

Remarks from the Recent Recognition of Oil & Gas Potential in Poland*

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Abstract

Poland as a country has a long story of exploration and production of oil and gas. The first field in the world was Bóbrka Field, dug (yes, dug with shovels) in 1854 in the Carpathian Mountains of southeastern Poland to a depth of 15 meters! The Bóbrka Field has since produced 9.5 Million BO and 6.7 BCFG from 163 wells. It was only the beginning of a drilling campaign resulting in 223 fields in the Carpathian region, producing 6.8 Billion BO and 53.7 BCFG to date. Poland currently has reserves of more than 115 Million BO, with the potential for vastly more.

With the success of the operations prior to liberation in 1989, several western companies invested for hydrocarbon exploration in Poland, but with quite limited success and very limited drilling. Now, implementing new techniques and technologies, and aided by the stable and supportive fiscal regime, there is new promise for potential in several petroleum basins.

There is a significant land-rush in Poland for shale gas exploration concessions, particularly in the Baltic and Lublin basins of northeastern Poland, where drilling and completions are already underway in the unconventional shales of the Ordovician and Silurian. Although more difficult to produce, these large basins are expected to yield good production from thousands of wells.

The Cambrian clastic sequences, covering nearly half of Poland, have oil or gas shows in at least half the wells drilled. With modern techniques and ideas, this appears to be a viable, large, tight gas and conventional oil play. The Devonian and Carboniferous “Old Red” facies tight-gas sandstones, and the thick dolomites and limestones of the Middle Devonian to Lower Carboniferous are also possible conventional oil and gas and huge tight-gas resource targets. The Permian - Rotliegend facies also has enormous potential, with more than 500 meters of gas-saturated, tight sandstones in several areas. The same would be related to the Zechstein carbonates, with conventional oil and gas potential and big central-basin gas accumulations. Triassic, Jurassic, and Cretaceous successions also have hydrocarbon shows all around

Poland, expressed already with several oil and gas fields in the Carpathian Foredeep basin in southern Poland.

The time has come to acknowledge that Poland is once again a player in the world oil and gas market.

Reference

Picha, F.J., 1996, Exploring for hydrocarbons under thrust belts; a challenging new frontier in the Carpathians and elsewhere: AAPG Bulletin, v. 80/10, p. 1547-1564.

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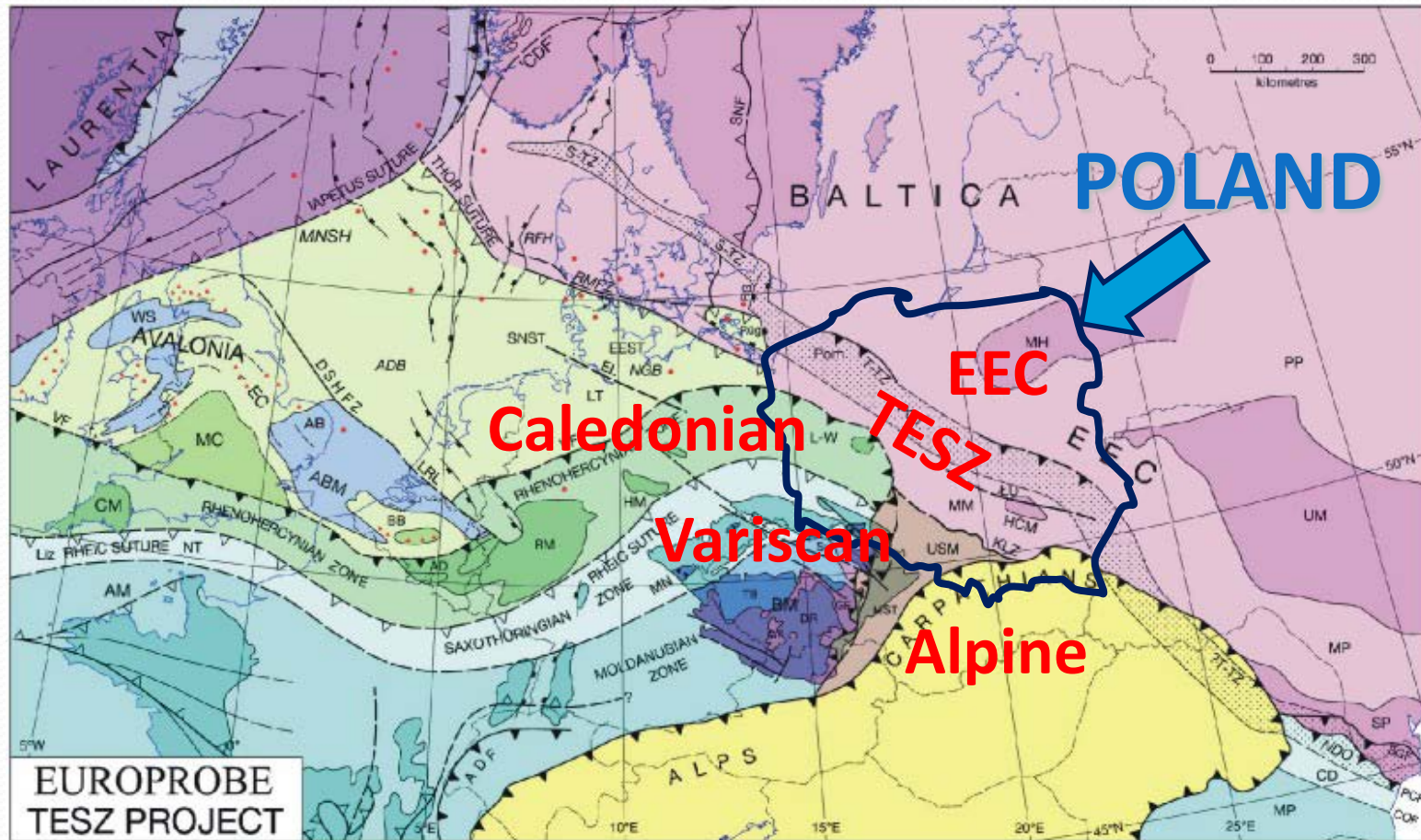
OG Petroleum Consulting, Warsaw¹

Discovery GeoServices Corporation, Forney²



Discovery GeoServices Corporation

Poland Setting in Europe



Historical Resources Exploration and Production Activity in Poland

1368 – First Mining Law in Poland
(significant financial prosperity from Salt Mining)

1368 – First mine management procedures

1528 - First Mining Authority State Organization

1782 - First Geological-Mining State Survey

Poland Oil Investment – 19th Century

1857 – First Klęczany Refinery (near Nowy Sącz town) – first downstream investment

1854 – First? Bóbrka Oil Field (near Krosno town) (first/oldest oil field) - production license received from the Austrian Emperor

1852 – Siara Oil Field by Prince Jabłonowski (near Gorlice town) - production license received from the Austrian Emperor



1817 – Rudawka Rymanowska Oil Field (near Sanok town) – First investment in Oil in Poland

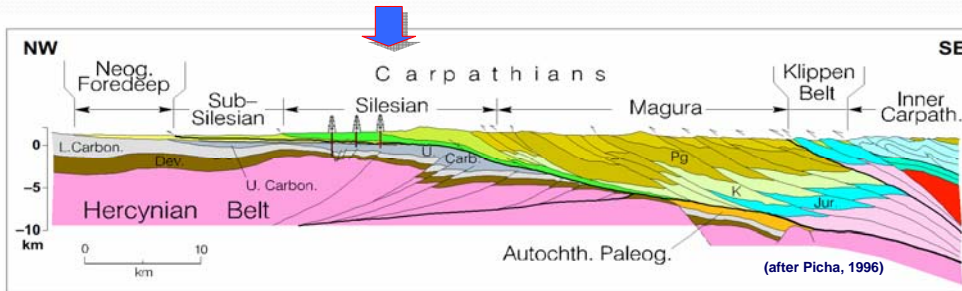
Poland Oil Investment – 19th Century

BÓBRKA OIL FIELD, 1912



Several examples of 3.5 MMBO production from single horizon

Almost every village had oil seeps Plenty of small oil fields to only 200m depth



Thin-skinned Carpathian Overthrust Belt

Presenter's Notes: First E&P area of the oil industry of modern world yielded plenty of small fields, but at the very shallow depths. In the area some hundred surface oil seeps are still active. All former fields showed pressures that resulted in flowage to the surface.

So, the Carpathian overthrust mountain belt seems to be still very promising for significant oil discoveries.

Oil and Gas in Poland

– Production before WWII (per Year)

Carpathians:

Oil – 4.1 MBO

Carpathians:

Natural Gas – 0.624 MMCM

– 22.04 MMCF



RAJSKIE OIL FIELD, 1895

Oil and Gas in Poland –

Production Recently/per Year

Baltic Basin: Oil – 1.4 MBO

Carpathians: Oil – 0.2 MBO

Carpathian Foredeep: Oil – 0.15 MBO

Polish Lowland Basin: Oil – 3.5 MBO

Total: 5.99 MBO

Baltic Basin:

Natural Gas – 19.53 MMCM – 690 MMCF

Carpathians:

Natural Gas – 32.49 MMCM – 1,147 MMCF

Carpathian Foredeep:

Natural Gas – 1,997.53 MMCM – 70,540 MMCF

Polish Lowland Basin:

Natural Gas – 3,789.60 MMCM – 133,824 MMCF

Total: 5.40 BCM – 190.73 BCF

Oil and Gas in Poland - Reserves

Oil – 203.16 MBO

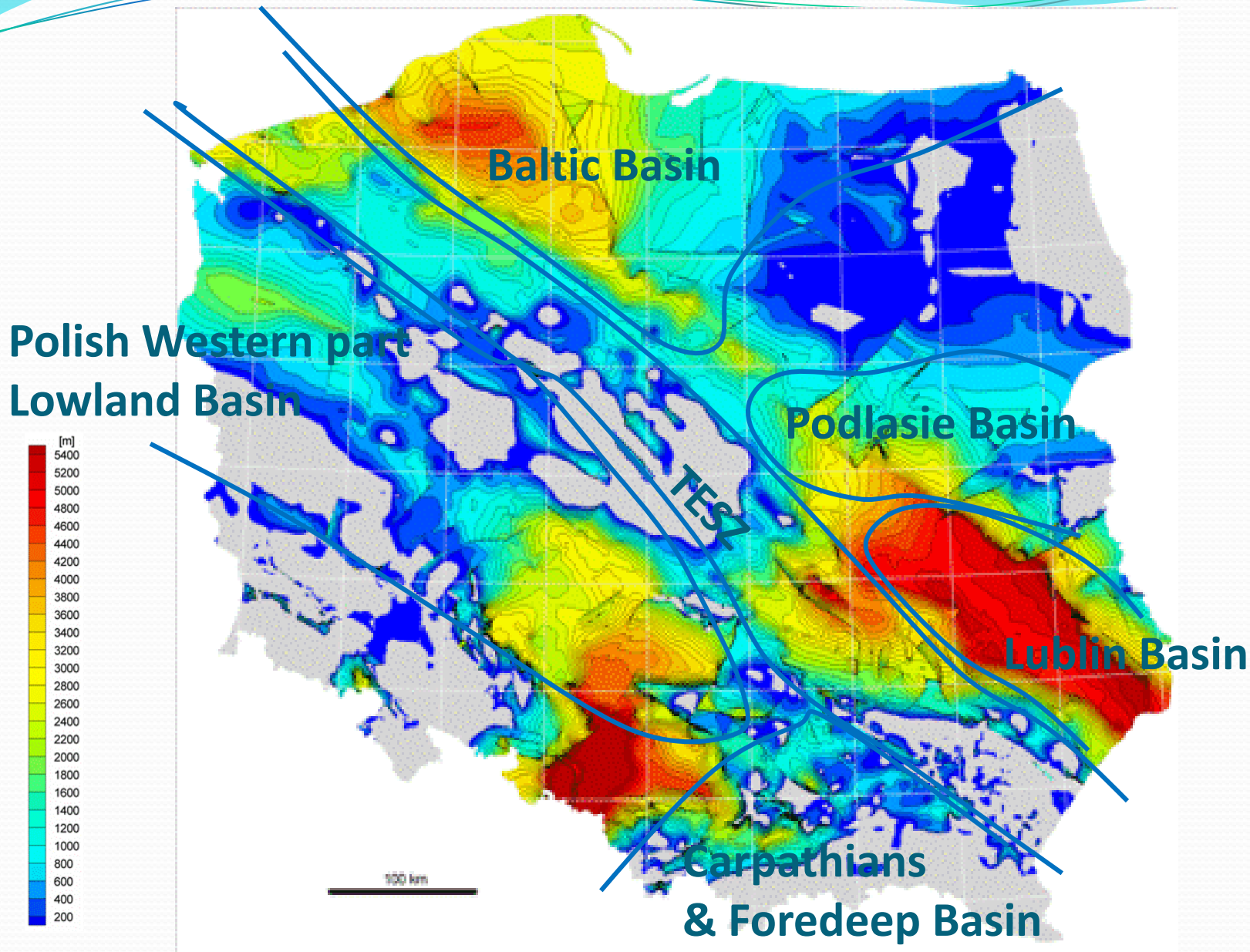
*Conventional Natural Gas – 136.42 BCM – 4.82 TCF
(8.0 TCF with CBM)*

Shale Gas in Poland:

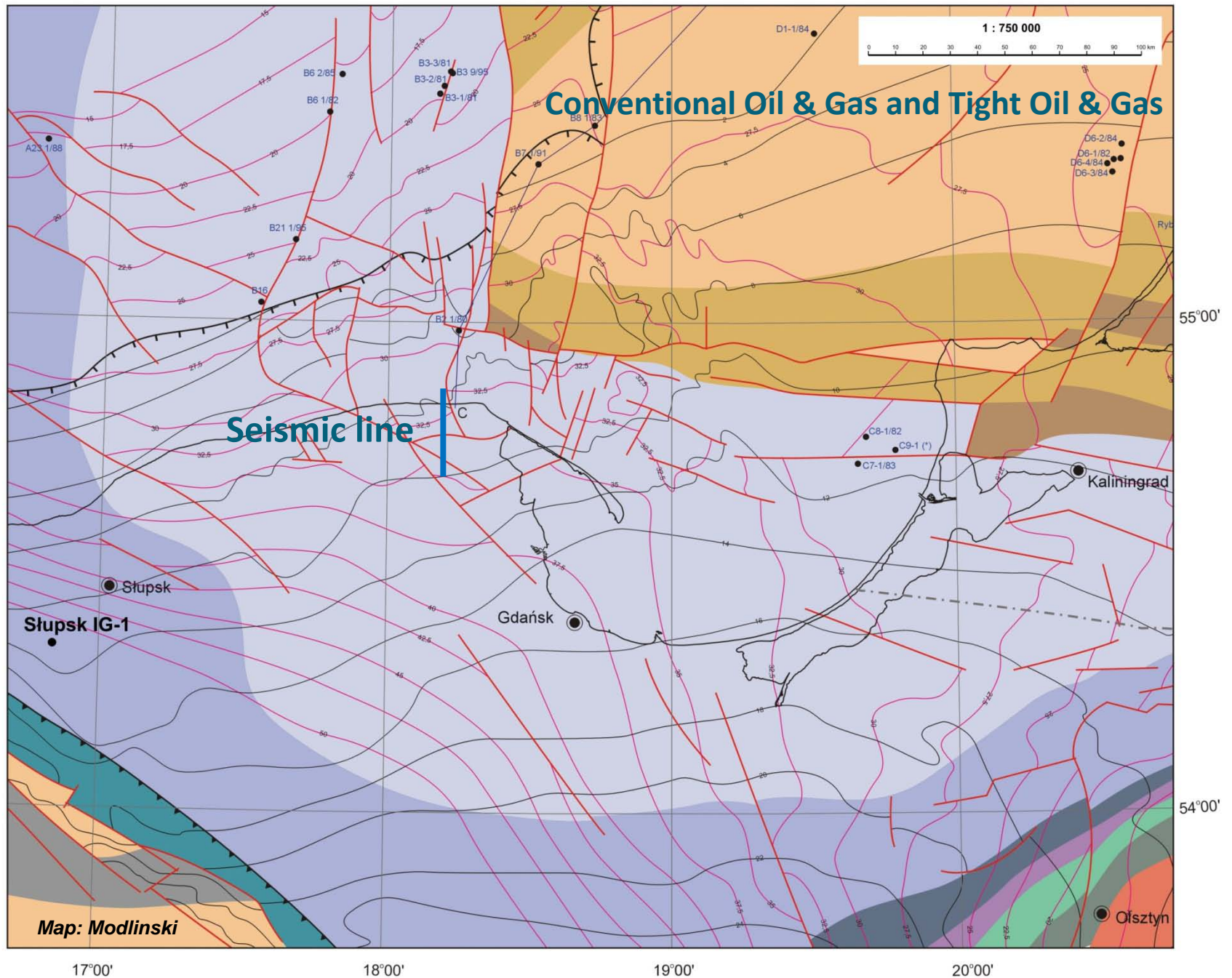
Idea implemented in 2006/2007 by some US and UK companies visiting Poland with presentations

*Shale Gas Reserves - 5.3 TCM – 187 TCF –
according to EIA*

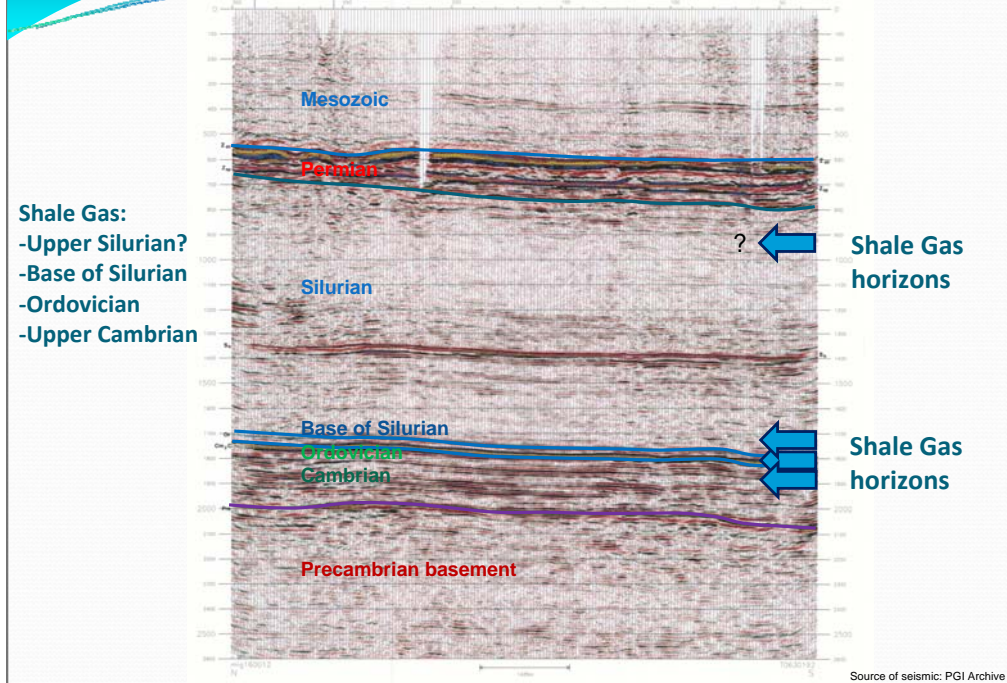
Thickness of the Paleozoic in Poland



Baltic Basin Structural Map



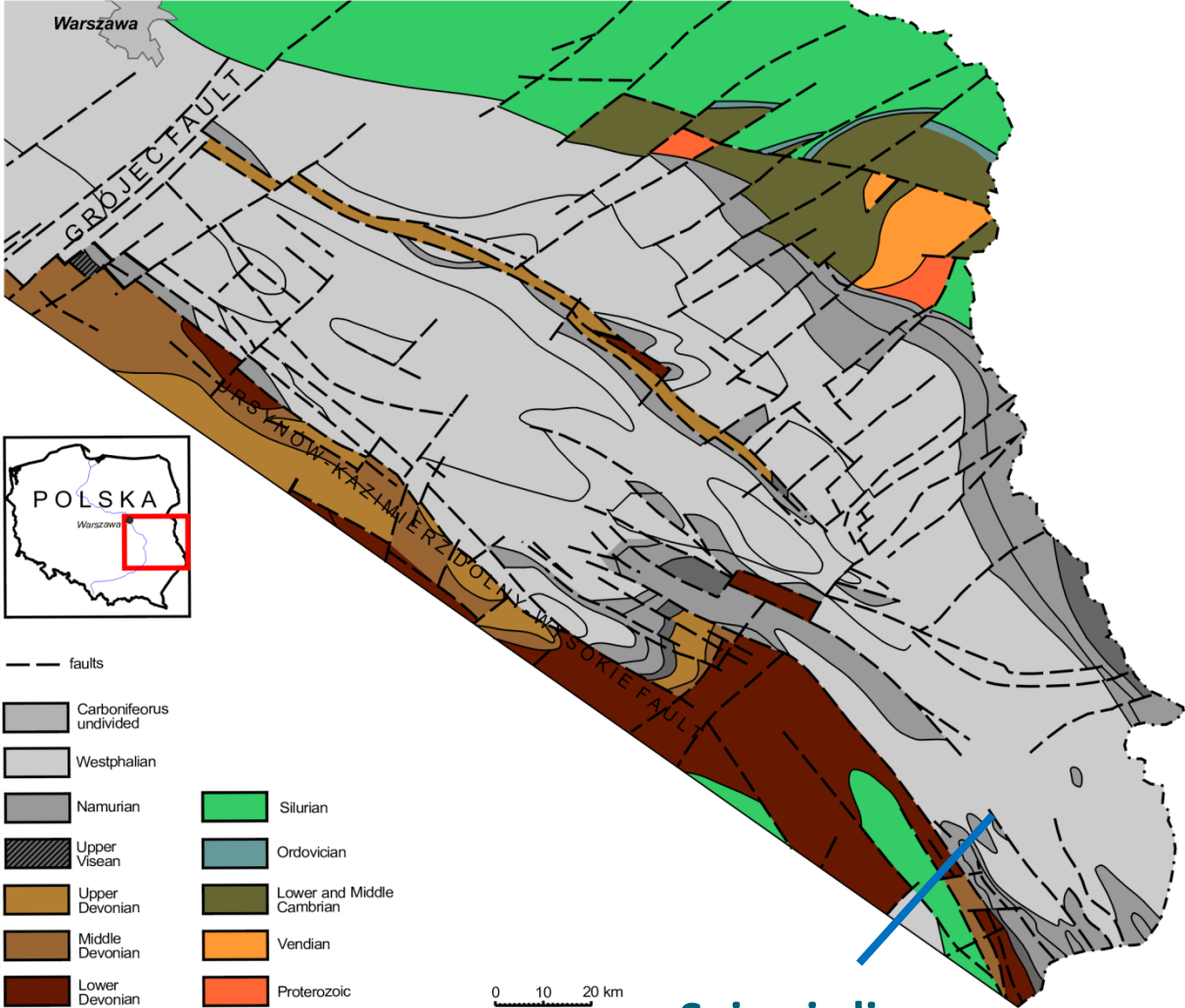
Baltic Basin Shale Gas Target



Presenter's Notes: Polish Lowland: Thick prolific sequence of Rotliegendes (Permian) sandstones, with very often gas accumulations (unfortunately seldom with high nitrogen content), with Zechstein (upper Permian) carbonates sealed by evaporites, by large oil and gas accumulations in the carbonate barrier settings.

Lublin Basin Geological Map, without Permian, Mesozoic, and Cenozoic

Conventional Oil & Gas and Tight Oil & Gas

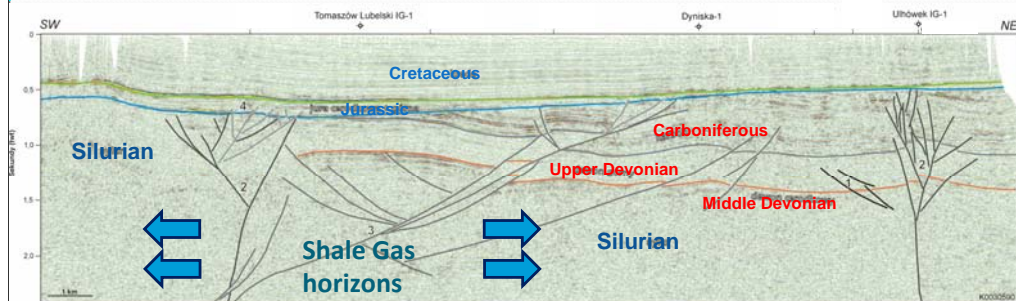


- faults
- Carboniferous undivided
- Westphalian
- Namurian
- Upper Viséan
- Upper Devonian
- Middle Devonian
- Lower Devonian
- Silurian
- Ordovician
- Lower and Middle Cambrian
- Vendian
- Proterozoic

0 10 20 km

Seismic line

Lublin Basin Shale Gas Target



Lopiennik IG-1 Well



Shale Gas:

- Upper Silurian?
- Base of Silurian
- Ordovician
- Upper Cambrian

Presenter's Notes: Polish Lowland: Thick prolific sequence of Rotliegendes (Permian) sandstones, with very often gas accumulations (unfortunately seldom with high nitrogen content), with Zechtein (upper Permian) carbonates sealed by evaporites, by large oil and gas accumulations in the carbonate barrier settings.

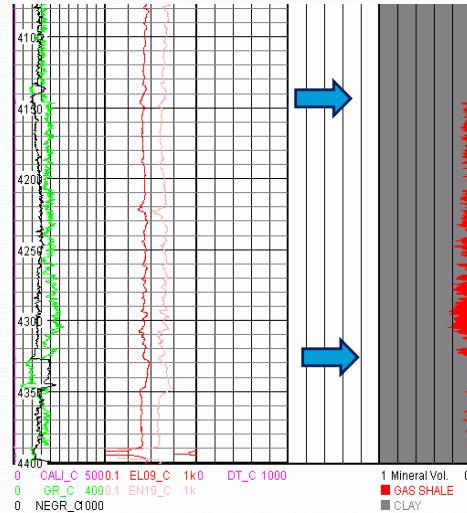
4332.1-4333.1 4333.1-4334.1 4334.1-4335.1 4335.1-4336.1 4336.1-4337.1 4337.1-4338.1 4338.1-4339.1 4339.1-4340.1 4340.1-4341.1 4341.1-4342.1
Source of seismic: PGI Archive

Lublin Basin Shale Gas Target

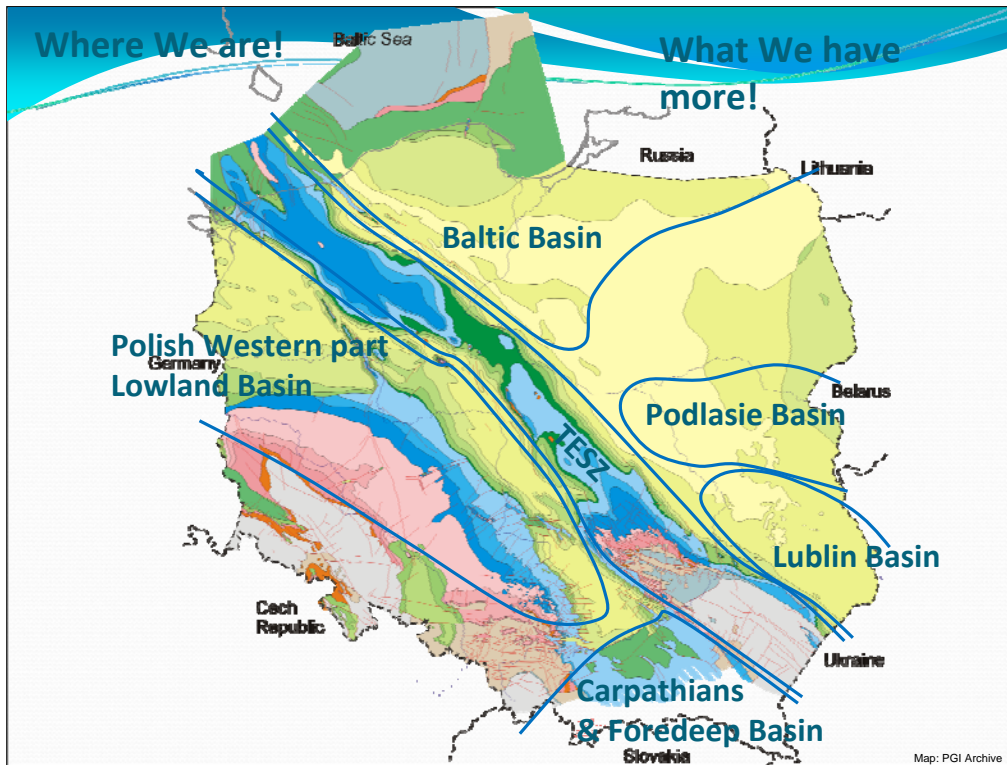
Lopiennik IG-1 Well

TOC from 0.2 to 1.4

150 m thickness of black shales

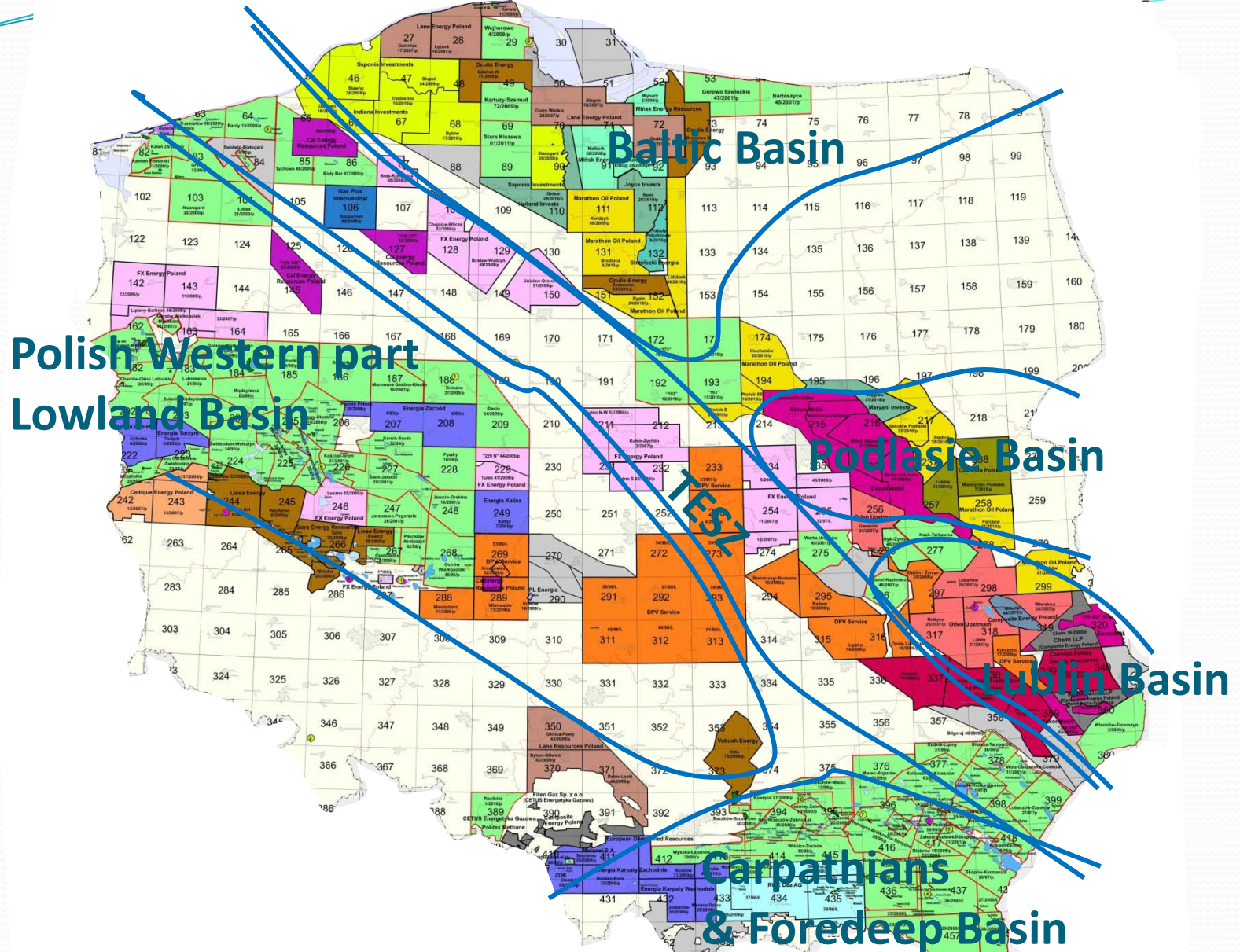


Presenter's Notes: Polish Lowland: Thick prolific sequence of Rotliegend (Permian) sandstones, with very common gas accumulations (unfortunately with occasional high nitrogen content); Zechtein (Upper Permian) carbonates sealed by evaporites, have large oil and gas accumulations in carbonate barrier settings.



Presenter's Notes: The Lublin Basin: The first E&P activity region for almost all foreign companies' initial investment in Poland.

Concession Map of Poland – E&P areas



85 concessions for unconventional gas granted

Tight Gas in Sandstones:

- Baltic Basin**
- Polish Lowland Basin**
- Podlasie Basin**
- Lublin Basin**
- Carpathians**

Tight Gas in Carbonates:

- Polish Lowland Basin**
- Podlasie Basin**
- Lublin Basin**
- Carpathian Foredeep Basin**

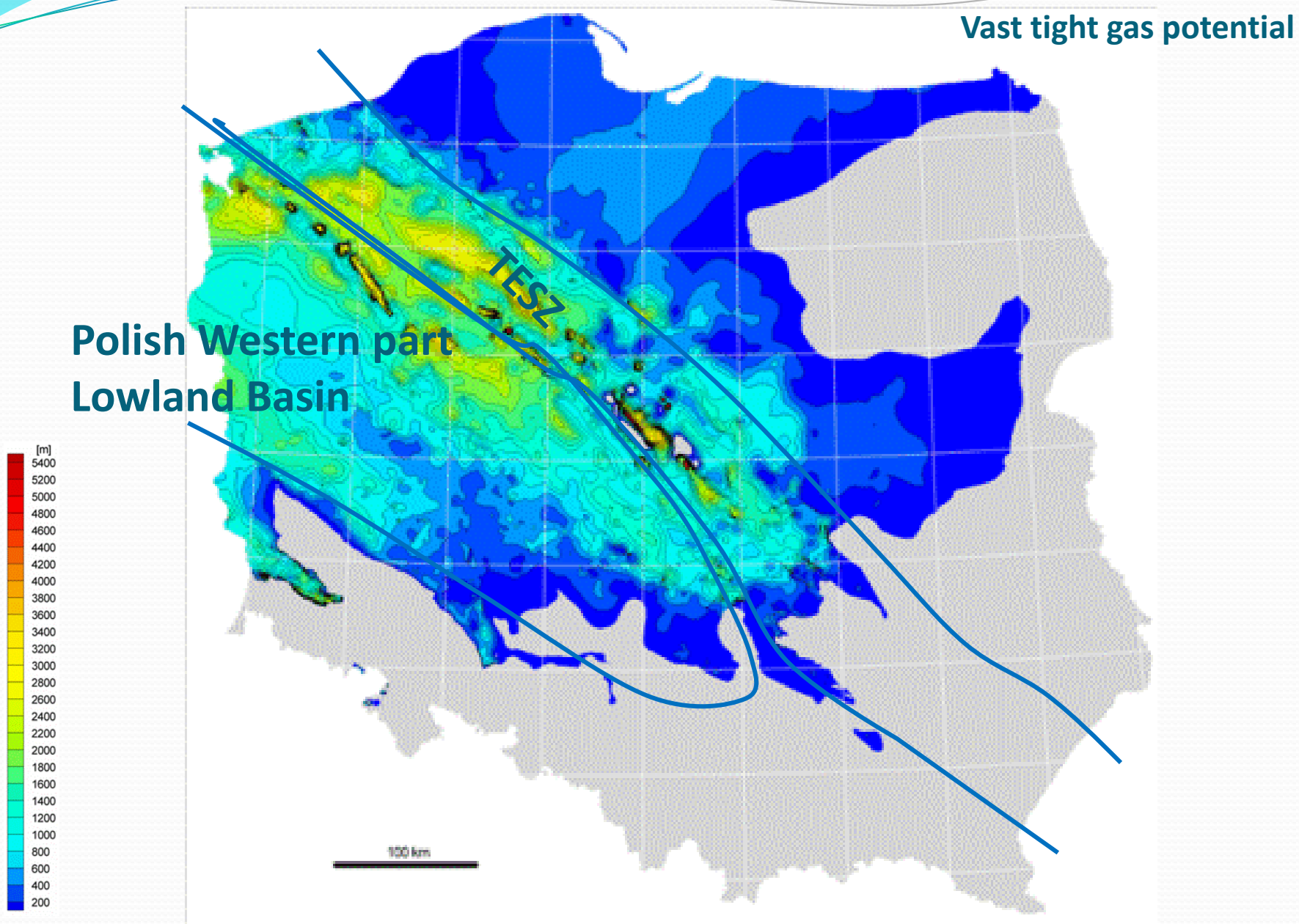
Tight Gas in Sandstones:

- Permian (Rotliegend) Sandstones**
- Cambrian Sandstones**
- Devonian (Old Red) Sandstones**

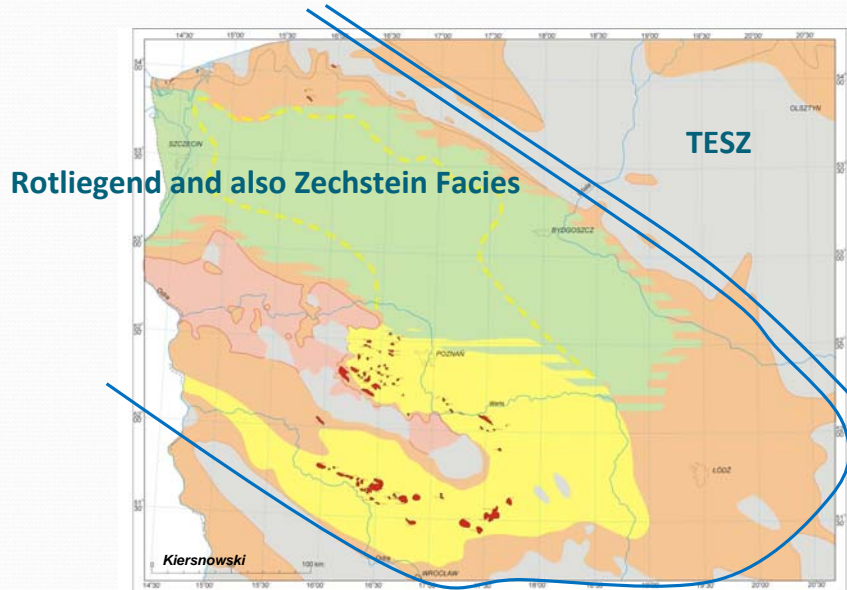
Tight Gas in Carbonates:

- Permian (Zechstein) Carbonates**
- Devonian Carbonates**
- Carboniferous Carbonates**

Thickness of the Permian in Poland

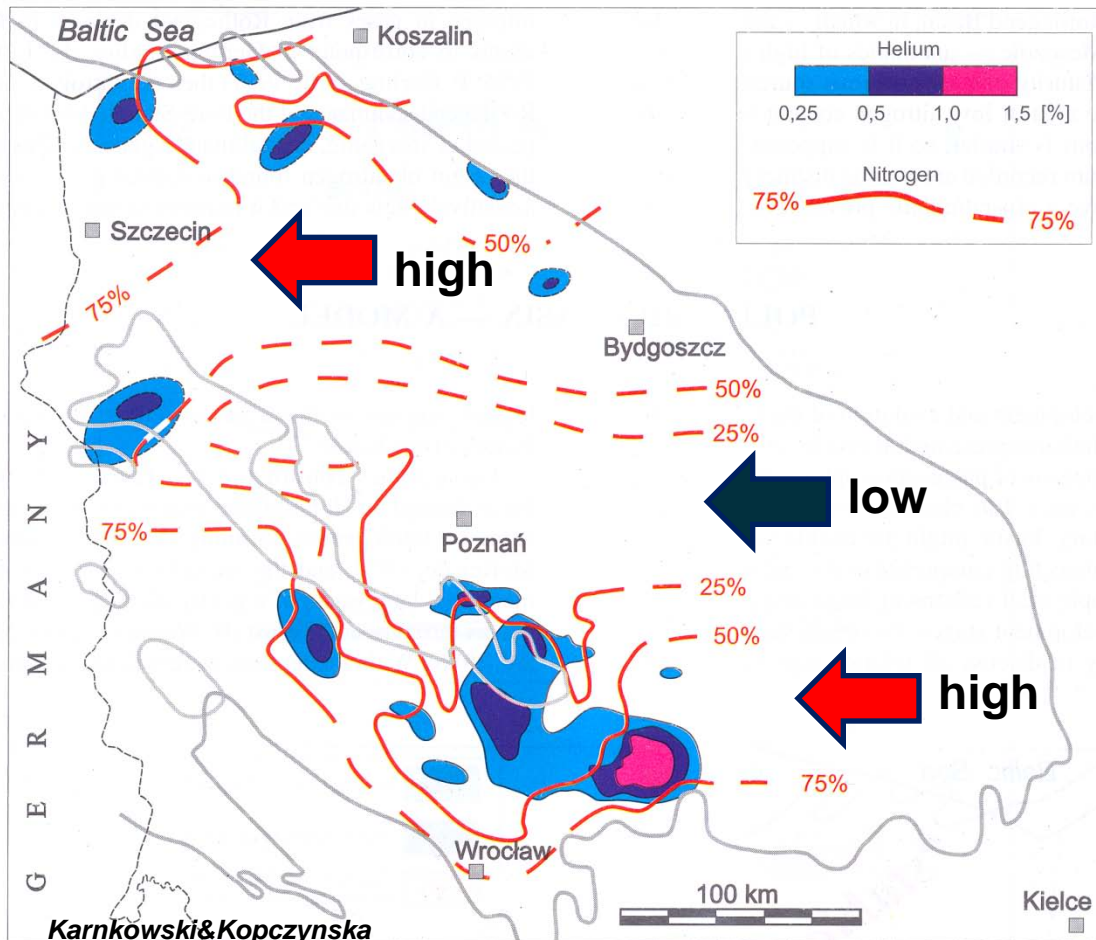


Polish Lowland Basin



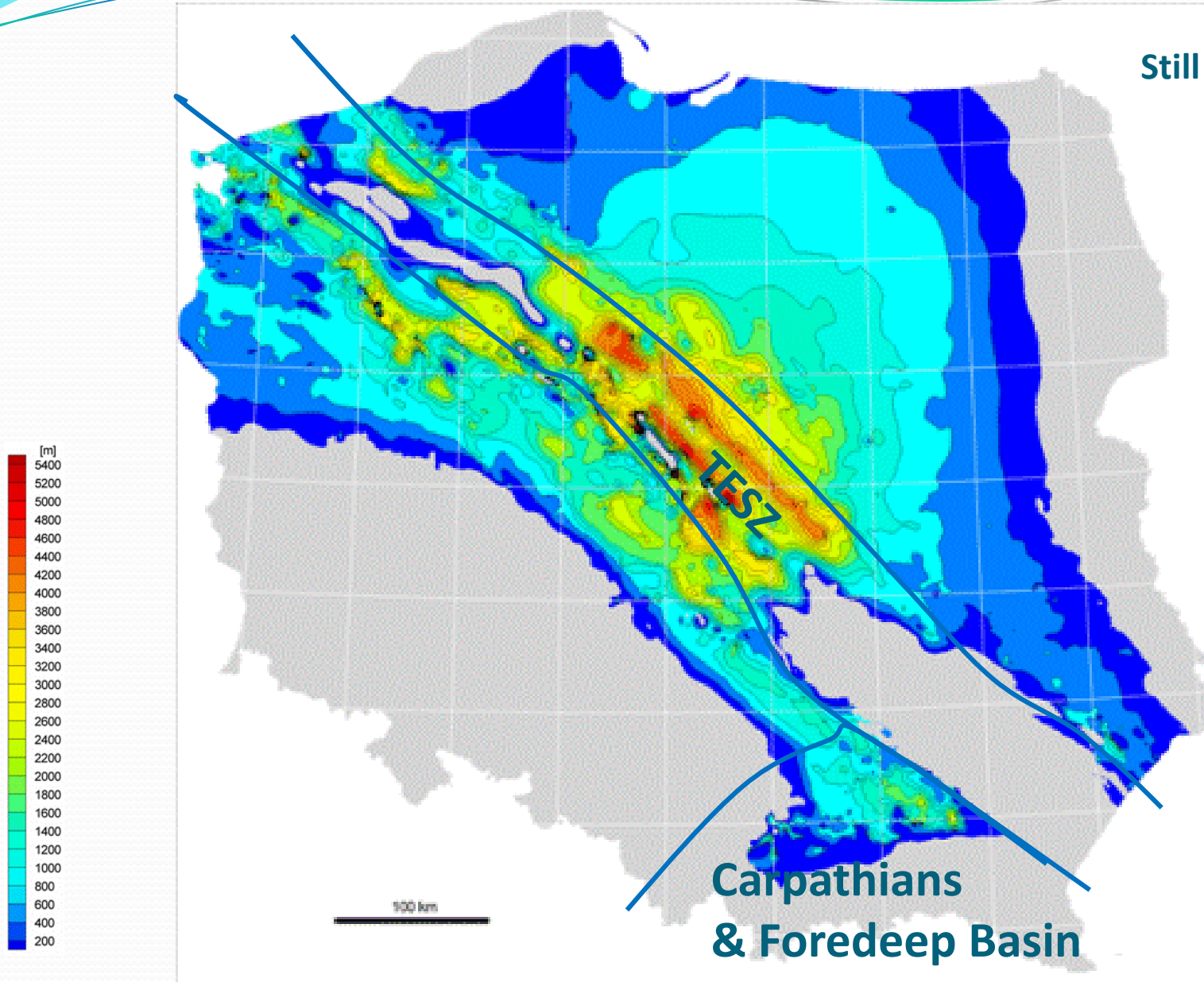
Presenter's Notes: Locations of gas fields in the vast area of dune sedimentary system (Rotliegend [Permian]). The distribution pattern of the most prolific fields includes several great gas discoveries.

Tight Gas – Rotliegend - Different Petroleum System and charging time in comparison to conventional gas accumulations – about uniform 12% of Nitrogen as gas content (according to Aurelian Oil & Gas)



Conventional Rotliegend Gas accumulations with differential Nitrogen as gas content

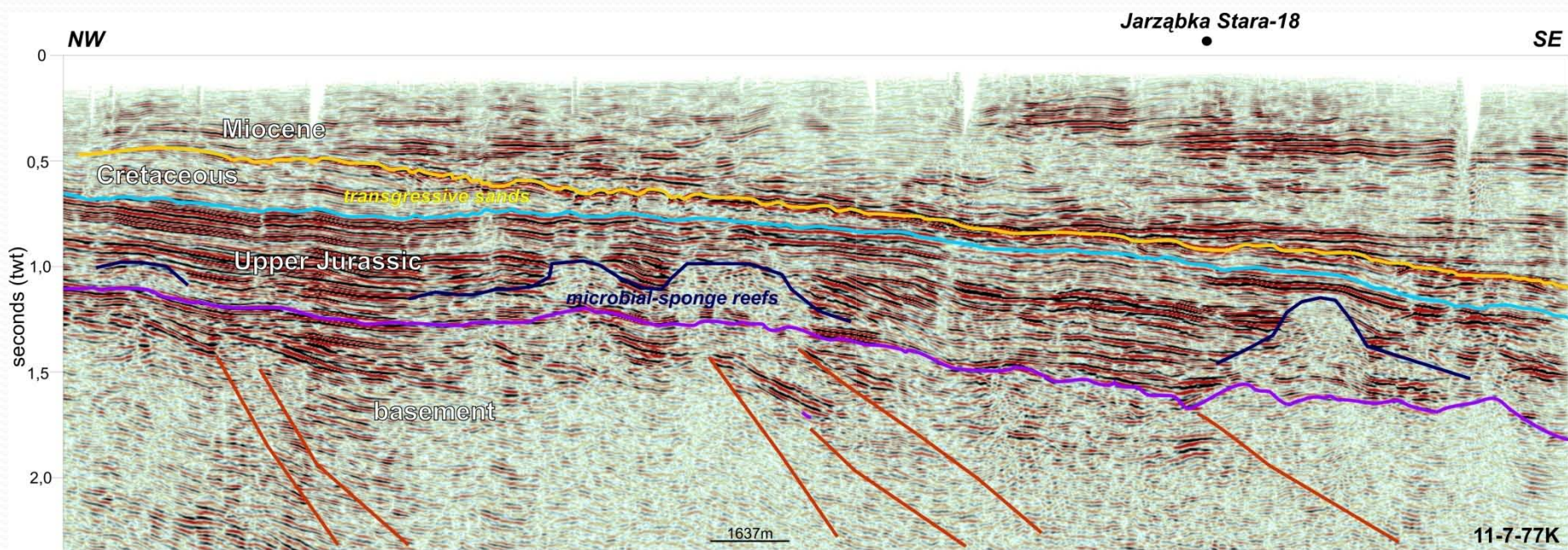
Thickness of the Jurassic/Cretaceous in Poland



Still promising

Carpathians
& Foredeep Basin

Carpathian Foredeep basin/overthrust boundary area



microbial-sponge reefs -> Smackover-like Formation

transgressive sands -> Viking-like Formation

Basin:

Conventional Oil & Gas and Tight Oil & Gas

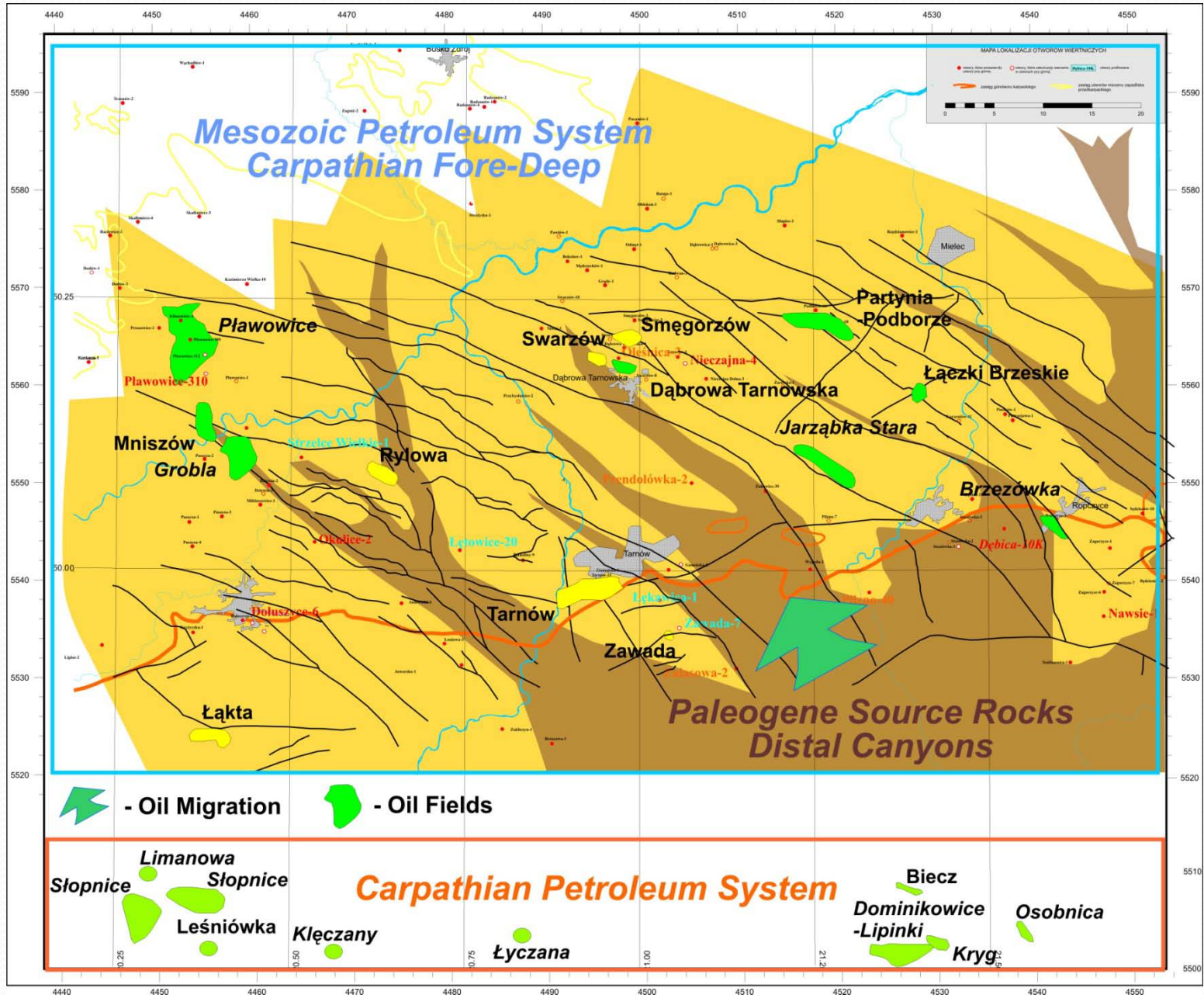
Mesozoic:

Conventional Oil & Gas

Tertiary:

Conventional Oil & Gas and Tight Gas

Carpathian Foredeep basin/overthrust boundary area



Oil and Gas in Poland – Exploration Activity

Poland is 45% the size of Texas

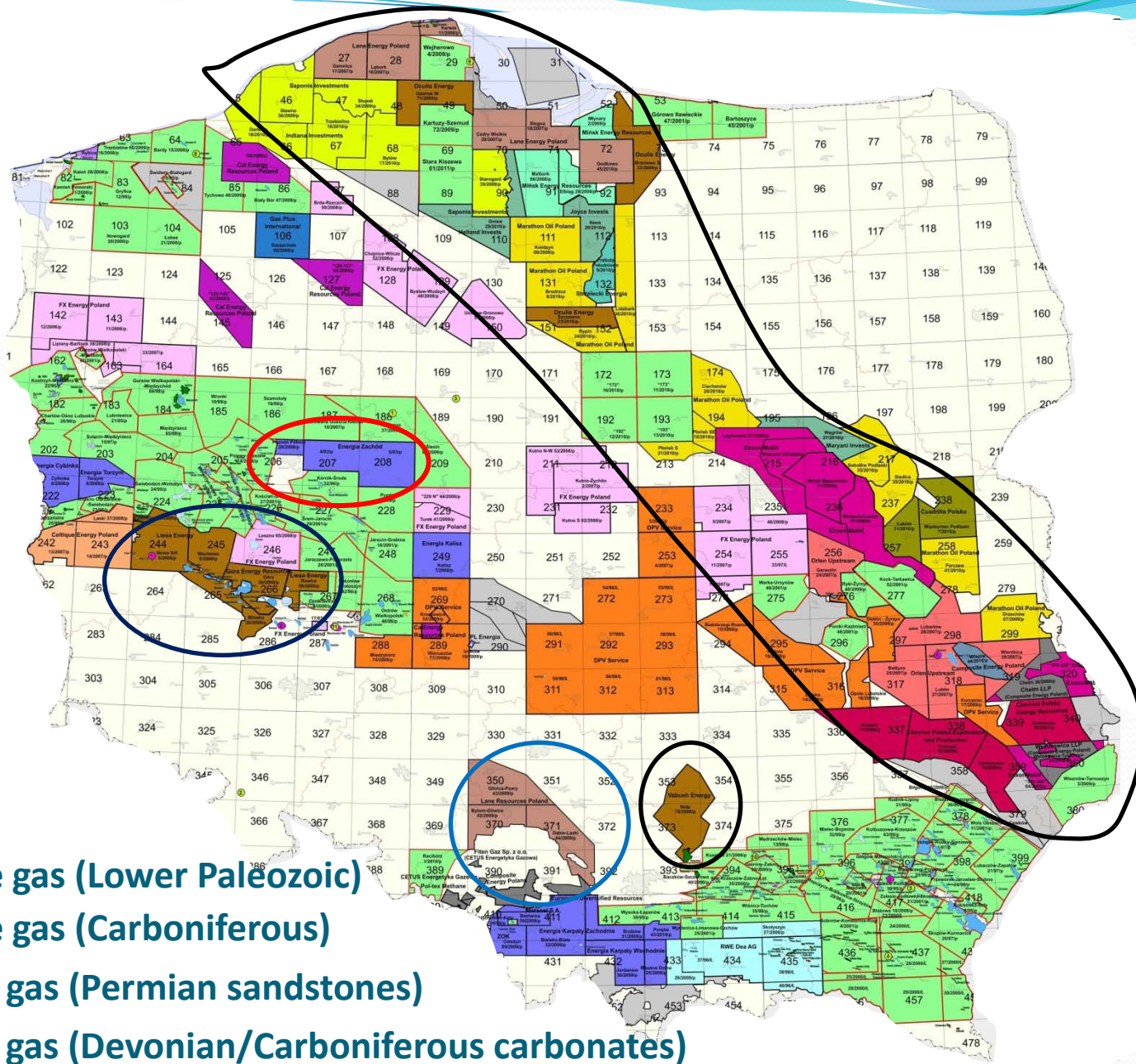
2D seismic – 198,027,761 km,
mostly old low-quality

3D seismic – 10,417.6 km² (3.3% of Poland)

7564 wells deeper than 1000 metres (3281 feet)
drilled in Poland by the end of 19th Century

1213 wells deeper than 3000 metres (9843 feet)
drilled in Poland by the end of 19th Century

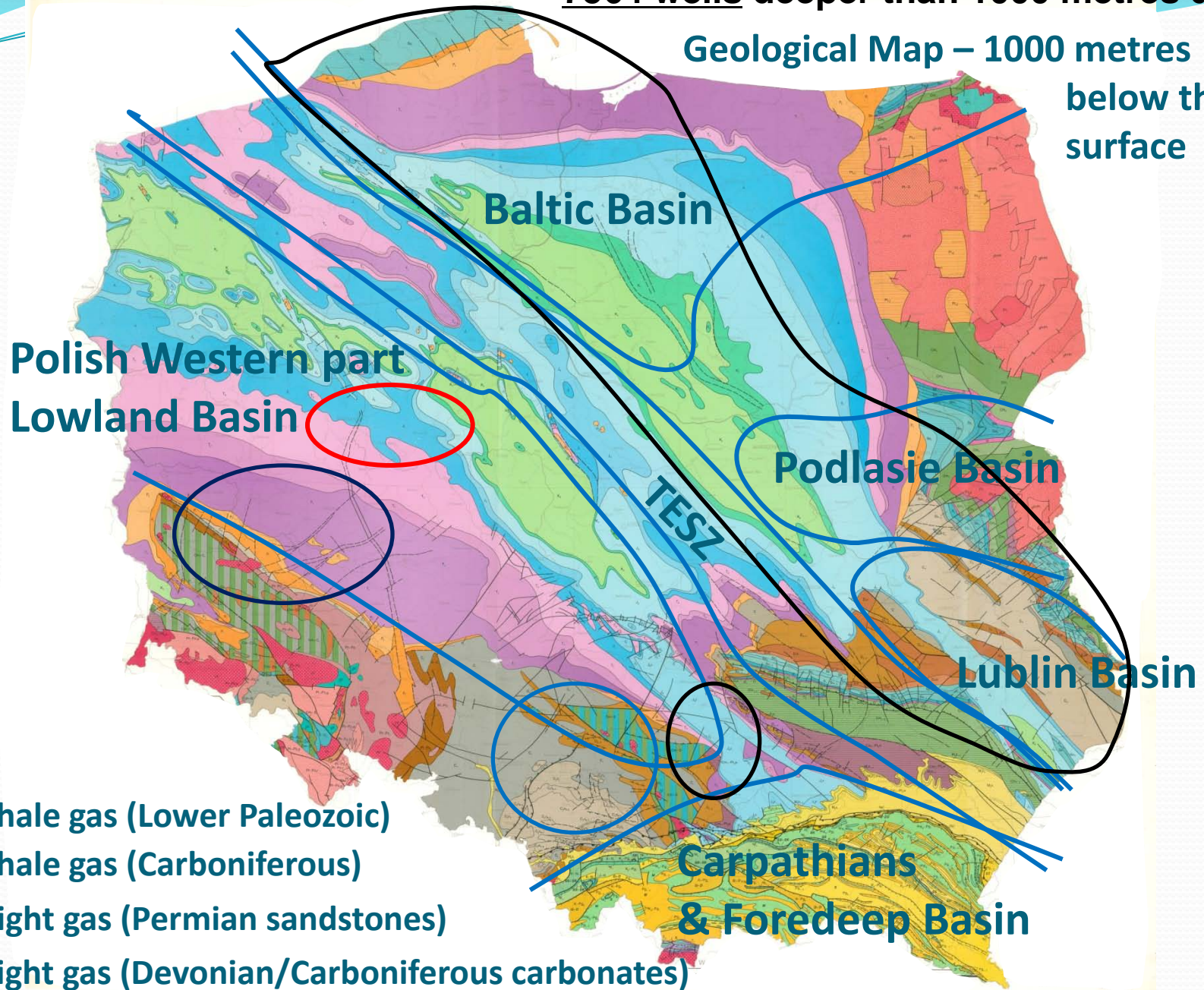
Concession Map of Poland – Target concessions



E&P areas in Poland

7564 wells deeper than 1000 metres drilled

Geological Map – 1000 metres below the surface

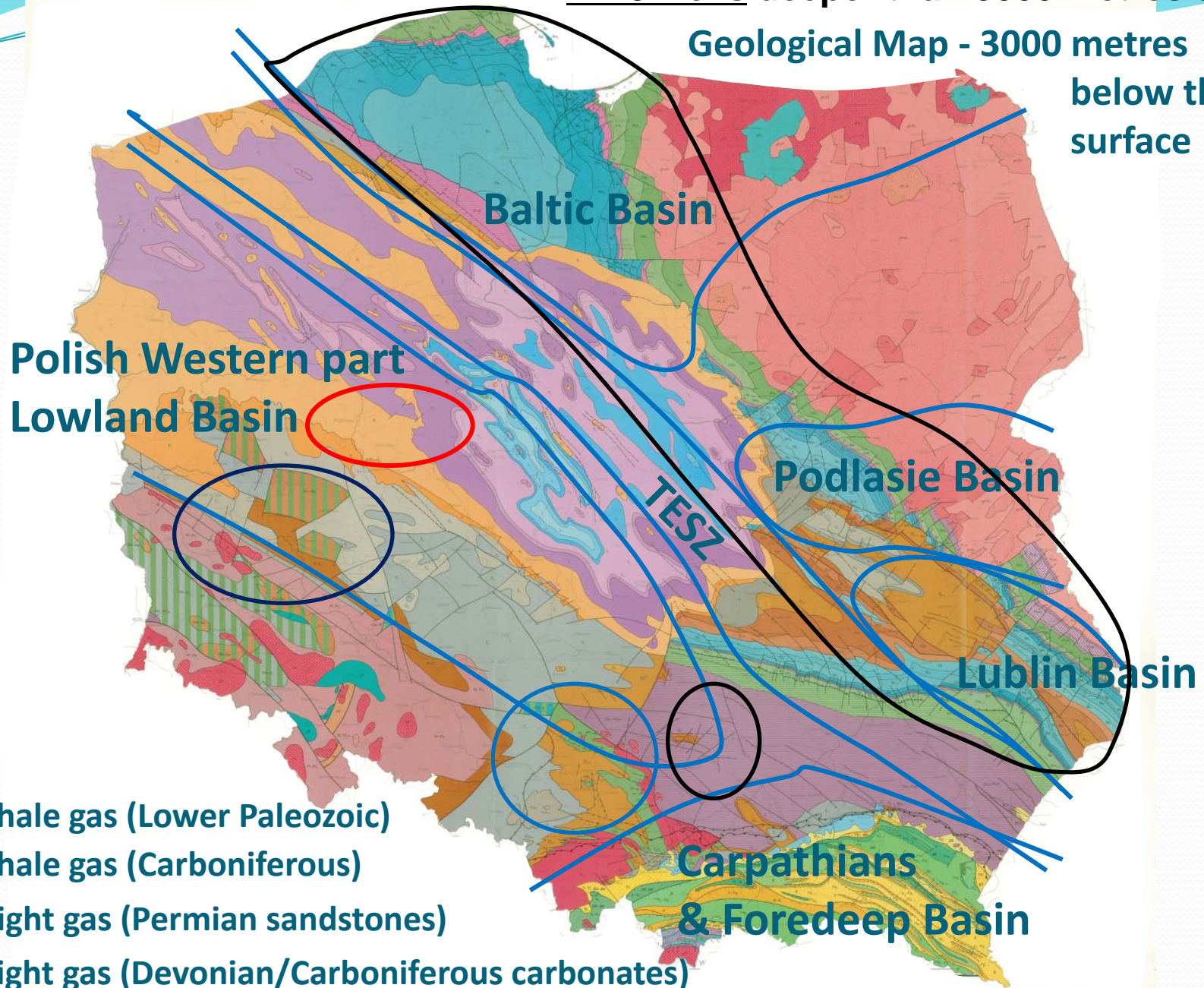


- - shale gas (Lower Paleozoic)
- - shale gas (Carboniferous)
- - tight gas (Permian sandstones)
- - tight gas (Devonian/Carboniferous carbonates)

E&P areas in Poland

1213 wells deeper than 3000 metres drilled

Geological Map - 3000 metres below the surface



- - shale gas (Lower Paleozoic)
- - shale gas (Carboniferous)
- - tight gas (Permian sandstones)
- - tight gas (Devonian/Carboniferous carbonates)

Lower Paleozoic Assets:

Heat flow related to extension and in platform-like settings

- massive early microbial methane**
- no pyro-bitumens (no oil cracking into gas)**
- more oil deeper**
- How true is TOC% in shale gas sequences, just expelled or mostly 'cooked' ?**

Devonian/Carboniferous Assets:

Heat flow related to extension and strike-slip movements while Devonian/Carboniferous had

- massive hot basinal fluids**
- very often pyro-bitumens (oil cracking into gas) !**

Permian (Rotliegend/Zechtein) Assets:


Heat flow related to massive strike-slip movement while Late Carboniferous – Permian had:

- massive hot basinal fluids**
- differential petroleum systems**

Jurassic/Cretaceous Assets:

Heat flow due to extension and higher order strike-slip

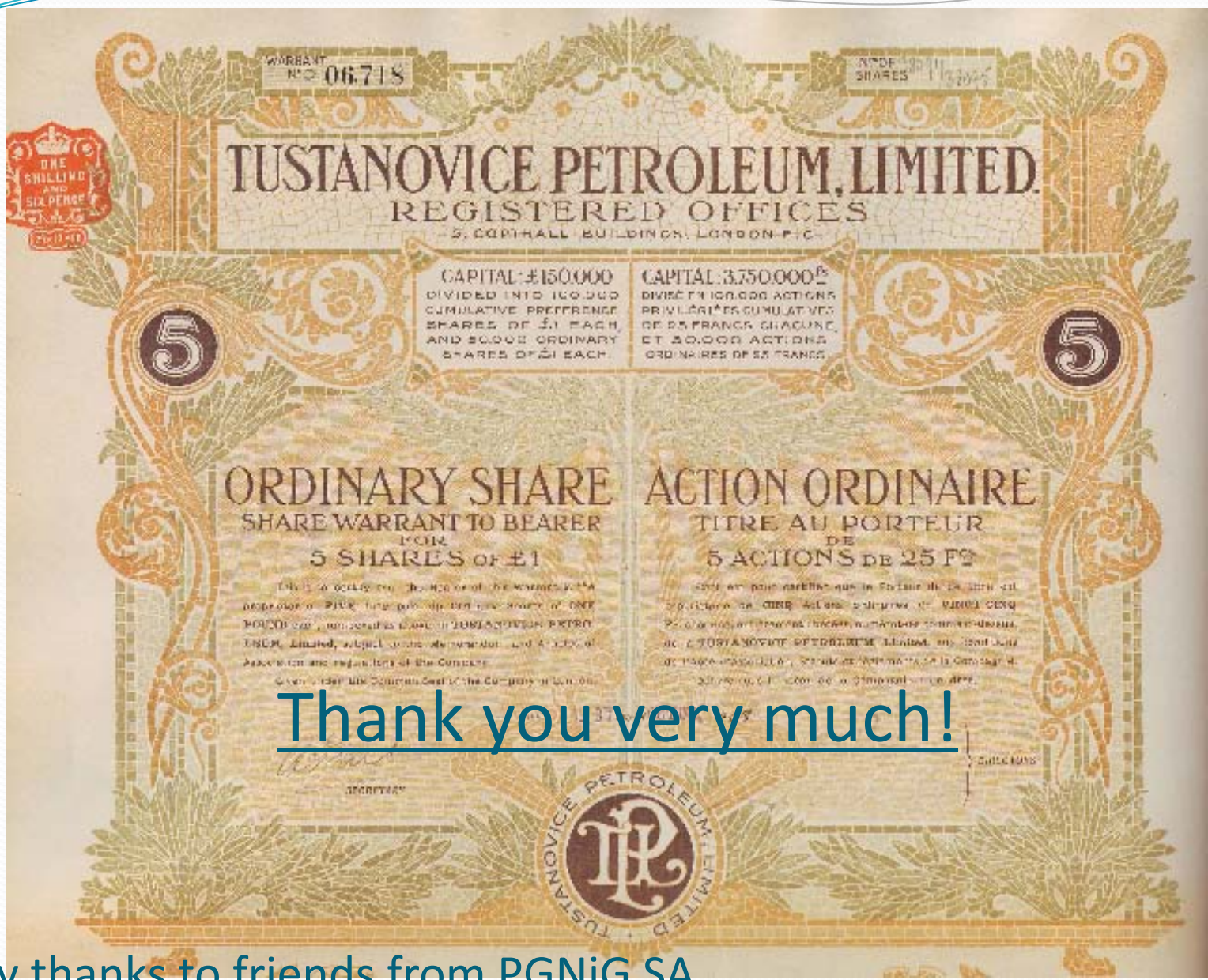
- oil and gas shows in one of every two wells**



Poland
seems soon once again to be
a player
in the world oil and gas market

Only a wish?

REGULAR OIL COMPANY SHARE, 1908, POLAND



Thank you very much!

Many thanks to friends from PGNiG SA