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

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Search and Discovery Article #10356 (2011)
Posted September 19, 2011

*Adapted from oral presentation at AAPG Annual Convention and Exhibition, Houston, Texas, USA, April 10-13, 2011

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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

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Poland Setting in Europe

- Caledonian
- Variscan
- Alpine

- EEC
- TESZ

Map showing geographical features and boundaries in Europe, including 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
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

Source of seismic: PGI Archive
Baltic Basin Structural Map

Seismic line

Conventional Oil & Gas and Tight Oil & Gas

Map: Modlinski
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

Seismic line

Map: Porzycki & Zelichowski
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.
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

- Baltic Basin
- Podlasie Basin
- Lublin Basin
- Carpathians & Foredeep Basin
- Polish Western part
- Lowland Basin

85 concessions for unconventional gas granted

Map: Ministry of the Environment
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

Vast tight gas potential

Polish Western part
Lowland Basin

Source of seismic: PGI Archive
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

Karnkowski&Kopczynska
Thickness of the Jurassic/Cretaceous in Poland

Still promising

Source of seismic: PGI Archive
**Carpathian Foredeep basin/overthrust boundary area**

**Basin:**
- Conventional Oil & Gas and Tight Oil & Gas

**Mesozoic:**
- Conventional Oil & Gas

**Tertiary:**
- Conventional Oil & Gas and Tight Gas

Source of seismic: PGI Archive
Carpathian Foredeep basin/overthrust boundary area

Mesozoic Petroleum System
Carpathian Fore-Deep

Paleogene Source Rocks
Distal Canyons

Carpathian Petroleum System

- Oil Migration
- Oil Fields
Poland is 45% the size of Texas

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

3D seismic – 10,417.6 km\(^2\) (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 19\(^{th}\) Century
Concession Map of Poland – Target concessions

- shale gas (Lower Paleozoic)
- shale gas (Carboniferous)
- tight gas (Permian sandstones)
- tight gas (Devonian/Carboniferous carbonates)
E&P areas in Poland

- **Baltic Basin**
- **Carpathians & Foredeep Basin**
- **Lowland Basin**
- **Podlasie Basin**
- **Lublin Basin**

**Polish Western part**
- shale gas (Lower Paleozoic)
- shale gas (Carboniferous)
- tight gas (Permian sandstones)
- tight gas (Devonian/Carboniferous carbonates)

**Geological Map – 1000 metres below the surface**

- 7564 wells deeper than 1000 metres drilled

Map: Kotanski et al.
E&P areas in Poland

- 1213 wells deeper than 3000 metres drilled
- Geological Map - 3000 metres below the surface

Polish Western part
- Lowland Basin
  - shale gas (Lower Paleozoic)
  - shale gas (Carboniferous)
  - tight gas (Permian sandstones)
  - tight gas (Devonian/Carboniferous carbonates)

Map: Kotanski et al.
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/Zechstein) 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?
Thank you very much!

Many thanks to friends from PGNiG SA