

3. Review of Reserved Deposits of Metals in Slovakia

PETER BALÁŽ¹

¹State Geological Institute of Dionýz Štúr, Regional Centre, Markušovská cesta 1, 052 01 Spišská Nová Ves
dusan.kusik@geology.sk

Abstract: Distribution of metal deposits and occurrences, related to various geological composition of Slovakia, is very uneven and depends on particular metallogenic conditions. Metal resources relate to particular tectonic and lithostratigraphic units, rock types and stratigraphic stages. At present (2013), 48 reserved deposits with reported metal content (antimony, copper, gold, iron ore, lead-zinc, mercury molybdenum, silver and tungsten) are registered in the territory of Slovakia. Geological reserves reached 335 Mt of ore. Other metal occurrences (manganese, nickel, tin, REE) represent uneconomic accumulations. Exploitation of metal reserves, extensively mined in the past, is limited due to exhaustion of resources, low ore grade and present economic and legal conditions.

Key words: Slovakia, metals, reserved deposit, reserves, mining

3.1. Introduction

Occurrences of mineral deposits are dependent on varied geological composition of Slovak territory. Distribution of mineral deposits is very uneven and depends on geological and metallogenic conditions. Every geological unit has its own characteristic complex of mineral resources, conditional to geological evolution of region.

Metal mining in Slovakia territory has a long history. In the past, mineral wealth provided sources for the development and growth of economy. Copper, mercury, gold and silver were mined extensively during the Middle Age.

Famous mining cities have grown up along with advances in mining techniques as mining get deeper underground. Exhaustion of precious metal deposits and decrease of metal prices by the end of 18th century have caused gradual decline of mining activities. The industrial revolution in the 19th and 20th century with its growing demand for raw materials and energy stimulated extensive exploitation of iron, manganese, base metals, coal and varied industrial minerals. After the World War I rising metal demand led to exploitation of deposits in the Slovak territory. Significant increase of mining activities has been brought after the World War II along with intense exploration, as political changes in 1948 resulted in isolation of country from western-world mineral markets. Transition to the market economy in the nineties of the 20th century with a cut of government subsidies resulted in closing of most of metal mines in Slovakia (Grecula et al., 1997).

3.2 Brief characteristics of reserved deposits

At present, reserved deposits with metal content of antimony, copper, gold, iron ore, lead – zinc, mercury, molybdenum, silver, and tungsten (Fig. 3.1) are registered in the territory of Slovakia. Other metal occurrences (manganese, nickel, tin, REE), representing uneconomic accumulations, are not subject of the paper.

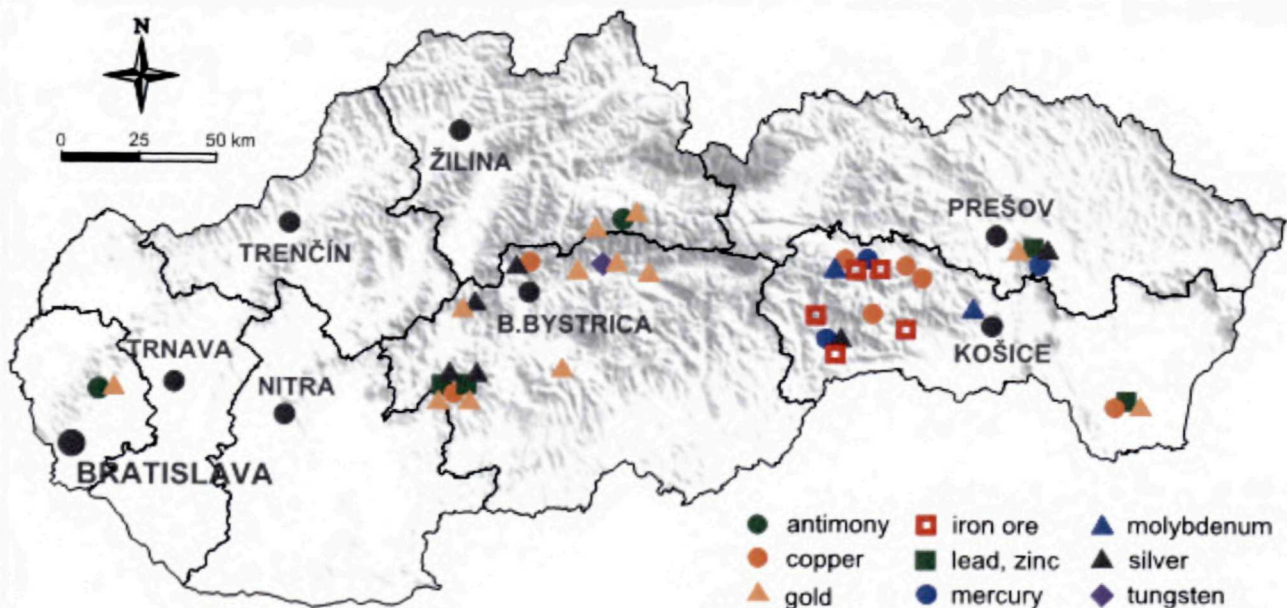


Fig. 3.1 Distribution of reserved deposits of metals (2013). Source: Slovak Minerals Yearbook 2014.

Processes of genesis relate individual mineral deposit types to various tectonic and lithostratigraphic units, rock types and stratigraphic stages. Quaternary formations are hosts for gold accumulations. Numerous metal deposits (antimony, copper, gold, iron ore, lead, silver, mercury, zinc) are hosted by Neogene volcanic formations. Palaeogene and Mesozoic sedimentary rocks host occurrences of gold and molybdenum. Palaeozoic sedimentary and volcanic rock complexes are the source formations of antimony, copper, gold, iron ores, lead, mercury, molybdenum, silver, tungsten and zinc (Fig. 3.2).

Essential classification of deposits reflects their metallogenic association to particular evolutionary stages of the Western Carpathian territory.

Pre-Hercynian and Paleohercynian stage (>380 Ma): reserved deposit of copper (Smolník) is hosted in metamorphosed volcano-sedimentary formations of Gemericum unit.

Neohercynian late-to post-orogenic stage (340–250 Ma): reserved deposits of antimony, gold and tungsten (Pezinok, Dúbrava, Dolná Lehota, Jasenie) are hosted by crystalline basement of the Tatricum and Veporicum units, re-

ERATHEM	SYSTEM	SERIES	Fe	Pb-Zn	Cu	Sb	W	Mo	Hg	Ag	Au
CAINOZOIC	QUATERNARY	HOLOCENE									
		PLEISTOCENE									
	TERTIARY	1,8 PLIOCENE									
		MIOCENE									
		24 OLIGOCENE									
		EOCENE									
		PALEOCENE									
	PALEOGENE	65 UPPER									
		MIDDLE									
		LOWER									
		142 MALM									
		DOGGER									
		206 LIAS									
MESOZOIC	CRETACEOUS	UPPER									
		MIDDLE									
		LOWER									
	JURASSIC	142 MALM									
		DOGGER									
		LIAS									
		206 LIAS									
	TRIASSIC	UPPER									
		MIDDLE									
		LOWER									
PALAEOZOIC	PERMIAN	248 UPPER									
		LOWER									
	CARBONIFEROUS	290 UPPER									
		LOWER									
	DEVONIAN	354 UPPER									
		MIDDLE									
		LOWER									
	SILURIAN	417 UPPER									
		LOWER									
	ORDOVICIAN	443 UPPER									
		MIDDLE									
		LOWER									
	CAMBRIAN	495 UPPER									
		MIDDLE									
		LOWER									
		545									

Fig. 3.2 Stratigraphic position of reserved deposits and occurrences (geological age data in million years). Source: Mineral resources of Slovakia (Zuberec et al., 2005), modified.

Tab. 3.1 Reserved deposits of antimony – estimation of Sb metal content in geological reserves

Reserved deposit	Mineralization	Grade [% Sb]	Metal content [tonne]
Dúbrava	Sb-Au, hydrothermal vein and shear-zone	1.9	3,250
Dúbrava – Ľubelská	Sb-Au, hydrothermal vein and shear-zone	1.6	10,140
Dúbrava – Martin štôľňa	Sb-Au, hydrothermal vein and shear-zone	1.7	12,230
Dúbrava – Matošovec	Sb-Au, hydrothermal vein and shear-zone	1.8	9,420
Dúbrava – Predpekelná	Sb-Au, hydrothermal vein and shear-zone	2.3	7,300
Pezinok	Sb-Au, hydrothermal vein and shear-zone	2.9	2,430
Pezinok – Sb	Sb-Au, hydrothermal vein and shear-zone	3.2	480
Pezinok – Vinohrady	Sb-Au, hydrothermal vein and shear-zone	0.4	2,870
Pezinok Sb	Sb-Au, hydrothermal vein and shear-zone	2.2	4,130

served deposits with molybdenum mineralization (Košice, Novoveská Huta) occur in Late Paleozoic formations.

Paleo-Alpine orogenic stage (110-90 Ma): reserved deposits of copper and iron ore (Gelnica, Slovinky, Rudňany, Poráč, Rožňava, Nižná Slaná, Medzev) occur in metasedimentary and metavolcanic rocks of Gemericum unit.

Paleo-Alpine late-orogenic stage (90-70 Ma): reserved deposits of copper and silver mineralization (Špania Dolina, Novoveská Huta) are hosted by Permian formations of the Veporicum and Gemericum units. Mercury mineralization of Rudňany deposit occurs in metasedimentary and metavolcanic rocks of Gemericum unit.

Neo-Alpine orogenic stage (24-10 Ma): reserved deposits with mineralization of copper, gold, silver, base metals and mercury (Banská Hodruša, Banská Štiavnica,

Brehov, Vysoká, Detva, Klokoč, Kremnica, Zlatá Baňa) are hosted by Neogene volcanites (Lexa et al., 2007).

Antimony

Nine antimony reserved deposits (Tab. 3.1) concentrated in two deposit areas (Pezinok and Dúbrava) were registered in 2013 (Slovak Minerals Yearbook 2014).

The Pezinok deposit in the Malé Karpaty Mts. is represented by quartz veins and silicified zones. Mineralization (arsenopyrite, stibnite and red antimony) is hosted by complex of Early Paleozoic graphite schists.

Sb-Au mineralization of Dúbrava deposit in the Nízke Tatry Mts. occurs in Hercynian granites and crystalline schists. Mineralization is represented by quartz veins and stockworks with stibnite, pyrite, arsenopyrite, sphalerite, tetrahedrite and rare native gold (Zuberec et al., 2005).

Tab. 3.2 Reserved deposits with copper content – estimation of Cu metal content in geological reserves

Reserved deposit	Mineralization	Grade [% Cu]	Metal content [tonne]
Banská Hodruša	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	0.5	27,810
Banská Štiavnica – Pb, Zn, Cu, Au, Ag	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	0.3	18,490
Brehov I	Cu-Pb-Zn-Au, intrusion related stockwork/ disseminated	1.0	4,560
Gelnica – Gelnická žila	Cu-Fe, metamorphic-hydrothermal vein	0.8	4,330
Gelnica – Krížová žila	Cu-Fe, metamorphic-hydrothermal vein	1.3	10,830
Gelnica – Nadložná žila	Cu-Fe, metamorphic-hydrothermal vein	0.9	6,860
Gelnica – Nová žila	Cu-Fe, metamorphic-hydrothermal vein	1.0	7,060
Medzev	Cu-Fe, metamorphic-hydrothermal vein	0.4	17,120
Rožňava – Mária žila	Cu-Fe, metamorphic-hydrothermal vein	0.6	14,600
Rožňava – Strieborná žila	Cu-Fe-Ag, metamorphic-hydrothermal vein	1.0	40,740
Rudňany – Matej a Jakub žily	Cu-Fe, metamorphic-hydrothermal vein	0.4	89,350
Slovinky	Cu-Fe, metamorphic-hydrothermal vein	0.7	79,630
Smolník	Cu-S, syngenetic volcanic massive sulphide	0.5	22,040
Spišská Nová Ves – Novoveská Huta	Cu, hydrothermal vein and stockwork/disseminated	1.2	88,010
Špania Dolina – Glezúr – Piesky – Mária šachta	Cu, hydrothermal vein and stockwork/disseminated	0.7	24,630
Vysoká – Zlatno	Cu-Au, intrusion related porphyry-skarn	0.5	67,210

Copper

There were sixteen reserved deposits with reported copper content (Tab. 3. 2) registered in 2013 (Slovak Minerals Yearbook 2014), occurring in the Spišsko-gemerské rudohorie Mts., Nízke Tatry Mts., Central and East Slovakia Neogene volcanites.

Metamorphic-hydrothermal vein deposits occur in the Spišsko-gemerské rudohorie Mts. (Slovinky, Gelnica, Novoveská Huta, Rudňany) and the Nízke Tatry Mts. (Špania Dolina). Ore veins of the Spišsko-gemerské rudohorie Mts. are formed in the Early Paleozoic volcano-sedimentary rocks and the Late Paleozoic sedimentary rocks. The major ore minerals are siderite, Fe-dolomite, chalcopyrite and tetrahedrite. Complex Fe-Cu ores made up by chalcopyrite and tetrahedrite on hydrothermal vein deposits Rudňany and Rožňava occur in the Early and Late Paleozoic in the Spišsko-gemerské rudohorie Mts. Siderite, chalcopyrite, tetrahedrite, cinnabarite and barite are the major economic minerals there. Permian conglomerates, sandstones and shales host copper deposit Špania Dolina in Nízke Tatry Mts. Ore is represented by chalcopyrite, tetrahedrite, pyrite, galena, sphalerite and stibnite.

Massive sulphide copper deposit Smolník, situated in the Spišsko-gemerské rudohorie Mts., is hosted in the Early Paleozoic chlorite/sericite/graphite schists with volcanic rocks. Main ore minerals are chalcopyrite and pyrite.

The skarn-porphyry copper deposits Vysoká is situated in the central zone of the Neogene Štiavica stratovolcano, formed in the Miocene. Disseminated porphyry type ores are of poor grade. Higher-grade ores are related to ex-skarns and endoskarns at diorite/carbonate contacts. Ore mineralization is represented by chalcopyrite, pyrite and native gold.

The epithermal base metal and precious metal vein deposits Banská Hodruša and Banská Štiavnica are situated in the Central Slovakia Neogene volcanites. Ore is made of chalcopyrite, galena, pyrite and sphalerite.

Stockwork copper mineralization of base metal deposit Brehov, situated in the East Slovakia Neogene volcanites, is related to the diorite porphyry intrusion emplaced in Miocene tuffaceous sediments (Zuberec et al., 2005).

Gold

Twenty one metal reserved deposits with reported gold content (Tab. 3.3) were registered in 2013 (Slovak Miner-

Tab. 3.3 Reserved deposits with gold content – estimation of Au metal content in geological reserves

Reserved deposit	Mineralization	Grade [ppm Au]	Metal content [kg]
Banská Hodruša I	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	13.9	4,730
Banská Štiavnica – Pb, Zn, Cu, Au, Ag	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	0.6	3,730
Brehov I	Cu-Pb-Zn-Au, intrusion related stockwork/ disseminated	2.7	1,410
Detva	Au, high sulphidation epithermal	0.6	48,960
Dolná Lehota	Sb-Au, hydrothermal vein and shear-zone	2.7	3,200
Dúbrava – Ľubelská	Sb-Au, hydrothermal vein and shear-zone	1.6	1,010
Dúbrava – Martin štôľňa	Sb-Au, hydrothermal vein and shear-zone	0.7	460
Dúbrava – Matošovec	Sb-Au, hydrothermal vein and shear-zone	1.1	580
Jasenie – Kyslá	W-Au, hydrothermal vein and shear-zone	0.5	1,400
Klokoč	Au, high sulphidation epithermal	1.7	430
Kremnica	Au-Ag, volcanic hosted low sulphidation epithermal	1.5	39,780
Magurka – št. Adolf – halda	Au in mine waste pile	8.6	2,060
Medzibrod	Sb-Au, hydrothermal vein and shear-zone	2.7	70
Pezinok	Au-As, hydrothermal vein and shear-zone	2.3	190
Pezinok – odkalisko	Au in setting pit	1.2	440
Pezinok – Sb	Sb-Au, hydrothermal vein and shear-zone	2.1	30
Pezinok – Vinohrady	Au-As, hydrothermal vein and shear-zone	2.8	1,830
Pezinok – Zlatá žila	Au-As, hydrothermal vein and shear-zone	3.7	3,600
Pezinok (Pezinok II)	Sb-Au, hydrothermal vein and shear-zone	4.7	2,980
Pezinok I	Sb-Au, hydrothermal vein and shear-zone	1.1	470
Zlatá Baňa	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	1.1	2,040

Tab. 3.4 Reserved deposits of iron ore – geological reserves

Reserved deposit	Mineralization	Grade [% Fe]	Ore reserves [thousand tonnes]
Medzev	Cu-Fe, metamorphic-hydrothermal vein	30.1	4,200
Nižná Slaná	Fe, metamorphic-hydrothermal vein, metasomatic	38.1	1,040
Nižná Slaná – Mano – Kobeliarovo	Fe, metamorphic-hydrothermal vein, metasomatic	33.5	17,710
Poráč – Zlatnícka žila	Fe-Cu, metamorphic-hydrothermal vein	33.1	2,740
Poráč – Zlatník	Cu-Fe, metamorphic-hydrothermal vein	30.9	15,160
Rožňava – Mária žila	Cu-Fe-Ag-Sb, metamorphic-hydrothermal vein	36.6	2,320
Rudňany	Cu-Fe, metamorphic-hydrothermal vein	30.1	7,340
Rudňany – Matej and Jakub žila	Cu-Fe, metamorphic-hydrothermal vein	29.3	21,790

als Yearbook 2014), occurring in the Malé Karpaty Mts., Nízke Tatry Mts., Central and East Slovakia Neogene volcanites.

Gold deposits of pre-Tertiary hydrothermal Au-As, Au-W and Au-Sb mineralizations are known from the Malé Karpaty Mts. (Pezinok deposit) and Nízke Tatry Mts. (Dúbrava, Magurka – mine waste pile, Dolná Lehota, Medzibrod, Jasenie) ore districts. Late Hercynian hydrothermal gold deposits occur in Tatricum and Veporicum units of metamorphic complexes and granitic rocks. Pyrite, arsenopyrite, tetrahedrite, stibnite, berthierite, chalcopryrite, galena and sphalerite are the major minerals.

Meaningful precious and base metal epithermal mineralization is related to the Central and East Slovakia Neogene volcanism. The Central Slovakia Neogene volcanic field is represented by Kremnica, Banská Hodruša, Banská Štiavnica, Klokoč and Detva deposits. Kremnica deposit represents Au-Ag mineralization of vein and veinlet type. Pyrite, chalcopryrite, galena, sphalerite, silver sulphosalts and electrum are major minerals. Banská Štiavnica deposit represents base metal and precious metal mineralization with an expressive zonal arrangement, Au-Ag mineralization is concentrated at higher (under surface) levels. The last discovered deposit in Neogene volcanites, representing large porphyry gold ore bodies, is Detva deposit. The only Slovakia's exploited metal deposit Banská Hodruša represents low sulphidation epithermal gold mineralization. Gold reserves of base metal deposit Brehov, situated in the East-Slovakia Neogene volcanites, are related to the diorite stock emplaced in tuffaceous sediments. The Klokoč deposit, situated in central zone of Javorie stratovolcano, represents high sulphidation epithermal (Zuberec et al., 2005).

Iron ore

Eight reserved deposits with reported iron ore (Tab. 3.4), concentrated in the Spišsko-gemerské rudohorie Mts. deposit area, were registered in 2013 (Slovak Minerals Yearbook 2014, revised).

Economically the most important iron ore deposit Nižná Slaná – Mano – Kobeliarovo is situated in the western part of the Spišsko-gemerské rudohorie Mts. Hydrothermal – metasomatic type deposit occurs in the form of lens, hosted in the Early Paleozoic rock complexes. The major ore mineral is siderite.

Hydrothermal vein deposits (Rudňany, Poráč, Rožňava – Mária žila, Medzev) of the complex Fe-ores occur in the north and south parts of the Spišsko-gemerské rudohorie Mts. hosted by the Early and Late Paleozoic rocks. Siderite, chalcopryrite, tetrahedrite, cinnabarite and baryte are the major ore minerals there (Zuberec et al., 2005).

Lead and zinc

Four base metal reserved deposits (Tab. 3.5a & 5b) were registered in 2013 (Slovak Minerals Yearbook 2014), occurring in the Central and East Slovakia Neogene volcanites.

Epithermal vein deposits Banská Štiavnica and stockwork-disseminated deposit Banská Hodruša in Central Slovakia Neogene volcanites are hosted by a volcanoplutonic complex in the central zone of andesite stratovolcano. Galena, sphalerite, chalcopryrite, pyrite, silver salts and electrum are major minerals there.

Zlatá Baňa and Brehov deposits are situated in the East Slovakia Neogene volcanites. Mineralization of Zlatá Baňa deposit is bound with central zone of andesite stratovolcano. Major minerals are galena, sphalerite, chalcopryrite, pyrite, silver salts and electrum.

Tab. 3.5a Reserved deposits of lead – estimation of Pb metal content in geological reserves

Reserved deposit	Mineralization	Grade [% Pb]	Metal content [tonne]
Banská Hodruša	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	0.6	31,230
Banská Štiavnica – Pb, Zn, Cu, Au, Ag	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	1.6	105,710
Brehov I	Cu-Pb-Zn-Au, intrusion related stockwork/ disseminated	0.8	77,750
Zlatá Baňa	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	1.2	22,560

Tab. 3.5b Reserved deposits of zinc – estimation of Zn metal content in geological reserves

Reserved deposit	Mineralization	Grade [% Zn]	Metal content [tonne]
Banská Hodruša	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	0.7	38,010
Banská Štiavnica – Pb, Zn, Cu, Au, Ag	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	2.4	161,580
Brehov I	Cu-Pb-Zn-Au, intrusion related stockwork/ disseminated	1.7	164,990
Zlatá Baňa	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	2.8	53,600

pyrite, pyrite, silver salts and electrum. Mineralization of Brehov deposit is related to the diorite porphyry intrusion in Miocene tuffaceous sediments. Major minerals are galena, sphalerite, chalcopryrite, pyrite and silver salts (Zuberec et al., 2005).

Mercury

There were two reserved deposits with reported mercury content (Tab. 3.6) registered in 2013 (Slovak Minerals Yearbook 2014, revised), occurring in the Spišsko-gemerské rudohorie Mts. and East Slovakia Neogene volcanites.

Mercury as an admixture in complex Fe-ores occurs in Rudňany deposit. Mineralization hosted by the Early and Late Paleozoic rocks is formed by cinnabarite, Hg-tetrahedrite (schwazite) and native mercury (Zuberec et al., 2005).

Molybdenum

Two reserved deposits with reported molybdenum content (Tab. 3.7) were registered in 2013 (Slovak Minerals Yearbook 2014), occurring in the Spišsko-gemerské rudohorie Mts.

Tab. 3.6 Reserved deposits with mercury content – estimation of Hg metal content in geological reserves

Reserved deposit	Mineralization	Grade [% Hg]	Metal content [tonne]
Dubník	Hg, volcanic hosted low sulphidation epithermal	0.16	3,910
Rudňany	Cu-Fe-Hg, metamorphic-hydrothermal vein	0.05	450

The most important economical accumulations of monomineral Hg-ores are situated in the East Slovakia Neogene volcanites (Dubník deposit). Major ore mineral is cinnabarite, locally meta-cinnabarite, accompanied by quartz, chalcedony, calcite, pyrite and marcasite. Mineralization is of veinlet – disseminated type, formed by irregular lens.

U-Mo deposits Spišská Nová Ves and Košice are situated in the north part of the Spišsko-gemerské rudohorie Mts. Stratiform mineralization (U minerals, molybdenite, chalcopryrite, pyrite) is related to Permian volcano-sedimentary horizons of Gemericum unit. Molybdenum is mineralogically bonded with uranium minerals (Zuberec et al., 2005).

Tab. 3.7 Reserved deposits with molybdenum content – estimation of Mo metal content in geological reserves

Reserved deposit	Mineralization	Grade [% Mo]	Metal content [tonne]
Košice I	U-Mo, syngenetic/diagenetic and infiltration	0.05	2,550
Sp. N. Ves – Novoveská Huta	U-Mo, syngenetic/diagenetic and infiltration	0.02	930

Tab. 3.8 Reserved deposits with silver content – estimation of Ag metal content in geological reserves

Reserved deposit	Mineralization	Grade [ppm Ag]	Metal content [kg]
Banská Hodruša	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	8.6	45,260
Banská Hodruša I	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	15.0	4,980
Banská Štiavnica Pb, Zn, Cu, Au, Ag	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	19.4	130,030
Kremnica	Au-Ag, volcanic hosted low sulphidation epithermal	12.0	314,580
Rožňava – Mária	Cu-Fe-Ag-Sb, metamorphic-hydrothermal vein	54.9	127,230
Rožňava – Strieborná	Cu-Fe-Ag-Sb, metamorphic-hydrothermal vein	204.5	866,880
Špania dolina-Glezúr-Piesky-Mária šachta	Cu, hydrothermal vein and stockwork/ disseminated	9.8	37,480
Zlatá Baňa	Pb-Zn-Cu-Au-Ag, volcanic hosted low sulphidation epithermal	32.2	62,160

Silver

Eight reserved deposits with reported silver content (Tab. 3.8) were registered in 2013 (Slovak Minerals Yearbook 2014), occurring in the Spišsko-gemerské rudohorie Mts., Nízke Tatry Mts., Central and East Slovakia Neogene volcanites.

The late volcanic formation is represented by Ag mineralization on precious and base metal deposits Kremnica, Banská Štiavnica, Banská Hodruša (Central Slovakia Neogene volcanites) and Zlatá Baňa (East Slovakia Neogene volcanites). The most productive were upper parts of ore veins in Banská Štiavnica deposit. Downwards Au-Ag mineralization melts into base metal (Pb, Zn, Cu) mineralization of lower Ag content. Majority of silver is bounded in galena, individual Ag minerals (argentite) are rare.

The early silver formation is represented by Ag mineralization related to Ag-tetrahedrites in complex Fe-ore and copper deposits of the Spišsko-gemerské rudohorie Mts. (Rožňava deposit) and Ag-tetrahedrites formed in the Permian rock complexes in Cu deposit Špania Dolina (Nízke Tatry Mts) (Zuberec et al., 2005).

Tungsten

There was one reserved deposit of tungsten (Tab. 3.9) registered in 2013 (Slovak Minerals Yearbook 2014), occurring in the Nízke Tatry Mts.

Gold-scheelite mineralization in Jasenie – Kyslá deposit is related to quartz veins and silicified shear zones in the Paleozoic crystalline schists. Major economic minerals are

scheelite and gold here. Tungsten mineralization age is the Late Carboniferous (Zuberec et al., 2005).

3.3 Review on reserves and production

Presented reserves (metal content respectively) are given as geological reserves i.e. in natural state on mineral deposits computed according to the valid efficiency conditions and the classification of reserves (Decree of the SGU no.6/1992 Col.). Present structure of reserves and their exploitation is mostly result of extensive state geological survey realised in the second half of the 20th century.

Following the Register of Reserves of Reserved Mineral Deposits of the Slovak Republic total of 48 reserved deposits with reported metal content (antimony, base metals, copper, gold-silver, iron ore, mercury, molybdenum

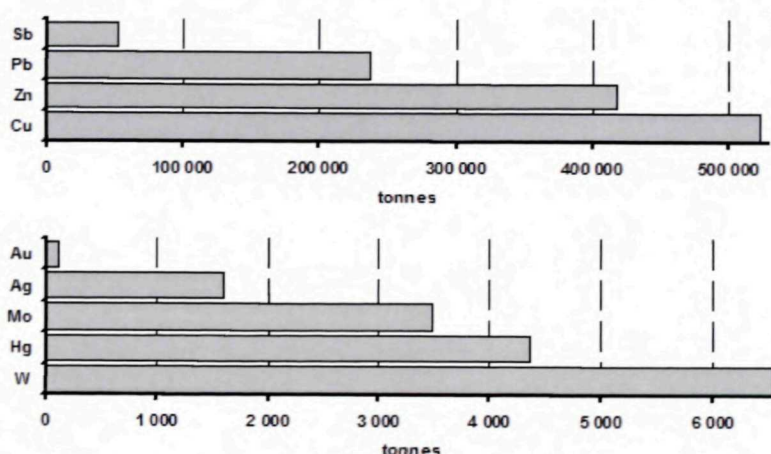


Fig. 3.3 Estimated metal content in geological reserves (in situ) in reserved ore deposits of Slovakia

Tab. 3.9 Reserved deposit of tungsten – estimation of W metal content in geological reserves

Reserved deposit	Mineralization	Grade [% W]	Metal content [tonne]
Jasenie – Kyslá	W-Au, hydrothermal vein and shear-zone	0.2	6,550

Tab. 3.10 Metal content in geological reserves and production of metals (2011-2013). Source: Slovak Minerals Yearbook 2012 – 2014, modified.

Metal	Number of deposits	Metal content in geological reserves	Production 2011*	Production 2012*	Production 2013*
Antimony [t]	9	52,240	-	-	-
Copper [t]	16	523,270	28	31	40
Gold [kg]	21	119,390	398	546	533
Iron ores [kt]	8	72,290 (ore)	-	-	-
Lead [t]	4	237,150	114	166	235
Mercury [t]	2	4,360	-	-	-
Molybdenum [t]	2	3,480	-	-	-
Silver [kg]	8	1,588,590	330	441	508
Tungsten [t]	1	6,550	-	-	-
Zinc [t]	4	418,170	103	134	190

Note: Metal content is calculated for average grade in deposit and geological (in-situ) reserves amount, with regard to grade of economic and uneconomic (potentially economic) reserve categories. Estimated amount of metal is informative figure only.

* Certain amount of silver, zinc, lead and copper occur in concentrate produced by gold ore processing in Banská Hodruša I deposit.

and tungsten) were registered in 2013 in the territory of Slovakia. Total geological ore reserves reached 335 Mt. Estimation of total metal amount in geological reserves is in Tab. 3.10 and Fig. 3.3.

Exploitation of ores, extensively mined in the past, is limited due to exhaustion of resources, low ore grade and present economic and legal conditions. The only exploited metal deposit is Banská Hodruša I at present, where gold ore is mined since 1993, although history of gold mining is known from 13th century there. Production of metals in 2011-2013 period is figured in Tab. 10.

3.4 Conclusion

Although present metal raw material basis provides relatively wide variety of mineral deposits, real exploitation of metal reserves, extensively mined in the past, is limited due to exhaustion of resources, low ore grade and present economic and legal conditions. The only currently exploited metal deposit is Banská Hodruša I, where gold-silver ores are mined. All production of concentrate is being exported. Because of a large import volume of metals (iron ore, zinc, materials for aluminium, iron and ferroalloys metallurgy) foreign trade metal balance of Slovakia has been permanently passive. Domestic consumption of these metals is covered mainly by import.

Slovak and similarly European production of metals covers only negligible part of the EU economy demands.

Ongoing initiatives (Raw Material Initiative, Critical Minerals) point out the necessity of metals and minerals securing, including reevaluation of domestic resources. Slovakia's potential of EU critical metals includes antimony and tungsten reserves and minerals for metal magnesium and silicon production.

Acknowledgements

The author also expresses his gratitude to peer reviewer for his valuable notes and propositions.

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