

## • ROCKS

### Key questions and key findings

What is the trend in the development of geological hazards that threaten the natural environment and ultimately also the humans?

- Activity of slope deformations is closely related to climatic conditions, especially to long-term intensive precipitations. The years 2011 and 2012 were poor in long-term intensive precipitations (unlike the year 2010 that was characteristic for extreme precipitations during the spring and summer months) which resulted in reduced groundwater levels within the landslide body. Reduction in the levels has been closely connected to reduced yield of draining wells and decreased movement dynamics of slope deformations, which was a positive trend that dominated at almost all monitored slope deformations.
- While two earthquakes were recorded as macro-seismic in Slovakia in 2011, in 2012 there were six earthquakes recorded - the earthquake of 05.03.2012 in the region of Záhorie, earthquakes on 02.05.2012 and 22. 06. 2012 in eastern Slovakia in the region of Vihorlatské hills, earthquakes on 31. 05. 2012 and 01.06.2012 in the region of High Tatras, and an earthquake on 18.11.2012 in the region of Dobrá Voda.
- Contamination of the environment by anthropogenic sediments of the character of environmental loads in monitored landfills and sludge beds has remained at approximately the same level as in 2011. Anticipated negative safety condition existing at the sludge beds of Slovinky and Nižná Slaná was confirmed by the report on technological and safety supervision of sludge beds elaborated by the state-owned company of Vodohospodárska výstavba š.p. in Bratislava.
- Monitoring of alluvial sediments points to a long-term contamination with fluctuating contents of pollutants in the water streams of Nitra, Štiavnica, Hornád, Hnilec, and Hron.

In what condition has been the use of the geo-thermal energy in Slovakia?

- Geo-thermal waters have been exploited at 36 agricultural sites, for heating purposes of buildings, and for leisure activities. In agriculture, geo-thermal water has been used for heating up greenhouses at the production of vegetable (cucumbers, tomatoes, peppers, eggplants) and flowers (Bešeňová, Podhájska, Čilližská Radvaň, Topoľníky, Tvrdošovce, Horná Potôň, Dunajská Streda, Vičany, Veľký Meder, Topoľovec, Dunajský Klátov, Kráľová pri Senci, Nováky) and for fisheries. (Vrbov, Turčianske Teplice).
- Geo-thermal energy has been used to heat up office space and technological facilities in Galanta, Topoľníky, Komárno, Bešeňová, Liptovský Trnovec, and Poprad, while hotel facilities are heated in Bešeňová, Veľký Meder, Podhájska, and in Štúrovo. In Galanta, geo-thermal water is used for heating up residential apartments, hospital, and pension house. In Nováky - Koš, geo-thermal water has been used to heat up locker rooms for miners and to heat up air for air conditioning in lignite mines.
- At 32 sites, geo-thermal water has been used for leisure purposes, especially for filling up swimming pools. (Poprad, Vrbov, Liptovský Trnovec, Bešeňová, Oravice, Podhájska, Senec, Kráľová pri Senci, Dunajská Streda, Galanta, Veľký Meder, Lehnice, Diakovce, Topoľníky, Tvrdošovce, Nové Zámky, Šaľa, Poľný Kesov, Gabčíkovo, Štúrovo, Komárno, Patince, Bánovce nad Bebravou, Malé Bielice, Partizánske, Chalmová, Koplotovce, Kremnica, Sklené Teplice, Rajec, Dolná Strehová, Tornaľa).

## Geological environmental factors

In line with the approved **Programme of monitoring for the year 2012**, monitoring has been carried out within the subsystem for **three basic types of slope displacements** - landslide (28 monitored sites), creep (4 sites) and indications of slope displacements of the character of tumbling. (9 sites) Stabilisation water levy in Handlová forms an individual specific category within the environment stability assessment process. Compared to the previous year, monitoring has been suspended in the landslide area above the municipality of Chmiňany where it has been carried out by the National Highway Company, Inc. of Bratislava.

The monitoring process included, beyond the scope of the Monitoring Programme in 2012, the most prominent slope deformations that occurred or have been reactivated in 2010 - the sites of Kapušany, Ruská Nová Ves, Petrovany, Nižná Myšľa, and Vyšná Hutka. Geological and engineering surveys were carried out on the said landslides in the period of years 2011/2012 and they provided the background for design and implementation of geological environment sanation activities. Sanation works were carried out mainly in 2012.

In 2012, as many as 7 415 tele-seismic, regional or local seismic phenomena were interpreted. More than 32 540 seismic phases were defined in seismic records. Approximately 70-80 earthquakes were localized, with the epicentre in the Slovak Republic. Macro-seismic observations confirmed 6 detected earthquakes in Slovakia.

In 2012, **environmental loads of the character of waste landfills and sludge beds** were monitored at these 12 sites: Bojná, Dunajská Streda, Krompachy - Halňa, Modra, Myjava-Surovín, Nižná Slaná, Poša, Prakovce - I., II., Šaľa, Slovinky, Šulekovo, and Zemianske Kostolány.

In 2012, continuing monitoring of **ore deposit areas** included Rudňany, Slovinky, Smolník, Novoveská Huta, Rožňava, Pezinok, Kremnica, Špania Dolina, Dúbrava, Nižná Slaná, and Štiavnicko-hodrušský ore district, as well as areas of lignite mining within the Upper-Nitra mining district.

## Geothermal energy

At present, there are 26 designated geothermal areas in Slovakia, taking up 27% of the state's territory. To this day, 144 geothermal wells have been made in these designated areas, analysing  $2\,084 \text{ l}\cdot\text{s}^{-1}$  of water with the outflow temperature of 18 – 129°C. Geo-thermal water was detected through wells with the depth of 56 – 3 616 m. Yield at the free overflow from these wells fluctuated within the interval of  $1.50 \text{ l}\cdot\text{s}^{-1}$  to  $100 \text{ l}\cdot\text{s}^{-1}$ . Dominating are water types of Na-HCO<sub>3</sub>, Ca-Mg-HCO<sub>3</sub>-SO<sub>4</sub> and Na-Cl with the mineralization of 0,4 - 90,0 g.l<sup>-1</sup>. Thermal output of geo-thermal water of these wells used up to its reference temperature of 15°C is 347.61 MWt, which represents 5.58% of the total mentioned geo-thermal energy potential in Slovakia.

## 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 Dionýz Štúr in Bratislava was commissioned to maintain the Register.

### Abandoned mining works (state to the date 31st December 2012)

Type of abandoned mine	
Mining shaft	5 566
Pit (hole)	696
Chute	65
Cut, excavation	133
Pingo	3 988
Pingo field	107
Pingo draw	130
Dump	6 454
Old randing	204
Sink mark	281
Placer	26
Tailings dump	53
Other	149
<b>Total</b>	<b>17 852</b>

Source: SGI DS

## Minerals deposits balance

### Energy deposits (state to the date 31st December 2012)

Raw material	Number of deposits	Number of deposits for mining	Unit	Balance deposits free	Geological deposits
Anthracite	1	-	thous. t	2 008	8 006
Bitumen sediments	1	-	thous. t	9 776	10 793
Brown coal	11	4	thous. t	113 565	463 706
Flammable natural gas – gasoline gas	9	1	thous. t	199	394
Lignite	8	1	thous. t	111 211	618 331
Underground stores of natural gas	13	2	mil. m <sup>3</sup>	807	6 510
Crude oil non-paraffinic	3	-	thous. t	1 592	3 421
Crude oil - semi-paraffinic	8	4	thous. t	126	6 341
Uranium ores	2	-	thous. t	5 427	9 303
Natural gas	36	13	mil. m <sup>3</sup>	7 9111	24 480
<b>Total</b>	<b>91</b>	<b>24</b>	thous. t mil. m <sup>3</sup>	243 904 8 718	1 120 295 30 990

Source: SGI DS

### Ore deposits (state to the date 31st December 2012)

Type of ore	Number of deposits included into balance	Number of deposits for mining in 2005	Unit	Balance deposits free	Geological deposits
Sb ores	9	-	thous. t	85	3 291
Complex Fe ores	7	-	thous. t	5 751	57 762
Cu ores	10	-	thous. t	-	43 916
Hg ores	1	-	thous. t	-	2 426
Poly-metallic ores	4	-	thous. t	1 623	23 671

# COMPONENTS OF THE ENVIRONMENT AND THEIR PROTECTION

Wolfram ores	1	-	thous. t	-	2 846
Gold and silver ores	12	1	thous. t	58 402	172 628
Fe ores	2	-	thous. t	14 476	18 743
<b>Total</b>	<b>46</b>	<b>1</b>	<b>thous. t</b>	<b>80 337</b>	<b>325 283</b>

Source: SGI DS

## Non-metallics deposits (state to the date 31st December 2012)

Minerals and minerals based products	Number of deposits included into balance	Number of deposits for mining	Unit	Balance deposits free	Geological deposits
Anhydride	7	1	thous. t	658 748	1 249 891
Baryte	6	1	thous. t	9 205	12 655
Bentonite	29	11	thous. t	35 758	48 906
Cast basalt	5	1	thous. t	22 373	39 548
Decorative rock	22	2	thous. m <sup>3</sup>	11 760	26 142
Diatomite	3	-	thous. t	6 556	8 436
Dolomite	21	10	thous. t	667 969	694 436
Precious stones	1	-	ct	1 935 867	2 309 085
Graphite	1	-	thous. t	-	294
Halloysite	1	-	thous. t	-	2 249
Rock salt	4	-	thous. t	838 697	1 349 679
Kaolin	14	1	thous. t	50 884	59 771
Ceramic clays	38	4	thous. t	117 739	192 622
Quartz	7	-	thous. t	301	327
Quartzite	15	-	thous. t	17 448	26 950
Magnesite	10	3	thous. t	764 138	1 157 950
Talc	5	1	thous. t	93 699	242 162
Mineralized I - Br waters	2	-	thous. m <sup>3</sup>	3 658	3 658
Pearl stone	5	2	thous. t	30 166	30 436
Pyrite	1	-	thous. t	-	14 839
Gypsum	6	2	thous. t	49 176	93 412
Sialitic raw material	5	2	thous. t	108 770	122 133
Glass sands	4	2	thous. t	410 354	589 080
Mica	1	-	thous. t	14 073	14 073
Building rock	131	84	thous. m <sup>3</sup>	659 541	788 645
Gravel sands and sands	25	12	thous. m <sup>3</sup>	139 785	158 811
Brick clay	37	7	thous. m <sup>3</sup>	92 122	114 398
Techn. usable miner. crystals	3	-	thous. t	253	2 103
Limestone – unspecified	29	14	thous. t	1 923 921	2 160 868
High-content limestone	10	4	thous. t	3 185 405	3 349 327
Limestone-marl	8	2	thous. t	163 911	166 163
Zeolite	6	3	thous. t	113 876	119 475
Foundry sands	14	1	thous. t	306 228	543 076
Refractory clays	7	1	thous. t	3 085	5 309
Feldspars	8	-	thous. t	20 548	21 786
<b>Total</b>	<b>1</b>	<b>-</b>	<b>ct</b>	<b>1 935 867</b>	<b>2 309 085</b>
	<b>273</b>	<b>66</b>	<b>thous. t</b>	<b>9 613 281</b>	<b>12 317 956</b>
	<b>217</b>	<b>105</b>	<b>thous.m<sup>3</sup></b>	<b>906 866</b>	<b>1 091 654</b>

Source: SGI DS

## Classification of mineral deposits by state of extraction (state to the date 31st December 2012)

Extraction symbol	Characteristics	Number of deposits
1	Deposits with developed extraction activity include exclusive mineral deposits sufficiently open and technically apt for extraction of industrial deposit.	229
2	Deposits with fading extraction activity include extraction mineral deposits where extraction activity will cease in a near future (within 10 years)	31
3	Deposits before completion include exclusive mineral deposits with documented deposits that give basis to one of the construction phases (starting with the projection phase)	32
4	Deposits with ceased extraction include exclusive mineral deposits with definitely or temporarily stopped extraction activity.	87

5	Non-extracted deposits include documented exclusive mineral deposits soon to be constructed and extracted.	46
6	Non-extracted deposits include documented exclusive mineral deposits with no plans for their extraction.	191
7	Surveyed deposits include deposits of exclusive and non-exclusive minerals with various degree of mapping.	12
<b>Total</b>		<b>628</b>

Source: SGI DS

**Non-reserved mineral deposits (state to the date 31st December 2012)**

Raw material	Number of listed deposit sites	Number of sites with extraction activities
Slate	3	-
Floatation sand	1	-
Tailing rocks	7	2
Clay	1	-
Other minerals	23	3
Sialitic raw material	6	-
Building stone	187	60
Gravel sand and sands	215	90
Brick clay	46	-
Tuff	2	-
Brucite	1	1
<b>Total</b>	<b>492</b>	<b>156</b>

Source: SGI DS