Environmental causes and geomorphic record of Early Medieval colonization: South-Western margin of the Rybnik Plateau and the neighbouring Odra valley

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Downstream of the Ostrava Basin, the Odra valley dissects a zone of loess plateaus – the Głubczyce and Rybnik Plateaus. The traces of human activity from the Early Medieval are recorded here as the natural levee and also alluvial fans at the Rybnik Plateau slope. In the Odra valley floor pronounced traces of palaeomeanders have been preserved. They are filled with fine-grained alluvia interbedded with organic layers, dated between 4,410±70 years BP and 3,250±70 years BP. The Odra channel is accompanied by a natural levee, 1 to 1.5 metres high and covering the palaeomeanders. On its flat summit, which was inundated only during catastrophic floods, human settlements existed at least as since the 12th or 13th century. The SW slope of the Rybnik Plateau is dissected by deep valleys. At their mouths to the Odra valley, alluvial fans have partly covered the Odra palaeochannels. Prograding alluvial fans interrupted the accumulation of organic matter. Radiocarbon dates for the top layers of those organic deposits are very similar: 1,390±80 years BP (cal 1σ 540-700 AD) and 1,430±70 years BP (cal 1σ 540-670 AD). This indicates that erosion within the catchments dissecting the margin of the Rybnik Plateau, settle by Slav tribes, intensified after the Migration Period.

Key worlds: Odra alluvial plain, palaeochannels, natural levee, alluvial fan, Slavs.

1 Introduction

The upper Odra valley breaks through from the Ostrava Basin in the south to the Koźle Plain in the north passing between the Głubczyce Plateau and the Rybnik Plateau. This valley has an average width from 3 to 4 km. The 30-kilometre-long north-western slope of the Rybnik Plateau forms a zone 3 to 5 kilometres wide (**Fig. 1**). The slope of the Plateau is dissected by the valleys of the Odra tributaries. Their valley heads are dissected by a network of deep, inactive gullies with significant gradients which are incised into the edge of the summit area in many places. The dissected margin of the Plateau, with a relative height of 85 to 115 metres, has an average gradient of 20 to 30 m/km.

This region, with an area of approximately 120 square kilometres, offered a hospitable environment for primitive farmers and herders: a dense stream network and favourable topoclimatic conditions, the prevalent "warm" slopes exposition were situated high enough not to be affected by winter and spring temperature inversions and frost pockets. In the neighbouring Odra valley, hunting and fishing grounds could be found. Archaeological sources however indicate only scant traces of prehistoric colonisation in the Odra Valley mainly in the lower reach of the Suminka stream (KULCZYCKA-LECIEJEWICZOWA 1993), in contrast to the situation on the Głubczyce Plateau (KLIMEK 2002 and 2003, ZYGMUNT 2004). There are more pronounced traces and sites of early medieval settlement related to the influx of Slavic tribes from the 6th century AD (KACZANOWSKI and KOZŁOWSKI 1998, FOŁTYN 1998). The largest of these settlements was the stronghold at Lubomia, which has been dated to betwe-

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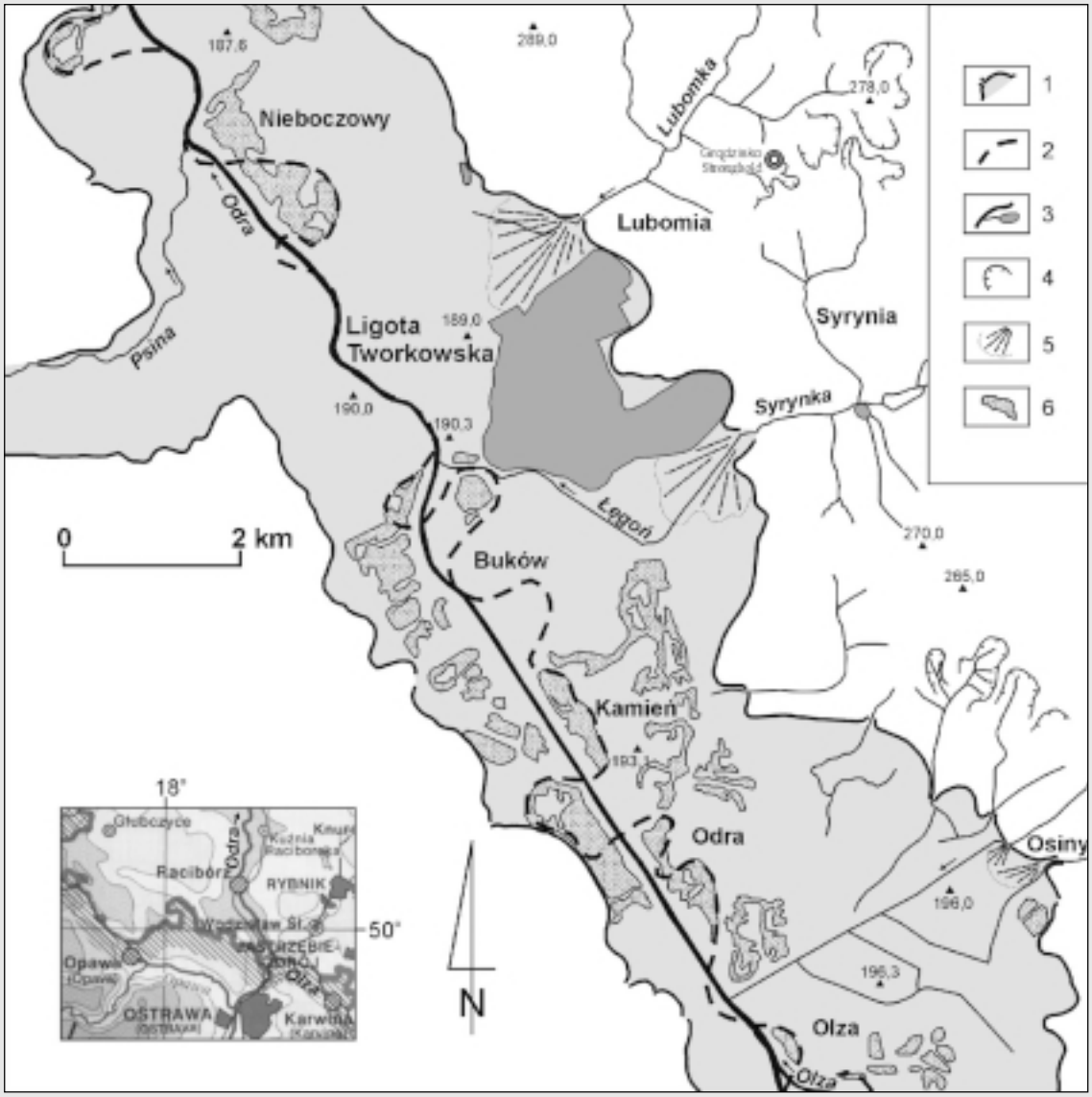

Fig. 1 Main relief features of the Odra valley & SW margin of Rybnik Plateau: 1 – Valley floor, 2 – The Odra course at the beginning of the 19th century, 3 – Present-day Odra course and its tributaries, ponds, 4 – Main valley heads within the Rybnik Plateau, 5 – Alluvial fans, 5 – Sand & gravel pits.

en the 7th and 9th centuries AD (SZYDŁOWSKI and PIERZYNA 1970).

This region is an example of human activity accelerating or modifying environmental processes. This paper aims to examine questions concerning the time during which early medieval colonisation initiated the soil erosion process within the Plateau slope and the transfer and redeposition of sediment in the neighbouring Odra valley floor as well as the degree to which it contributed to this process.

2 The alluvial plain of the Odra at the foot of the Rybnik Plateau

Downstream of the Ostrava Basin Odra drains a basin an area of 4,666 km^2 . Its mean discharge at the Chałupki gauge station is 64 m^3/sec. (Rocznik Hydrologiczny IMGW, DUBICKI et al. 1999). Here the maximum discharge is over 52 times higher than the average one and is the result of heavy precipitation in the mountainous areas of the river basin. This is caused by over-

lapping flood waves from the Carpathian (Ostravica, Olza) and Sudetian (Opava) tributaries of the Odra.

The present Odra valley floor, which lies in the "gorge"/narrowing between the two Plateaus, was formed at the end of the Vistulian/Last Glaciation and in the Holocene as a result of changes in the hydrological regime of the river, driven by climatic change, and – at least since the beginning of the historic era – by the direct or indirect human impact within the basin. The alluvial plain has a traces of old meandering channels on the Odra valley floor, which lies at 4 to 6 m above the average water level. These forms two distinct groups. The younger ones follow the present river channel (**Fig. 1**).

The youngest are usually filled with water and have radii ranging from 250 to 350 m. These cut-off channels were formed when the Odra channel was straightened and meanders bends were cut off, a process which was initiated in the second half of the 19th century (CZAJKA 2005). Slightly older meanders, which were cut off naturally a few centuries ago, have a similar curvature and are also clearly visible against the valley floor.

Sections of a flat natural levee, few kilometres long, follow the right bank of the Odra river. These are up to one kilometre wide, with a relative height 1-1,5 m above the valley floor (**Fig. 2**).

Settlements were located on the top of this levee at least from the mid 13th century. They started to appear in written sources slightly later (**Fig. 1**): Buków 1303, Kamień 1308, Lgota Tworkowska (?), Nieboczowy 1290, Odra 1264 (PANIC 1992). The location of these settlements indicates that the levee had already been deposited in this narrow section of the Odra valley, before the Early Medieval and that its summit was situated above the level of major floods at that time. The fact that the levee has been preserved points to the long-term horizontal stability of the Odra river channel upstream from Racibórz. Intensive supply of fine-grained deposits from the upper part of the Odra basin is evidenced by the alluvia forming the levee. These deposits came from the tributaries of the Odra, which dissected the slopes of the Moravian Gate, and from the tributaries of the Olza river, which drained the Ostrava Basin and its hilly margins (the Stonavka stream) as well as the southern slope of the Rybnik Plateau (the Piotrówka, the Szotkówka streams). As a result of the intensive mining of gravel during the last 50 years, numerous gravel pits have been formed in the valley floor, usually filled with water (**Fig. 1**), and the ox-bow lakes that had been cut off at an earlier time as well as the accompanying natural levees have largely been destroyed.

Further from the Odra river channel, the older part of the alluvial plain emerges from under the natural levee. It is up to 2 km wide and lies between the levee and the foot of the Rybnik Plateau (**Fig. 2**). Within this plain, distinct traces of the older generation of palaeomeanders have been preserved. These are particularly pronounced between Olza and Bełsznica as well as between Lgota Tworkowska and Lubomia (**Fig. 3**). These palaeomeanders have similar radii, ranging from 100 to 150 metres, i.e. two or three times smaller than the younger one. They are usually several tens of metres wide. Despite the similar curvature, in many places only fragments of their "older" sections can be seen since these have been destroyed by the fully developed "younger" ones. This indicates the long-term horizontal stability of the floodplain, within which a river with a stable hydrological regime migrated. This, in turn, indicates the long-term stability of the natural environment in the upper, mostly mountainous part of the basin.

The palaeomeanders are filled with fine-grained alluvia with organic interbeddings at various depths. Radiocarbon dates (3 datings) for these organic layers range from 4,410±70 BP to 3,250±70BP. This indicates that the mountainous section of the basin was in equilibrium before and

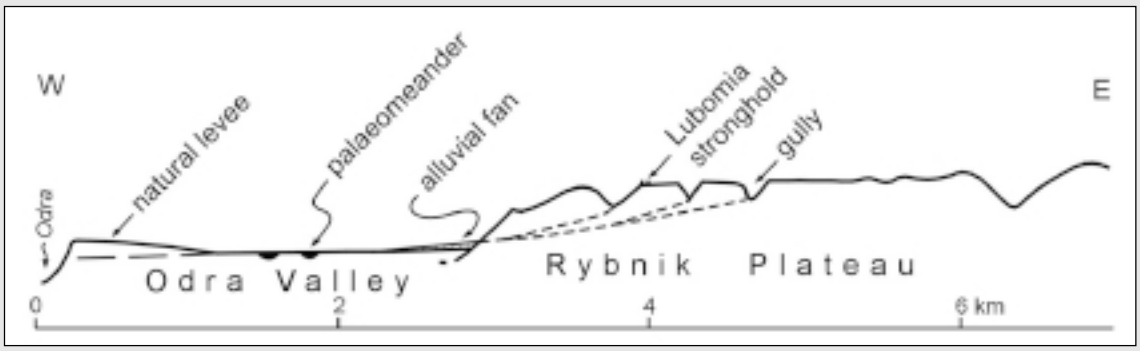

Fig. 2 The cross-profile of the Odra valley and SW slope of the Rybnik Plateau

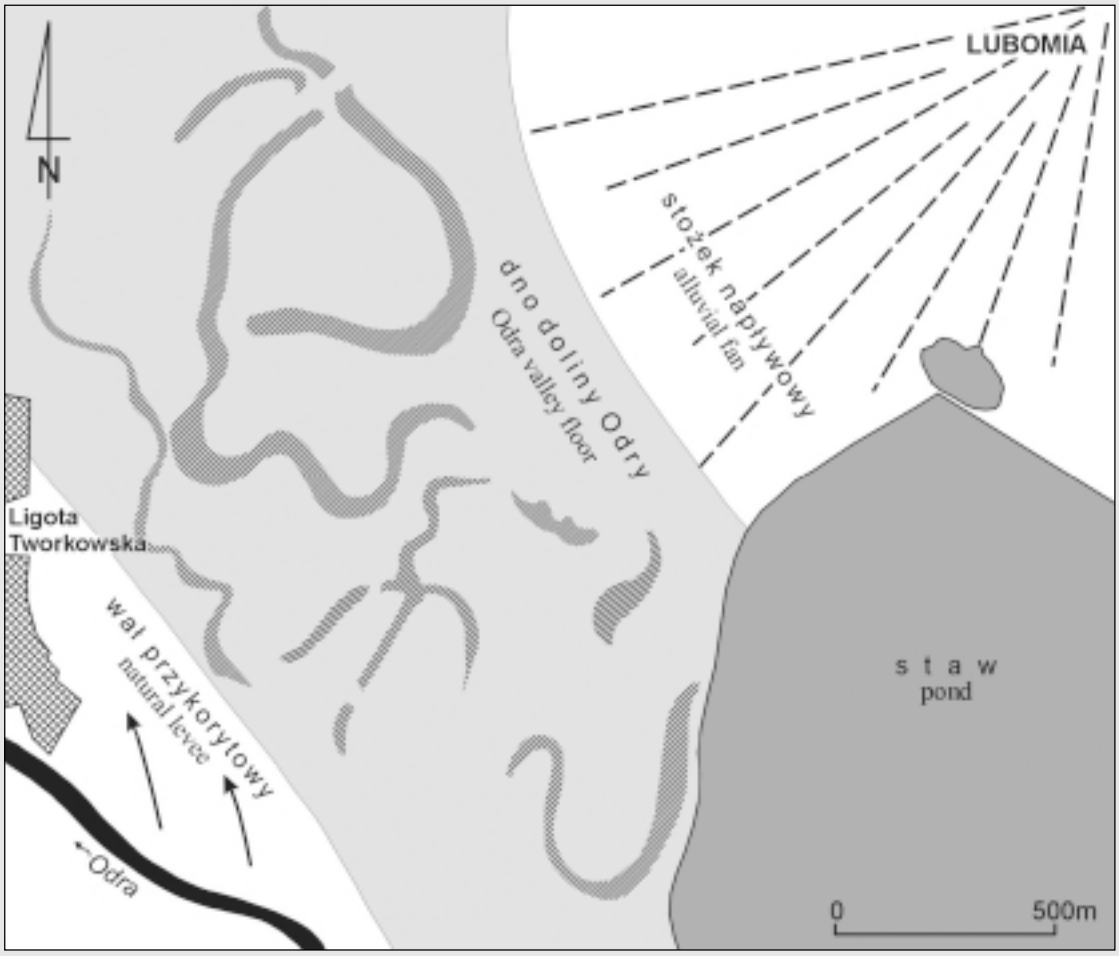

Fig. 3 The oldest palaeomeanders and natural levee of the Odra near Lgota Tworkówska.

during that period. Taking the organic interbedding dates as indicative of the time that has elapsed since the meanders were cut off and gradually filled in, it may be supposed that the Neolithic farming and herding communities that migrated north through the Moravian Gateway only minimally transformed the natural environment of the upper part of the Odra basin.

These palaeochannels exist under the deposits of alluvial fans lying at the foot of the Rybnik Plateau and situated at the mouths of the valleys that dissect it (**Fig.3**).

3 Alluvial fans at the foot of the Rybnik Plateau

The bedrock of the Quaternary deposits in the south-western part of the Rybnik Plateau consists mainly the silty-sandy sediments from the upper Miocene (Tortonian) (SARNACKA 1956). Their varied uppermost face is covered by Quaternary sands and gravels, and in the summit area by loess of several metres thick (DWUCET 1986). There are isolated patches of fluvioglacial sands below the summit area (SARNACKA 1956). Permanent streams can be found in valleys dissecting the slope of the Plateau, in the area where outcrops of underlying, predominantly silty Miocene deposits occurr. During the last Scandinavian glaciation/ Vistulian /Würm the region was in the periglacial climatic zone, around 250 km south from the ice sheet margin. Denudation processes and loess deposition smoothed the contrast of the former landforms.

The margin of the Plateau is dissected by valleys whose length ranges from 1.5 to 8 kilometres. Downstream of the Odra valley, alluvial fans at the mouths of the "Osiny," Syrynka and Lubomka streams can clearly be visible at the foot of the Plateau (**Fig. 1**). It may be supposed that during the Holocene, when the slopes of the Plateau were covered by forest, the intensity of the sediment transfer and redeposition processes was very slight. Limited, local soil erosion could only be in-

duced by prolonged frontal precipitation or spring thawing floods, when the deciduous forests overgrowing the slopes were without leaves. This would lead to sediment transfer and deposition at valley mouths in the form of alluvial fans. The significant sizes of valley heads in relation with relatively small alluvial fans indicate that the deposits from the early stage of this progradation were washed away by the Odra river (**Fig. 1**). This is confirmed by old arc-shaped Odra undercuts in the Plateau slope. As yet, no information is available concerning the age of these undercuts. Only in the lower reaches of the Odra valley, in Ligota upstream from Krapkowice, such arc-shaped undercuts of valley slopes have been radiocarbon dated and to be older than 6,420 years BP (ŚLESZYŃSKI 2006). Other, more straight sections of the Plateau margin as well as the alluvial fan at the mouth of the Lubomia stream, may be older.

Alluvial fans, which later prograded, have covered the Odra palaeochannels in several places and encroached on the alluvial plain, which means that they were deposited after the Odra channel had migrated towards the left valley side. Drilling the "root" sections of the fans indicates that they mainly consist of clays, with predominant sandy fractions (SITEK 2005). This indicates a relatively low water energy of flowing water in the lower sections of the streams dissecting the Plateau slope, caused by the low energy of the water flow and the prevalence of fine-grained soil cover in their catchments. It may be supposed that sedimentation proceeded evenly in the fan area and grass or bush communities colonised those sections of fan surface that were less active. In their distal part, the fans encroached on the waterlogged floor of the Odra valley, which sometimes contained organic infill. The probing of this part of the fans indicated that their progradation accelerated at some point. This is indicated by the slightly thicker fraction of deposited sediment encroaching on the areas where pools that were also filled with organic matter had been located.

At the mouth of the small 1.5 kilometre long "Osiny" stream, organic deposits were covered as a result of the fan changing the direction in which it prograded "to the left," perhaps as a result of vegetation growth in the "old" channel (**Fig. 4**). The uppermost layer of the organic deposits that has been found, located under 1.9 metre thick, silty-sandy fan deposits, was dated back to 1,390±80 years BP (cal.1σ 540–700 AD).

At the mouth more longer tributary stream reaching 9 km, the Syrynka, prograded alluvial fan overlapped the Odra palaeochannel and formed in its distal part three-fingers swell (**Fig. 5**).

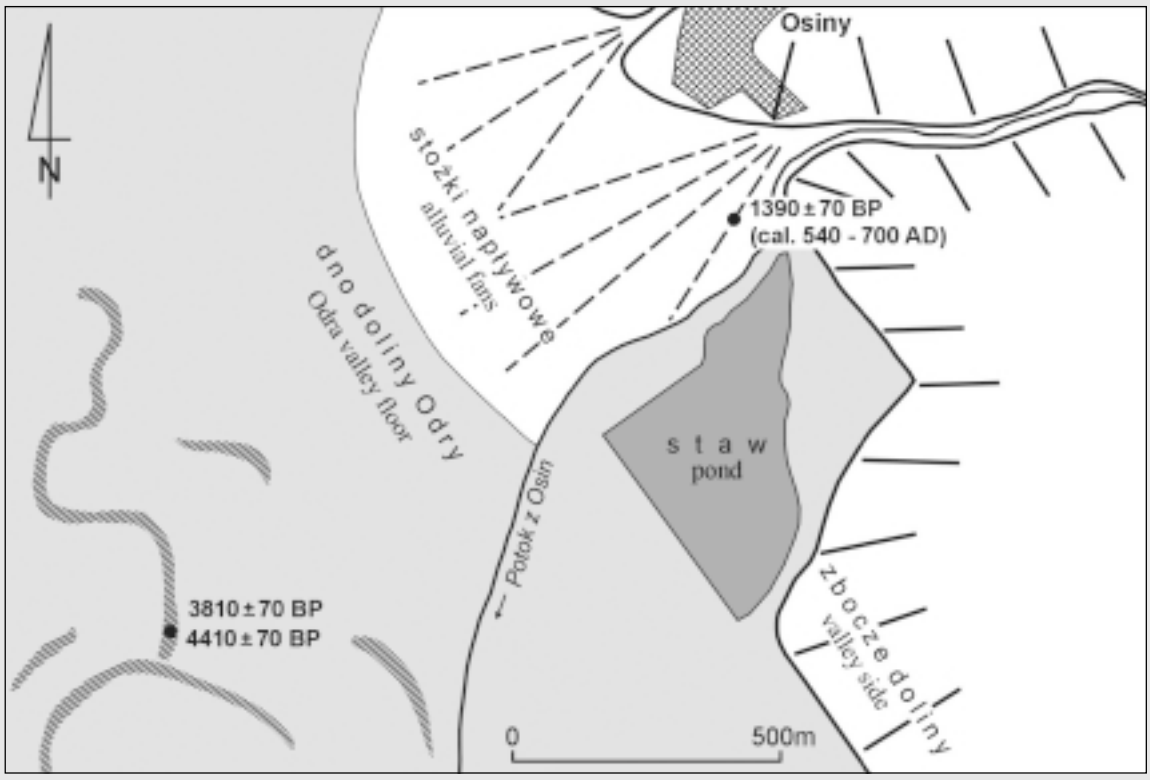

Fig. 4 The Odra palaeomeandrs and Osiny stream alluvial fan

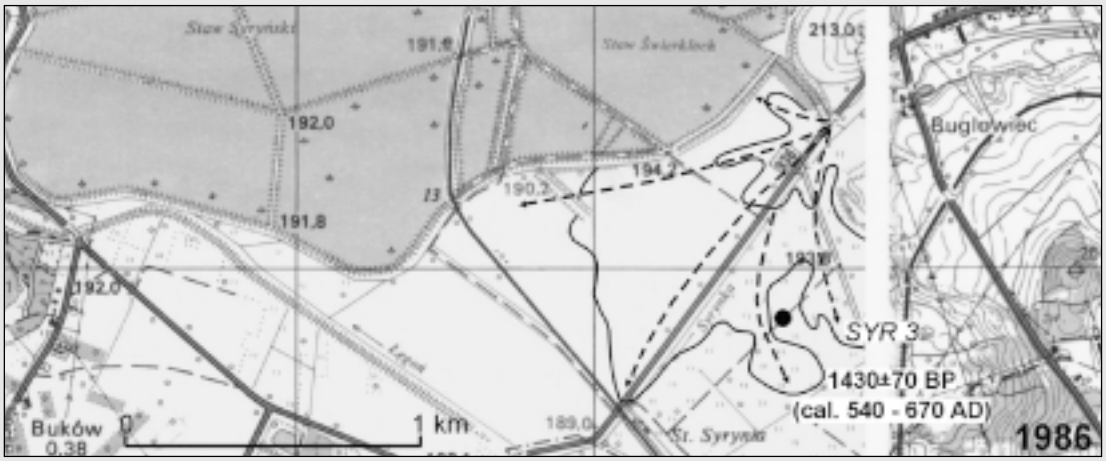

Fig. 5 The Syrynka stream alluvial fan

In the depression between these prongs (**Fig. 5**) organic silts with small charcoal pieces were found under a 0.5-metre-thick layer of coarse-grained sands. They were dated to 1,430±70 years BP (cal. 1σ 540–670 AD). Charcoal pieces point to forest fires within the stream catchment, probably caused by humans who had already penetrated the slope of the Plateau in the 6th and 7th century AD, perhaps to a greater extent than archaeological research has indicated to date. The coarse-grained sands covering the charcoal show that the energy of the stream grew, at least periodically. This could also have been the result of the loess cover dissection and erosion of the underlying sands. The increases in sediment transfer activity within the fans at the foot of the Plateau margin all occurred at the same time, despite the fact that the basins are situated a few kilometres from each other and their sizes differ (**Fig. 1**). It is highly probable that these events were caused by humans who colonised the Plateau slope.

The fan of the Lubomia stream (**Fig. 3**), which is probably older than those discussed above, is clearly visible against the foot of the Plateau slope. A sizeable stronghold is situated in the watershed zone between its source tributaries and the tributaries of the Syrynka stream. This was dated to between the 7th and 9th centuries AD based on archaeological sources (SZYDŁOWSKI and PIERZYNA 1970). According to the authors cited, this was a settlement of the Gołęszyce tribe, which was burned in the 9th century, probably as a result of Great Moravian incursions. The large fortified settlement, four hectares in area, was built on a flat section of the Plateau slope, at an altitude of around 280 m a. s. l., i.e. 70 metres above the Odra valley floor. This was an advantageous location from the point of view of access to water since streams flowed just below the settlement, as well as defence (wide ranging views, steep slopes), topoclimate (it was situated beyond the reach of fog and temperature inversions) and opportunities for farming or herding in the vicinity. In order to construct a double, 500-metre-long palisade as well as the 400-metre structure surrounding the part of the settlement outside the walls, more than 4,000 trees had to be felled, mostly oaks with a diameter of around 0.3 metres. The need to obtain construction materials and charcoal as well as to clear arable land and/or pastures for the people who lived in the two hamlets adjacent to the stronghold (FOŁTYN 1998) probably caused extensive deforestation around the settlement. In later centuries, clearance must have gradually spread to other sections of the Plateau, particularly after the establishment of the Opole Duchy (1202–1211) and the intensification of settlement combined with later economic growth. In the 12th and 13th centuries, several new settlements were founded in the area; these were later mentioned in written sources: Pszów 1265, Zawada 1294, Lubomia 1300, Rydułtowy ca. 1300, Syrynia 1303 (PANIC 1992). The depopulation of Western Europe caused by the plague pandemic of 1347–1350 led to economic decline in the areas affected. In Silesia, which escaped the epidemic, the "Magdeburg Charter" colonisation initiated in the 13th century by Henry the Bearded (1165–1238) (GALAS and GALAS 2001) contributed to a rapid rise in population. According to ŁADOGÓRSKI (1955), in the first quarter of the 14th century the population density along the eastern side of this section of the Odra valley reached 7 to 10 people per square kilometre. Given the low crop yields at that time, a family consisting of several people must have farmed one feud/łan (about 15 to 30 hectares) of land. Even the establishment of small hamlets consisting of a few homesteads resulted in the deforestation of the Plateau, which was dissected by deep valleys.

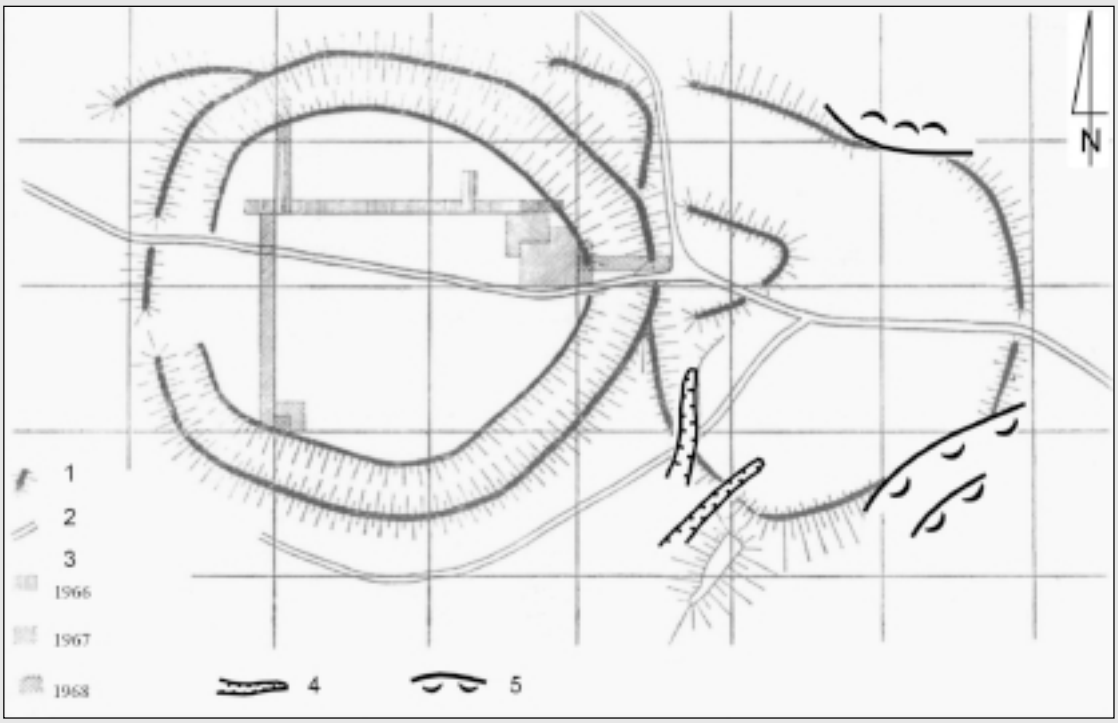

Fig. 6 Lubomia stronghold (according to SZYDŁOWSKI and PIERZYNA 1970): 1 –Stronghold walls, 2 – Routes, 3 – Years of archaeological excavations, 4 – Gullies, 5 – Landslides.

Deforestation, especially on the slopes prevailing in this area, initiated the wash of the soils and/or gully erosion, particularly during heavy frontal precipitation or short thunderstorms (RUTKOWSKI 1997). Summer thunderstorms, which occur here 150 times a year on average (Racibórz), and were even recorded up to 236 times in some years (BIELEC-BĄKOWSKA 2002), could dramatically increase the sheet flow locally, particularly on fields with winter or spring crops which prevailed during this period (FOŁTYN 1998). The streams that currently drain the Rybnik Plateau and whose partly forested basins are around 100 square kilometres in area (the Nacyna in Nędza or the Szostkówka in Gotkowice), increase their discharge 16 to 18 times compared to their average discharge (Rocznik Hydrologiczny IMGW, 1966–1975). Thus the aforementioned deforestation of certain Plateau slope areas facilitated the quick overland flow of water from the steep slopes of the valley heads along the growing gully network. The significant stream gradient, reaching over 50 m/km in some upper reaches, increased the water energy considerably. As a result, local knick points formed, which quickly "migrated" upstream, typical in loess plateaus dissected by valleys (RUTKOWSKI 1997). Such transformations of valleys that had been deforested earlier are confirmed by former rapids preserved on the valley floor and which have not been smoothed out. These knick points still sometimes re-emerge after heavy rains, despite the fact that the slopes have been covered by forests. Headward erosion caused the gullies to extend "upwards" of the valley heads and enabled new branch gullies to form. The intensity and duration of this process are evidenced by the incisions in the ramparts surrounding the outer part of the Lubomia stronghold (**Fig. 6**).

Gully erosion must have gradually rendered certain areas unfit for farming, particularly within the deeply dissected valley heads. This enabled the renewed succession of forest communities. The examination of sediments infilling the now forested and geomorphologically inactive gullies has shown that younger, fine-grained alluvia up to 2 metres thick with some sandy interbeddings can be found upon the sandy deposits forming the original bottom layer (SOWA 2006). This indicates the gradual reduction of slope erosion and diminished sediment transfer, which was caused by the exclusion of unsuitable land from farming. Charcoal pieces were also found in the youngest alluvia which were dated to 390±50 years BP (cal. 1560–1660) and the 18th century (250±60 years BP). Taxa typical of cereal weeds, root plants, ruderal vegetation and waterlogged areas have also been found there (SADY and SOWA 2006). This indicates that as recently as 200 to 300 years ago, the gully slopes were still not fully stabilised, and that

relict plants from old agricultural practices were still present.

The topography of the distal part of the Syrynka fan whose headwater area reaches as far as the southern forefield of the Lubomia stronghold indicates that the river channels dissecting it were active for several centuries. However, as the valley heads and gullies, which were unfit for farming, gradually became covered with forest, these channels dried out.

They have been preserved as narrow, winding depressions. As late as the first decades of the 19th century (URMEßTISCHBLATT 1825/27), the distal part of the Syrynka fan was dissected by a winding channel with bifurcated sections. Its meandering course was made more pronounced by tree thickets growing alongside the lower reach, called the "Lengon Graben." At the end of the 19th century (MEßTISCHBLATT 1884), the stream was transformed into a ditch consisting of straight sections; the course of the dry meandering channel is also marked on this map. As the Syrynka was straightened and became shorter, its channel incised more deeply, reaching two metres at the base of the fan.

4 Conclusions

The geomorphic and sedimentological record of events that occurred on the south-western slopes of the Rybnik Plateau and in the neighbouring Odra valley indicates that this area could have been colonised by Slav communities as early as the 6th or 7th century AD to a much greater extent than it is assumed based on the knowledge gleaned from the archaeological sites that have been examined to date. The warm period called the "Medieval Climate Optimum," which started at that time, and which has been acknowledged in Western Europe for several decades (GROVE 1988), but has not been confirmed by Polish researchers so far (KLIMEK 1997), could have contributed to that. It is also probable that farming receded from the watershed and source area of this part of the plateau slopes as a result of the climate becoming wetter and cooler; a process beginning in the 16th century or earlier.

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