Petroleum Provinces in Poland

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A b s t r a c t. The scheme in which the Carpathians, Carpathian Foredeep and Polish Lowland are distinguished as the hydrocarbon prospective zones was used hitherto in Poland. Good geological diagnosis of Poland area enables to distinguish the petroleum provinces in terms of basin analysis (methodology). This procedure are based on an integration of multidisciplinary geological and geophysical data with into a petroleum play concept. Results of drillings and petroleum play procedures allow to predict boundaries of petroleum provinces. Effects of basin analysis with regards to the stratigraphy of hydrocarbon-bearing areas are presented in Figure 1. All these prospective areas (Fig. 1) have been matched into five independent units (Fig. 2) which could be defined as following petroleum provinces: Pomerania, Wielkopolska, Małopolska, Lublin and Gdańsk. These petroleum provinces are only the parts of sedimentary basins the individual development of which enabled generation, migration and preservation of hydrocarbons. Location of the above mentioned petroleum provinces is also brightly reflected on the map of crustal consolidation (Fig. 3): every province in Poland has its own individual geologic history.

Key words: *petroleum provinces, basin analysis, petroleum play, Poland*

Exploration and industrial utilization of hydrocarbons in Poland has already 150 years' history. During this period the geological, geophysical and geochemical sciences has highly progressed and nowadays prognosis of future petroleum zones is worked out by a methodology called "basin analysis". Principle of this procedure is integration of Earth sciences focussed to determine a petroleum play, i.e. profitable conditions for generation, migration and accumulation of hydrocarbons. Results of explorations and procedures of petroleum play within the sedimentary basins permit to define the borders of petroleum provinces. Because in the given area several sedimentary basins could exist in various time respectively, hence the complex geologic settings in distinguished petroleum provinces are very possible. The hitherto good geological recognition of Poland area allows to distinguish five petroleum provinces: Małopolska, Wielkopolska, Pomerania, Gdańsk and Lublin.

Importance of sedimentary basin studies was perfectly understood already in the 1950s, when ideas of preliminary geological exploration of Poland were born. Olewicz paper (1959) was not only a recapitulation of the contemporary knowledge state about the subsurface geology of Poland, but mainly a certificate of understanding the relationships between occurrence of petroliferous areas and development of proper petroliferous rocks. He referred to the Mesozoic and the Palaeozoic sedimentary basins respectively indicating the examples with possibility of petroleum occurrences. In spite of poor geological and geophysical data the correctness of palaeothickness maps and regional geological cross-sections was especially striking. In this paper the structural subdivision of Poland by Pożaryski (1956) was still used. Following sedimentary basins were distinguished: the Wielkopolska Basin (in today's understanding the epi-Variscan basin of the Polish Lowland), the Baltic Basin (i.e. Lower Palaeozoic Basin in the border zone of the East European Craton) and the Carpathian Basin with its foredeep. The valid supplement to the contemporary state of knowledge on these basins is the *Geological Atlas of Poland; Stratigraphic and Facies Problems, 1 : 3,000,000* (Pajchlowa & Tyska, ed, 1961–1965).

In the late 1950s the huge gas fields in the Carpathian Foredeep have been discovered: Lubaczów — 1957, Jaksmanice — 1958, Przemyśl — 1960 (the biggest field in Poland). First oil field in the Polish Lowland (Rybaki near Krosno Odrzańskie) was found in 1961 within the Zechstein Main Dolomite formation. The first gas field discovered (1964) in the Rotliegend deposits by Bogdaj-Uciechów 1 borehole (near Ostrów Wielkopolski) caused concentration of forces and resources to recognize the Wielkopolska Basin. The period 1965–1975 was significant as the high inflow of information about a subsurface geology of the Polish Lowland. This resulted in appearance of numerous cartographical elaborations: Sokołowski, 1964; Znosko, 1968; Czermiński and Pajchlowa, 1974–1975; Depowski, 1978; Karnkowski P., 1980; Dadlez, 1980; Pożaryski and Karnkowski P., 1992. In other regions (particularly the important preliminary materials) geological exploration was also continued, e.g. elaborations by: Karnkowski P. and Ołtuszyk, 1968; Żelichowski and Kozłowski, 1983. Problems of petroleum explorations in Poland were presented in following papers: Karnkowski P., 1973; Depowski, 1976; Sokołowski and Tomaszewski, 1988; Kuśmierek, 1990; Skarbek, 1990; Karnkowski P. et al, 1991; Strzetelski, 1993; Strzetelski and Kruczek, 1993; Weil et al, 1994; Górecki et al, 1995.

The latest geological-cartographic elaborations concerning all Poland territory are the maps of horizontal cutting at levels: 500 m, 1000 m, 2000 m, 3000 m, 4000 m and 5000 m below sea level (Kotański, ed, 1997). These maps are comparable to 3D seismic horizontal images; it is a peculiar Earth scanning and a way for presentation of structural settings irrespectively of the object scale.

Prognosis of the hydrocarbon zones is based on a multidisciplinary methodology, including structural, sedimentological, petrophysical, geochemical, palaegeographic and palaeotectonic aspects. Huge amount of geophysical and geological data, hitherto collected by petroleum companies, is now elaborated by the methodology called "sedimentary basin analysis" (comp. Allen & Allen, 1990). Its fundamental principle is a vast multidisciplinary integration of different disciplines, applied to study the areas of the present and the past sedimentary basins. In Poland this method was especially applied and developed in the Polish

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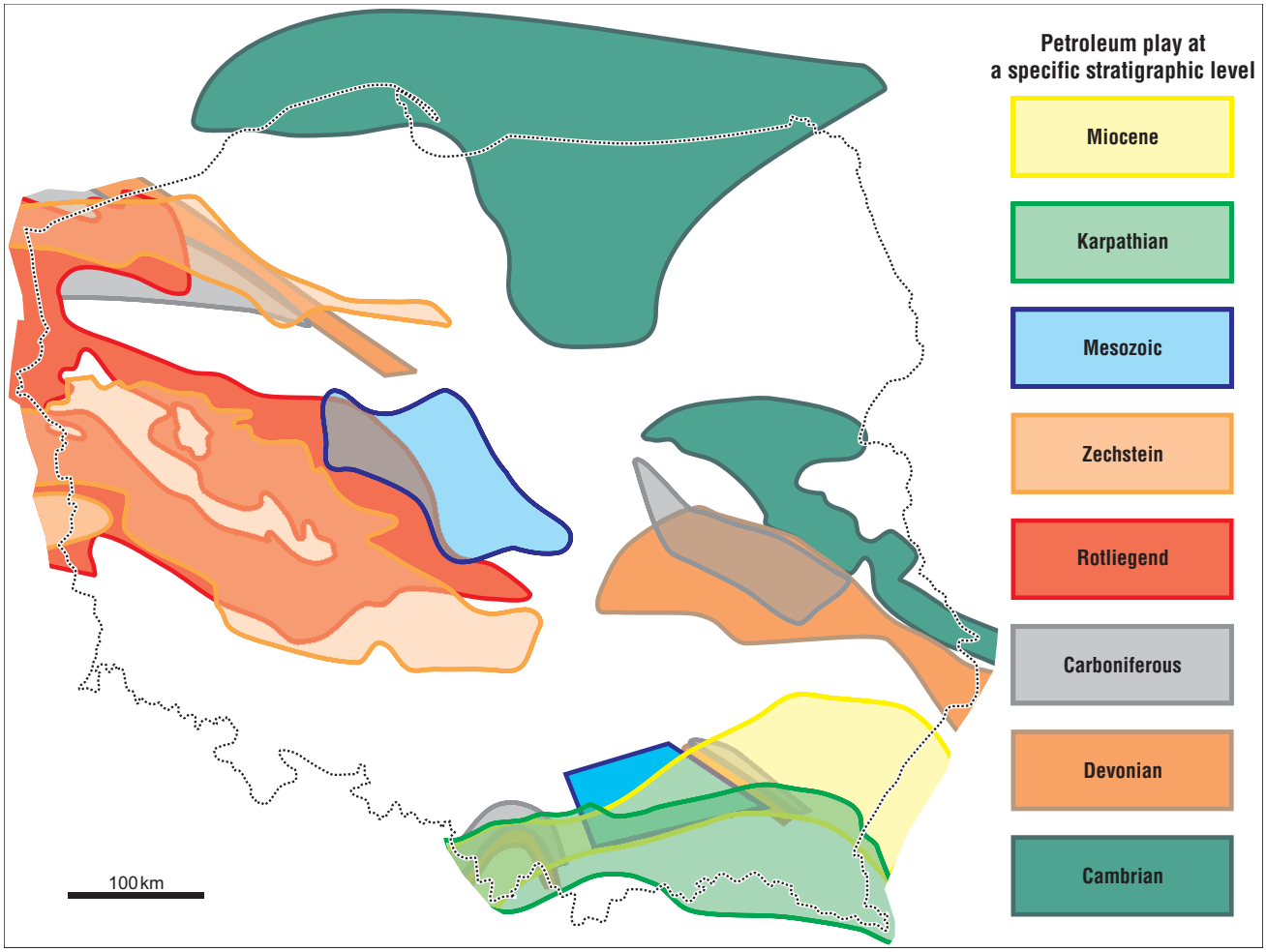

Fig. 1. Summarized hydrocarbon-bearing areas at a specific stratigraphic level

Geological Institute (comp. Narkiewicz, 1995). The final aim of sedimentary basin analysis is to show the most prosperous zones for petroleum exploration. Besides the geological factors, a very important role in exploration plays also economics (costs of drillings, royalties, taxes, infrastructures etc). Discovering of oil or gas field confirms the established assumptions of supposed hydrocarbon zones. These zones never occur in the whole sedimentary basin area, but only this part which fulfil a petroleum play condition. Taking into account that in one region a few formations can be of petroleum play category, and these formations are regionally limited, their external boundaries limit the exploration area of petroleum provinces. Hitherto in the Polish Oil and Gas Company the scheme with three hydrocarbon-bearing units was used: the Carpathians (19,000 km^2), the Carpathian Foredeep (17,000 km^2) and the Polish Lowland (221,000 km^2). Total surface of the prospective areas is 257,000 km^2, what equals 82% of the total Poland area. Actually good geological knowledge of Poland area empowers to establish the petroleum provinces using a methodology of sedimentary basin analysis, especially by applying an algorithm of petroleum play. As for the Polish Basin (Permo-Mesozoic Basin of the Polish Lowland) the author used mainly own research results (Karnkowski P.H., 1996a, b, 1999), in other cases the published elaborations and papers became essential data for such analysis (Kutek & Głazek, 1972; Jaworowski, 1979, 1982; Pokorski, 1988; Wagner, 1988; Dadlez, 1989; Karnkowski P., 1993a, b).

Sedimentary basins

Early Palaeozoic basins

In the Peribaltic Syneclise and the Podlasie region more than 70 deep boreholes were drilled exploring the Cambrian deposits for oil findings. In many of them oil seeps and highly mineralized brines have been noticed. Small oil production has been obtained from Dębki 2 and Żarnowiec IG-4 wells, about 1 t/d (in the Łeba Elevation area). The production horizon is the Middle Cambrian sandstone (Weil & Łabęcki, 1987). Results of drillings confirmed prosperous reservoir features in the Middle Cambrian sandstone in the Peribaltic area, the Podlasie region and the northern slope of Lublin Graben (Stolarczyk et al, 1997). The main trap type is close-fault structures formed during the Early Devonian tectonic movements. Favourable reservoir properties decrease with the depth. To establish the present hydrocarbon-bearing zones in the Cambrian deposits the position of sandstone was assumed the depth interval between 1000 m and 3000 m. The surface covered by this predicted zone includes the area continued from the Łeba Structural Elevation through the Elbląg-Olsztyn region up to the Lublin Graben. Because the oil fields were discovered not only in the Łeba Elevation area but also in

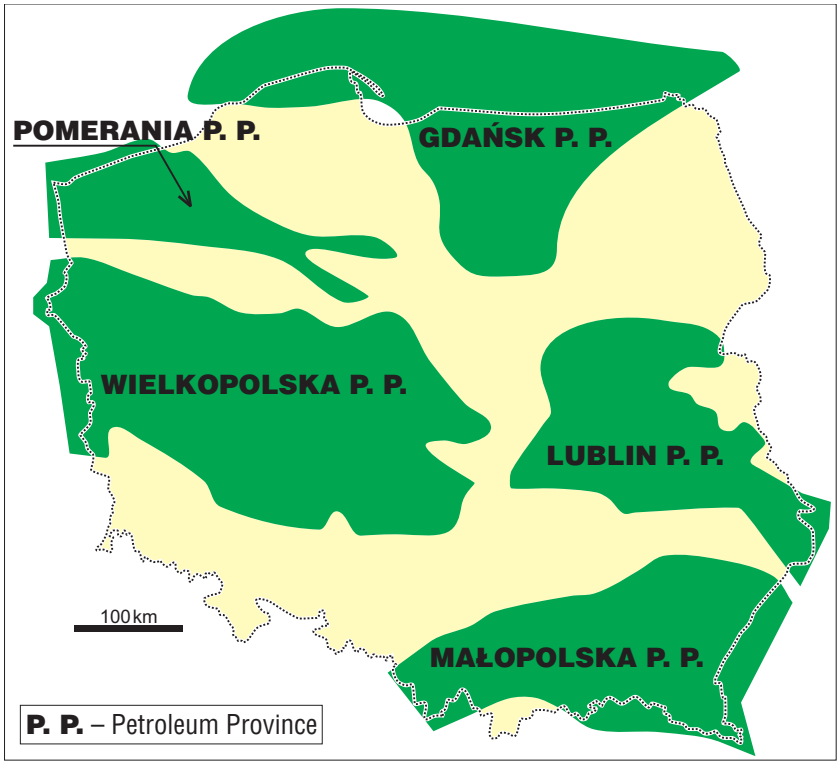

Fig. 2. Petroleum provinces in Poland

the southern part of Baltic Sea and in the Kaliningrad District (along the northern Poland state boundary), it is supposed that this zone should to be reanalysed at first. Geological modelling carried out in the Peribaltic Syneclise (Karnkowski P.H., 2003a) confirmed the prospective target of exploration in the Cambrian deposits but in a smaller area than it was accepted earlier. Besides the structural traps also the stratigraphic (lithofacial) ones are the exploration objects. In the Cambrian series from Podlasie-Lublin region the numerous hydrocarbons seepages during drilling were frequently often observed (e.g. Kałuszyn 1). Thickness-facial changes visible on the seismic sections become the principle for searching both stratigraphic and/or structural-stratigraphic traps. The Cambrian deposits are sealed by the Ordovician siltstones tens metres thick and the Silurian claystones (hundreds metres).

Late Palaeozoic Basins

Devonian Basins. Devonian sedimentary basin in Poland was characterised by three main sedimentary zones: 1) a shore basin zone — mainly sandy and limestone lithofacies of a shallow shelf, 2) a zone of deep shelf with a shaly sandstone lithofacies, and 3) a deep marine zone (Miłaczewski, 1981, 1987). For the petroleum play concept only the zone of shallow shelf is prosperous, which extends from the Pomerania region (northern Poland) along the edge of East European Craton through the Lublin area up to the Małopolska vicinity including the Carpathian Foredeep basement. Burial history of the Devonian deposits allows to distinguish only three hydrocarbon-bearing zones: the narrow area in the Pomerania region, the Devonian deposits in the Lublin Graben including weakly recognized the Radom vicinity and the Devonian series occurring sporadically beneath the Miocene deposits in the Carpathian Foredeep and in the Carpathians. Boreholes confirming these prosperous zones are Ciecierzyn and Małgiew ones in the Lublin Graben and Lachowice in the Sub-Carpathians region. In the Pomerania area only a few hydrocarbons seepages have been registered. The best reservoirs are the Upper Devonian calcareous reef sediments. The problem of source rocks there is not yet solved (Merta, 1993).

Carboniferous Basins. The Early Carboniferous Basin was in a shape and extent quite similar to the Late Devonian sedimentary image. The Lublin area is an exception here because in the Early Carboniferous time it was an uplifted land being eroded and karsted. Similar conditions were in the eastern Małopolska area but far to the west the Upper Silesia Basin conditions were dominant, and the transition from the Devonian to the Carboniferous sedimentation was continuous or there occurred a little stratigraphic gap and a slight tectonic unconformity. The Late Visean transgression flooded the large areas including the Lublin Basin with a continued sedimentation up to the Stephanian period. Similar type of sedimentation dominated in the Upper Silesia Basin. Tectonic movements of the Sudetic Phase caused generation of paralic facies later being replaced by limnic ones, both in the Lublin and Upper Silesia Basins. In the other area of Polish Lowland a marine sedimentation was finished in the Namurian A time. In the Pomerania region the terrestrial Westphalian facies overlaid, locally with a little unconformity, the Lower Carboniferous or the Upper Devonian rocks (Żelichowski, 1964, 1987; Lech, 1985).

Gas fields (Gorzysław, Trzebusz, Wrzosowo, Daszewo) occurring in the Upper Carboniferous reservoirs confirm their prospectivity. Hence in the Pomerania, the hydrocarbon-bearing zone in the Carboniferous deposits occurs between the Variscan orogenic front and the north-east limit of Carboniferous rocks. In the Variscan area were found the gas fields occurring partly in the Carboniferous deposits, e.g. Kościan, Paproć fields (Gregosiewicz et al, 1985; Kotarba et al, 1992). The upper part of these gas fields is built of the Zechstein reef limestones. It is assumed that where good structural conditions for reef construction (uplifted blocks) occurred the synsedimentary tectonic movements influenced organic build-ups. Strongly fractured Carboniferous rocks are sub-reef reservoirs for a natural gas. Exploration of Carboniferous traps lying directly beneath the Zechstein Limestone unit focus on searching the Werra calcareous buildups. Hence the hydrocarbon zones are lacking in the Variscan area, because there are not reservoirs with a known porosity pattern.

In the Lublin Graben oil source rocks are silty deltaic deposits (marine, the Westfalian in age, the Dęblin Formation), and reservoirs are paralic sandstones. Besides searching structural traps the sedimentological analyses are very important to recognize an extent of particular lithofacies and facies influence on the petrophysical parameters of litho-structural traps. Good example is the Stężyca field. The hydrocarbon-bearing Carboniferous zone in the Lublin

area is limited to the north-western part of Carboniferous extent where the top of Carboniferous rocks are located below 1000 m (Karnkowski P.H., 2003b).

The Carboniferous hydrocarbon-bearing zones in the sub-Carpathians and the sub-Carpatian Foredeep are placed in two regions: Rzeszów vicinity (Nosówka oil field) and the western sub-Carpathians (Maksym et al, 2003).

In the small areas of these prospective regions is visible the complex geological settings but from the other side — they are promising for further petroleum exploration, especially in the area of prolongation of the Miechów Syneclise into the sub-Carpathians where the basement is composed of the Devonian and the Carboniferous proper facies of petroleum play parameters.

Polish Permian Basin:

❑ **Rotliegend Basin.** The Rotliegend deposits (as the Zechstein ones) occur in the Polish Permian Basin which was the eastern part of the giant sedimentary basin extending from England, through the Netherlands, Denmark, Germany up to Poland (Kiersnowski et al, 1995; Karnkowski P.H., 1999). Gas fields are located on the uppermost, sandy part of the Rotliegend section sealed by the Zechstein evaporates. If above the Rotliegend sandstones sometimes occur Zechstein reefs they built complex traps, e.g. Wierzchowice, Bogdaj-Uciechów. For evaluation of the Rotliegend hydrocarbon-bearing zones the results of computer analysis of potential gas accumulation in the Rotliegend sandstones were accounted (Karnkowski P., 1966a). Indicated area is limited to zones with a higher saturation index of natural gas. Additional criterion is a structural position of the Rotliegend top: the higher gas saturation so the exploration possibility locates deeper. The results of this assumption are areas placed generally around the Wolsztyn Ridge and in the Pomerania region. Part of gas traps have a stratigraphic connotation, e.g. Paproć, Ujazd. In the deeper part of Polish Rotliegend Basin the transition zone between sandy and silty facies could construct lithofacies traps and the supposition of hydrocarbons concentration there was confirmed by gas seepages in the Resko-1, Piaski IG-2, Zabartowo 1 wells. Similar situations could be expected in the eastern basin flank (Rydzewska, 1987; Bojarska & Głowacki, 1990; Muszyński & Oziembłowski, 1991; Głowacki et al, 1993; Karnkowski P.H. et al, 1996) but the problem is rather difficult to solve because it seems that most chances for new discoveries are directed to the eastern Wielkopolska and Pomerania regions.

❑ **Zechstein Basin.** In the Zechstein formations only the carbonates have a sufficient porosity to be reservoirs. In the Werra cyclothem it is the Zechstein Limestone unit, and in the Stassfurt cyclothem — the Main Dolomite unit (Peryt, 1978; Antonowicz & Knieszner, 1984; Głowacki, 1986; Knieszner & Protas, 1996). The Zechstein Limestone deposits as the reservoirs are commonly connected with the Rotliegend sandstones or the Carboniferous basement. However, the Main Dolomite unit constitutes the closed petroleum play, where source rocks and reservoirs are in the same place or at a short distance (e.g. the BMB oil and gas filed — the largest one in Poland; Mamczur & Radecki, 1997). In such situation combination of area with thick and porous reef carbonates and the extent of "oil and gas window" delimits the petroleum play area. Geological modelling to establish the hydrocarbon zones in the Zechstein deposits has been made using the *PetroMod* software and several modelled cross sections. Distribution maps of organic matter maturity zones for the top and the bottom of Zechstein formations were composed (Karnkowski P.H., 2000). For contouring the carbonate reservoir facies of Zechstein Main Dolomite unit the isopahytes 10 m was assumed as the edge of carbonate platform, i.e. an extent of reservoirs. Such delimited areas are individually positioned in the Wielkopolska and Pomerania regions.

Mesozoic basin

History of petroleum research in the Mesozoic deposits started in the pre-Second World War time. Especially extensive works were carried out in 1947–1970 period when the Cretaceous basins with their Jurassic basement were well recognised (Marek & Znosko, 1972). Positive researches results as the oil fields discoveries were in the southern part of the Miechów Syneclise (partly beneath the Carpathians and the Carpathian Foredeep deposits). The source rocks in this region could be Palaeozoic in age. Computer simulation for the Polish Basin has shown the extent of "oil window" in the Doggerian deposits, where content of organic matter is 2–5%, mainly of kerogen type III. Oil seepages in the Mogilno 21; Koło 3, 4; Dobrów IG-1; Przybyłów 1 wells are the evidence of generation and preservation of hydrocarbons in some zones within the Mesozoic deposits (Wilczek, 1986).

Carpathians

Hitherto in the Carpathians 63 oil and 14 gas fields were discovered, in the most cases they are small fields and nowadays they are exploited in a considerable range. In the Carpathians exploration works are still carried out both in shallow horizons (depth to 1000–2500 m) but occasionally deeper as in the super deep boreholes (> 7000 m, Paszowa-1, Kuźmina-1). These explorations focussed on discovering oil fields in the structures so-called "Borysław-Dolina type", known from the very efficient production of crude oil in the Ukrainian part of Carpathians. A problem of "deep-seated folds" is one of the most important in the Polish Carpathians. Geological recognition in interval of 3000–5000 m is very poor and the depth below 5000 m was reached only in 7 boreholes. Except the Pieniny Clippen Belt and Tatra Mountains the whole area of the Flysh Carpathians is prospective for petroleum exploration.

Carpathian Foredeep

From petroleum point of view this region is the most prosperous and efficient in Poland. Gas-bearing deposits are the Miocene sandstones and claystones, the Lower Cretaceous sandstones and the Jurassic carbonates (Gliniak & Urbaniec, 2005; Gliniak et al, 2005). Also the Sarmatian sandstones occurred at depth 500–3000 m are considered as the very efficient formation (Jawor, 1983; Kotarba & Jawor, 1993). The most prospective area is still the Przemyśl-Rzeszów-Tarnów-Bochnia zone. The southern boundary of Miocene deposits is located beneath the Carpathians and the Miocene Basin fill was an effect of subsidence caused overthrusting Carpathians (Karnkowski P., 1978). Analysing thickness and facies changes within the Miocene Foredeep Basin it is necessary to consider an influence of highly variegated basement surface and an effect of sedimentological processes just before the Carpa-

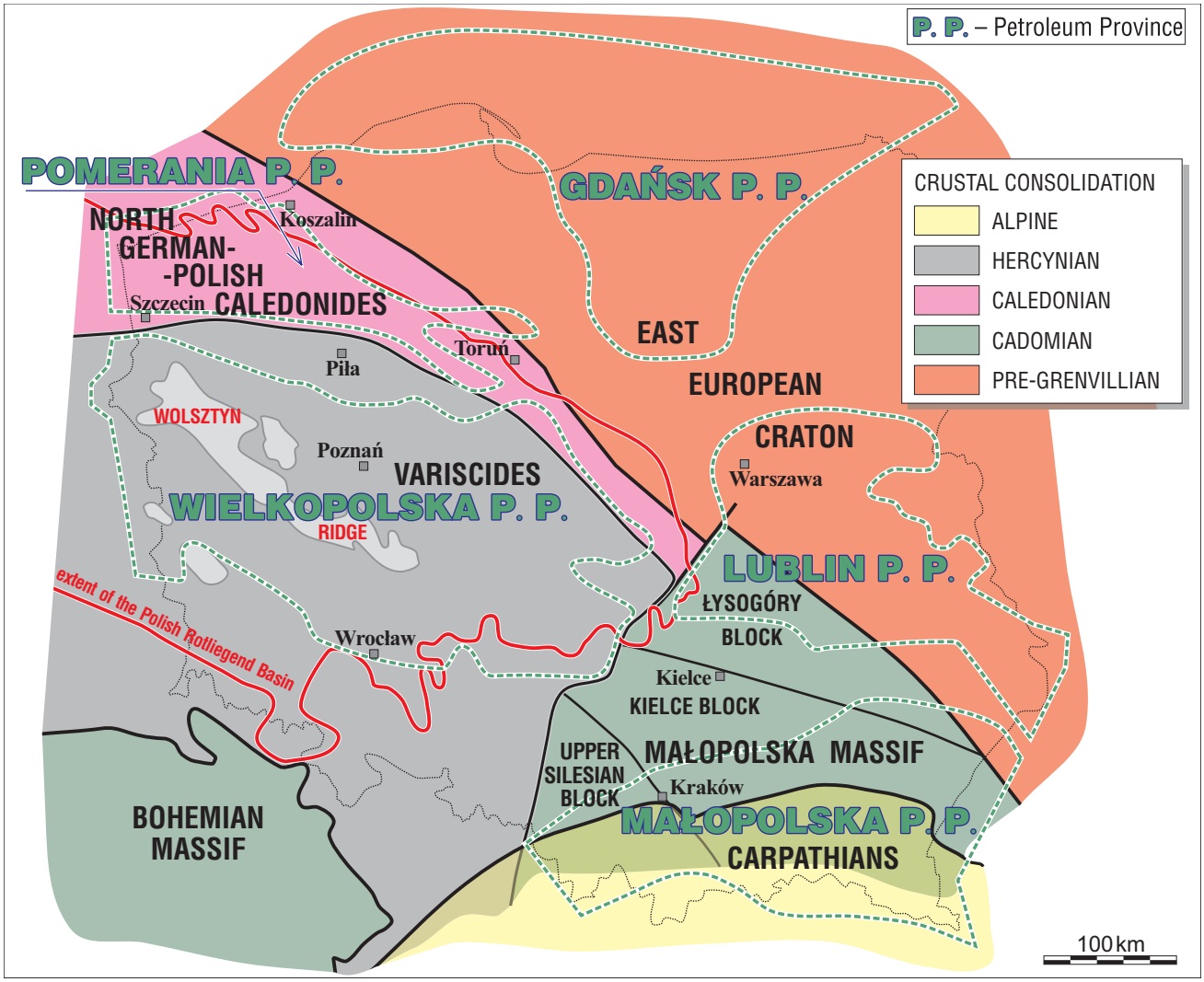

Fig. 3. Position of petroleum provinces on the background of the crustal consolidation in Poland

thians front. Studies of all these geological and structural conditions require the specialistic procedures and equipments; it allows to hope for further hydrocarbons discoveries in the Miocene deposits and their basement (Górka et al, 2005).

Petroleum Provinces in Poland

The extents of hydrocarbon zones, in particular stratigraphic complexes within the sedimentary basins in Poland, have been marked on Figure 1. The individual zones of different rank, e.g. the Cambrian deposits in the Podlasie-Lublin region or the Devonian ones in the Pomerania area, have been not confirmed by petroleum discoveries. Every marked area could evaluate individually but it is clearly visible that they compose five independent units established as petroleum provinces (Fig. 2). Boundaries of these provinces are fixed by the maximum extent of individual hydrocarbon-bearing zones. Shape and area of every field can change with input of new informations or due to other classification criterion. Following proposed petroleum provinces: Pomerania, Wielkopolska, Małopolska, Gdańsk and Lublin, are the parts of sedimentary basins which characterize with the individual development enabled to create the proper source and the reservoir rocks, a burial and a thermal history, changes of structural construction favourable for hydrocarbons generation, migration and preservation within traps.

Location of mentioned above petroleum provinces should be also result from specific geological events. Poland is an area composed of complex stratigraphic and tectonic units. Petroleum provinces, being only the parts of sedimentary basins, reflected in their pattern a basement consolidation (Fig. 3). Gdańsk and Lublin Provinces, composed of the Paleozoic rocks, are situated on the East European Craton. The Pomerania Province is located on the epi-Caledonian Platform, and the Wielkopolska Province is situated totally on the epi-Variscan Platform. The Małopolska Province has more complicated construction: the Palaeozoic and the Mesozoic deposits composing this province are located on the epi-Cadomian Platform, however the Carpathians were overthrusted onto these platform rocks, and the Miocene Carpathian Foredeep became an effect of overloading by the moving Carpathians. Hence every petroleum province in Poland had its individual geologic history.

The Małopolska Petroleum Province is composed of sediments inherited after a few sedimentary basins: the Palaeozoic and the Mesozoic ones, the Carpathians and the

Carpathian Foredeep. Years of exploration in the Polish part of Carpathians resulted in discovery of tens oil fields and several gas fields. Their resources are small due to long exploitation (sometimes up to 150 years). Explorations are still continued also with participation of foreign companies. In the Palaeozoic and the Mesozoic rocks beneath the Carpathians and the Carpathian Foredeep several oil and gas fields were found. Geochemical evaluations confirm the prospective of these rocks arguing for new seismic acquisitions. The Miocene deposits of the Carpathian Foredeep are the most promising part of the Małopolska Petroleum Province. Multihorizontal gas fields discovered here have significant resources in a limited fields area.

The Lublin Petroleum Province is a remnant after the Devonian-Carboniferous basins in the Lublin region. Hitherto discoveries in the Devonian carbonates and the Carboniferous clastics confirm the prospectivity of this area. Rather small extent of the late Palaeozoic basins favoured considerable lithofacial diversity of source and reservoir rocks. Additionally, the multistage diagenetic processes imprinted on reservoirs causing their low permeability. Nevertheless of these difficulties explorations are proceeding with increasing share of foreign companies.

The Gdańsk Petroleum Province is composed of deposits belonged to the southern part of Baltic Basin. Most off-shore petroleum successes were on the Baltic shelf in the Polish Economic Zone (*Petrobaltic Company*), but the onshore results are still rather insufficient. New geological elaborations prepared the basis for new drillings in the nearest future.

The Pomerania Petroleum Province is as a part of Devonian-Carboniferous and the Permian basins situated on the epi-Caledonian platform. In the Carboniferous traps usually gas is concentrated (the same gas generation as in the Rotliegend sandstones) and in the Zechstein carbonate formation (Main Dolomite unit) oil predominates. One borehole could be used for exploitation hydrocarbons from different stratigraphic and structural horizons. Actual state of geosciences knowledge offers a good basis for further exploration in this area.

The Wielkopolska Petroleum Province is mainly a southern part of the Polish Basin. There are two main exploration targets: the Rotliegend clastics and the Zechstein carbonates (Main Dolomite unit). In the uppermost part of the Rotliegend, sandstones sometimes accompanied with the Zechstein Limestone deposits into one gas reservoir sealed by evaporates. Gas was generated from the Carboniferous deposits lying directly beneath the Rotliegend series. Discovered fields have mainly a structural construction, but stratigraphic (lithofacies) ones also exist. Future exploration will be continued at depth below 3000 m in the zones with containing gas of a high quality (high methane content). It is conceivable that new gas findings within the Zechstein Limestone deposits will be soon. The Main Dolomite formation in the last years was very profitable. Oil fields found in the reefs and the carbonate platform of Stassfurt cyclothem compose a huge amount for the Polish petroleum reserves. The Main Dolomite unit in the Wielkopolska Petroleum Province is the main exploration target on the Polish Lowland.

The petroleum exploration in Poland is concessioned. Both the *Polish Oil and Gas Company* (POGC) and other companies organising their activity must obtain the proper documents in the public offers. Numbers of the POGC concessions in particular provinces are as follow: Małopolska Petroleum Province (P.P.) — 30, Lublin P.P. — 4, Gdańsk P.P. — 5, Pomerania P.P. — 5, Wielkopolska P.P. — 21, totally — 68 concessions. Other companies in Poland: *CalEnergy Gas Polska* Sp. z o.o. — 5, *Energia Zachód* Sp. z o.o. — 2, *EuroGas Polska* Sp. z o.o. — 8, *FX Energy Polska* Sp. z o.o. — 6, *Medusa Polska* Sp. z o.o. — 4, *RWE-DEA Polska* Sp. z o.o. — 11, totally 36 concessions.

In the POGC's strategy is planned the gas production increase up to 5.5×10^9 m^3/y, increase of oil exploitation up to 1.4×10^6 t/y, and keeping the restore resources index at level 1.1 compared to exploitation. The level of future exploitation is possible at present hydrocarbon fields capacity, but stabilization on this level with the restore resources index at level 1.1 value is possible only in the case of new fields findings. The present resources in gas (106×10^9 m^3) and oil (22.5×10^6 t), especially the gas, become the significant share in the energy balance of Poland. Investments expenses in petroleum exploration were refunded tenfold in the last years. The present geological knowledge does not prove a supply of our whole request for hydrocarbons, but profitableness of exploration in Poland and possibility of significant participation in the national energetic security by our own gas reserves — are a real basis for new challenges in searching.

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