



Contents lists available at ScienceDirect

Quaternary International

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

Revised limit of the Saalian ice sheet in central Europe

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ARTICLE INFO

Article history:

Available online xxx

Keywords:

Saalian
Ice sheet limit
Holsteinian Interglacial
Central Europe
Neotectonic uplifting
Dnieper lobe

ABSTRACT

Geological investigations in the southern part of the Polish-Belarusian cross-border area were focused on correlation of main Middle Pleistocene stratigraphic units and on extent of the ice sheet of the Saalian Glaciation. Determination of regional stratotype horizons, establishing new key sites and sections of regional significance for Central Europe were based mostly on vegetation and paleoclimate changes recorded in glacial and interglacial lake deposits. Results of stratigraphical investigations abolished a predominant palaeogeographic image on ice sheet limits in this area. The Saalian maximum ice sheet limit was similar or even less extensive than during the subordinate Warta Stadial. Most of the area between the Middle Vistula in Poland and the Middle Dnieper in Belarus and the Ukraine was ice-free during this glaciation. On the other hand, immense glacial lobes during Saalian in the Middle Vistula and the Middle Dnieper valleys have not advanced presumably in the same time and were fed by ice moving from different parts of Scandinavia. Diversified Pleistocene tectonic uplifting in the area influenced much dynamics of the penultimate ice sheet in this part of Europe.

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1. Introduction

A cross-border correlation of stratigraphical regional subdivisions and of Middle Pleistocene ice sheet limits is among main items in Quaternary studies of Central Europe (cf. Ehlers et al., 2011). Varied methodological approach and research tradition in neighbouring countries as well as restricted access to full set of references and archival data from the other country has favoured construction of local stratigraphical schemes and many a time not enough attention was paid to results of investigations in the neighboring areas. From this point of view, the border area of Poland and Belarus has not been an exception. Previous attempts of cross-border correlation of geological units of the Quaternary and

of glacial limits have been based mainly on arbitrary and controversial adjustments (e.g. Mojski, 1972; Matveyev and Pavlovskaya, 2001). The first step in reliable correlation of ice sheet limits and stratigraphy in Poland and Belarus, based on complex field and laboratory examination was done in the northern part of the cross-border area (Marks and Karabanov, 2011; Marks, 2012).

Recent geological studies in the southern part of the Polish-Belarusian cross-border area (Fig. 1) focused on correlation of main stratigraphic units of the Middle Pleistocene of Poland and Belarus and on limit of the Odranian/Pripyatian Glaciation (Saalian). A principal task comprised determination of regional stratotype horizons of the Middle Pleistocene, establishing new key sites and sections of regional significance for Central Europe and was based mostly on vegetation and paleoclimate changes recorded particularly in lacustrine and fluvial deposits of Mazovian/Alexandrian (Holsteinian) and Eemian/Muravian interglacials (Fig. 2; cf. Kalnina et al., 2000; Marks, 2005; Szymanek, 2011; Hrynowiecka and Winter, 2016).

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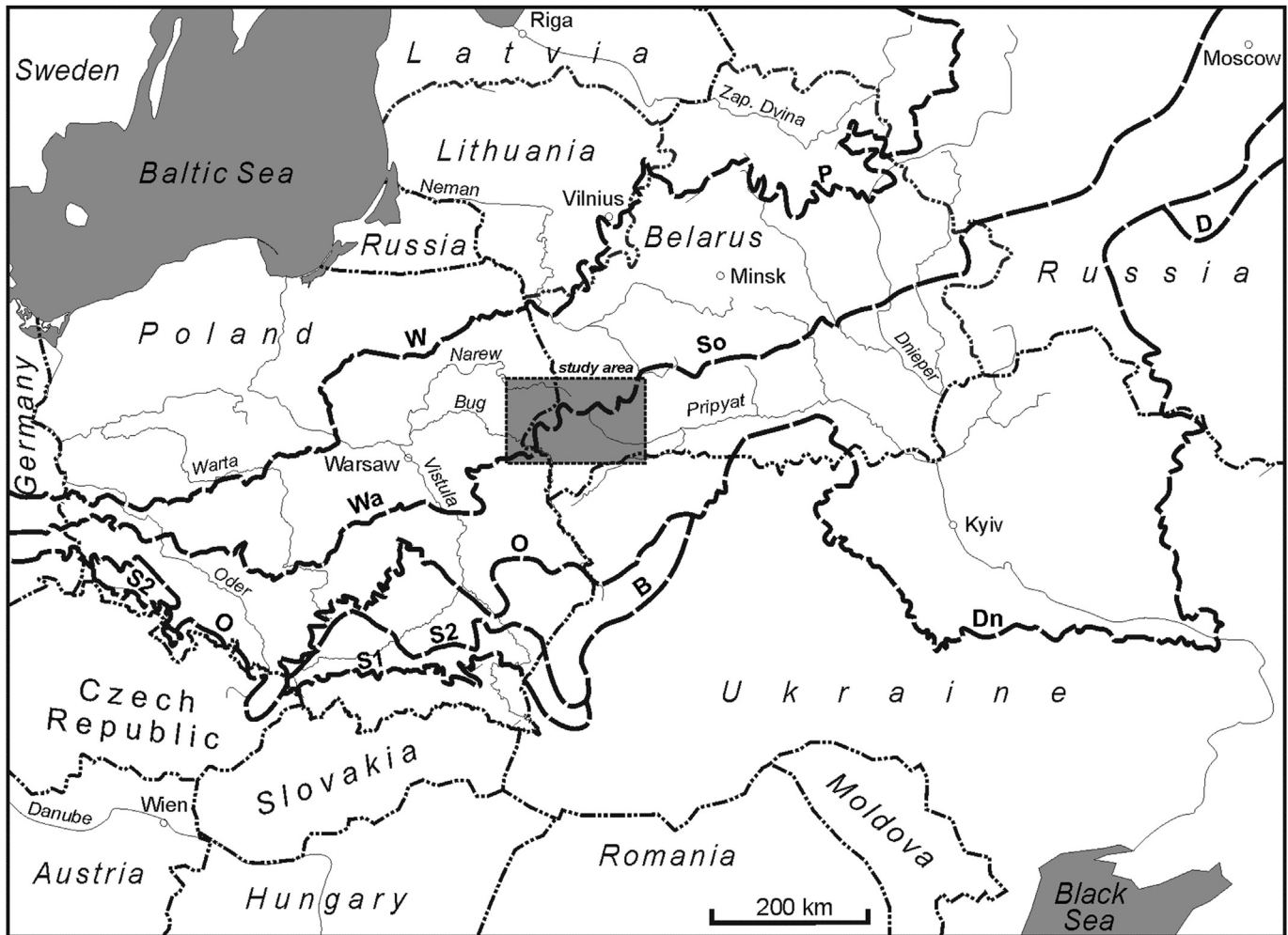


Fig. 1. Location sketch with traditional limits of the Scandinavian ice sheet in central and eastern Europe. Limits of glaciations at a land surface: D – Donian; S1 – Saanian 1, S2 – Saanian 2, B – Berezinian, O – Odranian, Dn – Dnieperian, Wa – Warta Stadial, So – Sozh Stadial, W – Weichselian (Vistulian), P – Poozierian.

A limit of the Saalian Glaciation in Europe was determined, based on occurrence of glaciomarginal features and Scandinavian erratics (cf. Ehlers et al., 2011). In the Netherlands, Germany and western Poland the Saalian Glaciation demarcated the outermost extension of the Scandinavian ice sheet during the Pleistocene (cf. Fig. 1). To the east of the Upper Oder River valley this glaciation was generally less extensive than the preceding ones (Elsterian, Donian and their equivalents). The only exception was the Lower Dnieper River valley, occupied during the Saalian by a large glacial lobe that advanced about 200 km more southwards than any ice sheet of the other Scandinavian glaciations in this region (cf. Ehlers et al., 2013).

The Saalian Glaciation is named the Odranian one in Poland (Fig. 2) and is represented by two stadials, the older Odra Stadial and the younger Warta Stadial, both correlated with the Marine Isotope Stage 6 (MIS 6; cf. Lindner et al., 2013). This glaciation corresponds with the Pripjatian one in Belarus, subdivided into the older Dnieper Stadial and the younger Sozh Stadial (Karabanov and Matveyev, 2011). In the Ukraine and in Russia it is the Dnieperian Glaciation, with its older, Dnieper stadial only (cf. van Kolfshoten and Gerasimenko, 2006; Gozhik et al., 2012).

The aim of this paper is to present the Saalian ice sheet limit in the Polish-Belarusian cross-border area, based principally on correlation of interglacial and glacial deposits in this area.

2. Limit of the Saalian Glaciation in central Europe

A history of delimitation of the penultimate Pleistocene glaciation in Europe has been started at the beginning of the 20th century. Keilhack (1911) named it the Saalian after the Saale River in Germany and this name has been commonly used since 1920s. In Poland, Sawicki (1922) treated maximum extension of the so-called 'Middle-Polish end moraine' as a limit of this glaciation what at that time was connected with the L4 Glaciation in western Europe (cf. Limanowski, 1922).

A limit of the corresponding Odranian Glaciation was indicated in western Poland along the northern edge of the Sudetes and to the east, it was connected with a distinct glacial lobe entering the Czech territory through the Moravian Gate (Fig. 1). In the Vistula drainage basin, the ice sheet reached northern slopes of the South Polish Uplands, moving through the gap of the Middle Vistula valley into the northern part of the Sandomierz Basin (cf. Lindner and Marks, 1999; Marks, 2004a, 2011; Marks et al., 2006). During the maximum extension of this ice sheet its meltwaters were drained eastwards along the so-called sub-Carpathian ice marginal streamway in southeastern Poland and then southeastwards along the Dniester valley in western Ukraine and in Moldova to the Black Sea (cf. Lindner and Marks, 2013, 2015). It was found obvious that the ice sheet limit in eastern Poland was highly

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