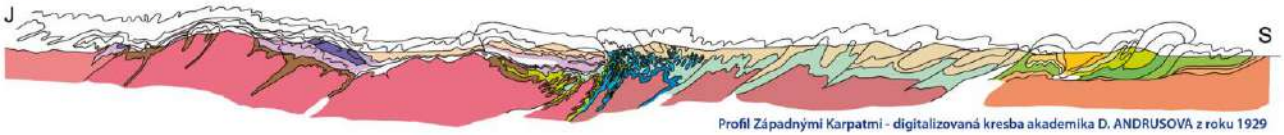


MONITORING AND RESEARCH OF SELECTED ENVIRONMENTAL BURDENS IN SLOVAKIA

Peter Šottník, Jozef Kordík

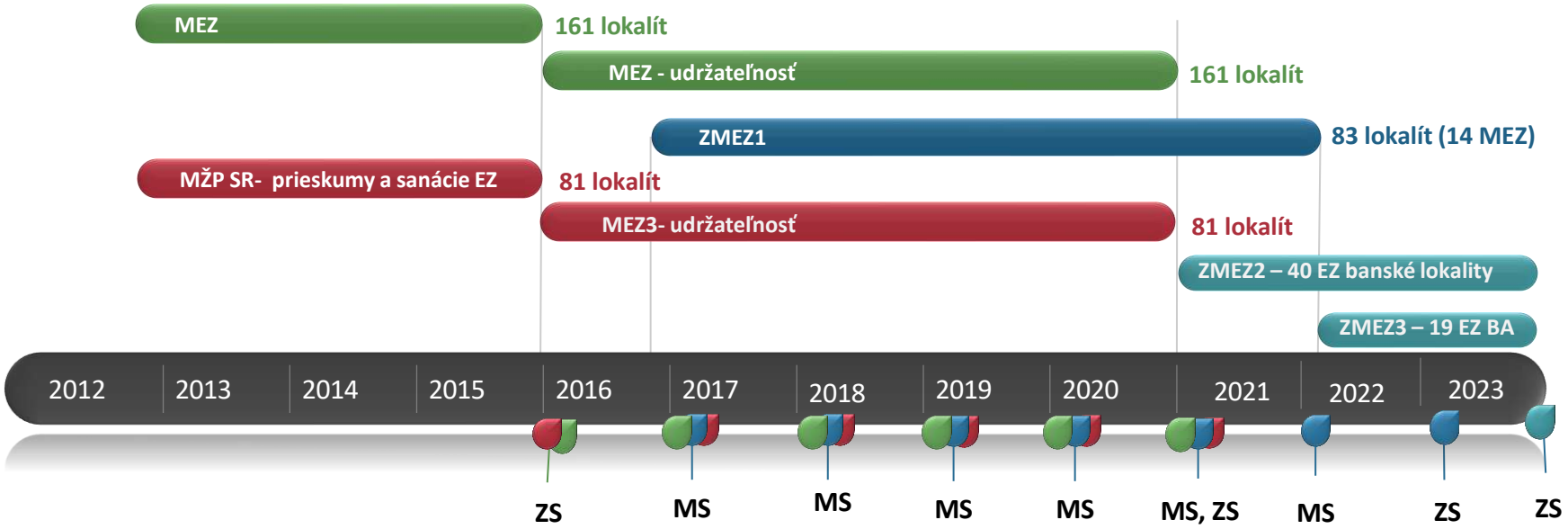
Karolína Adzímová, Dušan Kúšik,

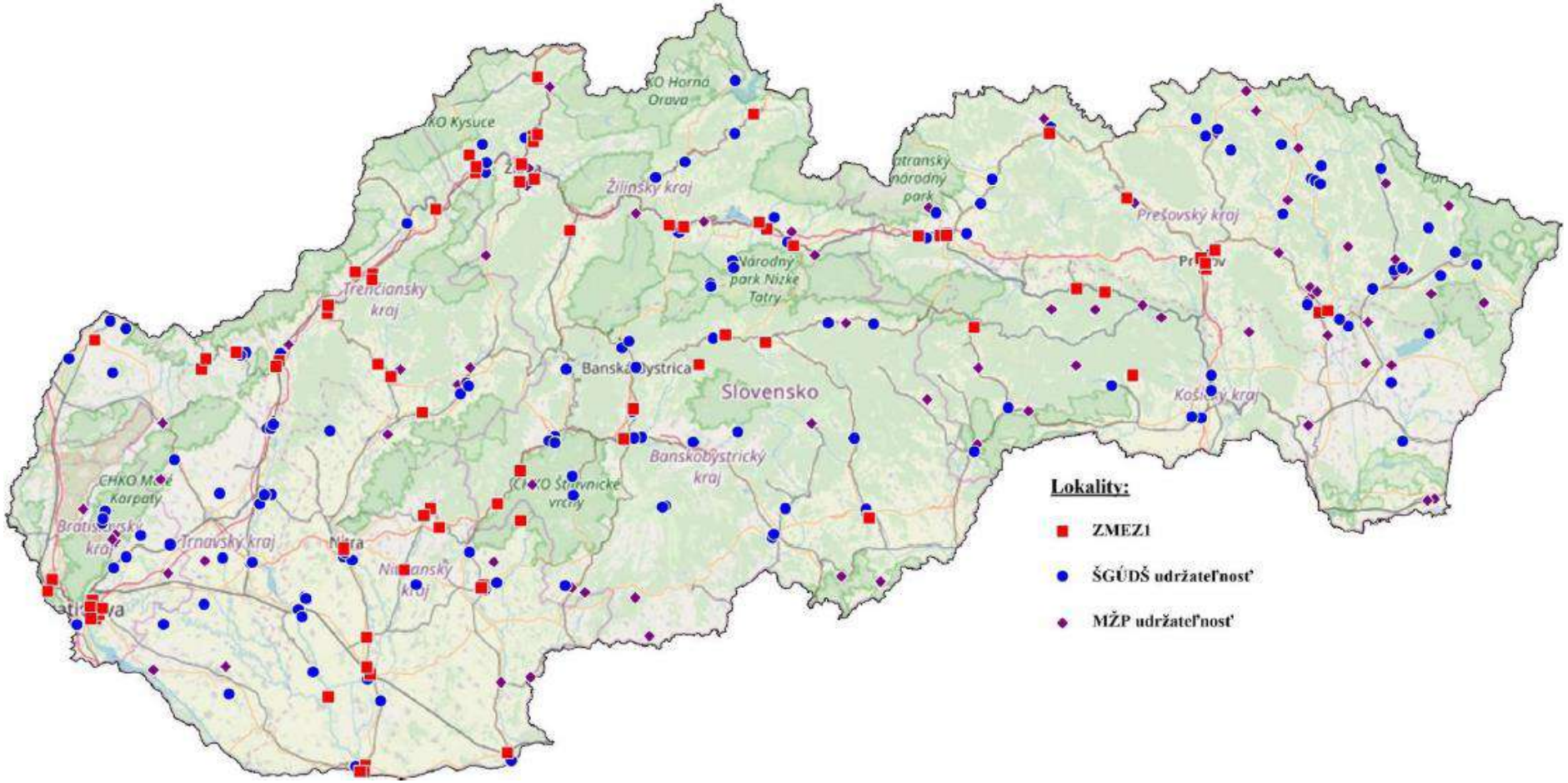
Radovan Černák

State Geological Institute of Dionýz Štúr in Bratislava

Basic information

- 2012-2015 "Monitoring EZ in selected localities of the Slovak Republic (MEZ)" - OPŽP - 7 million Euros (2015 WS), 2016-2020 - sustainability - 530,000 Euro/year (state budget) - 161 EZ
- The project followed on from the results of previous tasks, in particular: "Systematic identification of EZ", "Study of regional impacts of EZ on ŽP in selected regions of Slovakia"
- 2016-2020 MEZ3 – Thu. budget 380,000 Euros/year – 81 EZs (monitoring was a follow-up to previous tasks related to surveys and remediation of EZs, sustainability)
- 2016-2023 ZMEZ1 – OPKŽP – 3.9 million Euros – 83 EZ (monitoring was a follow-up to previous tasks related to surveys and remediation of EZ)
- 2021-2023 ZMEZ2 – OPKŽP – 3.8 million Euros – 40 mining sites
- 2022-2023 ZMEZ3 – OPKŽP – 0.7 million Euro – 19 EZ (Bratislava)





About 350 locations (high and medium priority) - industrial sites, urban environments, landfills, mining waste, paper industry, metallurgy, military sites, etc.

IS MEZ, server MEZ

A large amount of various types of data and information from various types of geological work (geology, hydrogeology, geophysics, geochemistry, engineering geology, remote sensing, modeling, etc.)

A large number of information units (many locations, monitoring points, monitoring cycles, extent of geological work, etc.)

Spatial nature of information – the need for GIS

The need for flexible and efficient data evaluation both from a temporal and spatial point of view

= necessity of efficient organization of storage, subsequent processing (interpretation) and archiving of data - SERVER with central storage of spatial data of a text, data and database nature

Monitorovanie EZ - databázový server

VŠEOBECNÉ INFORMÁCIE

- (●) **všeobecné informácie o lokalitách** / názov tabuľky v DB: lokality_centroidy
- ( ) **zoznam všetkých objektov** / názov tabuľky v DB: objekty
- ( ) **všeobecné informácie o vrtoch** / názov tabuľky v DB: vrty_info
- ( ) **časovo premenlivé údaje o objektoch** / názov tabuľky v DB: objekt_zmeny

TERÉNNE CHARAKTERISTIKY

- ( ) **terénne charakteristiky vôd / odber vzoriek vôd na analýzu** / názov tabuľky v DB: teren_vody
- ( ) **vlastnosti zemín a hornín v profiloch vrtov** / názov tabuľky v DB: teren_horniny_zeminy
- ( ) **vlastnosti / terénne charakteristiky pôd** / názov tabuľky v DB: teren_pody, vlastnosti_pody
- ( ) **odber pevných vzoriek na analýzu / inžinierskogeologické skúšky** / názov tabuľky v DB: pevne_vzorky_zoznam
- ( ) **inštalácie dataloggerov** / názov tabuliek v DB: dataloggre_instalacia, dataloggre_stahdata

VÝSLEDKY

- ( ) **výsledky inžinierskogeologických laboratórnych skúšok zemín** / názov tabuľky v DB: analyz_zeminy_ig
- ( ) **výsledky chemických (bulk) analýz pevných vzoriek** / názov tabuľky v DB: analyz_pevne_chem
- ( ) **výsledky analýz pevných vzoriek - mikrosonda** / názov tabuľky v DB: analyz_pevne_sonda
- ( ) **výsledky chemických a izotopových analýz vôd** / názov tabuliek v DB: analyz_vody_chem, analyz_vody_izotop
- ( ) **informácie o čerpacích a stúpacích skúškach** / názov tabuliek v DB: vrty_skusky_zoznam, vrty_skusky_vysledky
- ( ) **spracované údaje z dataloggerov** / názov tabuľky v DB: dataloggre_data

MONITOROVANIE

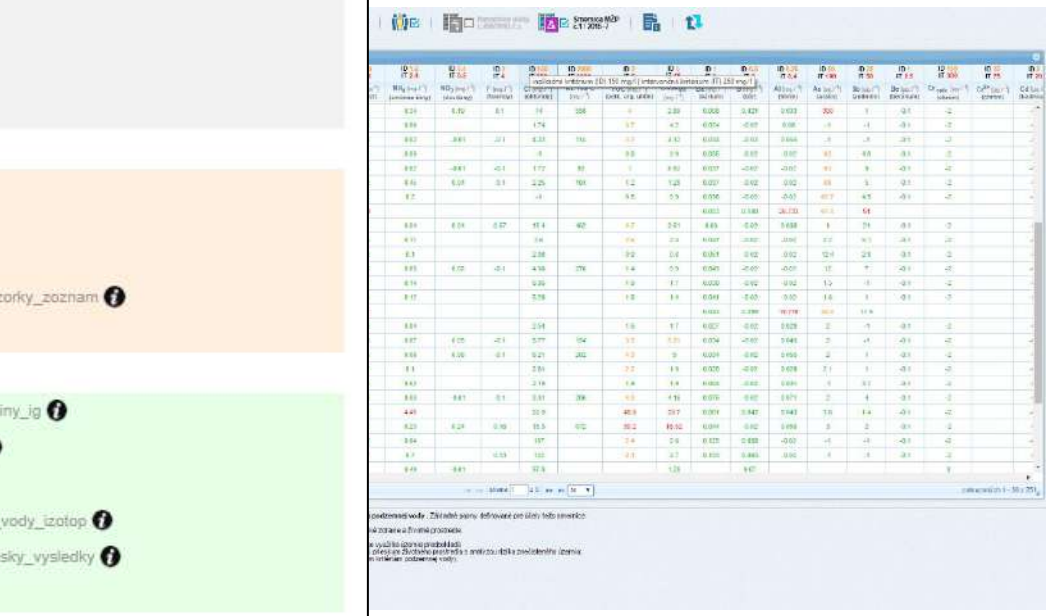
- ( ) **plánovanie monitorovania na objektoch** / názov tabuliek v DB: monit_schemy_zozn, monit_datum, monit_schemy_def

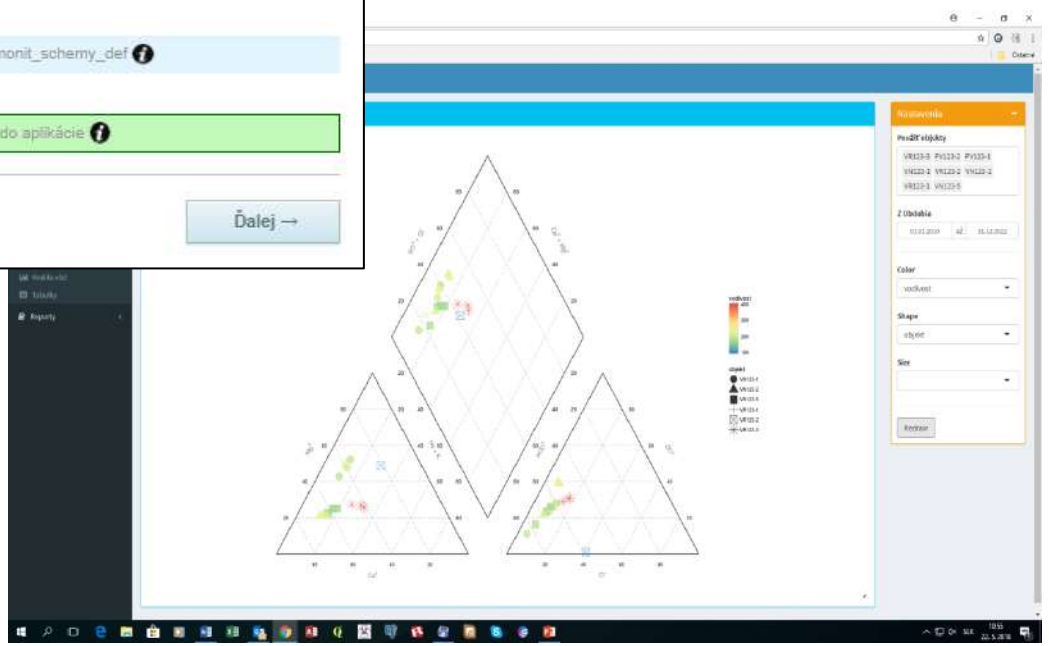
MEZONATOR

- ( ) **MEZonator 3.0** / vizualizácia dát, grafy, štatistické modelovanie... / po prihlásení budete presmerovaní do aplikácie

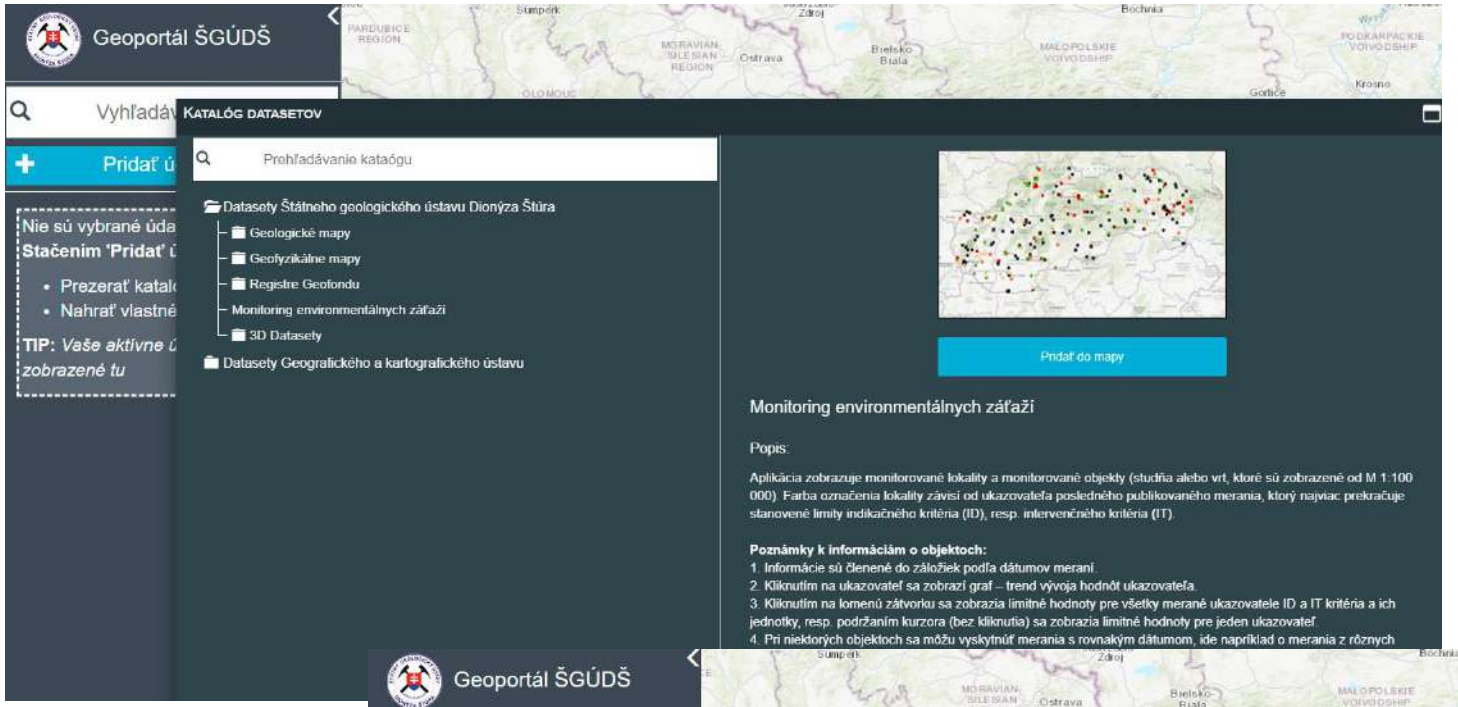
Prosím, vyberte si zo zoznamu a kliknite na tlačidlo Ďalej...

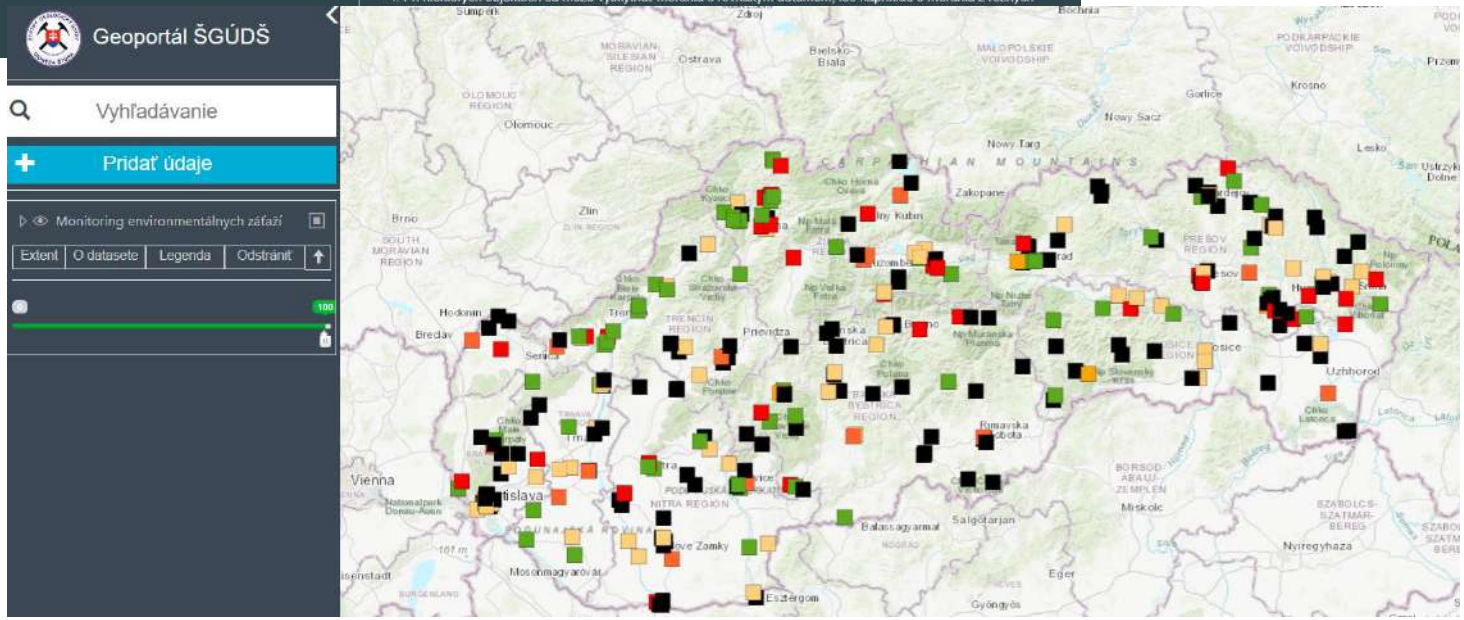
Ďalej →





Geoportál ŠGÚDŠ (https://apl.geology.sk/mp2)

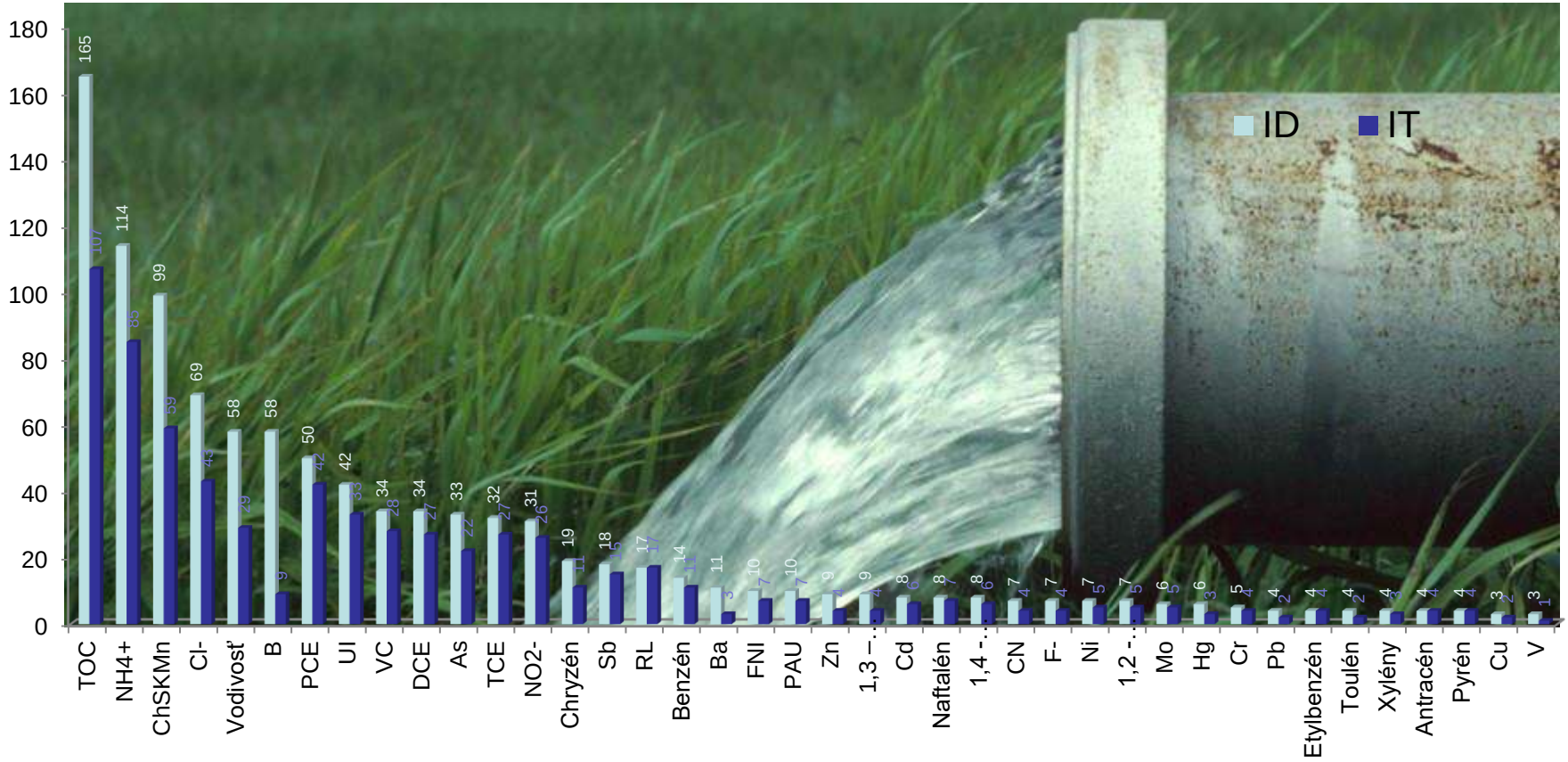




Monitoring results - groundwater

- the chemical composition of the waters in the vicinity of the majority of monitored EZs has changed - a greater presence of substances of secondary origin (Na+, Cl-, sulfates) - anthropogenically changed water types, e.g. Ca-Na-Cl-HCO3, etc.
- average value of M of groundwater 903.8 mg.l-1 (background level mostly 150-600 mg.l-1)
- Increased content of Cl-, NH4+ and ChSK-Mn in connection with pollution from waste management facilities
- NELui (C10-C40) pollution represented mainly by petroleum substances almost exclusively in military facilities as well as in industrial production (chemical production, engineering production)
- As, Sb pollution in connection with waste management facilities and mining sites
- ClU (aliphatic chlorinated hydrocarbons) approx. 20% of locations, the highest exceedances are mainly related to industrial production, but also to the storage and distribution of goods and to waste loading facilities

The number of locations with exceeding the limit values of ID and IT according to the Directive of the Ministry of the Interior of the Slovak Republic No. 1/2015-7

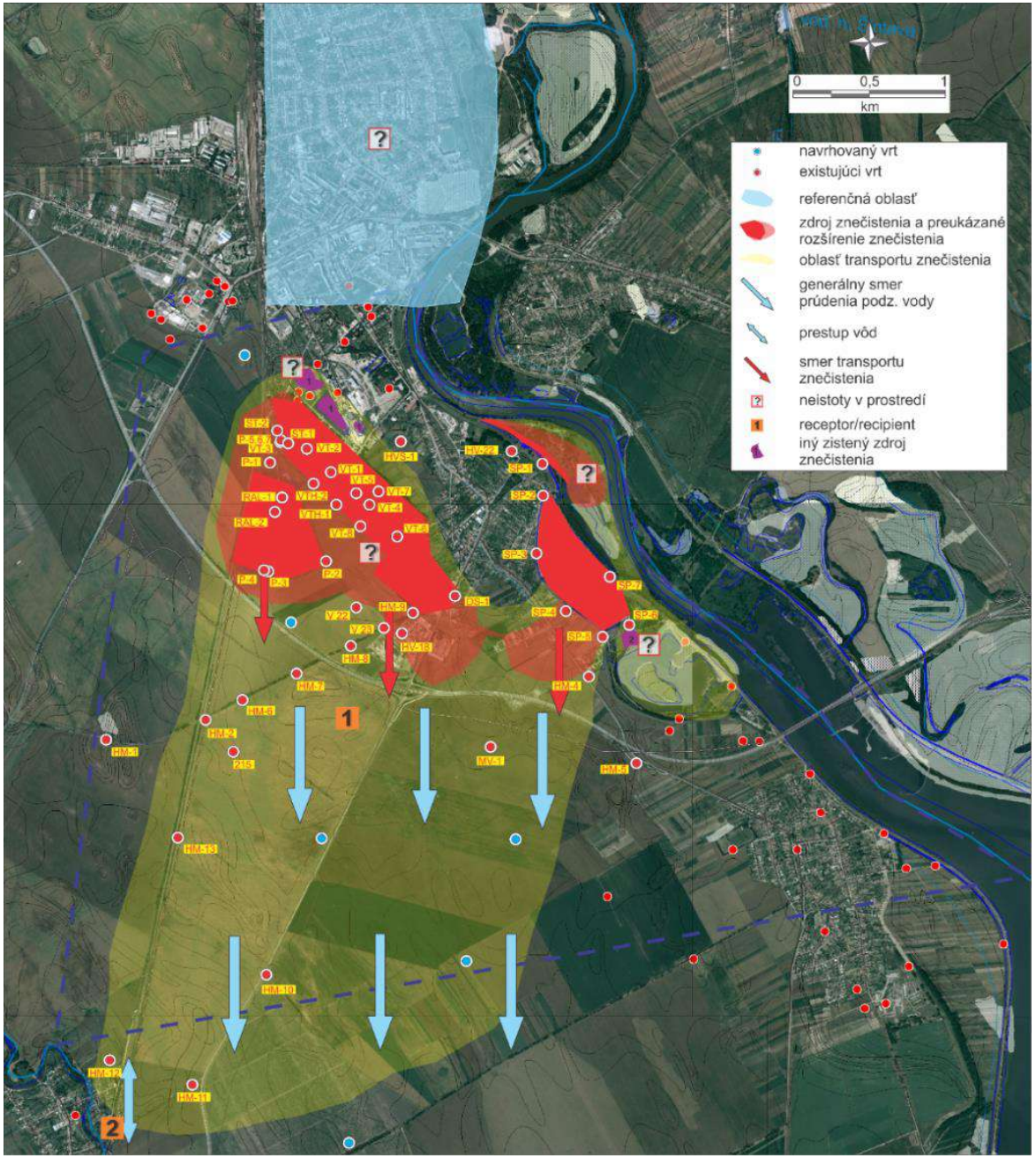


Location: Sereď – nickel smelter and processing waste dump

- Neogene and Quaternary sediments (valley floodplain - gravel, sand, sandy gravel, 8-10 m thick)
- water level in Váh in hydraulic dependence with groundwater
- quaternary gravel sands – very good groundwater collector, high hydraulic conductivity
- replenishment of underground water - precipitation activity, seepage from surface flows

- processing waste dump - waste from the production of Ni and Co in the former plant Niklová huta š.p.
- industrial production 1963 – 1993 focused on the processing of Fe-Ni ore by hydrometallurgical method
- the estimate of the material in the Luženca landfill is approximately 6.5 million. tons (in the highest part the height is approximately 35 m)
- source of contamination – pollution by leachate from the Luženac landfill into groundwater and its spread to the distant surroundings of the landfill
- pollution under the slag field gradually eliminated by dispersion and diffusion processes in relatively dynamic HG conditions of the riparian zone of the water reservoir Kráľová na Váhu

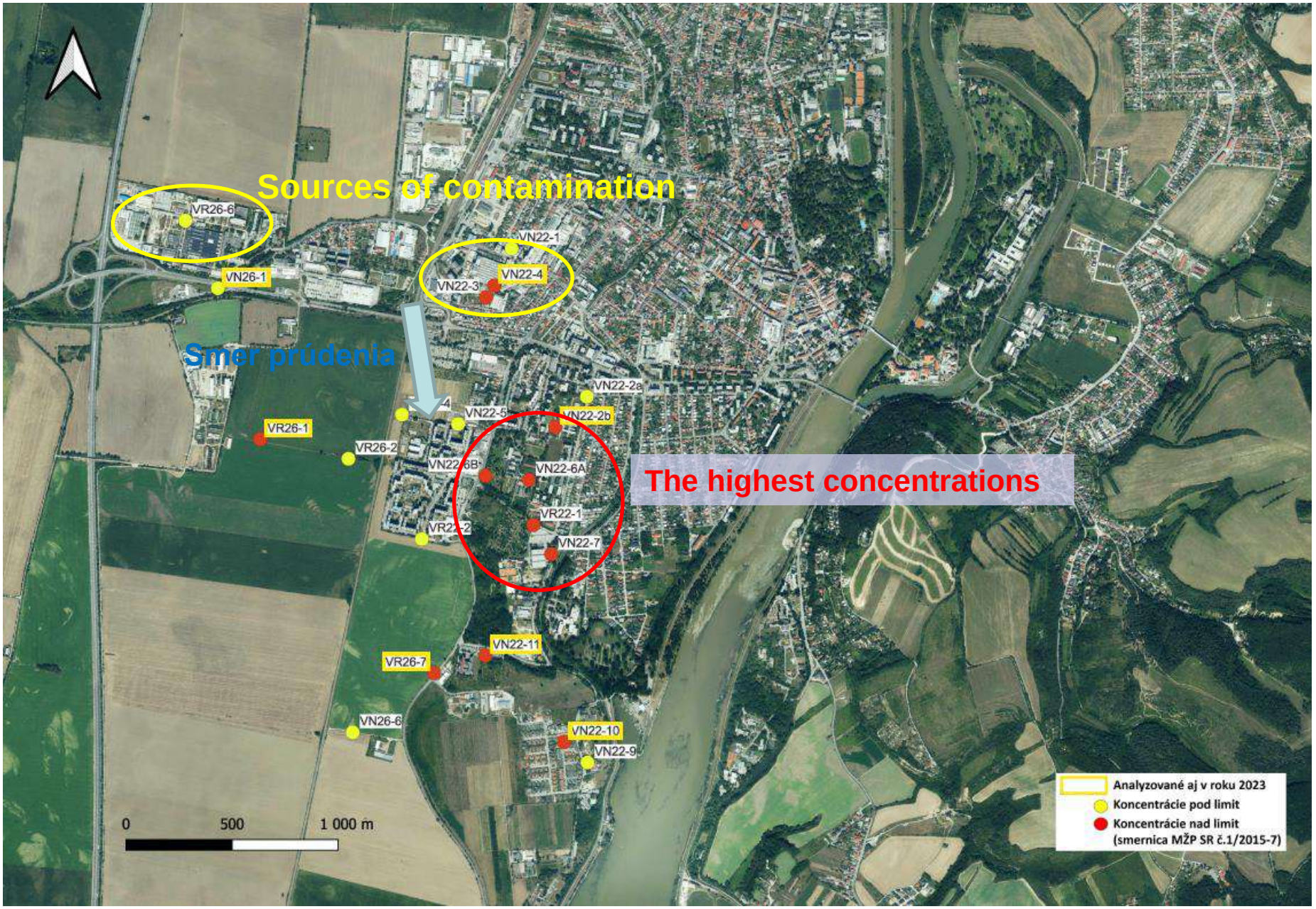
unloaded part of waste dump



- Part of the pollution relatively distant from the original source
- The highest concentrations – an area with intensive agricultural activity (between the municipalities of Dolná Streda, Gáň, Nebojsa, Terezov, Gorazdov dvor)
- The leachate landfill is also a significant source of dust (increased Ni and Cr contents in soils - 500 mg/kg and 800 mg/kg, respectively)

Piešťany – Chirana (Tesla)

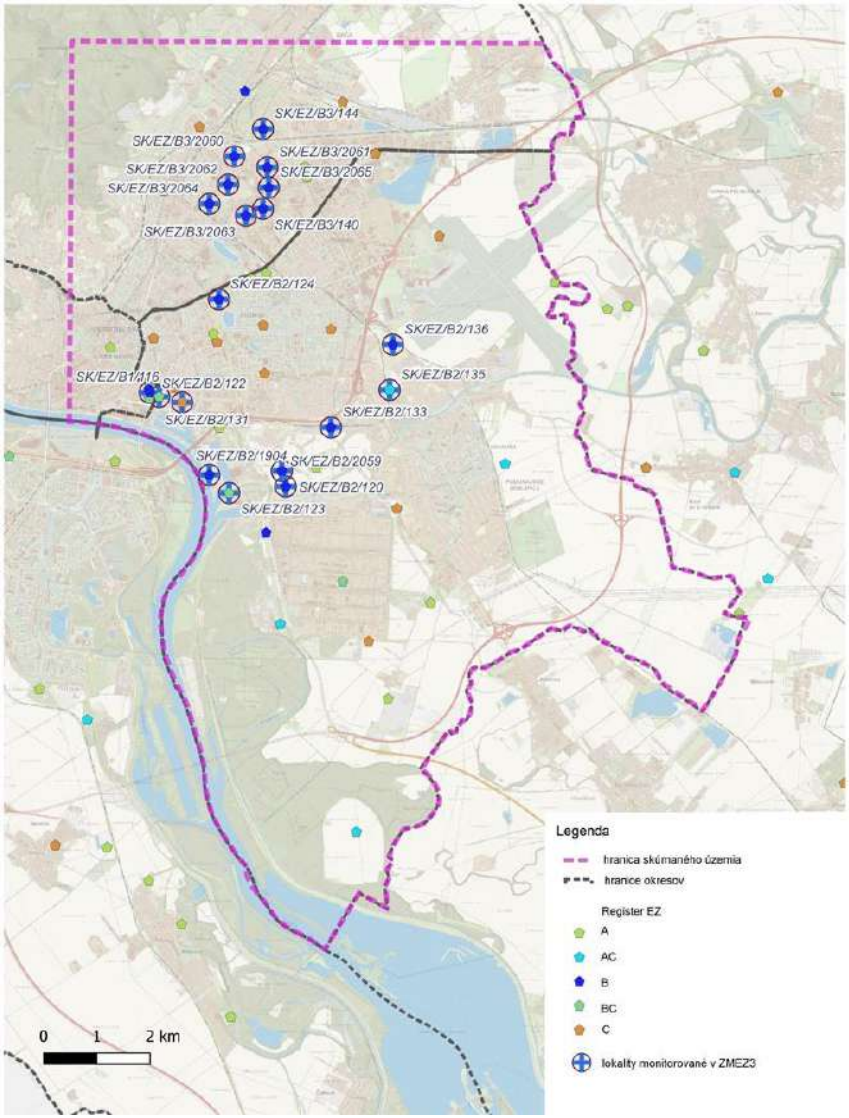
- Pollution by aliphatic chlorinated hydrocarbons (engineering):
- The presumed cause is carelessness in the handling of harmful substances during industrial production and related inadequate storage conditions and handling procedures in the 1980s
- Since 1997 - primarily development, production, sale and service of dental technology
- Production processes included the operations of degreasing metal products before their surface treatment, plating (zinc, copper, nickel, chrome and anodizing), production and disposal of alkaline-acidic and chromium waters at the neutralization station
- For the purpose of degreasing, mainly 1,1,2-trichloroethene and 1,1,2,2-tetrachloroethene were used to an increased extent in the areas of the galvanizing and paint shops
- The pollution affected the former industrial but also the current residential zone
- Quaternary gravels – thickness up to 20 m, good permeability
- Area extent of contamination approx. 4 km2
- ClU pollution detected S to SE of the Tesla site, as well as S to SE of the Chirana site (highest contents detected especially along the line of Bratislavská cesta, west of the Dubová canal)


Sources of contamination
VR26-6
VN22-1
VN26-1
VN22-4
VN22-3
Smer prúdenia
VN22-2a
VN22-5
VN22-2b
VR26-1
VR26-2
VN22-6A
The highest concentrations
VR22-1
VN22-7
VN22-11
VR26-7
VN26-6
VN22-10
VN22-9
0
500
1 000 m
Analyzované aj v roku 2023
Koncentrácie pod limit
Koncentrácie nad limit
(smernica MŽP SR č.1/2015-7)


0
250
500 m
oblasť s veľkou pravdepodobnosťou znečistená chlórovanými uhľovodíkmi v podzemnej vode
oblasť pravdepodobne ohrozená znečistením chlórovanými uhľovodíkmi v podzemnej vode
monitorovacie vrty

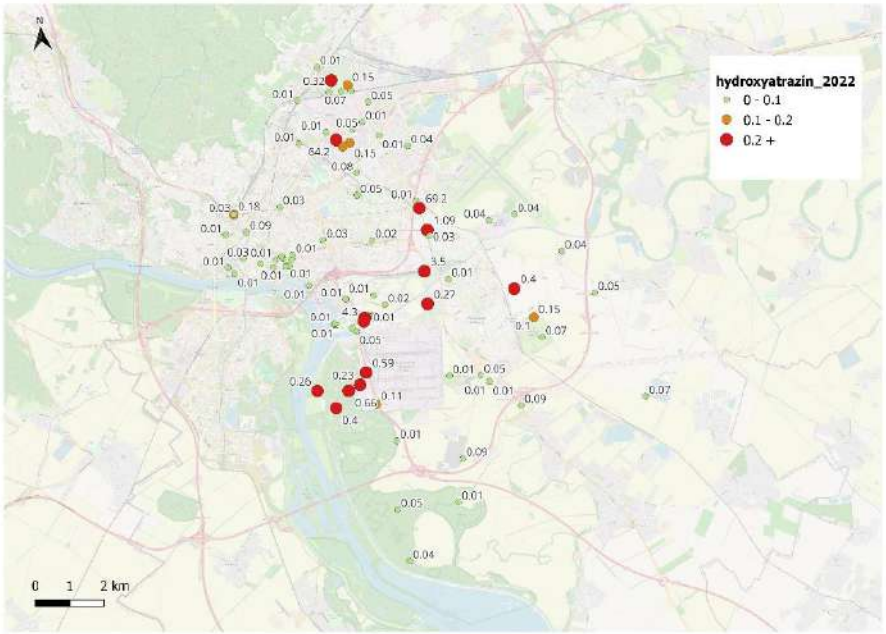

0
250
500 m
oblasť s veľkou pravdepodobnosťou znečistená chlórovanými uhľovodíkmi v podzemnej vode
oblasť pravdepodobne ohrozená znečistením chlórovanými uhľovodíkmi v podzemnej vode
monitorovacie vrty

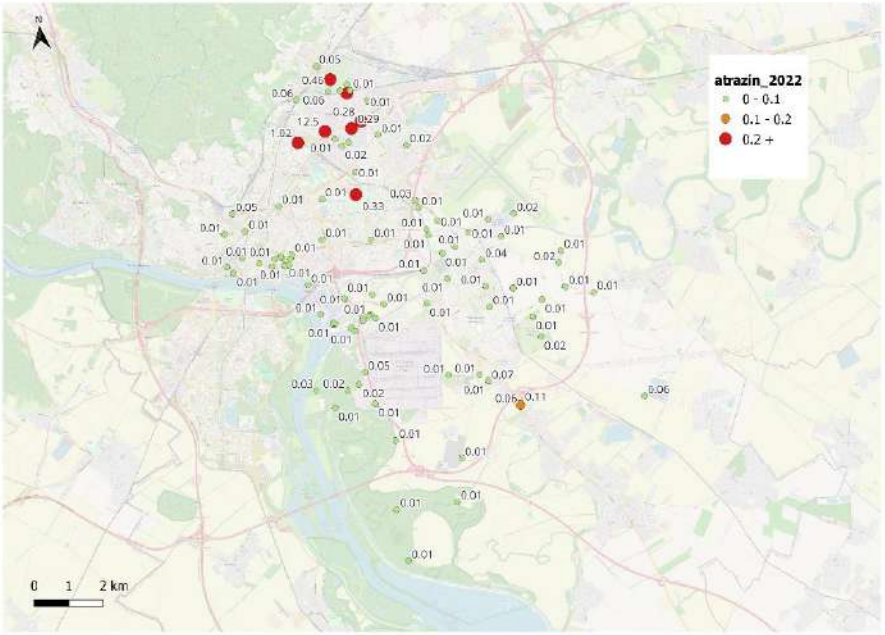
Ensuring the monitoring of environmental burdens in Slovakia – Part 3 (ZMEZ3)

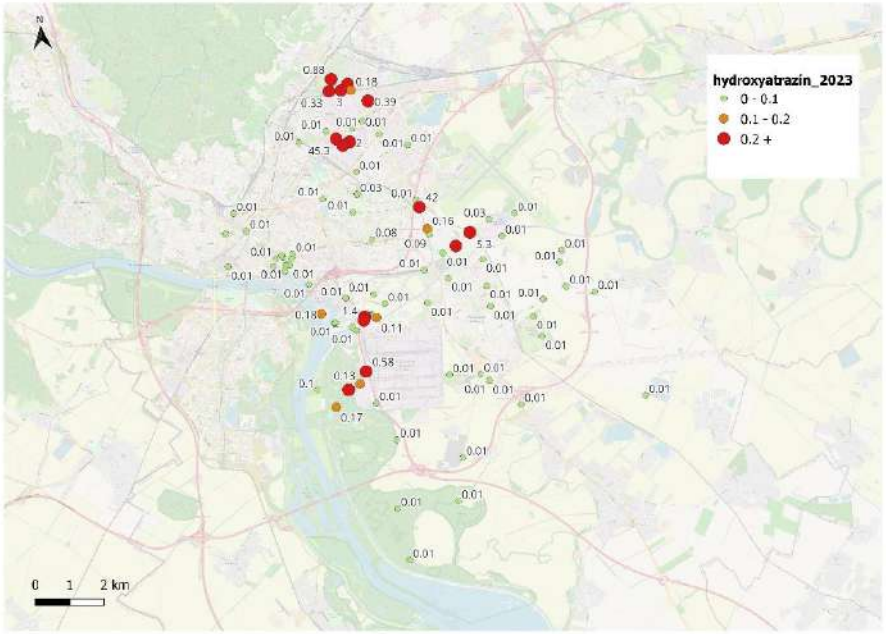


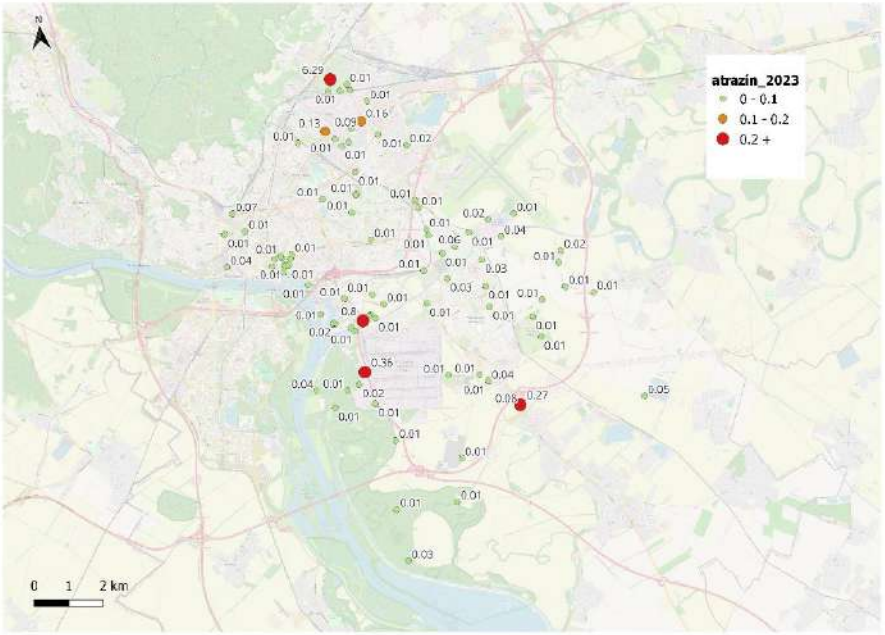
Objectives:

- **defining the surface and spatial extent and level of pollution in groundwater**
- **identification and characterization of pollutants, including their quantitative and qualitative parameters in groundwater**
- **evaluation of the way pollution spreads and the development of groundwater pollution**
- **proposal for the addition and completion of the underground water monitoring network in relation to the identified and probable environmental burdens**


hydroxyatrazin_2022
0 - 0.1
0.1 - 0.2
0.2 +
0 1 2 km


atrazin_2022
0 - 0.1
0.1 - 0.2
0.2 +
0 1 2 km


hydroxyatrazin_2023
0 - 0.1
0.1 - 0.2
0.2 +
0 1 2 km

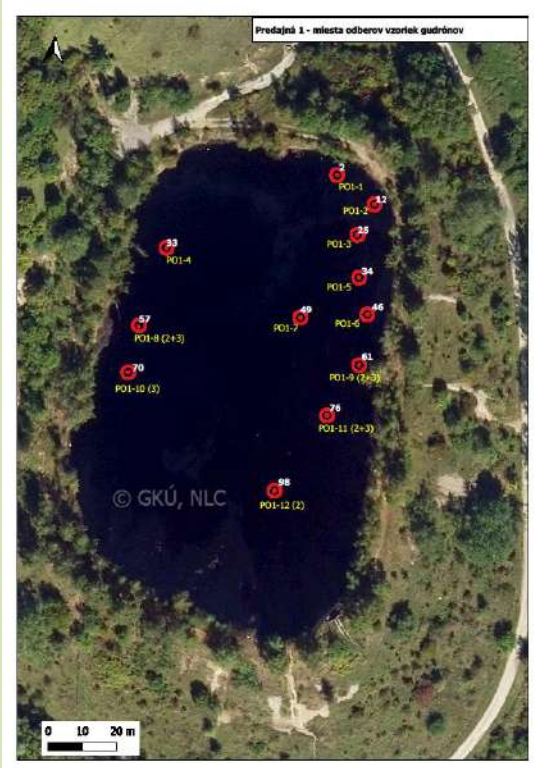

atrazin_2023
0 - 0.1
0.1 - 0.2
0.2 +
0 1 2 km

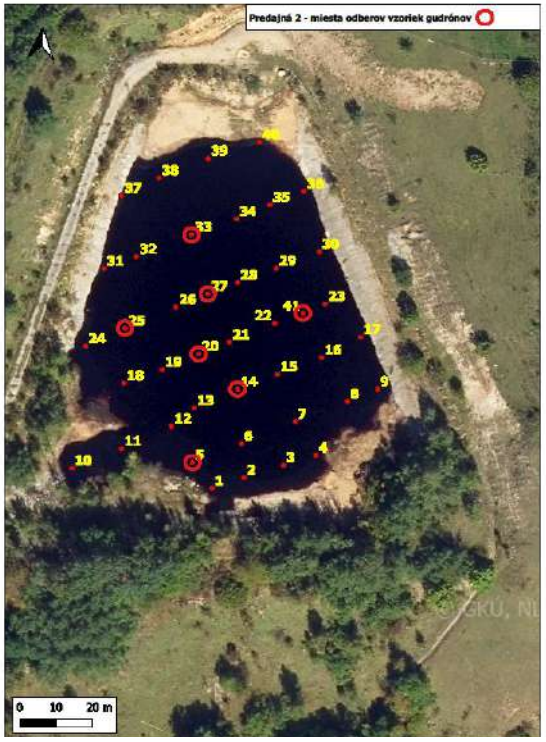
GEOLOGICAL INVESTIGATION OF SELECTED ENVIRONMENTAL BURDENS 4 - ŠGÚDŠ

DESCRIPTION OF THE STUDIED LOCATION

The refinery in Dubova was built in the years 1935-1937, the first test production was in September 1938. Gbely non-paraffinic oil, which did not contain gasoline, was processed. The refinery had a boiler distillation of oil with a capacity of 40 kt/y. In addition to refining imported gasoline from Romania, it produced high-quality transformer and cable oils using sulfuric acid refining. The resulting acid resins (tars) were neutralized with lime and sold to Switzerland. The refinery was damaged by bombing at the end of World War II.

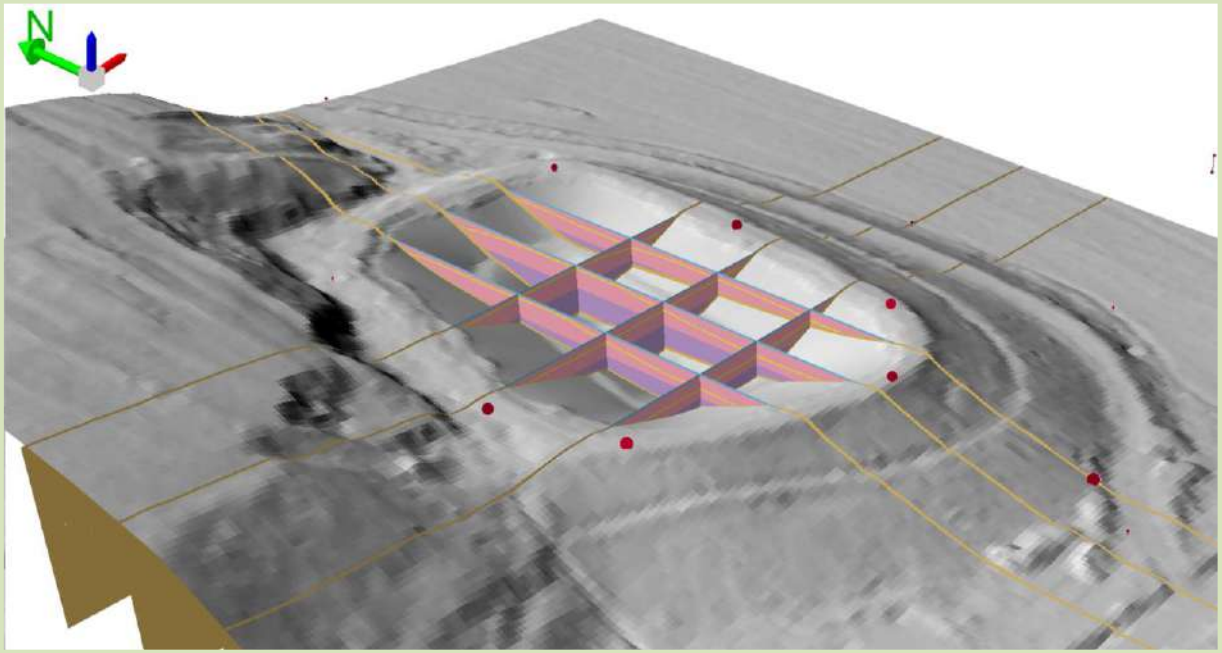
After nationalization, the production program and processed oil were partially adjusted. From 1947, white medicinal oils and sulfonates began to be produced. Later, production of alkyl aryl sulfonates (Ballestra technology) was added to the production program. At first, the waste was stored in the premises of the company in Dubova. Later, Predajná I (1963-1976) and Predajná II (1974-1982) landfills were built. In 1975, the Predajná I landfill was covered with an unproven solution, in which geotextiles, Bitumax asphalt strips, dolomite, bleaching clay, PVC film, soil were used on the wooden structure. The structure later sank and the composition of the wastes may be affected by this. Part of the stored material from the Predajná I landfill was pumped to the Predajná II landfill (1975-1976). An incinerator was later built in the Petrochema Dubová area, where waste from the Predajná II landfill was burned in the period 1974-1982. The original records of the composition and amount of deposited waste are not known.





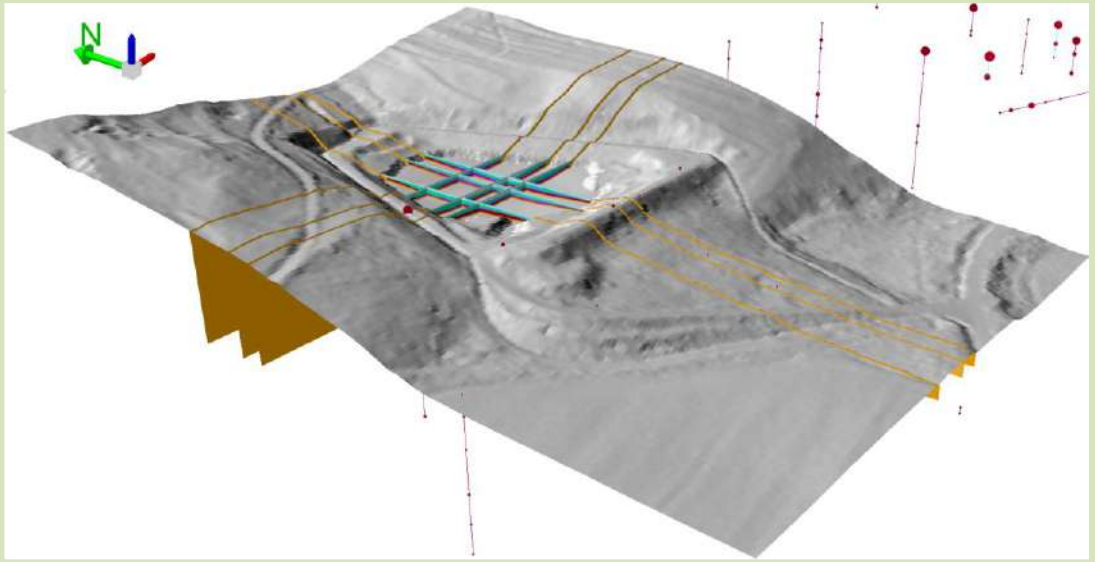
Obrázok 1: Mapa odberov vzoriek Predajná I.

Obrázok 2: Mapa odberov vzoriek Predajná II.



Obr. č. 1 Predajná I: Voxelový 3D model (vybraté S-J a V-Z rezy): Geologické vrty s obsahmi NEL GC. LiDAR DMR s krokom 1x1m

Modelované bázy rozhraní: kvapalná fácia, plastická fácia, tuhá fácia, ponorená prekážka Vrty: NEL-GC:



Obr. č. 1 Predajná II: Voxelový 3D model (vybraté S-J a V-Z rezy s krokom 10m). Geologické vrty s obsahmi NEL GC. LiDAR DMR s krokom 1x1m.

Modelované bázy rozhraní: podložie, íl, tuhá fáza, plastická fáza, kvapalina Vrty: NEL-GC:

Facies	liquid	pasty	solid	weathered bedrock	TOTAL
Predajná I					
volume (m3)	5 720	35 900	15 700	4 200	**61 520**
weight (t)	5 720	39 849	17 898	11 928	**75 395**
Predajná II					
volume (m3)	6 400	6 900	3 000	2 700	**19 000**
weight (t)	6 400	7 659	3 420	7 668	**25 147**

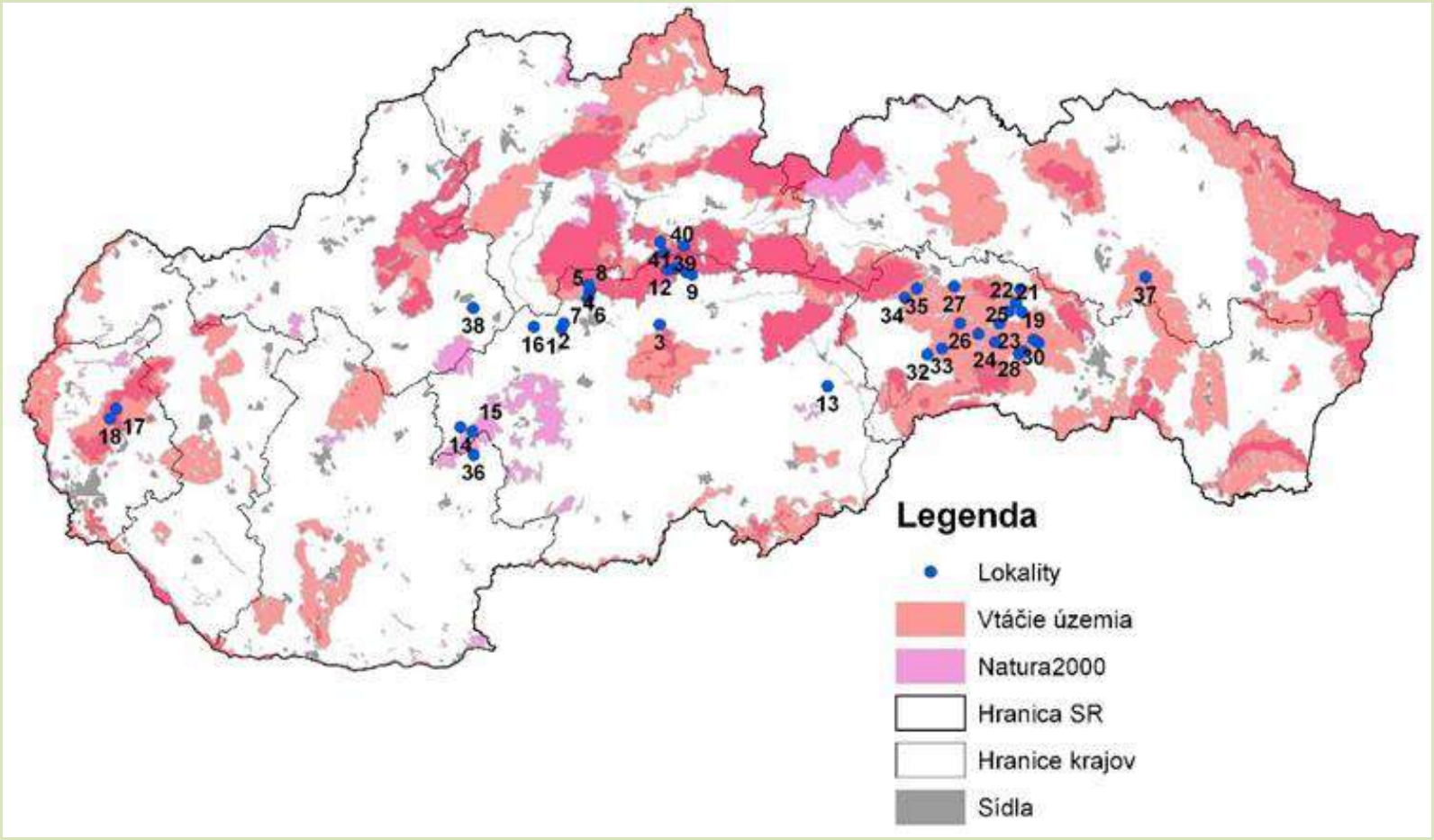
At the Predajná I landfill, there is a collapsed wooden structure under the liquid facies, the volume of which we estimated at 5,300 m3, and in the case of remedial works, this figure will need to be added to the total volume of waste.

Proposal of remediation options

According to the Directive of the MoE no. 1/2015 – 7 the selection of a suitable remediation method is obtained based on the evaluation of remediation scenarios (variants) expressing the various goals of remediation of the polluted area and technological procedures, including an estimate of the necessary financial costs.
For the needs of the next decision-making process, it is necessary to develop and compare 4 rehabilitation scenarios (variants)
a) zero variant,
b) isolation of the territory,
c) remediation up to the proposed remediation target values,
d) complete removal of pollution.

The zero variant represents the current state, i.e. j. polluted territory without remedial intervention. It is necessary to assess whether it is not enough to propose only protective organizational measures in the investigated area, such as the prohibition of bathing, watering, drinking water from wells, consumption of fish from water reservoirs, or surface flows, etc., or it is necessary to start remediation of the polluted area, or minimal groundwater monitoring.
Isolation of the territory is a passive remediation intervention, the goal of which is to prevent the spread of groundwater pollution into the surroundings by means of technical barriers. Active remediation work will not be carried out in the polluted area itself, and in the event of a change in its use, it will probably be necessary to carry it out. Isolation is particularly suitable in the event that the persistence of the activity of sources of pollution is assumed, or there is an increased risk of emergency leaks in the locality, therefore it is necessary to ensure regular and long-term monitoring of groundwater.
Remediation in selected parts of the territory up to the proposed remediation target values is an active remediation intervention, the aim of which is to reduce the concentration of pollutants to an acceptable level in those parts of the polluted territory, where their presence may represent the most significant risks.

Ensuring the monitoring of environmental burdens in Slovakia – Part 2 (ZMEZ2)



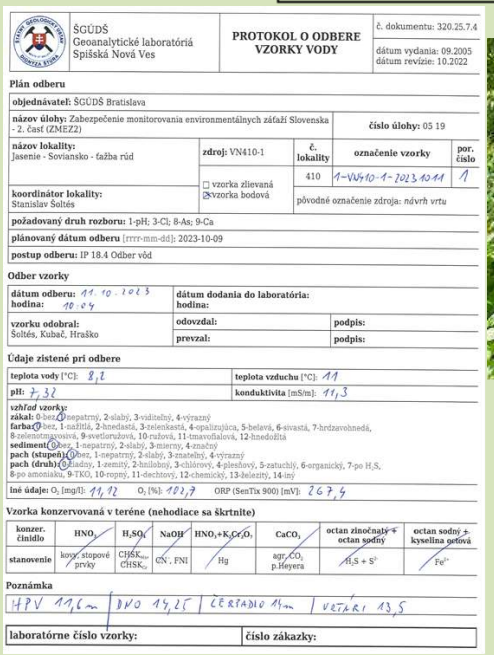
The main goal – ensuring the monitoring of selected 40 EZs in Slovakia with a focus on locations after mining activity

Sampling, field measurements and laboratory work

- **Sampling work during drilling operations from 135 wells - 158 disturbed soil samples. Of these, 47 were classified according to STN 72 1001 as fine-grained soils, 15 as sandy soils and 96 as gravelly soils, 148 chemical samples**

Terénne merania	2021	2022	2023	Spolu
Podzemné vody	263	349	662	**1274**
Povrchové vody	340	448	464	**1252**
Spolu	***603***	***797***	***1126***	***2526***

Odber vzoriek	2021	2022	2023	Spolu
Podzemné vody	127	326	606	**1059**
Povrchové vody	186	429	432	**1047**
Spolu	***313***	***755***	***1038***	***2106***



ŠGÚDŠ
Geoanalytické laboratóriá
Spišská Nová Ves

PROTOKOL O ODBERE VZORKY VODY

č. dokumentu: 320.25.7.4
dátum vydania: 09.2005
dátum revízie: 10.2022

Plán odberu

objednávateľ: ŠGÚDŠ Bratislava

názov úlohy: Zabezpečenie monitorovania environmentálnych záťaží Slovenska - 2. časť (ZMEZ2) — **číslo úlohy:** 05 19

názov lokality: Jasenie - Sovjansko - fažba rúd — **zdroj:** VN410-1 — **č. lokality:** 410 — **označenie vzorky:** 1-VN410-1-2023.10.11 — **por. číslo:** 1

koordinátor lokality: Stanislav Šoltés

☐ vzorka zlievaná ☒ vzorka bodová

pôvodné označenie zdroja: *návrh vrtu*

požadovaný druh rozboru: 1-pH; 3-Cl; 8-As; 9-Ca

plánovaný dátum odberu [rrrr-mm-dd]: 2023-10-09

postup odberu: IP 18.4 Odber vôd

Odber vzorky

dátum odberu: 11.10.2023 **hodina:** 10:04 — **dátum dodania do laboratória:** **hodina:**

vzorku odobral: Šoltés, Kubač, Hraško — **odovzdal:** **podpis:** — **prevzal:** **podpis:**

Údaje zistené pri odbere

teplota vody [°C]: 8,2 — **teplota vzduchu** [°C]: 11

pH: 7,32 — **konduktivita** [mS/m]: 11,3

vzhľad vzorky:
zákal: 0-bez, 1-nepatrný, 2-slabý, 3-viditeľný, 4-výrazný
farba: 0-bez, 1-sivastá, 2-hnedastá, 3-zelenkastá, 4-opalizujúca, 5-belavá, 6-sivastá, 7-hrdzavohnedá, 8-zelenotmavosivá, 9-svetlooružová, 10-ružová, 11-tmavofialová, 12-hnedočervená
sediment: 0-bez, 1-nepatrný, 2-slabý, 3-mierny, 4-značný
pach (stupeň): 0-bez, 1-nepatrný, 2-slabý, 3-znateľný, 4-výrazný
pach (druh): 0-žiadny, 1-zemitý, 2-hnilobný, 3-chlórový, 4-plesňový, 5-zatuchlý, 6-organický, 7-po H_2S, 8-po amoniaku, 9-TKO, 10-ropný, 11-dechtový, 12-chemický, 13-železitý, 14-iný

iné údaje: O_2 [mg/l]: 11,12 — O_2 [%]: 102,7 — ORP (SenTix 900) [mV]: 267,4

Vzorka konzervovaná v teréne (nehodiace sa škrtnite)

konzer. činidlo	HNO_3	H_2SO_4	NaOH	$HNO_3+K_2Cr_2O_7$	$CaCO_3$	octan zinočnatý + octan sodný	octan sodný + kyselina octová
stanovenie	kovy, stopové prvky	$CHSK_{Mn}$, $CHSK_{Cr}$	CN⁻, FNI	Hg	agr., CO_2 p.Heyera	$H_2S + S^{2-}$	Fe^{3+}

Poznámka

HPV 11,6 m | DNO 14,25 | ČERPADLO 14 m | VEŤAH 13,5

laboratórne číslo vzorky: — **číslo zákazky:**

Sampling, field measurements and laboratory work

- **Sampling and field work (soils) – 135 samples**
- **Sampling and field work (river sediments) – 240 samples**
- **Sampling and field work (heap sediments) – 69 samples**

Sampling, field measurements and laboratory work

- **Analytical work on an electron microanalyzer (EPMA)**

	rok 2021	rok 2022	rok 2023	spolu
počet analyzovaných vzoriek	26	159	221	**406**
analýzy oxidov	420	3698	3485	7603
analýzy kovov	23	329	394	746
počet analýz	443	4027	3879	**8346**
počet fotografií	529	4162	3793	**8484**

Rákoš - old mining works

Cooperation with PriF UK, SNM (monitoring + survey: water, soil, rock environment, ochre, mushrooms...)

APVV-21-0212 "Selected environmental loads as a stress factor affecting biodiversity and health risks for exposed population groups."

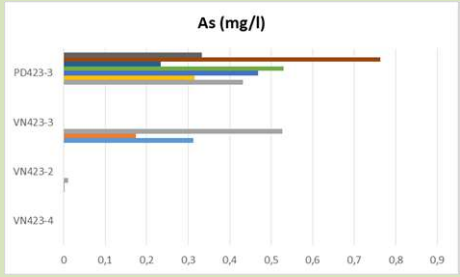
APVV-17-0317 Antimony - a critical element and a hazardous contaminant affecting biodiversity at mining waste sites

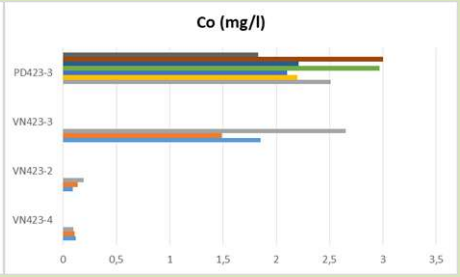
- **The main environmental risk is the formation of acidic mine waters directly in the body of the heaps after the mining of Hg ores caused by the decomposition of sulphide minerals (mainly pyrite). Acidic waters apparently decompose the surrounding rocks located on the heap, which are a source of other potentially toxic elements (Co, Ni, Cr)**
- **Mine waters from the heap near the Hg shaft are captured by drainage shafts, but are subsequently diverted to the recipient flowing through the village of Rákoš. When these acidic mine waters are mixed with surface waters, they are neutralized and Fe oxyhydroxides precipitate.**
- **Seepage of strongly acidic waters on the second heap near the Petrlína tunnel is not captured and apparently seeps into the groundwater.**

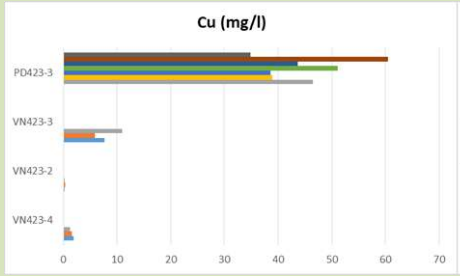
objekt	dátum odberu	pH ter. (reakcia vody) [-]	EK pri 25 °C ter. (merná el. vodivosť) [mS/m]	Al (hliník) [mg/l]	As (arzén) [µg/l]	Sb (antimón) [µg/l]	Pb (olovo) [µg/l]	Co (kobalt) [µg/l]	Ni (nikel) [µg/l]	Cd (kadmium) [µg/l]	Cu (meď) [µg/l]	Zn (zinok) [µg/l]	Mo (molybdén) [µg/l]	V (vanád) [µg/l]	Cr (chróm celk.) [µg/l]	Hg (ortuť) [µg/l]
ID		*6 – 6,5 a 8,5 – 9*	*200,000*	*0,250*	*50,000*	*25,000*	*100,000*	*100,000*	*100,000*	*5,000*	*1000,000*	*1500,000*	*180,000*	*150,000*	*150,000*	*2,000*
IT		*< 6 a > 9*	*300,000*	*0,400*	*100,000*	*50,000*	*200,000*	*200,000*	*200,000*	*20,000*	*2000,000*	*5000,000*	*350,000*	*300,000*	*300,000*	*5,000*
PD423-2	2021-12-01	2.58	735,000	259,000	21,200	-0,500	26,700	4110,000	2080,000	7,600	13100,000	1680,000	-3,000	51,000	163,000	-0,100
PD423-2	2022-04-22	2.34	792,000		8,700	0,700	22,300	5360,000	2350,000	6,800	37700,000	2290,000	-3,000	12,000	263,000	
PD423-3	2021-12-01	2.21	622,000	70,800	333,000	0,600	-0,500	1830,000	1400,000	8,900	34900,000	1660,000	-3,000	11,000	35,000	0,200
PD423-3	2022-06-30	2.42	864,000	114,000	762,100	0,700	0,700	3000,000	2050,000	16,500	60500,000	2540,000	-3,000	14,000	55,000	-0,100
PD423-3	2022-09-07	2.42	628,000	78,400	234,000	-5,000	-5,000	2210,000	1440,000	8,700	43700,000	1700,000	-3,000	14,000	39,000	-0,100
PD423-3	2022-12-01	2.43	769,000	92,900	529,000	-5,000	-5,000	2970,000	1680,000	14,200	51100,000	1940,000	-3,000	22,000	47,000	-0,100
PD423-4	2021-12-01	2.18	589,000	66,800	295,000	0,500	-0,500	1820,000	1350,000	8,500	33300,000	1590,000	-3,000	11,000	34,000	0,200
PD423-4	2022-06-30	2.54	863,000	116,000	701,600	0,700	0,700	2860,000	2060,000	16,100	61300,000	2640,000	-3,000	13,000	55,000	-0,100
PD423-4	2022-09-07	2.26	724,000	97,400	413,000	-5,000	-5,000	2650,000	1720,000	12,400	76600,000	2140,000	-3,000	19,000	48,000	0,200
PD423-4	2022-12-01	2.31	786,000	101,000	461,000	-5,000	-5,000	3150,000	1780,000	12,000	55400,000	2070,000	-3,000	28,000	50,000	-0,100
PD423-5	2021-12-01	6.28	7,280	0,040	-0,500	-0,500	-0,500	-2,000	-2,000	-0,100	-2,000	6,000	-3,000	-2,000	-2,000	-0,100
PD423-5	2022-06-30	6.41	8,560	0,020	-0,500	-0,500	0,800	-2,000	-2,000	-0,100	2,000	11,000	-3,000	-2,000	-2,000	-0,100
PD423-5	2022-09-07	6.29	13,570	0,160	1,800	-0,500	0,800	4,000	4,000	-0,100	73,000	15,000	-3,000	-2,000	6,000	-0,100
PD423-5	2022-12-01	6.74	48,600	0,010	-0,500	-0,500	-0,500	-2,000	-2,000	-0,100	4,000	14,000	-3,000	-2,000	-2,000	-0,100
PD423-6	2022-06-30	7.43	12,800	0,030	-0,500	-0,500	0,500	-2,000	-2,000	-0,100	8,000	12,000	-3,000	-2,000	-2,000	-0,100
PD423-6	2022-09-07	6.26	25,900	1,400	1,500	-0,500	8,500	12,000	8,000	0,200	70,000	65,000	-3,000	2,000	-2,000	-0,100
PD423-6	2022-12-01	6.57	17,230	0,050	-0,500	-0,500	-0,500	4,000	2,000	-0,100	39,000	15,000	-3,000	-2,000	-2,000	-0,100
PD423-7	2021-12-01	4.8	63,600	0,660	-0,500	-0,500	-0,500	29,000	23,000	0,200	180,000	57,000	-3,000	-2,000	-2,000	0,200
PD423-7	2022-12-01	5.98	74,000	1,030	1,600	-0,500	1,200	136,000	74,000	0,100	437,000	48,000	-3,000	-2,000	-2,000	-0,100

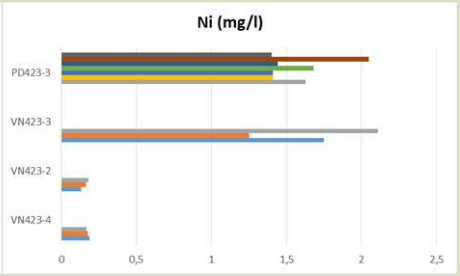
PD423-1	drenážna šachta - západ	začiatok drenáže haldy Rákoš-Hg s úklonom v smere na juhovýchod, nezakrytá, drenážna kvapalina na dne šachty iba po zrážkach !!!
PD423-2	pod haldou Rákoš-Hg, časť Petrlina	priesak spod haldy Rákoš-Hg (časť Petrlina), trvalo zamokrené / zabahnené, mláky, minimálny odtok najmä po zrážkach
PD423-3	**sútoková / drenážna šachta - stred**	**priesaková kvapalina sústredená z oboch strán spod haldy jamy Rákoš-Hg s odtokom**
PD423-4	**výtok z podzemného potrubia drenáže**	**výtok z potrubia drenážnych kvapalín spod haldy jamy Rákoš-Hg do povrchového betónového rigola a odtiaľ do potoka Rákoš**
PD423-5	zrekonštruovaná stará kamenná studňa	pravá strana potoka Rákoš, nad cestou, oproti výtoku drenážnych vôd do potoka
PD423-6	šachta vodovodnej prípojky	šachta s pripovrchovou vodou, JZ pod haldou jamy Rákoš-Hg, nad domom s.č. 117
PD423-7	drenážna šachta - záhrada	kamenný objekt v záhrade pod haldou Rákoš-Hg
PD423-8	priesak spod haldy	Rákošská Baňa
PD423-9	nešpecifikovaný prameň (PD)	

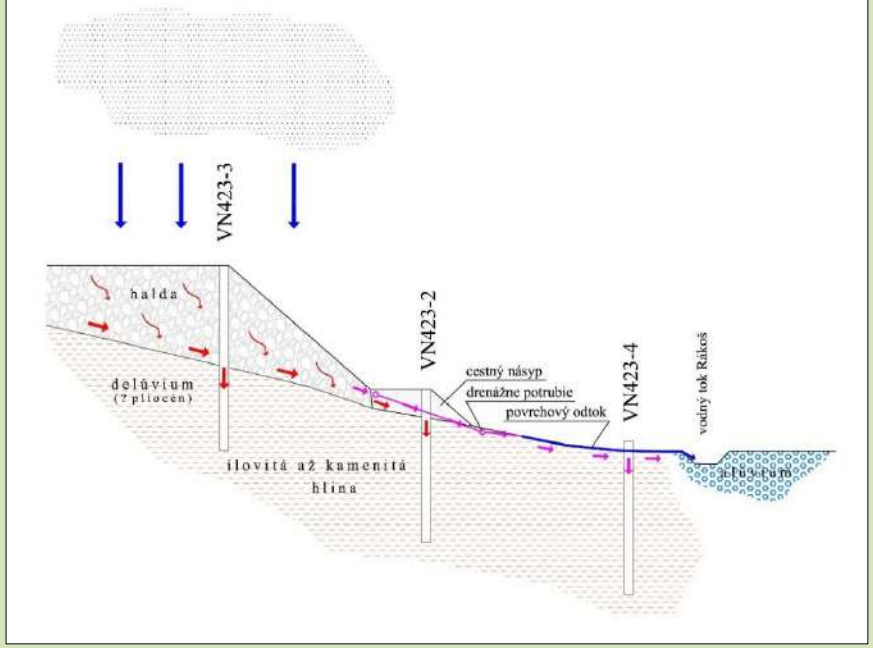
Location Rákoš, tunnels and heaps

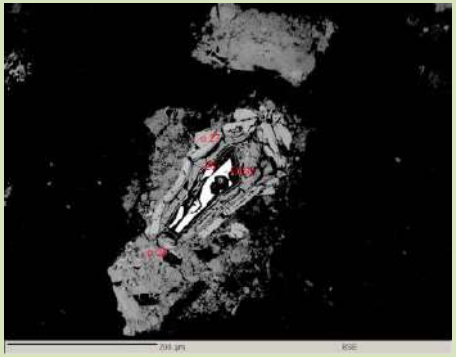


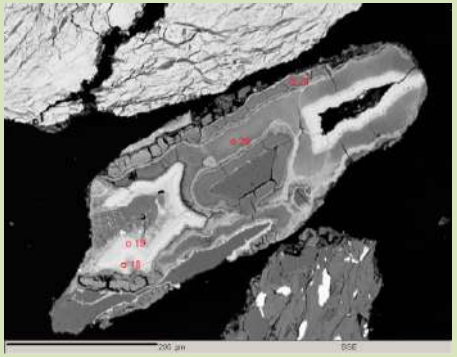




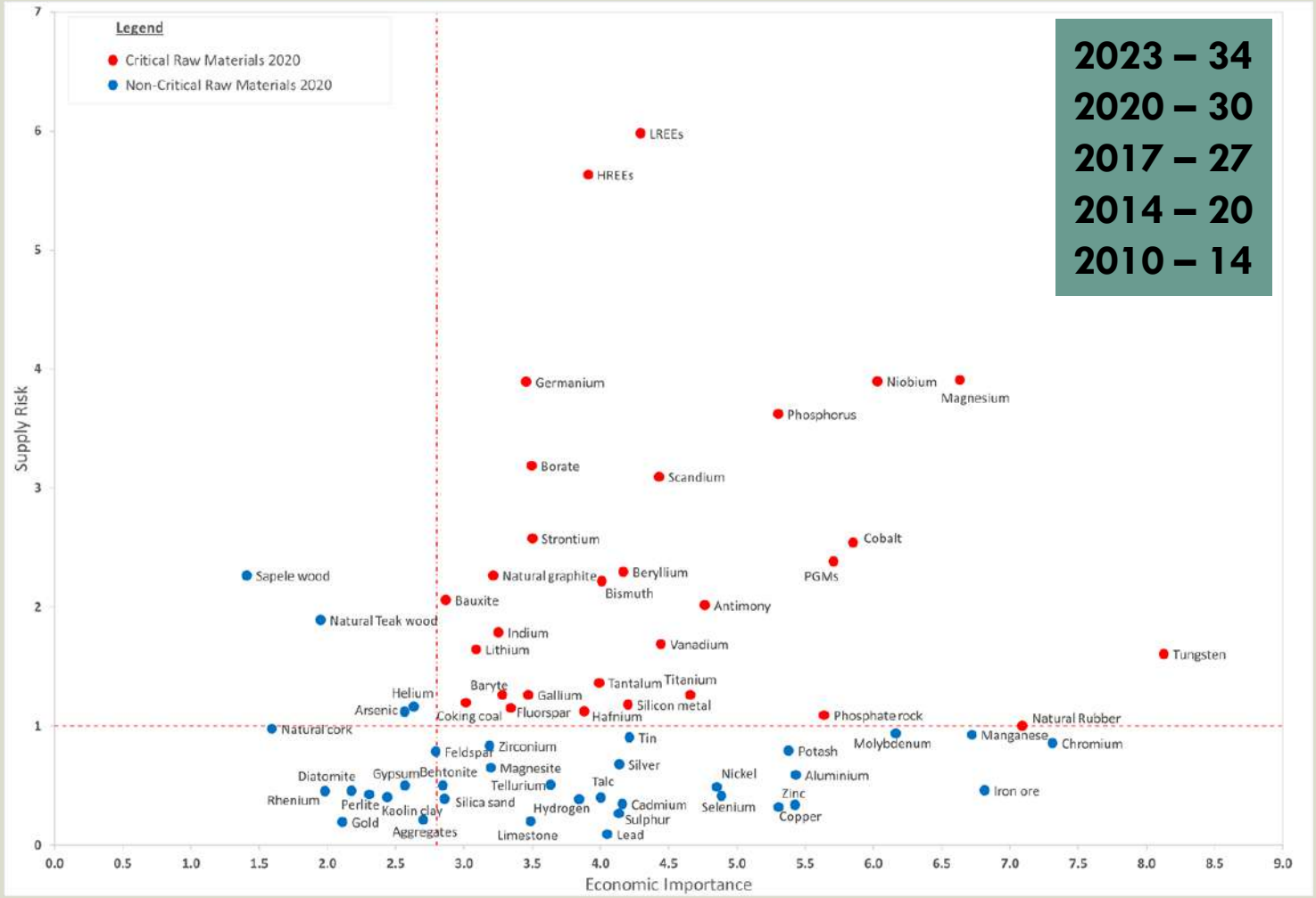








Critical raw materials for the EU



- Strategically and economically important
- They are evaluated every 3 years
- Last - 2023 - 34 CRMs
- Identification method - economic importance and supply risk

Main results of the 2023 criticality assessment

The following 34 raw materials are proposed for the CRM list 2023:

2023 Critical Raw Materials (*new CRMs in italics*)			
aluminium/bauxite	coking coal	lithium	phosphorus
antimony	*feldspar*	LREE	scandium
arsenic	fluorspar	magnesium	silicon metal
baryte	gallium	*manganese*	strontium
beryllium	germanium	natural graphite	tantalum
bismuth	hafnium	niobium	titanium metal
boron/borate	*helium*	PGM	tungsten
cobalt	HREE	phosphate rock	vanadium
		*copper**	*nickel**

* Copper and nickel do not meet the CRM thresholds, but are included as Strategic Raw Materials.

REGULATION (EU) 2024/1252 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 11 April 2024
establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020

CHAPTER 3
STRENGTHENING THE UNION RAW MATERIALS VALUE CHAIN
SECTION 1 Benchmarks
Article 5 Benchmarks

1.The Commission and Member States shall strengthen the different stages of the strategic raw materials value chain through the measures provided for in this Chapter in order to:

(a) ensure that, by 2030, Union capacities for each strategic raw material have significantly increased so that, overall, Union capacity approaches or reaches the following benchmarks:

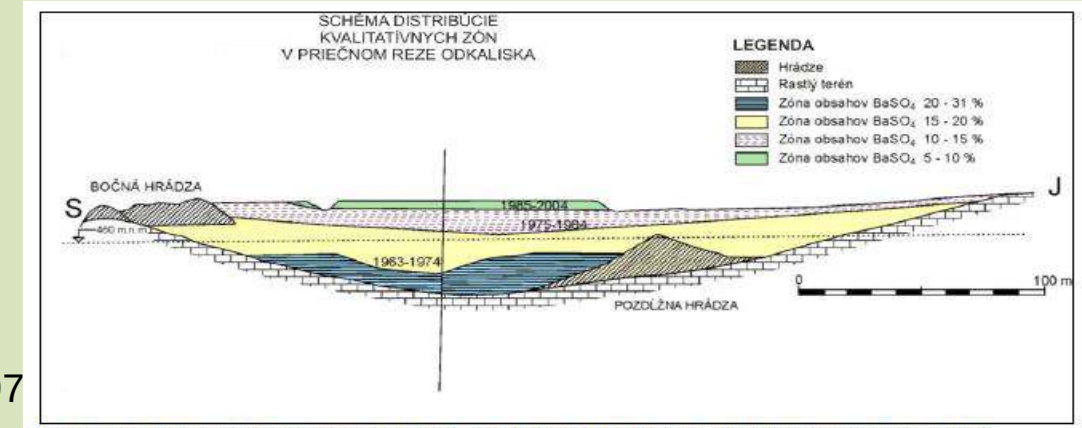
(i) Union extraction capacity is capable of extracting the ores, minerals or concentrates needed to produce at least 10 % of the Union's annual consumption of strategic raw materials, to the extent possible in light of the Union's reserves;

(ii) Union processing capacity, including for all intermediate processing steps, is capable of producing at least 40 % of the Union's annual consumption of strategic raw materials;

(iii) Union recycling capacity, including for all intermediate recycling steps, is capable of producing at least 25 % of the Union's annual consumption of strategic raw materials and is capable of recycling significantly increasing amounts of each strategic raw material from waste;

(b) diversify the Union's imports of strategic raw materials with a view to ensuring that, by 2030, the Union's annual consumption of each strategic raw material at any relevant stage of processing can rely on imports from several third countries or from overseas countries or territories (OCTs) and that no third country accounts for more than 65 % of the Union's annual consumption of such a strategic raw material.

Markušovce



Obr. 2. Vertikálna distribúcia obsahu $BaSO_4$ v odkalisku Markušovce (podľa Jančura et al., 2005)

- Tailings pond - 1085 m long
- - 130 to 340 m wide
- - 38 m thick and 12310 kt
- 3 stages - old tailings pond - 1963 to 197
- - middle part - 1975 to 1984
- - poor packaging - 1985 to 2004
- In 2005 The Slovak Ministry of Agriculture issued a certificate of exclusive deposit for the tailings pond with calculated reserves: balance: 8,602 kt, with BaSO4 content - 17.1% (Jančura et al., 2005).

Thanky you for attention!