



MINISTRY OF THE ENVIRONMENT OF THE SLOVAK REPUBLIC



**STATE OF THE ENVIRONMENT REPORT
SLOVAK REPUBLIC 2005**





The purpose of this law is to establish the principles of protection and rational exploitation of mineral resources, especially by carrying out geological researches, openings, preparation and breaking of mineral deposits, enrichment and refining of minerals, performed in relation with their extraction, as well as providing for security of operations and environment protections during these operations.

§ 1 of the Act on Protection and Exploitation of the Mineral Resources No. 44/1988 Coll. (Mining Act) as subsequently amended

• ROCKS

Geological environmental factors

Partial Monitoring System - Geological factors (PMS - GF) as part of environmental monitoring in Slovakia, is focused mainly on so-called geological hazards or harmful natural or anthropogenic geological processes that threaten the natural environment and eventually the humans.

PMS - GF consists of 13 independent sub-systems:

- 01: Landslides and other slope deformation
- 02: Erosion processes
- 03: Weathering processes
- 04: Volume unstable soils
- 05: Influence of mineral exploitation upon environment
- 06: Change of anthropogenic sediments
- 07: Stability of massifs underlying historic objects
- 08: Covered anthropogenic sediments
- 09: Tectonic and seismic activity of the territory
- 10: Monitoring of snow pack quality
- 11: Monitoring of seismic phenomena in Slovakia
- 12: Monitoring of stream sediments
- 13: Monitoring of the volume activity of Radon in the geological environment



Summary of the major outcomes from the monitoring activities in 2005:

Landslides and other slope deformities belong to the most prevalent and socially challenging geodynamic phenomena. In 2005, monitoring activities were carried out at 22 sites. Primary measurements

are saved in a database that is part of a detailed information system. As of December 2005, the database contained more than 900 000 entries from monitoring activities.

In 2005, automated level measuring devices with online connected interfaces were installed at socially significant sliding sites of **Veľká Čausa and Okoličné**. This is an important shift to a higher level of monitoring in terms of regime monitoring and direct implementation of its outcomes. The devices were installed at new, specifically equipped hydro-geological wells, in order to reach the maximum quality of monitoring. We suppose that after checking the devices' functionality, toward the end of 2006, it will be possible to set the limit levels of ground water depth in the most objective manner, as well as the level's rising speed, which will initialize sending alarm signals.

Greatest increment in **erosion processes'** area and length was recorded at the Plaveč site, located in the flysh rocks of the Spiš and Šariš ridges. Over the last 43 years, area of erosion furrows at this site increased by 58 % (1.3 % per year) and grew in length by 11 % (0.25 % per year).

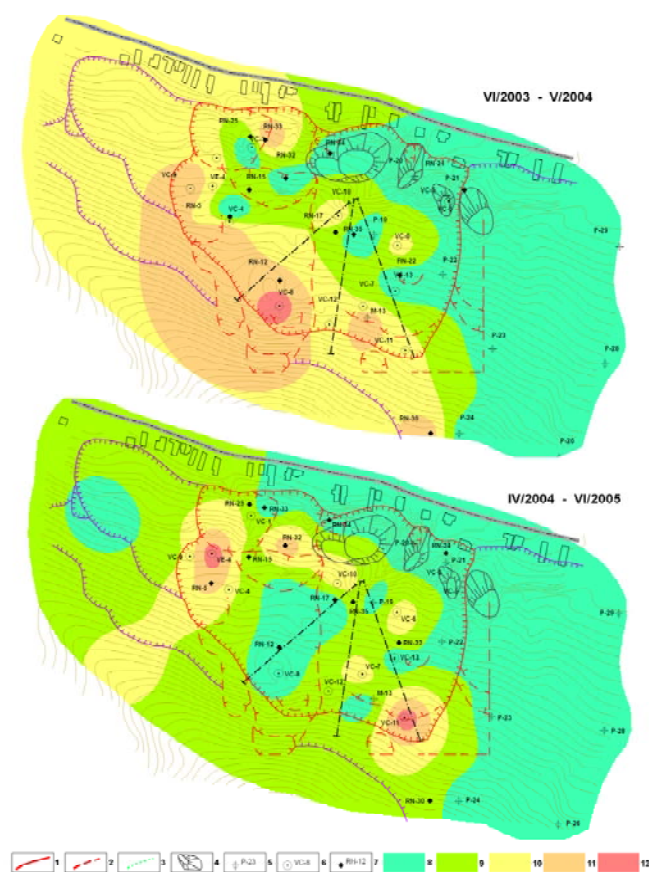
In 2005, we focused our monitoring on 10 sites within the sub-system called 07: **Stability of massifs underlying historic objects**. Most important movements were recorded near Perúnova rock at the Spiš castle. Over the last year there was a gradual closing up followed by a subsequent re-opening of the rift, with the movement amplitude of 0.27 mm. Since the Summer of 1992, the rift opened by 5.034 mm.

Vertical surface movements together with movements alongside the furrows, as well as seismic activity of the territory, were monitored within the **Tectonic and Seismic Activity of Territory** subsystem. An on-going registration of **seismic phenomena** in 2005 was carried out at **12 seismic stations**. All of the stations are registered in the International Seismological Centre, ISC, in Great Britain. 78 earthquakes were localised with the epicentre in the focal area of the Slovak Republic. 1 earthquake was recorded on the macro-seismic scale in Slovakia, in the Komárno focal zone.

Snowcap quality monitoring has been carried out since 1976. After the snow melts away, the samples are homogenised and subsequently analysed for the following association of elements: Na, K, Mg, Ca, NH₄, Sr, Al, Zn, Cu, Pb, Fe, Mn, Cl, F, NO₃, SO₄, HCO₃. Overall snow mineralisation in the Winter of 2004/2005 was between 2.68 to 23.07 mg/l. Values below 3 mg/l were measured at the sites of **Banský Studenec and Chopok – Srdiečko**, while the maximum values were recorded at **Vojany** - beyond 20 mg/l, showing an apparent anthropogenic impact.

Chemical monitoring of alluvial sediments showed that exceeding the C group limit values, which induced very heavy contamination, was in 2005 recorded in the watercourses of Štiavnica (Pb), Hnilec (As), and Nitra (Hg).

Monitoring of the volume Radon activity was done in 2005 at five sites that showed medium to high Radon risk. Long winter season and frequent rainfalls increased soil humidity and consequently the Radon transfer within rocks. As a consequence of the mentioned fact, volume Radon activity monitoring activities showed higher values than in the previous years.

Complex summary of monitoring outcomes from the sliding site of Veľká Čausa for 2003 through 2005


- 1 - demarcation of active landslide forms,
- 2- demarcation of potential and stabilised landslides,
- 3-local landslides and tears,
- 4-displaced blocks of the volcanic rock,
- 5-geodetic network points,
- 6- inclinometer and piezometer wells,
- 7- monitoring of surface residual tensions,
- 8- stable condition of parts of territory,
- 9-signals of the landslide movement activity,
- 10-slightly active state,
- 11-active state,
- 12-highly active state,

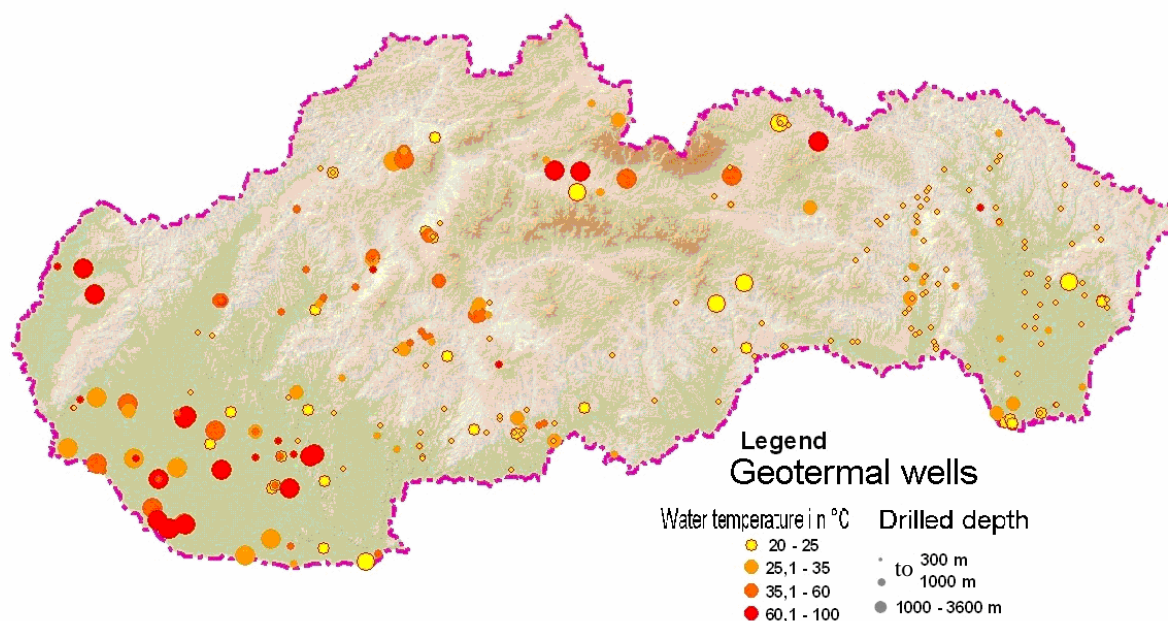
Source: SGI DS

Geothermal energy

Geothermal energy represents a significant, thermo-energetic potential of Slovakia. At present, there are 26 designated hydro-thermal areas in Slovakia, taking up 27 % of the state's territory. Rocks that function as thermal water collectors outside the spring areas are found in the depth of 200-500 m and contain geothermal water with the temperature of 20 – 150 °C.

Summary **thermo-energetic potential of geothermal water** of all prospective areas represents 5 538 MW_t.

Distribution of geothermal wells in Slovakia and their thermal characteristics



Source: SGI DS

Register of geological mapping

The registers are processed in form of typical registers on records sheets and maps. Individual registers are kept also inside a computer database and the geographical information system.

Registers of geological mapping (as of December 31, 2005)

Registers of	Accumulation in 2005	Total number
surveyed territories	30	428
surveyed territories drafts	29	359
landslides	2	11 393
wells	6 094	732 956
hydro-geological wells	158	22 795
landfills	6	8 318
map drawing and purpose mapping	182	9 368
geophysical mapping	374	3 681
abandoned mining works	45	16 517

Source: SGI DS

Abandoned mining works

Pursuant to **Act No. 44/1988 Coll. on protection and exploitation of mineral deposits (Mining Act)**, as amended, MoE SR also ensures searching for abandoned mining works. The State Geological Institute of Dionyz Stur in Bratislava was commissioned to maintain the Register.

Abandoned mining works as of December 31, 2005

Type of abandoned mine	Number
Mining shaft	4870
Pit (hole)	506
Chute	63
Cut, excavation	88
Pingo	3 987
Pingo field	109
Pingo draw	128
Dump	6 124
Old randing	205
Sink mark	292
Placer	20
Tailings dump	10
Other	115
Total	16 517

Source: SGI DS

Survey territories

Under the geology legislation and pursuant to the GS SR status - the GEOFOND department keeps the register of survey areas for selected geological activities. In 2005, there were 30 survey areas and 29 registered proposals to designate a survey area. As of December 31, 2005, there were 100 recognised areas.

Overview of deposits in Slovakia**Energy deposits (state to the date 31st December 2005)**

Raw material	Number of deposits included into balance	Number of free balance deposits	Number of deposits for mining in 2005	Unit	Balance deposits free	Geological deposits
Anthracite	1	1	0	thous. t	2 008	8 006
Bitumen sediments	1	1	0	thous. t	9 780	10 797
Brown coal	12	7	4	thous. t	180 483	536 088
Flammable natural gas – gasoline gas	8	6	4	thous. t	207	405
Lignite	8	3	1	thous. t	112 264	619 882
Non-resinous gases	1	0	0	mil. m ³	0	6 360
Underground stores of natural gas	8	1	2	mil. m ³	25	2 450
Crude oil non-paraffinic	3	3	1	thous. t	1 632	3 422
Crude oil - semi-paraffinic	8	4	4	thous. t	159	6 494
Uranium ores	2	1	0	thous. t	1 148	2 861
Natural gas	39	25	15	mil. m ³	9 110	27 545
Total	91	52	31			

Source: SGI DS

Ore deposits (state to the date 31st December 2005)

Type of ore	Number of deposits included into balance	Number of free balance deposits	Number of deposits for mining in 2005	Unit	Balance deposits free	Geological deposits
Sb ores	9	1	0	thous. t	85	3 344
Complex Fe ores	9	2	0	thous. t	5 806	60 057
Mn ores	2	0	0	thous. t	0	11 009
Cu ores	15	0	0	thous. t	0	49 336
Molybdenum ores	2	0	0	thous. t	0	131 855
Nickel and cobalt ores	1	0	0	thous. t	0	17 000
Hg ores	4	0	0	thous. t	0	3 311
Other ores	1	0	0	thous. t	0	73
Poly-metallic ores	8	1	0	thous. t	1 623	26 459
Wolfram ores	2	0	0	thous. t	0	10 286
Precious soils	1	0	0	thous. t	0	8
Gold and silver ores	12	6	1	thous. t	3 292	13 202
Fe ores	4	2	1	thous. t	21 974	30 273
Total	70	12	2			

Source: SGI DS

Non-metallics deposits (state to the date 31st December 2005)

Raw material	Number of deposits included into balance	Number of free balance deposits	Number of deposits for mining in 2005	Unit	Balance deposits free	Geological deposits
Anhydride	6	5	1	thous. t	646 846	1 059 599
Asbestos and aspestos rock	4	1	1	thous. t	5 022	28 216
Baryte	4	0	0	thous. t	0	1 732
Bentonite	21	15	5	thous. t	1 031 071	1 044 351
Cast basalt	4	4	2	thous. t	23 085	40 080
Decorative rock	23	20	1	thous. m ³	22 240	27 798
Diatomite	3	2	0	thous. t	6 556	8 436
Dolomite	20	20	8	thous. t	610 344	633 677
Precious stones	1	1	0	ct	1 207 812	2 518 510
Graphite	1	0	0	thous. t	0	294
Halloysite	1	0	0	thous. t	0	2 249
Rock salt	4	4	1	thous. t	840 644	1 351 626
Kaolin	14	13	3	thous. t	54 696	59 978
Ceramic clays	37	34	5	thous. t	271 468	346 059
Quartz	7	7	0	thous. t	311	328
Quartzite	15	13	1	thous. t	18 357	26 956
Magnesite	10	6	3	thous. t	753 909	1 134 034
Talc	6	3	1	thous. t	93 664	242 228
Mineralized I - Br waters	2	1	0	thous. t	3 658	3 658
Pearl stone	5	5	1	thous. t	30 296	30 616
Pyrite	3	0	0	thous. t	0	18 771
Gypsum	6	5	2	thous. t	62 792	93 552
Sialitic raw material	5	5	3	thous. t	83 302	96 665
Glass sands	2	2	1	thous. t	53 289	53 289
Marl	8	7	2	thous. t	167 553	169 805

Mica	1	1	0	thous. t	14 073	14 073
Building rock	139	136	76	thous. m ³	464 608	761 456
Gravel sands and sands	29	27	21	thous. m ³	185 530	210 566
Brick clay	42	39	12	thous. m ³	113 192	138 061
Technically usable mineral crystals	3	1	0	thous. t	253	69 743
Limestone – unspecified	31	28	13	thous. t	1 916 861	2 264 717
High-content limestone	10	10	4	thous. t	3 202 636	3 366 558
Zeolite	7	7	2	thous. t	103 250	111 474
Foundry sands	16	16	1	thous. t	730 997	946 033
Refractory clays	9	6	0	thous. t	3 106	5 490
Feldspars	6	6	0	thous. t	10 402	11 640
Total	505	450	170			

Source: SGI DS

Classification of mineral deposits by state of extraction (2005)

Extraction symbol (ZV)	Characteristics	Number of deposits
1	<i>Deposits with developed extraction activity</i> include exclusive mineral deposits sufficiently open and technically apt for extraction of industrial deposit.	205
2	<i>Deposits with fading extraction activity</i> include extraction mineral deposits where extraction activity will cease in a near future (within 10 years)	40
3	<i>Deposits before completion</i> include exclusive mineral deposits with documented deposits that give basis to one of the construction phases (starting with the projection phase)	24
4	<i>Deposits with ceased extraction</i> include exclusive mineral deposits with definitely or temporarily stopped extraction activity.	116
5	<i>Non-extracted deposits</i> include documented exclusive mineral deposits soon to be constructed and extracted.	47
6	<i>Non-extracted deposits</i> include documented exclusive mineral deposits with no plans for their extraction.	220
7	<i>Surveyed deposits</i> include deposits of exclusive and non-exclusive minerals with various degree of mapping.	15

Source: SGI DS

◆ Ground water volumes

Ground waters deposits in the SR (state to the date 31st December 2005)

Category	A	B	C	Total
Efficient deposits of the ground waters (I.s-1)	-	88.56	2 714.68	2 803.24
Efficient amounts of the ground waters (I.s-1)	-	-	9 299.93	9 299.93

Source: SGI DS

Legend:

C calculated on the basis of assessment of the existing hydrogeological mapping

B calculated on the basis of hydrogeological mapping with long-term extraction test

A calculated on the basis of hydrogeological mapping with semi-operational test

Geological activities funded from the state budget

Summary of geological activities carried out in 2005 from the state budget funds

Surveyed area	Task	Objective
Research and development	Basic hydro-geological maps of selected Slovak regions	Production of basic hydro-geological maps in the scale of 1: 50 000 from 11 regions with captions
	Thermal and pressure changes in the Earth's crust of the West Carpathian in the geological past, and their probable repeated pattern in the near and distant future	Defining the type of crust, its nature, composition and evolution (age) in the West Carpathian territory Study of the paleo-climatic conditions in the area, based on the paleo-ontological information and the lithological trend in the rock complexes.
Nuclear fuel	Assessment of geological activities with the U ore in selected areas of Slovakia	Processing the results of research and survey of the uranium ore in geological formations of the West Carpathians, complex revision of written and graphic documentation from these deposits.
Energy other than electricity	Regional hydro-geo-thermal assessment of the Humenné ridge	Assessment of the geothermal potential of the Humenné ridge and its extraction potential.
	Regional assessment of the Topoľčany bay	Assessment of the geo-thermal potential of the Topoľčany bay
Extraction of minerals	Auriferous structures in the crystalline metamorphic rocks of the south-western Slovak Rudohorie ridge	Determination of the magnitude and distribution of auriferous structures, determination of the basic gold mineralisation parameters.
	Ore clusters at the border of the crystalline rocks and the central Slovakia neo-volcanic formations	Search for ore clusters at the border of crystalline shales and granitoid forms with sequences of central Slovakian neovolcanic rocks, and determine their prognostic significance in terms of the revision of primary and secondary, mostly ore accumulations.
	Searching for formations containing precious ores, near the Hodruša Svetozár deposit	Implementation of geologic activities to verify the Au /Ag, Pb, Cu ore deposit's trend in unmapped areas of the Štiavnicko-hodrušský ore-mining territory, and revision of 500 thous. tons of economically extractable stores of the quality of 8 g/t Au.
Reduction in pollution	Monitoring of environmental loads' impacts on geological environmental factors, in selected West Carpathian regions	Monitoring of environmental loads' impacts on geological environmental factors, in selected West Carpathian areas.
	Implementation of the globe's remote monitoring to monitor environmental loads for geological environmental factors in selected regions	Use of the globe's remote monitoring to assess the interaction of selected environmental loads with geological factors in a designated territory in Slovakia.
Nature and landscape protection	Evaluation of the effectiveness of surveys and landslide repair in various geological structures of Slovakia	Evaluation of the effectiveness of implemented surveys and proposed repair activities in various geological structures of Slovakia prone to landslides.
	Atlas of slope stability of Slovakia in the scale of 1: 50 000	Stable regionalisation of landslides of Slovakia and definition of basic geological fault types.
	Kremnica - securing the land sink at the Štefánik square	Securing and elimination of the abandoned mining work and a created land sink at the square in Kremnica.

Environmental protection	Building the geo-park of Banská Štiavnica	Preserving the unique geological importance phenomena, uniqueness for scientific research focused on environmental education.
	Uses of magneto-telluric measurements to interpret depth composition and verify geophysical (gravitational) transects of the eastern part of the West Carpathian mountains	Re-evaluation of the geological composition of Slovakia, examination of the tectonic composition and characteristics of the aquifer of the inner-Carpathian tertiary planes, interpretation of the depth composition and the aquifer of the Alpine formations, regional faults, and deformation zones.
	Set of regional maps of environmental geo-factors of the Myjavská hills and White Carpathians regions	Maps created in the scale of 1: 50 000 that evaluate major environmental factors, state of pollution, and distribution of elements in individual components of environment (rocks, water, soil, alluvial sediments), and natural radioactivity of rocks and water.
	Hydro-geological map of the southern SGR part	Objective of the project is to create hydro-geological and hydro-geochemical basic map of the region of Spiš - Gemer rudohorie, and draft directives.
	Engineering geology atlas of rocks in Slovakia	Creation and publishing of the engineering geology atlas of Slovakia. The atlas will include major engineering geology characteristics of most dominant rock types in Slovakia.
	Set of environmental geological factors Ipeľ region (IPREG)	Maps of the Ipeľ region created in the scale of 1: 50 000 that evaluate major environmental factors, especially the state of pollution, and distribution of 36 elements in individual components of environment (rocks, water, soil, alluvial sediments), and natural radioactivity of rocks and water.
	Set of geological environmental factors maps of the Lučenská and Rimavský basins	Maps created in the scale of 1: 50 000 that evaluate major environmental factors, state of pollution, and distribution of 36 elements in individual components of environment (rocks, water, soil, alluvial sediments), and natural radioactivity of rocks and water.
	Set of geological environmental factors maps of the Záhorská lowland region	Maps created in the scale of 1: 50 000 that evaluate major environmental factors, state of pollution, and distribution of 36 elements in individual components of environment (rocks, water, soil, alluvial sediments), and natural radioactivity of rocks and water.
Water supply	Engineering geological mapping of slope deformities in the most threatened areas of the flysch zone in the scale of 1: 10 000	Drafting geological purpose maps focused on slide and flood risks of the most vulnerable territories of the flysch zone, as well as proposals for necessary measures for their elimination.
	Hg Tracking and localisation survey of the Veľká Fatra and Low Tatras Mesozoic formation, between Ploská and Donovaly	Objective is to assess hydro-geological and hydro-geochemical conditions of the territory, assess the natural and available ground water volumes, and set the conditions for quantitative and qualitative ground water protection.
	Neo-volcanic formations of the northern slopes of the Štiavnické hills	Objective is to assess hydro-geological and hydro-geochemical conditions of the territory, assess the natural and available ground water volumes, and set the conditions for quantitative and qualitative ground water protection.
Public health	Hg tracking and location survey of the eastern part of the PQ 115 hydro-geological region – Palaeogene of the Hornád basin and parts of the Poprad basin	Objective is to assess hydro-geological and hydro-geochemical conditions of the territory, assess the natural and available ground water volumes, and set the conditions for quantitative and qualitative ground water protection.
	Trenčianske Teplice - calculations of mineral water volumes	Objective is to calculate natural and available volumes of mineral ground water in the Trenčianske Teplice category C hydro-geological structure.

Source: MoE SR