Quaternary International 357 (2015) 22–32

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Early and Middle Pleistocene fluvial series in northern foreland of the Carpathians (Poland and Ukraine) and their relation to Dnistr River terraces

Leszek Lindner, Leszek Marks*

University of Warsaw, Department of Climate Geology, Żwirki i Wigury 93, 02-089 Warsaw, Poland

ARTICLE INFO

Article history:
Available online 31 October 2014

Keywords:
Fluvial deposits
Carpathian and Scandinavian erratics
Mixed gravels
Early and Middle Pleistocene
Carpathians foreland
Dnistr River valley

ABSTRACT

This paper discusses buried fluvial series in northern foreland of the Carpathians and their possible correlation with the Upper Dnistr River terraces. These fluvial series have been deposited mostly by the rivers from the Carpathians, with their runoff either westwards or eastwards. The whole river system has been considerably transformed during Early and early Middle Pleistocene glaciations when a streamway in the so-called sub-Carpathian channel drained this area through the Dnistr valley to the Black Sea. Re-interpretation and compilation of the previously published material from key sites with examined interglacial pollen sequences and in some of them, with the palaeomagnetic record of the Brunhes/Matuyama boundary, distinguished the first appearance of the Scandinavian material in fluvial series, as well as the directions and chronology of river discharges. Several fluvial series were identified and correlated with river terraces in the Dnistr valley. The Ruda Series in the interfluves of Odra and Vistula, and the Majdan Series in the Upper Vistula drainage basin were deposited during the preglacial part of the Early Pleistocene and corresponded with the development of Dnistr terraces X–VIII. The Kończyce Series in the interfluves of Oder and Vistula and the Rakszawa Series in the eastern part of the upper Vistula drainage basin were deposited during the early Podlasian Interglacial (Cromerian I–III) and they corresponded with development of Dnistr terrace VII. The Torhanovychi Series in the interfluves of San and Dnistr was deposited mainly during the late Podlasian Interglacial, and it corresponded with development of Dnistr terrace VI. The Krukienichi Series in the interfluves of San and Dnistr and in the Upper Dnistr valley was deposited during the Ferdynandovian Interglacial (Cromerian IV) and corresponded with development of Dnistr terrace V.

1. Introduction

This paper presents a re-interpretation and compilation of the previously published material from key sites in the northern foreland of the Carpathians in Poland and Ukraine where Early and early Middle Pleistocene fluvial deposits were identified. Geological setting of the most important key sites with interglacial pollen sequences and paleomagnetic record of the Brunhes/Matuyama boundary are discussed (Fig. 1). The first appearance of the Scandinavian material in fluvial series, but also the directions and chronology of river discharges, were found to be crucial in the paleogeography of this region.

The aim of the paper is a correlation of the buried fluvial series in the northern foreland of the Carpathians with the Upper Dnistr River terraces. These fluvial series were deposited mostly by the rivers from the Carpathians, draining either westwards or eastwards. During Early and early Middle Pleistocene glaciations the whole river system was considerably transformed into an ice-marginal streamway, being supplied with proglacial waters. Predominant draining occurred eastwards through the so-called sub-Carpathian channel and the Dnistr valley to the Black Sea.

Reconstruction of evolution of the fluvial system in northern foreland of the Carpathians was strictly connected with the origin and age of the so-called 'mixed gravels' (cf. Lindner and Marks, 2013a, b). The term was introduced in the geological literature in Austrian Galicia for fluvial gravels of Carpathian derivation (Hilber, 1882; Tietze, 1883; Uhlig, 1888), but containing 5–10% admixtures of Scandinavian rocks (Stupnicka, 1962; Łanczont, 1997).

* Corresponding author.
E-mail addresses: l.lindner@uw.edu.pl (L. Lindner), leszek.marks@uw.edu.pl (L. Marks).

http://dx.doi.org/10.1016/j.quaint.2014.09.053
1040-6182/

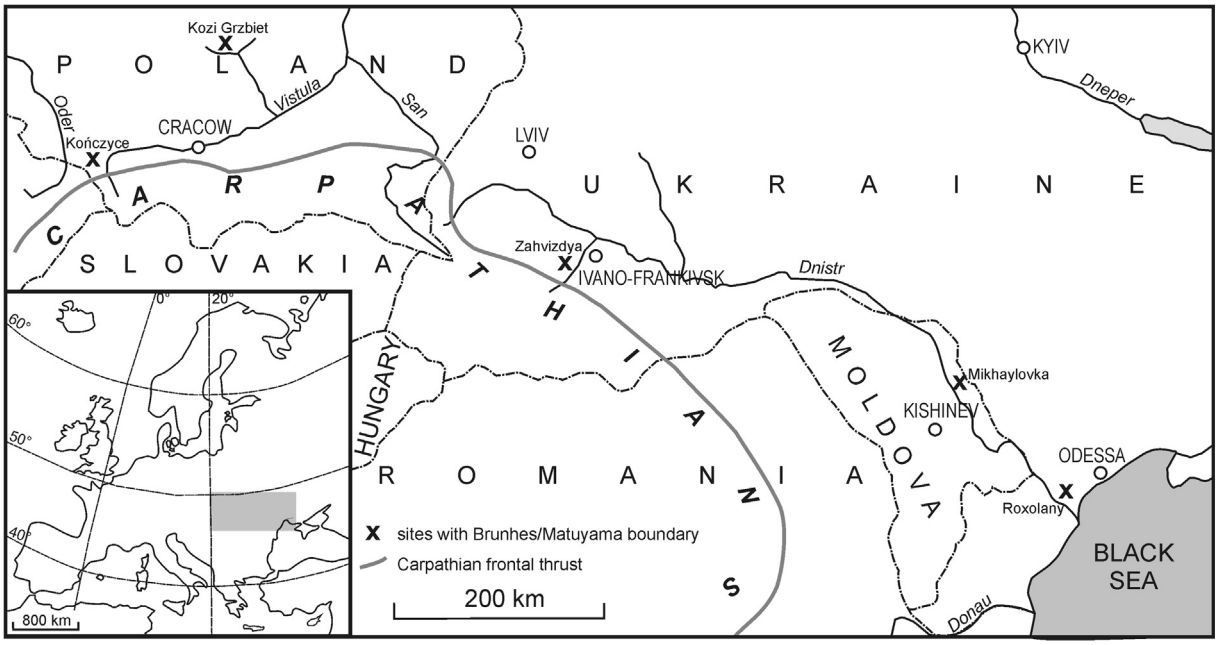

Fig. 1. Location sketch of northern foreland of the Carpathians with sites in which the Brunhes/Matuyama boundary was determined.

2. Key sites in northern foreland of the Carpathians

Three sites were selected as the most representative for the study area (Fig. 2). They were located in interfluves of Oder-Vistula (Kończyce site) and Vistula-San (Łowisko site) in Poland, and San-Dnistr (Krukienichi site) in Ukraine. Lithological logs from these sites comprised not only fluvial deposits but also interglacial organic series of late Early and early Middle Pleistocene. Therefore, they constructed a framework to establish chronology and paleogeography of river drainage in the northern foreland of the Carpathians.

2.1. Key site Kończyce

The exposure was located in the interfluves of Oder and Vistula (Fig. 2; cf. Wójcik et al., 2004). The sequence started with gravel of the lower fluvial series, containing mostly pebbles of the Carpathian sandstones that have been transported northwards from the mountains (Fig. 3). This series passed upwards into glacial deposits, composed of two beds of glaciofluvial gravel and sand, locally separated with a till of the Nidanian Glaciation (Fig. 5; cf. Lindner et al., 2013). These beds of glaciofluvial deposits were separated by organic silt, with an erosive discontinuity at the top. The silt comprised a fragmentary bimodal interglacial pollen succession (Fig. 4). The lower part started with open vegetation, but passed upwards into birch-pine forest and then into a characteristic deciduous forest phase with alder, hornbeam and hazel, followed by pine and open vegetation. The upper part of the interglacial sequence had pine and alder at the bottom, followed by a deciduous forest with alder, hornbeam and hazel, then with increasing participation of open vegetation but accompanied by pine and birch. The interglacial sequence was correlated by Wójcik et al. (2004) with the first Cromerian interglacial. Later, its stratigraphic setting was reconsidered and connected with the Augustovian pollen succession, located in the older part of the Podlasian Interglacial (cf. Lindner et al., 2013).

The organic silt was overlain by gravels ('mixed gravels') of a braided facies of the upper fluvial series. The latter was composed of pebbles of Carpathian sandstones with a small admixture of Scandinavian crystalline rocks. Separated by an erosive discontinuity, these fluvial deposits were overlain by the upper series with silt and organic silt, the pollen spectrum of which was typical for the Ferdynandovian Interglacial (Wójcik et al., 2004; cf.; Lindner et al., 2013). Loess-soil complexes capped the Kończyce sequence.

Paleomagnetic examination of Kończyce indicated distinct duality in curves of declination and inclination (Fig. 4; Wójcik et al., 2004). The loess-soil complex and the underlying organic-silt with peat had declination close to 0° and inclination around 60°, suggesting a record of the Brunhes chron. Reversed direction of the magnetic field, preserved in organic silt and sandy silt at depth below 14.0 m, seem to indicate its probable correlation with the Matuyama chron.

Based on the opinion of Wójcik et al. (2004) who cited suggestions of Nowaczyk et al. (1994), a considerable thickness of deposits with normal paleomagnetic record, seemed to exclude its connection with any short paleomagnetic event. Curves of declination and inclination in the Kończyce section resembled a record of the Brunhes/Matuyama boundary in cave sediments at Kozi Grzbiet in the Holy Cross Mts (cf. Głazek et al., 1977) and in loesses at Zahvizdya in the Upper Dnistr drainage basin (Fig. 1; Nawrocki et al., 2002). This boundary was set at 780 ka (778 ± 2.5 ka after Tauxe et al., 1996), within MIS 19 in deep-sea sediments, during which interglacial conditions prevailed (Bassinot et al., 1994).

2.2. Key site Łowisko

The site was located in the Kolbuszowa Upland, in the interfluves of Vistula and San rivers (Fig. 2; Stuchlik and Wójcik, 2001). In a research borehole (Fig. 6), the Miocene dark gray marine clays were overlain by sand and gravel (5.5 m thick) with pebbles of Carpathian sandstones, quartz, and chert. Lack of Scandinavian material, also among heavy minerals in sand, suggested that fluvial deposition occurred presumably prior to the Nidanian Glaciation (Gozhik et al., 2012), the first glaciation in this area (cf. Laskowska-Wysoczańska, 1971; Starkel, 1971, 1984).

Fluvial gravel and sand were overlain by silt and organic mud, pollen spectrum of which (Fig. 6) indicated a deciduous forest (LPAZ Łow1) at the beginning, composed of alder wood in wet habitats,