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The Slovak Mine Waters – Possibility of Utilization

SOŇA CICMANOVÁ[1] - MICHAL LUKAJ[2] - MIROSLAV RAČICKÝ[3]

[1]Geological Survey of Slovak Republic, Regional Centre, Markušovská cesta 1, 05240 Spišská Nová Ves
[2]Geological Survey of Slovak Republic, Regional Centre, Kynceľovská 10, 974 00 Banská Bystrica
[3]Ministry of the Environment of the Slovak Republic – Division of Geology and Natural Resources, námestie Ľ. Štúra č.1, 812 35 Bratislava

Abstract: Development of various sorts of mineral raw materials from deposits in Slovakia left residues such as mine water outflows from abandoned and still active mines. The character of these waters reflect rock composition and the abundance of minerals to which the waters were exposed. In many cases mine waters or outflows waters mainly from abandoned ore deposits occurs in water deficient areas and thus are of possible interest as a potable water source. The intensity of their utilitization depends on their quantity and quality. This paper describes Slovakian mine waters and evaluates the present conditions of usage of the mine water as drinking water. We do not evaluated the quantitative and qualitative protection of these water sources.

Key Words: mineral raw material, mine workings, mine water, chemistry, utilization, drinking water, environment

Introduction

The exploration for, and processing of various earth resources in Slovakia dates back to prehistoric times. Throughout history this activity reflects the development of civilization. In Europe as in the World among the important materials mined were gold, silver and polymetalic ores. In Slovakia at present magnesite deposits are the most of important mineral comodity. Copper and iron were deposits important too, and now coal deposits are of interest.

The extent and duration of underground and surface mining are caused refected in the kind and intensity of environmental effects. Recently abandoned mines have brought new kinds of environmental impact. In many cases past mine closures caused changes of the hydrogeologic conditions of more extensive surroundings. Dewatering underground mines was a major technical and economic problem.

Historically, mine waters were variously used both during and after mining went on. Where other waters were in short supply mine water were commonly utilized as drinking water by the population. In this paper we discuss the development of the use of mine waters as a drinking water source for population of Slovakia. Because the protection of source this is a complication separate problem, it is not discused in this paper.

Charakterization of the mineral deposits

The quantity of mine waters produced varies from one mining district to another, and similarly, mine drainage volumn influences variously the groundwater sources in these districts. In general, has three kinds of mining conditions, which are influenced by geology, structure and type of mining method used.

Vein ore deposits in massive rocks were a major type of ore deposit in Slovak republic. It is the region of these include the neovolcanites of the historical Štiavnica – Hodruša mining district, where gold, silver and polymetalic ores were extracted. Another district is that of the Spišsko-gemerské rudohorie Mts. From whitch iron, copper and complex ores were extracted over a long time. Also, the small and mainly inactive deposits in the Veporides, Slánske vrchy Mts., Nízke Tatry Mts., Malé Karpaty Mts. and elsewhere belong to this group.

The drainage effects of these mine in rock with fracture permeability caused a dewatering of the overlying rock body. These effects depend on the geology, underground development, surface morphology and other conditions of the locality, such as the hydrogeology, hydrology and climatic conditions. The damaging of primary hydrogelogy conditions and drainage of the rocks had an unfavourable influence on the water sources in surrouding area, that forms the catchment area of utilized springs. On the other hand, the dewatering of the overlying rock by the mine drainage adit concentrated water that could be utilized as drinking water, where the quality was suitable.

Subhorizontal deposits in sedimentary flyshoid sequenses cover all of Slovakian coal deposits of the Nováky, Handlová – Cígeľ, Modrý Kameň and Gbely districts. The Mn-ores of the Kišovce – Švábovce region also belong to this group. Mining ended in this region a few years ago because operation were uneconomical and the ore exhaused. Mining led to the down of the groundwater table whose influence extended over a wide region. Many wells went dry or had to be deepened. In several cases, such as Kišovce – Švábovce and Bojnice, the sources of mineral and thermal waters might be jeopardize, as well.

The deposits in carbonates, sulphates and salt formation with karst phenomena are represented in the Jelšava, Lubeník, Košice – Bankov, Podrecany and Burda areas. Others included the gypsum deposit of Novoveská Huta and the salt deposits of Prešov and Zbudza.

In this type of deposit the drainage effect of mine activity is multiplied by the presence of karst zones and particularly by karst with open spaces. The drainage influence is widely extended around such deposits. A change in the hydrogelogical conditions in rock massive with karst permeability is also likely to haven profound influence on groundwater volumnt. In the case of magnesite deposits, these groundwater sources generate karst springs of enormous yield (20–30 $l.sec^{-1}$). Through underground mining below the groundwater level active development is enhandced. Karst creations, together with surface undercuting, is connected with changes of the land surface and creates surface fractures and sinks. Changes of relief surface are caused by intensive rock solution and by the removal of some materials by mine water.

Quantitative and qualitative charakterization of mine waters in different deposit types.

Ore deposit mine water characterization

Mine waters vary widely in yield and chemical composition, depending on many factors, such as geomorphology, climate and hydrology; geology and hydrogeology; hydrogeochemistry and the development and drainage of the mine workings.

Ore deposits fall into some groups. One group occurs in neovolcanic rocks (Štiavnica – Hodruša ore district, Slánské vrchy Mts); another is Palozoic rocks (Spišsko – gemerské rudohorie Mts) and third is in granitoid bodies in core mountings such as the Malé Karpaty Mts., Nízke Tatry Mts.

Ore deposits in neovolcanic rocks

One of this group of deposits is the ***Štiavnica – Hodruša*** mining district which was extensive by mined in the past and has had recent mining activity. The district covers about 100 km^2. Past workings extend some hundreds kilometers of adits on 18 levels and more then 50 open pits with a maximum depth of 1000 m. Polymetalic ores (Cu, Pb, Zn) and Au and Ag stockwork ores were mined for at least 800 years.

It is underlain by Paleozoic and Mesozoic rocks is covered by an extensive sheet of Neogene andesite and are intruded by diorites and granodiorite porphyrias. Steep faults cut these rocks and have quided the emplacement of mineralized veims. Joints are abundant. Together, the faults and joints control the movement of groundwater to the carbonate rocks that generally lie below the water table. Although the fault zones are open and narrow (commonly 10–20 cm). Their water yield can be large. For example the Terezia vein (12 th level of the Michal adit) flows at about 20 $l.sec^{-1}$ and at times even at 80 $l.sec^{-1}$ (Lukaj, M. 1982). Some inflows also occur in carbonate rocks where no faults are present. The maximum inflow registered in such a place was 120 $l.sec^{-1}$ from the 12 th level of the Ferdinand Open Pit. However upon continuous water withdrawal this flow was stabilized at a lower volumn. In some cases the mine outflow expired often the source was drained. Inflows at mines in the porphyritic rocks of the Hodruša part of the district were smaller.

The steep dips of shatter belts along the faults and the relative high water yield of bodies with intensive fracturing created conditions for vertical movement of groundwater and good comunication of mine waters into depth. By this method the upper levels of adits are dewatered to deeper adits.

The Štiavnica – Hodruša mining district is drained by Voznica drainage gallery. The highest yield during the years of the main mine activity was about 350 $l.sec^{-1}$. The long term average in the past was about 220 $l.sec^{-1}$ and at present it is about 100 $l.sec^{-1}$. Through this drainage the mine was given 10 more years of operation. The Voznica drainage gallery was built in 1740 – 1850. Through it is drainage effect the inflow from higher drainage galleries in the surrounding terrane, which was dewatered decreased or stopped.

In the Kremnica area the mine waters are also drainage by water adits. Where their loccation is suitable they are used as a source of energy (small power stations) and for recreational purposes.

In the ***Slánske vrchy Mts.*** neovolcanic rocks free inflows of mine water are connected with the past mining of Hg-ores. The deposits were mined only through adits. The development of the deposits was not so extensive as to have influenced local groundwater drainage. Moreover these waters contain Hg which make then unsuitable for consumption. Indeed, this water is presently an environmental problem.

Ore deposit mine waters in Paleozoic rocks (Spišsko-gemerské rudohorie Mts.)

Geomorphological, climatic and hydrological conditions have a big influence on the mine waters of Spišsko-gemerské rudohorie Mts. Paleozoic rocks assemblage (metapsamites, phyllites, metavolcanics) have unsuitable hydrogeological conditions to be good sources of groundwater.

Subsurface layers and fault zones are more important aquifers, especially where they are sealed at depth with products of weathering, mainly of schist. Mostly, the groundwater in these areas occur in surficial deposits and weathered rock. These waters are commonly derived from meteoric water and inflowing from streams. The inflow of the groundwater in the mines diminished with depth. In some cases deep mine levels are predicably dry. The mine workings in deposits creates the opened and semi-opened systems of channels which act as a drainage system for the weakly pervious surroundings. The mine activity itself opens up some kind of fissure – pseudokarst permeability.

Over old abandoned mines the land surface is damaged because the ore veins reach the surface. The veins are usually entered the surface. Such workings, together with open pit mines created a more pervious medium for infltration of surface waters. The old mines are partly drained by old adits but may also accumulate water. In this way they make up one of the main permanent source of inflows of mine waters into deeper parts of the deposits. Their yield is about 10–20 $l.sec^{-1}$. The other inflows are associated with shattered belts along faults. Their yields are lowest (to 10 $l.sec^{-1}$) and inflows usually stop in time.

The mine waters in granitoid massives (Nízke Tatry Mts,..)

Extensive mining took place in recent times on the Sb deposits in Liptovská Dúbrava and Pezinok and on the W-Au deposit in Jasenie, both in granitoid bodies. Groundwater movement is associated with shatter belts along faults. Water inflows at adits is concentrated in zones one meter to few tens meters thick. All these deposits are drained by galleries. The inflow yield varied from a few $l.sec^{-1}$ to 10 $l.sec^{-1}$.

Inflows into mine workings are perennial but they reflects meteoritic conditions with a reaction time of a few days to 3 weeks. The variability of inflow yields from shattered zones is reduced toward the central parts of massif.

The important hydrogeological functions are the width of mylonite zones, their permeability, tightness and their conection to different parts of a granitoid body.

Mine water from granitoid bodies have not been utilized, because there is neither enough water quantity or demand in the mountain localities.

Chemical composition of mine waters

The mineral consistnens in groundwater collected by mine adits reflects the host rocks composition as well as the ore minerals the district. In silicate rocks the common process is the hydrolysis of minerals to form basic Ca-Mg bicarbonate type of waters. In rocks with sulfides particularly pyrite, oxidation of sulfides is wichespread, especially of shalow levels. Sulfate - enriched mine waters typically originate where meteoric waters circulates trough pyritized rock. Mostly such sulfide oxidation occurs in the old pits and shalower parts of mine. Deeper circulation these waters occurs only locally in the vicinity of active mines.

In general, the basic Ca-Mg – bicarbonate type of water with low total dissolved solids has agresive CO_2. Where sulfides are abundant in the rock, the sulphur oxidizes and the water become changed with calcite-magnesium-sulphate. Where circulation in deeper as along fault zones in the neovolcanic rocks, the higer temperature, higher total dissolved solids and the water content of bicarbonate Na occurs. Exeptional are the inflows of thermal waters from depth into the mine in Banská Štiavnica (Grűner vein) and Kremnica (KS-1 underground hole) deposits.

In rare cases the originaly chemistry of silicatogenic groundwater near mines is changed by the process of the dissolution of carbonate, carbonate vein filling (siderite) and evaporites.

From a qualitative point of view of drinking water derived from mine waters of first importance is the total conten of sulphates, the different kind of metals (mainly Fe, Mn, As, Sb, Cu, Zn), the radioactivity and the pH. These mine waters are often too radioactive to be potable. The content of these elements depends on hydrogeological and hydrogeochemical condition of the deposit and from witch the main inflows were derived. One can not assume the presence of abundant heavy metals in mine waters derived from a particular because the ores present there. In many cases mine waters are suitable according of stricter criterion STN 75 7111 – drinking water (since 1998) and they can be used as drinking water. On the other hand in some hydrogeological and hydrogeochemical conditions certain elements of mine water chemistry have extremly high values and present a big environmental problem for the region as at the Smolnik deposit (acid mine drainage).

Mine water of coal deposits

The Slovak coal deposits occur in the sedimentary systems of the Neogene of the Western Carpathians. They occur in the marginal parts of the intracarpathian basins or the intramountain depressions. The coal layers form horizontal beds in the Neogene sediments – intercalated clays, sands, gravels - at depths of 100–500 m. The distribution of clays determines the distribution forms of the confined aquifers. Groundwater circulation patterns are influenced by the thickness and continuity of the permeable units and by the distribution of faults that have broken these basin deposits into tilted blocks.

The coal-mining is subsurface and to commonly is accompanied by the inflow of mine waters therefore the hydrogeological conditions are the decisive factor of succes mining. The extensive system of the mine workings caused the dewatering of a huge area, not only above the mines but also a wide surrounding region. This substantial inflow to the coal mines results in a large and permanent yield from the mines sometimes has a character of the sudden inflow of water in mine workings.

Surface deformations above the mines are typical in the coal mine areas. In addition to subsided terrains, there are some enormous and thick landslides. The margins of the volcanic mountains where the bedrock consists of the sedimentary Neogene units are also stricken by block landslides.

Chemical composition of mine water of coal deposits

The quality of the inflow of mine water in coal mines is the same as that of the surrounding in Neogene rocks, witch are commonly tapped groundwater bodies as a

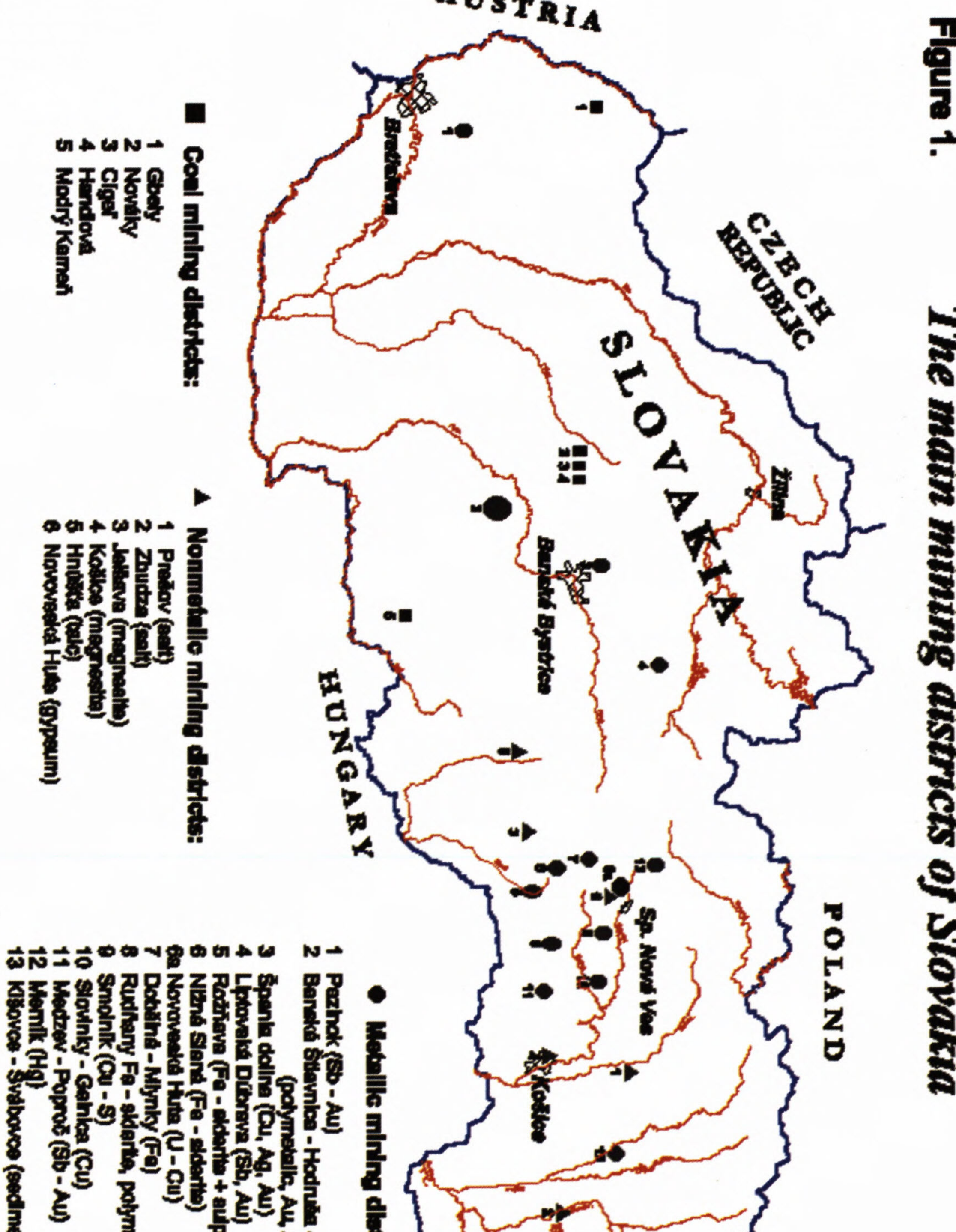

Fig. 1 The main mining districts of Slovakia

source of drinking water. In most shallow aquifer the Ca^{2+} and HCO_3^- ions prevail in the water; waters of Na^+-HCO_3^- group with total dissolved solids of 0.5–1 $g.l^{-1}$ occur deeper. The total dissolved solids and concentration of Na^+, and Cl^- ions increases with depth. Some coal mine water contain a raised levels of As, F and S, which ise typical of many lignite deposits. Sulphide waters are formed by the oxygenation of pyrite or marcasite in the coal is confined locally because the sulphide water is usually quickly mixed with substantially greater amounts of the carbonate water. The contamination of the mine water generally arises during the time of removal and dressing of the coal.

More specifically the mine water of the Modrý Kameň coal region contain free CO_2, Fe and Mn. These attributes limit its use as pottable water.

Mine water of the magnesite, gypsum and halite deposits

Magnesite deposits

The Jelšava-Lubeník and Košice-Bankov deposits are some of the most significant European magnesite deposits. These deposits are still being mined but activity hat ended at the smaller deposits Burda and Podrecany.

The magnesite occurs with dolomite generally in lenses several kilometres long and hundreds of metres thick in Paleozoic volcano-sedimentary assemblages of basalt, basaltic tuffs, sericite-quartz phyllites and dark gray sandy phyllites. The magnesite and dolomite bodies are faulted. They have a fissure-karst permeability, and they form significant aquifers contrasting with the surrounding impermeable rocks. Faulted carbonate bodies with a fissure and fissure-karst permeability creates suitable conditions for infiltration of rainfall and for water circulation in the deeper part of a body. The vertical flow of groundwater prevails high above the groundwater table. The result of this flow is mainly development of vertical karst phenomena, such as chimneys and cavern of great height. Near the groundwater table the water flows becomes move horizontal. These horizontal karst phenomena, such as chanels, develop.

The mining of magnesite usually started at quarrys; later it was combined with underground mining, and gradually it was entirely by underground mining, mostly using the room advancing method. At present they operate at the depths of about 50 m below the groundwater table and mining is planning to a 130 m depth. The mine water is pumped from the accumulation adits on the lowest mining level. Most average discharge of inflow waters is about and may exceed 10 $l.s^{-1}$. The karstification of the carbonate body may lead to the sudden inflow of water due to opening of a karst cavern (with a discharge about 100 $l.s^{-1}$). Such an event may wash up masses of mud filling from the cavern and can cause great problems. After the drainage of static groundwater reserves from a karst system the discharge is drops considerably and in many cases stops. Furthermore the karstification and mining activity remove magnesite, witch commonly underlies raised surfaces. Pumping mine waters from the depth below the groundwater table creates conditions suitable for the development of karst processes not only in these parts of body but also in a wide surroundings area.

Gypsum deposits

Only one deposit of evaporites - gypsum and anhydrite – is situated in Novoveská Huta near Spišská Nová Ves in Slovakia. Thick beds of gypsum and anhydrite occur in a sequence of Permian and Triassic shale. Fissures permeability of these rocks is combined under the influence of groundwater circulation in easy soluble sulphates with a development of sulphate karst. Exploitation of gypsum was accompanied by sudden inflow of water and unexpected inflow of water from cavern open by mining. Global average inflow to the mine is 5–10 $l.s^{-1}$. Undermine of surface and karstification of subsurface parts causes the development of the expansive belt of subsidences and sinks in deposit area.

Halite deposits

Slovak halite deposits occur in subhorizontal Neogene sequences along the edges of an intracarpathian basin - in Solivar pri Prešove and Zbudza.

In terms of hydrogeology they creates primary isolated hydrogeological structures, which are a basic genetic condition for the origin of a suitable raw-material. Raw-material at this deposit are salt-bearing clays, sandstones and breccia. The deposits usually have the shape of extended subhorizontal lenses. They occur at depths of 300 –500 m. Strata of clays 30–50 m thick isolates the deposits from the sedimentary surrounding Neogene rocks. Aquifers occur in these underlying and overlying Neogene sediments. Halite deposits are exploited by leaching around drill holes using surface water. The salt in the Solivar pri Prešove is obtained from a brine pumped from the deposit with groundwater inflow to shaft occuring faults. Conditions for the interconection of deposit with his surround are created by opening and way of exploitation and they opened a new potential way for groundwater inflow to deposit from surronding aquifers. Mine-technical and hydrogeological conditions depend on degreee of these hazards. Discharge of inflow from surrounding Neogene aquifers is low, mostly in tenths of $l.s^{-1}$.

Chemical composition of mine waters of magnesite, gypsum and halite deposits

The quality of mine waters from magnezite, gypsum and halite mines is result of solution. Consequently, these waters are charged with carbonate, sulphate and chloride ions. Typically the total dissolved solids of these waters are above 1000 $mg.l^{-1}$. In addition, pH values are high and may even reach a value of 12. Mine waters of gypsum deposits may carry more than 1 000 mg $mg.l^{-1}$ SO4; mine waters of halite mines may carry 100–300 $g.l^{-1}$ NaCl. Magnesite mine waters have the highest pH value. Such waters are unfit for drinking but they are suitable for certain industrial uses. These waters raised levels of heavy metals and other toxic materials.

Examples of types of mine waters and their exploitation

Area of Štiavnica-Hodruša mining district

The Štiavnica-Hodruša Mining District has several large mines and many smaller ones. Some of these mines produce potable water and two generate water for industrial use. The district is one of metallic ore deposits, chiefly copper; activity ceased more than 30 years ago and the last exploration efforts date back to the 1960 $^{-ies}$. The potable waters came from adits along weakly mineralized reins, and they are used by several small towns and other building clusters.

The largest water flow (10.85 $l.sec^{-1}$) comes from the *Kreuzerfindung* Mine (Viest, Ľ., 1994). This is a 2.5 km long crosscut adit chiefly in Triassic carbonate rocks and some Triassic shale and Neogene shattered granite. Short drifts follow bedding planes, along which the low-grade faults lie.

Another importand water source (2 $l.sec^{-1}$) is the *Windischleuten* Mine. It is an adit 2 km long largely in Triassic shale. Its waters are high in Fe ions. Waters of both this mine are utilized by the town of Vyhne.

The *Kesser* Mine is developed in carbonate rocks and granodiorite. It produces about 3 $l.sec^{-1}$ water to the village Hodruša – Hámre.

The *Richnava-dolná* Mine is developed in andesite and its adit flows 1.5 $l.sec^{-1}$. These waters are used by the village Štiavnické Bane. Nearby other adits discharge 0.1 – 0.5 $l.sec^{-1}$ water that is used by local groups of dwellings.

In addition to this mine water usage the *Colorado* and *Rozália* Mines provide contaminated waters for industrial use in the towns of Dolné Hámre (the Sandrik Company) and Hodruša (the Ore Mine Company).

Area of Rudňany and Hnilec valley of Spišsko-gemerské rudohorie Mts.

Mine waters have been an important sources of drinking water in the area of The Spišsko-gemerské rudohorie Mts. for many years because this area does not have sufficient number of natural sources. For example the entire village of Markušovce is supplied by mine water *(František* adit). The village of Hnilcík (adits: *Ernest, Georgi, Gezwäng, Tokárne*), part of Nálepkovo (*Xantipa* adit) and part of Gelnica are supplied by mine water as well (adits*: Roberti, Lýdia, Štefánia*). Additionally, many local homes use outflow from small nearby adits. The opening of many of these small adits are collapsed and so they may simply be as springs. The fact that water from many of these adits is potable in accordance with norm *STN 75 7111 - drinking water* is known.

František is an old drainage adit of the Bindt mine district in Markušovce valley about 4,5 km southwest of the village the Markušovce. Iron mining ended here in 1932, but the adit was used during the geological search for cooper veins in the eastern region of deposit during the sixties. Mining was done by system of horizontal and vertical works. Deeper levels have been flooded since end of the operation. Steep siderite veins cut Paleozoic rocks, mainly Carboniferous and Permian conglomerates, sandstones, shales and intercalate volcanic rocks. The outflow of mine water from *František* adit is 5–10 $l.s^{-1}$. The water quality is in accordance with norm *STN 75 7111 - drinking water*, except for the microbiological content. The water is tapped at the mouth of the adit is chlorinated for use in the village of Markušovce.

Rudňany deposit

Rudňany deposit lies on an E – trending steeply diping vein 10–100 m thick. Their vein carries mainly siderite/ankerite/quartz/sulfide – pyrite and chalkopyrite – and in the upper parts barite, tetrahedrite and cinnabar. The mining works are extensive and near the surface the host rocks are much broken by subsidence and sinks making possible increased infiltration of rainfall and surface waters to the deposit (Bajtoš,1994). Drainage of the deposit is ensured gravitationaly by through a crosscut adit to the main shaft These the mine waters are pumped to the overlying *Rochus* adit. From *Rochus* adit the water flows out to a sump tank. These waters was used for industrial purposes in ore dressing. The total amount of mine water available varies seasonally from 10 to 20 $l.s^{-1}$.

At a shallow level the waters are silicate - strong basic Ca-Mg-HCO_3 type with low level of total dissolved solids. At deeper levels they are changed to slightly basic or intermediate Ca-Mg-HCO_3-SO_4 type of water with total dissolved solids of at least 1000 $mg.l^{-1}$,and with a higher pH value. These waters contain elevated values of Mg, Fe, Mn, and Zn.

Smolník deposit

The mining of this deposit of disseminated pyrite and chalcopyrite lasted long time but ended in 1990 because it had been exhanded. The dense network of mine workings covered by extensive old mine refuse heaps was flooded and leaked out through the main shaft into a local brook. The mine water is typical water of that of the oxidized zone of pyrite deposits, which contains free sulfuric acid derived from the oxidation of sulphides. These waters present a serious problem because they mobilize heavy metals from the surrondings (AMD - acid mine drainage). Consequently heavy metals get into the brook and become a major problem. The discharge from the mine is about 20 $l.s^{-1}$; its pH is very low (2-3); it contains total dissolved solids 10 - 50 $g.l^{-1}$ and includes sulphates of Fe, Mn, Cu, Al, Zn, As in a mounts higher than acceptable limits of surface water (Jaško et al.,1996).

The composition of the waters from this mine varies with depth and location. The inflow of water that floods the deposit is entirely nearly surface water. It infiltrate through the disturbed surface terrain, old refuse heaps and subsurface mine works. This initially low - mineralized water of shallow circulation obtain aquires its anomalous chemical composition during infiltration and accumulation in mine below the water table of the area.

At present some technical arrangements are being made at the deposit in order to eliminate or reduce the unfavourable enviromental factors listed above. Questions concerning the utilization of these metal - bearing mine waters as a useful comodity are still open.

Jelšava deposit - Dúbrava massif

The magnesite deposit of the Dúbrava Massif occurs in the 600–m–thick carbonate sequence of Upper Carboniferous of the Gemericum territory. The carbonate beds extend many metres below the water table where it is an aquifer with a fissure-karst permeability betveen relatively impermeable Paleozoic phylites and shales, volcanits rocks. A karst spring at the water table (300 m above s. l.) drains the aquifer. The discharge of this spring is 15 - 20 $l.s^{-1}$. The spring is called Hot Water and it was utilized by the local waterworks as drinking water. In 1986 the Hot Water spring vanished after a large sudden inflow of water at the mine level 229 m (Lukaj et al., 1990). This was result of progressive drainage of deeper parts of deposit. The mine works had been flooded by water to the level of approximately 308 m. It was pumped from this level at this time with a discharge of 5 - 20 $l.s^{-1}$. This water was strongly basic Ca-Mg-HCO_3 type with total dissolved solids content of about 400 $mg.l^{-1}$.The waters use for industrial purposes in the processing and dressing of the magnesite raw-material.

Only part of the pumped mine water flow into the river. The quality of the river water is mostly within the acceptable limits of surface waters; only once were the limits of insolute material.

Conclusion

Mining activity presents a considerable interference with the natural environment. Unrecoverable changes of hydrogeological and hydrogeochemical conditions are the result of these works.because of recent public concern about problems with drinking water and environmental issues hydrogeological and hydrogeochemical valuation have become necessary. Stricter criterion of the acceptable limits of *STN 75 7111 - drinking water* (since 1998), particularly with respect to the content of metals considerable reduces the possibilities of utilizing mine waters as a source of drinking water. In spite of this situation, the utilization of mine waters is possible in some parts of Slovakia. After proper treatment of some mine waters their quality will be suitable for drinking water. In addition to the issues of the proper treatment of potable water control must also be carried out.

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