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Geological peculiarities from the Konin Lignite Mine, central Poland: An overview

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Abstract

The 80th anniversary (1945–2025) of the Konin Lignite Mine (KLM) invites some summaries of the mine's characteristics. Therefore, the current study is devoted to rocks/sediments and tectonic or sedimentary structures that were observed and examined in lignite opencasts in the vicinity of the town of Konin. Some of them can be considered wonders and/or curiosities of nature, some are unique, and others are quite common. Hence, they were generally defined as geological peculiarities in this article. In stratigraphic order they are sandstones, cleats, crevasse splays, palaeochannels and palaeosols. They represent various lithostratigraphic units (formations and members) of the Neogene of central Poland, while their age ranges from the Early Miocene to the earliest Pliocene. Among the listed objects, quartzite sandstones (situated below and between the lignite beds) and palaeosols in the Poznań Clays are very common, known from other lignite opencasts in Poland. In the case of cleats and crevasse splays occurring within the lignite seam exploited by the KLM, they are among the most numerous and best developed of all lignite-bearing formations in the world. On the other hand, the presence of palaeochannels in fine-grained sediments, constituting the overburden of the exploited lignite seam, provides additional and convincing evidence for the fluvial origin of the Poznań Clays.

Key words: sandstones, cleats, crevasse splays, palaeochannels, palaeosols, Neogene

1. Introduction

The current study includes the following four opencasts belonging to the Konin Lignite Mine (KLM): Lubstów, Kazimierz N, Jóźwin IIB and Tomisławice. From mid-2023, only in the Tomisławice opencast, is lignite still being exploited (Fig. 1). However, in the last 2–3 years, its extraction there has been only about 0.5–0.9 mill. tonnes. Based on data from the KLM, it is estimated that lignite mining in the Konin region will ultimately end in 2026–2027 (Frydrychowicz et al., 2024; Kasztelewicz et al., 2025).

Over the years, lignite opencast mining has provided great opportunities for field research. Available for direct observation were primarily exploited lignite seams and overburden deposits several dozen metres thick. This is very important because most of the geological peculiarities characterised in this paper have not been identified by exploratory

Fig. 1. Location of the opencasts belonging to the Konin Lignite Mine (KLM) mentioned in the text. Note the years of lignite mining.

drilling. In other words, they would not have been discovered and explored if it were not for opencast mining of lignite.

The main aim of this study is to present some of the most interesting geological objects and structures that have been discovered in the opencasts of the KLM during its mining operations. The review nature of this paper means that the geological peculiarities studied are briefly described and interpreted. Detailed information about them can be found in the original studies cited in the text.

2. Geology of the study area

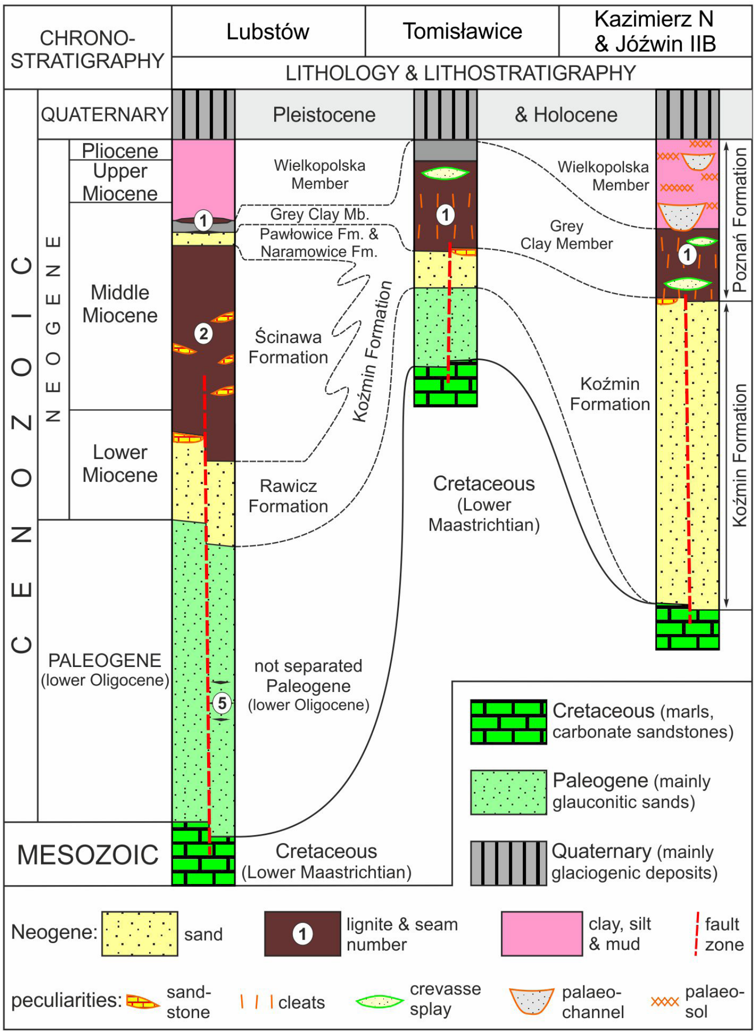
The lignite opencasts described in this article belong to the middle portion of the Szczecin-Miechów Synclinorium, namely to the Mogilno-Łódź Segment (Żelaźniewicz et al., 2011). To be more precise, they include the northern parts of the Konin Elevation (Widera, 1998, 2021). Three of them (i.e. Kazimierz N, Jóźwin IIB, Tomisławice opencasts) cover fault-bounded and relatively shallow graben-like structures that are up dozens of metres deep (Widera, 2007, 2022). Lignite is found in them and on their flanks; hence, the lignite deposits represent both epeirogenetic and tectonic genetic types. The exception is the Lubstów opencast, which is located in the area of the third deepest (up to >220–240 m) tectonic graben in the Polish Lowlands territory filled with productive lignite seams (Widera, 2021; Widera et al., 2024a). In this case, lignite occurs only in the graben; therefore, this deposit should be classified exclusively as a tectonic genetic type (Widera, 2016a).

In the area of all the opencasts, rocks of the Mesozoic were drilled. These are mainly marls and carbonate sandstones of Late Cretaceous age (Pożaryski, 1952; Dadlez et al., 2000). Then, in the deepest parts of the grabens, Paleogene sediments occur. They consist mainly of marine glauconitic sands of early Oligocene (Rupelian) age in the area of the Lubstów and Tomisławice opencasts. On the contrary, in the case of the neighbouring Kazimierz N and Jóźwin IIB opencasts, the Neogene rests directly on the Mesozoic top (Fig. 2).

The Neogene lithostratigraphy in the Lubstów opencast area differs significantly from that in the territories of the other characterised opencasts. This is due to the fact that in Lubstów, there is a very thick (up to 86.2 m) second Lusatian lignite seam (LLS-2), belonging to the Ścinawa Formation, which is missing in other opencasts in the Konin region (Fig. 2). The age of the LLS-2 ranges from the latest Early Miocene to the early Middle Miocene (Piwocki & Ziembińska-Tworzydło, 1997). However, in the Kazimierz N, Jóźwin IIB and Tomisławice opencasts, only the first Mid-Polish lignite seam (MPLS-1) is present. Lithostratigraphically, it belongs to the lower part of the Poznań Formation, called the Grey Clay Member. The MPLS-1 is up to several metres thick, on average about 6.6–6.9 m (Widera, 2021; Chomiak et al., 2024). Furthermore, in the study area, its age has been determined quite precisely at ~15.1–14.3 Ma (Widera et al., 2021a, b), i.e. the middle part of the Middle Miocene (Fig. 2).

The Wielkopolska Member (the upper part of the Poznań Formation) is also important for the described geological peculiarities. It was most fully developed (up to >30 m thick) in the Kazimierz N and Jóźwin IIB opencasts, where it consisted mainly of clays, silts and muds. However, among these fine-grained and multi-coloured sediments, deposits of palaeochannels and palaeosols were also found, which will be discussed below. The Neogene in each opencast is covered by 40–60 m of glaciogenic Quaternary sediments (Fig. 2).

Fig. 2. Simplified stratigraphy with approximate location of the studied peculiarities in the opencasts of the Konin Lignite Mine (KLM).



3. Material and methods

This paper is based mainly on materials from the former Lubstów, Kazimierz N and Jóźwin IIB opencasts, as well as from the still-operating Tomisławice opencast. In general, fieldwork covered the years in which lignite was mined in individual opencasts (see Fig. 1), but after 1995, i.e. for the last three decades. Then, all the investigated rocks/sediments and structures were identified, described and measured, and samples were taken for laboratory analyses. Other information, including the borehole data needed to prepare lithostratigraphic profiles (see Fig. 2), was obtained from the KLM archive.

The research methods used in the current study have been described in detail in original papers. Thus, the methodology for analysing quartzite sandstones is given in the article of Górniak et al. (1996). In the case of cleats, the methods of their investigation and the presentation of results were described, for example, by Laubach et al. (1998) and Widera (2014a, b). In turn, the crevasse splays and palaeochannels were subjected to basic sedimentological studies, including facies analysis (Miall, 2006; Boggs, 2012; Zieliński, 2014; Maciaszek et al., 2019; Widera et al., 2019; 2024b; Zieliński & Widera, 2020; Kędzior et al., 2021; and other references therein). Finally, for most of the Poznań Clays, interpreted in this study as palaeosols, in addition to sedimentological methods, mineralogical and nuclear ones were used (Klęsk et al., 2022, 2023; Klęsk, 2023).

4. Results

4.1. Lower to Mid-Miocene sandstones

Description. Quartzite sandstones were observed in all opencasts belonging to the KLM. They were located below exploited seams (LLS-2, MPLS-

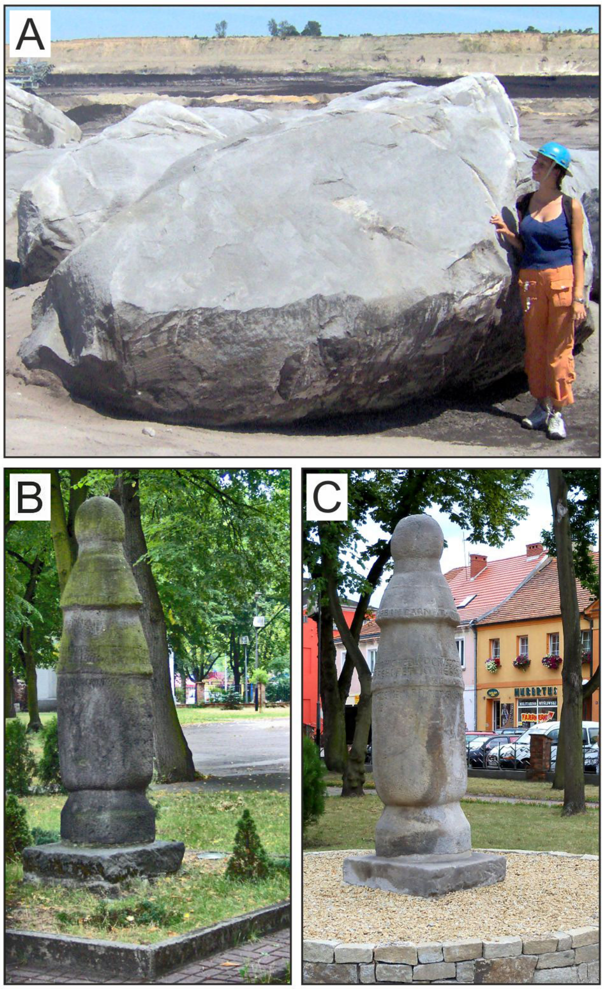


Fig. 3. Quartzite sandstones in the Konin region. **A –** Large sandstone bodies in the internal dump of the Lubstów lignite opencast, 2005; **B**, **C –** The Konin Pillar made of sandstone in 2008 and 2011, respectively.

1), their benches or layers (see Fig. 2), which were not always preserved in the rock record. In the latter case, this is indirectly proven by the presence of fossilised roots of peat-forming woody vegetation in the upper parts of the sandstones. These rocks were most common in the Lubstów opencast in the years 1990–2005, where they occurred on several levels and were characterised by the greatest thickness and lateral spread (see Górniak et al., 1996).

The largest sandstone bodies were available for observation in the mine walls of the Lubstów opencast, but mainly in its internal dump. Most of them had a volume of more than 5 m^3, while the largest sandstones had volumes even >20 m^3 (Fig. 3A). They cannot be compared to those from the Bełchatów Lignite Mine, where the volume of the largest lens of such sandstones was estimated at approx. 200,000 m^3 (Hycnar et al., 2022; Ratajczak et al., 2022). However, it is not the size but the significance of quartzite sandstones from the Konin vicinity for the history of lignite mining and geology in Poland that makes it worth devoting some attention to them once again.

Interpretation. Quartzite sandstones are known from all lignite deposits, including lignite opencasts in Poland. For example, those from the nearby Adamów Lignite Mine were definitely larger (>100 m^3) and better developed (Widera, 2007; Widera et al., 2022a). An interesting fact for the reader may be that the so-called Konin Pillar was made of quartzite sandstone (Fig. 3B, C), exploited in the current eastern suburbs of Konin, in the village of Brzeźno. It is the most famous symbol of Konin and the oldest road sign (milepost) in Europe, outside the borders of the former Roman Empire. The date of 1151 engraved on it is considered to be the beginning of lignite mining in Poland (e.g., Ciuk, 1994; Widera, 2021; Frydrychowicz et al., 2024; Kasztelewicz et al., 2025). Simply, to extract the sandstone, the lignite layer had to be removed (Skoczylas, 1994; Kowalczykiewicz, 1995).

For decades, there have been at least two hypotheses about the origin of the silica that holds quartz grains together. Firstly, it was associated with the dissolution of diatom shells, and secondly, with the dissolution of siliceous components common in the carbonate rocks of the Mesozoic top (e.g., Widera, 2022; Widera et al., 2022a). Therefore, studies of these freshwater sandstones from the aforementioned Lubstów opencast allowed a convincing explanation of their genesis. Using a scanning electron microscope (SEM), it was found that they were formed in the environment of Miocene palaeosols – a pedological hypothesis (Górniak et al., 1996). The sub-lignite sands were bonded by silica, as evidenced by the presence of organo-quartz aggregates in the examined samples and crystalline

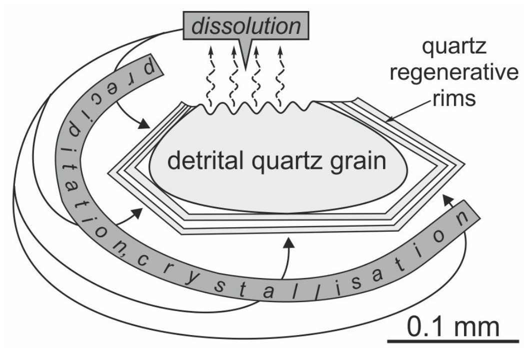


Fig. 4. Sketch of the formation of freshwater quartzite sandstones in a palaeosol environment (modified from Górniak et al., 1996). Note where silica dissolves and precipitates.

silica in the form of regenerative rims. Thus, the process of silica activation was linked to the decomposition of organic matter found in the palaeosol. In more alkaline places, the detrital quartz grain was dissolved, while in places with a relative increase in acidity, silica precipitated on the same quartz grain as regenerative rims (Fig. 4; Górniak et al., 1996).

4.2. Mid-Miocene cleats

Description. The term cleats is used exclusively for coals with different ranks (lignite, hard coal, etc.) and corresponds to the vertical fractures or joints in other sedimentary rocks (e.g., McCulloch et al., 1974; Laubach et al., 1998; Widera 2014a). In the described case, cleats are natural opening-mode fractures that are almost perpendicular to the bottom and roof of the MPLS-1. These cleats, based on geometric relations (abutting and crossing patterns), are arranged in two sets that are perpendicular to both each other and the stratification. The more prominent set (longer) is called face cleats, while the secondary set (shorter) is called butt cleats (Fig. 5).

Cleats were found in all opencasts belonging to the KLM, although they are best developed in the Kazimierz N and Jóźwin IIB opencasts. Of course, the face cleats are longer and more regularly oriented than the butt cleats, which are abutting the face cleats (Fig. 5). In general, the face cleats run NW–SE, while the butt cleats are oriented NE–SW (Fig. 6A). The described cleats dip very steeply, i.e. their angle of dip is in the range of 75–90° (Fig. 6B). The face and butt cleat spacing ranges approx. from 10 to 17 cm. However, their aperture is in the range of 0.2–1.9 cm (see Fig. 5). Other geometric attributes of these cleats (spacing and aperture) are characterised in detail by Widera (2014b).

Interpretation. The examined face and butt cleats are nearly perpendicular to each other, i.e. close to 90°. Simply put, they form an almost perfect, orthogonal (NW–SE and NE–SW) cleat system (compare Figs. 5, 6). On the other hand, fractures in the MPLS-1 in the vicinity of Konin can be classified as macrocleats, because their maximum ap-

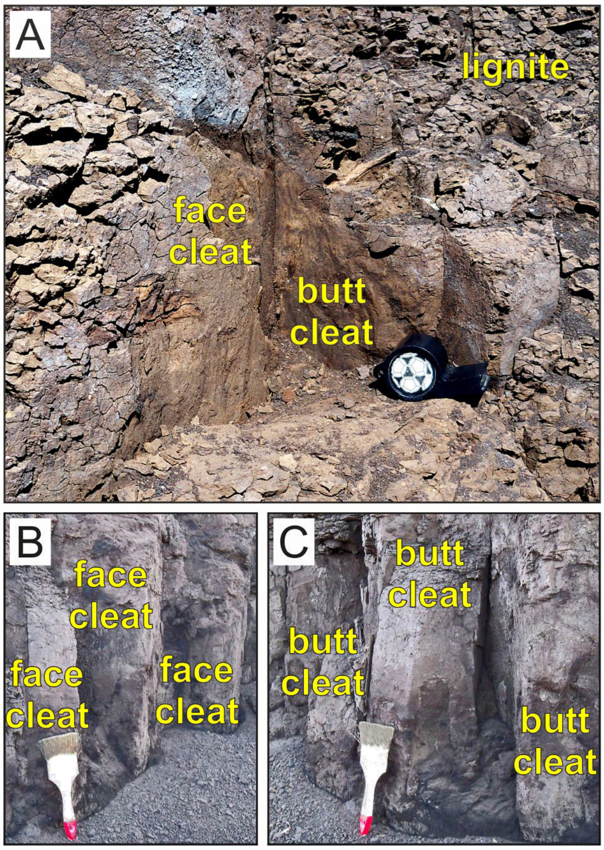


Fig. 5. Cleats within the lignite seam (MPLS-1) from the Konin region. **A –** The Kazimierz N lignite opencast, 2011; **B –** The Jóźwin IIB lignite opencast, 2014. Note the face and butt cleats.

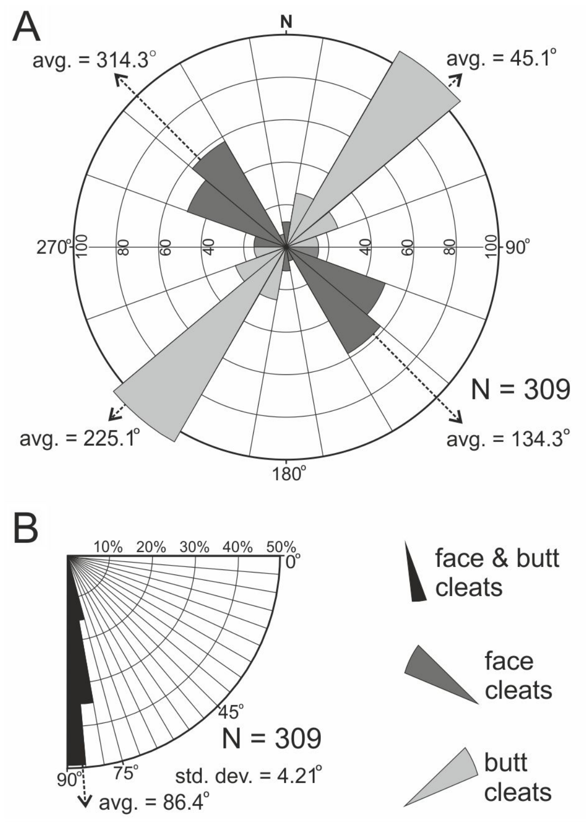


Fig. 6. Characteristics of cleat surfaces influencing the lignite seam (MPLS-1) from the Kazimierz N and Jóźwin IIB lignite opencasts. **A –** Rose diagram for face and butt cleat strikes; **B –** Rose diagram for face and butt cleat dips. Note the average values.

erture width is greater than 0.1 mm (Hooker et al., 2013).

The origin of these cleats also requires a short interpretation. First of all, they are parallel (NW–SE) and perpendicular (NE–SW) to the elongation of the main tectonic structures in central Poland. This phenomenon can be explained in at least two ways. The first hypothesis links the creation of the cleats (mainly the face cleats) with the uplift of anticlinal structures with NW–SE elongation in the sub-Cenozoic basement. The second hypothesis connects the formation of the cleats directly with the activity of the salt structure (e.g. the deep-seated salt pillow), occurring in the sub-Mesozoic substrate of the Konin area. Most likely, the NW–SE orientation of the face cleats is mainly associated with the older, regional extension, while the NE–SW butt cleat orientation is the result of local extension taking place in the cover of the salt structure (Widera, 2014b).

4.3. Mid-Miocene crevasse splays

Description. Among the numerous crevasse-splay sand bodies occurring in the KLM opencasts (e.g., Widera, 2016b, 2017, 2020; Chomiak, 2020; Widera et al., 2022b, 2023, 2024b; Dziamara et al., 2022, 2023; Chomiak et al., 2024; Wachocki et al., 2024), two of the most spectacular ones were selected for characterisation in this study. The first one is the crevasse-splay microdelta from the Jóźwin IIB opencast, and the second one represents the crevasse-splay complex from the Tomisławice opencast (Figs. 7, 8). All these crevasse-splay deposits were present within the exploited MPLS-1.

The crevasse-splay microdelta sediments were available for study over a length exceeding 550 m. They formed a lens-shaped and up to 2-m-thick body, extending in the N–S direction. Its middle part, up to 90 cm thick, is the most characteristic. It is composed of sands and coaly sands, steeply dipping at an angle of up to 25°. Moreover, these sediments are strongly deformed post-depositionally in both ductile and brittle manners (Fig. 7B).

In the case of the crevasse-splay complex, its sediments were perfectly available for direct observations over a distance of 400 m. The thickness of the sandy complex (with lignite intercalations) reached up to 4.8 m in the field. In this case, the sand beds are separated by 3–4 layers of lignite, with a maximum total thickness of 1–1.2 m (Fig. 8A, B). Among the mineral-organic facies, planar cross-stratified sands and coaly sands deserve mention. Their stratification is dipping at angles of up to 25° (Fig. 8C). These facies continue for over 200–300 m and occur within the lowest and highest portion of the described crevasse-splay complex.

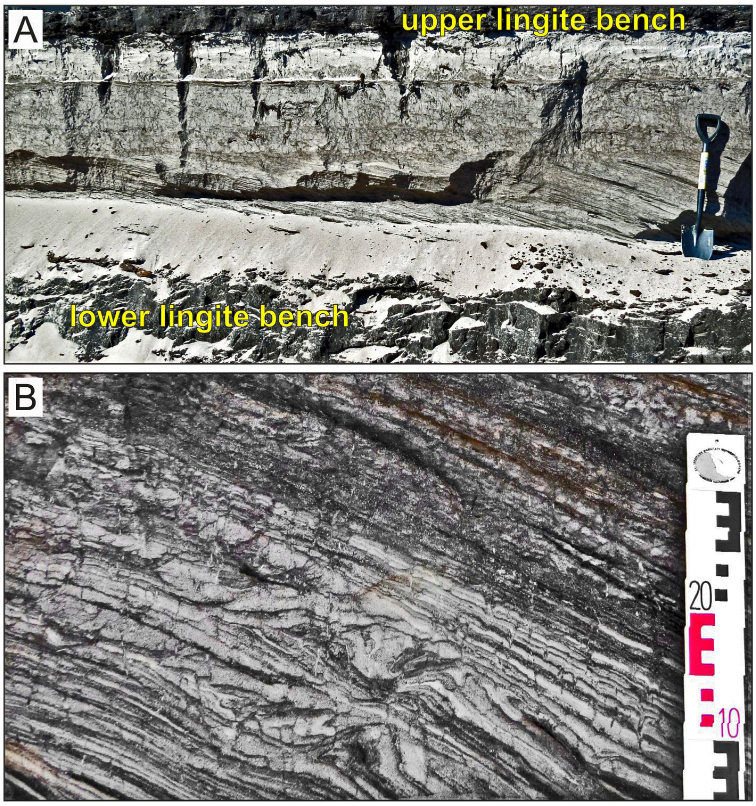


Fig. 7. Crevasse-splay microdelta in the Jóźwin IIB lignite opencast in 2018. **A –** Broad view of the sandy crevasse splay located between two benches of the MPLS-1; **B –** Close-up view of the microdelta foreset; note clearly inclined layers and their deformations both brittle and ductile.

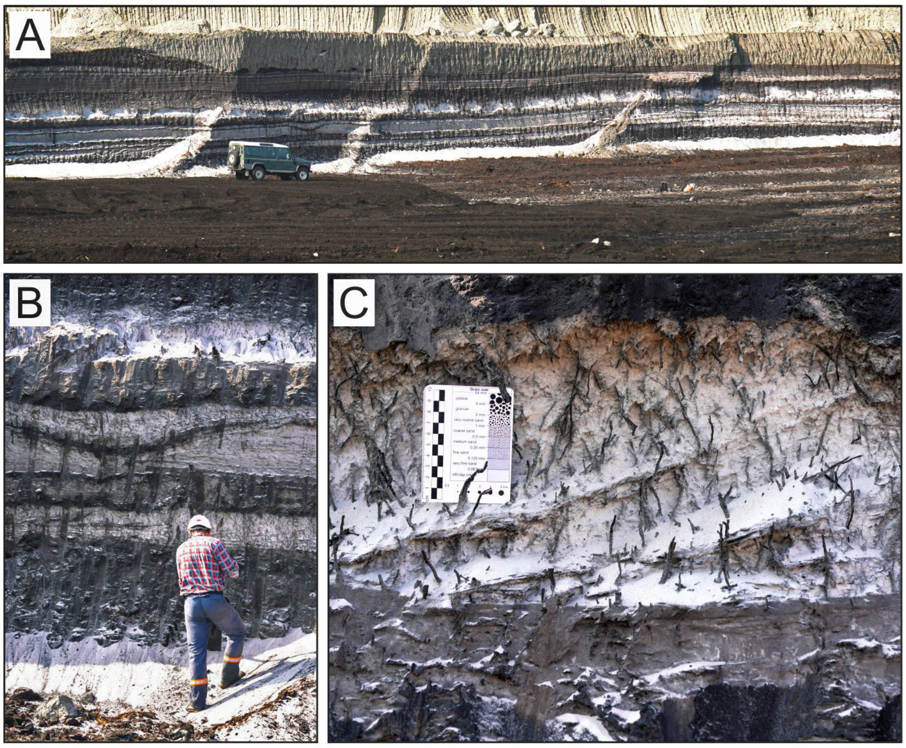


Fig. 8. Crevasse-splay complex from the Tomisławice lignite opencast in 2022. **A** – Broad view of the crevasse-splay complex; **B** – Close-up view of the crevasse-splay complex showing sandy and coaly layers; **C** – Close-up view of sand with a planar cross-stratification typical of a crevasse-splay microdelta.

Interpretation. Crevasse splays form in overbank (extra-channel) areas by breaching natural levees during the initial stages of a flood. Therefore, they are located in close proximity to river channels (e.g., Miall, 2006; Boggs, 2012; Zieliński, 2014). Ancient crevasse-splay deposits in global coal/lignite-bearing successions have been documented relatively often. On the contrary, exposures of such sediments were not known until 2015 from the lignite-bearing Miocene of Poland (see Widera et al., 2024b). In addition, the examined crevasse splays from the Tomisławice and Jóźwin IIB lignite opencasts are among the most numerous and genetically most diverse in the world.

The first case described above concerns mainly, and the second case only partially, sediments deposited in standing water as a crevasse-splay microdelta. This is proven by well-developed ‘prograding splay deposits’, dipping at an angle of up to 25° and with a lateral extension of tens to hundreds of metres (compare Figs. 7, 8; Chomiak et al., 2019; Dziamara et al., 2023). Other structures, not described so far among the crevasse-splay sediments from the world’s coal/lignite-bearing areas, are brittle and plastic deformations. Since the area of the Jóźwin IIB opencast during the Mid-Miocene peat accumulation covered a tectonically active area (Kleczew Graben), the formation of the aforementioned deformations can be associated with tectonics. Most likely, plastic deformations caused by a weak seismic shock occurred first. Then, brittle deformations were superimposed on them and tectonic breccia was formed as a result of a strong seismic shock (see Fig. 7; Chomiak et al., 2019, 2024).

The crevasse-splay complex from the Tomisławice opencast must be interpreted slightly differently than the one from the Jóźwin IIB opencast. Among the four (locally five) crevasse splays of this complex, the lowest and the highest were formed in standing water as a microdelta. The remaining crevasse splays were created in flowing water on the ‘dry’ surface of the Mid-Miocene mire, i.e. backswamp (Dziamara et al., 2022, 2023; Chomiak et al., 2024). Finally, based on the age of peat accumulation, which was then transformed into lignite interlayers (up to 1.2 m thick in total; see Fig. 8A, B), it was indirectly estimated that the interpreted complex was created for approx. 50,000 years (Widera et al., 2024b).

4.4. Mid-Miocene to Upper Miocene palaeochannels

Description. In the last two decades, numerous palaeochannels have been discovered in the Poznań Clays of the Wielkopolska Member (see Fig. 2). Most of them occurred in the Kazimierz N opencast (e.g., Widera, 2012, 2013), although the largest and best sedimentologically developed ones were

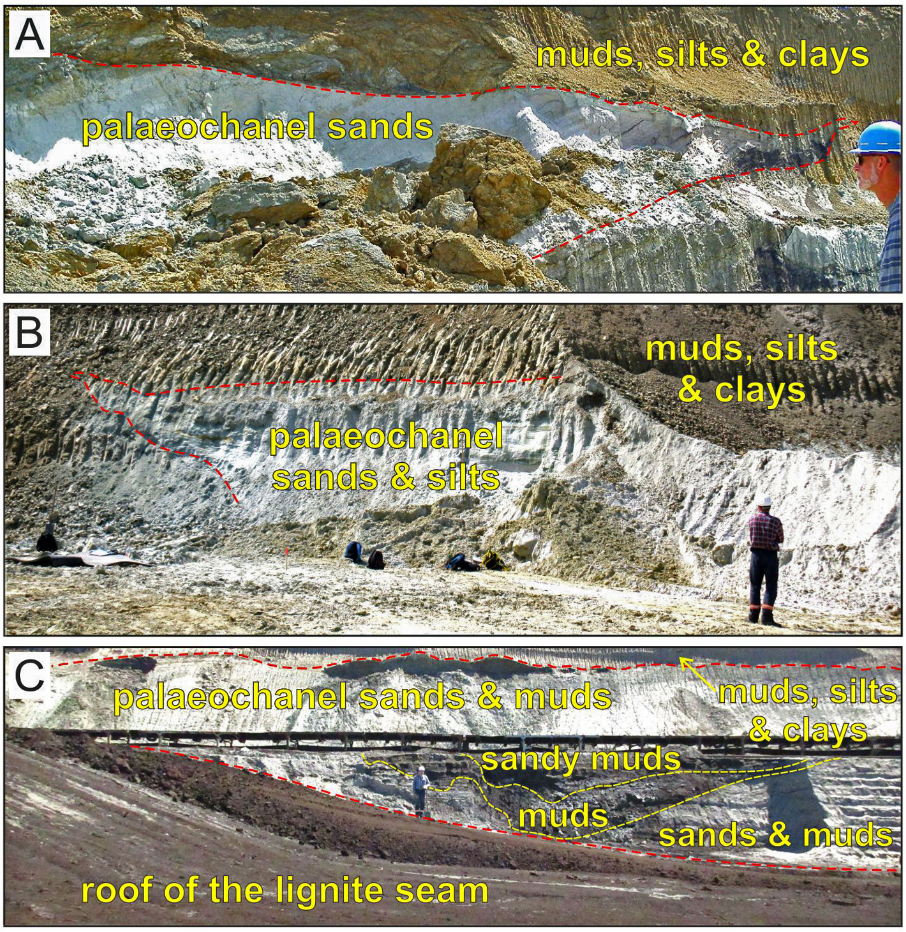


Fig. 9. Broad view of the fragments of the biggest sandy and sandy-muddy palaeochannels in the opencasts of the Konin Lignite Mine (KLM). **A –** The Kazimierz N lignite opencast, 2007; **B**, **C –** The Jóźwin IIB lignite opencast in 2016 and 2018, respectively; note the deeply incised palaeochannel into the lignite seam and secondary palaeochannels inserted into the primary palaeochannel.

those from the Jóźwin IIB opencast (Fig. 9; Widera et al., 2017, 2019, 2021b; Maciaszek et al., 2019, 2020; Zieliński & Widera, 2020; Kędzior et al., 2021). In the KLM opencasts, a total of >30 palaeochannels have been documented so far, mostly surrounded by varicoloured Poznań Clays (i.e. muds, silts and clays) with palaeosol horizons, which are characterised below.

The filling of the described palaeochannels was most often a mixture of fine-grained sands to sandy silts and sandy muds (Fig. 9). However, there were also exclusively sandy or muddy ones (Widera 2012, 2013; Kędzior et al., 2021). It is also worth mentioning the occurrence of secondary channels (2–3 m deep, up to 30 m wide) within the primary channels (up to 12 m deep, up to 150 m wide), filled with muds and sandy muds (Fig. 9C). In the cross-sectional view, the majority of the examined palaeochannels were relatively deep and narrow, for which the average width/thickness ratio (w/t ratio) was <15. The sediments filling them, especially in the Jóźwin IIB opencast, were characterised by numerous sedimentary structures, including heterolithic bedding, such as flaser, wavy and lenticular structures (Maciaszek et al., 2019; Widera et al., 2019; Zieliński & Widera, 2020).

Interpretation. The cross-sectional geometry of the palaeochannels, with the w/t ratio <15, allows them to be classified as broad ribbons (Gibling, 2006). On the other hand, the channel-fill sediments, containing the above-mentioned heterolithic bedding, demonstrate an extremely low-energy fluvial environment (e.g., Maciaszek et al., 2019). It must be added that this specific type of lamination is unique both in contemporary global fluvial sedimentary environments and in the rock record (Martin, 2000). However, the widespread presence of large-scale stratification within the palaeochannels (see Widera et al., 2019; Zieliński & Widera, 2020) indicates short-term increases in water flow energy (e.g., Miall, 2006; Boggs, 2012; Zieliński, 2014).

Taking into account the geometry of the palaeochannels and the results of the facies analysis of the sediments filling them, the morphological type of the late Neogene rivers was determined. In fact, this only applies to the area of the Konin lignite opencasts. Thus, the mentioned geometry and characteristic facies indicate an anastomosing (anabranching) type of palaeochannels. Such a pattern of these palaeochannels was also mapped in a small area of the Jóźwin IIB opencast (Widera et al., 2019, their fig. 14). On the other hand, some secondary palaeochannels show features of lateral movement (i.e. meandering), while the primary ones were rather stable. All this information means that the studied palaeochannels from the Konin area have recently been interpreted as typical for the late Neogene anastomosing-to-meandering transitional fluvial system (Zieliński & Widera, 2020).

4.5. Mid-Miocene to lowermost Pliocene palaeosols

Description. In contrast to the above-described and interpreted palaeochannel deposits, now the attention will be focused on the overbank (extra-channel) deposits also occurring within the Poznań Clays. In this case, the colour variability of these very fine-grained sediments should be considered as a geological peculiarity (Fig. 10). Locally, directly on the lignite seam (MPLS-1) roof, they are made of grey clays with dispersed organic matter and fossilised wood fragments (xylites) – the uppermost Grey Clay Member. However, the most important clays here are the so-called green and flame-like – the Wielkopolska Member (see Fig. 2).

In general, the Poznań Clays of the Wielkopolska Member consist of alternating, multi-coloured muds, silts and clays. However, what distinguishes them in the KLM opencasts, masking other textural and structural features of the sediment, are horizontally (if not disturbed post-depositionally) arranged coloured bands. Some of them are several to several hundred metres long, up to 0.3 m thick and black, and they contain >60 wt% of organic matter. They are just thin layers of lignite (Fig. 10A, B).

On the other hand, there are also sedimentary sequences which, at the top, are enriched with organic matter in amounts up to >1% wt% or do not contain it at all. In the latter case, the top layers are characterised by 'warm' colours (red, cherry-red, orange, yellow), which become increasingly pale towards the base (Fig. 10C, D). Of course, sediments with 'cold' colours (grey to black, yellow-green, blue-grey, etc.) can also be observed in the field (see Kłęsk et al., 2023).

Interpretation. The above-described sediments have recently been interpreted as palaeosols formed on the floodplains of a late Neogene river system (e.g., Widera et al., 2017, 2021b; Kędzior et al., 2021).

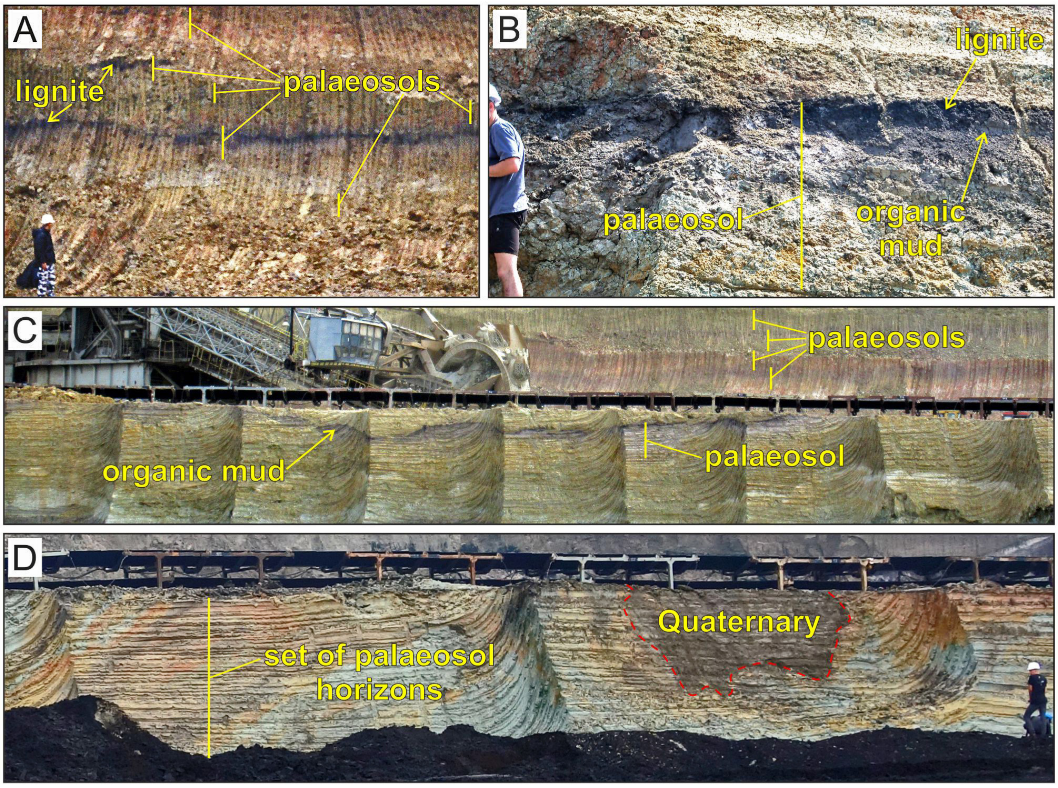


Fig. 10. Examples of palaeosol horizons from the opencasts of the Konin Lignite Mine (KLM). **A –** The Kazimierz N lignite opencast, 2004; **B–D** – The Jóźwin IIB lignite opencast in 2013, 2016 and 2021, respectively. Note the colour variation of the clayey deposits and the presence of thin lignite layers.

However, their colour variability depends mainly on the presence/absence of hematite and goethite, as well as on the presence/absence of organic matter in the interpreted sediments. It should be noted that the colour of the sediments depends on the hydrological conditions (indirectly reducing-oxidising) prevailing post-depositionally (i.e. in the inter-flood periods) on the mentioned floodplains. Thus, 'warm'-coloured layers were formed at low groundwater level as Vertisols, while 'cold'-coloured layers formed at high groundwater levels as Histosols (Klęsk et al., 2023).

The above statement was confirmed by detailed studies of the Poznań Clays from the Jóźwin IIB opencast (Fig. 10D; Klęsk et al., 2023, 2024). For this purpose, in addition to sedimentological analysis, the following methods were used: powder X-ray diffraction (PXRD), Mössbauer spectroscopy (^{57}Fe-MS) and scanning electron microscopy with energy-dispersive spectroscopy (SEM-EDS). It turned out that sediments with 'warm' colours are relatively rich in hematite and/or goethite. On the contrary, sediments with 'cold' colours are poor in these main pigments but may contain pyrite, anatase, 'green illite' and traces of organic matter. Another strong yellow pigment commonly known from the Poznań Clays, e.g. jarosite (Duczmal-Czernikiewicz, 2013; Klęsk et al., 2022; Klęsk, 2023), may be masked mainly by organic matter. This was the situation that occurred in the grey clays lying directly on the exploited MPLS-1 in the Jóźwin IIB opencast (Klęsk et al., 2023).

5. Discussion

The quartzite sandstones characterised in this paper, and especially the cleats and crevasse splays from the KLM opencasts, are among the best known in Poland and in the world, respectively. Their cognitive value is great, but their origin has already been explained in the global geological literature. It can even be said that their discoveries complement the existing geological knowledge on this topic. On the contrary, the genesis of the Poznań Clays, containing the palaeochannels and palaeosols within them, looks different. Although it is mainly important for Polish geology, it requires a short discussion. This is due to the fact that the origin of the Poznań Clays has been arousing interest and controversy since the second half of the 19th century.

For nearly a century, until the 1960s, the lacustrine hypothesis of the origin of the Poznań Clays proposed by German researchers was widely accepted. There was even talk of a 'Pliocene Lake' (e.g., Areń, 1964; Piwocki et al., 2004). Then, a lacustrine-fluvial-marine hypothesis appeared (e.g., Dyjor, 1970). In turn, two decades ago, mainly based on borehole data, Piwocki et al. (2004) proposed a fluvial hypothesis for the formation of the Poznań Clays. These researchers attributed the sandy bodies to the presumed palaeochannels and the varicoloured fine-grained sediments (with lignite beds and even seams) to the floodplains. In addition, they associated the colour of these sediments with the degree of iron oxidation and the content of organic matter (Piwocki et al., 2004). We strongly believe that our research in the KLM opencasts, covering palaeochannel and extra-channel sediments with palaeosols and thin layers of lignite (compare Figs. 9, 10), has provided additional and convincing evidence for the fluvial genesis of the Poznań Clays. Thus, the hypothesis proposed by Piwocki et al. (2004) was positively verified.

6. Conclusions

Lignite mining in the Konin region contributed to a better understanding of the geology of this area. In the opencasts of the Konin Lignite Mine (KLM), many rocks and sediments were uncovered that can certainly be called geological peculiarities. Most of them constitute difficulties in mining activities, but they have great cognitive and aesthetic value.

Studies of quartzite sandstones from the Lubstów opencast allowed, for the first time in Poland, the determination of their pedological genesis. In turn, the cleats and crevasse splays occurring in the first Mid-Polish lignite seam (MPLS-1) are among the most numerous and best developed, not only in Polish coal/lignite-bearing formations. They complement the general knowledge about their stratigraphic architecture and genetic diversity.

The multi-coloured Poznań Clays are particularly aesthetically attractive. However, the well-documented palaeochannels and palaeosols within them confirm their terrestrial origin. Therefore, it can be stated that the Poznań Clays were formed in the environment of the late Neogene anastomosing or anastomosing-to-meandering transitional fluvial system.

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