6 Oil and Gas Exploration in Poland

JERZY ZAGORSKI

CONTENTS

1 Introduction .................................. 175
2 Carpathian Province .......................... 175
2.1 Polish Carpathian Flysch .................... 175
2.2 Carpathian Foredeep ......................... 177
3 Polish Lowlands .............................. 178
4 Exploration History, Production, Reserves .... 201
4.1 Surface Exploration .......................... 201
4.2 Drilling ................................... 202
4.3 Production .................................. 203
4.4 Reserves ................................... 204
5 Hydrocarbon Potential ......................... 205
5.1 Carpathian Province ........................ 208
5.2 Polish Lowlands .............................. 209
6 Conclusion ................................... 214
References ..................................... 215
Suggested Reading .............................. 215

1 Introduction

The aim of this chapter is to present the geologic framework of the oil and gas prospective zones and the hydrocarbon exploration history of Poland. In almost 100 years of exploration it has been proved that hydrocarbon prospective area covers roughly 82% of the whole territory, i.e. 257,000 km$^2$. This area falls into two major oil-and gas-bearing provinces (Fig. 1):

**The Carpathian Province** comprises folded Flysch (with an area of 19,000 km$^2$) and Foredeep (with an area of 17,000 km$^2$) tectonic zones. The Carpathian Foredeep has an external part situated north of the frontal overthrust fold of the Carpathian Flysch and an internal part, under the overthrust of the Carpathian Flysch. **Polish Lowlands** cover the eastern part of the NE German-Polish basin and the western part of the E European Platform. It comprises platform areas of Poland and the Polish sector of the Baltic Sea with an area of 221,000 km$^2$.

2 Carpathian Province

This is the oldest oil-producing region in Poland. Exploration and production began around 1854 when the first oil field Bobrka was found. Up to now, 65 oil fields and 15 gas fields, most of them small in size, have been discovered in the Polish Carpathian province.

2.1 Polish Carpathian Flysch

The Flysch zone is divided into five main overthrust tectonic units. They are from the south to the north:

- I. Magura Nappe
- II. Dukla Folds
- III. Silesian Nappe
- IV. Sub-Silesian Nappe
- V. Skole Nappe

Most oil and gas fields have been discovered in the so-called Central Carpathian Depression, the depressed part of the Silesian nappe between Sanok-Krosno-Jaslo.

The Carpathian Flysch deposits, of Cretaceous-Oligocene age, are up to 5000 m thick. The oil and gas reservoirs are Cretaceous, Paleocene, Eocene and Lower Oligocene sandstones. They have highly variable porosity, permeability and thickness. As a rule, reservoir properties are very poor.

The most important hydrocarbon bearing formations are the Upper Cretaceous Istebna Sandstone, the Paleocene-Lower Eocene Ciezowice Sandstone and the Oligocene Kliwa Sandstone. More than 70% of recovered hydrocarbons come from these formations. The oil and gas accumulations in the Carpathian Flysch are in general structurally or sometimes structurally and lithologically trapped.
The local oil- and gas-bearing structures have variable geometry: normal anticlines, asymmetrical folds, displaced central core folds, multiple folds, folds covered by overthrusts and various types of minor traps on folded limbs (Fig. 2).

The Carpathian Flysch oil and gas fields are classified as bedded deposits with edge waters. The initial reservoir pressures are close to hydrostatic pressure and it is only at greater depths (more than 5000 m) that the pressures are significantly greater than the hydrostatic pressure. The crude oil is methane-rich and sulphur-poor, its density varies from 0.820 to 0.850 g cm$^{-3}$ (35 to 41°API). The main component of the gas is methane, and the content of heavy hydrocarbons does not exceed a few percent. There is no evidence of the presence of hydrogen sulphide gas. The source rocks are the organic matter-rich clays and argillaceous sediments which commonly occur in the whole sedimentary sequence of the Carpathian Flysch.

The tectonic structure, between depths of 200 and 2000 m, is fairly well understood, compared with a less well defined knowledge of the structural complexity, particularly below 3000 m. New and significant geological data have been supplied by deep wells such as Paszowa 1, Kuzmina 1, Lachowice 1 and 2, Zawoja 1, Czudec 1, Raclawowka 1 and Slopnice 1. Most of these have penetrated the flysch “basement”, i.e. the NE German-Polish Platform deposits.

One of the most interesting discoveries has been well Nosowka 1 near Rzeszow (Fig. 3), where an oil flow with a specific gravity of 0.854 g cm$^{-3}$ (34°API), and a stabilized production flow of about 30 tonnes/day was obtained from Visean limestones at the depth interval 3540–3465 m. The Lower Carboniferous deposits are covered by the Carpathian overthrust and a Miocene transgressive series about 200 m thick. Well Nosowka 1 bottomed at 3807 m in the Precambrian. At present, this field is being delineated by outpost wells, two of which have been successful.

Over the past few years, exploration activity was aimed at defining traps occurring at depths of 3000–5000 m and deeper. In the Polish Carpathians, deep exploration in conjunction with geological mapping focussed on confirming the presence of Boryslaw-Dolina type folds known from...