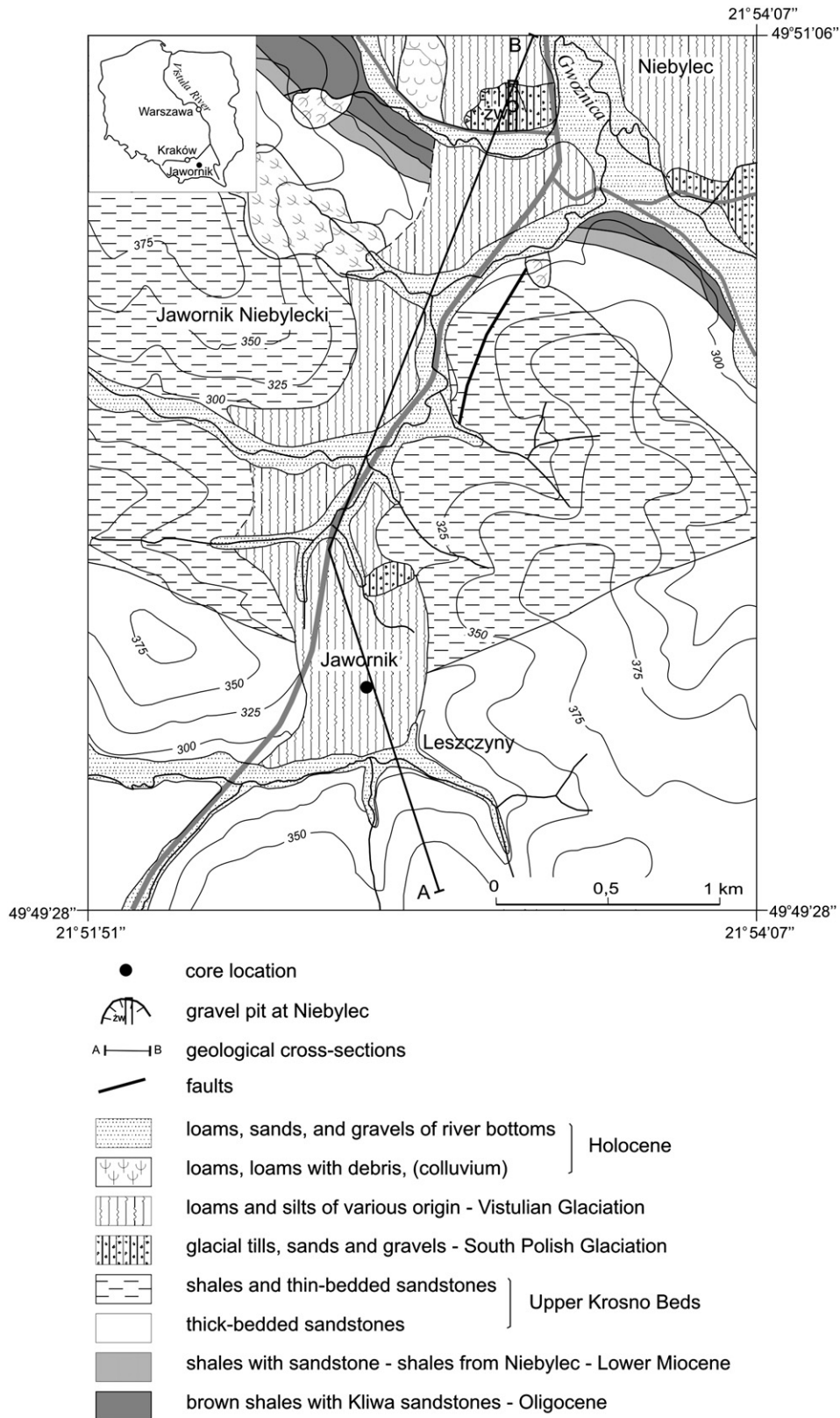


Figure 1. Location of the study area in the Detailed Geological Map of Poland (after Malata, 2009). Elevation contours (25-m increments) are given in m a.s.l.

and plant macrofossils (Szafer, 1954). The pollen succession from site Mizerna near Czorsztyn (Fig. 2) comprises several climatic phases: Dacian, Reuverian, Praetiglian, Tiglian, Eburonian, and Wallian (~5.3–1.3 Ma) (Zagwijn, 1985; Stuchlik, 1994). According to Szafer (1954) and Stuchlik (1994) the Reuverian/Praetiglian boundary is

recorded in the profile from Mizerna, where it is marked by the decline of the Tertiary pollen elements as well as by the decline of the Quaternary taxa with higher climatic demands, mainly broadleaved trees. Although the Jawornik core contained only a sparse fossil record, the molluscs and pollen recovered from it nevertheless extend

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