

*Review paper*

## DEVELOPMENT OF THE PRODUCTION OF LEAD AND PRECIOUS METALS IN CENTRAL ASIA

### RAZVOJ PROIZVODNJE OLOVA I PLEMENITIH METALA U CENTRALNOJ AZIJI

Nikolić Branislav<sup>1</sup>, Nikolić Svetlana<sup>2</sup>, Vujačić Vesna<sup>3</sup>, Trajković Slobodan<sup>4</sup>

Received: April 7, 2014

Accepted: May 3, 2014

**Abstract:** There were several rich deposits of polymetal ores of non-ferrous and precious metals in the region of Imperial Russia and the Soviet Union. Metallurgical production of these metals was developed even a thousand years ago and was in the top of the world at the beginning of the fourth quarter of the twentieth century.

The disintegration of the Soviet Union and the change of government structures caused a reduction of metallurgical production, but there are all conditions to intensify and increase the production of non-ferrous and precious metals in Russia and other former Soviet republics, which are now middle-asian countries.

**Key words:** lead, silver, gold, metallurgy, development

**Apstrakt:** Na prostorima Carske Rusije i SSSR-a bilo je više bogatih nalazišta polimetalnih ruda obojenih i plemenitih metala. Metalurška proizvodnja ovih metala vršena je još pre hiljadu godina, a bila je u svetskom vrhu početkom četvrtog kvartala XX veka.

Raspad SSSR-a i promena državnih struktura prouzrokovali su i smanjenje metalurške proizvodnje, ali postoje svi uslovi za intezivniju i veću proizvodnju obojenih i plemenitih metala u Rusiji i drugim bivšim sovjetskim republikama, a sada susednim srednje-azijskim državama.

**Ključne reči:** olovo, srebro, zlato, metalurgija, razvoj

---

<sup>1</sup> Engineering Academy of Serbia, Kneza Miloša 9/IV, 11000 Belgrade, Serbia, e-mail: office@ias.org.rs

<sup>2</sup> University of Belgrade - Faculty of Technology and Metallurgy, Karnegijeva 4, 11120 Belgrade, Serbia, e-mail: snikolic@tmf.bg.ac.rs

<sup>3</sup> Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000 Belgrade, Serbia

<sup>4</sup> University of Belgrade - Faculty of Mining and Geology, Djušina 7, 11000 Belgrade, Serbia, e-mail: slobodan.trajkovic@rgf.bg.ac.rs

## 1. INTRODUCTION

Mining-metallurgical production of non-ferrous and precious metals was developed in the Russian Empire and then the Soviet Union because of the excellent raw material base. In the republics of the former Soviet Union, in Central Asia, there were several deposits of polymetallic ores of lead and zinc in which silver and gold is always present as supporting metals. The most famous of these metals mines are located in Kazakhstan, on Altai, Zabajkal, Ural, North Caucasus, Magadan, whose polymetallic ores, in addition to base metals lead and zinc, contain a range of ancillary, non-ferrous, precious and rare metals, such as copper, antimony, silver, gold, cadmium, bismuth, selenium, tellurium, indium, germanium and other.

## 2. EARLY MIDDLE AGE

Back in the Bronze Age, the old nation "Čudi" had a great experience in production of metal, which is found in the ore excavations on Altai, on Bayan-Aul mountains, in Kizil-Tau, and elsewhere.

In old Russia in the region of Central Asia, lead was produced in the distant past, primarily as a metal with which is easier to produce silver and gold, and which was known to all the old metallurgists. Therefore, the production of precious metals stimulate the production of lead as evidenced by remnants of ancient sites and waste slags in Turkestan, on Altai, Ural and in the Far East.

In the IX and X centuries AD between the rivers Sir Darya and Amu Darya was a state Maveranahr with its capital in Bukhara (Uzbekistan), and the famous mines Shash (Tashkent), in the Karamazar region, where there was more lead-silver deposits. The silver coins from Shash are well known, minted in 804. In 826, from Shash mines, a 607,100 dirhem (drachma), ie. about 20 tons of silver was produced (Максимов, 1970). In these areas, well known mines of polimetal ores of non-ferrous and precious metals are: Jerkamar, Jeltimas, Kanjol and in the region Adrasmana, mine Kanimansur. From Kanjol mine, in the period of IX-XI century, about 1,500 tons of silver was produced annually. These areas then were part of the Arab Caliphate, which is in the mining and metallurgical industry of this region had solid economic base, which was a very good basis for further expansion.

The first silver and gold coins were minted in Russia in X and XI century during the reign of Vladimir I, Svjatopolk and Jaroslav and were called differently: dirhem, kuna, skot, nogat, griven, deneg. Their weight was mostly from 2.7 to 3.4 grams. Russian silver coin "Denga" was made in Moscow in the period of 1360 - 1385. In XV century, Novgorod had his own coins called "porča". In 1209, in Novgorod Charter states that the city Rector Regent Dimitrije had silver, and according to the Chronicle in 1386. people of Novgorod donated to Dimitrije Donski 8,000 silver coins (Максимов, 1970). In 1229, according to the chronicle of Pskov, people of Pskov wrote to Jaroslav: "...you went to Kolivanja, took silver". There are records that during the XVI-XVIII centuries silverware was produced in Moscow and Novgorod, which shows that non-ferrous and precious metals were produced and processed and that metallurgy of non-ferrous and precious metals was developed in the early Middle Ages in Russia.

In the XV century, deposits of silver and lead-silver ores were discovered near the rivers Pečora, Kama, North Dvina, on Jugorska Šara, Janka, Ufi and Toboli. In XVII century E. Habarov stated in the Siberian report that the mountains near Amur contain silver ores, and Cossack Ataman Maksim Perfilevij learned that near the river Silkar (Šilka), in Nerčin area, live people who exploit the ore and produced silver from them.

In Nerčin area ie. in the area of Zabajkal in eastern Siberia, deposits of silver were found in 1669. During the next ten years geological investigations were intensified and several mines (deposits) were found near Argun River and its tributaries: Olovna, Otaga, Ruzjaga and Silver river. In 1669, it is decided to build a smelter, which was founded on the river Serebrjanka in 1700 and began to work in 1704. The production of silver from Nerčin mines is presented in Table 1 (Максимов, 1970).

**Table 1** - The production of silver from Nerčin mines

Year	Amount [kg]
1704	0.41
1705-1709	226
1710-1719	1,196
1720-1749	4,332
1750-1779	88,711
1780-1794	70,385
1795-1799	17,569
1704-1799 total	182,419.41

The highest production of silver was during the period 1780-1784, and then production declines as rapidly growing interest and involvement in the production of gold in Nerčin area ie. in Zabajkal, from 1704. to 1906, about 1,520,000 t of ores was processed, from which about 50,000 t of lead and 500 t of silver was produced (Милман, 1989). Nerčin mines are situated between the river Uruljunge in the south and the river Gazimir and Šilke in the north. There were about 540 sites, of which 120 had a practical use. In Nerčin institutes were 13,000 workers-men in 1784 (Милман, 1989).

In XVII and XVIII centuries silver ore was also processed on Bear Islands in the White Sea, but due to high costs, the exploitation of these mines stopped in 1883.

Altai ores were processed by ancient tribes Čudi, and in XVIII century the mining and metallurgy were renewed in this area. In 1733, Kolivano-Voskresenski institute has been working already, and then Loktevski, Barnaulski and Šulbinski institute in 1760, Pavlovska silver smelter, Suzun copper smelter, and then smelter of silver ores nearby river Aleja (Максимов, 1970).

### 3. AFTER XVIII CENTURY

At the end of XIX century, on Altai more than 800 mines were registered, though it was open only a few dozen of which are annually put more than 12,000 kg of

silver. In the period 1745-1799, 454,477 kg of silver was produced from Altai ores (Максимов, 1970). Polymetal silver mines on Altai were near rivers: Čarša, Uba, Aleja, Ulba and Buhtara, and main mines were: Zmeinogorsko, Leninogorsko (Ridersko) and Zirjanovsko which were near old mine Kolivansk. At the end of XVIII century, in Altai and Nerčín area, about 1,330 t of lead and 28 t of silver were produced annually (Чижигов, 1976). Leninogorsk, Zirjanovsk and southern part of Altai mountains are in Kazakhstan, east of lake Zajsak.

In the first half of XIX century, the lead smelters in Kyrgyz and in the North Caucasus (Kosmo-Demjanski, Stepanovski and Alagirski institutes) began with the work. Alagir smelter of lead and silver started its operations in 1840 (Чижигов, 1976).

From 1705. to 1900, 140,000 t of lead and 3,000 t of silver were produced in Russia, from which about 78% in Altai area, 18% in Nerčín area, and 6% on Caucasus, in Turkestan and Kyrgyz (Чижигов, 1976).

Due to the reduction of ores rich in metal, in XIX century slightly lower production was in Russia. At the beginning of XIX century, annual production in Russia was 600 t - 1.000 t of lead and 19 t - 22 t of silver, but in 1897. only 450 t of lead was produced (Чижигов, 1976).

In Russia and other republics of the former USSR were several gold mines: native, with minerals of non-ferrous metals and in gold-bearing river sediments. About 15% of total world reserves of gold were in the USSR.

Until XX century most of produced gold was from gold-bearing fluvial deposits on Siberian rivers (Lena, Amur, Alden), and in 1913. 85% of total gold production in Russia was from fluvial deposits. From 1493. to 1938. in Russia and USSR, 3,860 t of gold was produced (Nikolić, 1969). In Čitin area (Siberia) gold was exploited over 100 years. In Kolima, on north-east Russia, in 1970, nugget of gold weight 9,680 kg and 4,439 kg were found (Nikolić, 1969).

The first twenty years of the twentieth century production of lead stagnated in Russia for many reasons, so in 1918 only 100 t of lead was produced (Nikolić, 1969). In this period, Germans (1902) get a concessions of the rich Russian mines, English (1905) and Belgians (1914), and most of the needs of lead were replaced by import. Thus, for example, in 1913 need for lead in Russia was 60,400 t, and only was produced 1,400 t (Лоскутов, 1965).

During the First world War and October Revolution, mining-metallurgical production was practically stopped. In the period 1917-1919, for the protection from war, 144 t Russian state gold was transferred to London, to Berlin 120 t, to Japan 86 t, to Stockholm 4 t, but this gold was not returned and stayed in those banks. Until 1922, it is estimated that over 500 t of gold from Russia carried off to the west, and was not returned to the USSR.

#### **4. SOVIET PERIOD**

Ten years after the October Revolution, in war-ravaged and impoverished country, with enormous efforts Institutes were gradually restored in Vladicaucasus, Sadon mines, Mizur smelter, but because of outdated technology, lack of appropriate filters for process gases, and small capacities, satisfied production was not achieved. In 1930. new facilities were built, such as (Лоскутов, 1965):

- Rider combine on Altai with annual capacity of 18,000 t of lead and 25,000 t of zinc;
- Nort- Caucasus combine with annual capacity of 4,500 t of lead and 10,000 t of zinc;
- Central-Asian Institute for lead for 30,000 t/year of lead in Čimkent;
- Čitin combine for 24,000 t of lead annually.

These projects includes not only the metallurgical plants, but along with them and mines and flotation. Čimkent, Ust-Kamenogorsk and Zirjanovsk are in Kazakhstan.

From 1935. new plants started with work and existing plants were reconstructed in Čimkent (Kazakhstan), Lenjinogorsk (on Altai), Ordžonikidzeu (Vladicaucasus, on river Terek) and Ust-Kamenogorsk. In this period more modern crushers and mixers for batch preparation were used, continual strip machines for contrates roasting and blast furnaces for melting high-capacity agglomerates. All these four combines have refineries of lead where pure lead and lead ores are produced, and silver and gold also depending on ore quality.

Lead-copper rock as a product in lead metallurgy was processed in Irtsk Institute in which raw copper with small amount of precious metals was produced.

Čimkent institute strated to work in 1933, and after several expansions and reconstruction, in 1980 this insitute produced about 150,000 t refined lead (Institute italiano del piombo e dello zinco, 1976). Modern process "Port Piri" of de-coppering of lead was used, as well as Haris process of softening, regeneration of alkaline Haris As-Sb melt and original electrothermic processing of silver spume. In Lenjinogorsk, in lead refinery, the capacity of refinery boilers was bigger - 310 t. The ore from Sadon mines was processed in institute Ordžonikidze which was disassembled and dislocated to east, during the second World War because of the invasion of the Germans. After the war was it was renewed, and lead refinery had 10 refinery boilers.

After 1945, the mining-metallurgical development was intensified in the Soviet Union, which has become one of the world's leading manufacturer of non-ferrous and precious metals.

During eighties in XX century, in USSR annual capacities of constructed plants was 700,000 t of refined lead, but real production was about 600,000 t of refined lead. USSR was the world's leading producers of lead and supporting metals. However, about two-thirds of the these capacities were located outside Russia, and mainly in Kazakhstan. At this time, about 1,500 t of silver and about 300 t of gold per year were produced in USSR, although this production varied depending not only on the work of metallurgical plants, but also on the level of supply of raw materials i.e. lead concentrates (Vesnik, 1987; Politika, 1973). The volume of production of silver and gold depends on the quality of concentrates. After the collapse of the USSR, in the period 2004-2010, the production of silver was 1,200 t - 1,400 t in Russia, 600 t - 800 t in Kazakhstan, and 70 t - 90 t in Uzbekistan (Privredni pregled, 1995).

USSR was the state rich in gold ores, and was one of the leading gold producers. According to estimates and data of the U.S. Geological Survey, in 1956. gold reserves in the USSR were about 30,000 t (Vesnik, 1987). According to estimates, the gold production in the USSR was as shown in Table 2, in which are also shown

data for leading manufacturers that are former states of the USSR (Privredni pregled, 1995; Hannis, 2010).

**Table 2 - The production of gold**

Year	USSR	Russia	Uzbekistan	Kazakhstan
1958	311 t	-	-	-
1972	240 t	-	-	-
1976	242 t	-	-	-
1993	-	150 t	-	-
1996	-	136 t	80 t	10 t
2004	-	169 t	88 t	19 t
2009	-	190 t	90 t	22 t

The USSR was the second world producer of gold, and from 1953 to 1965 about 3,000 t of soviet gold was sold at London and Zurich markets (Vesnik, 1987). During the last fifteen years, 10 t- 20 t of gold was produced annually in Kyrgyzstan, about 2 t in Tajikistan. In addition to Russia, Uzbekistan became an important world producer of gold.

Research and development work and human resources was developed in the Soviet Union, not only in Moscow and Leningrad, but in the centers of distant regions with rich polymetal lead-zinc ores: Alma-Ata, Ust-Kamenogorsk, Taskent, Vladicaucasus etc.

## 5. CONCLUSIONS

In wide area of Central Asia, at the time of Imperial Russia, there was a series of rich deposits of non-ferrous and precious metals. In this region, metals were produced back in the Bronze Age and the mining-metallurgical production has grown rapidly on Caucasus, Altai and Lake Baikal. Aggression of Europeans on rich Russian landscapes and wartime events slowed the economic development, but still in the fourth quarter of XX century, the USSR was one of the world leading producer of non-ferrous and precious metals.

The disintegration of the USSR, the change of socio-political system and the privatization of state companies in the last decade of XX century, had a negative impact on the mining-metallurgical production of lead and precious metals in the new states of the Eastern bloc. A significant number of mines and melting plants remained outside Russia, in Kazakhstan, Azerbaijan, Uzbekistan and other emerging countries in the region of the former USSR. In the process of the privatization, a number of these plants become the property of the Western European companies, therefore Russia has become less important by mining-metallurgical and economic power on a global scale and less independent than twenty years ago.

As mining and metallurgical production capacities were developed in the southern parts of the Soviet regions, so it can be developed on the areas of Russia, because there is a good raw material and human resources, but it takes time and considerable financial investment. Metallurgy is an important consumer of solid, liquid

and gaseous fuels and electricity. The production of many metals is defined as the higher level of the finalization of energy. Since Russia is an energy rich country, it is reasonable to expect intensive mining and metallurgical developments in Russia and its return to the top world producers of metals.

## REFERENCES

- [1] ЧИЖИКОВ, Д.М. (1976) *Очерк становления и развития цветной металлургии СССР, Цветная металлургия-научные поиски, перспективы*. Москва: Наука.
- [2] HANNIS, S.D. (2010) *World Mineral Production 2004-2009*. Nottingham: BGSK.
- [3] INSTITUTE ITALIANO DEL PIOMBO E DELLO ZINCO (1976) *Metallii non Ferrosi e Ferroleghie, Statistich*. Roma: AMMI.
- [4] ЛОСКУТОВ, Ф.М. (1965) *Металлургия свинца*. Москва: Металлургия.
- [5] МАКСИМОВ, М.М. (1970) *Очерк о серебре*. Москва: Недра.
- [6] МИЛМАН, А.Е. (1989) Начало промышленного производства серебра и свинца в России. *Цветные металлы*, 3 и 4.
- [7] NIKOLIĆ, B. (1969) *Increasing the use of precious metals*. Study, Zvečan: Трeпчa.
- [8] REDACTION (1973) World Economy and Finance: USSR exports ton of gold per day. *Politika*, 3rd Sep, p.4.
- [9] REDACTION (1987) Soviet gold: A well-kept secret. *Vesnik*, March, p.58.
- [10] REDACTION (1995) Precious and rare metals. *Privredni pregled*, 13th Apr, p.14.