

Main advance directions and maximum extent of Elsterian ice sheet in the eastern part of the Šluknov Hilly Land, Northern Bohemia, Czechia

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Abstract. During the geological mapping of Quaternary sediments in the eastern part of the Šluknov Spur nordic erratics have been recorded on places, where they were not found before. Only indicator erratics have been taken into consideration for the reconstruction of main advance directions and maximum extent of a continental ice sheet within the study area. Nordic indicators are scattered about the flat interfluvies and on upper sideslopes of valleys (at altitudes 350-450 m a.s.l.) as a result of being left there as the remnants of a former basal till. That the ice sheet crossed over the flat interfluvies NE of Šluknov was confirmed by records of these indicators.

Keywords: Nordic erratics, Elsterian ice sheet, Middle Pleistocene, Northern Bohemia, Czechia

Introduction

Much progress has been made in order to determinate the position of the maximum extent of the Pleistocene ice sheets in the marginal zone of central Europe, but there are still many places where the position of that line is uncertain, as in the Šluknov Hilly Land (Nývlt 1998). This is due to the removal of large volumes of glacial sediments by subsequent, mainly fluvial, erosion. The Šluknov Hilly Land lies in the westernmost part of the Sudeten Mountain System, and represents the northernmost spur of Czechia. Glacial deposits within the Šluknov Spur have not been studied in detail so far. It is believed that the ice sheet reached this area only once, and that these remained glacial sediments are of early Elsterian age (Grahmann 1933, Šibrava 1967, Eissmann 1975, 1997, Wolf and Schubert 1992, Nývlt 1998). However, the exact stratigraphic position of these sediments is due to the absence of any radiometric dating, and to the impossibility of a direct morphostratigraphical correlation with fluvial terrace system still open to debate.

In the last years new geological mapping at a scale of 1:10,000 for the Basic Geological Map of Czechia in 1:25,000 scale of the area of study has been undertaken by geologists of the Czech Geological Survey. The mapping of the whole Šluknov Spur began in 1998 and it is planned that it will be completed in 2001. The mapping of Quaternary deposits will also be focussed on the reconstruction of the maximum extent of the Elsterian ice sheet within the Šluknov Hilly Land. Final results will be presented as a GIS map, which will be one of the layers of the entire GIS system of Czechia.

The surface mapping took advantage especially of fresh-ploughed fields, mowed meadows and mole-hills. Only indicators, such as Baltic flints, Dala porphyries,

Smíland granites, Lland porphyries and granitoids, have been marked on the map. These rocks place mainly relics of a basal till at positions, where the subsequent impact of fluvial erosion was insufficient to remove larger clasts. Finer matrix has usually been removed. Nevertheless tills were not widely affected in some places and will be studied in detail later.

Historical background

Hibsch (1896) described the reach of the ice sheet to Varnsdorf, to a maximum altitude of ~ 475 m a.s.l., which is considerably higher than it was believed by more recent authors. Nearly the same extent was presented by Šibrava (1967), unfortunately the Šluknov Spur was in a rather peripheral position in his work. The first detailed stratigraphy of glacial sediments within the wider area was established by Grahmann (1933). He suggested these accumulations in the lower parts (below ~ 420 m a.s.l.) of the Šluknov Spur were of Early Elsterian age. This opinion was also adopted by other authors such as by Fusán et al. (1967), Šibrava (1967), Eissmann (1975, 1997), and by Wolf and Schubert (1992). According to these authors the extent of the glaciation in the Šluknov Spur was limited to the area below ~ 420-450 m a.s.l.

The Geological Map of Czechia at a scale 1:50,000; sheet 02-22 Varnsdorf (Opletal et al. 1996) shows tills and glaciofluvial sediments in the southeastern and eastern part of the Šluknov Spur near Varnsdorf, Rumburk and Jiříkov, but the maximum extent of the ice sheet was not presented in this map. No glacial sediments are drawn in the northern part of this map in the surroundings of Šluknov, which were demonstrated by Šibrava (1967). For comparison of previous ideas on the maximum ice sheet extent see fig. 1.



Fig.1 The maximum extent of the Elsterian glaciation in the Šluknov Spur.

Results

During the mapping of Quaternary deposits at a scale of 1:10,000 on sheets Šluknov 02-221, Jiříkov 02-222 and Varnsdorf 02-224 (scale 1:25,000), new occurrences of nordic rocks have been found. The extent of glacial sediments on the sheet Varnsdorf is almost equal to that presented on the map in 1:50,000 scale (Opletal et al. 1996), the till remnants occur on sideslopes of the Mandava River in the surrounding of Varnsdorf. The results of a new mapping of Quaternary sediments by the author suggest, on the other hand, a larger glaciated region in the northern part of the spur (especially NE of Šluknov), than was indicated on the 1:50,000 map (Opletal et al. 1996), which is in good agreement with Šibrava's (1967) attempt. From the viewpoint of general geomorphology and with respect to the regional distribution of the erratics, it is possible to consider some hills (e. g. Jitrovník and Špičák) as nunataks.

Most occurrences of nordic indicators (Fig. 2) are scattered about the flat interfluvies and on upper sideslopes of valleys N and E of Šluknov as a result of being left there as the remnants of a former basal till. The highest place bearing traces of nordic material is a hilltop

(50°59.682' N, 14°31.833' E) near the road Šluknov-Jiříkov at an altitude of 450 m a.s.l. The occurrence of glacial deposits as high as 475 m a.s.l. (Hibsch 1896) cannot be confirmed. On the other hand, during the gas-main construction in 1998, sands and gravels with Baltic flints and nordic porphyries were exposed at the bottom of the Lesní Brook, SE of Šluknov (M. Opletal, pers. comm., April 2000). These glaciofluvial sediments are overlain by fluvial and colluvial deposits.

Glaciofluvial sands and gravels up to 10-15 m thick (proved by boreholes) in the northern part of the "Fukov Spur" are excavated near the Spree River. The sequence consists of two main sets of facies, the first one is horizontally more limited and is dominated by massive and trough cross-bedded sands and gravels partly of nordic origin (Fig. 3a), with the cross-bedding filling up shallow channels. In some parts the sand beds are horizontally or subhorizontally stratified. The second facies set is characterised by the sheet-like appearance of the majority of beds. Another obvious feature is absolute prevalence of well-sorted sands which is responsible for the uniform character of these mainly subhorizontal to horizontal and planar facies (Fig. 3b). Some sands are massive with no significant bedding. The sand and gravel sequence repre-

Fig. 2 Baltic flint (the orange clast top right of a lens cover) on the top of a mole-hill, lens cover ~ 60 mm (for the position of this find see Fig. 4).
Photo by D. Nývlt.



Fig. 3 Glaciofluvial sands and gravels from the "Fukov" sand pit, lens cover ~ 60 mm (for the position of sand pit see Fig. 4).
a: massive sands and gravels with rounded nordic clasts; b: sheet-like sand facies.
Photos by D. Nývlt.

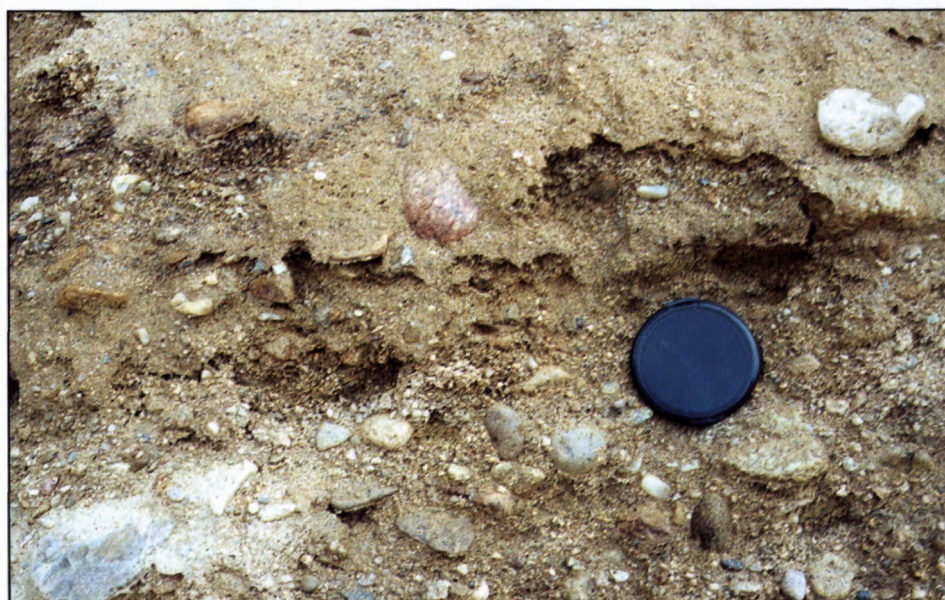
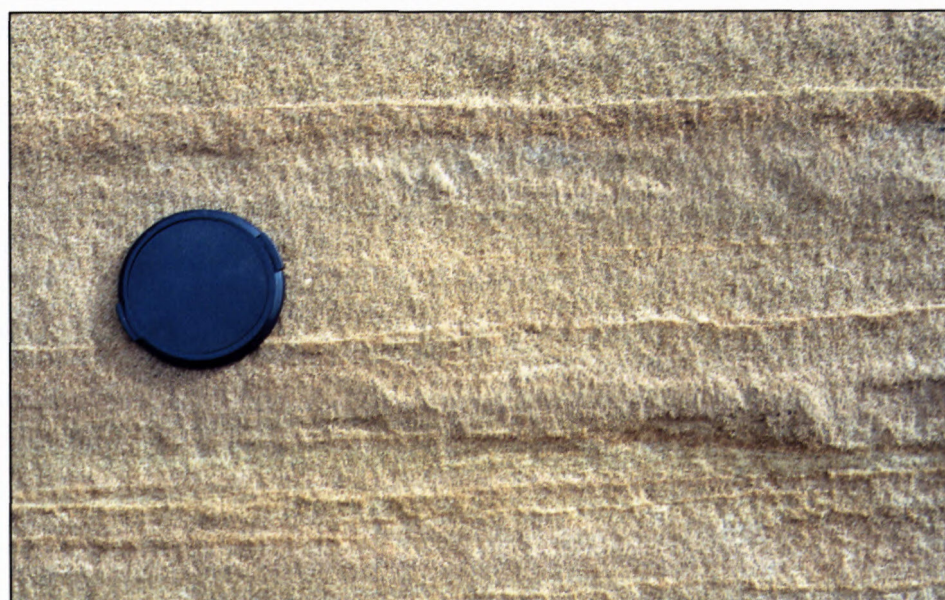


Fig. 3b



sents a typical wide intermediate reach of a sandur, documenting the aggradation and then abandonment of channels during the glacier melting, changing with longer periods of sheetfloods with a lower drift energy of the stream.

Discussion and Conclusions

The highland relief and the marginal position of the Šluknov Hilly Land with respect to the Elsterian ice sheet enable us to study phenomena which were not pre-



Fig. 4 The main advance directions and maximum extent of Elsterian ice sheet in the eastern part of Šluknov Spur with finds of nordic indicators. Dashed line denotes uncertainty

served/are overlain by younger sediments in the lowlands of Germany and Poland; it is therefore very useful for the understanding of processes associated with the margin of continental glacier in a wider context. We can accept the outline of Šibrava (1967) as a very successful attempt to reconstruct maximum extent of the continental glacier in the northern part of the studied area, even he was focussed on the study of more eastward situated region. The other authors (Eissmann 1975, 1997, Wolf and Schubert 1992) did not reason about the ice sheet crossing over the flat interfluvies N and NE of Šluknov (~ 385-400 m a.s.l.) and penetrating into the valley of Rožanský Brook and its tributaries, such as Lesní Brook (see above). This was confirmed by the author, who records the nordic indicators scattered about the interfluvies and upper sideslopes of river valleys in altitudes 350-450 m a.s.l.

The distribution of nordic indicators in the eastern part of the Šluknov Spur has been used to reconstruct the main advance directions and maximum extent of Elsterian ice sheet on the map in the 1: 50.000 scale (Fig. 4). Furthermore, the position of the maximum ice sheet extent is essential for the preparation of GIS database and maps (not only for the project of the GAGE workgroup about glaciotectionic phenomena in central Europe). The study of the distribution of ice-transported indicators will follow until the next year, when the mapping of the whole Šluknov Spur should be completed.

The stratigraphic classification of these sediment remnants cannot be confirmed or challenged, therefore the Early Elsterian stratigraphic position of these accumulation proposed by Grahmann (1933) and followed by Šibrava (1967), Eissmann (1975, 1997), Wolf and Schubert (1992) and Nývlt (1998) remains still valid. However, the stratigraphic revision is required. As one possibility, the indicator statistics could be mentioned, because there is no possibility for a direct morphostrati-

tigraphic correlation with fluvial terrace system. Beside this, it exposes that a new mapping of glacial sediments in adjoining parts of Germany and a detail sedimentary research of described tills and till remnants will be very useful.

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