



25th world gas conference
"Gas: Sustaining Future Global Growth"

PERSPECTIVE OF SHALE GAS PROSPECTION IN POLAND

Marek Karabula, PGNiG; Stanislaw Rychlicki, AGH
UST Krakow, PGNiG;
Jerzy Stopa, AGH, UST Krakow, PGNiG; Michal
Szubski, PGNiG

Date:
Kuala Lumpur:



Patron



Host



Host Sponsor



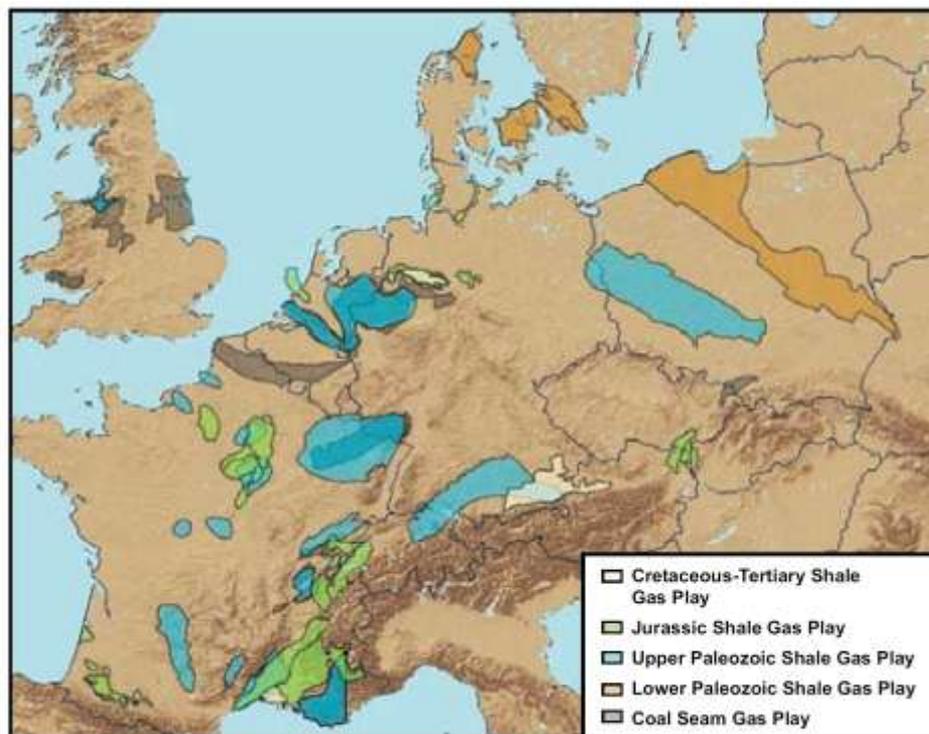
PRESENTATION OUTLINE



- European Shale Gas Resources Estimates
- Polish Shale Gas Resources Estimates
- Shale Gas Activity in Poland
- What is the risk associated with exploration of unconventional gas resources in Poland?
- PGNiG (POGC) shale gas exploration activity
- Lubocino-1 well results
- Summary and Conclusions

EUROPEAN SHALE GAS RESOURCES ESTIMATIONS

GEOLOGICAL DISTRIBUTION OF SHALE PLAYS IN EUROPE



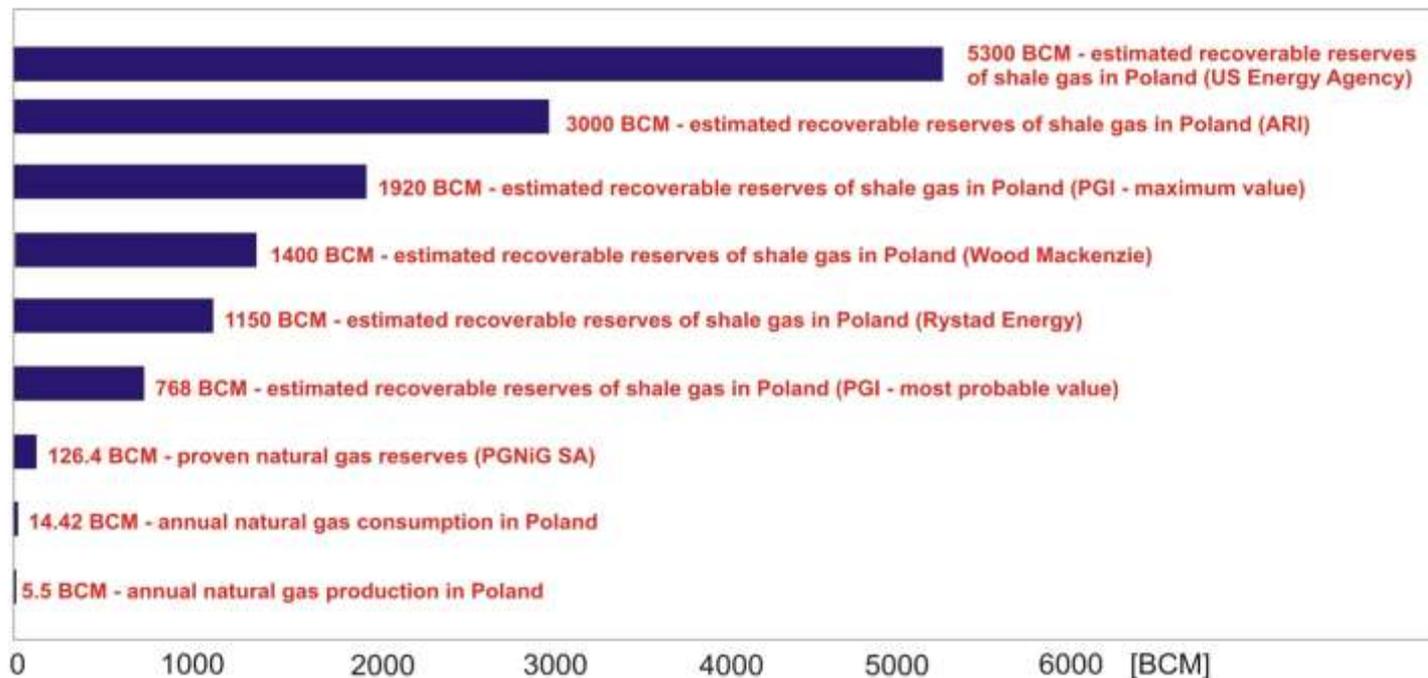
Source: IHS CERA.

Country	Shale Gas Resources		Natural Gas Reserves	
	Bcm	Tcf	Bcm	Tcf
Poland	5295,84	187	164,256	5,8
France	5097,6	180	5,664	0,2
Norway	2350,56	83	2039,04	72
Ukraine	1189,44	42	1104,48	39
Sweden	1161,12	41	0	0
Denmark	651,36	23	59,472	2,1
U.K.	566,4	20	254,88	9
Netherlands	481,44	17	1387,68	49
Turkey	424,8	15	5,664	0,2
Germany	226,56	8	175,584	6,2
Lithuania	113,28	4	0	0
Ro+Hu+Bg	538,08	19	76,7472	2,71

Source US Energy Information Administration, April 2011
Bcm=10⁹m³, Tcf=10¹²ft³

According to present estimates, the Europe's total shale gas in place could be 173.2 Bcm (6.115 tcf). If these can be proven and exploited, it could dramatically change Europe's energy equation, reducing the continent's dependence on gas imports.

POLISH SHALE GAS RESOURCES ESTIMATES

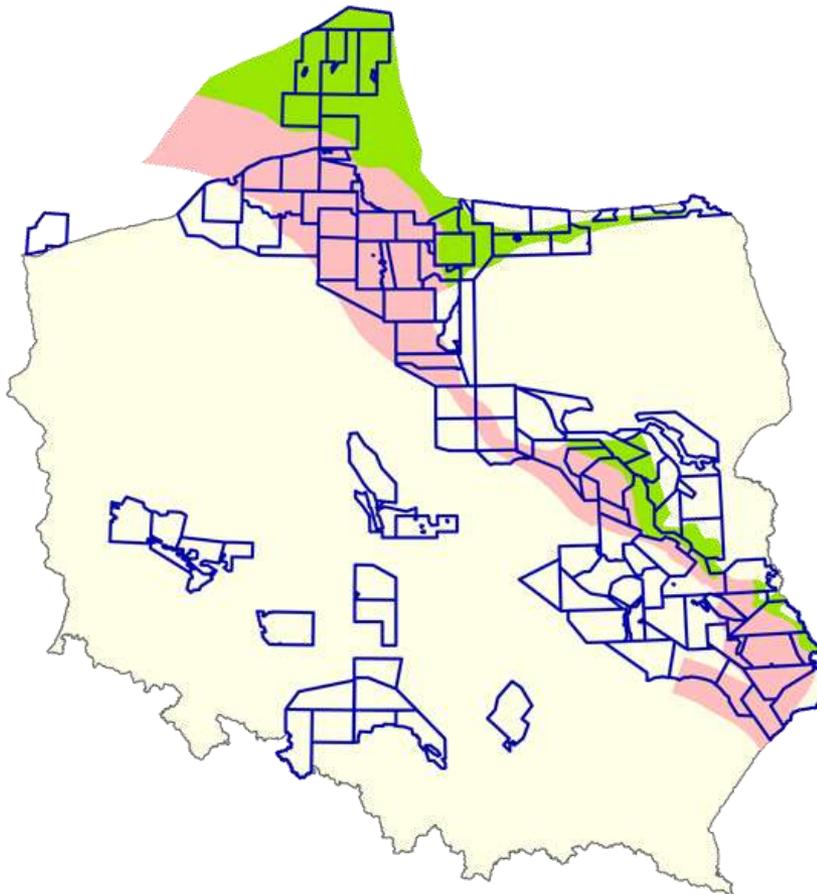


Shale Gas Basins	Risked Gas In-Place		Technically Recoverable Resource	
	Bcm	Tcf	Bcm	Tcf
Baltic Basin	14556	514	3653	129
Lublin Basin	6287	222	1246	44
Podlasie depression	1586	56	396	14

Source US Energy Information Administration, April 2011
 Bcm=10⁹m³, Tcf=10¹²ft³

SHALE GAS ACTIVITY IN POLAND

Up to date 21 companies (including 3 Polish companies: PGNiG SA (POGC), Orlen Upstream and Lotos) have been awarded 107 licenses for exploration of unconventional resources. Another submitted applications wait for awarding decision in the Polish Ministry of Environment.



„Shale gas/shale oil” exploration concessions in Poland – 31.03.2012 status

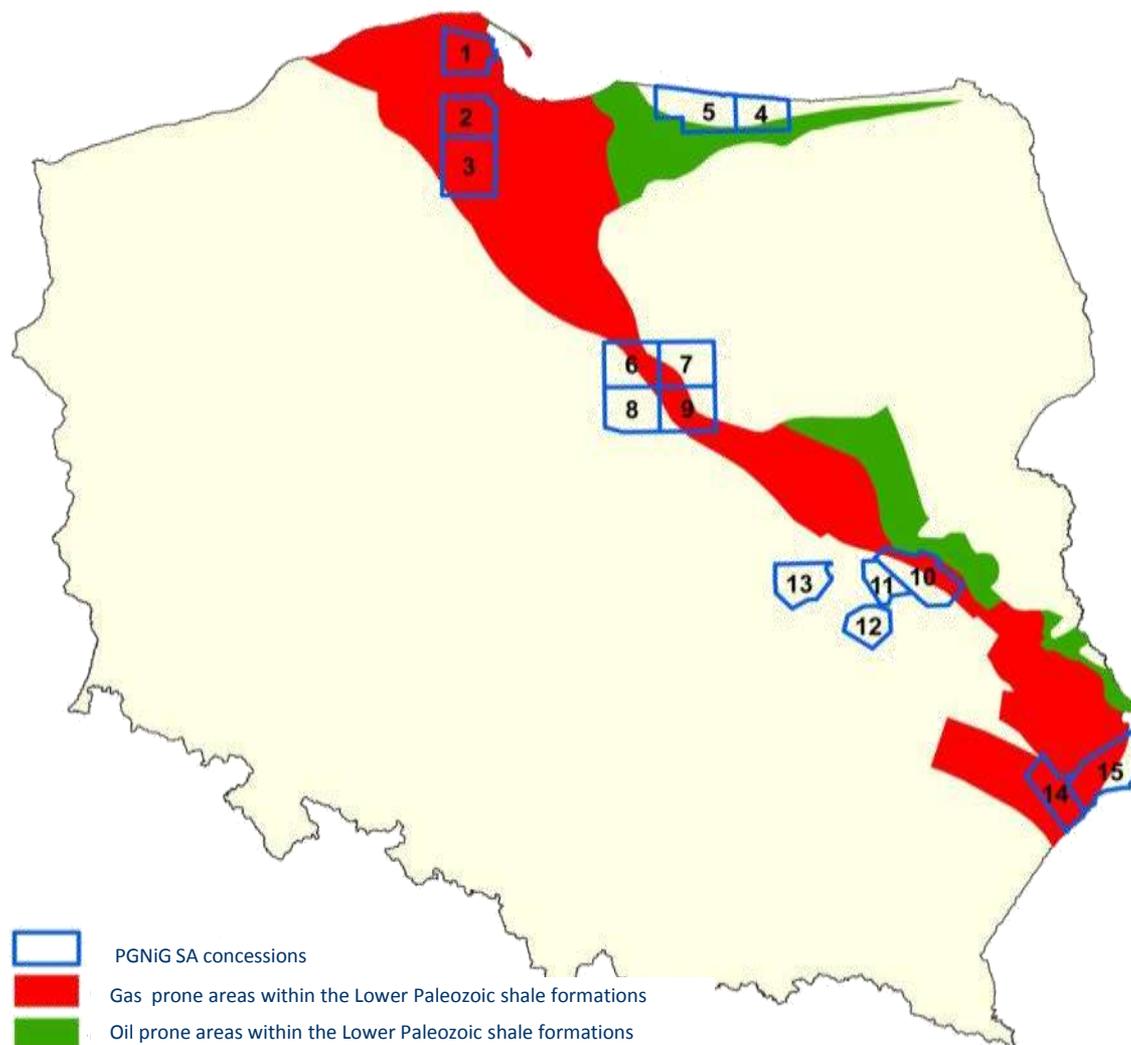
company	number of concessions
Chevron	4
Composite Energy	1
Cuadrilla	2
DPV Service	5
Eco Energy	4
Eni Polska	3
Exxon	6
Gora Energy Resources	1
Indiana Investments	3
Lane Energy	13
Mac Oil	1
Marathon Oil Poland	11
Orlen Upstream Sp.z o.o.	7
Petrobaltic	7
POGC	15
Realm Energy	3
Saponis Investments	3
Silurian Sp.z o.o.	9
Strzelecki Energia	6
Talisman	3
Vabush Energy	1
TOTAL	108

WHAT IS THE RISK ASSOCIATED WITH EXPLORATION OF UNCONVENTIONAL GAS RESOURCES IN POLAND?

The risks associated with exploration of unconventional gas deposits in Poland include:

- unrecognized geology – most of the archive wells come from 1970s and 1980s, what results in the absence of the most required data for shale perspective analysis (geochemical data indicating organic matter content and maturity, kerogen type etc.). Old geophysical measurements don't give the possibility of reliable reservoir parameters estimation,
- urbanization of the area – population density in Poland is quite high (122 persons/km²). What is more, the perspective zones for “shale gas” exploration are located within areas used for rural activities,
- restrictive regulations on environmental protection – the license owner has to take into consideration local Polish and European Union law,
- large number of environmentally protected areas and objects – many of license areas are covered by National Parkas, Nature Preservation Areas as well as Natura 2000 zones. Exploration works are highly limited within these. Exploration should be run according to Spatial Development Plan created by local authorities,
- negative opinions from local authorities, especially from attractive touristic areas,
- access to proper water reserves – drilling and fracturing one horizontal well requires 8000-20 000 m³ of water,
- very high capital cost (cost and number of wells, large production facilities),
- cost of proper technologies,
- uncertainty of gas prices.

PGNiG (POGC) SHALE GAS EXPLORATION ACTIVITY



	Concession	area km ²
1	Wejherowo	729.99
2	Kartuzy - Szemud	782.61
3	Stara Kiszewa	1 178.14
4	Bartoszyce	669.36
5	Górowo Iławeckie	1 094.39
6	Blok 172	936.79
7	Blok 173	936.69
8	Blok 192	921.87
9	Blok 193	942.03
10	Kock - Tarkawica	1 028.64
11	Ryki - Żyrzyn	426.86
12	Pionki-Kazimierz	532.00
13	Warka-Ursynów	734.42
14	Tomaszów Lubelski	745.76
15	Wisznów-Tarnoszyn	1 106.55
	Sum	12 766.10

Polish national company PGNiG SA (POGC) has been awarded 15 licenses covering an area of 12 766.10 square kilometers. PGNiG SA (POGC) licenses are located within important Paleozoic sedimentary basins, starting from the Baltic Basin in the northern Poland, through Podlasie Basin in the central part, ending in the Lublin Basin in the south. Lower Paleozoic shales of Silurian and Ordovician age are considered as the most perspective horizons for unconventional hydrocarbons and are the main target for “shale gas” and „shale oil” exploration.

PGNIG (POGC) SHALE GAS EXPLORATION ACTIVITY

Accessible geological, geophysical and geochemical data suggest that Ordovician and Silurian shales are rich enough in organic matter and are thermally mature enough to be worth an inputed interest. According to available data, PGNiG SA (POGC) licenses are located within the area of different, but generally high, exploration potential what creates hope for the future success.



Basic Data	Basin/Gross Area	Baltic Basin (101,611 mi ²)	Lublin Basin (11,882 mi ²)	Podlasie Basin (4,306 mi ²)	
	Shale Formation	Lower Silurian	Lower Silurian	Lower Silurian	
	Geologic Age	Llandovery	Wenlock	Llandovery	
Physical Extent	Prospective Area (mi ²)	8,846	11,660	1,325	
	Thickness (ft)	Interval	330 - 820	330 - 1,115	360 - 720
		Organically Rich Net	575 316	415 228	540 297
	Depth (ft)	Interval	8,200 - 16,400	6,560 - 13,450	5,740 - 11,350
Average		12,300	10,005	8,545	
Reservoir Properties	Reservoir Pressure	Overpressured	Overpressured	Overpressured	
	Average TOC (wt. %)	4.0%	1.5%	6.0%	
	Thermal Maturity (%Ro)	1.75%	1.35%	1.25%	
	Clay Content	Medium	Medium	Medium	
Resource	GIP Concentration (Bcf/mi ²)	145	79	142	
	Risked GIP (Tcf)	514	222	56	
	Risked Recoverable (Tcf)	129	44	14	

LUBOCINO-1 WELL RESULTS

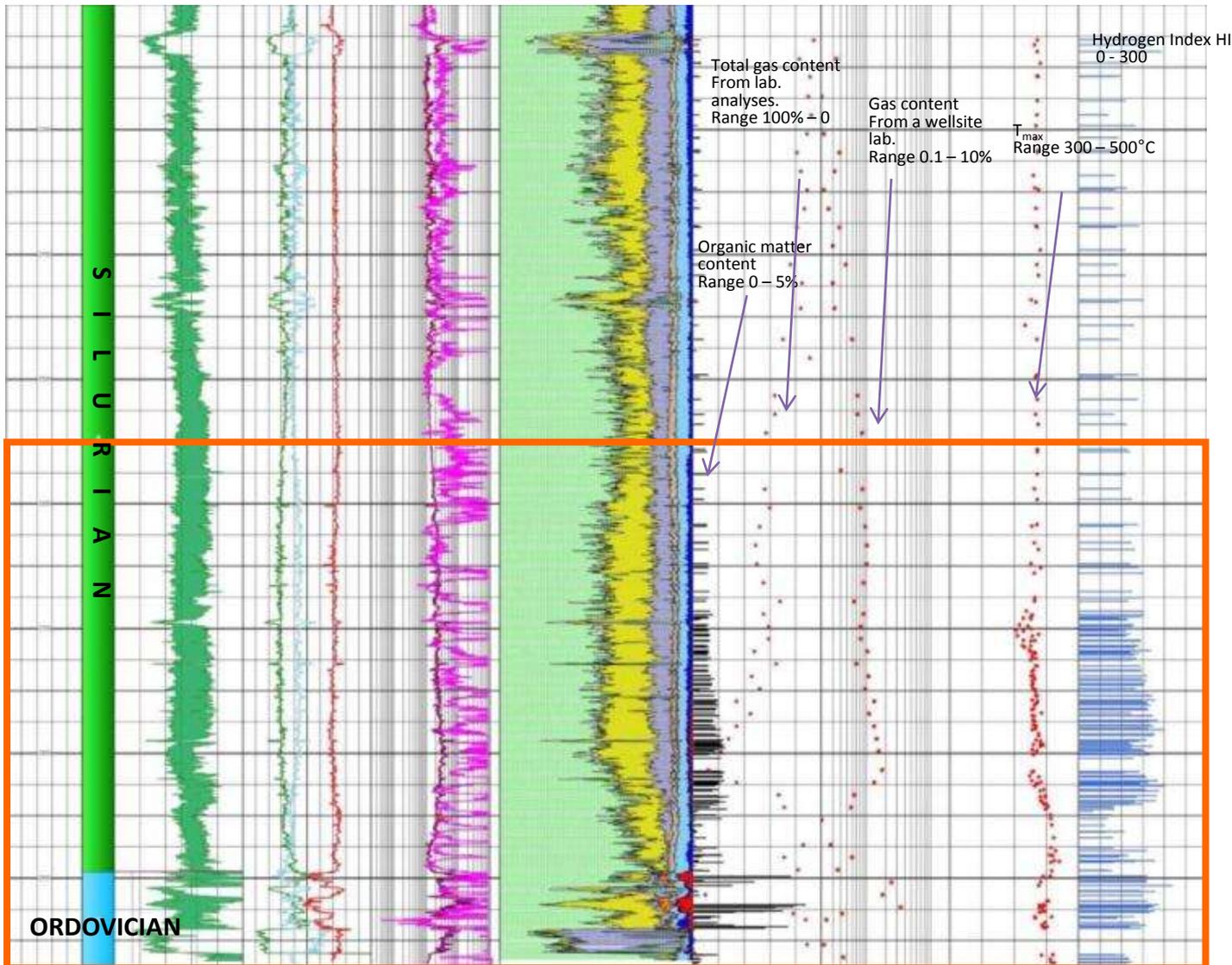


The first vertical exploration well, Lubocino – 1, was drilled at the beginning of 2011. The well ended up in Cambrian deposits and drilled 1843.5 m of Silurian and 63 m of Ordovician strata. 800 m of core was recovered, which was further analyzed to examine geochemical, petrophysical and geomechanical parameters of the rocks. Wide spectrum of wireline logging measurements was also applied. The results of combination of both, laboratory and geophysical analysis, turned out to be very promising and confirmed the presence of unconventional gas within the Ordovician and Silurian strata.

The 13 m vertical section in the Ordovician interval was hydraulically fractured and the gas flow was recorded. In 2012 the hydraulic fracturing will be performed in Silurian intervals to test their prospectivity for shale gas. Currently the 3D seismic survey is being acquired in the area of Lubocino-1 well in order to recognize in detail the pattern of faults and fractures in the region and allow to optimize the horizontal well trajectories in the future.

The horizontal Lubocino-2H well will be drilled this year from the same drilling pad as vertical Lubocino-1 well.

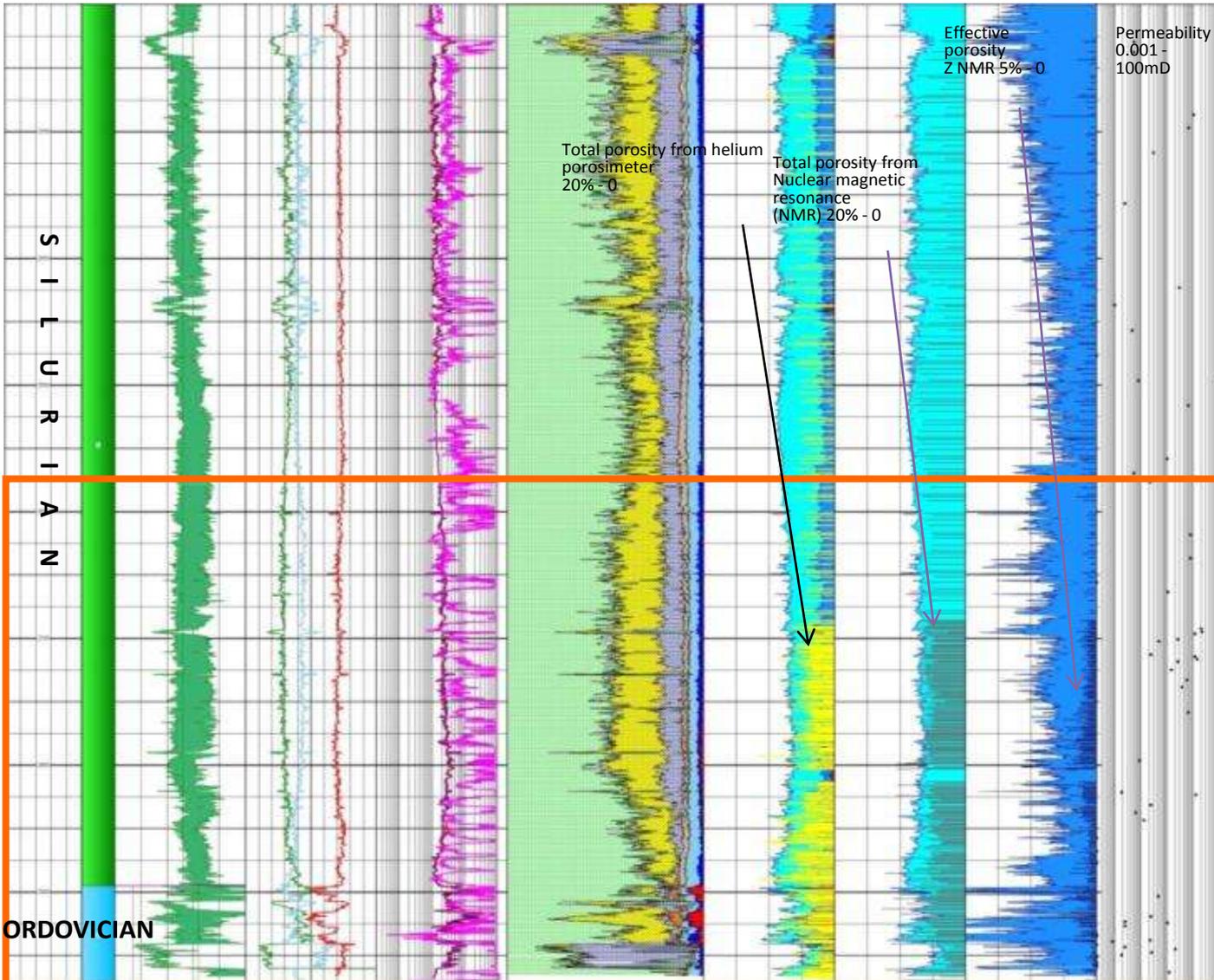
LUBOCINO-1 WELL RESULTS



Geochemistry interval 2200 - 2972 m

- Presence of organic matter content (TOC > 0.5%) from laboratory analyses indicate good and very good source rock potential in prospective interval (2550 - 2972m).
- Total gas from MudLog during shows increased value in the most prospective interval 2550 - 2972 m.
- Temperature T_{max} shows sufficient thermal maturity of organic matter within Lower Silurian and Ordovician deposits.
- Hydrogen index values are also satisfactory and are placed at the transition zone of oil and wet gas window.

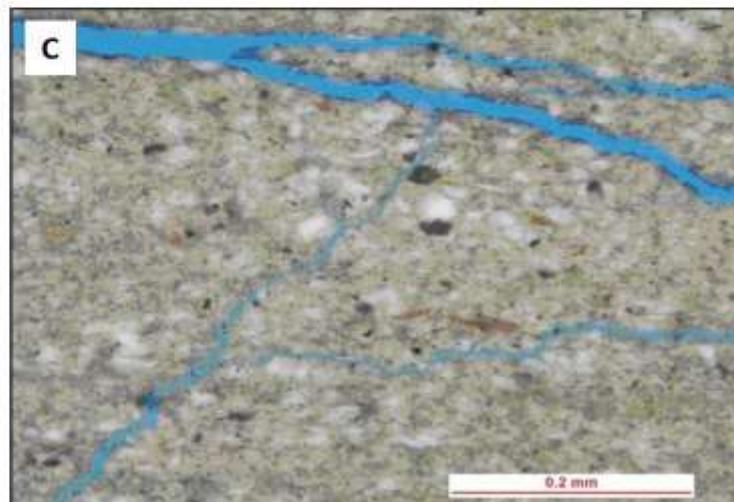
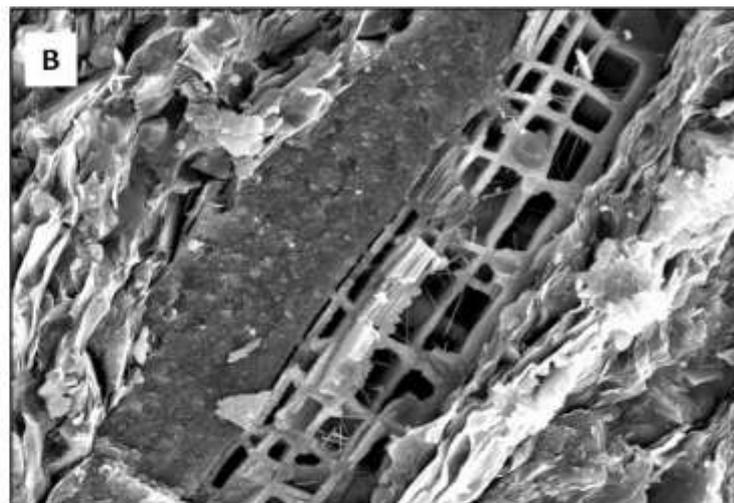
LUBOCINO-1 WELL RESULTS



Reservoir properties interval 2200 - 2972m

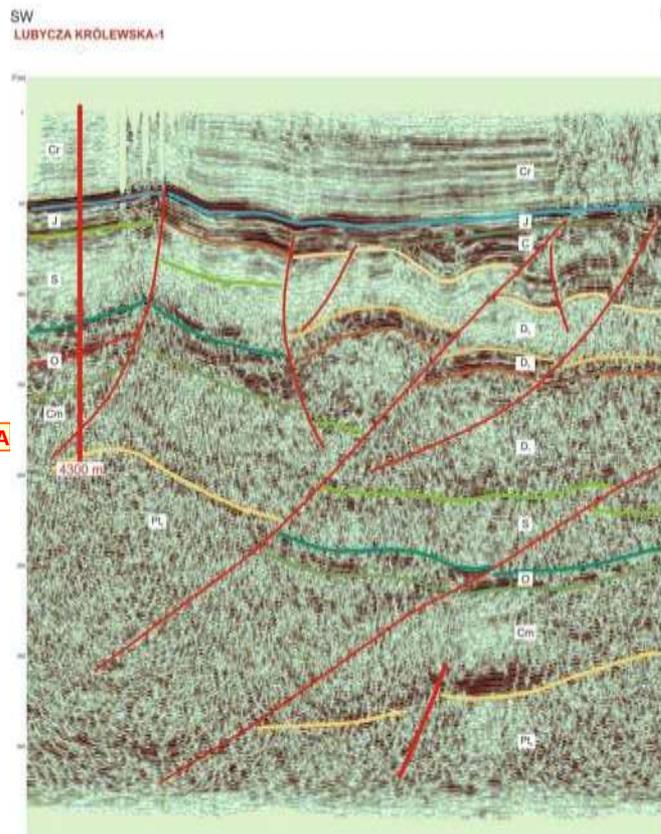
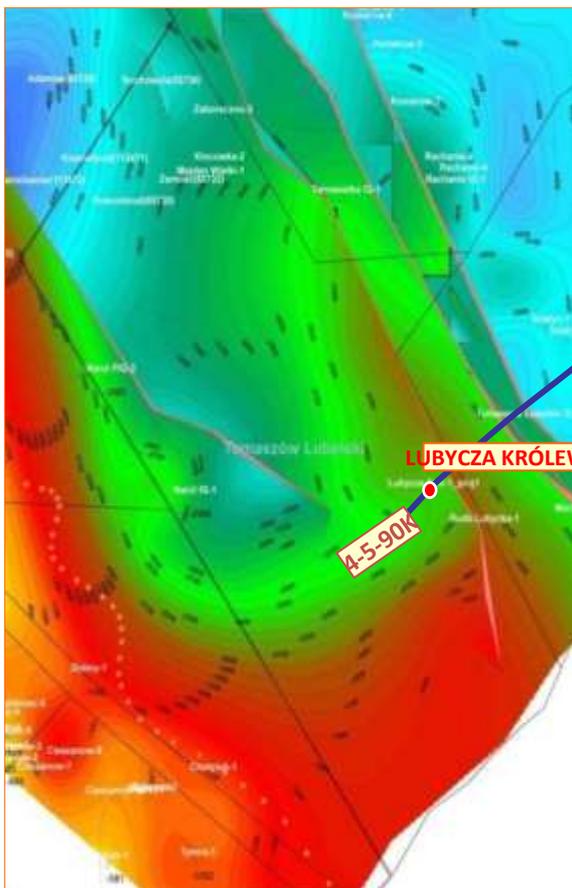
- Laboratory analyses of permeability indicate its good properties especially in the 2550 – 2972 m interval where they reach up to 50mD. Its significant scattering suggest rock matrix permeability as well as fracturability and presence of fractures.
- Total porosity values measured by porosimeter and magnetic resonance analyses correspond well with total porosity interpreted from wireline logs.
- Effective porosity values measured by NMR analyses do not correlate sufficiently with effective porosity interpreted from wireline logs.

LUBOCINO-1 WELL RESULTS



Black shales of Silurian age (A); Microporosity (B) and micro-fractures (C) in Silurian shales

LUBYCZA KRÓLEWSKA-1 WELL



Lubycza Królewska-1 well, on Tomaszów Lubelski concession, was spudded on 26.03.2012. The well is going to be drilled up to 4300 m. The analysis of available geological data from that area points to the promising results of that well. The well is going to recognize 1300 m of Silurian and 250 m of Ordovician deposits. The plan is to recover 958 m of continuous core and subject it to the detailed laboratory analysis. The well is also going to be logged with all necessary tools to get the reservoir characteristics as accurate as possible

SUMMARY AND CONCLUSIONS

- Poland has the Europe largest probable reserves of shale gas.
- The development of the unconventional gas in Europe is still in the preliminary stage.
- Authors' research and experience show that exploration of unconventional natural gas deposits will not be easy but one should remember that such gas deposits create opportunities for both Europe and for companies starting the exploration.
- The existing evaluations of the shale gas potential in Poland are promising.
- Further evaluation is ongoing and each month brings new data. The understanding of Palaeozoic formations increases with each drilled well.
- It is very possible that Poland could have gas on a large enough scale not only to cover its demand, but probably to export gas or to displace coal-power generation as well.



THANK YOU FOR YOUR ATTENTION