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3. Slovak Mining Road

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Abstract: Among the main objectives of the Association of Mining Clubs and Guilds of Slovakia and one of the reasons why the Association was conceived in the period of 2004-06 in the relatively advanced period of the decline of ore mining as co-operation of clubs and guilds in the mining regions is the preservation of the mining heritage and active mining activity. It ought to be projected into presentations of technical level, education and mining science, metallurgy and coinage in the territory of Slovakia and in its previous state structures, preservation of mining history and maintenance of mining traditions and customs, preservation and revitalization of mining technical works in Slovakia. It is only logical that, in addition to one of the statutory obligations to terminate the mining activity "liquidation and securing", specified and fulfilled in the program of ore mining mines declared by the government of the Czechoslovak Socialist Republic in 1990 and approved by the Government of the Slovak Republic, 1991, whose final fulfilment is to return mainly the surface of mining operations to the original state for further civilian use, or reclamation as "pure nature" is, on the other hand, an initiative to preserve and promote the idea, that not all of the recession programme deserves destruction and disappearance from the surface of the earth. These mining, technological, transport, water and other construction works incorporated in the secondary transformed landscape create in many smaller and larger areas of the mining regions an organic whole with the landscape and document the history of our territory materialized in several cases at the level of the cultural heritage of Slovakia as well as in the lists of National Cultural Monuments.

Keywords: Slovak Mining Road, ore mining, coal mining

3.1 Introduction

The idea of the Slovak Mining Road was established as an initiative of mainly ore mining and iron mining regions and mining and metallurgical associations, which resumed their activity in the process of the decline of ore mining after the year in 1991. In many operations and plants, the last phase of the survey, opening, mining, and terminating the mining process is implemented as the liquidation and securing of mines, including surface structures. The above-mentioned ore and iron mining regions, owing to the use of stones and clay by the earlier settlements living in our territory, have exceeded their significance and maturity in many of the mining, related sciences and education fields of Slovakia, or Czechoslovakia and Austria-Hungary during their more than a thousand years of uninterrupted history and processing of ores. The oldest documented data on the extraction of metals in Slovakia in Špania Dolina has been estimated to 4,500 BC by the research work of the Bergbaumuseum Bochum and the Mining fraternity Herrengrund realized in 2015 – 2016. In addition to the ore mining regions, active coal, oil, and non-ore regions are also actively involved in the presentation of the mining heritage, and are represented today by major Slovak mining organizations.

With the idea of the project is to preserve and highlight selected mining and technical works and other related buildings and relics, geological phenomena and bring them into the attention of a wide range of domestic and foreign public, professionally focused experts from the world on mining, geology and history, as well as preservation for future generations. In 2005, seven active mining clubs and guilds were associated mainly with the purpose of preserving the tangible and intangible mining heritage, and created the umbrella organization Association of Mining Clubs and Guilds of Slovakia, c.a. (hereinafter referred to as "the Association"). By 2017, the Association has grown

Fig. 3.1 Mining tools in Bartolomej Gallery – open air museum Slovak mining museum in Banská Štiavnica

to 36 members representing practically all historical and active mining regions and significant sites of mining and processing of raw materials. Several mining and metallurgical associations, guilds and mining fraternities have built their own museums, exhibitions, instructional walkways, memorial rooms, mining houses, etc. during their modern 10 to 25 year existence (for example, the Museum of Copper in Špania Dolina, the operation of the Mining Museum in Kremnica, expositions in Ľubietová, Nižná Slaná, Rudňany, Pezinok, Marianka, the rebuilding of important galleries in Banská Štiavnica, Hodruša-Hámre, Poráč, Vyšná Boca and others).

The completion of the effort and the goal is to create the conditions for the further use of mining works and other related objects nowadays primarily for the purpose of tourism development.

3.2 Brief characterization of the Slovak Mining Road establishment

To achieve these objectives, the Association of Mining Clubs and Guilds of Slovakia, c.a., Rudné bane, š.p. Banská Bystrica, Faculty of BERG TU Košice – Department of Business and Tourism, Slovak Mining Museum in Banská Štiavnica and local governments initiated the project of the Slovak Mining Road (SMR). The representatives of the above-mentioned entities established a so-called SMR Task Force.

The name of the project is not taken over historically and justified by a particular stage of mining in a certain geographical axis; it is based on a linear link between the characteristic mining regions and the centres of these regions in a direction from the west to the east of Slovakia. At the same time, the name highlights the need to solve the complex question of preserving and transforming mines and operations at some points. This time limit results from the final phase of the mining liquidation and reclamation, as defined in the Mining Act, that is to say, the direct mitigation of the effects of mining activities. The title SMR should also capture part of the history of Slovakia, namely the second half of the 20th Century, when the mining in Slovakia represented thanks to the mines development, the number of active plants, the assortment of raw material extraction and the extensive geological survey, the influence on settlement, activity and employment of people in the sinusoid boom and decline an unrepeatable stage and at the end of this period there were substantial negative changes for many of the remote settlements. In the second half of the 20th Century the mining business was exclusively owned by the state through national enterprises renamed at the end of the period to state-owned enterprises. The liquidation and securing of old mining works for which the original operator is not known or does not exist, remains a responsibility of the State under the competence of the Ministry of Economy of the Slovak Republic. The Ministry executes the above mentioned activity through its state-owned enterprise Rudné bane Banská Bystrica with scope of activity on the whole territory of Slovakia, as well as in the former other enterprises of the original VHJ RBMZ (Rudné bane production unit and magnesite plants, and Spišská Nová Ves Železorudné bane mines with numerous plants in the Spiš and Gemer regions) and geological survey. The implementation of the recession program in 1993 – 2005 was exceptional by the rapid liquidation of some surface and underground facilities as a whole with subsequent reclamation and a vision of perfect and ultimate destruction of the consequences of mining activity, which is unrealistic in many cases. The intervention of mining clubs and guilds and intensive co-operation of the then management of the š.p. Rudné bane and the Ministry of Economy of the Slovak Republic in 2006 and the cooperation with the mining museums, the BERG Faculty, the Slovak Chamber of Mines and other professional organizations and self-governments (mining towns and municipalities), were a significant stimulus and change in the view of the liquidation and securing of some selected mining works and operations and the initiative to develop the tasks of the Slovak Mining Road project.

3.3 Characterization of SMR spatial arrangement

In the beginning, the design of the project was supposed to create the centres of the Slovak Mining Road (Fig. 3.2). These centres represent geographically, but also historically divided close or distant mining regions with varied assortment of extracted raw materials,. The basic division consists of the following SMR centres and subtitles:

1. Malé Karpaty Mts. mining – Small Carpathians Mining Road with Pezinok and Marianka centres (Au, Sb, pyrite, shale).
2. Coal mining in Slovakia – Upper Nitra Coal Basin and South-Slovakian Coal Basin with the centres of Handlová, Cigeľ, Veľký Krtíš, Malá Stracina (brown coal, lignite).
3. Mining of gold, silver and non-ferrous metals – Golden Royal Towns with centres Banská Štiavnica, Kremnica, Hodruša-Hámre and Nová Baňa (Au, Ag, Pb, Zn, Cu, Sb, rhyolite).
4. Mining of copper, gold and antimony – the surroundings of Banská Bystrica, Liptov and Upper Hron Catchment regions with the centres of Špania Dolina, Ľubietová, Vyšná Boca (Cu, Au, Sb, Fe, Hg).
5. Spiš region – copper and iron mining with centres Spišská Nová Ves, Rudňany and Smolník (Cu, Fe, Ba, Hg, Au, Ag).
6. Gemer region – mining of iron, magnesite and talc with centre in Rožňava (Fe, $MgCO_3$, Sb, Cu, Au, Ag).
7. Mining in Košice, Prešov and Slanské vrchy Mts. – with a centre in Košice (NaCl, noble opal, Sb, Fe).

The original intention consulted during the development phase in 2007 with the Ministry of Economy of the Slovak Republic consisted in the central financing of the Slovak Mining Road project through the EU funds in the

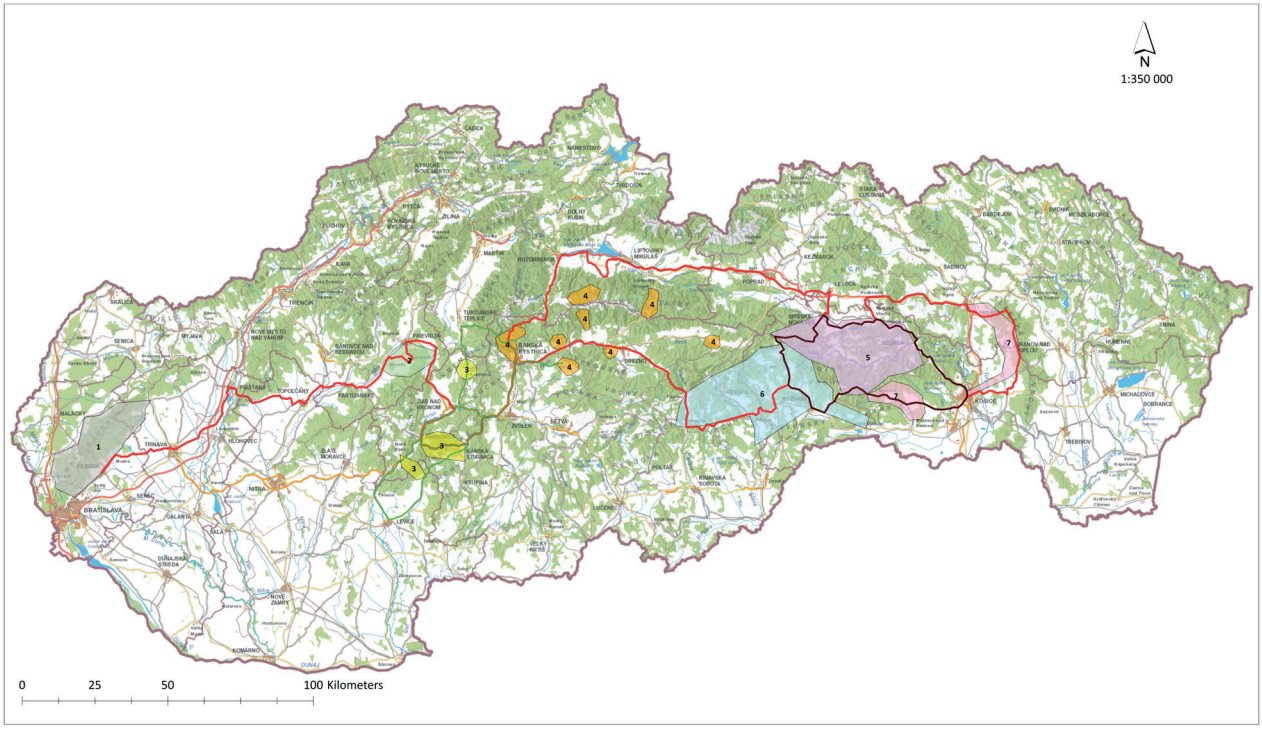

Fig. 3.2 Slovak Mining Road (1. Malé Karpaty Mts. mining – Small Carpathians Mining Road, 2. Coal mining in Slovakia – Upper Nitra Coal Basin and South-Slovakian Coal Basin, 3. Mining of gold, silver and non-ferrous metals – Golden Royal Towns, 4. Mining of copper, gold and antimony – the surroundings of Banská Bystrica, Liptov and Upper Hron Catchment regions, 5. Spiš region, 6. Gemer region, 7. Mining in Košice, Prešov and Slanské vrchy Mts.

2007 – 2013 funding period and the concept of the project as a national project for the preservation and transformation of mining works and plants. After clarifying the conditions for the provision of these subsidies in January 2008, it was clear that it is not possible to fulfil the defined conditions (in particular settlement of ownership relations, etc.) in a number of criteria. Therefore, the implementation and the main role of the Association lies in the level of promotion of the project as a whole and creation of the conditions for partial realization in the regions, active cooperation in the tasks of the programme. In order to realize this intention, the Association in cooperation with the company Rudné bane, š.p. has agreed to cooperate on the promotion of Slovak Mining Road sites through a website, information boards and a prepared printed guide to mining-technical monuments and mining museums in Slovakia. The individual centres and locations presented on the SMR map as the main sites are planned for the SMR info-panels. These locations are marked by a numeric code expressing the route and the centre. In addition to the basic info-panels, the boards are also located on important mining-technical monuments in the country.

Fig. 3.3: The first SMR table in the former royal town of Smolník

During 2008 – 2016, the SMR Task Force carried out documentary work on the selection of sites, a description of the mining-technical sights and related cultural monuments in the regions and localities concerned, thus making a list of the sites. Despite the fact that in Slovakia there are about 300 mining towns, municipalities and sites with mining or metallurgical activity and history, the list of 2017 consists of 96 sites selected. The primary criterion for inclusion of a site in the SMR list is, in addition

to historical data, the current state of preservation of the object, so that it could be tangibly presented to-date.

In 2009, the first SMR table (Fig. 3.3) in the former royal town of Smolník was officially unveiled and consecrated on May 1, 2009, which launched a concrete work on bringing the sites and objects of the mining and metallurgy to the foreground.

The SMR info-panels have an agreed type of a headline and a left edge. In the locations where the SMR copies at the same time the sites of the Iron Route – especially in the Gemer and Spiš area, the upper edge of the board in the right corner also bears the logo of the Iron Route – now under the name of the Slovak Iron Road (hereinafter referred to as "SIR").

In 2011, during the 3rd meeting of the Mining Towns and Municipalities in Rožňava, the Chairman of the Association of Mining Clubs and Guilds of Slovakia, and the Chairman of the civic association Slovak Iron Road signed a cooperation agreement. An important purpose of the agreement is the joint promotion of the sites which are identical in the Gemer and Spiš regions with respect to the extraction and processing of the iron ores all over Slovakia as the SMR sites.

The final update of the list of SMR and SIR sites in 2017, which should conclude a site presentation plan for a longer period of time, based on the criteria described above, including the updating of the centres in each region, is as presented hereinafter. The centres of the regions are the sites where a mining museum or an info-centre are located where further data on a mining region can be obtained.

3.4 Regions and centres of the Slovak Mining Road (centres marked in bold)

3.4.1 Malé Karpaty Mts. mining – Small Carpathians Mining Road

Mining in Malé Karpaty Mts. region (the most important sites are depicted in Fig. 3.4) has historically not been as important as in other areas, but it was an important part of the economic prosperity of the region. The earliest documented mining in the area was precious ore mining, the origins of which date back to the 14th Century, when the Charter of 24.6.1339 was granted by the Hungarian King Karol Róbert of Anjou to Šebuš and Peter, the counts from Svätý Jur and Pezinok who operated the gold mines, provided the 15th of the yield of the gold will be transferred to the royal court (Wittgrúber et al., 2001). The documented annual gold production was 300 – 2,000 grams, which was delivered to the Kremnica Mint (Bergfest, A., 1951). The first valid account of the amount of gold extracted comes from 1778, namely 1,267 grams of pure gold (Wittgrúber et al., 2001). The end of gold mining in this area is dated to 1861, when the last gold was shipped to Kremnica. In recent years, the mining has been limited to the panning of the material of old heaps.

Historically, the second oldest mining in the region was the antimony mining, the beginnings of which date back to the late 18th Century when precious metal mining was already in decline, and local miners tried to replace their business by prosperous minerals. Antimony, which

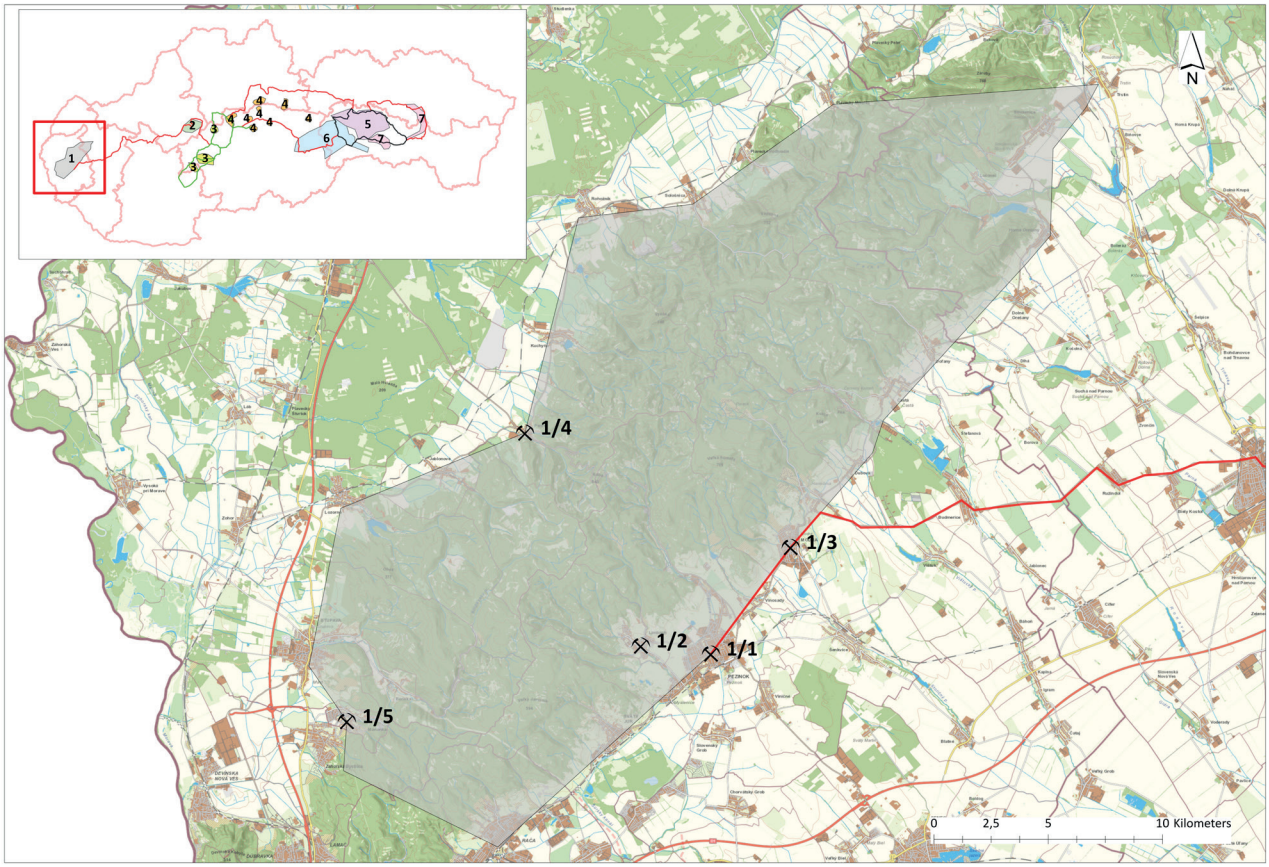

Fig. 3.4 SMR sites of Small Carpathians. 1/1 Pezinok, 1/2 Limbach, 1/3, Modra, 1/4 Pernek, 1/5 Marianka

was the source of pigment production earlier, but it importance has grown in this period as a metal that was added as an additive to alloys (e.g. the military industry). Since in the Small Carpathians sources of antimony mineralization, have been genetically linked with pyrite-pyrrhotite volcanic-exhaling mineralization, they were used historically together. Firstly, in 1790 in Pernek the Barbora Upper and Lower Galleries were developed (Wittgrúber et al., 2001). Later on, the Zubau and Pavol Galleries were also excavated. The 1790 report also mentions the galleries around Kuchyňa, namely Trojičná and Puklišova Galleries, but they were merely the exploration galleries. Work on the deposit on the Kolársky vrch near Pezinok also started (Fig. 3.5). Here, in the years 1809 – 1810, 11.1 t of antimony concentrate was extracted and processed, in the Pernek region at the same time, it was only about 3 t of antimony concentrate.

Fig. 3.5 Budúcnosť Adit with information boards of local mining road, Kolársky vrch Hill.

The large mining boom focused on the extraction of pyrite ores was connected with the construction of the first sulphuric acid plant in the then Hungarian Kingdom, which was built in Cajla in 1848. However, its operation was relatively short since it had stopped in 1896. There were several reasons for this development, the low quality of local pyrite ores was the main cause of frequent operational disorders (Bergfest, A., 1951). The mining excavation in the Pernek had halted in 1922, and the extensive geological exploration study associated with the restoration of the old mines as

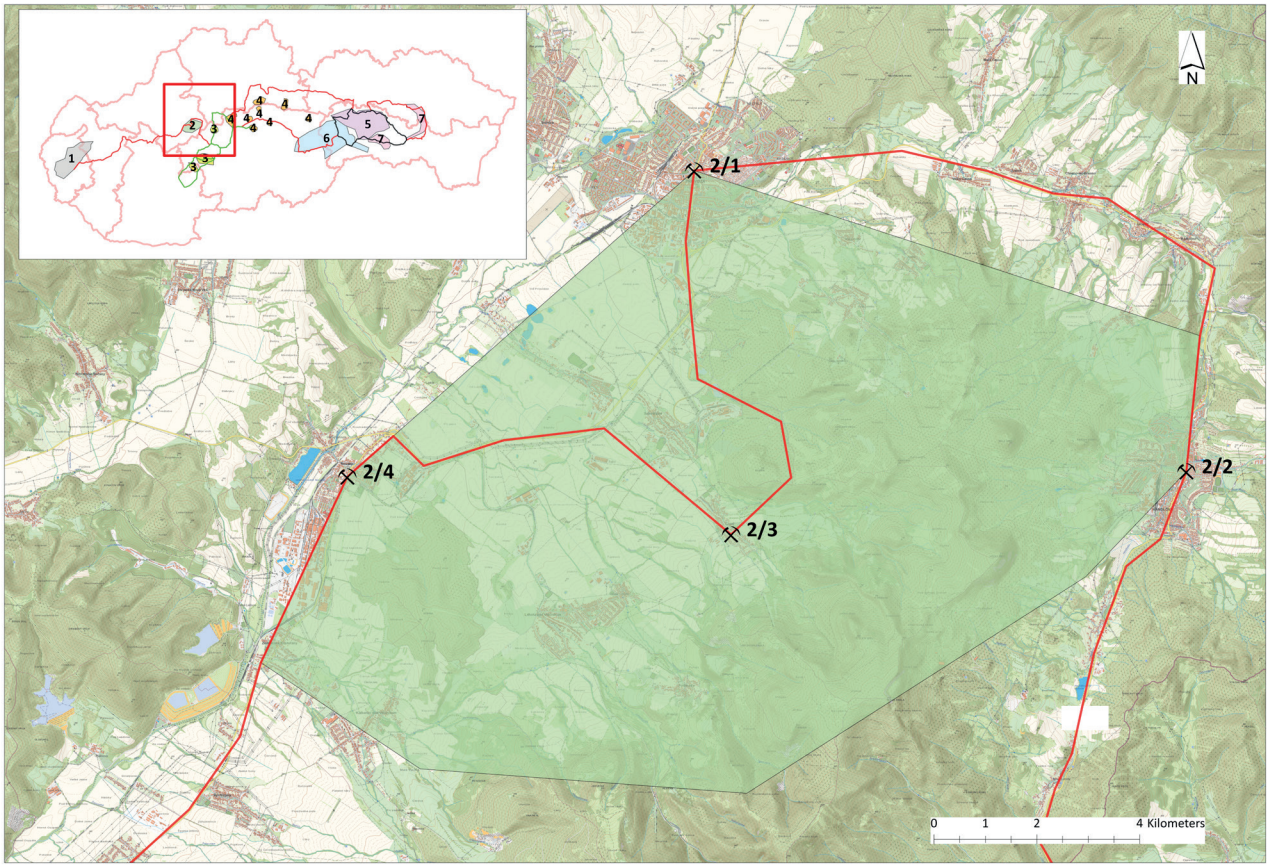

Fig. 3.6 SMR sites of coal mining in Slovakia. 2/1Prievidza, 2/2 Handlová, 2/3 Cigeľ, 2/4 Nováky, 2/5 Veľký Krtíš – Baňa Dolina, 2/6 Malé Straciny, 2/7 Modrý Kameň

well as the excavation of the Stanislav research pit carried out in the 1950s did not yield satisfactory results and the mining on the deposit did not recover. In the Pezinok area, the antimony ores were mined with less breaks until 1991, when the mining was stopped and the mining works were slowly liquidated.

The youngest mining industry, which is part of the SMR, is the mining associated with the excavation of the Lower Jurassic black roofing shales around Marianka, which was developed by the founding the enterprise of the French financier Paul Eugene Bontoux in 1859 (Kráľ et al., 2011). From the very beginning, this company exclusively devoted to the production of roof coverings, but later it also went to the production of slate school tables, which supplied the whole Hungarian Kingdom, and part of the production was directed to export to the Balkans, but also to Egypt, America and elsewhere. Evidence of the high-quality work of the company was the award of silver medal for shale products at the IVth World Exhibition in Paris in 1867. With the advent of producing lightweight coverings that replaced the slate roofs, however, the plant gradually declined and during the World War I it completely stopped the operations.

3.4.2 Coal mining in Slovakia – Upper Nitra Coal Basin and South-Slovakian Coal Basin

The origins of exploitation and extraction of coal in our lands are associated with the processing of gold-bearing ore by roasting with the addition of mineral coal (the most important sites are depicted in Fig. 3.6). This procedure was firstly used in Kremnica in the treatment process at the end of the 17th Century and it is assumed that coal originated from the nearby Ortúty site (Zámora et al., 2003). But the very beginnings of the search and subsequent industrial coal mining in Slovakia fall to the end of the 17th and the beginning of the 18th Century. All this was related to the finding of an alternative to wood (the lack of wood near mining centres) as an energy raw material in the mining and processing of precious metals, copper and iron mainly in the Central Slovakia region. These facts led to efforts to find coal deposits in Slovakia and to make attempts to use it in mining and metallurgy. The Viennese Court Chamber supported the search for mineral fuel deposits through various appeals, regulations, rewards, and so on. In 1722, the English mechanic, Isaac Potter, built a new steam-powered wood-fuelled fire-engine in New Baňa. On the basis of the experience gained, until 1758 another 6 fire fire-engines were built in the Banská Štiavnica Ore District. The fuel consumption (wood) was very high for these machines. Therefore, a great effort was made to find coal deposits in the Central Slovakia Ore District. This effort was also supported by the Vienna Court Chamber, which promised 100 ducats of reward to the one who finds coal and delivers it to the smelter plant in Banská Štiavnica. This situation caused the first time to mention the coal deposit in Handlová. Another wave of discovery of coal deposits was stimulated again by the Vienna Court Chamber. In 1751, it ordered all subordinate offices to search for deposits of coal and peat and to test for these types of fuel. In 1766, it promised a reward of 100 ducats to anyone who finds a coal or peat deposit. Already in the same year, an application for permission for coal mining in Badín was filed. In 1768, the first coal deposit survey was carried out at Obyce. In the 18th century almost all major coal deposits in Slovakia were known. However, their regular mining did not occur at that time. For the coal deposits in the Habsburg Empire it should be noted that the coal was not among the reserved minerals for quite a long time. Until April 2, 1782, the Vienna Court Chamber issued a decision to proceed as it did to other minerals when granting the coal mining. The coal mining approval should be granted by the mining courts. However, on June 20, 1788, it issued a decree according to which the deposits of coal which would be found in Hungary and Transylvania in the future should be completely exempt from consent to mining them by the mining courts, and should be left to the landowners who could freely dispose of them. Such a legal status was in force until the adoption of the General Mining Act in 1854. Although it was favourable for the Hungarian nobility, which owned most of the land, it had negative consequences for the development of industry especially in Slovakia. It caused not only technological delays in metallurgy and iron smelting, but it also affected the overall decline of these industries. In the first third of the 19th Century there were a number of sins in Slovakia that evidenced the gradual rise of the industrial revolution. Already in the 1820s, for example, modern steam engines started to be built in the Central Slovakia mining region, and they were gradually introduced in other areas of Slovakia. Therefore, the pressure to acquire the mineral fuel has risen and forced the exploration of coal deposits. The first well-known exploration of the coal deposit in Handlová and the first coal mining in Slovakia after 1837 in Badín belonged to this period. Already in the 1850s the efforts have been made to excavate other major coal deposits in Slovakia, which in some cases led to the start of regular mining. In 1854 Ján Pálffy, the owner of the coal mine, started the quarrying of coal in the Handlová deposit. Early 1850s the extraction was started in the Obyce-Jedľové Kostoľany deposit. In 1873, the extraction proceeded to the systematic extraction of the Badín coal mine depression. A great effort to extract the coal deposits led to the further development of the industry and the construction of the railways, and a major impetus was the issue of the General Mining Act on November 1, 1854. This law declared coal as a reserved mineral and thus made its extraction independent of the consent of the landowner. Overall, however, the Slovak coal in the 18th and 19th centuries contributed very little to the development of industrial production in Slovakia. It was because there was no quality coal in Slovakia, the coal deposits were distant from the major metallurgical centres, and the mining was complicated due to the unfavourable legal relations, which, for a short period of time, did not reflect the miners' needs (Hronček & Herčko, 2014). In the last quarter of the 19th Century only 3 bigger coal plants were operating in Slovakia, in Handlová, Badín and Obyce. Minor mining operations were also carried out in the South Slovakia coal basin around Veľký Krtíš. The most important were the

coal mines in Handlová, where the origins of the coal mining were associated with the name of the Bojnice Count Ján Pálffy, who secured in 1858 – 1861 the right to mine the coal in the mining fields Karol, Konštantín, Ján, Barbora, Anna and Laura in the north-east edge of the deposit, where the coal seam is just below the surface. However, their greatest development began in the early 20th Century after extensive drilling. Since 1919 the company was operating under the name of Handlová Coal Mines, stock company, Bratislava. Since its inception in the new Czechoslovakia, the Handlová deposit has secured a substantial part of coal mining in Slovakia. Already in 1910, the construction of a thermal power plant in Handlová began, which gradually increased its capacity and until 1953 it was the largest thermal power plant in Slovakia. In 1938 the stock company Handlová Coal Mines opened mining fields in the vicinity of Modrý Kameň and in 1940 began lignite mining in Nováky (Zámora et al., 2003).

The coal mining in Slovakia has acquired its importance and its development after the WWII. Socialist industrialization required the provision of the necessary fuel-energy base. Limited import possibilities of noble fuels and energy have led to high requirements for the development of mining in all coal mines of the Czechoslovak Republic and thus also in Slovakia, despite the fact that, besides the Handlová deposit, the coal from other deposits did not reach high the caloric values (Hronček & Herčko, 2014). The nationalized stock company HUB under the name Handlová Coal Mines, n.p., also administered the coal mines in Obyce, Veľká Tŕňa and Čakanovce. Opening works started in Nováky in 1940 and developed after 1950s and the Nováky Coal Mine was established with the mines Mier, Lehota and Nováky, renamed in to Youth Mine in 1957. From the original Handlová operation, the mine Cigeľ split in 1959 as an independent company (Zámora et al., 2004). After a variety of organizational changes, the coal mining company with its headquarters in Prievidza operates under the name of Hornonitrianske bane Prievidza, a.s. Interesting examples of the coal mining history are exposed in Museum of Ján Procner in Handlová (Fig. 3.7).

Fig. 3.7 Handlová – Museum of Ján Procner

3.4.3 Mining of gold, silver and non-ferrous metals – Golden Royal Towns

It is difficult to determine when the precious stone mining began in this most important mining region (the most important sites are depicted in Fig. 3.8). It is assumed that the Celts, whose coinage was based on gold and especially silver, could exploit these rich finds (Kolníková, 2012). Based on the finds (Roman coins, terra sigillata and Roman glass) from Banská Štiavnica, the location of the Staré mesto (Old Town), where the very beginning of underground mining in this mining region is likely, we can assume that there was a relatively extensive mining of precious ores during Roman times. We do not have the direct reports on the mining and processing of precious ores by Slavs. But considering the popularity of these metals by the Slavs and the material documents for processing and producing jewellery (Bojná, Nitra, Bojnice, Pobedim), we assume that well-known ore deposits such as Kremnica, Banská Štiavnica and others were exploited. The exploitation of ore deposits continued even after the demise of Great Moravia, when Slovakia became part of the early-feudal Hungarian state. It looks like the ore mines produced so many precious metals that they were not only able to conceal domestic consumption but also exported. This is evidenced by Nestor's Kiev Chronicle, which mentions the import of Hungarian silver to Kievan Rus in about 969. Undoubtedly, the mining of precious stones in the Banská Štiavnica area was of utmost importance. It is assumed that 50% of the extracted silver originated from the Banská Štiavnica Ore District. This silver served as a basis for the coinage of Hungarian silver coins (Kúšik, 2015). During the 10th Century, significant mining of precious metals ores was in the Banská Štiavnica area. The record from the year 963 on the arrival of Czech miners in Banská Štiavnica has been preserved (Lichner, 2002). In the Charter of 1156, this territory is termed "Terra Banensium" – the land of miners. Later in 1217 it is mentioned as "Bana". But the seal of the 1275 document contains already the name Štiavnica (Schemnitz). Historians explain this by saying that the name of Bana refers to the Staré mesto – Glanzenberg and Štiavnica was a settlement in a valley that is identical to today's centre of Banská Štiavnica. The production of gold and silver in the 11th Century can be considered very interesting due to the high content of metals in the surface parts of deposits and the easy accessibility of the ores (Kúšik, 2015). The boom of mines brings a change of settlement to the city that in 1238 received from King Béla IV

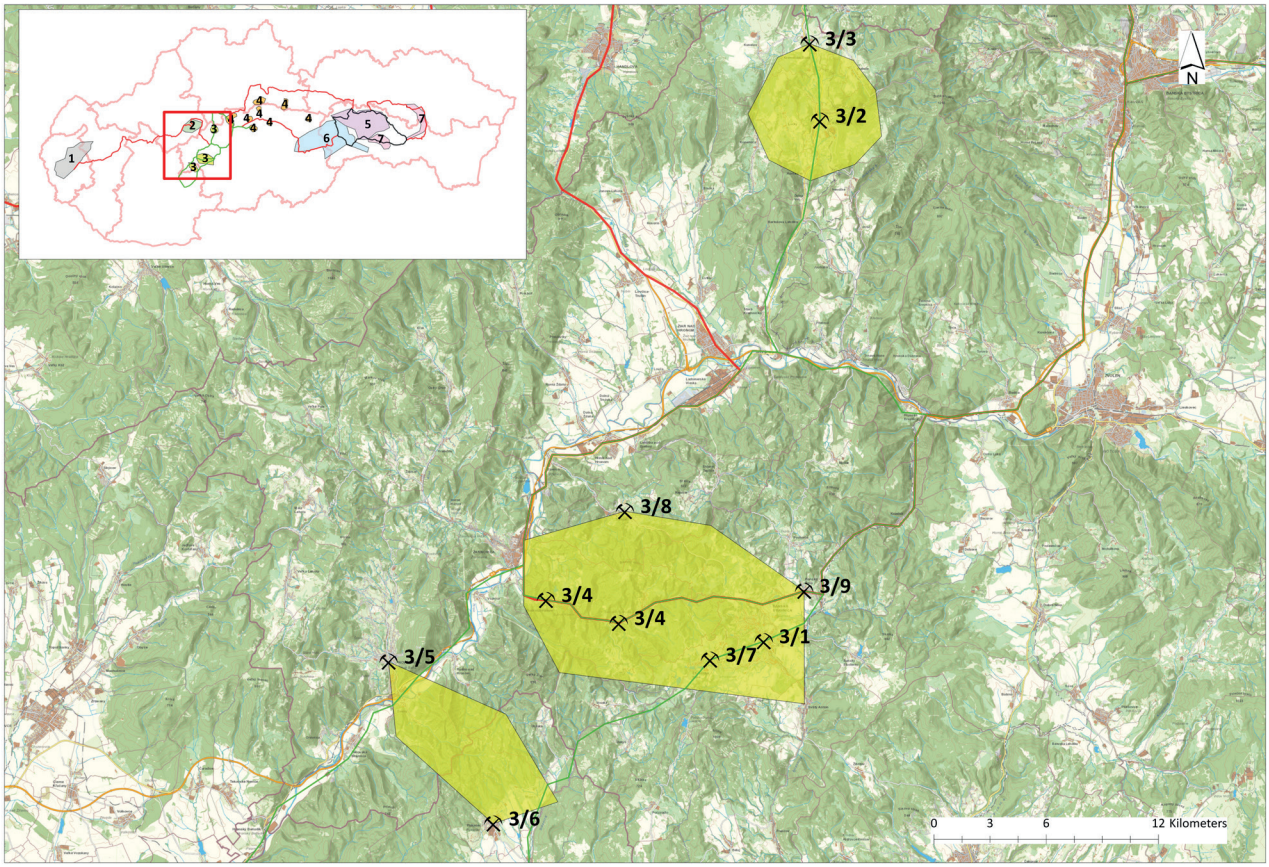

Fig. 3.8 SMR of mining of gold, silver and non-ferrous metals. 3/1 Banská Štiavnica; 3/2 Kremnica, 3/3 Kremnické Bane, 3/4 Hodruša, 3/5 Nová Baňa, 3/6 Pukanec, 3/8 Výhne, 3/9 Banská Belá

the city privileges and mining rights. The significance of mining is also emphasized in the 1275 town seal, where the coat of arms of the city, besides the walls, contains symbols of mining tools (as illustrated in Fig. 3.1), such as pick and hammer (Lichner, 2002).

The first written records proving the existence of Kremnica are from the 14th Century. In 1328, Charles I, also known as Charles Robert of Anjou granted special privileges the "guests" concentrated in the Cremnych Bana settlement – coiners from Kutná Hora; that encouraged its intense development. Thus, the settlement was given the privileges of a free royal city and mining mint rights under the Kutná Hora law. At Kremnica, however, there was already developed mining business with total annual production estimated at 130 kg of gold per year (Beránek, 1977). Shortly after the arrival of the miners, the first coins – the Hungarian Groschen – were minted in 1329. Eight years later, the mint production included also the golden florins. Later, they became known as Kremnica ducats. It is believed that Kremnica's mining history began much earlier. However, there is no documentary evidence linking to the beginning of mining on this deposit. However, the only direct evidence was found by a detailed geological survey of the Šturec deposit. It was the rest of the wooden pillar from the old mines in Šturec, which was dated to 1050 by the ^{14}C method. The depth of the find below the surface shifts the beginning of mining for at least 100 years back. According to other authors, the mining activities began in the 8th or 9th centuries, eventually in the beginning of the 11th Century, when in 1004-1008 the miners from Harz settled in the region. The most likely beginning of the Kremnica mining is the end of the 9th to the beginning of the 10th Century. The document from the year 1385 mentions, for example, a hereditary gallery that was 4 km long. This fact points to the long-term use of the deposit. The oldest codified mining law in the territory of Slovakia dates back to the thirties of the 13th Century. It was probably the law of the Štiavnica Mines, which was given the privilege by the King Béla IV. However, the document defining the mining law was probably destroyed during the Tatars' invasion in 1241 – 1242. Until now only the German language copy from 1466 has been preserved. All mining towns in the territory of today's Slovakia adopted it either as a whole or at least some parts. Most decision-making on mining was given to free mining towns. King Stephen I (997 – 1038), the founder of the Árpád dynasty, established the royal mining chamber, which was the forerunner of the Chambers of Mines.

Since the second half of the 13th Century, a significant development of mining occurred in Slovakia. All major deposits and numerous smaller occurrences were exploited, exploring the possibilities of extraction and treatment of precious metals ores first. All ore deposits in Banská Belá, Hodruša (Fig. 3.9), Štiavnické Bane, Pukanec and Nová Baňa areas were mined. Since the 14th Century mining our territory experiencing a great boom, but with the deepening of mines and the tracking the ore columns to the depth water problems occur in most mining areas. This led in

most of the areas to construction of drainage galleries and the construction of pumping equipment, treadmills. At the same time, the deepening of mines also reduced the quality of ores and the mining was more complex and required the involvement of more miners, thereby increasing the cost of mining. In every mining town, according to King Charles Robert's order, they built a royal house, Kammerhof, in which the Chamber Count was seated. The miners were obliged to exchange gold and silver in Kammerhof, and the Chamber Count was the only one authorized to determine the fineness of the metals. On April 7, 1388, Banská Štiavnica held the founding meeting of the Union of Central Slovakia Mining Towns, which was tasked with jointly solving the problems of mining towns. In Banská Štiavnica, water reservoirs for surface water capture started to be used to propel water wheels (Kúšik, 2015) at the end of the 15th Century.

In the 14th and 15th centuries, the exploitation of precious metals ores in Kremnica reached a maximum and the annual production of gold exceeded 400 kg, representing a third of the total production in Hungary and a tenth in the world (Beránek et al., 1977). The prosperity of the city in the 14th Century is documented by its rapid expansion. In Kremnica, the waterworks were built to supply water. The oldest of them was built in the 15th Century.

At the beginning of the 16th Century there were 426 individual mining centres around Banská Štiavnica. The technique of work has changed by improving mining. The rock was first transported in backpacks, then dragged on the rims, later wheel-bags were used, and then took over from Tyrol the carts they had modified for the Banská Štiavnica conditions; these mining carts were also called the Hungarian carts. Vertical transport was secured by a simple device with a winch, later using a treadle wheel, horse winder or water wheel. The water was needed to build up artificial water reservoirs. In the period 1500 – 1638 there were only 4 water reservoirs / Veľká Vodárenská, Malá Vodárenská, Brennerštôlnianska, Evička/. The water was pumped by the rope container, the ventilation was natural, or the blasts were used. Lighting went from primitive rays and torches to oil burners. The development of mining also required some specialization of workers. The professions were created as miners – breakers /rock disintegration/, loaders /rock loading into transport vessels/ and runners /they transported the rock to the destination/. Special squads provided water pumping. Specialists worked on ore treatment and compaction. Several mines from smaller miners who were unable to maintain mining financially were gradually taking over by the state. In the 17th Century a separate mining administration was established, for the mines belonging to the state, so-called Mines Administration on Vindšachta. Although in the 17th and the beginning of the 18th Century Banská Štiavnica was challenged severely – the Turkish raids, the anti-Habsburg noble uprising, the plague epidemic in 1709 – 1710, which killed about 6,000 people, the Banská Štiavnica mining continued to progress. The year 1690 was the richest year of the Banská Štiavnica mining area when 29,000 kg of silver and 605 kg of gold were produced in the smelters. The ores mining moved deeper-and-deeper, the mining work became technically more demanding, more systematic mining techniques and

Fig. 3.9 Knocking Tower in Banská Hodruša

Fig. 3.10 Portal of Bieber Hereditary Adit

more complicated finishing and metallurgical processes were needed. The rock was still disconnected manually (using a pick and a hammer), exceptionally with fire. On February 8, 1627, Kaspar Weindl from Tirol made the first underground mining blast in the world with black powder in the underground of Horná Bieberova Gallery (Fig. 3.10; Kúšik, 2015).

Handheld drills were also used. Mining water was pumped from the level of hereditary adits to the surface by vessels, leather bags and piston pumps. The first mention of piston pumps is from 1604 in the Brenner works. There, for the first time in 1619, a horsepower treadmill was used to drive piston pumps. However, human and horsepower did not meet the increasing need for ever deeper mining. Greater emphasis was put on improving the construction of treadmills and the use of water energy. At the beginning of the 18th Century, in 1700 – 1701, the chief engineer Adam Unger built a water-powered wheel pump. Flooding of the galleries was an increasing problem and there was a threat of mines closure. The engineer Matej Kornel Hell helped to rescue them. He constructed water pumps in the Magdaléna Shaft at Vindšachta and in the Horná Bieberova Gallery. Development required better and better processing of ores. The method of treatment in the stamp mills was applied, that belonged to the most important treatment ores processing in Banská Štiavnica. The increasing need for more propellant water required an expanding network of artificial water reservoirs – the "ponds" that secured energy for mining machinery, water pumps, hoisting and treatment equipment and smelters. This sophisticated water management system of artificial water reservoirs, powered and interconnected by collecting, conducting and drive ditches, not only saved the Banská Štiavnica mining, but on its energy base developed a mining pumping technique, which was also a model for other mining sites in the world. Two major personalities, engineer M. K. Hell and Samuel Mikoviní, who was appointed in 1735 for imperial-royal geometer and the first professor of the mining school in Štiavnické Bane, had a large share in this development. In the near Nová Baňa, after a short epoch of boom (14th-15th centuries), the town, experiencing the internal unrest in Hungary and anti-Turkish wars, had suffered one blow of fate after another – the destruction of the city by the Turks in 1664, the anti-Habsburg uprising and the plague epidemic, which made the city almost extinct in the 17tth Century. The mining water problems also negatively affected the further development of mining. The flooded mining works were to save by the atmospheric fire engine, built in 1722 by the English designer Isaac Potter (the model of the machine is located in the Hron Regional Museum in Nová Baňa). It was the first steam engine on the European continent (Kúšik, 2015). In Banská Štiavnica at the end of 18th Century. the construction engineer Jozef Karol Hell proceeded with the construction of additional reservoirs. In 1738 he built the first weft pumping machines. J. K. Hell put in operation in 1755 his invention – Hell's Air Pump Machine, where he used a completely new driving element – compressed air in addition to water. The machine had a revolutionary design and overtook its time. However, the atmospheric steam /fire/ pumping machines were still largely used. In the Banská Štiavnica ore district they were built in the greatest number in Europe and were assembled completely in Slovakia. At the end of the 18th Century more economical Hell's water-column machines started to be used. A major breakthrough in the mining of precious ores in Banská Štiavnica was the completion of the inauguration of the Hereditary Adit of Joseph II (Voznická), which began to be drilled in 1782 and completed 96 years later, in 1878. This hereditary drainage gallery, which drains the deposit up to level of the 12th horizon, has a length of 16,210 m and at the time of its construction it was a unique mine work on an European scale (Kúšik, 2015). This gallery has greatly facilitated the mining in the region, since only horizons below its level pumped were pumped, so the mining costs were not so high. At the beginning of the 19th Century, Hell's water-column machines were perfected by professor of the Banská Štiavnica Mining Academy, Jozef Schitko. In the course of the 18th and 19th centuries, the ores treatment achieved a high technical standard in Banská Štiavnica. In their reports, many experts and foreign travellers included Banská Štiavnica among cities with excellent technics and technology of ore processing. Emperor Maria Theresa adopted the proposal of John Tadeus Peithner, and by decree of December 13, 1762, ordered the establishment of a Mining Academy in Banská Štiavnica. It was the first college of this focus in the world, and Banská Štiavnica became the centre for the development of mining science and technology in Europe (Kúšik, 2015). The first lecture at the Mining Academy was presented on October 1, 1764. The professors (Jacquin, Poda, Delius, Scopoli) of this school are associated with many European and world lead-

Fig. 3.11 Farewell to the Old Year in Glanzenberg Hereditary Adit

ers in science and technology. The Mining Academy later merged with the Forestry Institute and thus established the Mining and Forestry Academy in Banská Štiavnica. The Academy trained a number of mining experts who were involved in introducing new methods and practices in mining practically all over the world. In Kremnica, in the second half of the 18th Century, with the drainage of mines (Deep Hereditary Adit) and the opening of deeper ore bodies, the production of precious metals began to grow. In the years 1748 – 1800, an average of 635 grzywnas of gold and 20,809 grzywnas of silver were obtained. But early in the 19th Century the Kremnica mines again struggled with great difficulty and were unprofitable. The mines reached into the deeper parts that were not drained by the Deep Hereditary Adit, and had to be pumped, ventilated and the hoisting of the extracted ore was too costly. In 1841, work began on the excavation of the Main Hereditary Adit, which was completed in 1899. It reached a length of 15,481 m (Kúšik, 2015).

After the end of the World War I and the creation of Czechoslovakia, in 1923 – 1931 the Banská Štiavnica and Hodruša plants interrupted their operations, as a result of the reconstruction and rehabilitation of partially suspended mining and metallurgical operations. Of the original 1,500, only 600 miners were employed. Preliminary work on the opening of the richest ore pillars on Špitaler and Grüner's veins was carried out, the shafts František, the blind Emil and Mária were deepened because of the ventilation. Later on, they began work on the Maximilián Shaft and the Svätotrojičná (Saint Trinity) Gallery and the Pacher Gallery. The system of stamp mills and gravitational treatments was also rebuilt. In the year 1930 in the František Shaft modern flotation treatment plant was built, which alternately processed precious and polymetallic ores. Around the year 1930, a mining operation was started with the mining of precious metals ores on the Grüner Vein and the polymetallic ores on the Špitaler Vein. During the monitored period, a total of 405,000 t of ores were exploited, of which 187 ths. t were precious metals ores and 13,920 t of lead concentrate were produced. The water reservoirs mostly lost their original purpose, ceased to provide energy water and began to serve fishermen and tourists. The Hodruša plants conducted an exploratory program focused on the Schöpfer Vein at the Lower Plant and the Finsterort and the Východná (Eastern) veins at the Upper Plant. At the same time, in Vyhne the work proceeded on the Pod Šivárňou veins. As the quality of the ores did not reach the expected parameters, in 1939 the Rozália Vein started to be explored for copper ores. In the year 1922 the plant in Kremnica took over Ing. Aurel Lehotzký, who was a native of Kremnica and a graduate of the Banská Štiavnica Mining Academy. He worked out a redevelopment plan for the plant, which focused on the more promising veins in the shafts Ferdinand, Ludovika and Anna. The ore was treated by amalgamation associated with flotation and subsequent leaching in the cyanization facility. In the period under review, 495 ths. t. of precious metals ores were mined out, from which about 2 tons of gold and 4 tons of silver were produced. Thanks to the use of the Turček Water Pipeline, the mining plant was self-sufficient in the production of electricity. By rebuilding the hydroelectric system (the Ferdinand Shaft (Fig. 3.12), the Anna Shaft and the Shaft IV), the electricity was also supplied to the public network.

After the end of the Second World War and after the change of social conditions, the newly-established enterprise Rudné bane, n.p., Banská Bystrica covered the plants in Banská Štiavnica, which in the post-war years also mined precious metals ores mainly on the Grüner Vein and the polymetallic ores were mined out on the Špitaler Vein. Until 1952 the exploratory work was done unsystematically, according to current needs. The intensive geological survey began in 1952, but it was not enough to offset the differences until 1965, and so irregular development of the mines had a long-term effect on the deposit economy. After the construction of the Nová (New) Shaft in 1973, a new conceptual solution was developed for the exploitation of the Banská Štiavnica ore district. It was decided to carry out an extensive geological survey in depth along the whole ore field, including the Piarg part of Štiavnické Bane and the whole Hodruša ore district. The estimated potential of the ore deposit was 5 million tons of geological reserves. The excavation of the Roveň Shaft began in the southern part of the deposit, which had to be an ventilating shaft and had to make accessible the ore units in the southern part of the ore field. An important achievement was the development of the New Drainage Gallery (NOŠ), which ought to help the Old Voznica Gallery, which was no longer able to drain the entire district. The gallery development started in 1978 and was

Fig. 3.12 Ferdinand Shaft in Kremnica

completed in the year 1989 in a circular profile of 3.4 m. The Banská Štiavnica plant was the largest plant of the Rudné bane š.p. Between 1946 and 1947, 17.5 thousand t. of precious ores were processed. After the transition to the extraction of polymetallic ores, 4,078.4 thousand of these ores were extracted in the period 1946 – 1990, of which 44,736 t of lead, 5,064 t of copper, 787 kg of gold and 39,460 kg of silver were produced. The zinc concentrate was processed separately, of which 56,470 tons of zinc and 10,871 kg of silver were produced (Kúšik, 2015). During the greatest development of the plant 1,500 – 1,600 workers worked in the field of mining. After 1989, the votes against the high production costs in the ore mining industry increased and in 1991 the Decision of the Government of the SR on the concept of utilization of selected mineral resources in the SR stated that the mines in Banská Štiavnica should attenuate the mining till 1995 and to carry out disposal of unnecessary mining spaces and facilities. In 1992, the mines went to private hands and the company Hell, s.r.o. continued with mining until 1993. In 1994, without any detailed analysis, the mines had been liquidated and the promising programme for the mines and the city ended and the industrial sector that gave rise to the city and its development disappeared (Lichner, 2002). However, the miners` ceremonial customs have been preserved (Fig. 3.11). The Hodruša-Hámre plant extracted the precious metals ores until the year 1950. In the period 1946-1950, a total of 47 ths. T of ore were extracted. Then the plant turned to the mining of copper ores in the mine Rozália. During the monitored period, 1,857 thousand tons of the copper ores were mined out in the plant. The copper concentrate was supplied to Krompachy smelter plant. At the beginning of the 90-ies after the termination of polymetallic ores mining, a precious metals deposit was discovered in the northern part of the deposit. Since 1992, the mining is taking place here up to the present day. The Kremnica plant with precious metals ores mining in the Anna Shaft; in 1959, the mining industry ended here. Similarly, in 1966 the Ludovika Shaft (Fig. 3.13) was closed, and in 1970 the mining on the richer veins of the ore section of the Ferdinand Shaft ended based on the Decision of the then Ministry of Mining. Between 1959 and 1965, the precious metal ore was extracted in Šturec. In the early 1980s, gold prices rose rapidly in the markets. This stimulated renewed interest in exploration and possible renewal of the ore mining in the Šturec area. In the years 1983 – 1986, a semi-operating line was built, and the machinery for the treatment facility was modified and along with the leaching plant for the cyanisation process. The plant developed a proposal to increase the mining capacity of 30 ths. t. ores a year, but no implementation took place. On the semi-operating line between 1987 and 1990, a total of 34,710 tons of ore was processed, with the yield of 46.5 kg of gold and 328 kg of silver. In the period 1946 – 1970, a total of 922.3 ths. t. of precious ores were extracted from the deposit (Kúšik, 2015).

Fig. 3.13 Ludovika Shaft – Mining Museum in Kremnica

3.4.4 Mining of copper, gold and antimony – the surroundings of Banská Bystrica, Liptov and Upper Hron Catchment regions

It is very probable that the Špania Dolina – Piesky deposit was exploited already in the Eneolithic Period. Beneath the old mining spoil tips at the site Piesky near Špania Dolina, stone tools (stone mills) were found, where copper ore was crushed and hammered into flour. It is reported that about 300 stone mills of different sizes were found in the Piesky saddle (Kvietok et al., 2015). At the same site, there were also the remains of a roasting fireplace where the ore was roasted before compaction. The instruments and fireplace probably belong to the Early Bronze Age (Kúšik, 2015). However, the town of Banská Bystrica was granted the privilege of a free mining royal town only in 1255 under the reign of Béla IV. The owners of the mines, the so-called waldbürgers and their mining rights to search for and extract gold, silver and other metals throughout the territory of Zvolen County – were declared by the Decree of Béla IV already in the year. 1242. The granted privileges also brought relief from all taxes, and the only duty was a royal “urbura”; the payment equalled 1/10 extracted gold of 1/8 extracted silver or other metals (derived from the Banská Bystrica privilege from 1255). In the Banská Bystrica ore district (the most important sites are depicted in Fig. 3.14), the deposits produced a lot of silver, which was obtained from the tetrahedrite ores. Of course, the mining in the local mines situated in Špania Dolina (Fig. 3.15), Piesky, Staré Hory – Richtárová (Fig. 3. 16) and Ľubietová was mainly focused on copper ores containing silver (so-called black copper). In the 14th Century, most of the black copper production was exported to Venice, where they were already able to

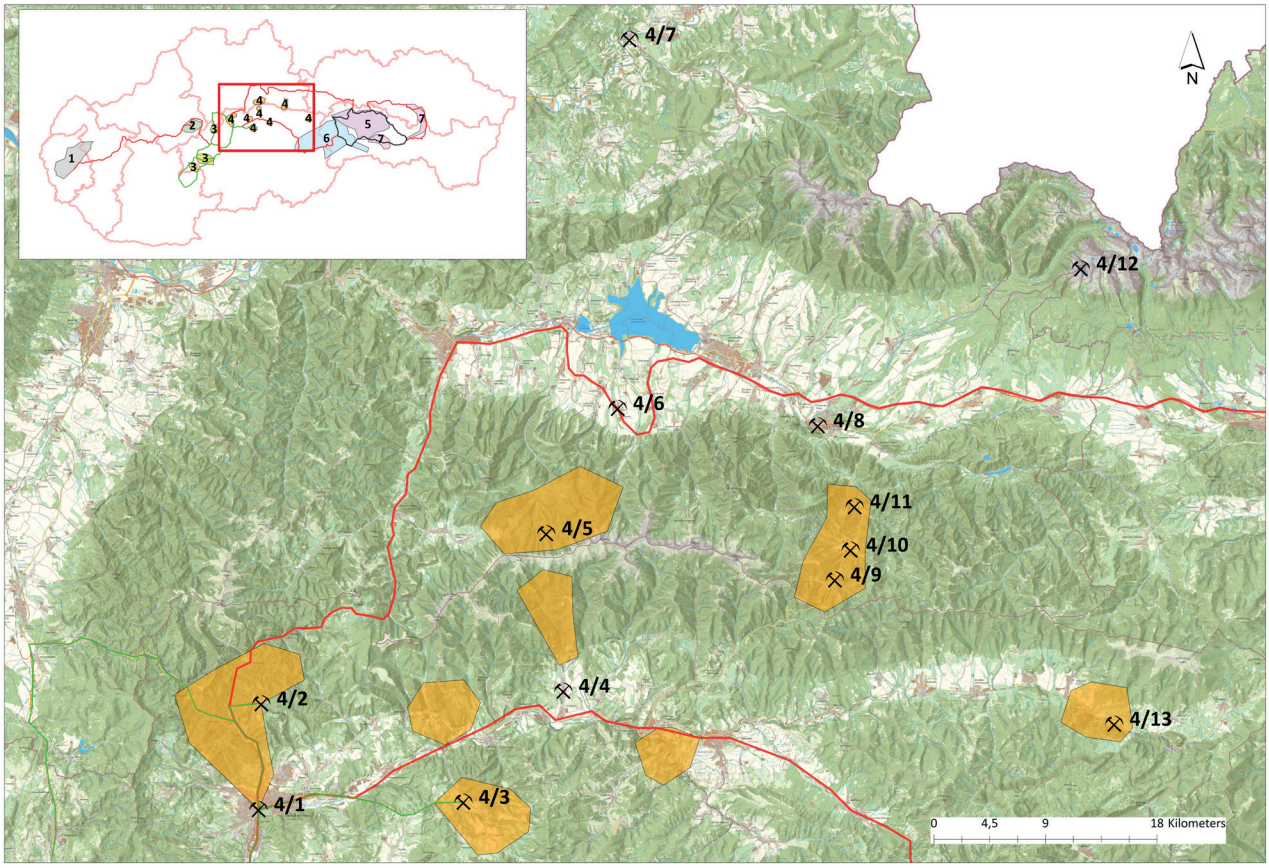

Fig. 3.14 SMR – Mining of copper, gold and antimony – the surroundings of Banská Bystrica, Liptov and Upper Hron Catchment regions. 4/1 Banská Bystrica, 4/2 Špania Dolina, 4/3 Ľubietová, 4/4 Jasenie, 4/5 Magurka, 4/6 Liptovská Dúbrava, 4/7 Podbiel – Františkova huta, 4/8 Liptovský Hrádok – Vážnica, 4/9 Vyšná Boca, 4/10 Nižná Boca, 4/11 Malužiná, 4/12 Kriváň-Vysoké Tatry, 4/13 Valkovňa

separate silver at the time. The secret of producing copper with its lesser content in ore brought to this area a Krakow burgher man Ján Thurzo at the end of the 15th Century. In 1494 he created together with the Upper Germany merchant house of the Fuggers, the grandiose business and enterprise company "Ungarische Handel". During the first half of the 16th Century, the company controlled all the copper markets. In the period 1496 – 1546, the company recorded the maximum development of the copper ores extraction with high Ag content, for which the ore had an extraordinary price. Interesting fact is, that in AD 1533, the Portuguese trade vessel Bom Jesus sunk off the coast of southern Namibia. Amongst the excavated materials recovered from the presumed shipwreck of the Bom Jesus, of paramount importance are 1845 copper ingots, showing the trademark of the Fugger company (Hauptmann, et al., 2016). In the 16th Century, the Banská Bystrica "Ungarische Handel" copper company was the largest copper producer in the world. In the area of Ľubietová, which in 1379 was granted the free mining town rights by the Charter issued by King Louis I of Hungary, with acknowledged privileges of 1382, the Medieval mining was profitable. It was only in the first half of the 15th Century, when Ľubietová was plundered and fired by the Hussite army, the mining here declinde until the Thurzo-Fugger company mentioned above took control over the local mines. The medieval copper mining in the mid-17th Century was concentrated mainly in the Banská Bystrica and Ľubietová districts. But it slowly moved to the Eastern Slovakia region. The Thurzo-Fugger company ended its activity in 1545 and the mines were taken over by the Empire. After Bockai and Bethlen's uprising, the Banská Bystrica copper company was in a desperate state. The mines were mostly flooded and the miners broke up. The situation improved somewhat when the state signed a contract with the entrepreneurs W. Paller and L. Henckel, who provided the money for mining operations. The production slowly began to rise. However, the copper companies began to compete in the markets first with Sweden, and later also with Japanese copper. In 1642, the state rented the mines to the Viennese merchant brothers Joanelli. But they had rather plundered the mines, and the had exploited mining community what caused their dissatisfaction. Following the rebellion of George I Rákóczi in 1645, a plague epidemic and hunger broke out and miners who did not receive wages, run away. In the second half of the 17th Century, the plant was restarted, and the state, which at that time operated the mines, introduced measures to make extraction more efficient and the production of copper rose again. However, the exhaustion of ore reserves was obvious. The shafts were over 350 m deep, the production costs increased, and the production declined. In the next period (18th – 19th centuries), the copper mining in Banská Bystrica region /Špania Dolina, Ľubietová/ still survived, but the mining of the copper was

already dominant in the Spiš-Gemer region. Nevertheless, in this area, significant mining-technical works were built and used; som of them are historical monuments in the present. In the 16th Century the construction of Špania Dolina Mining Water Supply was built, one of the most important historical and technical works of that time in the vicinity of Banská Bystrica. The water for the drive of the hoisting equipment was supplied with this mine water, which had a total length of about 33 km and the water was supplied from distant Prašivá Hill. The so-called "cementation waters", which began to be utilised in the 17th Century, were very interesting. This phenomenon is already described in the work of the alchemists, Paracelsus, as well as classical scientists – montanists such as J. Agricola, travellers doctor E. Brown, J. G. Becker and F. E. Brückman, physicist I. Newton and A. F. Marsigli (Grecula et al., 2002). This water was trapped in the underground in special tanks into which the old unusable mining iron was deposited on which the excreted copper was precipitated. By the late 18th and early 19th Century, the copper mining was also under the influence of foreign competition. Still in the middle of the 19th Century about 50-70 tons of copper were extracted annually in Špania Dolina and about 800 people were employed there. Gradually, the mining fell, and the mines were finally closed in the year 1888. The famous history of Špania Dolina today reminds so-called "Špania Dolina glasses" scattered across European museums and private collections. These rare pieces of art were gifted to great visitors. They were made by Banská Bystrica goldsmiths from sheet metals produced from "cementation waters" in Špania Dolina. They were decorated with gold and precious stones. They have characteristic inscriptions engraved, such as: I was iron, I have become copper, gold is covering me. In the 20th Century, attempts were made to restore copper ore production around the Špania Dolina deposits. Certain re-discovered parts of the veins were mined in the 1960s. Since 1964, old heaps from the Richtárová Valley and the Piesky deposit were extracted for the industrial accumulation of copper ores in them. The ore was driven by a new-built traffic junction to a plant in Špania Dolina. The processing of rocks was gradually stopped and in 1986 the facility turned to the treatment plant of the Hg-ore from Malachov, from a deposit in which the mercury was mined in the 14th Century. Several stages of the geological survey were carried out along with the extraction from old heaps, the remains of which can be found mainly on the site of Piesky. This ended the famous epoch of the copper mining around Banská Bystrica.

Iron ore mining was of great practical significance also for the Hron Catchment in the vicinity of Hronec, Poniky, Ľubietová, Železná Breznica, Vyhne and Horné and Dolné Hámre. The production in this area was mainly responsible for the supply of precious ore mining facilities. But new iron smelters were founded, for example, at the end of the 17th Century in Tisovec and Ružomberok. The ores were still largely obtained from the surface areas of the gossan-type deposits. Generally, however, the ores in the Hron Catchment had lower metal content than the Spiš-Gemer ores. At the end of the 17th Century, the first blast furnace was built and put into operation in this area, in 1692 in Ľubietová (Kúšik, 2015). In the 18th Century, a huge iron complex was established in Hronec. In the first half of

Fig. 3.15 Miners` Church and houses in Špania Dolina

Fig. 3.16 Old Haliar Hereditary Adit

Fig. 3.17 Mining cart: Welcome to mining village of Vyšná Boca

the 19th Century, the construction of a strip mill under the hummock of Brezová was ordered by G. Schweizer – the Chamber Count in Banská Štiavnica. At the end of the 19th Century, Podbrezová Iron Works belonged to the largest and most prosperous factories in Hungary (Zámora et al., 2003).

Relatively prominent in this area is also the mining of precious metals ores. The first mention of this mining was in the 13th Century, when the precious metals ores in the Nízke Tatry Mts., in Vyšná Boca (Fig. 3.17), Partizánska Ľupča-Magurka, were mined. In the vicinity of Hybe penning was reported. However, in the 16th – 17th centuries mines in this area are reported as less profitable (Kúšik, 2015). The revival took place in the 19th Century, when a hereditary adit was excavated at Magurka. Since the ores contained antimony, it also became a by-product of the gold mining. The end of the gold mining in this locality came in 1923.

The development of antimony mining in the Nízke Tatry Mts. region dates back to the late 17th Century, but especially to the 18th Century, with the revitalization and flourishing of mining of the entire area of the Nízke Tatry region and, in particular, with the prospecting and extraction of stibnite ores. The restoration of mining works occurred after the year 1806, and with the breaks, the Liptovská Dúbrava deposit was mined until 1993. Before and during the Second World War, until the 1947, only those ores were mined, from which a concentrate with a metal content of more than 40% Sb could be obtained. The great revival of the exploration and mining of the Sb-ores occurred in the 50 – 80s of the 20th Century. Concentrations quality with a content of 54.12% Sb achieves global parameters (Grecula et al., 2002).

3.4.5 Spiš region

The beginnings of mining in this region (the most important sites are depicted in Fig. 3.18) are not clearly documented by discoveries directly in mining centres, but indirect evidence may be the archaeological finds from the Hornádska kotlina Basin, indicating local metallurgical processing of metals. Some authors put the mining beginnings in the region of mining and iron metallurgy into Halstatt Period (iron) (Daniel et al., 2011), some are considering the Bronze Age in terms of extraction and processing of precious metals ores and copper due to the existence of significant centres of the Bronze Age at Spišský Štvrtok in Myšacia Hôrka and found depots of bronze and gold products, which were probably produced directly in the settlement (Vladár, 2012). Since the second half of the 13th Century, the Spiš region had experienced a significant development of mining. At that time, silver was mainly mined in Gelnica, Smolník and Spišská Nová Ves. Even in the 14th to 15th centuries, the precious metals ores were mined in this area and their production had to be high when King Charles Robert of Anjou made Smolník in 1328 the seat of one of the two coin chambers in our territory; the second one was in Kremnica (Kúšik, 2015).

The copper ore mining was also very well developed in this area. Significant mining facilities were in Gelnica, Smolník and Spišská Nová Ves. Particularly noteworthy was the production of cementation copper in Smolník. This phenomenon is already described in the work of the alchemists, A. Smoczký, as well as classical scientists – geographer D. Fröhlich, physician D. Geyger, F. E. Brückman, and A. F. Marsigli and others (Grecula et al., 2002). In the 17th Century, this region was already dominant in the mining and processing of copper ores. But even in this area, periods of deep decline alternated with periods of relative prosperity. During this period, the most important enterprise in the Spiš region was the Smolník plant, less Gelnica and Švedlár plants. In the 19th Century, the decline of the copper ore mining in Spiš started with overrunning of the European market with cheap and quality copper from newly-discovered American deposits; the Spiš copper could not compete with the price. These circumstances lead to the gradual disappearance of the copper ore mines and smelters throughout the region in the second half of the 19th Century. The recession also affected the ancient mining towns of Gelnica and Smolník, where, for example, copper mining ceased to exist at the end of the 19th Century and only pyrite for the production of sulphuric acid (Jančura, internet source) was exploited. At the beginning of the 20th Century, the copper ore mining was the most developed on the Slovinky deposit. Originally it was a plant that focused on complex siderite ores with a relatively high copper content of 4%. After the liquidation of the ironworks of Krompachy, it was decided that the iron component would not be recovered from the deposit. After stopping the iron ore processing, the possibilities of recognition the copper component at the market were sought. After the founding of the copper smelter in Krompachy, the mining operation

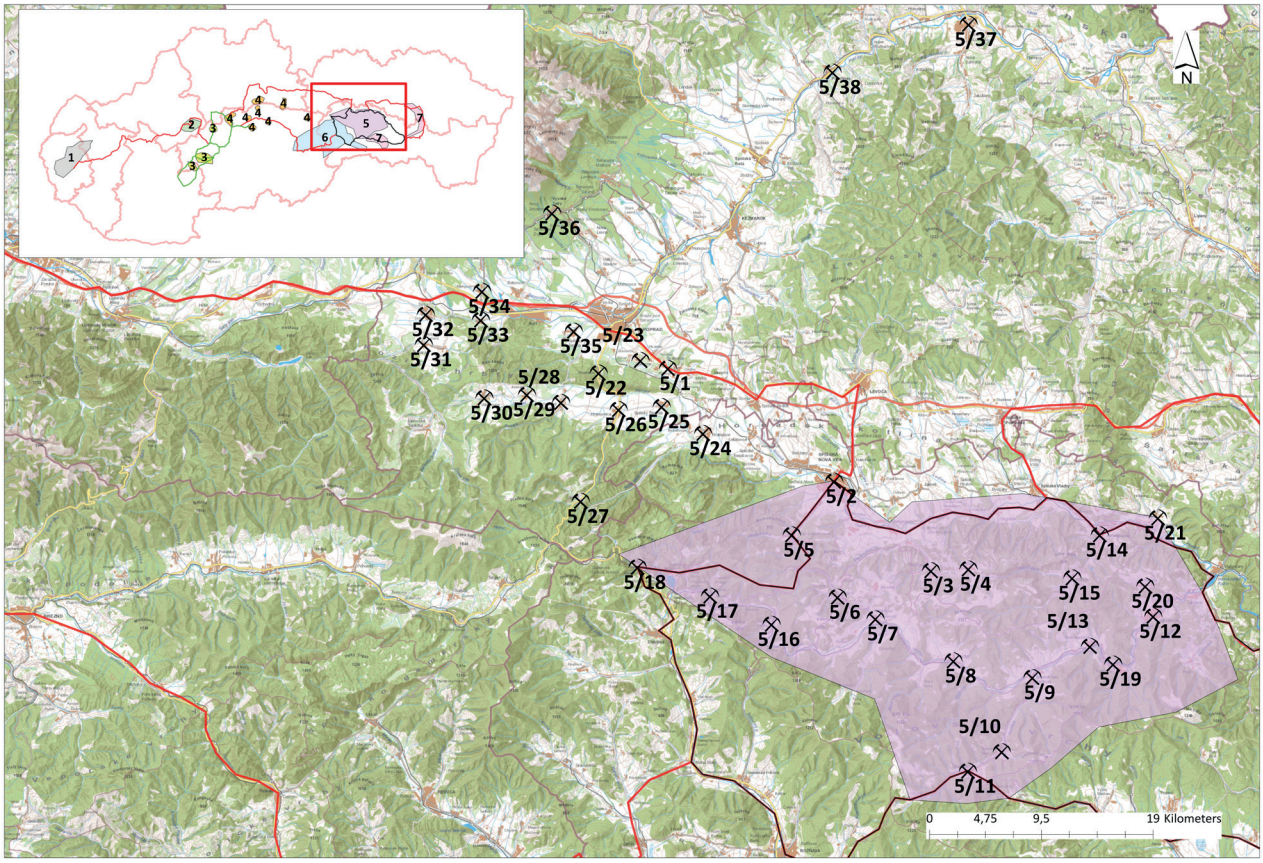

Fig. 3.18 SMR in the Spiš region. 5/1 Kišovce-Švábovce, 5/2 Spišská Nová Ves, 5/3 Rudňany, 5/4 Poráč, 5/5 Novoveská Huta, 5/6 Hnilčík (Roztoky, Bindt, Grétla), 5/7 Nálepkovo and Henclová (Stillbach), 5/8 Švedlár and Stará Voda, 5/9 Mníšek nad Hnilcom, 5/10 Smolnícka Huta, 5/11 Smolník, 5/12 Gelnica, 5/13 Helcmanovce, 5/14 Krompachy, 5/15 Slovinky, 5/16 Hnilec, 5/17 Mlynky, 5/18 Stratená, 5/19 Prakovce, 5/20 Žakarovce, 5/21 Kluknava – Štefanská Huta, 5/22 Poprad – Kvetnica, 5/23 Gánovce, 5/24 Hrabušice, 5/25 Spišský Štiavnik, 5/26 Hranovnica, 5/27 Vernár, 5/28 Spišské Bystré, 5/29 Kravany, 5/30 Vikartovce, 5/31 Šuňava, 5/32 Štrba, 5/33 Lučivná, 5/34 Mengusovce, 5/35 Spišská Teplica, 5/36 Vysoké Tatry, Tatranská Javorina, 5/37 Stará Lubovňa-Jakubany, 5/38 Podolínec, Vyšné Ružbachy

was restarted in 1938 and continued with the use of copper ores. In the period 1919-1944, 1,043 thous. t. of the copper ore was extracted, which represented 97.7% of the Slovak production. After the World War II, the Smolnik plant was exploiting the pyrite-copper ores, which were mined already in pre-war years. The pyrite ore was treated to a coarse-grained concentrate which was suitable for burning in furnaces for the production of sulphuric acid in all Slovak pulp –mills and paper-mills. The pyrite roaster-grains, which contained more than 50% of Fe, bought the Vitkovice Ironworks, which extracted from them the copper and silver. The mining of these ores was carried out until 1989. During the period under review, 4,980.7 thousand tons of the pyrite-copper ores was recovered on the deposit. The Slovinky plant in the post-war period appeared to be non-perspective and the management of the national enterprise decided not to invest in the renewal of this plant. Only in the year 1948 a report on the evaluation of the efficiency of mining and metallurgical processing of metals (Cu, Au and Ag) was developed. This report triggered a series of situations that led to the re-establishment of the plant and the launch of an extensive exploration programme. From 1950 to 1990, 8,437 ths. of the copper ores were extracted here (Kúšik, 2015).

As we have already indicated in the introduction, the iron ore mining has a very long history in the Spiš region. Since the end of the 13th Century, rich iron ores were predominantly obtained from the surface deposits of the gossan-type. But also by moving to the lower parts of the deposits due to the above-mentioned interconnectedness with the copper ore mining, the iron production was very important. At the end of the 17th Century a second blast furnace was built in this area, namely in 1710 in Hnilec. However, since the middle of the 19th Century, the iron ore mining and the iron production were vigorously developing as opposed to the development of the copper ore mining industry. This development stems from the industrial revolution and the need for iron as a raw material for commodity mass production. The mining, heat treatment and iron metallurgy were driven by large companies integrating all these industrial activities. For the Spiš region, the construction of the Košice – Bohumín railway line and the subsequent construction of numerous mining railways, enabling the rapid and relatively inexpensive transport of ore or agglomerate to the massive metallurgical factories in the Ostrava region, or in Silesia where there is enough energy raw material – coal, was crucial. The old deposits of Roztoky, Grétla, Bindt, Mlynky (Fig. 3.19), Poráč-Rudňany,

Fig. 3.19 Miners` houses – Mlynky-Rakovec

Žakarovce and others received investments in the opening and modernization (mechanization) of mines, treatment of ores and agglomeration furnaces (Jančura, internet). After the First World War, however, the situation changed diametrically, and iron ore mining was experiencing difficulties in finding markets for the outgoing ores, since the total demand for iron ores was significantly lower than in the pre-war years. The ore mining was limited in our territory. During this period, mining was carried out mainly on the deposit in Koterbachy (Rudňany), but also on the deposits Roztoky, Grétla, Bindt and Mlynky (Grecula et al., 2002). After the World War II all operations were gradually closed, the Rudňany deposit was the last mined, where during the boom and subsidies of the ore mining the investment was still made at the Markušovce plant. But subsequently, in the 1990s, as a result of social change, the decline of ore mining and the passage to market conditions, the iron ore mining in Spiš disappeared. Only the Poráč mine was in operation, with the baryte extraction.

Since the 14th Century, the deposit Gelnica-Zenderling benefited from mercury. In the 19th Century, the mercury ores were also mined at the complex ores deposit in Koterbachy (Rudnany), where the mercury was a by-product of the siderite mining. In the Gelnica-Zenderling deposit (Kúšik, 2015) the mercury mining also continued.

The mining of manganese ores started at the Kišovce deposit at the turn of the 19th – 20th centuries, first from the surface, for the needs of local ironworks. Later, in 1908, the Vítkovice ironworks began to with the underground mining. However, the development of mining occurred during the First World War (1916) as the import of manganese ores was interrupted. In the inter-war years, the manganese ores mining decreased again, the original level was reached only in the World War II; in 1943 it doubled. The majority of the production was provided by the Kišovce Švábovce deposit, during the World War II there were also mined the deposits in Michalová and Čučma. After the World War II, the plant in Švábovce covered two deposits of the manganese ores in Švábovce and Kišovce. The end of the mining on these deposits was mainly affected by the cheap ores supplied by the world's largest producer of manganese ores, the USSR. Over the monitored period, a total of 3,430 ths. of the manganese ores were extracted (Kúšik, 2015).

3.4.6 Gemer region

Iron ore mining has a very long history in this area (the most important sites are depicted in Fig. 3.20). The finding of a Roman kiln in 1896 (Rákošská Baňa), as well as the finds of iron slag in the earth kilns, called the wolf holes, shift the boundary of the use and compaction of the iron in this area into the time of La Tène Period (Frák, 1987). The iron ore mining began to appear in the written reports from the 13th Century. However, the great development of the ferrous mining occurred only in the 14th Century. This was also related to the development of precious metals and copper mining and metallurgy as they needed iron to produce working tools, stamp mills and various pumping and transport equipment. The iron ores were located on the territory of present-day Slovakia in large quantities and in numerous places, but the deposits of the Gemer region were particularly profitable. In the first half of the 14th Century, there was a major change in the iron production. A water wheel for furnaces and hammer forge was introduced. Extensive mining of the iron ores was in the middle of the 15th Century at the Železný vrch deposit near Dobšiná. An important iron area was also formed around iron-bearing deposits Železník, Rákoš and Hrádok (Kúšik, 2015). An important factor in the development of the iron ore extraction was the fact that the iron produced did not come under the royal tax "urbura", that is, transferred to the present times, the iron ores were not reserved minerals. The iron ore mining was at a loss at the end of the 18th Century. The mining administration attempted to push for change so that the iron became a reserved mineral, and the state could collect the taxes. However, this change was achieved definitively at the beginning of the 19th Century. During that period the state attempted to promote the iron ore mining, owned the ironworks in Tisovec and partially in Sirk (Železník). But the decisive position in the mining industry was still in private hands. The most important miners of that time include the noble families of the Andrassy and the Coburgs. The largest concentration of iron-and-furnace and hammer forges was in the Gemer region near the rich deposits. At the Gemer region, at the end of the 18th Century, about 70% of the then Slovak territory iron production was produced (Kúšik, 2015). Significant deposits of the iron ores were at this time at the Gemer region in Železník, Rákoš and Dobšiná. The large deficiency of the iron ore production was the fact that it focused only on the production of pig iron (lack of secondary manufacturing). Most of the production was exported to the western countries

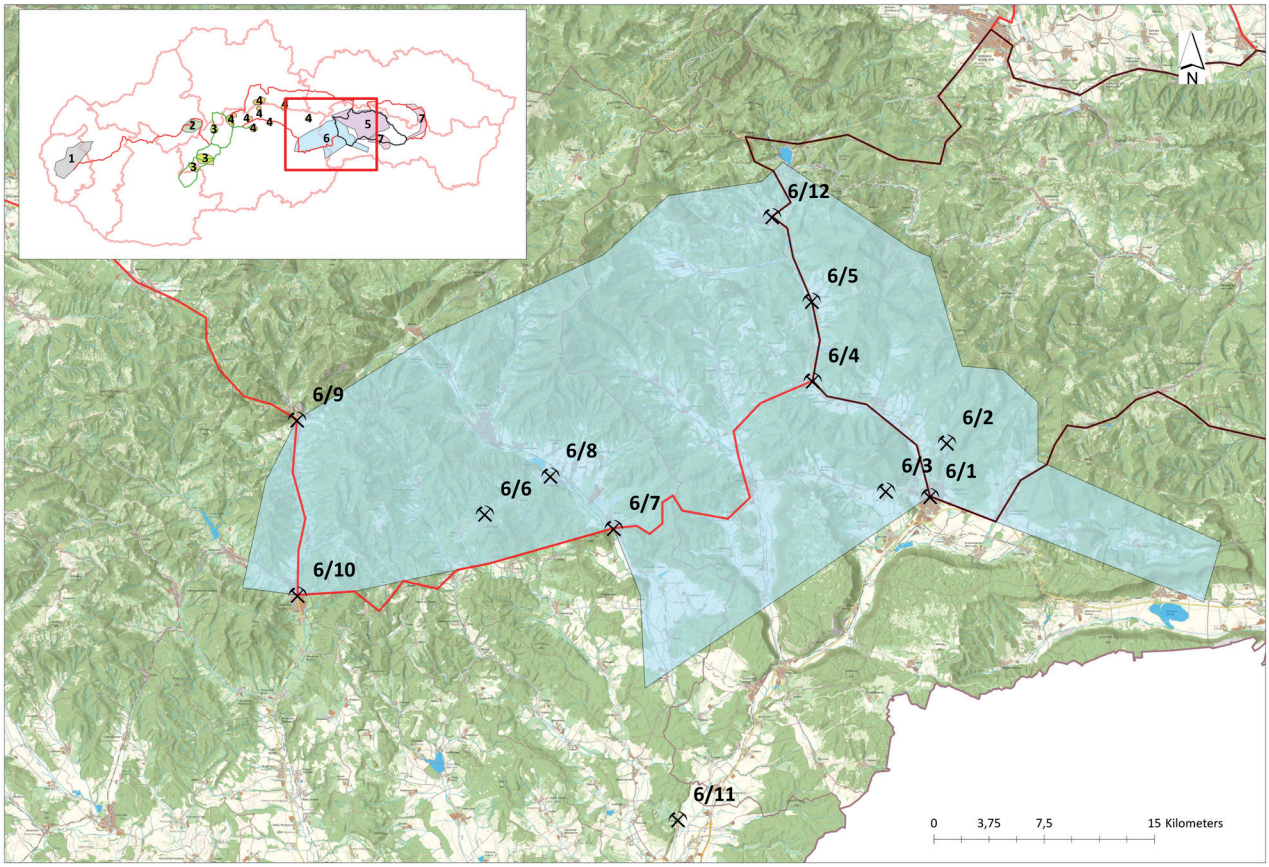

Fig. 3.20 SMR in the Gemer region. 6/1 Rožňava, 6/2 Čučma, 6/3 Rudná, 6/4 Nižná Slaná, 6/5 Vlachovo, 6/6 Železník, 6/7 Jelšava, 6/8 Lubeník, 6/9 Tisovec, 6/10 Hnúšťa, 6/11 Gemer

of the monarchy, from where various iron products (from Austria and the Czech Republic) were imported. At the beginning of the 20th Century, the extraction of the iron ores took place mainly on the deposits of Dobšiná, Nižná Slaná-Vlachovo (Fig. 3.20), Železník, Rákoš, Sirk, Rožňava, Nadabula. After the Second World War and the change of the social establishment, the newly-founded enterprise Železorudné bane, (n.p.) Spišská Nová Ves covered the extraction of siderite ores and mercury in Rudňany. The total amount of the siderite ore extracted during the reference period, which includes the years 1945 – 1990, was 30,615 ths. t. The Dobšiná plant, despite the rich tradition and the extensive ore field, had the problem to provide for a larger number of quality ores, so the plant was cancelled in 1958 and the mining stopped in 1969. During the period under review, 1,363 thousand tonnes of the iron ore were extracted. Before the nationalization the Železník plant consisted of two or up to four mining enterprises. The nationalization of the industry enabled to bring together all parts of the deposit. In 1946, the Rákošská Baňa plant was also added to the ironworks. In 1957, exploration work was carried out to clarify the geological structure of the Železník Hill with the deposits of Železník in the north and Rákoš in the south. The extensive exploratory work, however, did not show sufficient reserves of the ores to ensure the prosperity of the plant. This was the end of the iron ore mining in the year 1965. At the Železník deposit in the monitored period 3,450 ths. t. of the iron ore were extracted. Between 1975 and 1987, the Rákoš deposit was still mined because of the mercury ore, but the operation was unprofitable. The Rožňava plant, which also included the sections Drnava, Malý Vrch, Dolný and Horný Hrádok, and the aforementioned plants after the cancellation were one of the largest iron-ore plants in Slovakia. On all known deposits, an intensive geological survey was carried out in post-war times, which secured the reserves of ferrous mineral ores in Rožňavské Bystré, Rudník, in the central part of the ore field on the deposits of Bernardy, Sadlovský, Štefan and Mária mine. The Maria Vein was explored on the Maria mine, where in 1981 a vein structure called Strieborná (Silver) was discovered, which earned her name for a high silver content in tetrahedrite (150 – 400 g/t). This was examined in detail from 1985 to 1991 and the great promise of this ore-mineralization has been confirmed. The iron ore mining was terminated in the whole ore district in 1993. In total, during the period under review, 9,988.34 ths. t. of the siderite ores and 2,422.7 ths. of the siderite-tetrahedrite ores were extracted, i.e. a sum of 12,411 thousand tons. The plant in Nižná Slaná thanks to an intensive geological exploration on the Manó deposit, which resulted in the reserves calculation in the year 1966, which confirmed at the extraction of 700,000 thous. t. annually a lifetime of 45 – 50 years. The further geological survey verified the depth of the deposit as well as the promising eastern part of Kobeliarovo. The positive results of the survey included the Nižná Slaná district as the most important iron ore region of the Spiš-Gemer ore district. During the monitored period, 16,471.8 thousand tonnes of

Fig. 3.21 Blast furnace Etelka near Nižná Slaná plant

the iron ores were extracted in this area. The operation was stopped in 2008 (Kúšik, 2015).

Since the 14th Century, at the deposit in Dobšiná cinnabar was extracted, from which mercury was obtained. In the 18th Century, the mercury was acquired on a smaller scale at a deposit in Nižná Slaná (Kúšik, 2015).

The antimony ores and gold were mined near Čučma since the end of the 17th Century. However, the main development of mining occurred only at the end of the 18th and early 19th centuries. The mining was terminated in 1952 (Rozložník et al., 2013).

Cobalt-nickel ores were mined in Dobšiná since 1780. Initially, there was a problem with the application of ores (used only for dyeing). At the beginning of the 19th Century, the ores began to be exported to England, Germany and Belgium. The mining of cobalt–nickel ores from the Dobšiná deposit represented up to 75% of mining throughout the Austro-Hungarian monarchy. After 1875, the mining began to cease and later ended (Kúšik, 2015).

The beginnings of magnesite mining in our territory are linked to the end of the 19th Century. The stimulus was the necessity to obtain refractories for blast furnaces. The magnesite as an unfamiliar stone was encountered by the workers who built the railway line Jesenské-Tisovec in 1871 between the towns of Hnúšťa and Hačava. Then there was a targeted search for this mineral, which resulted in the discovery of the magnesite deposits near Ratková, Jelšava, Lubeník, Ochtiná, Bankov near Košice, Ružiná and Cinobaňa. In 1900, the plants of the company Magnesit Industrie Aktien-Gessellschaft (MIAG) were built in Hačava and Jelšava The so-called Horný Hačavský (Upper Hačava) plant used magnesite extracted on deposits in Ratkovská Suchá and Burda. The raw material was first transported by horse-drawn vehicles, later a cableway from Burda to Hačava was built. In 1909, the Danish firm Schmidt from Copenhagen installed the rotary kiln for magnesite clinkering, which was the first of its kind in the world. At the Jelšava plant, which was supplied from the Dúbrava deposit, the magnesite was just burned and assorted and thus dispatched to the Kobányi (Budapest) brick works. Later, other companies started to extract and process magnesite, and the plants were founded in Hačava Dolný závod (Lower plant), Chyžná Voda-Lubeník and Bankov near Košice. The magnesite mining was negatively influenced by the nostrification law after the creation of the Czechoslovak Republic, as all magnesite plants were in private hands. At the same time, the destruction of the Slovak ironworks industry after the First World War had an impact on the development of the magnesite industry. Sales to this market represented only 2 – 3% of total sales. The Czech companies were mostly supplied with refractories from Austria. Only 7 – 8% of total sales were sold to this market by the Slovak magnesite works. The Austrian magnesite industry also gained a dominant position on a worldwide basis thanks to the Cartel Agreement of the main suppliers of refractories, which established disadvantageous quotas for producers in the Czechoslovak Republic. For export to overseas, our manufacturers also competed with the magnesite products from Greece and Yugoslavia, thanks to cheap shipping. The deposits in Hnúšťa-Ružiná, Košice-Bankov, Lubeník, Studená, Hačava, Hnúšťa-Horná Magnezitka (Upper Magnesite Plant), Ratkovská Suchá, Burda, Ploské, Sirk, Jelšava and Ochtiná were mined in this period. The production was exported to entire Europe. Of the total there were sold 8.5% of unprocessed magnesite, 76% of clinker and only 15.5% of final magnesite product. This also reduced the prosperity of using such a rare raw material (Kúšik, 2015). During the World War II, approximately 2.6 mil. t of crude magnesite were extracted. The Slovenské magnezitové závody, n.p., Košice (Slovak Magnesite Plants) have begun renewing the mining of destroyed factories after the retreating German troops destroyed mainly surface objects of plants (generators, magnesite burning furnaces, electric power sources and others). In the war years, a geological service (search and exploration) was neglected, data on possible magnesite reserves was missing, since the magnesite did not belong among the reserved minerals. By the Regulation SNR No. 46/1947 the magnesite was declared a reserved mineral. Between 1953 and 1965, a geological survey was carried out on all magnesite deposits. The mostly rich deposits were Jelšava-Dúbrava, Burda-Poproč, Košice-Bankov, Podrečany and Lubeník-Studená. The International Magnesite Cartel ceased to function in the war years, and after the war it was legally dissolved in 1947. This has conditioned the development of the magnesite industry in Slovakia. In 1963, the government of Czechoslovakia decided on the development of the magnesite industry in Slovakia, when it was decided that the Jelšava plant would produce clinkers and the Lubeník plant would produce the building materials. Unfortunately, the trends that have been taken to improve the quality and economy of mining

and production have not been maintained, which has had a negative impact on the development of the magnesite industry since 1990. In the period under review, since 1959, surface mining has been transferred to underground mining of the magnesite. The Slovak magnesites are of lesser quality, they are demanding for treatment and subsequent processing after firing. Because of this, the Slovak magnesite industry was hardly resistant to natural-quality Chinese and North Korean magnesite. During this period, the production took place at the plants in Hačava, Jelšava, Košice, Lovinobaňa and Lubeník (Kúšik, 2015). During the monitored period 86.6 mil. t. of the magnesite were extracted.

already lost. The main metal was silver, the production of gold and antimony was always relatively small, other metals (Pb, Zn) were not extracted. Overall, about 126,000 kg of Ag, 78 kg of Au and 3,300 t of Sb were mined out on the deposit (Koděra et al., 1986 – 1990). The mining terminated in 1924, during the Second World War, temporary work was restored in the period 1940 – 1944. At the end of the 1970s, reserves and possibilities for further exploration were verified. Two types of veins were distinguished (Rozlozsnik in Koděra et al., 1990), in the new ones three types of veins (Varček and Kodera et al., 1990): from the oldest to the youngest – l. quartz-siderite with a sulphide association poorer in jamesonite and rich in Cu-minerals

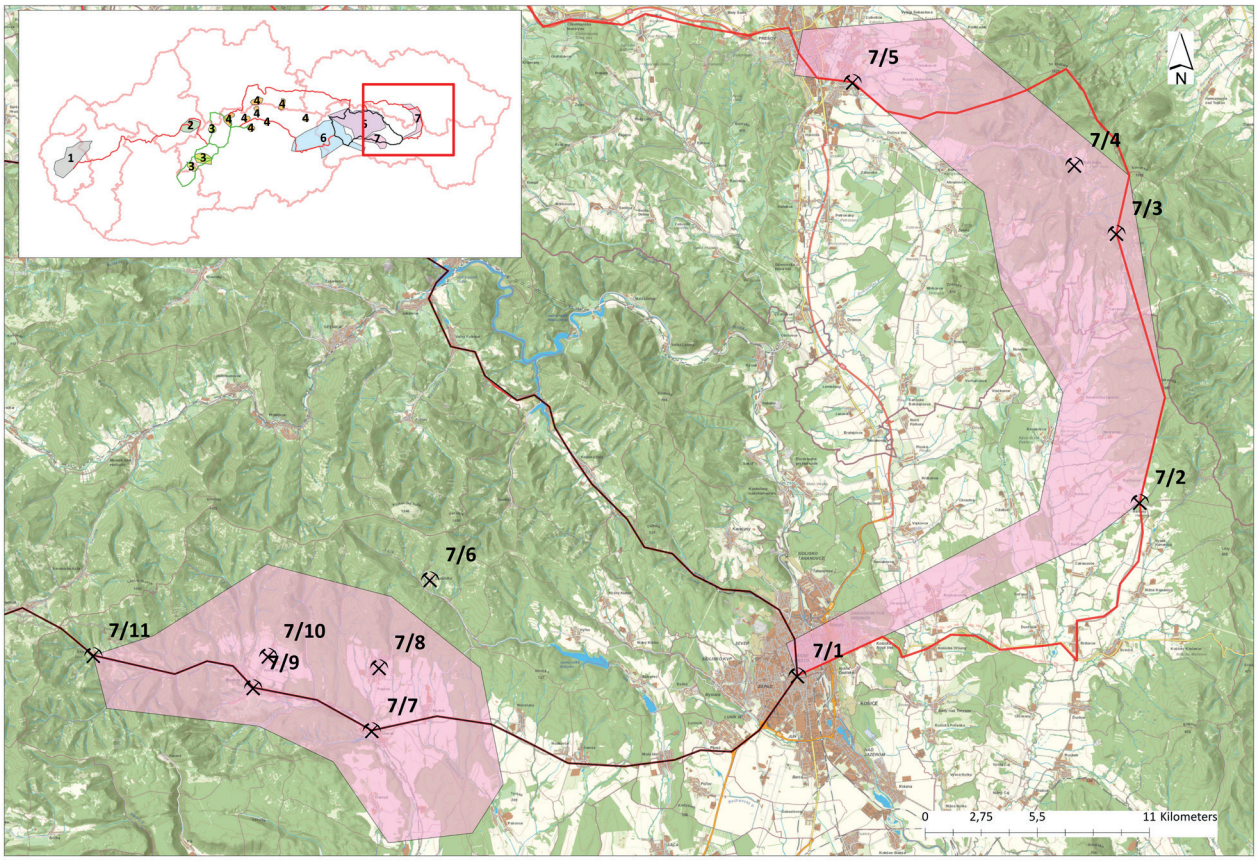

Fig. 3.22 SMR – Mining in Košice, Prešov and Slanské vrchy Mts. 7/1 Košice, 7/2 Herľany, 7/3 Opálové bane, 7/4 Zlatá Baňa, 7/5 Prešov-Solivar, 7/6 Zlatá Idka, 7/7 Jasov, 7/8 Poproč, 7/9 Medzev-Luciabaňa, 7/10 Vyšný Medzev, 7/11 Štós

3.4.7 Mining in Košice, Prešov and Slanské vrchy Mts.

The first written document of precious metal mining is from this area (the most important sites are depicted in Fig. 3.22) from the second half of the 13th Century, where Zlatá Idka and Jasov are mentioned in the list of King Béla IV of Hungary. In the area of Zlatá Idka, Jasov and Poproč, the gold was originally obtained from the Ida Brook, later from the upper, near-subsurface parts of the veins. At the time of Matthias Corvinus (15th Century) gold coins were minted in Košice from the Zlatá Idka gold. The privilege of mining was granted to the village of Zlatá Idka in the year 1439. The biggest flowering of the mining was in the decade. 1863 – 1873, when the average annual production of Ag was 2,800 kg. Since 1895 the mining industry was

(veins Anton, Jozef), 2. quartz-sulphidic with abundant jamesonite and inferior representation of siderite, antimony and gold (most of the main veins), 3. quartz-sulphide with abundant stibnite and increased content of Au (veins František, Štefan, Jeremiáš and other small veins).

The first documented data on the acquisition of precious and non-ferrous metals in the vicinity of the Zlatá Baňa came from the 14th and 15th centuries. The mining of Pb-Zn-ores and gold developed in the 17th and 18th centuries, during the first half of the 19th Century almost all the deposits were abandoned. However, more accurately documented gold mining was carried out only from the end of the first half of the 18th Century until the beginning of the 19th Century, but it was totally unsuccessful. The interest in polymetallic ores was restored only in the

second half of the 20th Century. The technical work carried out since 1975 has confirmed an in-depth continuation of the vein-stockwork structures, whose surface parts were of interest in the past, and consequently industrial deposit accumulations of polymetallic ores (Koděra et al., 1986-1990) were discovered at the Zlatá Baňa deposit.

Iron ore mining was also significant in this area, especially in the surroundings of Medzev, Štós and Poproč. This is the Štós – Luciabaňa vein zone, of the E-W direction, with a total length of 18 km, attributed to the siderite formation of the south siderite stripe of the Spišsko-gemerské rudohorie Mts. This vein band binds to the tectonic failure line in the rocks of the Gelnica group, is of a linear character, and the ore veins are concentrated at the crossing points of longitudinal tectonic structures with transverse and diagonal structures. The transverse tectonics of the normal fault character is intensely manifested only in the eastern part on the deposits of Fortúna and Rúfus in the village of Poproč. The mineralization is not uniformly distributed over the entire length of the vein zone; it has the character of lenses and ore columns (Koděra et al., 1986 – 1990). The Rima plant in Luciabaňa produced during the inter-war period 1,227.1 kt of iron ores (Grecula et al., 2002). After the World War II, the Luciabaňa plant, as a stand-alone plant, ceased mining in 1962 and the production was stopped in 1969. During the period under review, 1,964 kt of iron ore was extracted (Kúšik, 2015).

Written reports document the salt springs at Prešov since the 13th Century. In 1348 three salt springs were mentioned. The brine from the salt springs was extracted by the Šóš family, which owned the land on which the salt springs surged. Since 1572, the salt mining was running underground, as the state administration took over the exploitation from the Šóš family, which did not want to give up. However, the dispute over saline springs lasted until 1592 and ended with the victory of the state. Later (in 1586), the state administration leased the plant until it was completely destroyed during the Bockai's uprising. In the year 1616 the plant was leased to the city of Prešov. By the end of the 17th Century, the deposit had been opened by 3 shafts and several galleries. The production of rock salt was steadily increasing. Only at the end of the rebellion of Franz II. Rákoczi the plant started to decline. In the middle of the 18th Century, the salt was still obtained in both ways, from the brine and by the extraction of halite. However, in 1752 the Solivar mines (Fig. 3.23) were flooded with the salt water, and the extraction of the halite was over. The brine was continuously pumped through the Leopold Shaft using the winder. At the end of the 18th Century, two salt cooking facilities with evaporating tanks were built. Production increased and profits were high. E.g., in 1790 the production of the Vienna cent of salt was worth 17 kreutzers and 2 denarii, the selling price was 1 gold and 40 kreutzers. About 80% of the production was sold on the domestic market, the remainder being exported. But the mining failed to cover the demands of the market, which had to import salt from Poland and Transylvania. The salt mining continued in the Solivar plant, which was named in 1925 Solivar President Masaryk after the establishment of Czechoslovakia. The plant was completely rebuilt and the salt cooked on the principle of vacuum cooking. Since the flooding of the mine in 1752 the salt was extracted in the form of a brine and there was no direct contact with the deposit, a survey was conducted to clarify the structure of the deposit. However, the 4 exploration wells carried out in 1922 did not sufficiently elucidate the deposit geometry. After the World War II, the Prešov plant was still in operation, in which the brine was obtained in two ways. The first was a classic old way from the brines drawn by the Leopold Shaft and evaporation in the tanks. This method was operational until 1970, when the shaft object as well as the cooking facilities were handed over to the Technical Museum. The second method was the use leaching by drilling an extensive exploration network, which continued with the 1939 survey. From the total of 15 boreholes, 11 boreholes were used for leaching. From 1947 to 1990, the total of 1,870 thousand tons of salt were extracted on the deposit. The salt mining was completed in 2009 by the company Solivary a.s. Prešov after many centuries of tradition of the salt mining in the region. Another deposit that was discovered during the oil exploration in 1959 was Zbudza with supplies of 1.5 billion tons of salt. A deep 192.6 m shaft and 2 km of mining corridors were excavated on the deposit. However, the production in Chemko Strážske plant was not carried out, and so in 1970 the mines Zbudza were liquidated (Kúšik, 2015).

Fig. 3.23 Leopold Shaft – house of winder for the removal of mine water, Slovak technical museum Košice – exposition Solivar Prešov

Fig. 3.24 *Dubník – opal mines, exposition in Jozef Adit*

The first mention on possible extraction of expensive opal at Dubník (Fig. 3.24) was made in 1603 in the licensing letter for Štefan Kecer granted by the Emperor Rudolf II (Semrád, Kováč, 2003). We can confirm the mining of the only Slovakian gemstone – noble opal from Dubník, from the second half of the 18th Century (under the reign of the Empress Maria Theresa). In the years 1750 – 60, Count Vecsey and his secretary Szukovicz made exploration pits here. In the year 1787 the state administration showed an interest in the opal mines, but already at the beginning of the 19th Century it put the mines for rent. Gradually, several tenants were replaced during the 19th Century, the members of the Goldschmied family of Viennese entrepreneurs were dominantly active in the opal mines. The most famous expensive opal found at Dubník was the so-called Harlequin, or Vienna Imperial Opal, which was found in 1775 and weighs 2,970 carats or 594 grams, and is currently exhibited at NHM in Vienna. In the beginning of the monitored period, the Dubník deposit of precious opals was allocated to Soľná Baňa. However, the directorate of Soľná Baňa did not manage the Dubník deposit issue and it was the beginning of the end of the opal mines. Then Czechoslovakia rented the opal mine for 10 years to the Bittner-Belangenay company in France in 1922. However, the company was unable to continue opal mining and thus ended its activity in the same year (Kúšik, 2015).

3.6 Promotion of the SMR project

Another work of the Association members in cooperation with the Slovak Mining Chamber, local authorities, the Ministry of Economy of the Slovak Republic and the Ministry of Culture of the Slovak Republic is the inventory, documentation and publication of printed colour publications on mining sites and the description of milestones and the development periods of mining and metallurgy in the regions.

To describe the phenomena of montane heritage at selected sites, the Association has developed the following manual and procedure:

Cultural, natural and industrial heritage – mining science:

1. Geology and mineralogy;
2. Outcrops of veins, oldest stopes and mines on the surface, exploration pits;
3. Mining and metallurgical units (mining plants, smelters, foundries, etc.);
4. Mining-technical works (shafts, hoisting towers, hereditary adits, “muntlochs” = entrances into galleries, ...);
5. Other related operations (plant administrations, test rooms, laboratories, workshops, transformer stations, power stations, heating plants, all buildings and facilities located in the yard, or near the mining facilities courtyards);
6. Mining railways, trails, cableways, waterworks (ponds, ditches);
7. Architecture of the region – the mining ones in particular (knocking towers), mining settlements – mining houses, colonies, urban (waldbürger houses, mining authorities and directorates, mining schools buildings), defensive – fortifications – parts of castles and chateaux related to the mining production, distribution and storage of raw materials, churches and other buildings with mining exhibitions;
8. Other attractions (geology, caves, other technical monuments of the region);
9. Additional information related to the mining and its history.

Typical mining elements in the architecture of the mining regions are completing the character of the landscape modified by mining, and in exceptionally rare preserved localities, the undistorted scope and harmony of the historical industrial architecture with the other elements of the natural and cultural heritage of the landscape.

At present, the resources for reimbursement the costs of realization of the goals and objectives of the project “Slovenská banská cesta” (Slovak Mining Road) are supported in the regions above all by active mining and geological exploration and other organizations, subsidies of mining towns and municipalities, by the involvement in other Higher Territorial Units in the calls and projects, own funds at the level of individual associations, guilds, and fraternities. Centrally, sponsored projects are sponsored by the Association, which are largely reimbursed within the meaning of the Law 71/2013 Coll. in the calls of the Ministry of Economy of the Slovak Republic.

The Association of Mining Clubs and Guilds of Slovakia, in the context of the presentation of the mountainous heritage of the Central European region, cooperates with the relevant national brethren organizations in the Czech

Republic, Hungary, Poland, Austria and Slovenia in order to create a joint project for preservation and presentation of the montane heritage.

3.7 Conclusions

The idea of the implementation of the project "Slovak Mining Road" was initiated by the mining regions and mining and metallurgical associations, which resumed their activity in the process of the decline of ore mining after the year 1991. In 2005, the seven active mining associations and guilds have joined together to preserve tangible and intangible mountainous heritage and created the umbrella organization – the Association. By 2017, the Association has grown to 36 members representing practically all historical and active mining regions and significant sites of mining and processing of raw materials. Several mining and metallurgical associations, guilds and mining fraternities have built their own museums, exhibitions, instructional walkways, memorial rooms, mining houses, etc. during their modern 10 to 25 year existence. The design of the SMR project has already created 7 centres at the beginning. These centres represent geographically divided mining regions. The Association in cooperation with the company Rudné bane, š.p. promotes the SMR sites through a website, information boards and a printed guide to mining-technical monuments and mining museums in Slovakia is being prepared. The individual centres and locations presented on the SMR map as the main sites are in the plan for installing the SMR info-panels. In addition to the basic info-panels the boards are also located on important mining-technical monuments in the regions. Currently, 96 locations are selected in the list by 2017. The first SMR table was officially unveiled and consecrated in the former royal town of Smolník on May 1, 2009. The presentation of the mining industry and the mining and metallurgical heritage in the SMR information means do not serve only active mining operations and mining-technical historical works, but also the material monuments related to the mining activities in the regions and built in elements of architecture (e.g. mining knocking towers, mining houses, church buildings with mining motifs elements, mining colonies, etc.) and all kinds of mining expositions and educational walkways. We believe that the SMR project will help us to better promote a significant part of our montane history, mining-technical historical works, traditions and unique architecture, thus contributing to the expansion and improvement of tourism in the regions concerned.

MAY LORD GIVE US SUCCESS!

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