Polish Geological Institute
National Research Institute

Polish Geological Survey
Polish Hydrogeological Survey

POLISH GEOLOGICAL INSTITUTE

HYDROCARBON PROSPECTIVE OF POLAND

ZŁOCZEW
TENDER AREA
ENGLISH ABSTRACT

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IV LICENSING ROUND
CONCESSIONS FOR HYDROCARBON
PROSPECTION, EXPLORATION AND PRODUCTION
IN POLAND

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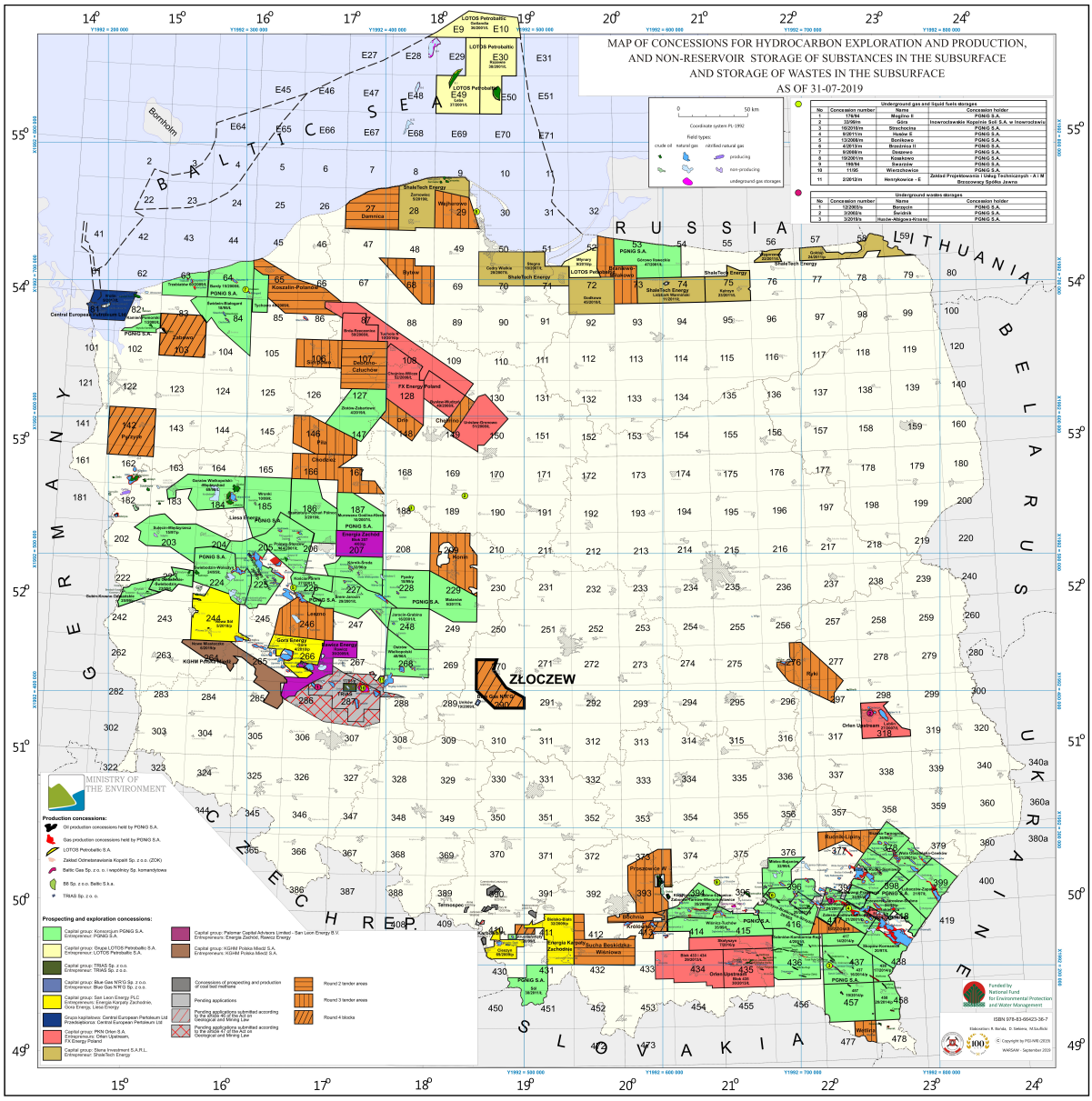


Location of the Złoczew tender area on the map of concessions for hydrocarbon exploration and production, and non-reservoir storage of substances in the subsurface and storage of wastes in the subsurface as of 31-07-2019.

1. GENERAL INFORMATION

The Złoczew tender area is located onshore in the central Poland, in the 270 and 290 concession blocks. The precise location is defined by geographical coordinates listed below.

Border points	1992 coordinate system	
	X	Y
1	422 699.68	465 433.21
2	422 598.89	480 146.84
3	415 125.67	477 759.62
4	402 260.28	486 821.61
5	394 857.71	500 000.00
6	387 287.14	500 000.00
7	387 359.94	478 635.54
8	400 377.34	465 280.57

Tab. 1. Border points coordinates of the Złoczew tender area (Fig. 1).

The brown coal deposits occur within the Złoczew tender area. Therefore, the south-western corner has been excluded for prospection, exploration and production of hydrocarbons to the depth of 170 m b.s.l. The precise location of the restricted area is defined by geographical coordinates listed below.

Border points	1992 coordinate system	
	X	Y
A	387345.52	482868.43
B	393675.46	482954.71
C	393824.86	472002.97
D	387359.94	478635.54

Tab. 2. Border points coordinates of the area excluded for hydrocarbon prospection, exploration and production to the depth of 170 m b.s.l. in the Złoczew tender area (Fig. 1).

Administrative centre:

- Łódzkie province; Bełchatów county, communes: Rusiec (participation in the tender area 0.55%), Łask county, commune: Widawa (14.53%); Sieradz county, commune: Błaszki (2.63%), Brąszewice (2.88%), Brzeźnio (18.29%), Burzenin (14.71%), Sieradz (9.63%), city Sieradz (1.29%), Warta (2.20%), Wróblew (16.05%), Złoczew (10.39%); Wieluń county, communes: Konopnica (6.75%), Ostrówek (0.10%).

In 1998–2014, the prospection and exploration works in the Złoczew tender area were carried out by RWE Dea. Since 2011, the area and its neighborhood were subjected to hydrocarbon prospection and exploration concession No. 31/2011/p „Sieradz" (Orlen Upstream), terminated on 29 May 2017. Currently, only one hydrocarbon concessions is provided in the neighborhood of the tender area – No. 19/2003/Ł "Uników", which is located to the south-west (Fig. 1).

There are still no oil and gas discoveries in the Złoczew tenter area, so far. However, the area is prospective, since hydrocarbon accumulations are possible within the Rotliegend and Zechstein deposits. Additionally, the Uników gas field and Gomunice oil field in the Main Dolomite have been discovered to the south.

The main exploration targets in the Złoczew tender area are related to conventional oil and gas accumulations in the:

- Carboniferous and Permian (with Carboniferous, Rotliegend and Zechstein Limestone as main reservoir rocks),
- Permian (with Zechstein/Main Dolomite as main reservoir rocks).

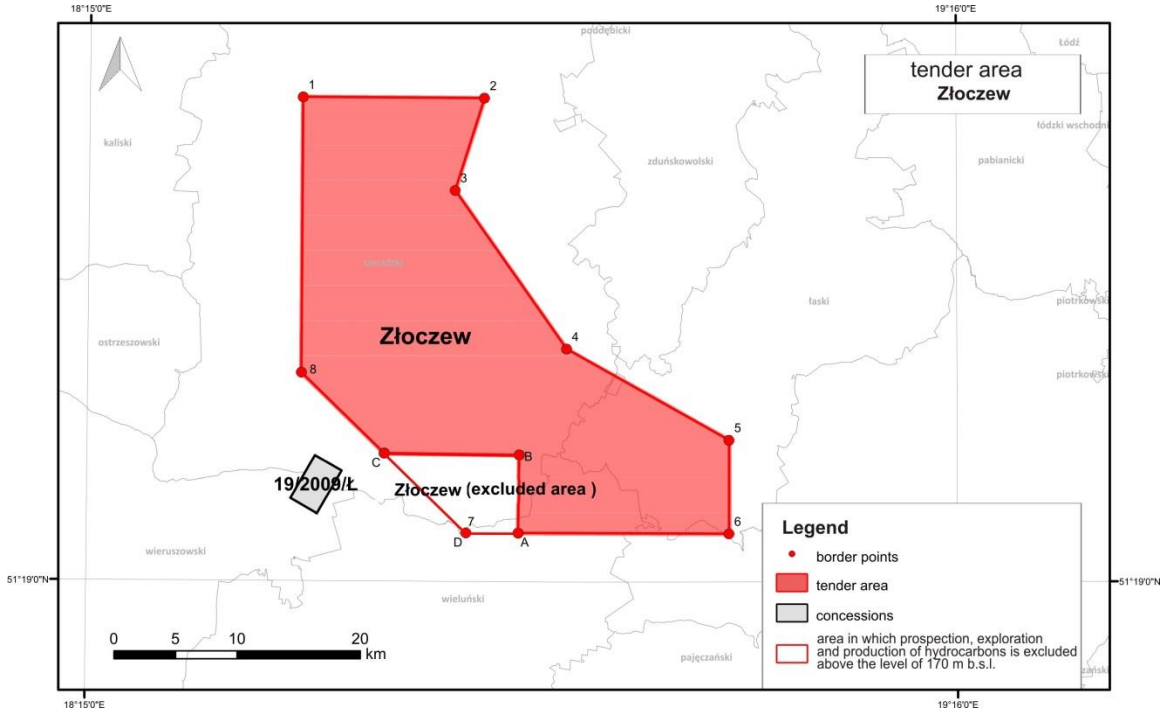


Fig. 1. Border points of the Złoczew tender area and location of the hydrocarbon concessions in the neighborhood as of 31-07-2019 (CBDG, 2019).

2. GEOLOGY

2.1. GENERAL GEOLOGICAL DESCRIPTION

The Złoczew tender area is located in the central Poland. It lies at the border of the Fore-Sudetic Monocline and Łódź Trough of the Szczecin-Miechów Synclinorium (Aleksandrowski, 2017a; Fig. 2). Below the Permian-Mesozoic and Cenozoic cover, the Carboniferous strata of the Variscan Externides occur (Aleksandrowski, 2017b; Fig. 3).

The stratigraphy and lithology of the Paleozoic and Mesozoic rocks are recognized in numerous wells located within the Złoczew tender area and its close neighborhood. These are: Barczew 1, 2, 4, Biady 1, Biała 2, Biesiec 1, 2, Błaszki 1, Brąszewice 1, Chrusty 1, Dymek IG-1, Gruszczyce 2, Iwanowice 1, Kalisz IG-1, Kliczków 1, 2, 3, 5, 5A, 6, 7, 8, Konopnica 1, Klonowa 3, Kuźnica Grabowska 1, 2, Kuźnica Strobińska 1, 3, Kuźnica Zagrzebska 1, Lututów 1, Masanów 1, Niechmirów IG-1, 2, Ostrów Kaliski 2, Ożegów IG-1, Prosna 1, Raduchów 2, Sobiesęki 2, Stanisławów 1, 2, Świątkowice 1, 2, Uników 1, 3, Węglewice 1, Wieluń 2, 3, 4, 6, Wieruszów 2, Wierzcholas 1, Zapole 1 and Złoczew 1 (see Fig. 14 for location; wells located within the tender area are highlighted).

2.2. TECTONIC

Two main structural stages are distinguished in the Złoczew tender area. The area is located within the Paleozoic Platform, about 100–120 km west from the border of the East-European Craton. The Carboniferous strata – as the oldest recognized by drilling – form the Variscan structural stage of the Paleozoic Platform cover. Above, the Permian-Mesozoic deposits lie with a distinct angular unconformity. This succession is formed by the Permian Rotliegend and Zechstein deposits, which (together with the Carboniferous basement) are the main exploration target. Above, the Triassic, Jurassic and Cretaceous occur. The Mesozoic is partly deformed due to halokinetic processes, which developed from the Middle Triassic up to the Late Cretaceous/Early Paleogene inversion of the Mid Polish Trough. The Kliczków and Złoczew grabbens and Złoczew salt diaper are probably related with. They originated during the rejuvenation of the older Variscan faults, when block deformations of the Mesozoic succession and activation of the Zechstein salts occurred.

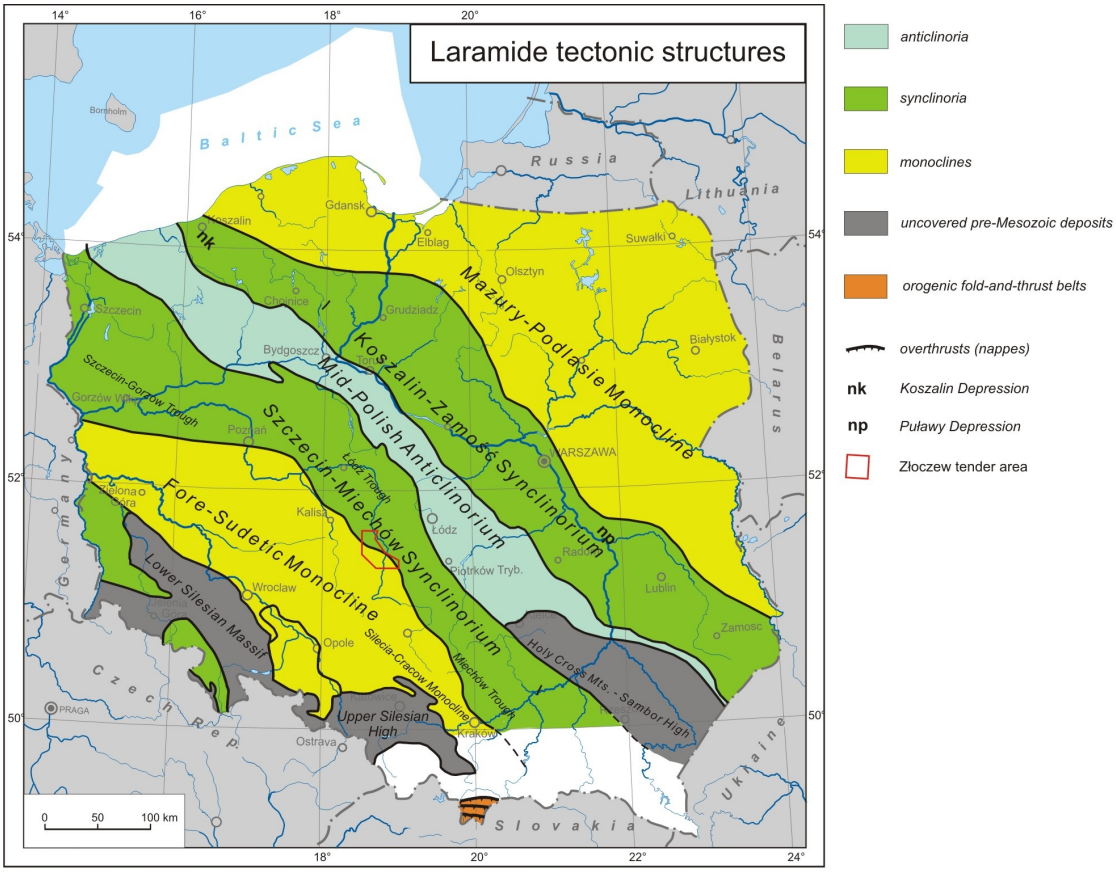


Fig. 2. Location of the Złoczew tender area on the map of Laramide tectonic structures (after Aleksandrowski, 2017a, modified).

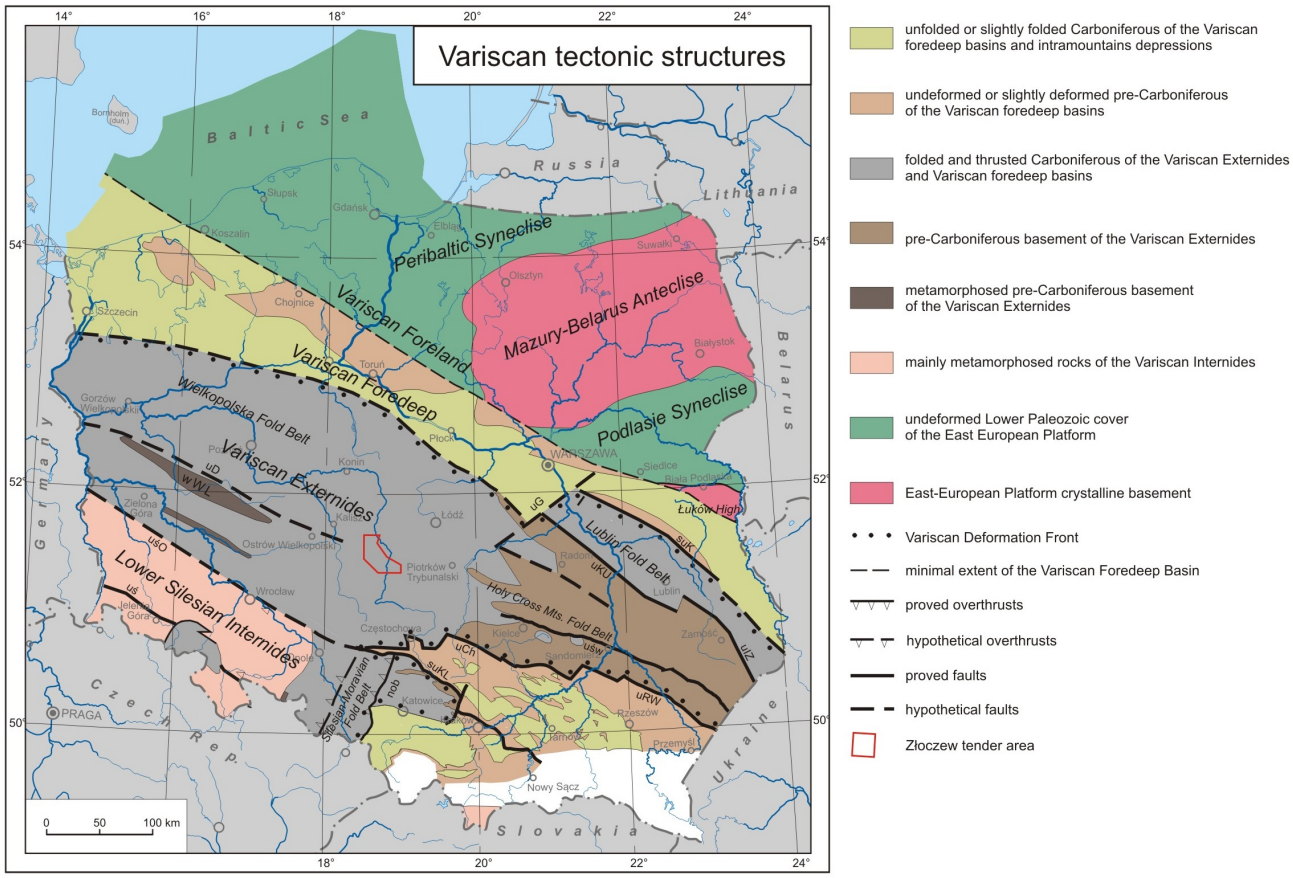


Fig. 3. Location of the Złoczew tender area on the map of Variscan tectonic structures (after Aleksandrowski, 2017b, modified). nob – Orłów-Boguszowice Thrust, suK – Kock Fault Zone, suKL – Kraków-Lubliniec Fault Zone, uCh – Chmielnik Fault, uD – Dolsk Fault, uG – Grójec Fault, uIZ – Izbica-Zamość Fault, uKU – Kazimierz-Ursynów Fault, uRW – Ryszkowa Wola Fault, uś – Intra-Sudetic Fault, uśO – Mid-Odra Fault, uśw – Holy Cross Mts. Fault, wWL – Wolsztyn-Leszno High.

2.3. STRATIGRAPHY AND LITHOLOGY

Carboniferous (Figs 4–5)

Lithology: Visean and Namurian (Kulm facies) sandstones and mudstones, Westphalian sandstones and mudstones.

Wells and depth: Biesiec 1 (2927.0–3023.0 m),
Biesiec 2 (2914.0–2987.0 m),
Kliczków 5a (3200.0–3204.0 m),
Kliczkow 8 (2911.0–2951.3 m),
Niechmirów 2 (3540.0–3587.0 m),
Stanisławów 1 (3127.5–3162 m),
Złoczew 1 (2867.0–2980.0 m),
Błaszki 1 (3344.0–3602.0 m),
Brąszewice 1 (2384.0–2525.0 m),
Chrusty 1 (3560.0–3571.4 m),
Dymek IG-1 (2702.0–2797.0 m),
Gruszczyce 2 (3172.0–3299.0 m),
Iwanowice 1 (3216.0–3272.9 m),
Kuźnica Grabowska 1 (2450.0–2564.0 m),
Kuźnica Grabowska 2 (2348.0–2430.0 m),
Kuźnica Strobińska 1 (2858.0–2950.0 m),
Kuźnica Strobińska 3 (2753.0–2935.1 m),
Lututów 1 (2249.0–2276.0 m),
Ożegów IG-1 (2710.0–2875.0 m),
Sobiesęki 2 (2898.0–3418.2 m),
Stanisławów 2 (2397.0–2435.2 m),
Świątkowice 1 (2270.0–2343.8 m),
Świątkowice 2 (2330.0–2380.0 m),
Uników 1 (2357.0–2476.0 m),
Uników 3 (2425.0–2450.0 m),
Wieluń 2 (2138.0–2084.2 m),
Wieluń 3 (2186.0–3201.0 m),
Wieluń 4 (2175.0–2227.0 m),
Wierzcholas 1 (2268.5–2324.0 m),
Masanów 1 (RWE Dea) (2492.0–2631.0 m),
Prosna 1 (RWE Dea) (2151.0–2300.0 m).

Thickness (according to wells): >4.0–113.0 m.

References: Wierzchowska-Kicułowa, 1984; Deczkowski, 1977, 1997.

Permian, Rotliegend (Figs 6)

Lithology: alluvial fan and plain sandstones and conglomerates, alluvial and fluvial sandstones and mudstones interbedded with aeolian sandstones, aeolian dune and interdune sandstones.

Wells and depth: Barczew 1 (3144.0–3220.0 m),
Biesiec 1 (2722.0–2927.0 m),
Biesiec 2 (2723.0–2914.0 m),
Chrusty 1 (3272.0–3560.0 m),
Dymek IG-1 (2594.0–2702.0 m),
Gruszczyce 2 (3047.0–3172.0 m),
Kliczków 5a (3959.0–3200.0 m),
Kliczkow 8 (2810.0–2911.0 m),
Konopnica 1 (2930.0–2960.0 m),
Niechmirów 2 (3130.0–3540.0 m),
Stanisławów 1 (2894.0–3127.5 m),
Złoczew 1 (2657.5–2867.0 m).

Thickness (according to wells): >76.0–410.0 m (>76.0–241 m for the Upper Rotliegend deposits).

References: Deczkowski, 1977, 1997; Kiersnowski and Buniak, 2006; Kiersnowski, 2013.

Permian, Zechstein (Figs 7–8)

Lithology: limestones, dolomites, clastic rocks and evaporites, including basin carbonates in the Zechstein Limestone and shallow-marine platform and slope carbonates in the Main Dolomite.

Lithostratigraphy: PZ1 – Cooper Shale (T1), Zechstein Limestone (Ca1), Lower Anhydrite (A1d), Oldest Halite (Na1), Upper Anhydrite (A1g), PZ2 – Stinking Shale (T2), Main Dolomite (Ca2), Basal Anhydrite (A2), Older Halite (Na2), Screening Anhydrite (A2r), PZ3 – Grey Pelite (T3), Main Anhydrite (A3), Top Anhydrite (A3r), PZ4a – Lower Red Pelite (T4), Lower Pegmatite Anhydrite (A4a1), Lower Pegmatite Anhydrite (A4a1), Youngest Halite (Na4a), Boundary Anhydrite (A4a), PZ4b – Upper Red Pelite (T4b), Top Terrigenous Series (PZt).

Wells and depth: Barczew 1 (2629.0–3144.0 m),
Barczew 2 (2579.0–2691.8 m),
Barczew 4 (2635.0–2908.8 m),
Biesiec 1 (2255.0–2722.0 m),
Dymek IG-1 (2231.5–2594.0 m),
Kliczków 1 (2372.0–2979.0 m),
Kliczków 2 (2819.0–3368.7 m),
Kliczków 3 (2310.0–2634.0 m),
Kliczków 5A (2312.0–2959.0 m),
Kliczków 6 (2534.0–3247.0 m,
Kliczków 7 (data are not available),
Kliczków 8 (2337.0–2810 m),
Stanisławów 1 (2228.0–2894.0 m),
Zapole 1 (2775.0–2878.8 m),
Złoczew 1 (2255.0–2657.5 m.

Thickness (according to wells): >103.8–713.0 m.

Wells and depth (Zechstein Limestone Ca1):
Barczew 1 (3137.0–3142.0 m),
Biesiec 1 (2711.0–2718.5 m),
Dymek IG-1 (2577.5–2592.0 m),
Kliczków 5A (2952.0–2957.0 m),
Kliczków 6 (3235.0–3247.0 m),
Kliczków 8 (2802.0–2807.0 m),
Stanisławów 1 (2884.5–2892.0 m),
Złoczew 1 (2647.0–2655.0 m).

Thickness (Zechstein Limestone Ca1, according to wells): 5.0–12.0 m.

Wells and depth (Main Dolomite Ca2):
Barczew 1 (3030.0–3047.0 m),
Barczew 4 (2895.0–2908.8 m),
Biesiec 1 (2411.0–2457.5 m),
Chrusty 1 (3035.0–3050.0 m),
Dymek IG-1 (2352.5–2386.0 m),
Kliczków 1 (2969.0–2979.0 m),
Kliczków 2 (3168.0–3187.0 m),
Kliczków 3 (2563.0–2579.0 m),
Kliczków 5A (2610.0–2652.0 m),
Kliczków 6 (2918.0–2933.0 m),
Kliczków 8 (2517.0–2547.0 m),
Stanisławów 1 (2433.5–2464.0 m),
Zapole 1 (2872.0–2878.8 m),
Złoczew 1 (2416.0–2456.0 m).

Thickness (Main Dolomite Ca2, according to wells): 0–46.5 m.

References: Deczkowski, 1977; Gliniak et al., 1999; Buniak et al., 2007; Wagner, 2012.

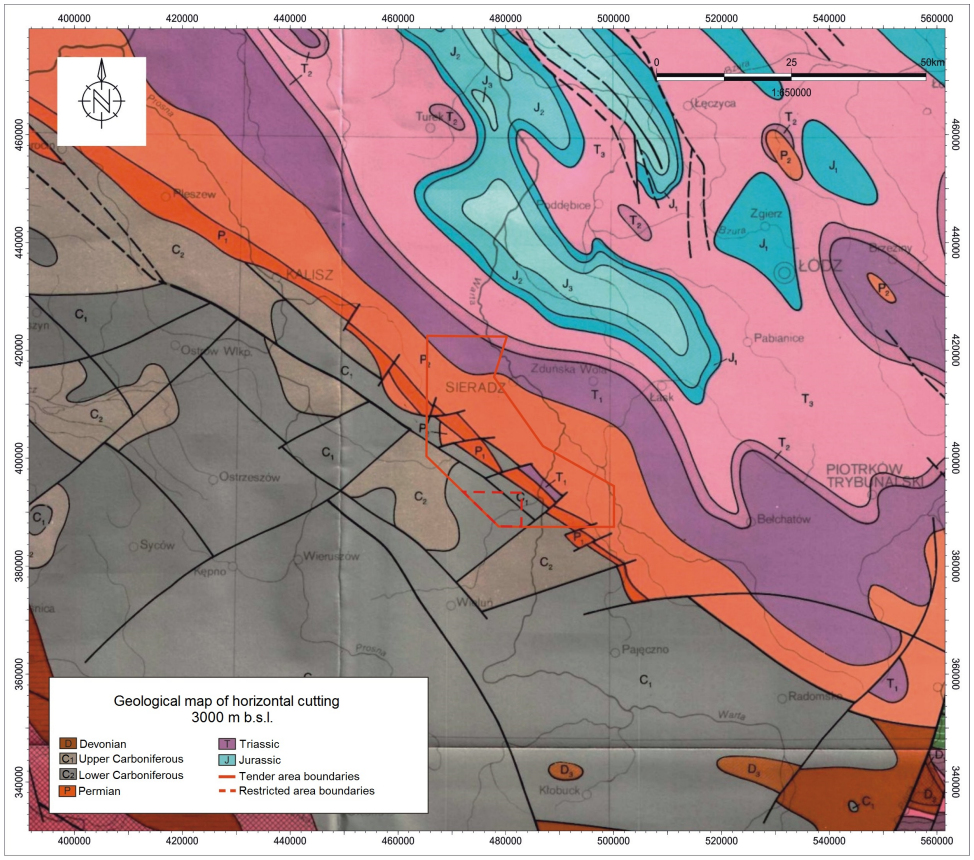


Fig. 4. Location of the Złoczew tender area on the geological map of horizontal cutting on the plane of 3000 m b.s.l. (Kotański et al., 1997).

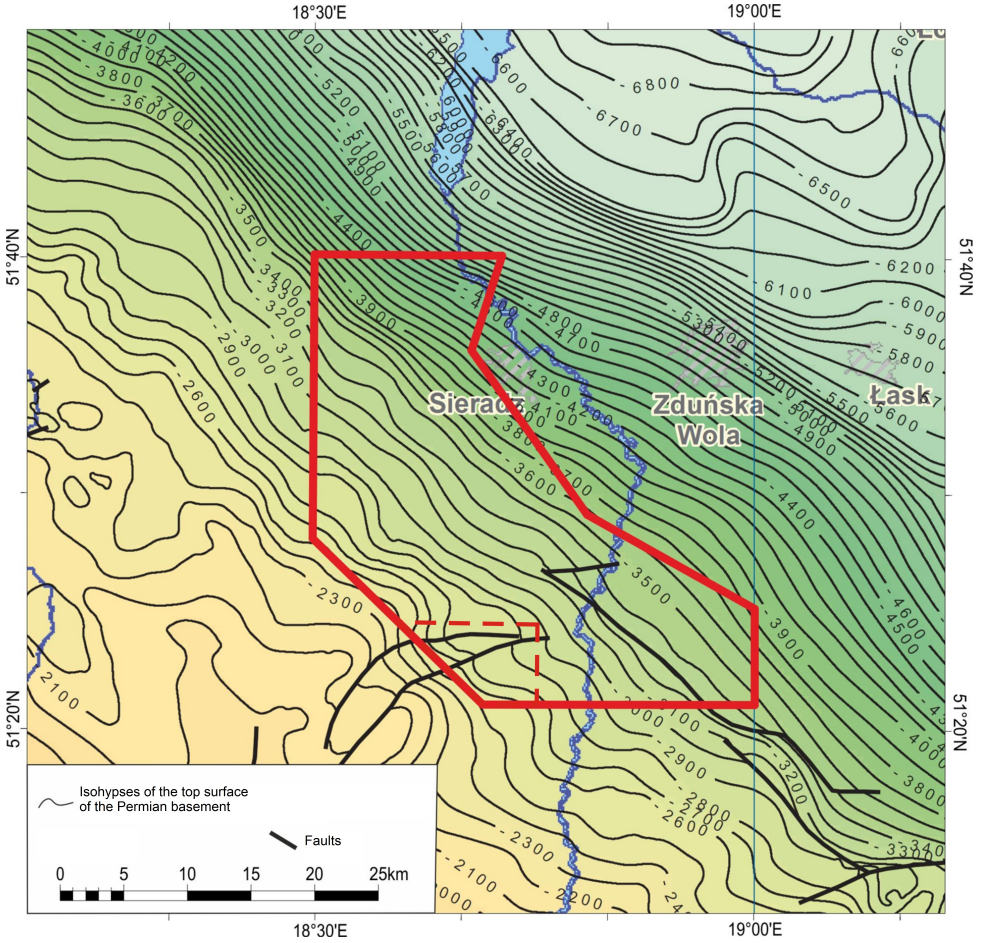
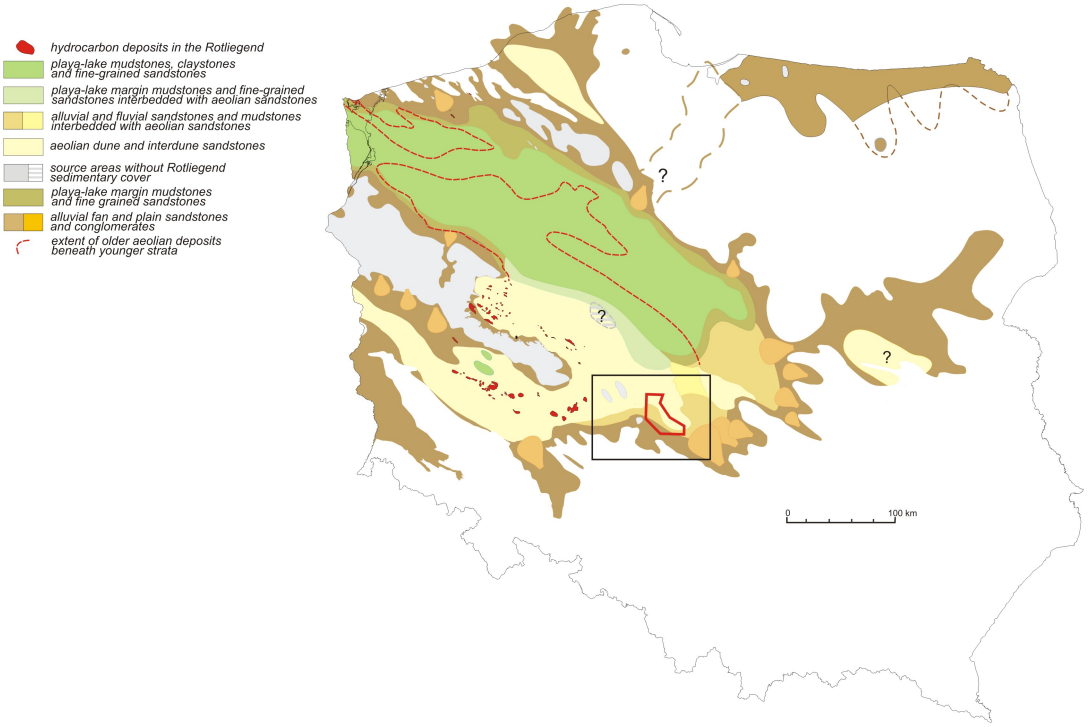


Fig. 5. Location of the Złoczew tender area on the structural map of the top surface of the Permian basement (Kudrewicz, 2007; modified).



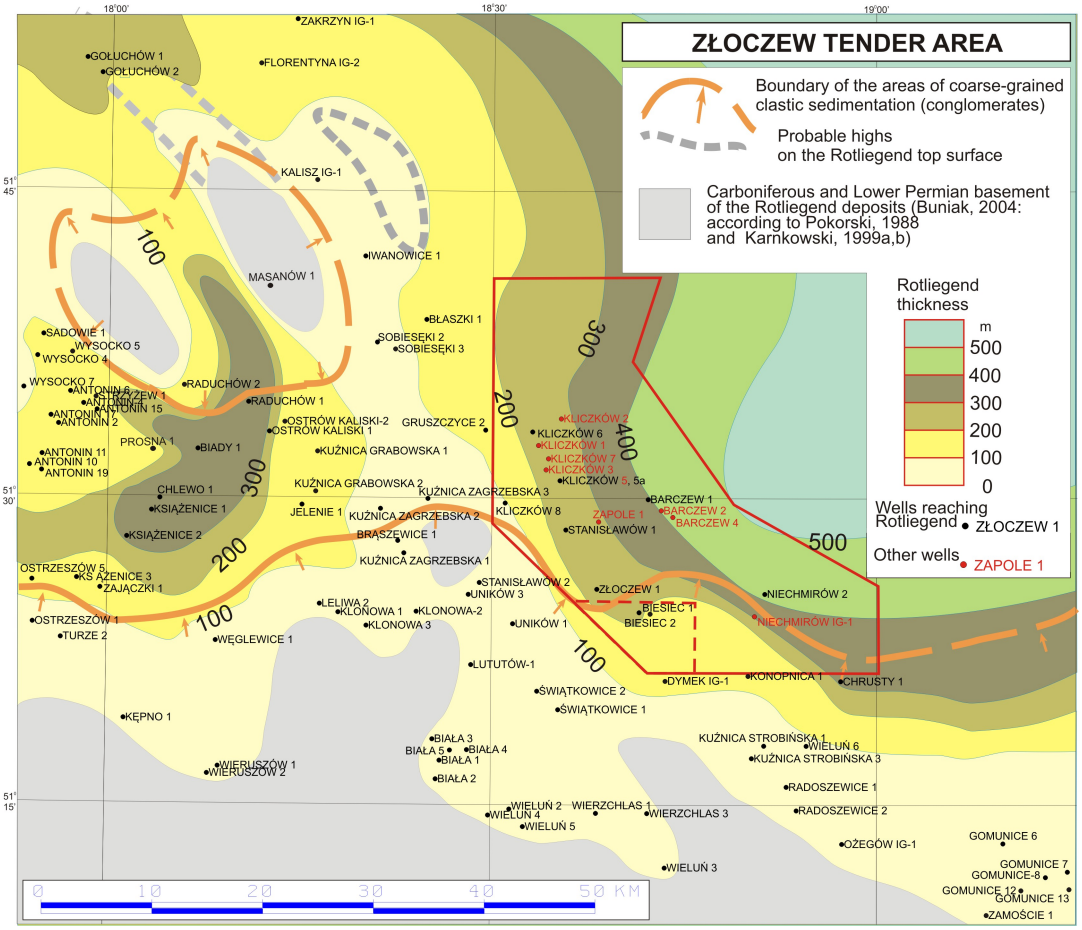


Fig. 6. Location of the Złoczew tender area on the maps of Upper Rotliegend palaeogeography, facies and thickness in Poland (Kiernowski and Buniak, 2006; Kiersnowski, 2013; modified).

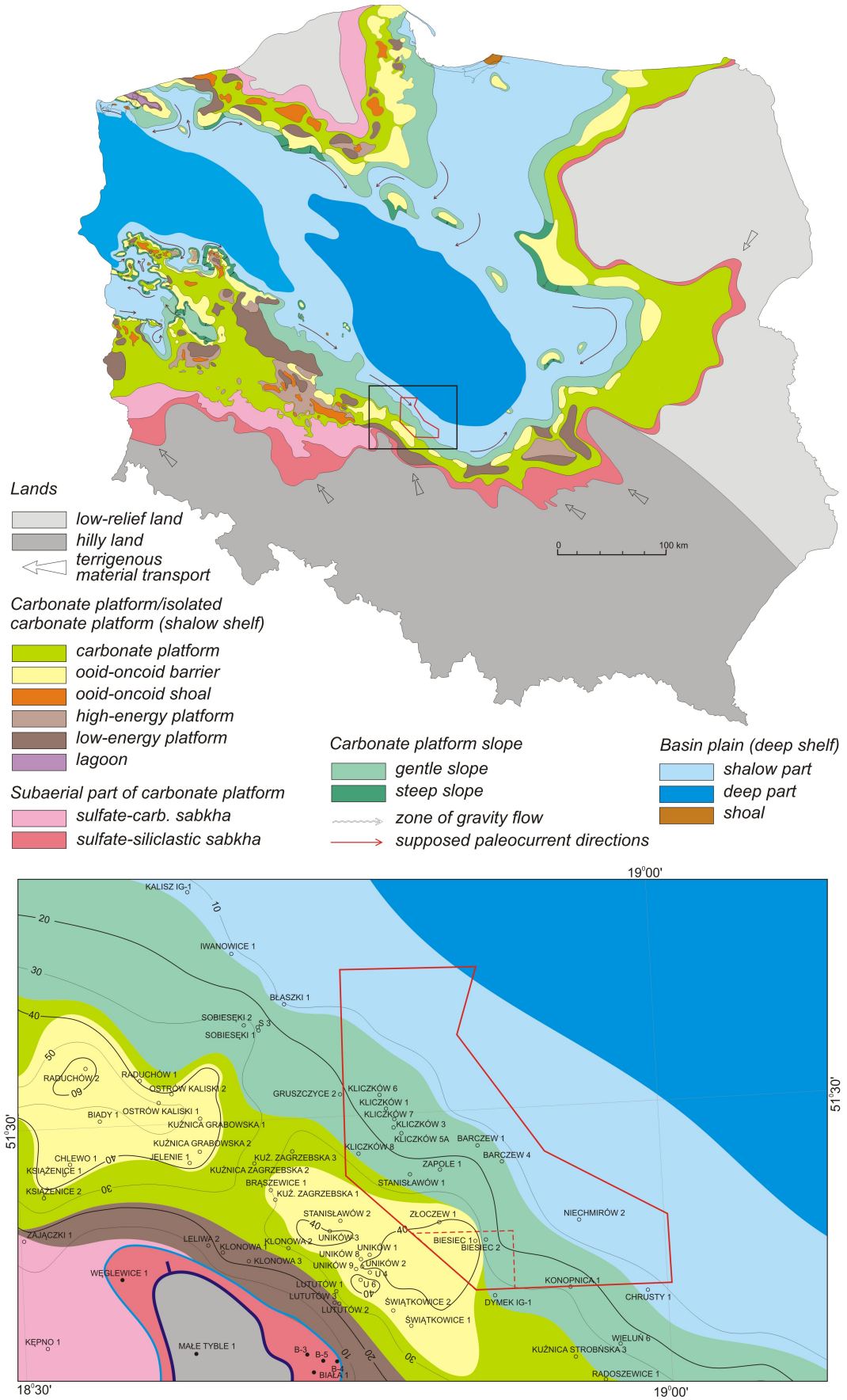


Fig. 7. Location of the Złoczew tender area on the map of the Zechstein/Main Dolomite palaeogeography and facies in Poland (Wagner, 2012; modified).

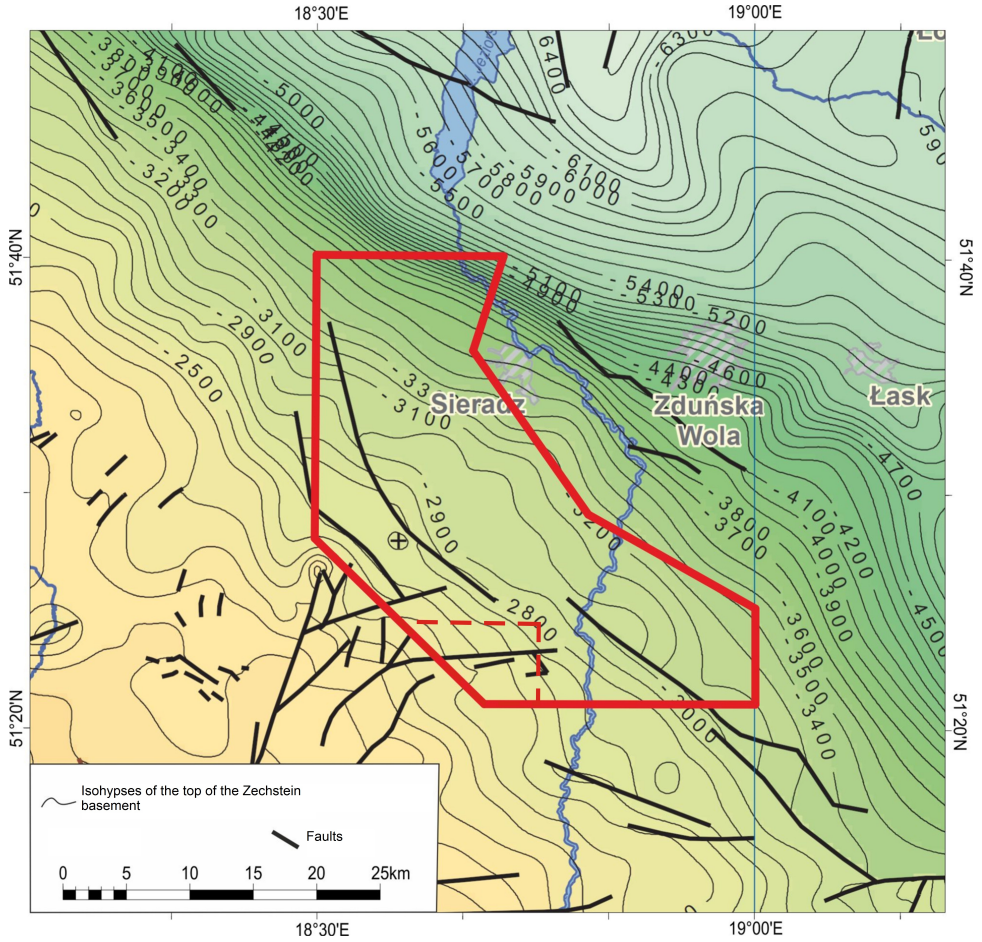


Fig. 8. Location of the Złoczew tender area on the structural map of the top surface of the Zechstein basement (Kudrewicz, 2007; modified).

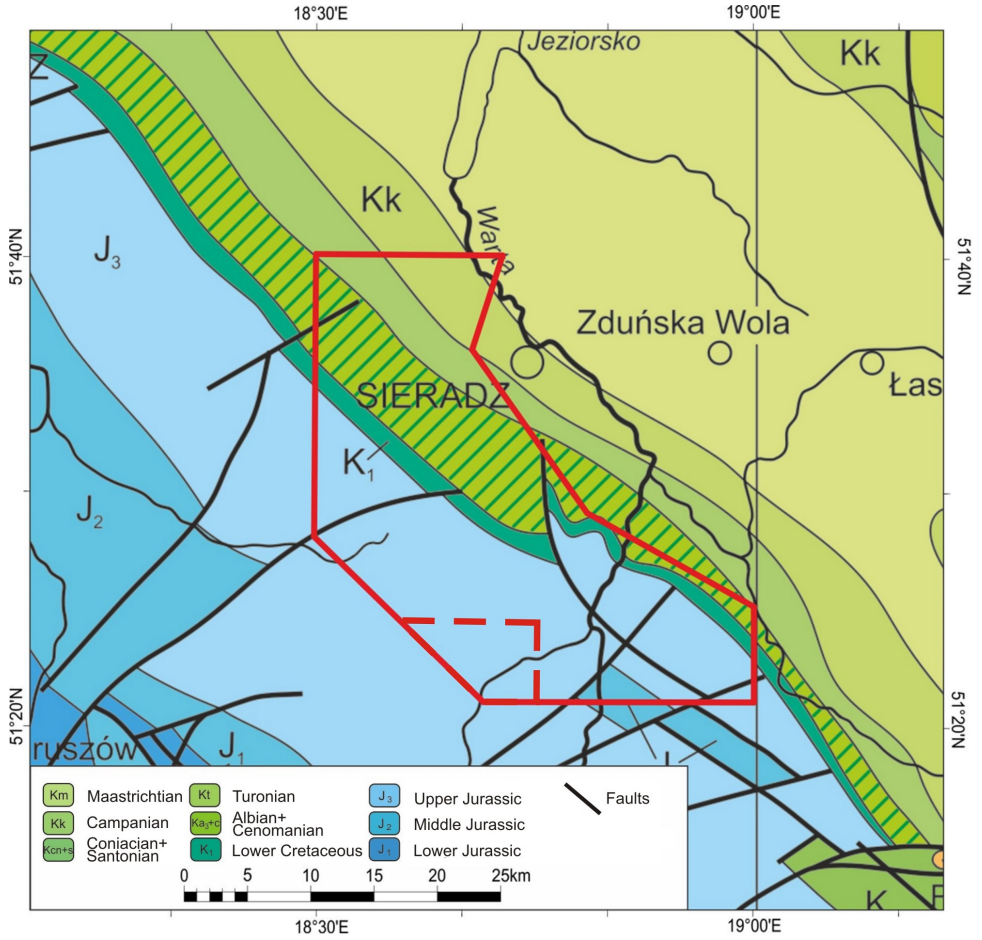


Fig. 9. Location of the Złoczew tender area on the geological map of Poland without Cenozoic cover (Dadlez et al, 2000; modified).

Triassic

Lithology: Buntsandstein – variegated claystones and mudstones with sandstones, limestones, marls and anhydrites intercalations; Muschelkalk – liemstones, marls and dolomitic claystones; Keuper – clastic rocks including variegated claystones and mudstones.
Wells and depth: Barczew 1 (1263.0–2629.0 m),
Barczew 2 (1193.0–2579.0 m),
Barczew 4 (1182.5–2635.0 m),
Biesiec 1 (872.5–2255.0 m),
Chrusty 1 (1535.0–2620.0 m),
Dymek IG-1 (820.0–2231.5 m),
Kliczków 1 (962.0–2372.0 m),
Kliczków 2 (1480.0–2819.0 m),
Kliczków 3 (884.0–2310.0 m),
Kliczków 5A (838.0–2312.0 m),
Kliczków 6 (993.0–2534.0 m),
Kliczków 8 (859.0–2337.0 m),
Niechmirów IG-1 (1443.0–2675.0 m),
Niechmirów 2 (1130.0–2621.0 m),
Stanisławów 1 (893.0–2228.0 m),
Zapole 1 (841.0–2370.0 m),
Złoczew 1 (975.0–2255.0 m).
Thickness (according to wells): 1280.0–1541.0 m.

Jurassic (Fig. 9)

Lithostratigraphy: Lower Jurassic – Zagaje Formation, Blanowice Formation, Ciechocinek Formation, Borucice Formation; Middle Jurassic – undivided; Upper Jurassic – Oxfordian undivided, Kimmeridgian Częstochowa Formation, Pilica Formation, Prusice Formation, Burzenin Formation.
Lithology: Lower Jurassic – sandstones, claystones and mudstones, claystones, mudstones; Middle Jurassic – claystones and mudstones, fine-grained sandstones with intercalations of mudstones and coal beds, sandstones; Upper Jurassic – mudstones, limestones, marly limestones, sandy limestones and marls.
Wells and depth: Barczew 1 (25.0–1263.0 m),
Barczew 2 (39.0–1193.0 m),
Barczew 4 (50.0–1182.5 m),
Biesiec 1 (121.0–872.5 m),
Chrusty 1 (85.0–1535.0 m),
Dymek IG-1 (53.0–820.0 m),
Kliczków 1 (60.0–962.0 m),
Kliczków 2 (15.0–1480.0 m),
Kliczków 3 (77.0–884.0 m),
Kliczków 5A (63.0–838.0 m),
Kliczków 6 (52.0–993.0 m),
Kliczków 8 (72.0–859.0 m),
Niechmirów IG-1 (67.3–1443.0 m),
Niechmirów 2 (7.0–1130.0 m),
Stanisławów 1 (30.0–893.0 m),
Zapole 1 (35.0–841.0 m),
Złoczew 1 (59.0–975.0 m.
Thickness (according to wells): 751.5–1465.0 m.
References: Deczkowski, 1977, 1997; Krzemiński and Bezkowska, 1987; Pieńkowski, 2004.

Cretaceous (Fig. 9)

Lithology: sandstones, sandy-mudstones, mudstones, claystones, marls, limestones and opokas.
Wells and depth: Sieradz 1 (49.0–381.0 m).
References: Jaskowiak-Schoeneichowa, 1977; Pożaryski and Brochwicz-Lewiński, 1978; Dadlez, 1997; Krzywiec, 2002, 2006; Mazur et al., 2005.

Cenozoic

Lithology: clays, muds, sands, gyttjas, bog limes, brown coals (Złoczew Trough), tills.
References: Borowicz et al., 2007.

3. PETROLEUM SYSTEMS

Two conventional petroleum systems are developed in the Złoczew tender area (Fig. 10). These are:

- Carboniferous-Permian petroleum system (with Carboniferous, Rotliegend and Zechstein Limestone as reservoir rocks),
- Zechstein petroleum system (with Main Dolomite as reservoir rocks).

They are separated by succession of evaporites of the first Zechstein cyclotheme (A1d, Na1, A1g).

Carboniferous-Permian (Rotliegend and Zechstein Limestone) petroleum system

Source rocks: Carboniferous fine-grained clastic rocks.
TOC = 0.4–4.7% (Masanów 1, Prosna 1).
Kerogen type: III, III/II.
Reservoir rocks: Carboniferous sandstones, aeolian sandstones of the Rotliegend succession, carbonates of the Zechstein Limestone.
Porosity (average in wells) = 4.83–11.46%.
Permeability (average in wells) = 0.0–320 mD.
Seal rocks: succession of evaporites of the first Zechstein cyclotheme (A1d, Na1, A1g).
Thickness of the overburden: 2657–3247 m.
Traps: stratigraphic (related to interfingering of aeolian sandstones with alluvial/fluvial sediments) within the Rotliegend succession, stratigraphic and structural (related to the top of the Rotliegend).
Hydrocarbon fields: none.
References: Nowak, 2003; Śliwiński et al., 2006; Górecka-Nowak, 2007; Malinowski et al., 2007; Burzewski et al., 2009; Pletsch et al., 2010; Kiersnowski and Poprawa, 2011; Botor et al., 2013.

Zechstein (Main Dolomite) petroleum system

Source rocks: organic-rich interbeds within the Main Dolomite succession.
Reservoir rocks: Main Dolomite carbonates.
Porosity (average in wells) = 0.48–1.95%.
Permeability (average in wells) = 0 mD.
Seal rocks: succession of evaporites of the second, third and fourth Zechstein cyclothemes.
Thickness of the overburden: 2411–3168 m.
Traps: structural, stratigraphic.
Hydrocarbon fields: Błotno, Rekowo, Sławoborze, Wysoka Kamieńska.
References: Kotarba and Wagner, 2007; Kosakowski and Krajewski, 2014.

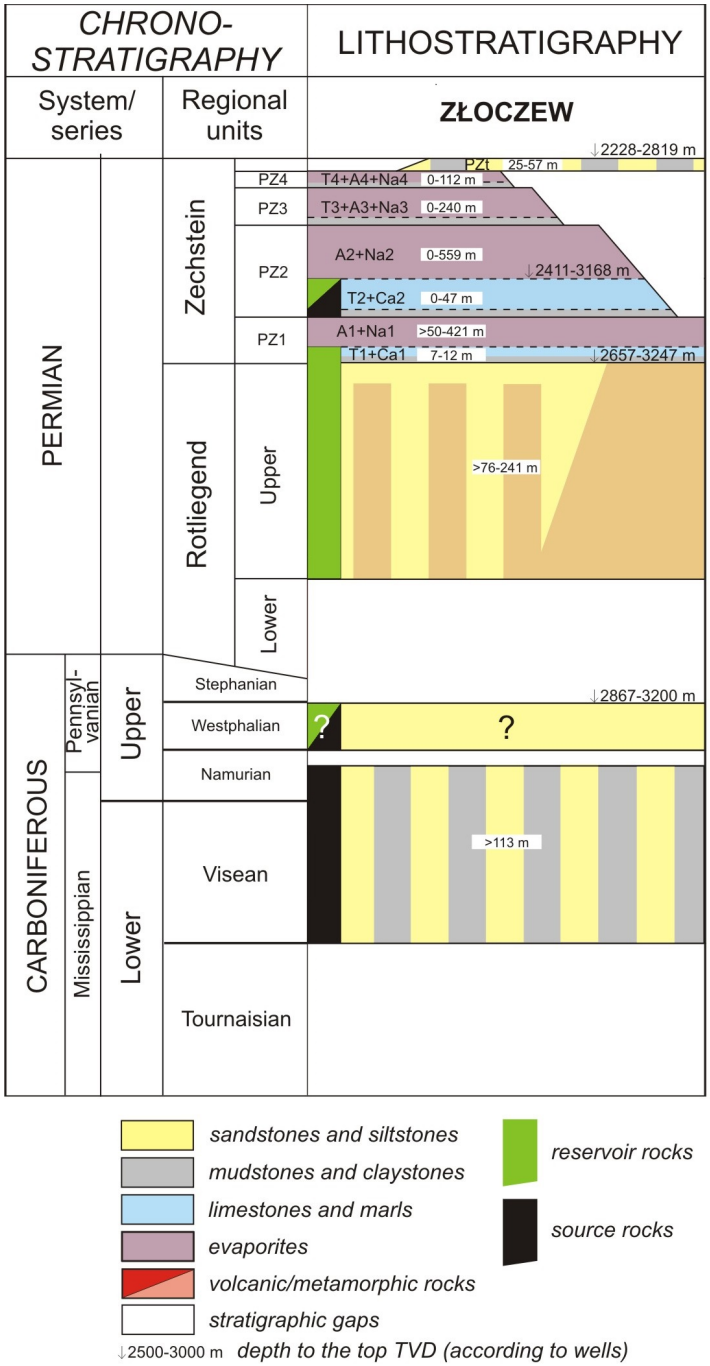


Fig. 10. Stratigraphy, lithology and major elements of petroleum system (main horizons of source and reservoir rocks) in the Złoczew tender area (Jagielski et al., 2019; modified).

4. HYDROCARBON FIELDS

In the southern vicinity of the Złoczew tender area, in the Main Dolomite deposits, two hydrocarbon fields have been discovered. These are (Fig. 15):

- Unikόw gas field (GZ 4731),
- Gomunice oil field (NR 4771).

Concession for prospection, exploration and exploitation of hydrocarbons from a deposit in Poland 2018

ZŁOCZEW TENDER AREA

0 2 4 8 12 16 20 km

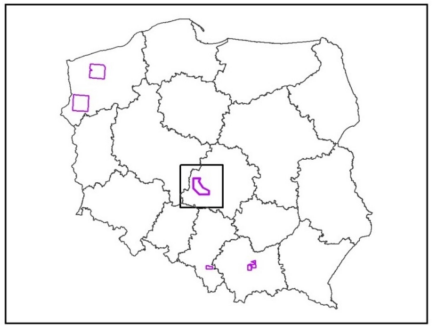
Legend

- tender area
- area restricted for prospecting, exploration and production of hydrocarbons to the depth of 170 m b.s.l.
- oil and gas fields
- communes
- counties
- voivodeships

Border points
coordinate system - PL 1992

Point no.	X	Y
1	422699,68	465433,21
2	422598,89	480146,84
3	415125,67	477759,62
4	402260,28	486821,61
5	394857,71	500000,00
6	387287,14	500000,00
7	387359,94	478635,54
8	400377,34	465280,57

Point no.	X	Y
A	387345,52	482868,43
B	393675,46	482954,71
C	393824,86	472002,97
D	387359,94	478635,54



The source of data:
System of management and protection of minera resources in Poland - MIDAS

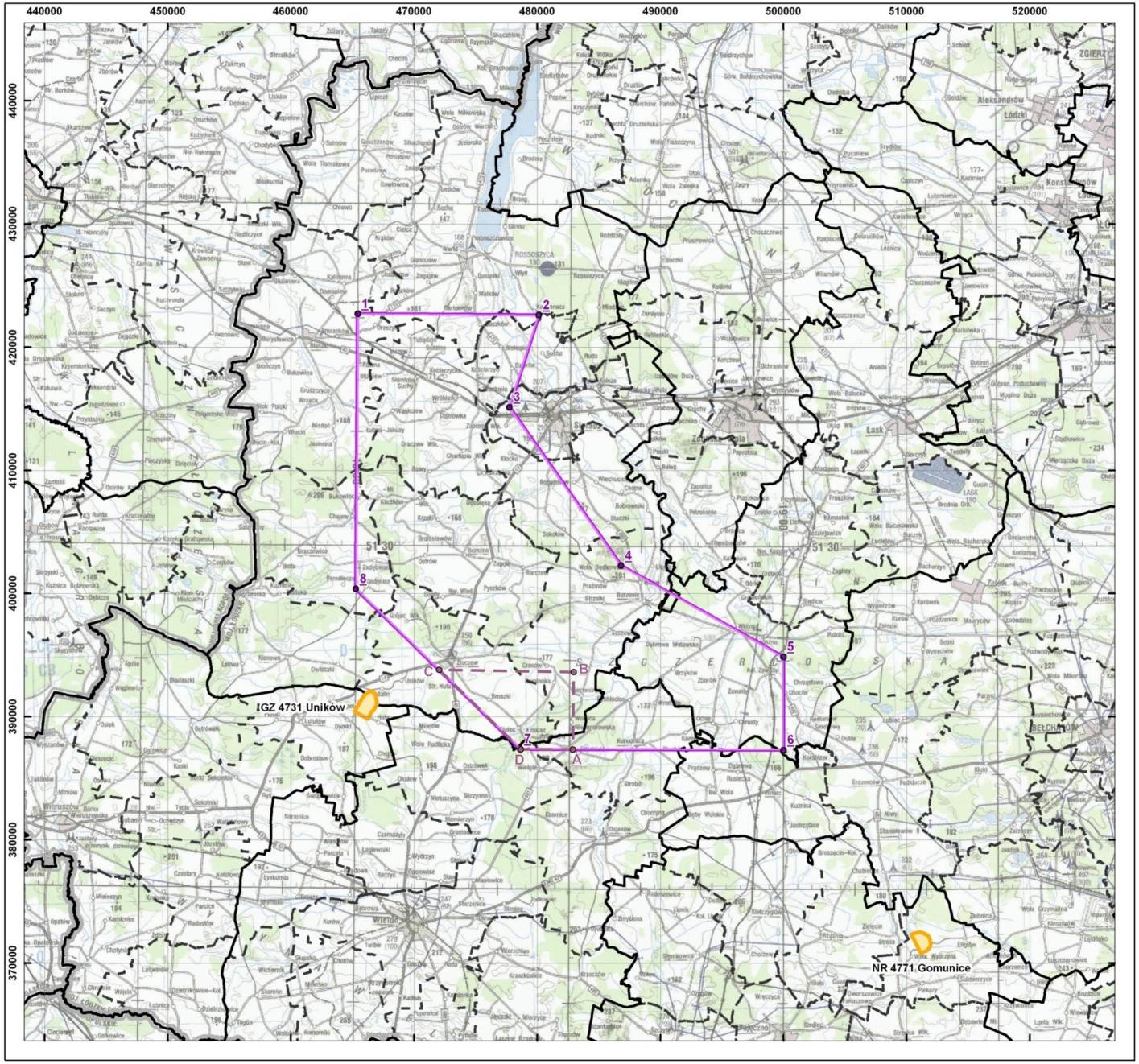


Fig. 11. Oil and gas fields in the neighborhood of the Złoczew tender area.

Uników gas field

Acreage: 238.00 ha
Depth: from -1775.0 m a.s.l.to -1794.2 m a.s.l.
Stratigraphy: Permian/Zechstein (Main Dolomite).
Resources:

- Extractable balance resources as of 2017:
  170.00 million m^3 of natural gas in cat. C,
- Economic resources in place as of 2017:
  none,
- Production in 2017:
  none.

Parameter	Average value	Unit	Comment
casing head preassure	171.00	atn	–
formation preassure	212.45	ata	used for calculation: 212.00 ata
aquifer depth	-1794.20	m	isobate contractual value – min. productivity contour is the bottom of the gas horizon perforation in Uników 2 well (1965 m)
net pay	14.10	m	–
porosity	3.76	%	–
maximum efficiency V_{max}	50.00	m^3/min	–

Tab. 3. Quality parameters of the Uników gas field (MIDAS, 2019; according to Mrozak et al., 1973).

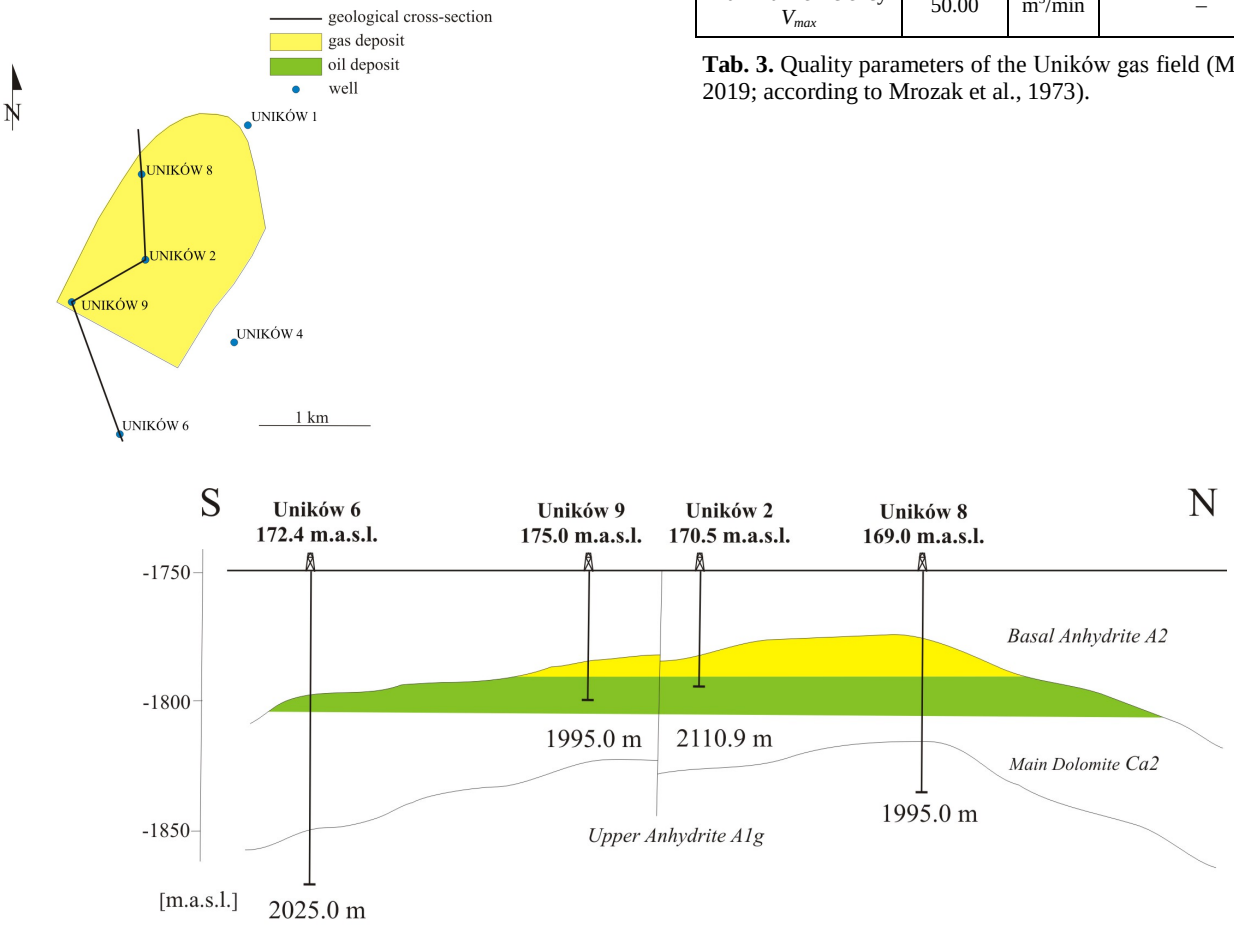


Fig. 12. Map and geological cross section through the Uników gas field (CBDG, 2019; Karnkowski, 1999a).

Gomunice oil field

Acreage: 170.00 ha
Depth: from -2585.00 m a.s.l. to -2700.00 m a.s.l.
Stratigraphy: Permian/Zechstein (Main Dolomite).
Resources:

- Extractable balance resources as of 2017: 39.73 ktonnes of oil in cat. C,
- Economic resources in place as of 2017: none,
- Production in 2017: none.

Parameter	Average value	Unit	Comment
reservoir pressure	26.48	MPa	Gomunice 9 well, at a depth of -2400 m
reservoir pressure	54.82	MPa	Gomunice 6 well, at a depth of -2600 m
net pay	21.90	m	net pay after including angle of inclination
porosity	1.42	%	based on laboratory measurements
porosity	1.70	%	average value used for resources calculation
porosity	0.91	%	pore porosity Gomunice 6 well, based on laboratory measurements
porosity	2.50	%	Gomunice 10 well
porosity	2.00	%	based on geophysical measurements
porosity	1.93	%	pore porosity, Gomunice 9 well, based on laboratory measurements
permeability	–	mD	low permeability, local 1.4-9.6 mD

Tab. 4. Quality parameters of the Gomunice oil field (MIDAS, 2019, according to Pernal and Wójcik, 1987).

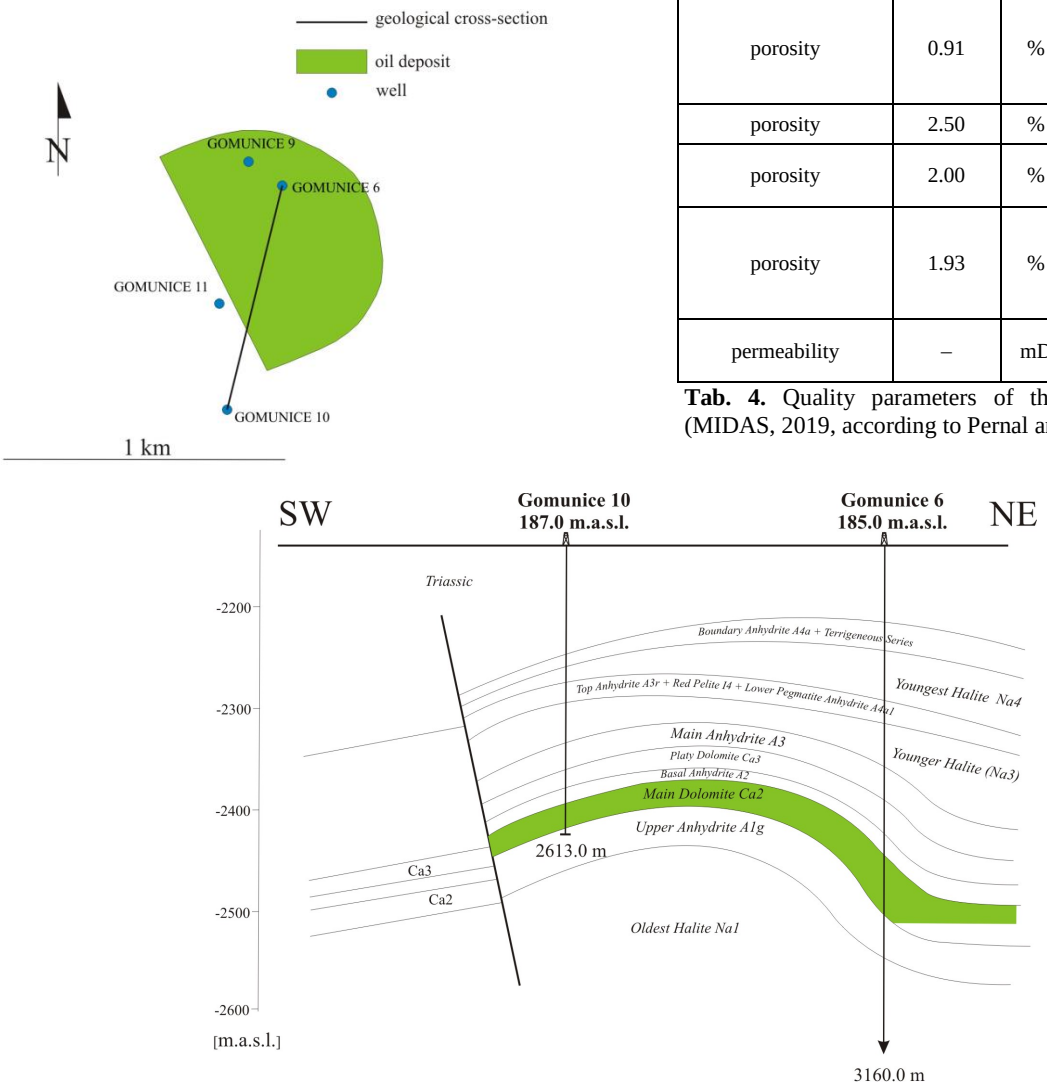
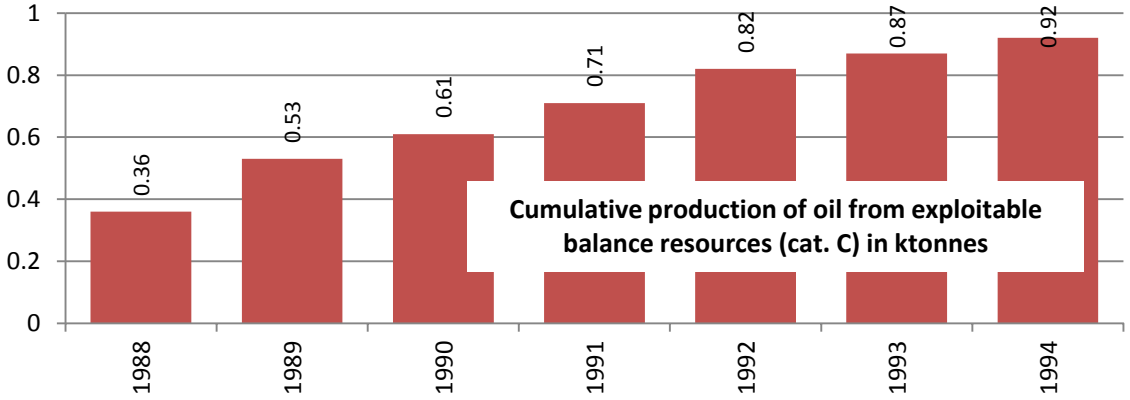


Fig. 13. Map and geological cross section through the Gomunice oil field (CBDG, 2019; Pernal and Wójcik, 1987).



5. WELLS

Fifty-three deep wells (>500 m TVD) reached the prospective intervals within the Złoczew tender area and in its close neighborhood (Fig. 14). These are: Barczew 1, 2, 4, Biady 1, Biała 2, Biesiec 1, 2, Błaszki 1, Brąszewice 1, Chrusty 1, Dymek IG-1, Gruszczyce 2, Iwanowice 1, Kalisz IG-1, Kliczków 1, 2, 3, 5, 5A, 6, 7, 8, Konopnica 1, Klonowa 3, Kuźnica Grabowska 1, 2, Kuźnica Strobińska 1, 3, Kuźnica Zagrzebska 1, Lututów 1, Masanów 1, Niechmirów IG-1, 2, Ostrów Kaliski 2, Ożegów IG-1, Prosna 1, Raduchów 2, Sobieseki 2, Stanisławów 1, 2, Świątkowice 1, 2, Uników 1, 3, Węglewice 1, Wieluń 2, 3, 4, 6, Wieruszów 2, Wierzcholas 1, Zapole 1 and Złoczew 1 (wells located within the tender area are highlighted).

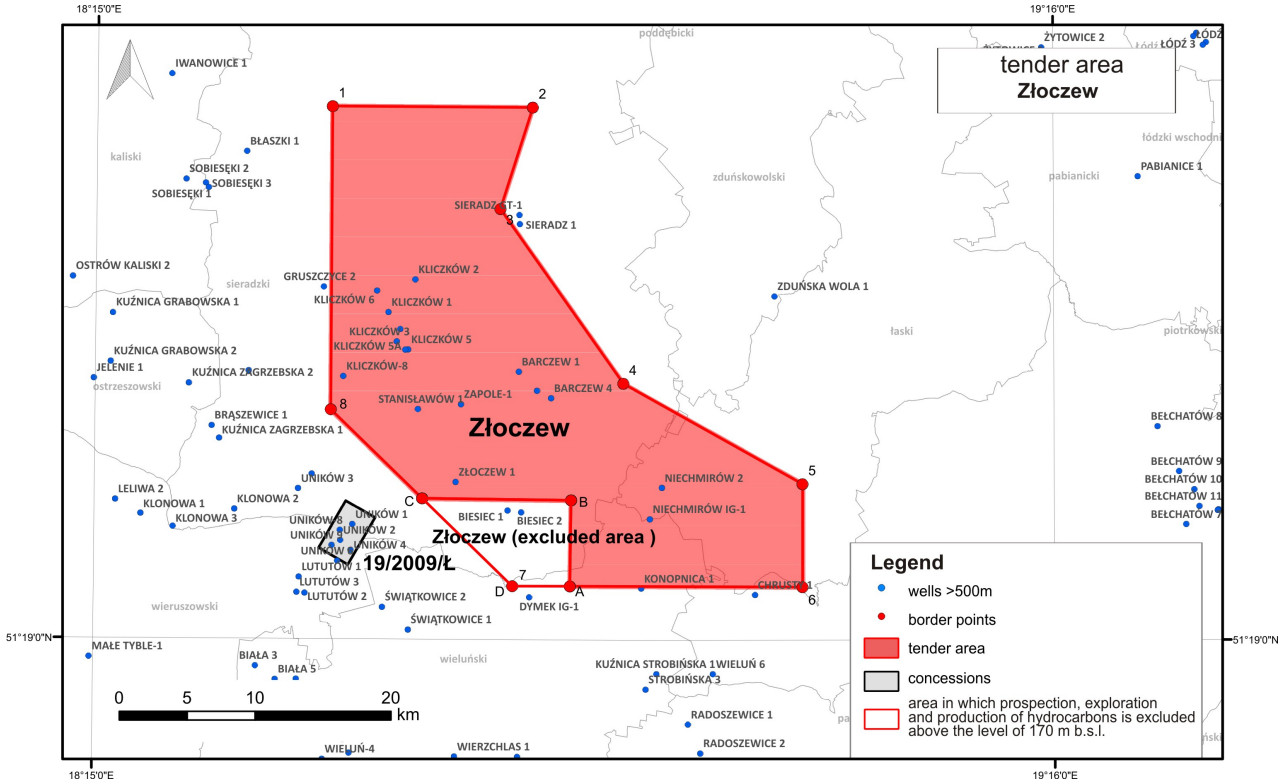


Fig. 14. Deep wells (> 500 m TVD) reaching the prospective intervals within the Złoczew tender area and in its close neighborhood.

STRATIGRAPHY		Barczew 1				Barczew 2				Barczew 4				Biesiec 1				Chrusty 1				Dymek IG-1			
		Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]
QUATERNARY		0.0	20.0			0.0	30.00			0.00	10.0			0.00	121.0			0.00	85.0			0.0	53.00		
PALEOGENE – NEOGENE		20.0	25.0			30.0	39.00			10.00	50.0														
JURRASIC	UPPER	25.0	660.0	3.0 – 20.4	1.3	39.0	610.0			50.0	607.5			121.0	322.0			85.0	336.0			53.0	239.0	5.24 – 6.92	
	MIDDLE	660.0	978.0	4.5 – 19.7	3.4	610.0	903.5	14.24	0.8	607.5	895.0			322.0	621.0			336.0	633.5			239.0	567.5	4.28	
	LOWER	978.0	1263.0	5.8 – 26.04	50.7 – 1249.2	903.5	1193.0	24.66	2500.0	895.0	1 182.5			621.0	872.5			633.5	1535.0			567.5	820.0		
TRIASSIC	UPPER	1263.0	1410.5			1193.0	1385.0	4.6 – 16.03	0.0	1 182.5	1 372.0			872.5	1 126.0			1535.0	1980.0			820.0	1 178.0	4.7 – 18.0	0.0 – 18.0
	MIDDLE	1 410.5	1 786.0	0.1 – 14.9	1.1 – 8.1	1385.0	1728.0			1 372.0	1 723.0			1 126.0	1 467.5							1 178.0	1 500.5		
	LOWER	1 786.0	2 629.0	0.1 – 15.5	1.9 – 29.2	1728.0	2579.0	0.5 – 14.1	0.0 – 35.0	1 723.0	2 635.0	0.5 – 44.8	0.0 – 2.2	1 467.5	2 255.0			1980.0	2620.0	3.1 – 9.9	0.0	1 500.5	2 231.5	1.9 – 19.7	0.001 – 15.8
PERMIAN	*Top terrigenous Series PZt*																	2620.0	2664.0			2 231.5	2 263.5	0.3 – 9.6	
	Upper Red Pelite T4b	2 629.0	2 683.0			2579.0	2633.5			2 635.0	2 647.0			2 255.0	2 267.5										
	Boundary Anhydrite A4a	2 683.0	2 685.0			2633.5	2636.1			2 647.0	2 648.0			2 267.5	2 268.5			2664.0	2665.0						
	Youngest Halite Na4a	2 685.0	2 724.0			2636.1	2671.5			2 648.0	2 685.0			2 268.5	2 281.0			2665.0	2700.0						
	Lower Pegmatite Anhydrite A4a1	2 724.0	2 727.5			2671.5	2673.5			2 685.0	2 687.0			2 281.0	2 282.0			2700.0	2701.0						
	Lower Red Pelite T4a	2 727.5	2 741.5			2673.5	2691.8			2 687.0	2 692.0			2 282.0	2 287.5			2701.0	2710.0						
	Top Anhydrite A3r	2 741.5	2 746.0							2 692.0	2 695.0			2 287.5	2 290.0			2710.0	2733.0			2263.5	2 268.5		
	Younger Halite Na3	2 746.0	2 772.5							2 695.0	2 733.0			2 290.0	2 325.0			2733.0	2836.0			2268.5	2 295.0		
	Main Anhydrite A3	2 772.5	2 818.0							2 733.0	2 780.0			2 325.0	2 381.0			2836.0	2857.0			2295.0	2 332.5		
	Grey Pelite T3	2 818.0	2 825.0							2 780.0	2 783.0			2 381.0	2 388.0			2857.0	2863.0			2332.5	2 340.0		
	Screening Anhydrite A2r	2 825.0	2 827.0							2 783.0	2 786.0			2 388.0	2 390.0			2863.0	2865.0			2340.0	2 352.5	1.01	
	Older Halite Na2	2 827.0	3 015.0	2.43						2 786.0	2 877.0							2865.0	3020.0	1.85 – 9.4					
	Basal Anhydrite A2	3 015.0	3 030.0							2 877.0	2 895.0			2 390.0	2 411.0			3020.0	3035.0						
	Main Dolomite Ca2	3 030.0	3 047.0							2 895.0	2 908.8			2 411.0	2 457.5	0.1 – 5.7	0.0	3035.0	3050.0	0.4 – 10.8	0.0 – 20.5	2352.5	2 386.0	0.6 – 1.2	
	Stinking Shale T2																					2386.0	2389.0	0.68	
	Recessive Terrigenous Series T2r	3 047.0	3 048.5																						
	Upper Anhydrite A1g													2 457.5	2 479.5	0.9 – 5.9	0.0	3050.0	3071.0	1.17 – 7.7	0.0	2389.0	2 417.5	1.0 – 9.6	
	Oldest Halite Na1													2 479.5	2 673.0			3071.0	3096.0			2417.5	2 484.0		
	Lower Anhydrite A1d	3 048.5	3 137.0											2 673.0	2 711.0			3096.0	3246.0			2484.0	2 577.5	0. 67	
	Zechstein Limestone Ca1	3 137.0	3 142.0	0.8 – 2.4										2 711.0	2 718.5	1.9 – 7.1	0.0	3246.0	3261.0	0.7 – 7.3	0.0	2577.5	2 592.0	1.4 – 2.52	
	Copper Shale T1	3 142.0	3 144.0											2 718.5	2 722.0	0.4 – 0.9	0.0	3261.0	3265.0	0.1 – 3.8	0.0	2592.0	2 594.0	6.0	
	Weissliegend																	3265.0	3272.0	0.1 – 4.8	0.0				
	Upper Rotliegend	3 144.0	3 220.0	0.2 – 17.6	0.3 – 92.4									2 722.0	2 927.0	0.4 – 8.7	0.0 – 1.5	3272.0	3560.0	1.1 – 9.7	0.0 – 1.8	2594.0	2 702.0	3.1 – 14.8	
CARBONIFEROUS														2 927.0	3 023.0			3560.0	3571.4			2702.0	2 797.0	0.8 – 6.0	

Tab. 5. Stratigraphy and petrophysical characteristics in the Barczew 1 (Urban-Łucka and Złonkiewicz, 1970a), Barczew 2 (Urban-Łucka and Złonkiewicz, 1970b), Barczew 4 (Gawęda, 1971), Biesiec 1 (Lis-Martyniak, 1974), Chrusty 1 (Gawęda, 1974), Dymek IG-1 (Chmielewski and Cygański, 1971).

STRATIGRAPHY		Kliczków 1				Kliczków 2				Kliczków 3				Kliczków 5		Kliczków 5A				Kliczków 6			
		Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]
QUATERNARY		0.0	60.0			0.0	15.0			0.0	35.0			0.0	62.0	0.0	50.0			0.0	52.0		
PALEOGENE – NEOGENE										35.0	77.0					50.0	63.0						
JURRASIC	UPPER	60.0	437.0	7.2 – 8.3	0.0	15.0	575.0	1.6 – 25.7	33.3 – 3454.2	77.0	349.5					63.0	213.0			52.0	495.0		
	MIDDLE	437.0	710.0			575.0	875.0			349.5	600.0			62.0	515.5	213.0	488.0			495.0	732.0		
	LOWER	710.0	962.0	24.92 – 26.8	573.0 – 1893.2	875.0	1480.0	9.5 –27.4	110.0 – 1191.2	600.0	884.0					488.0	838.0			732.0	993.0		
TRIASSIC	UPPER TRIASSIC	962.0	1183.0	10.7 – 22.1	3.8 – 14.1	1480.0	2182.0	0.0 – 17.5	0.5 – 119.5	884.0	1130.0					838.0	1439.0			993.0	1347.0		
	MIDDLE TRIASSIC	1183.0	1557.5	1.53 – 12.1	0.0 – 2.4	2182.0	2545.0	0.0 – 8.3	0.0	1130.0	1502.5					1439.0	1458.0			1347.0	1725.0		
	LOWER TRIASSIC	1557.5	2372.0	2.3 – 14.3	0.0	2545.0	2819.0	1.2 – 10.1	0.0	1502.5	2310.0					1458.0	2312.0	10.36		1725.0	2534.0	1.33	0.0
PERMIAN	*Top terrigenous Series PZt*	2372.0	2410.0			2819.0	2853.0			2310.0	2346.0					2312.0	2350.0			2534.0	2566.5		
	Boundary Anhydrite A4a									2346.0	2347.5					2350.0	2351.0			2566.5	2567.5		
	Youngest Halite Na4a									2347.5	2383.0					2351.0	2378.0			2567.5	2611.5		
	Lower Pegmatite Anhydrite A4a1									2383.0	2385.0					2378.0	2379.0			2611.5	2613.5		
	Lower Red Pelite T4a									2385.0	2392.0					2379.0	2384.0			2613.5	2621.0		
	Top Anhydrite A3r									2392.0	2396.0					2 384.0	2 391.0			2621.0	2626.0		
	Younger Halite Na3					2853.0	2955.0			2396.0	2433.0					2 391.0	2 422.0			2626.0	2680.0		
	Main Anhydrite A3					2955.0	3069.0	2.06	0.0	2433.0	2490.0					2 422.0	2 477.0			2680.0	2745.0	0.75 – 4.7	
	Grey Pelite T3					3069.0	3093.0			2490.0	2494.0					2 477.0	2 485.0			2745.0	2760.0		
	Screening Anhydrite A2r	2410.0	2414.0							2494.0	2496.0					2 485.0	2 487.0			2760.0	2765.0		
	Older Halite Na2	2414.0	2961.0			3093.0	3151.0			2496.0	2529.0	0.81	0.0			2 487.0	2 572.0			2765.0	2911.0		
	Basal Anhydrite A2	2961.0	2969.0			3151.0	3168.0			2529.0	2563.0					2 572.0	2 610.0	0.46 – 0.6		2911.0	2918.0		
	Main Dolomite Ca2	2969.0	2979.0	0.8 – 2.9	0.0					2563.0	2579.0	0.9 – 2.13	0.0			2 610.0	2 625.0	0.1 – 1.22	0.0	2918.0	2933.0	0.75 – 1.4	0.0
	Stinking Shale T2					3187.0	3192.0			2579.0	2584.0	0.5 – 1.9	0.0			2 625.0	2 628.0	0.2 – 0.97	0.0				
	Upper Anhydrite A1g					3192.0	3193.5			2584.0	2634.0	0.3 – 1.0	0.0			2 628.0	2 652.0	0.1 – 0.6	0.0	2933.0	2973.0		
	Oldest Halite Na1					3193.5	3210.0									2 652.0	2 802.0			2973.0	3193.0		
	Lower Anhydrite A1d					3210.0	3368.7	0.5 – 6.5	0.0							2 802.0	2 952.0			3193.0	3235.0		
	Zechstein Limestone Ca1															2 952.0	2 957.0	2.1 – 2.67	0.0	3235.0	3247.0	1.1 – 6.9	0.0
	Copper Shale T1															2 957.0	2 959.0	2.46	0.0				
	Upper Rotliegend															2 959.0	3 200.0	1.4 – 8.9	0.0 – 11.0	3247.0	3353.3	6.86 – 6.93	0.0
CARBONIFEROUS																3 200.0	3 204.0						

Tab. 6. Stratigraphy and petrophysical characteristics in the Kliczków 1 (Lis-Martyniak, 1973a), Kliczków 2 (Urban-Łucka and Wandas, 1969), Kliczków 3 (Urban-Łucka, 1972), Kliczków 5 and Kliczków 5A (Lis-Martyniak, 1972a), Kliczków 6 (Urban-Łucka, 1971).

STRATIGRAPHY		Niechmirów IG-1				Niechmirów 2				Stanisławów 1				Zapole 1				Złoczew 1			
		Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]	Top [m]	Bottom [m]	Porosity min–max [%]	Permeability min–max [mD]
QUATERNARY		0.0	67.3			0.0	7.0			0.0	30.0			0.0	35.0			0.0	59.0		
PALEOGENE – NEOGENE																		59.0	71.0		
JURRASIC	UPPER	67.3	475.5			7.0	600.0			30.0	332.5	12.9		35.0	147.0			71.0	370.0		
	MIDDLE	475.5	925.0	11.6 – 25.3	49.5 – 236.8	600.0	865.0	4.69	0.0	332.5	622.0	23.54		147.0	494.0			370.0	678.0		
	LOWER	925.0	1703.0	2.3 – 26.3	0.0 – 833.3	865.0	1130.0	4.0		622.0	893.0	26.86	1005.9	494.0	841.0			678.0	975.0		
TRIASSIC	UPPER	1703.0	1870.0	0.6 – 16.8	0.001 – 142.1	1130.0	1395.0	1.45	0.0	893.0	1089.0	12.44		841.0	1550.0	1.07 – 19.6	0.0 – 253.0	975.0	1155.0	3.47	0.0
	MIDDLE	1870.0	2240.0			1395.0	1762.0	1.18		1089.0	1446.0	0.98		1550.0	2140.0	0.77		1155.0	1503.0	2.42	
	LOWER	2240.0	2675.0			1762.0	2621.0	2.9 – 13.3	0.0 – 15.6	1446.0	2228.0	0.8 – 15.1	12.6 – 179.3	2140.0	2775.0	0.9 – 3.0	0.0	1503.0	2255.0	6.68	0.0
PERMIAN	*Top terrigenous Series PZt*	2675.0	2709.8			2621.0	2678.0			2228.0	2265.0	1.45		2775.0	2800.0			2255.0	2289.0	5.62	
	Boundary Anhydrite A4a					2678.0	2679.0			2265.0	2267.0							2289.0	2293.0		
	Youngest Halite Na4a					2679.0	2720.0			2267.0	2285.5							2293.0	2306.5		
	Lower Pegmatite Anhydrite A4a1					2720.0	2721.0			2285.5	2287.0							2306.5	2307.5		
	Lower Red Pelite T4a					2721.0	2740.0			2287.0	2290.5							2307.5	2310.0		
	Top Anhydrite A3r					2740.0	2742.0			2290.5	2292.5							2310.0	2311.0		
	Younger Halite Na3					2742.0	2773.5			2292.5	2326.0							2311.0	2334.0		
	Main Anhydrite A3					2773.5	2824.0			2326.0	2373.0			2800.0	2805.0			2334.0	2380.0		
	Platy Dolomite Ca3													2805.0	2820.0	2.68	0.0				
	Grey Pelite T3					2824.0	2832.0			2373.0	2381.0							2380.0	2384.0		
	Screening Anhydrite A2r					2832.0	2837.0			2381.0	2383.0							2384.0	2387.0		
	Older Halite Na2					2837.0	2917.0			2383.0	2412.0							2387.0	2398.5		
	Basal Anhydrite A2					2917.0	2928.0			2412.0	2433.5			2820.0	2872.0			2398.5	2416.0		
	Main Dolomite Ca2					2928.0	2939.0	1.1 – 2.6	0.0 – 1.0	2433.5	2464.0			2872.0	2878.8			2416.0	2456.0	0.7 – 2.8	0.0 – 24.8
	Stinking Shale T2																	2456.0	2459.0	0.7 – 3.05	0.0
	Upper Anhydrite A1g					2939.0	2955.0			2464.0	2486.0							2459.0	2475.0	1.9 – 2.65	0.0 – 7.6
	Oldest Halite Na1	2709.8	2782.1																		
	Middle Anhydrite A1s	2782.1	2799.4			2955.0	3051.0			2486.0	2 845.0							2475.0	2555.0	1.16	
	Oldest Halite Na1	2799.4	2861.8																		
	Lower Anhydrite A1d					3051.0	3120.0			2845.0	2 884.5							2555.0	2647.0	0.25 – 0.55	
	Recessive Terrigenous Series T1r	2861.8	2892.0																		
	Zechstein Limestone Ca1					3120.0	3128.0			2884.5	2892.0	3.57						2647.0	2655.0	0.31	
	Copper Shale T1					3128.0	3130.0			2892.0	2894.0							2655.0	2657.5		
	Upper Rotliegend					3130.0	3540.0	1.8 – 8 7	0.0 – 1.3	2894.0	3127.5	1.5 – 17.5	1.5 – 1874.4					2657.5	2867.0	0.2 – 10.4	0.0 – 190.7
	Lower Rotliegend																				
CARBONIFEROUS						3540.0	3587.0	0.0	0.0	3127.50	3162.0							2867.0	2980.0		

Tab. 7. Stratigraphy and petrophysical characteristics in the Niechmirów IG-1 (Spurek and Walczewski, 1971), Niechmirów 2 (Urban-Łucka, 1974), Stanisławów 1 (Lis-Martyniak, 1971), Zapole 1 (Lis-Martyniak, 1973b), Złoczew 1 (Lis-Martyniak, 1972b).

WELL:	BARCZEW 1	BARCZEW 2	BARCZEW 4	BIESIEC 1	BIESIEC 2	CHRUSTY 1	DYMEK IG-1	KLICZKÓW 1	KLICZKÓW 2	KLICZKÓW 3	KLICZKÓW 5	KLICZKÓW 5A	KLICZKÓW 6	KLICZKÓW 7
DEPTH:	3220.0	2691.8	2908.8	3023.0	2987.0	3571.4	2797.0	2979.0	3368.7	2634.0	515.5	3204.0	3353.0	2864.0
Drill core – storage	NO core	NO core	NO core	NO core	NAG: Chmielnik	NO core	NAG: Leszcze	NO core	NO core	NO core	NO core	NO core	NO core	PGNiG: Chmielnik
PK	25.0 – 3200.0	25.0 – 2675.0	25.0 – 2300.0	25.0 – 3025.0		25.0 – 3490.0	0.0 – 2790.0	25.0 – 2920.0	25.0 – 3320.0	25.0 – 2610.0		25.0 – 3200.0	25.0 – 2970.0	0.0 – 1440.0
PŚr	21.0 – 3144.0	175.0 – 2667.0	587.0 – 1612.0	119.0 – 3016.5	60.0 – 2992.0	145.0 – 3486.0	0.25 – 2792.75	30.0 – 2848.5	56.0 – 3345.0	130.0 – 2602.25	10.0 – 171.0	231.5 – 3200.0	26.0 – 2905.5	312.75 – 2858.0
PŚr SKS-4	1498.0 – 2226.0			122.0 – 3017.0	240.0 – 2990.0									
mPŚr	1494.0 – 3153.0	630.0 – 1470.0				2836.5 – 3360.0			235.0 – 1435.0	1494.5 – 2585.0			2914.0 – 3330.0	
BS								32.0 – 2848.0	56.0 – 3345.0	133.0 – 2618.0	231.5 – 3200.0		26.0 – 2905.5	320.0 – 2865.0
PA							80.0 – 2794.0			2475.0 – 2595.0		2575.0 – 3201.0	46.0 – 3250.0	
PAa1				2393.0 – 2876.0										
PAdt				2394.0 – 2876.0	15.25 – 2995.5	2830.0 – 3489.0							2875.0 – 3248.0	320.0 – 2864.0
PAt1				2393.0 – 2876.0	275.0 – 2992.0	2837.0 – 3490.0	1500.5 – 2789.25							260.0 – 2865.0
PAt2					275.0 – 2992.0	2837.0 – 3490.0								260.0 – 2865.0
PAc	202.0 – 2503.0					893.0 – 1602.0				5.0 – 2498.0		53.0 – 2583.0		
PG	1.75 – 3154.25	8.25 – 2675.0		8.0 – 3014.5	2.25 – 2992.0	0.0 – 3494.0	0.0 – 2792.75	54.25 – 2848.0	200.0 – 3346.25	13.0 – 2633.75		1.5 – 3200.0	1.0 – 2912.5	0.25 – 2862.5
PG SP–60	3.0 – 602.0													
PG SP–62	550.0 – 3152.0	10.0 – 2675.0	10.0 – 1625.0	10.0 – 2834.0			0.75 – 2792.75							
PGG												1575.0 – 2327.0		
PNG	4.25 – 3207.75	10.0 – 2677.25		10.0 – 3018.0	14.0 – 2992.0	2.0 – 3495.0	1.5 – 2792.75	56.5 – 2849.75	202.5 – 3348.0	15.0 – 2633.0		5.0 – 3203.0	3.5 – 2915.0	0.25 – 2862.5
PNG SP–60	3.0 – 602.0													
PNG SP–62	550.0 – 3206.0	10.0 – 2675.0	10.0 – 1625.0	10.0 – 2936.0			1.5 – 2796.50							
PNNt					265.0 – 2992.0		1202.25 – 1319.75							0.0 – 2865.0
PI					1193.0 – 1758.0									320.0 – 1442.0
PS	27.0 – 252.0	31.0 – 2616.0	587.0 – 2285.0	118.0 – 2725.0	79.0 – 2990.0	151.0 – 2836.5	2377.25 – 2798.75	32.0 – 2835.0	60.0 – 3320.0	132.0 – 2441.0		235.0 – 3201.0	163.0 – 2913.0	320.0 – 2865.0
gPS							257.5 – 2788.75							
PO	A2.0M0.5N 2748.0 – 3201.0			ABK-3 2230.0 – 2423.0	EL18 75.0 – 2992.0		A0.1B1.0M 190.0 – 756	B4.48A1.62M 32.0 – 284.0	B4.48A1.62M 60.0 – 950.0	B4.48A1.62M 132.0 – 390.0		M0.5A0.1B 235.0 – 2331.0	M0.5A0.1B 163.0 – 1536.0	A0.4M5.7N 320.0 – 1440.0
	B4.48A1.62M 27.0 – 252.0	B4.48A1.62M 31.0 – 181.0			EL16 75.0 – 2993.0		B0.1A1.0M 53.4 – 91.0	B5.7A0.4M 32.0 – 284.0	B5.7A0.4M 60.0 – 950.0	B5.7A0.4M 132.0 – 390.0		M1.0A0.1B 235.0 – 2331.0	M1.0A0.1B 163.0 – 1536.0	A1.62M4.48N 320.0 – 1440.0
	B5.7A0.4M 27.0 – 252.0						B2.5A0.25M 192.0 – 2780.0	M0.5A0.1B 250.0 – 1476.0	M0.25A0.1B 1579.0 – 1913.0	M0.5A0.1B 422.0 – 2095.0		M2.5A0.25B 25.0 – 2802.2	M2.5A0.25B 163.0 – 2913.0	A5.28M0.82N 320.0 – 1440.0
	M0.5A0.1B 251.0 – 2228.0	M0.5A0.1B 63.0 – 2180.0	M0.5A0.1B 50.0 – 2285.0				B4.48A1.62M 700.0 – 2483.0	M1.0A0.1B 250.0 – 1476.0	M0.5A0.1B 235.0 – 2765.0	M1.0A0.1B 132.0 – 2611.0		M4.0A0.5B 235.0 – 2802.2	M4.0A0.5B 163.0 – 2913.0	A8.0M1.0N 320.0 – 1440.0
	M1.0A0.1B 251.0 – 3151.0	M1.0A0.1B 63.0 – 2616.0	M1.0A0.1B 587.0 – 2285.0				B5.7A0.4M 700.0 – 2483.0	M2.5A0.25B 250.0 – 2835.0	M1.0A0.1B 235.0 – 2765.0	M2.5A0.25B 422.0 – 2441.0	M2.5A0.25B 27.5 – 168.5	M8.0A0.5B 235.0 – 3201.0	M8.0A0.5B 163.0 – 2913.0	EL18 313.75 – 2865.0
	M1.0A0.5B 1494.0 – 1669.0						M0.1N1.0A 170.0 – 270.0					EL02 234.0 – 2333.0	EL03 157.0 – 2208.0	EL64 311.0 – 2864.75
	M2.5A0.25B 251.0 – 3151.0	M2.5A0.25B 63.0 – 2616.0	M2.5A0.25B 75.0 – 2285.0	M2.5A0.25B 1898.5 – 2423.0			M0.5A0.1B 700.0 – 2780.0		M2.5A0.25B 235.0 – 3320.0	M4.0A0.5B 422.0 – 2441.0		EL03 234.0 – 2333.0	EL18 33.5 – 151.5	
	M4.0A0.5B 251.0 – 3151.0	M4.0A0.5B 63.0 – 2616.0	M4.0A0.5B 75.0 – 2285.0	M4.0A0.5B 1898.5 – 2725.0		M4.0A0.5B 151.0 – 3367.0	M1.0A0.1B 53.5 – 2780.0	M4.0A0.5B 250.0 – 2835.0	M4.0A0.5B 235.0 – 3320.0			EL09 235.0 – 3202.0		
	M5.28A0.82B 27.0 – 252.0	M5.28A0.8 31.0 – 181.0					M2.5A0.25B 192.0 – 2780.0	M5.28A0.8 32.0 – 284.0	M5.28A0.8 60.0 – 950.0	M5.28A0.8 132.0 – 390.0		EL14 238.0 – 3201.0		
	M8.0A1.0B 251.0 – 3151.0	M8.0A1.0B 63.0 – 2616.0	M8.0A1.0B 587.0 – 2285.0	M8.0A1.0B 1898.5 – 2423.0			M5.28A0.82B 700.0 – 2780.0	M8.0A1.0B 250.0 – 2835.0	M8.0A0.5B 235.0 – 3320.0	M8.0A0.5B 422.0 – 2441.0		EL27 240.0 – 3203.0		
	EL09 253.0 – 3152.0	EL09 175.5 – 2677.75		EL09 122.0 – 3018.0		EL14 153.0 - 3448.0	M8.0A1.0B 700.0 – 2780.0	EL09 1064.0 – 2834.0	EL09 236.75 – 3325.0	EL09 422.25 – 2617.0				
							EL03 M0.1N1.0A 180.2 – 273.85							
							EL03 M1.0A0.1B 50.5 – 273.75							
							EL09 183.25 – 2792.75							
							EL09 M2.5A0.25B 181.75 – 2795.5							
							EN10 B2.5A0.25M 183.25 – 2479.75							
							EN10 181.75 – 2792.75							
mPO	A1.0M0.1N 250.0 – 1499.0	A1.0M0.1N 63.0 – 1690.0	A1.0M0.1N 587.0 – 2285.0				A0.025M0.025N 700.0 – 1320.0	A1.0M0.1N 250.0 – 2050.0	235.0 – 2340.0	A1.0M0.1N 422.0 – 1476.0		A1.0M0.1N 235.0 – 2331.0	A1.0M0.1N 150.0 – 2221.0	
	A2.0M 250.0 – 1315.0	A2.0M 63.0 – 1217.0						A2.0M 250.0 – 2050.0	A1.0M0.1N 60.0 – 2337.0	A2.0N 422.0 – 1476.0		A2.0N 235.0 – 2331.0	A2.0N 150.0 – 2221.0	
		A2.0N 175.0 – 1690.0	A2.0N 587.0 – 2285.0						A2.0N 60.0 – 280.0					
		M1.0A0.1N 175.0 – 580.0												
POp					340.0 – 2990.0									1520.0 – 2865.0
					ZPO-2 79.0 – 336.0									
POg				M2.5A0.25B 122.0 – 3017.0	340.0 – 2990.0	1668.0 – 1839.0								1520.0 – 2865.0
				M4.0A0.5B 122.0 – 3017.0	ZPO-2 79.0 – 2388.0	M1.0A0.1B 151.0 – 1175.0								
				M8.0A1.0B 122.0 – 3017.0		M2.5A0.25B 151.0 – 3495.0								
						M4.0A0.5B 151.0 – 3495.0								
						M8.0A1.0B 151.0 – 3495.0								
POpł					50.0 – 2990.0		1160.25 – 2794.75							325.0 – 2865.0
POst	2748.0 – 3201.0			2415.0 – 3017.0		2564.0 – 2835.0	1250.0 – 2780.0	1450.0 – 2850.0	2855.0 – 3320.0	1206.25 – 2611.75		2190.5 – 3202.0	1519.0 – 2913.5	314.25 – 2865.0
POst LL3				2182.0 – 3019.0	332.0 – 2993.0									
mPOst						1250.0 – 2780.0								1522.5 – 2719.0
PP				1898.5 – 2877.0										
PPu						2250.0 – 3495.0								
PT				7.0 – 1383.0			80.0 – 2445.0	14.0 – 405.0		8.0 – 2608.0		6.0 – 1571.0	40.0 – 1300.0	
PTn					350.0 – 2990.0									325.0 – 2700.0
PTu								25.0 – 2907.0	10.0 – 2900.0	2281.0 – 2590.0				
PTn/c				1.0 – 564.0 564.0 – 2924.0										
PGaz						2281.0 – 3495.0		1048.0 – 1173.0	0.0 – 1496.0	2566.8 – 2586.0		2588.5 – 2962.6	3205.5 – 3254.8	
Velocity survey				18 – 2818	20.0 – 2880.0	7.0 – 3457.0		20 .0 – 2823.0	20.0 – 2780.0			20.0 – 3176.0		20.0 – 2860.0

Tab. 7. Well geophysics. Logs available in digital format are highlighted.

WELL:	KONOPNICA 1	MASANÓW 1	NIECHMIRÓW IG-1	NIECHMIRÓW 2	PROSNA 1	STANISŁAWÓW 1	ZAPOLE 1	ZŁOCZEW 1
DEPTH:	2960.0	2631.0	2892.0	3587,0	2300,0	3162,0	2878,8	2980,0
Drill core – storage	PGNiG: Chmielnik	NAG: Halinów	NAG: Leszcze	NO core	NO core	NO core	NO core	NO core
PK	0.0 – 2959.0		0.0 – 2305.0	2600.0 – 3575.0		25.0 – 3150.0	25.0 – 2425.0	25.0 – 2200.0
PŚr	435.0 – 2544.0		0.25 – 2664.5	342.0 – 3562.0		175.0 – 3138.5	91.0 – 2431.0	300.0 – 2689.0
PŚr SKS-4	435.0 – 2545.0		52.5 – 2664.5	1544.0 – 2723.0		176.0 – 3199.0	80.0 – 2430.0	300.0 – 2693.0
mPŚr				2742.0 – 3170.0		226.0 – 1350.0		
BS	435.0 – 2958.0			342.0 – 3562.0		178.0 – 3160.0		300.0 – 2689.0
PA	370.0 – 2959.0					2200.0 – 3152.0		2423.0 – 2693.0
PAa1							80.0 – 1795.0	
PAdt	435.0 – 2545.0			2735. – 2993.0			91.0 – 1790.0	
PAt1				2742.0 – 2995.0			80.0 – 1795.0	
PAt2				2742.0 – 2995.0			80.0 – 1795.0	
PAc	0.0 – 2545.0					100.0 – 2971.0		190.0 – 2490.0
PG	0.0 – 2543.25		0.0 – 2664.4	0.0 – 3569.5		5.5 – 3158.0	12.75 – 2433.0	9.0 – 2732.0
PG SP–62	2536.0 – 2959.0		2.5 – 2664.75	1.0 – 2253.0		5.0 – 3155.0	15.0 – 2432.0	5.0 – 2435.0
PNG	0.0 – 2544.25		0.5 – 2664.75	2.5 – 3572.0		7.0 – 3160.0	15.5 – 2433.0	11.0 – 2732.0
PNG SP–62	2536.0 – 2959.0		0.25 – 2664.75	1.0 – 3570.0		5.0 – 3155.0	15.0 – 2432.0	5.0 – 2435.0
logPNG SP-62	2536.0 – 2959.0							
PNNt	0.0 – 2544.0							
PS	435.0 – 2959.0		64.0 – 2664.50	347.5 – 1548.0		176.0 – 3150.0	91.0 – 2430.0	304.0 – 2703.0
PO	A5.25M0.82N 435.0 – 2542.0		M0.5A0.1B 1960.0 – 2302.0	M1.0A0.1B 347.5 – 1065.0		M0.5A0.1B 176.0 – 3150.0	M4.0A0.5B 2250.0 – 2832.0	M0.5A0.1B 304.0 – 2703.0
	A8.0M1.0N 435.0 – 2542.0		M1.0A0.1B 1960.0 – 2302.0	M2.5A0.25B 347.5 – 1065.0		M1.0A0.1B 176.0 – 3150.0	EL09 91.75 – 2432.0	M1.0A0.1B 304.0 – 2440.0
	N4.48M1.62A 435.0 – 2542.0		M2.5A0.25B 1960.0 – 2302.0	M4.0A0.5B 347.5 – 3170.0		M2.5A0.25B 176.0 – 3150.0		M2.0A0.5B 304.0 – 597.0
	N5.7M0.4A 435.0 – 2542.0		M5.28A0.82B 1960.0 – 2302.0	M8.0A1.0B 347.5 – 1065.0		M4.0A0.5B 176.0 – 3150.0		M2.5A0.25B 525.0 – 2968.0
	E16N 429.75 – 2959.0		M8.0A1.0B 1960.0 – 2302.0	EL03 347.5 – 1067.5		M8.0A0.5B 176.0 – 3150.0		M4.0A0.5B 304.0 – 2968.0
			EL02 M0.5A0.1B 1955.5 – 2300.25	EL28 357.5 – 3570.0		EL09 790.0 – 3154.25		M8.0A1.0B 304.0 – 2968.0
			EL03 M1.0A0.1B 1955.5 – 2300.25					EL09 305.0 – 2963.0
			EL09 A2.5M0.25N 1603.0 – 2664.75					
			EL09 M2.5A0.25B 64.5 – 2304.75					
			EL18 M5.28A0.82B 1955.25 – 2301.75					
			EL26 M8.0A1.0B 1955.25 – 2301.75					
			EN10 B2.5A0.25M 1953.5 – 2306.75					
			EN10 64.5 – 2664.75					
			EN16 B5.7A0.4M 1954.25 – 2306.75					
mPO			A1"M1"N 1800.0 – 2302.0			A1"M1"N 176.0 – 847.0		2419.5 – 2699.5
			A2"M 1800.0 – 2302.0			A2"M 176.0 – 847.0		A1"M1"N 300.0 – 1600.0
								A2"M 300.0 – 1600.0
POp	A5.7M0.4N 2536.0 – 2959.0		B2.5A0.25M 1960.0 – 2302.0					
	A8.0M1.0N 2536.0 – 2959.0		B5.7A0.4M 1960.0 – 2302.0					
POg	2125.0 – 2542.0		63.0 – 2265.0	M2.5A0.25B 945.0 – 2726.0			M0.5A0.1B 91.0 – 1664.0	
	A1.0M0.1N 2536.0 – 2959.0		M2.5A0.25B 1594.5 – 2302.0	M4.0A0.5B 945.0 – 3570.0			M1.0A0.1B 91.0 – 1792.0	
				M8.0A1.0B 945.0 – 2726.0			M1.0A0.25B 91.0 – 2430.0	
							M4.0A0.5B 91.0 – 2430.0	
							M8.0A1.0B 91.0 – 2430.0	
POpł	450.0 – 2540.0		1955.25 – 2301.75	348.0 – 1547.0				
POst	435.0 – 2543.0			945.0 – 2726.0		226.0 – 3150.0	91.0 – 2430.0	2420.5 – 2968.0
POst LL3				343.5 – 3567.0				
mPOst	2536.0 – 2959.0			2145.0 – 2726.0				
logPOst	435.0 – 2959.0							
PP				1545.0 – 2726.0				
PT			1850.0 – 2302.0					5.0 – 2525.0
PTn	450.0 – 2540.0		1850.25 – 2305.25					
PGaz						2701.0 – 2903.5		2290.0 – 2966.7
Velocity survey	20.0 – 2960.0			20.0 – 2933.0		20.0 – 2900.0		20.0 – 2465.0

Tab. 10. Well geophysics. Logs available in digital format are highlighted. PK – deviation log, PŚr – caliper, PŚr SKS-4 – caliper using SKS-4 probe, mPŚr – caliper – microlog, BS – nominal diameter log, PA – acoustic log, PAa1 – amplitude, acoustic log, PAdt – interval transit time – acoustic log, PAt1 – travel time T1 – acoustic log, PAt2 – travel time T2 – acoustic log, PAc – cement bond log – acoustic log, PG – gamma ray log, PG SP-60 – gamma ray log using SP–60 probe, PG SP-62 – gamma ray log using SP–62 probe, PGG – density log, PNG – neutron-gamma ray log, PNG SP-60 – neutron-gamma ray log using SP–60 probe, PNG SP-62 – neutron-gamma ray log using SP–62 probe, logPNG SP-62 – neutron-gamma ray log using SP–62 probe (logarithm), PNNnt – epithermal neutron log, PI – induction log, PS – spontaneous potential log, gPS – gradient of spontaneous potential log, PO – conventional electric log, mPO – conventional electric microlog, POp – electric log using potential probe, POg – electric log using gradient probe, POpł – salinity log, POst – focussed electric log, POst LL3 – focussed electric log using LL3 probe, mPOst –focussed electric microlog, logPOst – focussed electric log (logarithm), PP – induced potential log, PPu – conductivity log, PT – temperature log, PTn – temperature log in thermal disequilibrium, PTu – temperature log in thermal equilibrium, PTn/c – temperature log in thermal disequilibrium after cementation, PGaz – gas log, velocity survey.

Well		Top [m]	Bottom [m]	Stratigraphy	Flow kind
Barczew 1	D	1629.1	1673.4	Muschelkalk	brine – 2.3 m^3/h, chloride-calcium brine with mineralisation > 184 g/l
	D	3165.0	3110.0	Rotliegend	no flow
	A	3120,6	3220,0	Zechstein basement, Rotliegend	flow of brine with drilling fluid
Biesiec 1	D	2400.0	2462.4	Main Dolomite	no flow, impermeable
	D	2685.0	2727.4	Zechstein limestone, Rotliegend	flow of drilling fluid from leaking pipe
	D	2689.5	2744.0	Zechstein limestone, Rotliegend	no flow, impermeable
	D	2742.0	2830.5	Rotliegend	flow of drilling fluid with gas traces
	A	2868.0	2877,0	Rotliegend	no flow from formation
	A	2723.0	2730,0		no flow from formation
	A	2421.0	2436,0	Main Dolomite	flow of gas with drilling fluid, and drilling fluid with flowback fluid and gasoline traces
	A	2421.0	2436,0		flow of drilling fluid with gas and flowback fluid
Chrusty 1	D	3002.0	3058.7	Main Dolomite	no flow
	D	3243.0	3278.8	Zechstein Limestone and top of Rotliegend	no flow
	D	3256.0	3320.8	Rotliegend	no flow
Dymek IG-1	D	1642.5		Buntsandstein	no flow
	D	1643.5			no flow
	D	1769.5			brine flow – 5 l/8 min
	D	1798.0			brine flow – 7 l/8 min
	D	1826.0			brine flow – 7 l/10 min
	D	1841.0			brine flow – 7 l/10 min
	D	1855.5			brine flow – 7 l/10 min
	D	1913.0			brine flow – 2 l/10 min
	D	1917.0			no flow
	D	1990.0			brine flow – 0.5 l/9 min
	D	2044.5			brine flow – 2.5 l/7 min
	D	2108.0			brine flow – 5 l/10 min
	D	2136.5			brine flow – 5 l/10 min
	D	2210.5			brine flow – 6 l/10 min
	D	2218.0			brine flow – 6 l/10 min
	D	2225.0			no flow
	D	2226.0			brine flow – 2 l/10 min
	D	2354.0		Main Dolomite	no flow
	D	2405.0		Upper Anhydrite	no flow
	A	758.0	765.0	Lower Jurrasic	fresh water flow – 2.8 m^3/h
	A	1400.0	1415.0	Muschelkalk	brine flow – 145 l/h
	A	1630.0	1642.0	Rhaetian	mildly salty water flow
	A	1761,0	1775.0	Buntsandstein	brine flow – 56.8 l/h
	A	2190.0	2212.0		salty water flow – 1.75 l/h
	A	2350.0	2365.0	Upper Dolomite	no flow
	A	2565.0	2680.0	Zechstein, Rorliegend	brine flow – 117 l/h
Kliczków 1	D	2968.0	2979.0	Basal Anhydrite, Main Dolomite	ca. 0.85 m^3 of drilling fluid with brine (with ca. 0.15 m^3/h of brine) in 110 min
	D				ca 25 l of oil and ca. 190 l of brine in 8 h
Kliczków 3		2550.0	2588.0	Basal Anhydrite, Main Dolomite, Stinking Shale, Main Anhydrite	0.9 m^3 of gasified oil with brine, in 155 min; productivity set at ca. 0.35 m^3/h.
		2563.0	2570.0	Main Dolomite	no flow
		2576.0	2590.0	Main Dolomite, Stinking Shale, Upper Anhydrite	drilling fluid flow –0.5 l/min; flow of water with oil traces after installation of siphon pipes to depth of 1000 m, acitizing process was performed, ejection of gas, oil and water from the well
		2563.0	2580.0	Main Dolomite, Stinking Shale	fracturing was performed, self-outflow of oil and oil with gas.
Kliczków 5A	D	2583.0	2636.6	Basal Anhydrite, Main Dolomite, Stinking Shale, Upper Anhydrite	drilling fluid flow from leaking pipe, sample of fluid from the probe has contained significant amounts – up to 0.29% – of bitumineous substance, its properties were characteristic fo oil bitumens
	A	2951.0	2974.0	Lower Anhydrytite, Zechstein limestone, Cooper Shale, Rotliegend	no flow
	A	2462.0	2503.0	Main Anhydrite, Grey Pelite, Screening Anhydrite, Older Halite	no flow
	A	2412.0	2503.0	Basal Anhydrite, Grey Pelite	no flow
Kliczków 6		2918.0	2933.2	Main Dolomite, Upper Anhydrite	no flow after 30 min
		3227.3	3254.8	Lower Anhydrytite, Zechstein Limestone, Cooper Shale, Rotliegend	slight flow of drilling fluid with bitumens traces after 45 min.
		3241.8	3337.0	Zechstein Limestone, Cooper Shale, Rotliegend	flow of brine with drilling fluid from formation – 0.9 m^3/h after 95 min.
Kliczków 8		2790.0	2842.1	Lower Anhydrytite, Zechstein Limestone, Cooper Shale, Rotliegend	no flow
		2842.0	2947.7	Carboniferous, Rotliegend	flow of brine with non-flammable gas traces
Niechmirów 2		2701.3	2965.6	Main Dolomite	1.1 m^3 of fluid with non-flameble gas flow, after 10 h of flow waiting and 4 h of preassure build-up
		3118.0	3190.0	Lower Anhydrytite, Zechstein Limestone, Cooper Shale, Rotliegend	flow of brine without bitumen traces, productivity specified at level 0.50 m^3/h
		zapięto paker na głęb. 2135.0		Buntsandstein	flow of brine with weak non-flammable gas traces, after 70 min of flow waiting and 50 min of preassure build-up
Stanisławów 1	D	1428.6	1557.8	Muschelkalk, Rhaetian	ca 0.65 m^3/h of drilling fluid with possible formation fluid, while 45 min of flow waiting
	A	2960.0	2965.0	Rotliegend	ca 100 l/h of drilling fluid with possible formation fluid and gas traces (analysed fluid proved to be a drilling fluid pressed to the well), while 78 min of flow waiting
	A	2884.5	2900.0	Zechstein Limestone, Cooper Shale, Rotliegend	ca 350 l/h of drilling fluid with possible formation fluid (analysed fluid proved to be a drilling fluid pressed to the well), while 38 min of flow waiting
	A	2439.0	2458.0	Main Dolomite	drilling fluid from leaky valve, while 160 min of flow waiting
	A				ca 50 l/h of drilling fluid from leaking pipe with possible formation fluid and weak gas traces, after 80 min of flow waiting
	A				55 l/h of acidizing fluid with weak gas traces after 360 min
	A				ca 110 l/h of slightly acidizing fluid with possible formation fluid, slightly gasified, while 300 min of flow waiting
Zapole 1		2800.0	2878.8	Upper Anhydrite, Platy Dolomite and Grey Pelite, Basal Anhydrite, Main Dolomite	no flow after 70 min of waiting and 100 min of preassure buil-up
Złoczew 1	D	2423.0	2448.0	Main Dolomite	ca 50 l of drilling fluid from fluid expansion, while 95 min of waiting
	D	2387.6	2487.6	Older Halite, Basal Anhydrite, Main Dolomite, Stinking Shale, Upper Anhydrite, Oldest Halite	50 l of drilling fluid from fluid expansion, while 60 min of waiting
	D	2637.4	2675.6	Lower Anhydrytite, Zechstein Limestone, Cooper Shale, Rotliegend	30 l of drilling fluid with gas traces and point traces of oil while 75 min of waiting
	D	2654.0	2703.5	Zechstein limestone, cooper shale, Rotliegend	1.3 m^3 of formation fluid with gasified drilling fluid and very weak oil traces while 75 min of waiting
	A	2657.0	2661.0	Cooper Shale, Rotliegend	30 l of drilling fluid from fluid expansion and traces of non-flammable gas, while 160 min of flow waiting
	A	2647.0	2663.0	Zechstein Limestone, Cooper Shale, Rotliegend	no flow while 30 h of waiting
	A	2435.0	2455.0	Main Dolomite	flow of ca. 3580 l of slightly gassified fluid, (ca 1250 l of formation fluid resulting from a leak outside packer and 2330 l of drilling fluid) while 28 h of flow waiting
	A				ca 600 l of fluid, slighlty gasified by flammable gas, while 29 h of flow waiting

Tab. 11. Tests during (D) and after (A) drilling.

Well	Top [m]	Bottom [m]	Stratigraphy	Shows
Barczew 1	1670.0		Lower Muschelkalk	bituminous odour of the core
Barczew 2	73.0		Lower Jurrasic	circulation loss – 20 m^3/h
	366.0	655.0	Lower and Middle Jurrasic	circulation loss
	1064.7	1071.0	Hettangian–Pliensbachian	brown spots on the core
	1243.3		Norian	circulation loss – 13 m^3 (ca 1 m^3/h)
	1256.4	1260.3		gas odour at the broken core
	1260.3	1272.2		bituminous odour at the broken core, gas resulting from core defassing doesn't contain hydrocarbons
	2691.8		Zechstein	circulation loss while well processing
Barczew 4	296.6		Upper Jurrasic	circulation loss – 10 m^3, and subsequently 11 m^3
	325.8			circulation loss – 60 m^3
	1346.6		Carnian	drilling fluid gelation during gypsum drilling
	2687.1		Lower Red Pelite	circulation loss – ca. 8 l/30min
	2735.0	2895.0	Main Anhydrite	< 0.8% of methane in drilling fluid
	2895.0	2902.8	Main Dolomite	up to 1.8% of methane in drilling fluid
	2902.8			abrupt self-outflow of drilling fluid, then hydrogene-sulphide brine with gas traces; hydrocarbons: C_1–C_4 – 24.7%
	2889.0	2894.8	Basal Anhydrite	strong H_2S odour after core breaking
	2894.8	2900.0	Basal Anhydrite, Main Dolomite	strong H_2S odour after core breaking
Biesiec 1	102.5		Cenozoic	total circulation loss
	131.0		Jurrasic	circulation loss – 41 m^3
	240.0	650.0		drilling with no circulation
	2315.6		Younger Halite	circulation loss – ca 15 m^3
	2372.0	2381.0	Main Anhydrite	circulation loss – 17 m^3
	2397.0	2432.3	Basal Anhydrite, Main Dolomite	circulation loss – 22 m^3, 15 m^3 and 35 m^3
	2448.3	2462.4	Main Dolomite, Upper Anhydrite	insignificant oil traces
	2718.6	2727.4	Rotliegend	insignificant oil traces
	2701.2	2718.6	Lower Anhydrite, Zechstein Limestone, Cooper Shale	strong odour of H_2S at the broken core
Chrusty 1	1177.8		Lower Jurrasic	circulation loss
	3041.0	3050.0	Main Dolomite	strong bituminous and H_2S odour
	3246.0	3261.0	Zechstein Limestone	strong H_2S odour
	3260.4	3278.8	Zechstein Limestone, Cooper Shale, Weissliegend, Rotliegend	visible traces of bright-green light oil with milky luminescence
	3571.4		Carboniferous	circulation loss – ca. 5 m^3
Dymek IG-1	1740.0	1749.0		slight gasification of drilling fluid
	2360.0	2380.0		fluorescence under the Wood's lamp
Kliczków 1	925.0		Pliensbachian	circulation loss – 20 m^3
	1381.5	1388.0	Middle Triassic	H_2S odour
	2643.6	2650.0	Older Halite	H_2S odour
	2971.5	2976.6	Main Dolomite	strong bituminous odour, locally oil traces visible in core cracks
	2977.3			gasified drilling fluid ejection
Kliczków 2	3274.6	3283.9	Lower Anhydrite	H_2S odour of the core
	285.0			strong water flow
Kliczków 3	2566.8	2569.8	Main Dolomite, Stinking Shale, Upper Anhydrite	strong H_2S odour after core breaking
	2575.4	2578.8		strong H_2S odour after core breaking
	2578.8	2581.6		strong H_2S odour after core breaking
	2581.6	2588.1		strong H_2S odour after core breaking
	2593.0	2599.0		strong H_2S odour after core breaking
	2566.8	2580.0		up to 0.1% of methane in drilling fluid
	2580.0	2586.0		7% of methane in drilling fluid
	2584.5	2588.1		gasified drilling fluid low with oil traces
	2588.1	2599.0		Strongly gasified drilling fluid
Kliczków 5	72.4		Jurrasic	circulation loss – ca. 10 m^3/10 min
	117.0			circulation loss – ca. 10–20 l/sec
	315.5			
	425.0			
Kliczków 5A	2579.1	2584.3	Basal Anhydrite	H_2S odour
	2588.5	2597.5		H_2S odour
	2597.5	2615.2	Basal Anhydrite, Main Dolomite	very weak H_2S and hydrocarbons odour
	2615.2	2619.7	Main Dolomite	hydrocarbons odour
	2619.7	2627.6	Main Dolomite, Stinking Shale	hydrocarbons odour
Kliczków 6	2918.0	2919.7	Main Dolomite	H_2S odour
	2919.7	2921.2		H_2S odour
	2921.2	2922.7		H_2S odour
	2922.7	2924.0		H_2S odour
	2924.0	2926.4		H_2S odour
	2926.4	2927.9		H_2S odour
	2927.9	2930.4		H_2S odour
	3198.8	3204.8	Lower Anhydrite	H_2S odour
	3221.0	3227.6		H_2S odour
Kliczków 8	2501.1	2503.2	Basal Anhydrite	strong H_2S odour after core breaking
	2518.9	2522.0	Main Dolomite	blue-milky luminescence
	2522.0	2530.4		strong bituminous and H_2S odour
	2530.4	2539.0		strong H_2S odour
	2539.0	2546.2	Main Dolomite, Stinking Shale	oil traces and H_2S odour
	124.8		Oxfordian	circulation loss – 60 m^3/40 min
	2546.2		Stinking Shale	outflow of drilling fluid from the pipe, then ca 500 l of brine contaminated with drilling fluid
	2821.4	2823.9	Rotliegend	very weak, white-blue point luminescence
	2823.9	2825.0		
	2941.6		Carboniferous	circulation loss – ca. 30 m^3 and total circulation loss
	2942.2			circulation loss – 15 m^3 and total circulation loss
Niechmirów IG-1		810.0	Bajocian	methane – 1.5%
		813.8		methane – 2.5%
	813.8	823.0		methane – from 3.5 to 4%
	289.0	838.0		methane – ca. 5%
	935.0	941.0	Toarcian	methane – from 2 to 3%
	1224.0	1252.0	Pliensbachian	methane – from 0 to 1%
	1300.0	1331.0		methane – from 0 to 5%
	1331.0	1339.2		methane – from 6 to 25%
	1339.2	1597.0	Pliensbachian-Carnian	methane – ftom 5 to 20%
	1597.0	1606.0	Carnian	methane – < 5%
	1606.0	1677.6		methane – < 2.5%
Niechmirów 2	50.0		Upper Jurrasic	circulation loss – ca. 60 m^3
	427.6			drilling with partial circulation loss
	546.0			oil bath
	2093.0		Połczyn Formation	oil bath
Stanisławów 1	228.0		Oxfordian	circulation loss – 5 m^3
	1003.0		Lower Gypsum Beds	circulation loss – 12 m^3
	1498.4	1504.4	Rhaetian	bituminous odour in limestones
	2693.5	2698.7	Oldest Halite	H_2S odour
	2699.7	2705.7		H_2S odour
	2716.7	2722.5		H_2S odour
	2814.4	2820.0		H_2S odour
	2856.0	2859.0	Lower Anhydrite	bituminous and H_2S odour
	2867.1	2874.1		H_2S odour, inner luminescence of the core
	2701.0	2903.5	Zechstein, Rotliegend	gas log showed CH_4 < 0.4%
Zapole 1	40.0		Oxfordian	circulation loss
	2875.0		Main Dolomite	strong flow of drilling fluid with formation water
Złoczew 1	2448.8	2451.6	Main Dolomite	cavern dolomites: cracks locally filled with greenish oil in; strong odour of hydrocarbons
	2451.5	2454.6		
	2455.6	2458.8	Main Dolomite, Stinking Shale	compact dolomites, fractured with cavern dolomites intercalations: traces of greenish oil and distinctive hydrocarbons odour
	2458.8	2464.5	Upper Anhydrite	point oil traces
	2464.5	2470.3		distinctive hydrocarbons odour, point oil traces
	2641.7	2647.4	Lower Anhydrite, Zechstein Limestone	strong H_2S odour
	2647.4	2654.0	Zechstein Limestone	strong H_2S odour
	2654.0	2660.4	Zechstein Limestone, Cooper Shale, Rotliegend	strong H_2S odour
	2671.9	2675.6	Rotliegend	weak hydrocarbons odour of the core, oil traces in compact conglomerate sandstone

Tab. 12. Hydrocarbon shows during drilling.

ZŁOCZEW 1
WELL LOG

GEOGRAPHIC COORDINATES

BEGINNING: 11.09.1970

FINISHING: 23.03.1971

DEPTH: 2980 m

X_1992 395037.32

Y_1992 474465.07

ALTITUDE: 185 m a.s.l.

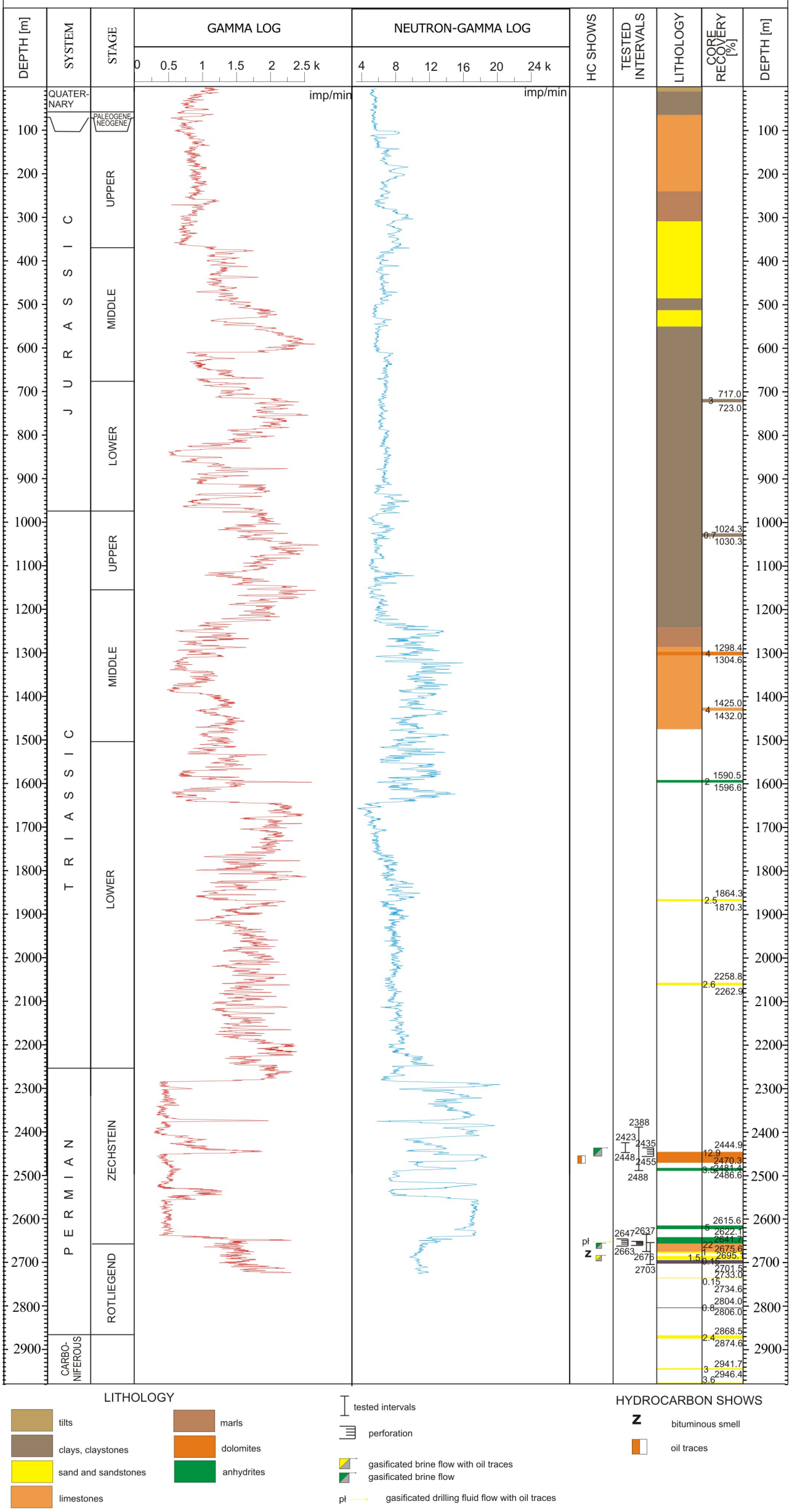


Fig. 15. Well log of the key well Złoczew 1 (Lis-Martyniak, 1972b).

6. SEISMIC SURVEYS

In the Złoczew tender area, the first seismic surveys with analogue recording were conducted in 1960s. From the beginning of 1970s, digital methods were developed. As a result – a dense grid of 2D seismic surveys appeared (Fig. 16, Tab. 13).

The most recent 2D measurements in the Złoczew area were conducted in 2013 and 2015 for Orlen Upstream Ltd. The investor has the exclusive right to use the geological information until the grace period expires (29.05.2022). The Złoczew Zachód 3D seismic survey was conducted for RWE Dea in 2005 (Tab. 13; Fig. 16).

Moreover, the CEL10 seismic profile, located in south-eastern part of the tender area, was carried out by refraction method under the CELEBRATION 2000 seismic project. The aim of this research was to interpret the deep geological structures of the Earth. Due to this purpose, as well as methodology and resolution, the survey cannot be used for hydrocarbon purposes.

Name	Year	Seismic project name	Owner	Length [km]
10-9-72K	1972	Kalisz-Iwanowice	State Treasury	6.7
14-2-72K	1972	Zduńska Wola-Szczerców-Mierzyn		7.8
20-11-75K	1975	Kalisz-Turek-Sieradz		12.3
21-11-75K	1975			7.2
1-2-76K	1976	Ostrów Kaliski-Bełchatów		12.8
16-2-76K	1976			30.2
2-2-76K	1976			12.8
25-2-76K	1976			15.8
32-2-76K	1976			19.5
3-2-76K	1976			18.8
32A-2-76K	1976			12
33-2-76K	1976			17.7
4-2-76K	1976			13.9
5-2-76K	1976			17.7
6-2-76K	1976			16.9
8-2-76K	1976			13.8
10-2-76K	1976	Sieradz-Piotrków Trybunalski		7.1
11-2-76K	1976			3.2
7-2-76K	1976			5.5
9-2-76K	1976			9.5
14-2-77K	1977	Ostrów Kaliski-Bełchatów		22.3
14A-82-77K	1977			4.6
18-82-77K	1977			6.6
26-2-77K	1977			16
27-2-77K	1977			18.5
28-2-77K	1977			17.3
29-2-77K	1977			16.5
30-2-77K	1977			7.6
31-82-77K	1977			25.3
38-82-77K	1977			15.9
39-82-77K	1977			19.6
40-82-77K	1977			16.3
40A-82-77K	1977			6.7
42-82-77K	1977			31.2
8-82-77K	1977			17.4
5A-4-81K	1981	Kalisz-Ostrzeszów-Złoczew		8.4
1-8-81K	1981			3.6
28A-4-82K	1982			8.1
26-8-82K	1982	Szczerców-P. Trybunalski		15.4
27-8-82K	1982			3.4
11-4-83K	1983	Kalisz-Ostrzeszów-Złoczew		4.6
12-4-83K	1983			6.5
13-4-83K	1983			3.4
33-4-83K	1983			4.1
47-4-83K	1983			6.9
11-8-83K	1983	Szczerców-		3.6
4-8-83K	1983	Piotrków Trybunalski		6.8
5-8-83K	1983			6.6
9-8-83K	1983			6
14-4-83K	1983	Kalisz-Ostrzeszów-Złoczew		14.8
TX100596	1996	Zduńska Wola	TEXACO	3.3
0411113T	2013	Sieradz - Łódź	State Treasury	13.1
0611113T	2013			18.7
0711113T	2013			17.9
0811113T	2013			16.9
0911113T	2013			18.6
1011113T	2013			18
1111113T	2013			10.7
1211113T	2013			10.4
1311113T	2013			14.8
1411113T	2013			12.6
1511113T	2013			11.4
1611113T	2013			13.9
1711113T	2013			34.8
1811113T	2013			42.9
1911113T	2013			19.9
2111113T	2013			20.9
2311113T	2013			5.4
T00112515	2015	Barczew		27.2
T00212515	2015			11.6
T00312515	2015			11.1
T00412515	2015			12
T00512515	2015			16.1
T00612515	2015			15.7
T00712515	2015			14.1
T00812515	2015			12.1
T00912515	2015			9.5
			SUMMARY:	
			State Treasury	**1035.5**
			Investor	**3.3**
			Total	**1038.8**

Name	Year	Seismic project name	Owner	Area [km^2]
Złoczew Zachód	2005	Złoczew Zachód 3D	State Treasury	119.8

Tab. 14. Seismic surveys conducted on the Żabowo tender area (CBDG, 2019).

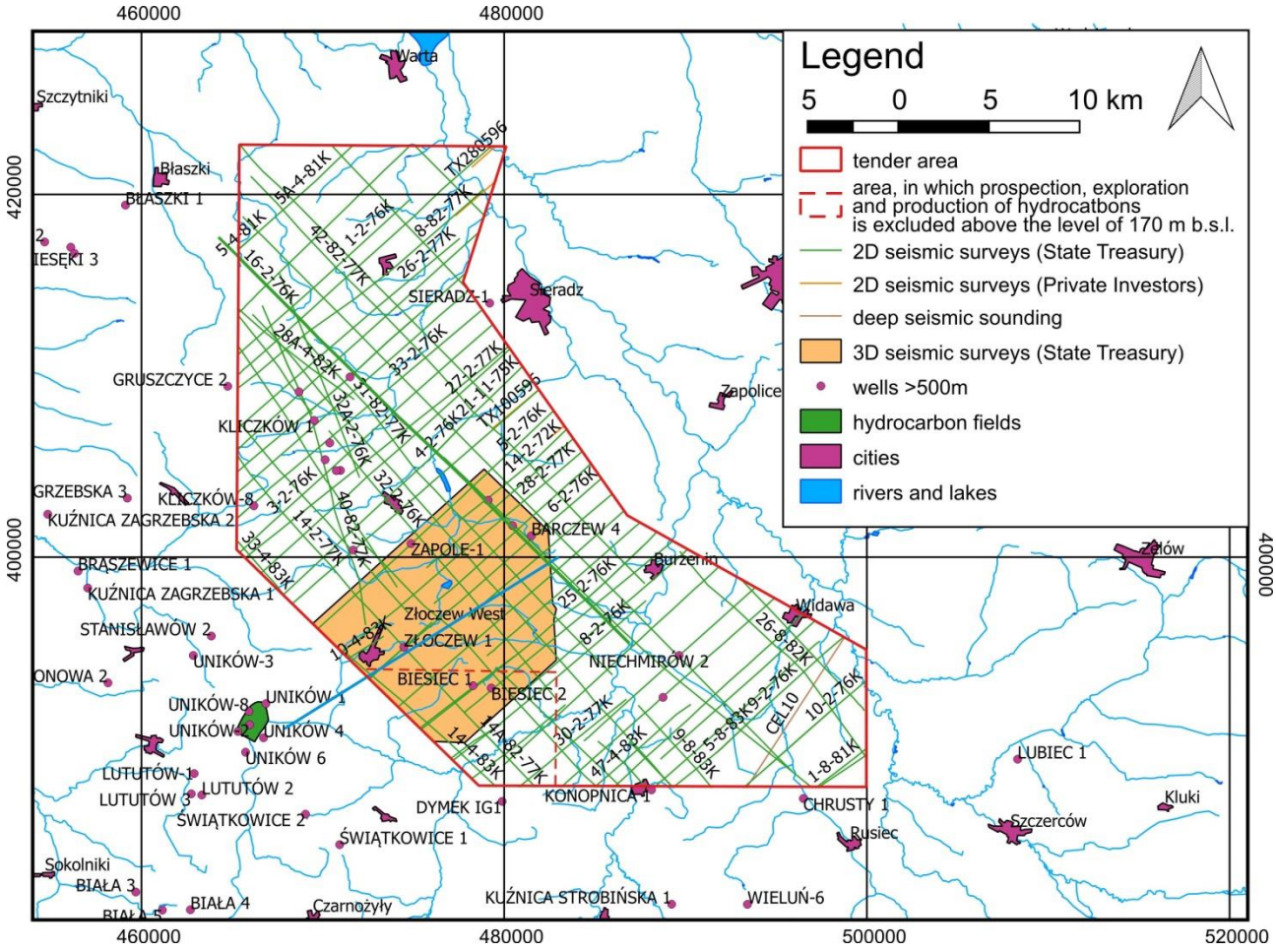


Fig. 16. Seismic surveys conducted on the Złoczew tender area.

7. GRAVIMETRY, MAGNETOMETRY AND MAGNETOTELLURICS

7.1 GRAVIMETRY

There are five semidetailed gravimetric surveys in the Złoczew tender area and in its close neighborhood (Fig. 17 – No. 1–5). Measurement density varies from 2 to 3.5 station/km^2. All the semidetailed surveys are unified and available in the CBDG database. Two detailed surveys (Fig. 17 – No. 6–7) were collected along the relatively short profiles, with 100 m step. Both were focused on brown-coal exploration.

The Złoczew tender area is placed at the distinct gradient zone (Fig. 18), which is a border between two gravity regions: Mogilno-Łódź Depression (southern part of Szczecin-Mogilno-Miechów Low) at the norh-east and Silesian High at south-west (Królikowski and Petecki, 1995). The Mogilno-Łódź Depression reflects light Cretacerous infill of the Łódź Syncline. There is an elongated, relatively negative anomaly within the Silesian High (south from Biesiec 1 well). Its source is the Złoczew Tectonic Thrust, infilled with light Neogene sediments (Złoczew brown coal deposit).

7.2. MAGNETOMETRY

Semidetailed, ground survey of total magnetic field intensity T in the Złoczew tender area and in its close neighbourhood was collected with an average density of 2 stations/km^2 (Fig. 19 – black crosses; Kosobudzka and Paprocki, 1997). A separate set of data is an older survey of Z-component of magnetic field intensity, collected on the Nida and Łódź Synclines (Fig. 19 – blue crosses; Kozera, 1954). The survey was used to fill the gaps on the new magnetic map of Poland, (Petecki et al, 2003; Petecki and Rosowiecka, 2017).

The magnetic map (Petecki and Rosowiecka, 2017) is divided into several regions with different magnetic characteristic. The Złoczew tender area is located within the Central and Western Poland domain (CWPd) – vast magnetic low (Fig. 20), bounded to the north by the Szczecin-Stargard Szczeciński-Piła-Inowrocław (SSPI) gradient zone (Petecki, 2008), and by the Słubice-Leszno lineament to the south. The absence of magnetic anomalies in this domain suggests either consistently lower magnetization of the basement rocks, or a smooth top of the basement at a great depth.

The south-western border of the Złoczew tender area coincides with a gradient zone of the magnetic field, which separates the SWPD and Upper Silesia–Małopolska domain (USMd). Generally, it covers the Upper Silesian Block and Małopolska Block (Dadlez et al., 1994).

7.3. MAGNETOTELLURICS

There are still no magnetotelluric surveys within the Złoczew tender area.

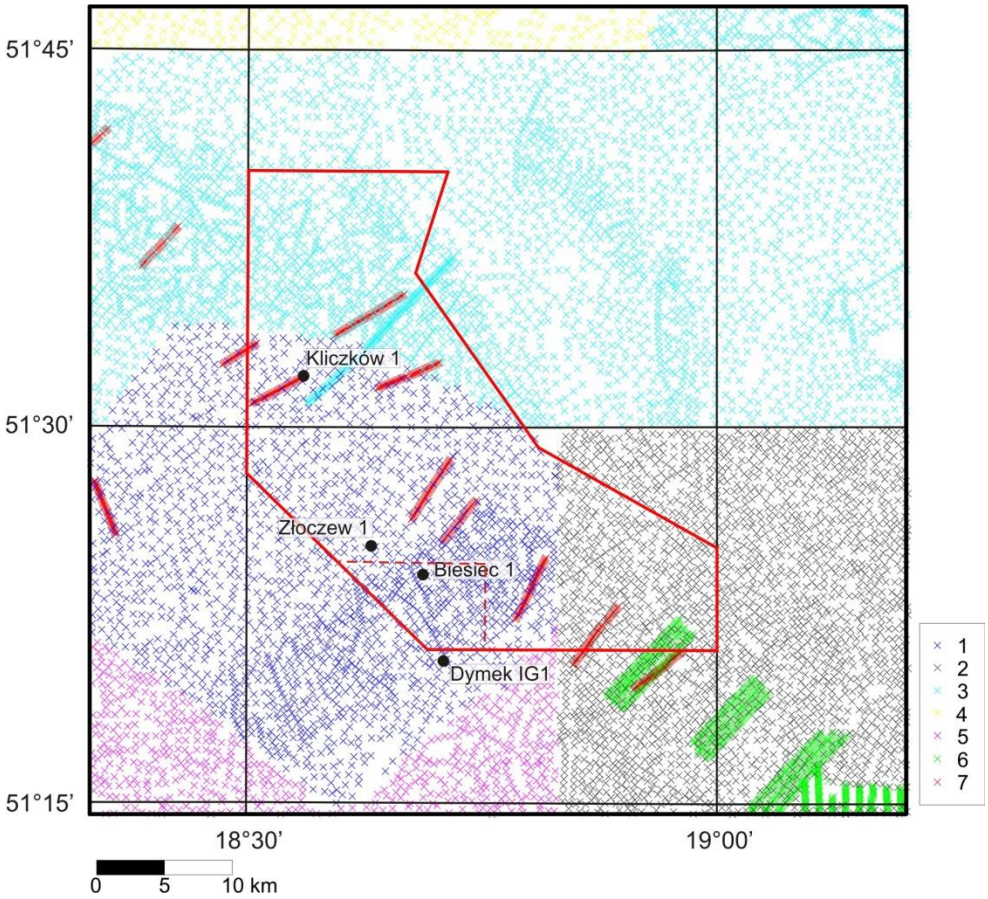


Fig. 17. Distribution of gravimetric measurements in the Złoczew tender area and in its close neighbourhood: 1 – Mikołajczak, 1961; 2 – Lisowski et al., 1989; 3 – Margul, 1971; 4 – Reczek, 1967; 5 – Reczek, 1969; 6 – Wasiak, 1962; 7 – Wasiak, 1990. Red line – boundaries of the tender area; black dots – key wells.

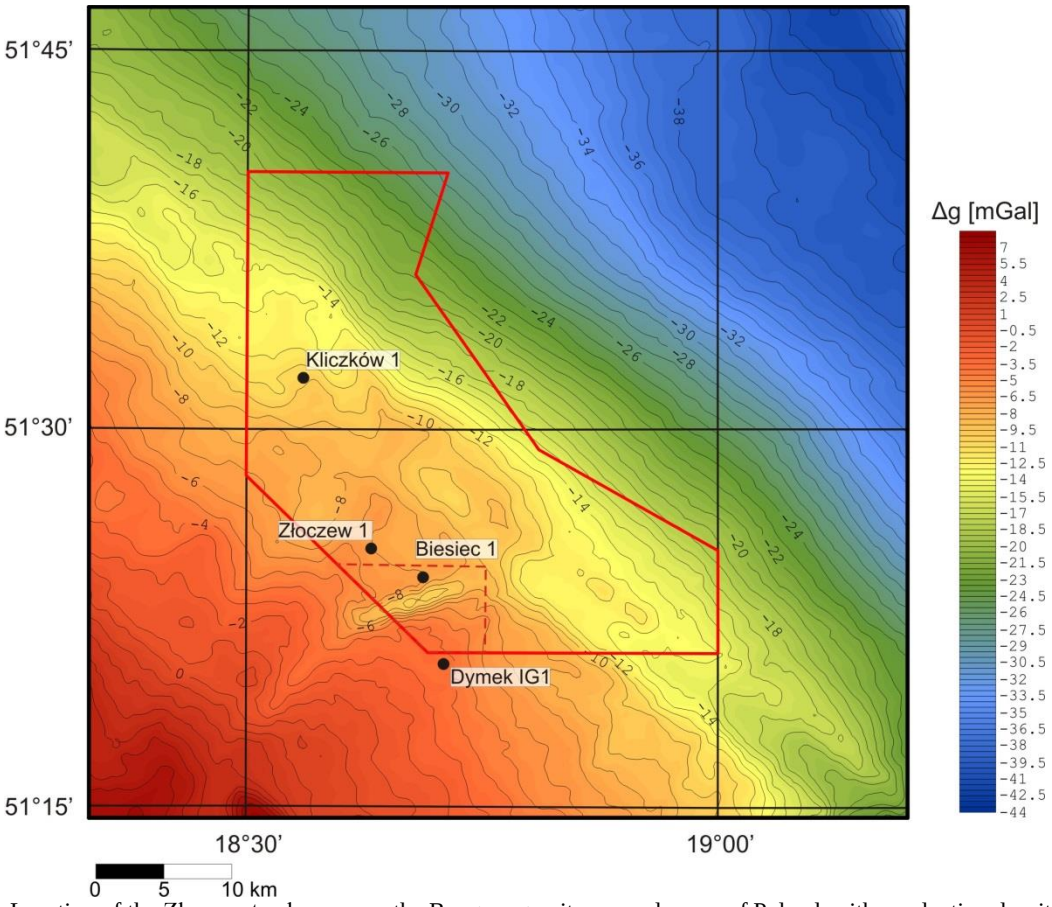


Fig. 18. Location of the Złoczew tender area on the Bouguer gravity anomaly map of Poland, with a reduction density of 2.25 g/cm^3. Red line – boundaries of the tender area; black dots – key wells.

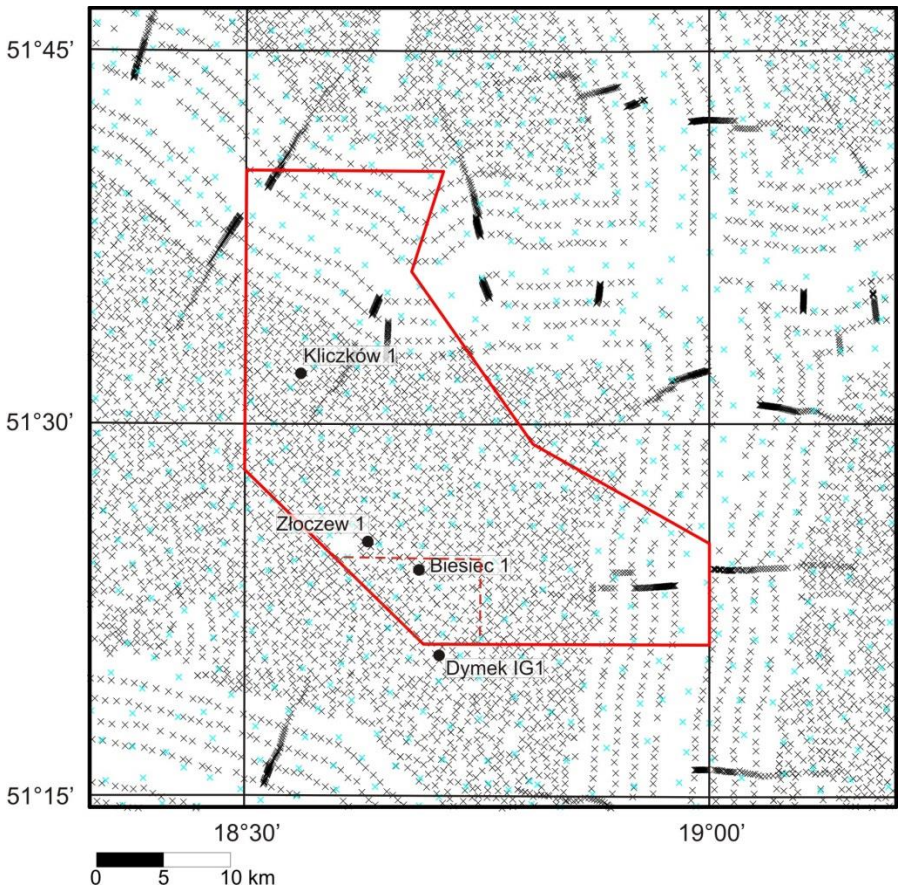


Fig. 19. Distribution of magnetic stations in the Złoczew tender area and in its close neighbourhood: black crosses – Kosobudzka and Paprocki, 1997; blue crosses – Kozera, 1954. Red line – boundaries of the tender area; black dots – key wells.

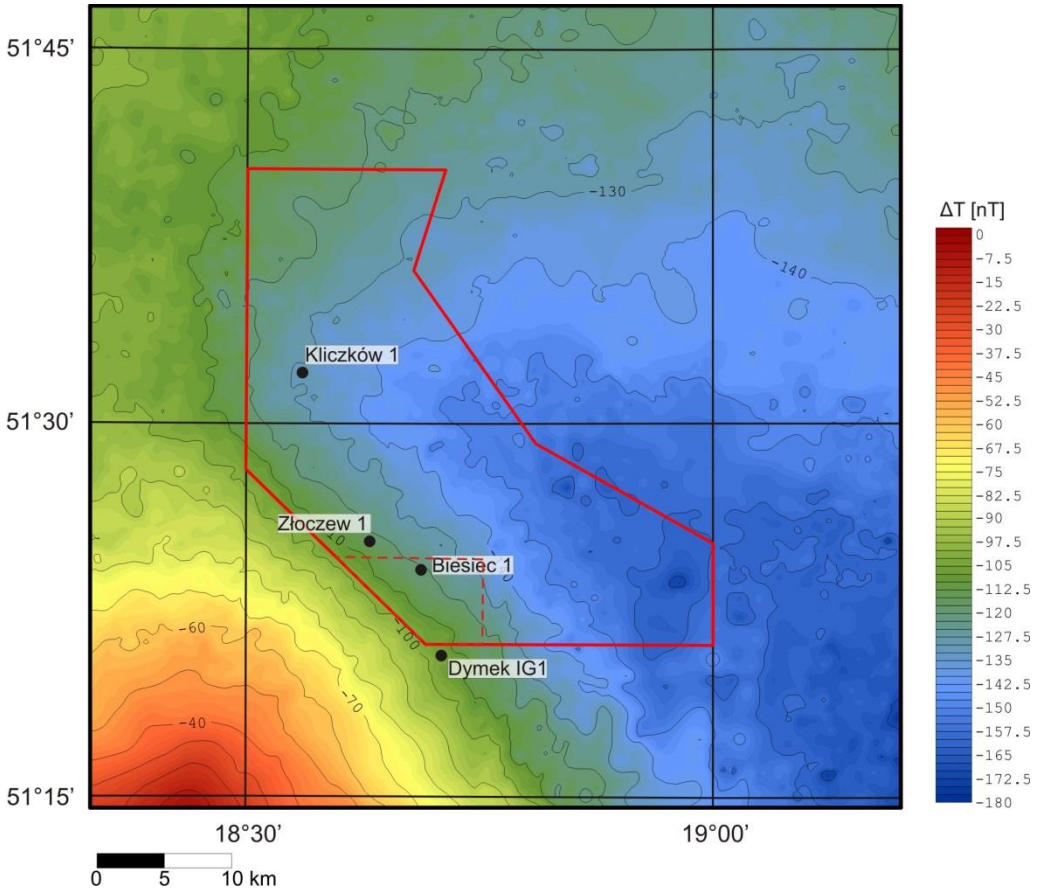


Fig. 20. Location of the Złoczew tender area on the magnetic anomaly map of Poland (based on CBDG, 2018). Red line – boundaries of the tender area; black dots – key wells.

8. HYDROCARBON PROSPECTIVE

The Złoczew tender area is located in the central Poland, in the Western Petroleum Province (Fig. 21). The Carboniferous strata of the Variscan Externides are the oldest reached by drilling. They are covered by the Permian-Mesozoic succession of the Łódź Trough and Fore-Sudetic Monocline. The main exploration targets in the Złoczew tender area are related to conventional oil and gas accumulations in the Carboniferous and Permian (Rotliegend, Zechstein Limestone and Main Dolomite).

Two independent petroleum systems work in the Złoczew tender area. The first occurs in the Carboniferous-Permian, in which gas is probably generated from the Carboniferous fine-grained sediments. Potentially, it can be accumulated in the Carboniferous and Permian/Rotliegend sand-stones, as well as in the Zechstein Limestone deposits. The second system occurs in the Main Dolomite, in which oil and gas are expected in the carbonate platform deposits, while organic-rich interbeds are supposed to be the source rocks.

Only two hydrocarbon fields occur in the close vicinity of the Złoczew tender area. These are Gomunice and Uników fields, discovered in the Main Dolomite deposits. The Złoczew area is well recognized by seismic surveys: 77 seismic profiles of total length about 1039 km have been conducted, so far. Fifty-three deep wells drilled out the prospective horizons, as wells.

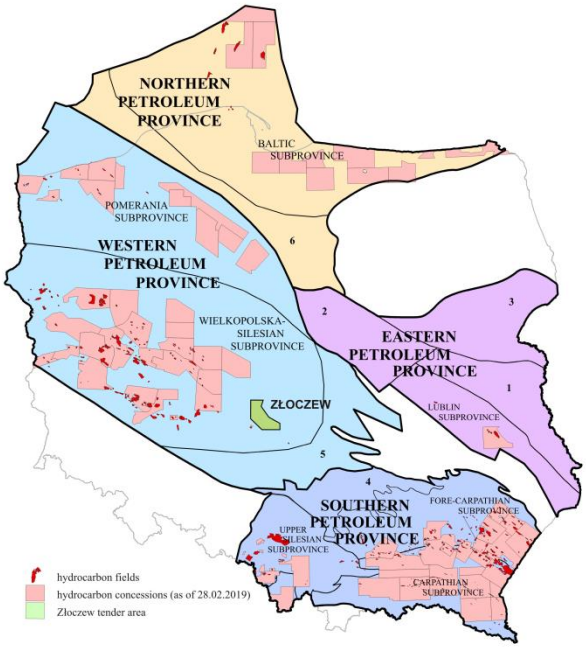


Fig. 21. Hydrocarbon subdivision of Poland (PIG-PIB, 2019) with location of the Złoczew tender area. 1–6 – petroleum regions (of unconfirmed/hypothetical prospective): 1 – Chełm Region, 2 – Płock-Warszawa Region, 3 – Podlasie Region, 4 – Małopolska Region, 5 – Łódź-Wieluń Region, 6 – Słupsk-Grudziądz Region.

Possible minimum work program for prospection and exploration phase:

- Stage I (12 months) – integration and reinterpretation of archival geological data;
- Stage II (48 months) – conduction of 2D seismic surveys (200 km) or conduction of 3D seismic surveys (100 km^2) and drilling of one well to maximum depth of 3500 m TVD with obligatory coring of prospective intervals.

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