HISTORY OF OIL AND GAS PRODUCTION IN THE CROATIAN PART OF THE PANNONIAN BASIN SYSTEM

Josipa VELIĆ[1], Tomislav MALVIĆ[1,2] and Marko CVETKOVIĆ[1]

[1]*Department of Geology and Geological Engineering, University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Pierottijeva 6, 10000 Zagreb, Croatia; josipa.velic@rgn.hr*

[2]*Sector for Geology and Reservoir Management, INAIndustry of Oil Plc., Exploration and Production of Oil and Gas, Šubićeva 29, 10000 Zagreb, Croatia*

Introduction

On the basis of historical data, Croatia belongs to the first few pioneer countries in the world in which oil accumulations were researched and produced in the middle of the 19th century. Earlier oil production was only recorded in Russia, France, Romania and Germany. Application of oil in industrial purposes has a long tradition in Croatia, e.g. applications in medicinal preparations were recorded as early as in 14th and 15th century as "asphalt and petroleum". More intense exploitation began just before the 2nd World war.

Geological outline

The Pannonian Basin System (PBS) is a back arc basin system that belongs to an area in the past covered by the Central Paratethys, and younger brackish and fresh-water environments formed from Paratethys. Inside PBS, numerous basins, depressions and subdepressions were formed along dextral and sinistral strike-slip faults. The area of the PBS in Croatian part is divided into the Drava, Sava, Mura, and Slavonija-Srijem depresions (Fig. 1A). The general evolution of their depositional environments, transport mechanisms, tectonics and dominant lithologies is very similar. Basin infill is manly comprised of Neogene-Quaternary rocks: breccia, conglomerates, sandstones, marls, shales, biogene limestones and efusives (1st megacycle – Lower and Middle Miocene), sandstones and marls (2nd megacycle – Upper Miocene) and clays, sands, loess and gravel (3rd megacycle – Pliocene, Pleistocene and Holocene) (Velić et al., 2002).

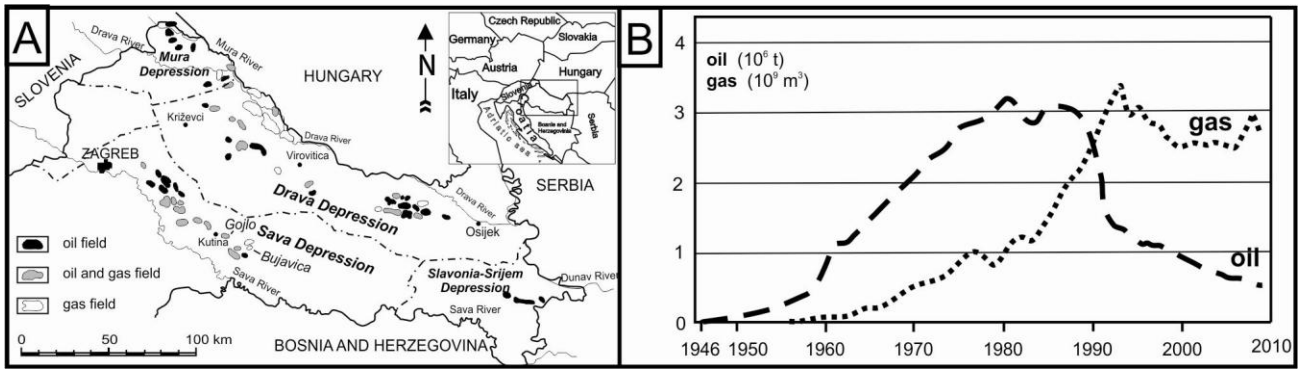

Fig. 1. *Depressions in Croatian part of the Pannonian Basin with positions of hydrocarbon fields (A) and the production of oil and gas in Croatia from 1946 to 2009 (B)*

History of oil and gas production

There are numerous locations of the natural outcrops of oil – in Međimurje (Paklenica and Selnica), Kalnik (Ludbreg, Veliki Poganac, Lepavina and Ribnjak), Moslavina (Ivanić, Kloštar and Mikleuškla), in Western Slavonia (Paklenica, Baćindol and Staro Petrovo Selo) and in Slavonska Požega (Eminovci). One of the oldest records of oil from Croatian part of the Pannonian Basin dates from 1778 when J. Winter from Budapest analysed the composition of oil from outcrops surrounding Mura River (Žgaljić, 1984). In the first detailed description of the oil outcrops in the area of Gojlo and Baćindol, Piller and Mitterpacher (1783) stated that oil can be observed in the local stream, it is easily flammable and burns with flame of yellow to green colour. At the beginning of 19th century, first exploitation of oil started in Međimurje in the village of Paklenica. At the same time, Vukotinović (1855) states that oil outcrops can be found in the vicinity of Mikleuška, Kutinica and Selište (Moslavina region). Moslavina can be regarded side by side with oldest oil

regions in the World because when the first eruption from Drake's well in Titusville occurred, exploitation of oil already started from the mining shaft "Martin" in Mikleuška (Gretić and Bobić, 2002). This was the first location of the mining way of oil exploitation which the mining shaft was 72 m deep and 2 m wide. Production was active until 1943. Oil was produced from fractured granite, by five workers which were able to produce approximately 100 t of oil annually and was locally refined into lamp oil.

First oil filed in Croatia, named Gojlo (Fig. 1A), is situated not far from Kutina. From the begging of exploitation in 1933 up to 1966, when production ceased, 300,000 t of oil and $170x10^6$ m^3 of gas were produced. As first methods of drilling were percussion with no mud, oil and gas findings were accompanied by eruptions.

If all activities of exploration and production of oil from the first wells in 1885 in Međimurje to the production of oil and gas in Gojlo in 1945 (the first 60 years of oil production in Croatia) the next could be stated: 365 exploration wells with total depth of 111,500 m (100-500 m deep) and 260 shallow wells (20 - 100 m deep) were made with 81,800 t of oil and $56x10^6$ m^3 and gas produced. The first major oil production started on 21st of May 1941 when well Gojlo-5 was activated (Ožegović, 1955). In the May of 1945, three oil fields were already in production: Gojlo, Selnica and Paklenica. During the next 30 years, production of oil grew rapidly which was followed by a decrease in 1989 (Fig. 1B, Velić, 2007, Velić et al., 2012).

Alongside the exploration for oil in Kloštar Ivanić, natural gas was also found. The first big eruption of gas occurred in 1912 at the depth of 139 m when an artesian well was made in Dugo Selo. The first start of Croatian gas industry can be set in 1917 when large amounts of natural gas were discovered at the depth of 351 m in Bujavica (Fig. 1A) near Lipik. For the first 15 months it erupted freely into air after which production started with 500,000 m^3 per year with pressure of 3000 to 3500 KPa. Later, oil was drilled at the depth of 391 m and 150 t were produced. Oil was dark, of aromatic smell and had a density of 940 kg/m^3.

The beginning of industrial refinement of oil was in 1858 in Baćindol where fist refinery was made for making wheel lubricant.

Conclusions

Croatia belongs in the few pioneer countries in the world in which oil was produced and refined in the middle of 19th century. The first oil field was Gojlo (1933-1968) and the first gas field was Bujavica (1917-1937). Approximately $105x10^6$ m^3 of oil and $65x10^9$ m^3 of gas were recovered during 150 years of exploitation (1855-2005). The production peak was attained between 1980 and 1989. Industrial refinement started in 1858 in Baćindol where oil was refined into wheel lubricant. Today, production is at a decline mainly because of the decreasing amount of remaining reserves and the long lasting production of the most of the fields with a very few or no new discoveries.

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