

# **Questionnaire**

## **Summary of the main activities of a research institute of the Slovak Academy of Sciences**

*Period: January 1, 2012 - December 31, 2015*



### **1. Basic information on the institute:**

#### **1.1. Legal name and address**

Institute of Geotechnics, Slovak Academy of Sciences, Watsonova 45, 040 01  
Košice, Slovakia

#### **1.2. URL of the institute web site**

<http://ugt.saske.sk>

#### **1.3. Executive body of the institute and its composition**

| <b>Directoriat</b>          | <b>Name</b>                     | <b>Age</b> | <b>Years in the position</b> |
|-----------------------------|---------------------------------|------------|------------------------------|
| <b>Director</b>             | Ing. Slavomír Hredzák, PhD.     | 49         | 2014 - present               |
| <b>Deputy director</b>      | Ing. Víťazoslav Krúpa, DrSc.    | 65         | 2014 - present               |
| <b>Scientific secretary</b> | Ing. Miroslava Václavíková, PhD | 39         | 2014 - present               |

| <b>Former Directoriat</b>   | <b>Name</b>                    | <b>Age</b> | <b>Years in the position</b> |
|-----------------------------|--------------------------------|------------|------------------------------|
| <b>Director</b>             | Ing. Víťazoslav Krúpa, DrSc.   | 65         | 1998-2013                    |
| <b>Deputy director</b>      | Ing. Slavomír Hredzák, PhD.    | 49         | 2004-2013                    |
| <b>Scientific secretary</b> | Prof. RNDr. Peter Baláž, DrSc. | 69         | 1996-2014                    |

#### **1.4. Head of the Scientific Board**

Prof. RNDr. Jaroslav Briančin, CSc.

## 1.5. Basic information on the research personnel

**1.5.1. Number of employees with university degrees (PhD students included) engaged in research projects, their full time equivalent work capacity (FTE) in 2012, 2013, 2014, 2015, and average number of employees in the assessment period**

|                                             | 2012   |        | 2013   |        | 2014   |        | 2015   |        | total  |                          |              |
|---------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------------------|--------------|
|                                             | number | FTE    | number | FTE    | number | FTE    | number | FTE    | number | averaged number per year | averaged FTE |
| Number of employees with university degrees | 38.0   | 34.310 | 38.0   | 36.290 | 41.0   | 37.410 | 40.0   | 38.220 | 157.0  | 39.3                     | 36.558       |
| Number of PhD students                      | 7.0    | 7.000  | 10.0   | 7.660  | 12.0   | 9.000  | 9.0    | 7.660  | 38.0   | 9.5                      | 7.830        |
| Total number                                | 45.0   | 41.310 | 48.0   | 43.950 | 53.0   | 46.410 | 49.0   | 45.880 | 195.0  | 48.8                     | 44.388       |

**1.5.2. Institute units/departments and their FTE employees with university degrees engaged in research and development**

| Research staff                                                         | 2012 |        | 2013 |        | 2014 |        | 2015 |        | average |        |
|------------------------------------------------------------------------|------|--------|------|--------|------|--------|------|--------|---------|--------|
|                                                                        | No.  | FTE    | No.  | FTE    | No.  | FTE    | No.  | FTE    | No.     | FTE    |
| Institute in whole                                                     | 38.0 | 34.310 | 38.0 | 36.290 | 41.0 | 37.410 | 40.0 | 38.220 | 39.3    | 36.558 |
| Department of Destructional and Constructional Geotechnics             | 6.0  | 5.120  | 6.0  | 6.000  | 6.0  | 6.000  | 6.0  | 6.000  | 6.0     | 5.780  |
| Department of Physical and Physico-Chemical Mineral Processing Methods | 11.0 | 10.320 | 9.0  | 8.790  | 9.0  | 8.400  | 9.0  | 8.530  | 9.5     | 9.010  |
| Department of Mechanochemistry                                         | 7.0  | 6.540  | 9.0  | 8.840  | 10.0 | 9.400  | 10.0 | 9.140  | 9.0     | 8.480  |
| Department of Mineral Biotechnologies                                  | 9.0  | 7.330  | 8.0  | 7.780  | 10.0 | 7.610  | 9.0  | 8.550  | 9.0     | 7.818  |
| Department of Environment and Hygiene in Mining                        | 4.0  | 4.000  | 5.0  | 3.880  | 5.0  | 5.000  | 5.0  | 5.000  | 4.8     | 4.470  |
| Central Laboratory                                                     | 1.0  | 1.000  | 1.0  | 1.000  | 1.0  | 1.000  | 1.0  | 1.000  | 1.0     | 1.000  |
|                                                                        |      |        |      |        |      |        |      |        |         |        |

## 1.6. Basic information on the funding of the institute

**Institutional salary budget and others salary budget**

| Salary budget                                                   | 2012    | 2013    | 2014    | 2015    | average        |
|-----------------------------------------------------------------|---------|---------|---------|---------|----------------|
| <b>Institutional Salary budget</b><br><i>[thousands of EUR]</i> | 411.809 | 455.103 | 448.002 | 464.283 | <b>444.799</b> |
| <b>Other Salary budget</b><br><i>[thousands of EUR]</i>         | 128.706 | 141.663 | 175.374 | 186.520 | <b>158.066</b> |

### **1.7. Mission Statement of the Institute as presented in the Foundation Charter**

The Institute of Geotechnics of Slovak Academy of Sciences (IGT SAS) is a non-profit scientific organization with a contributory economy form founded 22<sup>nd</sup> November 1954 by Presidium of Slovak Academy of Sciences. The main objective of the IGT SAS is the basic research in the fields of Earth and environmental sciences, environmental engineering, mineral biotechnologies and nanotechnologies.

The Institute of Geotechnics SAS:

- investigates continuous disintegration of the rock mass and underground constructions stability, the transport of energy and mass in the rock disintegration processes; basic research of solid dispersions origin patterns and modification of their properties by physical, mechanical, chemical and biotechnological processes; qualitative and quantitative evaluation of phase interactions at the disperse systems origin and at their spreading in working and living environment;
- focuses on application of theoretical knowledge from presented areas for detailing the top technologies principles in the following fields: rock disintegration, mineral processing, monitoring of selected components of working and living environment, monitoring of environmental, chemical and geological changes in the waste repositories and dumping ponds with the aim of ecological revitalizations and utility components recovery;
- provides advisory and expertise services related to main activities;
- covers scientific education in terms of generally valid legislation;
- provides publication of the scientific-research activities using the periodic and non-periodic press. The publishing of periodic and non-periodic press follows the regulations of the SAS Presidium;
- has a dominant position in Slovakia within the basic and applied research in the area of rock disintegration, mineral processing, mechanochemistry, mineral biotechnologies and environmental protection.

### **1.8. Summary of R&D activity pursued by the institute during the assessment period in both national and international contexts, (recommended 5 pages, max. 10 pages)**

Current research activities of IGT SAS issue from the Institute's tradition related to the mining activities in Slovakia strongly connected to mineral exploitation, processing and beneficiation of raw materials. After the regression in mining industry (in 1990s), the IGT SAS has begun the transition to the new research activities such as:

- tunnelling,
- environmental remediation of mining and industrial areas,
- material development for environmental applications,
- mechanosynthesis and mechanochemical activation of materials,
- water and soil clean-up technologies,
- biotechnologies for mineral processing, separation and remediation processes,
- stabilization of solid wastes.

During the current assessment period, the IGT SAS intensively competed in the projects within the European Research Development Funds (ERDF), which open-up the possibilities to improve the research infrastructure of the institute. The total ERDF funding reached 3.024 mil Eur within 8 ERDF projects. New high-tech devices (see chapter 2.8.3) significantly improved the quality of research outputs, international competitiveness as well as the collaboration between the departments within the IGT SAS.

Nowadays, the IGT SAS possesses a scientific community with a strong interdisciplinary background offering the favourable climate and opportunities for career development of both young and experienced researchers in developing their existing skills and acquiring new competencies and expertise in complementary disciplines. IGT SAS provides quality training via complementary skills of the researchers in terms of transfer of knowledge and filling the skills gaps of particular research teams across all departments.

The IGT SAS has a strong position on both international and national level, which is reflected by substantial number of invitation to participate on project proposals, scientific papers and projects proposal reviews, invited lectures, expert studies and reports, etc. The publication activity of the institute as whole is growing with the significant impact on young researchers.

Since 2013, the IGT SAS is coordinating beneficiary of the project within Industry Academia Partnership & Pathways programme of the 7th Framework Programme of EU (FP7-PEOPLE-2013-IAPP/612250).

The overview of the most important activities achieved during the assessed period is presented across the individual departments.

#### Department of Destructional and Constructional Geotechnics (DDCG)

Department of Destructional and Constructional Geotechnics offers a wide range of high level knowledge and experience on the processes running in cutting and drilling of rocks and concrete, focused from small-diameter rotary drilling up to the large-diameter tunneling using full-face tunnel boring machines (TBM). Major expertise of the group is in of both key- and side-effects of rock drilling process, such as acoustic and vibration signals for optimization of rock cutting process control as well as in investigation of interactions in the system drilling bit-rock.

Research activities of DDCG resulted in the development of advanced monitoring and optimization systems for rock drilling rigs, shaft drilling machines and for full-face tunnel boring machines, which were successfully deployed in Slovak mining and tunneling industry in 1980s-2000s. DDCG team developed automated systems for monitoring and optimization of rock cutting process (e.g. WORS, IKONA) for lab scale rotary drilling and for in-situ tunnel excavation applications. Both WORS and IKONA methods allow to describe the energy- and strength characteristics of the rock mass based on operational parameters of the tunneling machine. These results were produced by basic research realized in laboratory and later in-situ conditions.

DDCG has actively participated in **two ERDF projects** during the Assessment Period, which helped to deliver new experimental devices for evaluation of various rock parameters (compression frame INSTRON 1000RD for determination of stress and strain characteristics of rocks, Point Load Tester PLT-100 by GCTS, abrasionmeter CERCHAR by ERGOTECH), and the unique experimental laboratory drilling rig was reconstructed and equipped with new measuring chains as well.

Two senior scientists from the DDCG retired from the Institute in 2013 and two young researchers joined the department in the same year, bringing new research ideas mainly in the field of rock data processing and mathematical modelling using functional analysis.

There have been **three main streams** of the DDCG research in the Assessment Period:

**1. Small diameter rotary drilling of rocks and concrete** was realized on experimental laboratory horizontal drilling rig. The system allows drilling with core-drill bits up to 46 mm diameter. Accompanying phenomena, such as noise - **acoustic signal and vibrations** induced during the drilling have been analyzed in time and frequency domains. Suitability of indirect monitoring of drilling process by scanning and assessment of accompanying vibration signal, which represents a non-conventional method for process control was confirmed by the experimental results. Use of vibration signal for monitoring and control of rock drilling process focused on delivering the process with least consumed amount of energy (cost-reduction) and thus least intensity of drill bit wear (drill bit lifetime extension) requires specific conditions of the drilling process: the vibration acceleration should have the highest component in the axis equal to the direction of drilling, and the highest possible dominant frequency should be achieved. Research results have also proved that the effective values of acceleration of vibrations along with the dominant frequencies values increase with higher uniaxial compressive strength of rock. (Ivaničová et al., 2013, AEC32; Feriančíková et al., 2014, AEC18). Another field of research was focused on the detailed investigation of **rock abrasiveness** as a dominant factor affecting the drill bit wear in rotary drilling. Different methods of rock abrasiveness testing were compared (CERCHAR, LCPC, ON 441121) and evaluated using the statistical means (Labaš et al., 2012, ADNA11).

**2. Large-diameter full-profile excavation of tunnels by TBM** was focused on the full-profile excavation in difficult geological and geotechnical conditions with a view to identify the properties of such system, to evaluate the cost-effectiveness of the TBM excavation and to find the possibilities to predict the TBM performance. Quantitative and qualitative evaluation of the TBM tunneling process based on monitored data provided the development of the inverse methods of the rock mass properties assessment. Artificial intelligence means penetrated the area of tunneling as well, hence the fuzzy supporting system for inclusion of the effects of geological structures on TBM advance rate

has been developed at DDCG serving for assessment of geotechnical conditions during tunneling. The research in this field was focused specifically on the conditions of **specific energy** (SE), as a variable which precisely expresses the drillability of the rock by TBM excavation. Apart from the rock stress properties, the variable SE considers also the strain properties with the applied tunneling regime (operating conditions), structural characteristics of the TBM cutterhead and disc cutters. We developed a new method for fast visualization of efficiency of the TBM tunneling process using the relation of specific energy to contact pressure of disc cutter to rock. This method issued from our previous results and experience combined with theoretical knowledge of several authors focused on disc cutter action in TBM tunneling. Cutting coefficient as a ratio of tangential to normal force was used for explanation of different mechanisms of rock breaking in the zone of interaction between the rock and the disc cutter. The method enables to assess the efficiency of applied tunneling regime in real-time and to prepare for adequate control measures during excavation (Lazarová et al., 2014, AEC54; Ivaničová et al. 2015, AFC11; Krúpa et al., 2015, ADMB17).

**3. Investigation of prediction of rock drillability** represents the latest phase of basic research in the field of rock cutting and drilling. Based on previous experiments performed at the experimental laboratory drilling rig at IGT SAS, the suitability of modelling the rock drillability upon the input parameters of drilling process was confirmed (Ivaničová et al., 2015, AFC11). Methods of mathematical functional analysis and abstract spaces were used for evaluation of experiments, delivering new approaches in data processing (Feriančíková et al., 2015, AFC07).

Activities of the DDCG also involved elaboration of expertise reports on testing the rock and concrete properties for construction companies (see chapter 2.6.3). The Department also collaborates intensively with other departments of the Institute in the research on biocorrosion of concrete, geological issues of soil treatment from mixed contaminants (FP7-WaSClean project), preparation of rock samples, large data processing and statistical assessment of experimental data (APVV-0252-10). The DDCG researchers also support the ICT services of the whole Institute (PC and ICT administration, website administration, etc.).

#### **List of projects of DDCG in assessed period:**

“Research Excellence Centre on Earth Sources, Extraction and Treatment – 2<sup>nd</sup> Stage”, ERDF Structural Funds Project ITMS Code 26220120038, Co-investigator: Ing. Milan Labaš, PhD., (2010-2014)

“Modernization of the Infrastructure and Internal Equipment of Teaching Facilities to Improve Education at Institutes of Slovak Academy of Sciences in Košice”, ERDF Structural Funds Project ITMS Code 26250120013, Coordinator for IGT SAS: Ing. Lucia Ivaničová, PhD., (2009-2014)

“Water and Soil Clean-up from Mixed Contaminants”, Project of European Union FP7-People-IAPP-WaSClean-612250, Project coordinator: Ing. Miroslava Václavíková, PhD., Project manager and co-investigator: Ing. Lucia Ivaničová, PhD., (2013-2017)

“Research of Abrasiveness and Other Rock Parameters Affecting the Tool Wear in Rock Disintegration by Direct and Indirect Methods”, national project VEGA 2/0142/11, Principal investigator: Ing. Milan Labaš, PhD., (2011-2013)

“Energy Interpretation of Rock Mass Strength Properties”, national project VEGA 2/0105/12, Principal investigator: Ing. Edita Lazarová, PhD., (2012-2014)

“Prediction of Drillability of Intact Rock and Rock Mass”, national project VEGA 2/0160/15, Principal investigator: Ing. Lucia Ivaničová, PhD., (2015-2018)

“Development of Advanced Water Treatment Technologies for the Removal of Inorganic Pollutants”, national project APVV-0252-10, Principal investigator: Ing. Miroslava Václavíková PhD., (2011-2014)

#### **Department of Physical and Physico-Chemical Methods of Mineral Processing (DMMP)**

DMMP research focus shifted from mineral processing to the new activities connected to environmental technologies (synthesis of advanced material for wastewater treatment, vitrification of wastes by unconventional microwave-assisted heating) and modernization of classical mineral processing methods.

Development of relatively new research areas was inhibited by absence of modern equipment necessary for characterization of synthesized materials and results evaluation. Fortunately, in 2011 and during assessed period (2012-2015) the IGT SAS was successful in ERDF projects, which allowed us to improve the infrastructure. New labs with high-tech devices for evaluation of textural properties, particle distribution, elemental analysis, thermal analysis, SEM-EDX analysis, chromatography (GC, LC) and mass spectrometry techniques were established.

The main research activities of DMMP during the assessed period were devoted to:

1. mineral processing of materials,
2. removal of toxic substances from waters and soils,
3. microwave treatment of raw materials, industrial wastes and biomass.

## 1. Mineral processing of materials

### Interaction of physical fields with fine-grained mineral materials in mineralurgical processes.

The raw materials such as magnesite, siderite and talc have a great impact for mining industry in Slovakia. For example, the sample of talc ore polluted by pyrite was assayed with the aim to pyrite liberation and characterization. A fine crushing less than 5 mm leads to the sufficient liberation of pyrite prepared for physical treatment. Pyrite can be eliminated from talc ore by means of gravity concentration with high efficiency. Thus, besides obtaining of clean talc, a relatively high-grade pyrite concentrate can be also obtained (Hredzák et al., 2014, ADMB11).

## 2. Removal of toxic substances from waters and soils

### Synthesis of low cost natural adsorbents.

Low cost natural adsorbents (zeolites, clay minerals, agricultural waste biomass) are effective adsorbents of heavy metal ions, especially cations. Modification of natural materials with magnetic nanoparticles leads to the increasing of their sorption capacity especially metal ions in anionic form (As, Cr). On the other hand, solid/liquid separation of nanomaterials is more difficult using centrifugation and filtration. One of the possibilities is utilizing of magnetic properties of magnetic sorbents and performs magnetic filtration by application of external magnetic field (Štefušová et al., 2012, ADNA15). Therefore, magnetite particles, iron modified activated carbon composites, clay/iron oxide composites were synthesized, fully characterized and tested as adsorbents for wastewater treatment.

- Bentonite/maghemite composite was characterized by XRD, Mössbauer spectroscopy, thermal analysis and textural analysis. It was found that the full transformation of  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> to  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> in the inert atmosphere at temperature 650 °C and only a partial transformation to Fe<sub>3</sub>O<sub>4</sub> in the reductive atmosphere at 300 °C (Orolínová et al., 2012, ADCA27). The research was realized in collaboration with Technical University of Braunschweig, Germany (Mössbauer spectroscopy measurements).
- Another example is the modification of commercial activated carbon with iron nanoparticles (Oroszová, 2014, DA104). A positive impact of ultrasound irradiation on synthesis of iron/carbon composite and sorption properties was achieved. The collaboration with the producer of activated carbons Mast Carbon International, Ltd. UK has been established to develop Fe-carbon composites for the removal for mixed contaminants from aqueous solutions.
- The influence of ultrasound irradiation on adsorption properties of montmorillonite, contained in Slovakian bentonite has been studied by Danková et al., (2014, ADCA28). The sonication markedly influenced the adsorption capacity of montmorillonite and its value increased by approximately 40% in comparison with the corresponding capacity of the non-sonicated material.
- The bentonite and quartz sand from Slovakia were modified by manganese oxides in order to increase their sorption properties towards to Cd(II) (Schütz, 2014, DA105). A simple modification could lead to a radical rise of its adsorption capacity. The main aim was to prepare low-cost adsorbents for the removal of hazardous compounds from aqueous solutions as an alternative to common commercial products.

### Degradation of Organic Pollutants in Waters and Soils

In 2011 a new research activities related to degradation of organic pollutants in soils and water have been initiated. These include: extraction of organic compounds from soil matrices (HCH, PCB, PAH); degradation of organic pollutants by chemical and biological techniques; electro-chemical degradation of synthetic dyes and other organic pollutants from waste waters, soils and model solutions. The collaboration with the textile industry HERMES S.A. Greece has been initiated to develop the technology to clean the heavily polluted textile effluents.

In 2013 above mentioned activities resulted in the successful project proposal within the FP7/People/Industry-Academia Partnership and Pathways programme, where IGT SAS is coordinating beneficiary and M. Vaclavikova serves as consortium coordinator and scientist in charge.

## 3. Microwave treatment of raw materials, industrial wastes and biomass

The new knowledge of microwave interaction with ores, coals and biomass were studied and summarized with regard to mineral grindability, carbon materials leachability and utilities recovery (Lovás et al., 2013, ADMB19; Dolinská et al., 2014, ADMB02; Znamenáčková, et al., 2015, ADEB29). Consequently, the research was focused on two following issues.

### Extraction of tetracyclic diterpane from Slovak brown coal.

Slovak brown coal contains unusual organic compounds such as tetracyclic diterpanes with potential biological activity. As a first, hydrocycloning, mechanical activation as pretreatment mineral processing methods for removing of ash was applied. Afterwards, the extraction and isolation of

16a(H)-phytylcladane was performed. Microwave-assisted extraction was found as an efficient method in comparison to the Soxhlet, low-temperature supercritical fluid extraction and high-temperature supercritical fluid extraction. Microwave-assisted extraction is much shorter compared with the other ones (Zubrik et al., 2013, ADCA86). This research was performed in collaboration with the Institute of Organic Chemistry and Biochemistry of the Academy of Sciences of Czech Republic. This collaboration connects and combines traditional mineral processing methods and modern chromatographic and identification methods (mass spectrometry).

#### Removal of zinc from blast furnace sludge.

Blast furnace sludge is an iron rich metallurgical waste generated in the iron making process. Its recycling is limited by high content of unfavourable contaminants such as zinc. Using microwave-assisted leaching in the acids, the material is heated rapidly, selectively and internally in comparison to the constant/external conventional heating method (Vereš et al., 2012, ADCA83). Moreover, to prevent improper handling of zinc-containing steelmaking wastes and find better solutions for recycling these materials, the major components of sludge (Fe, Zn) and other chemical elements were characterized by AAS, XRD and Mössbauer spectroscopy (Vereš, 2014, ADEA02; Vereš et al., 2015, ADMB31).

#### **List of projects of DMMP in assessed period:**

"Water and Soil Clean-up from Mixed Contaminants", Project of European Union FP7-People-IAPP-WaSClean-612250, Project coordinator: Ing. Miroslava Václavíková PhD., (2013-2017)

"Technical Advances to Detect and Remove Contaminants from Water for Safety and Security", NATO SPS Multi-Year Project EAP.SFPP 984403, NATO Country Co-director: Ing. Miroslava Václavíková PhD., (2012-2016)

"Development of Advanced Water Treatment Technologies for the Removal of Inorganic Pollutants", national project APVV-0252-10, Principal investigator: Ing. Miroslava Václavíková PhD., (2011-2014)

"Centre of Excellence for Research and Treatment of Earth Resources", ERDF Structural Funds Project ITMS Code 26220120017, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (2009-2012)

"Centre of Excellence for Research and Treatment of Earth Resources" – 2nd Stage, ERDF Structural Funds Project ITMS Code 26220120038, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (2009-2012)

"Slovak Research-Innovation Platform on Sustainable Mineral Resources", ERDF Structural Funds Project ITMS Code 26220220053, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (2009-2012)

"PROMATECH – Research Centre of Advanced Materials and Technologies for Present and Future Applications", ERDF Structural Funds Project ITMS Code 26220220186, IGt SAS Coordinator: Ing. Slavomír Hredzák, PhD., (2013-2015).

"Interaction of Physical Fields with Fine-Grained Mineral Materials in Mineralurgical Processes", national project VEGA 2/0175/11, Principal investigator: Ing. Slavomír Hredzák, PhD., (2011-2014)

"Microwave Energy Application for Intensification of Extraction and Pyrolytic Processes of Coal and Wastes", national project VEGA 2/0114/13, Principal investigator: RNDr. Silvia Dolinská, PhD., (2013-2016)

"Microwave-Assisted Synthesis of Polycomponent Materials for Mineral Processing and Environmental Technologies", national project VEGA 2/0158/15, Principal investigator: RNDr. Anton Zubrik, PhD., (2015-2018)

### **Department of Mechanochemistry (DM)**

Research in Department of Mechanochemistry focuses on the elaboration of mechano-chemical, physico-chemical and chemical methods of synthesis and application of nanocrystalline materials and their composites prepared from precursors based on natural minerals, synthetic substances, as well as selected components of intermediate products and wastes from various industries. Mechanochemistry is a branch of chemistry, which is concerned with the chemical and the physico-chemical changes of substances of all states of aggregation due to the influence of mechanical energy. According to this definition two main processes are applied in the department: i) mechanochemical synthesis, where the new materials are produced and ii) mechanical activation of substances, where the improvement of their properties is obtained. Shearing, stretching and grinding are typical methods for the mechanochemical generation of reactive sites. Potential for application of the products rests in their implementation to the electrotechnical industry (semiconductors, photovoltaic cells, batteries, and fuel cells based on sulfides, oxides and silicates), hydrometallurgy (recovery of precious (gold), economically important (copper, bismuth) or on the other hand undesirable metals (antimony, arsenic)), ecology (cleaning of waters, CO<sub>2</sub> storage), and medicine (drugs based on minerals). Within the Slovak Republic, the department has a unique position as it is a leader in the study of mechanochemical processes and in the synthesis of new materials using mechanochemistry. The members of the department have been identified by independent agency ARRA in 2013 as a top team under umbrella of Slovak Academy of Sciences (see awards 2.3). Moreover, Prof. Šepelák became a President of International Mechanochemical Society in 2014. Except the national cooperation the department has fruitful international collaboration (see Supplementary information in chapter 2.4, where list of collaborating organizations is given).

This cooperation resulted into common projects as well as publications in international current contents journals, which are mentioned in Questionnaire later. The mutual cooperation is based on the complementarity of both a theoretical and an experimental knowledge as well as infrastructure in different research areas.

Although, the mechanochemistry is ranking between unconventional methods of materials preparation, it is established a branch of chemistry and nowadays it has growing tendency in worldwide applications. This is evidenced by the special issue published in 2013 by prestigious journal Chemical Society Reviews dedicated to Mechanochemistry (*Chem. Soc. Rev.* 2013, vol. 42, issue 18, 24.892-IF2012), where selected department members have been asked to publish their results as the authors or co-authors. Several international conferences are also dedicated to mechanochemistry. The first and the oldest one is so called INCOME (International Conference on mechanochemistry and Mechanical Alloying), which was established in 1993 in Kosice and is organized regularly for every three years.

Recently two world mechanochemistry leaders P. Baláž and V. Šepelák belong to the DM, which is reflected by their publication and citation records. Moreover they both were invited to publish a review papers in the prestigious journal Chemical Society Reviews:

- a) "Hallmarks of Mechanochemistry: From Nanoparticles to Technology" (P. Baláž et al., 2013, ADCA11).
- b) "Mechanochemical reactions and syntheses of oxides" (V. Šepelák et al., 2013, ADCA65).

1. In the field of **materials science and preparation of nanomaterials** the selected results are given:

Synthesis of nanocrystalline selenides: Nanocrystalline selenide semiconductors ZnSe, CdSe, CoSe, SnSe, SnSe<sub>2</sub>, PbSe, BiSe and Bi<sub>2</sub>Se<sub>3</sub> were synthesized by mechanochemical synthesis using a planetary ball mill. Synthesis of ZnSe and PbSe has been performed in an industrial eccentric vibrating ball mill as well. Nanosized selenides with great semiconducting, electrochemical, photocatalytic and optical properties can be prepared by well controlled mechanosynthesis. (M. Achimovičová, P. Baláž, 2015, ABC01).

Synthesis of Sb<sub>2</sub>S<sub>3</sub> and Bi<sub>2</sub>S<sub>3</sub> nanoparticles: The mechanochemical synthesis of Sb<sub>2</sub>S<sub>3</sub> and Bi<sub>2</sub>S<sub>3</sub> nanoparticles has been studied, starting from the corresponding metals and sulfur and using high-energy mechanochemical processing in a planetary laboratory mill. XRD, specific surface area measurement, SEM and TEM (HRTEM) with ED were used for the characterization of the nanoparticles. (E. Dutková et al., 2013, ADCA31).

Synthesis of ZnAl<sub>2</sub>O<sub>4</sub>: Zinc aluminate nanoparticles with an average size of about 10 nm were synthesized via one-step mechanochemical processing. The formation of the phase was followed by XRD and <sup>27</sup>Al MAS NMR. HR-TEM studies revealed a non-uniform nanostructure of mechanosynthesized aluminate consisting of ordered grains and disordered surface/interface regions. It was demonstrated that the as-prepared aluminate possesses a partly inverse spinel structure with a far-from equilibrium arrangement of cations. Thermally induced redistribution of cations approaching their equilibrium positions. (M. Fabián et al., 2015, ADCA34)

Synthesis of α-Fe<sub>2</sub>SiO<sub>4</sub>: Nanostructured fayalite (α-Fe<sub>2</sub>SiO<sub>4</sub>) with a large volume fraction of interfaces is synthesized for the first time via single-step mechanosynthesis, starting from a 2α-Fe<sub>2</sub>O<sub>3</sub> + 2Fe + 3SiO<sub>2</sub> mixture. The nonequilibrium state of the as-prepared silicate is characterized by the presence of deformed polyhedra in the interface/surface regions of nanoparticles. (V. Šepelák et al., 2012, ADCA66)

Synthesis of PbS@cystine: PbS@cystine nanocrystals were synthesized mechanochemically, with lead acetate and L-cystine being used as the lead and sulphur precursors, respectively. The resulting defect-free nanocrystals are 22-34 nm in size, well-faceted and octahedral in shape. The nanocrystals were prepared using a solvent-free procedure that was performed under ambient temperature. (P. Baláž et al., 2014, ADCA16)

Preparation of As<sub>4</sub>S<sub>4</sub> nanosuspensions: Nanosuspensions of three arsenic sulfide (As<sub>4</sub>S<sub>4</sub>) compounds were prepared. Nanosuspensions were obtained by ultrafine wet milling in a circulation mill. The average particle size in the individual samples varied from 137 to 153 nm. The effects of milling were associated with the formation of arsenic sulfide crystalline nanoparticles and the fragmentation of the corresponding free volume entities. Consequently, an increase in the arsenic dissolution was observed. The anti-cancer effects of the nanosuspensions were verified on the human cancer H460 cell line, in which case DNA damage and greater numbers of apoptotic cells were observed (Z. Bujňáková et al., 2015, ADCA19).

2. In the field of **ecology** the selected results are given:

Cadmium sorption on waste biomaterial: The adsorption ability of the waste eggshell biomaterial toward cadmium ions was evaluated with respect to its milling. The main conclusion is that milling positively influences the adsorption ability, as upon milling, it is possible to increase the values of maximum sorption capacity more than 100-fold. Obtained values are higher than in the case of the majority of natural and modified adsorbents. The key parameter for the adsorption seems to be the formation of the aragonite phase during milling. The adsorption process is irreversible. (M. Baláž et al., 2015, ADCA04)

Arsenic sorption on mechanically activated magnetite: The sorption of arsenic onto nanocrystalline magnetite ( $\text{Fe}_3\text{O}_4$ ) mineral was studied in a model system. Nanocrystalline magnetite was produced by mechanical activation in a planetary ball mill from natural microcrystalline magnetite. As a consequence of milling, the specific surface area increased from  $0.1 \text{ m}^2/\text{g}$  to  $11.9 \text{ m}^2/\text{g}$  and the surface site concentration enhanced from  $2.2 \text{ sites}/\text{nm}^2$  to  $8.4 \text{ sites}/\text{nm}^2$ . These changes in surface properties of magnetite led to the enhancement of arsenic removal from model system. A good correlation between the decreasing particle size, increasing specific surface area and reduction of saturation magnetization was found. (Z. Bujňáková et al., 2013, ADCA20)

Interaction of vermiculites with  $\text{CO}_2$ : The interaction of natural and thermally processed (exfoliated and heated) vermiculites with  $\text{CO}_2$  during mechanical activation in a planetary ball mill (in-situ) and in an autoclave after mechanical activation (ex-situ) was investigated using X-ray diffraction, Fourier transform infrared spectroscopy, surface area analyses and total carbon analyses. Mechanical activation under an air or a  $\text{CO}_2$  atmosphere, especially in wet mode, increased the surface area and pore volume of the studied vermiculites. Moreover, activation under a  $\text{CO}_2$  atmosphere resulted in a higher degree of amorphisation (comparing the basal reflections in the XRD patterns of the vermiculites milled under air or  $\text{CO}_2$ ), indicating that  $\text{CO}_2$  interacted with the sample during activation. (E. Turianicová et al., 2014, ADCA78)

3. In the field of **hydrometallurgy** the selected results are given:

Extraction of gold from the White Hill (Detva, south of Central Slovakia) deposit: Mechanical activation of the gold ore in a stirring ball mill (attritor) influenced the increase of its specific surface area as well as brought about the structural changes in the ore and this resulted in the following thiourea leaching and electrolysis. This type of leaching and electrolytic process are more advantageous for rapid extraction of gold from the golden ore (gold leaching time: 1-2 hours) in comparison to conventional cyanide leaching (gold leaching time: 24-48 hours), which in Slovakia is prohibited. It is possible to achieve more than 99 % gold recovery (J. Ficeriová et al., 2015, BEE03).

Extraction of bismuth from lead sulphide concentrate: In this study, the aim was to investigate bismuth recovery from fine lead sulphide concentrate by using hydrochloric acid, sulphuric acid with sodium chloride and sodium thiosulphate. Experimental studies were carried out on the sulphide sample from Atacocha (Peru) deposit, which contains 1.3% bismuth. Only 38% of bismuth was recovered from the 'as received' concentrate in 60 min. The physicochemical changes in the complex sulphide concentrate due to mechanical activation have an influence on the increase in the recovery of bismuth for subsequently thiosulphate leaching. It was possible to achieve ~99% bismuth recovery within 3 min. (J. Ficeriová et al., 2012, ADMB07).

Extraction of arsenic from enargite concentrate: The possibility of enargite concentrate treatment using an environmentally friendly route was investigated. Enargite  $\text{Cu}_3\text{AsS}_4$  contains dangerous arsenic, and this element can be removed by leaching with  $\text{Na}_2\text{S}$  in very alkaline environment ( $\text{pH} > 12.5$ ). Arsenic passes into the leach, while the copper sulfide produced represents a raw material suitable for pyrometallurgy. We have shown that more than 80% of the arsenic can be extracted by atmospheric alkaline leaching at  $95^\circ\text{C}$ , when mechanical pretreatment of enargite concentrate in an attritor is applied. The solubilized arsenic can be transformed into solid  $\text{Na}_3\text{AsS}_4$ . The solid product  $\text{Cu}_2\text{S}$  can be further treated with elemental iron by mechanochemical reduction in a planetary mill. The final product forms a Cu/FeS composite from which iron can be separated by leaching with HCl. The proposed two step process of milling (enhancement of arsenic removal (I) and obtaining of elemental copper (II)) illustrates the principal possibility of transforming minerals into metals. (Z. Bujňáková et al., 2014, ADCA21).

**List of projects of DM in assessed period.** The department has participated in several international and domestic projects. The most important are:

"Structure-Function Relationship of Advanced Nanooxides for Energy Storage Devices", international project V4-JST Japan. Principal investigator in IGT SAS: Prof. RNDr. Vladimír Šepelák, DrSc., (2015-2018)

"Industrial production of metal sulphides by mechanical activation in vibration mill", bilateral project (IB-COMSTRUC-010). Principal investigator in IGT SAS: Prof. RNDr. Peter Baláž, DrSc., (2015-2017)

“Mechanochemically-nanostructured arsenicals with guided anticancer functionality: from ab-initio quantum-chemical modeling to experimental verification”, bilateral (SK-UA-2013-0003). Principal investigator in IGT SAS: Prof. RNDr. Peter Baláž, DrSc. (2015-2017)

“Arsenic in cancer treatment: mechanisms of action and new forms of delivery”, bilateral project (SAS-NSC JRP 2010/03). Principal investigator in IGT SAS: Prof. RNDr. Peter Baláž, DrSc. (2011-2013)

“NanoCEXmat2 - Infrastructure Development of the Center of Excellence for Progressive Materials with Nano and Submicron Structure”, ERDF Structural Funds Project, ITMS Code 262201200350, responsible for IGT SAS: prof. RNDr. Peter Baláž, DrSc. (2010-2013)

“PROMATECH - Research Centre of Advanced Materials and Technologies for Recent and Future Applications”, ERDF Structural Funds Project ITMS Code 26220220186, Co-investigators: prof. RNDr. Peter Baláž, DrSc., (2013-2015)

Two projects based on the request of the Japan company Nihon Seiko Co., Ltd. with confidential results (2013-15).

## Department of Mineral Biotechnologies (DMB)

The main objective of the DMB is to perform basic and applied research in the field of geomicrobiology and environmental microbiology.

The research is currently focused primarily on the development of advanced technologies for the exploitation and processing of mineral raw materials, waste recycling and elimination of toxic substances from the environment. Research focuses on the study of biotic processes in these technologies, particularly, the study of biodiversity and application of microbially mediated reactions.

Activities during the assessed period were mainly devoted to:

1. elimination/separation of various industrially and environmentally important trace contaminants from wastewater, soil and sediment,
2. application of advanced oxidation processes (AOPs) in connection to biological methods for the degradation of persistent pollutants,
3. toxicity and biodegradability assessment of the contaminants and their degradation/transformation products,
4. implementation of molecular approaches in the study of biodiversity,
5. liberalization of Ag/Au particles from silicate matrix by bioleaching,
6. bacterial deferrization of clay minerals and silica sands,
7. biological-chemical preparation of magnetic nanoparticles,
8. prediction and prevention of bio-corrosion of building composite materials.

### **1. Elimination/separation of various industrially and environmentally important trace contaminants from wastewater, soil and sediment**

Current trends of industrial wastewater treatment are focused not only on contaminant elimination down to the legislation requirements, nevertheless on the effective and selective recovery of useful components. Sample of real acid mine drainage AMD effluent from the abandoned Smolník deposit (Eastern Slovakia) was studied. The most efficient method for AMD treatment seems to be the combined removal of acidity, metals and sulphates using a bacterially mediated iron oxidation and sulphate-reduction. Bacterially produced hydrogen sulphide reacts with the available metal ions occurring in AMD to form insoluble metal sulphides. Iron-oxidizing bacteria facilitate the step of ferrous iron oxidation followed by co-precipitation of ferric iron (Kupka, et al., 2012, ADNA10). The benefit of using the sequential precipitation is the possibility for selective recovery of the metals in the form of oxides and sulphides with more than 99% efficiency (Luptáková et al., 2012, ADCA51; Mačingová et al., 2012, ADMB26; Mačingová et al., 2015, ADMB24). Another promising approach in the treatment of high volume low-grade solutions (e.g. drinking water, AMD, industrial wastewater) is the application of highly selective sorbents/ion-exchangers amenable to efficient biological or chemical regeneration for numerous cycles (Kupka et al., 2013, ADFB05; Bekenyiova, et al., 2015, ADEB01; ADEB02; Danková et al., 2015, ADEB03; AFD04).

### **2. Application of advanced oxidation processes (AOPs) in connection to biological methods for the degradation of persistent pollutants**

While biological processes are the most widespread technology for the treatment of industrial waste effluents, satisfactory results are not always achieved due to the presence of toxic and/or non-biodegradable pollutants. Electrochemical oxidation has been applied to treat the industrial wastewater contaminated with synthetic dyes (Voinovschi et al., 2015, AFG47). Process selection depends on the nature and structure of the electrode material, experimental conditions, and electrolyte composition. Significant reduction in TOC and COD concentration and ultimately complete mineralization of organic matter in the treated liquors was obtained. Ionic species and the degradation products were identified using chromatographic separation techniques coupled with tandem mass spectrometry (IC-HPLC-MS) (Jager et al., 2015, AFG23).

### **3. Toxicity and biodegradability assessment of the contaminants and their degradation/transformation products**

Advanced oxidation processes can, however induce formation of potentially harmful by-products or transformation products. Flow through respirometry developed in our laboratory was used as a screening method to quantify activated sludge system performance due to discharge of various industrial waste effluents. Biological oxygen demand obtained in respirometric assays with activated sludge represents an excellent control parameter as it provides a direct assessment of the inherent activity and viability of microorganisms which promote biodegradation process in wastewater treatment plant (Kupka et al., 2015, AFG26).

### **4. Implementation of molecular approaches in the study of biodiversity**

Utilization of molecular biology methods has brought a new view on detection, isolation, identification and taxonomic classification in environmental microbiology. The most common approaches used in molecular microbial ecology focus on the small subunit of the rRNA. The application of molecular approaches in the study of biodiversity started at the Institute only recently, in 2012 within the project #1. The DNA isolated from cultures of acidophilic iron-reducing bacteria was used as template for amplification of 16S rDNA with universal primers 0028F and 1521R. PCR products were purified and sequenced. All phylogenetic comparisons indicated that the 16S rRNA sequence of *Acidiphilium* SJH shows considerable homology with other three species of *Acidiphilium* genus, particularly *Acidiphilium cryptum*, *Acidiphilium multivorum* and *Acidiphilium organovorum*. Because there are many bacteria with very small differences in their 16S rRNA gene, sequencing of the other gene regions or whole genome is often necessary (Hagarova et al., 2015, AFD12).

### **5. Liberalization of Ag/Au particles from silicate and iron matrix by bioleaching**

The laboratory tests were carried out as part of industry company initiative to increase recoveries of silver from the ore material by in-situ heap leaching. The bioleaching pretreatment of raw materials liberated Ag and Au particles for the intensification cyanide leaching and the elimination of high cyanide concentration and fine grinding. Results have been concealed according to the requirement of the company (contract research with Newmont Technologies Limited Denver, USA).

### **6. Biological-chemical preparation of magnetic nanoparticles**

The use of biosynthetic activities of microbial cells for the synthesis of nanosized materials has emerged as an innovative approach for the synthesis of metal nanoparticles. The extracellular bioprecipitation by sulphate-reducing bacteria (SRB) present one of the ways for metal nanoparticles synthesis, especially of the magnetic nanoparticles. The optimal conditions of SRB cultivation provide the highly magnetic sulphides production, which has the potential to be used in biomagnetic separation (Luptáková et al., 2012; ADMB23; Jenčárová et al., 2012; ADMB03; Jenčárová et al., 2014, ADMB05).

### **7. Bacterial deferrization of clay minerals and silica sands**

The research realized in collaboration with Cristalerías Chile SA, has focused on the development of new technology for the purification of quartz sand. The company exploits deposit of raw silica sand of insufficient purity for high quality glass. The heap bioleaching with leachate recycling followed by magnetic separation provides the decrease of Fe<sub>2</sub>O<sub>3</sub> content from 0.26% to 0.05% (Štyriaková et al., 2015, ADEB25; Šuba et al., 2015, ADEB26). The bacteria related to the *B. cereus* species and indigenous heterotrophic bacteria were studied in the bioleaching of non-metallic raw materials (quartz sands, feldspars, kaolin) of the Slovak provenance. The Fe oxides were dissolved with successive release of poorly ordered clay minerals from the surface of silicate particles, providing suitable purification of the material. These bioleaching results could be very important for the quality improvement of non-metallic raw materials (Štyriaková et al., 2012, ADCA73; Štyriaková et al., 2015, AFD16).

### **8. Prediction and prevention of bio-corrosion of building composite materials**

Bio-corrosion process caused by microorganisms producing sulphuric acid is a special type of sulphate deterioration of concrete materials. The biogenic sulphuric acid is generated by complex mechanisms and various microbial species particularly sulphur oxidizing bacteria *Acidithiobacillus thiooxidans*. The biogenic sulphuric acid attacks the cement matrix of the concrete causing loss of strength and cohesion. Based on previously published results cooperation with the enterprise Považské cementárne a. s., Ladce was created. The collaboration focuses on the development a reliable methodology for testing the cement composites biocorrosion resistance (Estoková et al., 2012, ADMB05; Eštoková et al., 2014, ADMB04; Kovalčíková et al., 2015, ADMB15).

#### **List of projects of DMB in assessed period:**

"GEOCEX - Centre of Excellence for Integrated Research of the Earth's Geosphere", ERDF Structural Funds Project, ITMS Code 26220120064, Coordinator for IGT SAS: MVDr Daniel Kupka, PhD., (2010-2014)

"Water and Soil Clean-up from Mixed Contaminants", Project of European Union FP7-People-IAPP-WaSClean-612250, Project coordinator: Ing. Miroslava Václavíková PhD., exploitation manager and WP3 leader: MVDr Daniel Kupka, PhD., (2013-2017)

"Study of positive and negative influences of sulphuretum in the environment and industry", national project VEGA 2/0166/11, Principal investigator: Ing. Alena Luptáková, PhD., (2011-2014)

"Stimulation of biochemical processes of raw material and waste treatment", national project VEGA 2/0109/11, Principal investigator: Ing. Iveta Štyriaková, PhD., (2011-2014)

"Bacterial transformation of sulphur compounds in processes of materials synthesis and degradation", national project VEGA 2/0145/15, Principal investigator: Ing. Alena Luptáková, PhD., (2016-2018)

"The development of bioremediation technology of metal removal from soils and sediments", national project VEGA 2/0049/15, Principal investigator: Ing. Iveta Štyriaková, PhD., (2015-2018)

"Development of in-situ bioleaching method to clean quartz sands and application through testing prototype pilot plant", Project: CORFO I+D Cod. 13IDL2 - 23505, Principal investigator: Ing. Iveta Štyriaková, PhD., (2014-2016).

"Liberalization of Ag/Au particles from silicate matrix by bioleaching"; Contract research with Newmont Technologies Limited Denver, USA, Co-investigator: Ing. Iveta Štyriaková, PhD., (2012-2013)

### Department of Environment and Hygiene in Mining (DEHM)

The department is focused on research on the impact of industrial and other anthropogenic activities on selected factors of living and working environments. The research was realized mainly across two national projects VEGA and partially of the two European structural funds projects. Research activities in the evaluated period followed up on previous research in the department and were mainly concentrated in two areas:

1. Study of atmospheric deposition and dust particles in relation to industrial and urban air pollution sources in the municipality areas of Košice and Krompachy (both Eastern Slovakia).
2. The study of contaminated soils, anthropogenic and bottom sediments in the area of current and historical industrial loads middle Spiš (Eastern Slovakia).

1. The long-time continual monitoring of **atmospheric deposition** (AD) with monthly samplings carried on at 11 sites in the area of Košice and at 7 sites in the area of Krompachy in the whole assessed period. Qualitative and quantitative characteristics of the total AD of solid particles, the deposition fluxes of elements (Fe, Al, Mn, Zn, Pb, Cu, Cr, Cd, As) and major ions ( $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$ ,  $\text{Cl}^-$ ,  $\text{F}^-$ ), their seasonal variations and the development of deposition these elements were studied. The atmospheric deposition fluxes of trace elements were determined separately for "water soluble" and "insoluble" phase. In the case of solid particles the particle size distribution, SEM and EDX characteristics has been studied too. The deposition fluxes of the observed elements from the localities were compared with results from different world areas.

In the case of Košice, the extremely high values of deposition of iron, manganese and the over-average deposition of chromium, partially of zinc mainly at sites near the ironworks and over-average values at sites in the city were measured as compared to the deposition of the other areas (Hančulák et al., 2013, AEC24, 2014, AEC25). Relatively high abundance of fine particles under 10  $\mu\text{m}$  (12.1 - 47.7%) was found in the samples. The analysis of selected components of AD, SEM and EDX analysis, assessment of enrichment factors and correlation analysis of observed elements confirmed the impact of the iron and steel industry, but also other urban emission sources on environment. The portion of emission sources iron and steel works on the deposition fluxes of iron (almost exclusively to bound to the insoluble phase) and thus the dust particles at the individual sites in the city was calculated in the range from 21.8 to 51.4% (Hančulák et al., 2015, ADMB10). In the area of Krompachy, high values of deposition fluxes of cadmium, zinc, copper and lead were detected in comparison with different regions. The determination of evaluated trace elements in atmospheric deposition, Pearson's cross-correlation analysis, enrichment factor and seasonal variation showed a significant effect of the copper smeltery on the deposition flow quantity of zinc, lead and cadmium. Iron, aluminium, manganese and chromium have mainly source in a soil horizon and their deposition is significantly higher in the summer season. The elements in order Al, Fe, Cr, As, Pb and Mn were fixed mainly in the insoluble phase. Zinc, cadmium and a lesser extent of copper were predominant bound in soluble phase. The highest values of AD these elements were detected on sampling sites up to 3 km from copper smeltery (Hančulák et al., 2012, AEC26, 2013, AEC24). The values of deposition of zinc do not correspond with the official emissions quoted the element. The emissions of zinc have been highly undervalued (Hančulák et al., 2014, ADNBO9).

Study of selected components of AD enables identify and quantify the contributions of emissions sources on environmental load of investigated areas. Research in the field atmospheric deposition of particulate matter is the only one in Slovakia and provides irreplaceable informations for assessing and research of air quality and thus the other components of the environment also in the international scale.

2. In the second area of department research, the potential **contamination of soils, bottom and anthropogenic sediments** collected from historical industrial loads middle Spiš, specifically from the Ružín water reservoir and municipalities Krompachy, Rudňany and Slovinky was assessed by combination of spectral methods (XRPD, FTIR, XRF, AAS) and thermal methods (TG/DTG, DTA) coupled with MS. Also the contamination of soils and sediments was studied by ecotoxicological tests (phytotoxicity tests), which has been successfully used to monitor their contamination and bioremediation. We conducted also the initial experiments with earthworms.

On the basis of the above mentioned methods the following results were found:

All studied samples had similar phase composition. X-ray powder diffractometry (XRPD) revealed that the study sediments contained quartz as the major mineral and that other minerals, such as sericite and the plagioclase mineral series, were present in smaller amounts. The alkaline pH was determined in all samples. Permissible limits have been exceeded the total content of Cu, As, Sb. One-step (EDTA) and five-step sequential extraction was used for a comprehensive assessment of the mobility of As, Sb and Cu in sediments. In water-soluble fraction were for all monitored metals determined small proportions. Cu was evaluated as the most mobile and mobilized. The results were evaluated using a methodology called "Risk Assessment Code": Cu - medium risk of danger release to aquatic environment, As and Sb - risk-free. According to the enrichment factor (KEF), the metal contamination level in the sediments from the Hornád and the Hnilec rivers was studied and it was found that the highest enrichment of Cu and Hg was in samples from the Hornád (Šestinová et al., 2015, ADCA70). Phytotoxicity research, where the assessment of the first stage of plant development *Sinapis alba*, was performed on fresh sediment samples from the Ružín I. It was found, that in the most samples did not exceed permissible effective concentration EC 50 (50%). Plant seed germination did not record a significant decline even at acidic pH. The results demonstrated little toxic effect on assessing the potential effect of phytotoxic elements observed in the sediments from the Ruzin I, which may be caused at higher plants by their defense mechanisms, such as the adaptation to stress factors (Šestinová et al., 2015, ADNB03). On the basis of thermal analysis study the kinetic parameters such as activation energy of individual processes, which has widely application not only in the chemical sciences but also in metallurgy and the environment, were calculated (Findoráková et al., 2014, AEC22). Also in studied sediments and soils it was found that the concentrations of the studied elements (Cu<sup>2+</sup>, Pb<sup>2+</sup>) increased with decreasing particle size and the most contaminated sediments were in the fractions 40 and 63 µm. After the addition of sorbents, the leachability of the selected metal cations decreased approximately 50 % for each sorbent. Sorbent addition caused metal immobilization, most likely due to the adsorption of cations on the illite surfaces and the precipitation of metal hydroxides (Findoráková et al., 2015, ADCA40).

Within the project of European Structural Funds ("GEOCEX") new equipment was acquired (XRF spectroscop Spectro Xepos III, Trace mercury analyzer DMA-80 Tricell, Portable laser aerosol spectrometer Grimm 1109, Samplers for sampling particulate matter Digitel DH77, Leckel MVS6). The result of the project PROMATECH was acquisition of new laboratory of Solid Phase of Aerosols and Bottom Sediments in the building of Promatech.

#### **List of projects of DEHM in assessed period:**

"GEOCEX - Centre of Excellence for Integrative Research of the Earth's Geosphere", ERDF Structural Funds Project ITMS Code 26220120064, Co-investigator: Ing. Jozef Hančulák, PhD., RNDr. Lenka Findoráková, PhD., (2010-2015)

"PROMATECH - Research Centre of Advanced Materials and Technologies for Recent and Future Applications", ERDF Structural Funds Project ITMS Code 26220220186, Co-investigator: Ing. Jozef Hančulák, PhD., RNDr. Lenka Findoráková, PhD., (2013-2015)

"Study on heavy metals, harmful mineral substances and their deposition in the selected components of environment in the areas of mining and metallurgical industry in the eastern Slovakia", national project VEGA 2/0142/11, Principal investigator: Ing. Jozef Hančulák, PhD., (2011-2014).

"The study of atmospheric deposition, particulate matters and contamination of selected environment components in industrial and urban area of Košice and middle Spiš", national project VEGA 2/0194/15, Principal investigator: Ing. Jozef Hančulák, PhD., (2015-2018).

## **2. Partial indicators of main activities:**

### **2.1. Research output**

#### **2.1.1. Principal types of research output of the institute: basic research/applied research, international/regional (ratios in percentage)**

Basic/applied research 95/5 (%)

International/regional 90/10 (%)

**2.1.2 List of selected publications documenting the most important results of basic research. The total number of publications listed for the assessment period should not exceed the average number of employees with university degrees engaged in research projects. The principal research outputs (max. 5, including Digital Object Identifier - DOI) should be underlined**

**ADCA11** BALÁŽ, Peter - ACHIMOVIČOVÁ, Marcela - BALÁŽ, Matej - BILLIK, Peter - CHERKEZOVA-ZHELEVA, Zara - CRAIDO, José Manuel - DELOGU, Francesco - DUTKOVÁ, Erika - GAFFET, Eric - GOTOR, Francisco José - KUMAR, Rakesh - MITOV, Ivan - ROJAC, Tadej - SENNA, M. - STRELETSKII, Andrey - WIECZOREK-CIUROWA, Krystyna. Hallmarks of mechanochemistry: from nanoparticles to technology. In *Chemical Society Reviews*, 2013, vol. 42, p. 7571-7637. (24.892 - IF2012). (2013 - Current Contents). ISSN 0306-0012. DOI: 10.1039/c3cs35468g

**ADCA65** ŠEPELÁK, Vladimír - DÜVEL, A. - WILKENING, Martin - BECKER, Klaus Dieter - HEITJANS, Paul. Mechanochemical reactions and syntheses of oxides. In *Chemical Society Reviews*, 2013, vol. 42, no.18, 7507-7520. (24.892 - IF2012). (2013 - Current Contents). ISSN 0306-0012. DOI: 10.1039/c2cs35462d

**ADCA66** ŠEPELÁK, Vladimír - MYNDYK, Maksym - FABIÁN, Martin - DA SILVA, K. L. - FELDHOFF, Armin - MENZEL, Dirk - GHAFARI, Mohammad - HAHN, Horst - HEITJANS, Paul - BECKER, Klaus Dieter. Mechanochemical synthesis of nanocrystalline fayalite, Fe<sub>2</sub>SiO<sub>4</sub>. In *Chemical Communication*, 2012, vol. 48, no. 40, p. 11121-11123. (6.169 - IF2011). (2012 - Current Contents). ISSN 1359-7345. DOI: 10.1039/c2cc36370d

**ADCA67** ŠEPELÁK, Vladimír - BECKER, S.M. - BERGMANN, Ingo - INDRIS, Silvio - SCHEUERMANN, Marco - FELDHOFF, Armin - KÜBEL, Ch. - BRUNS, M. - STÜRZL, Ninette - ULRICH, Anne S. - GHAFARI, Mohammad - HAHN, Horst - GREY, Clare P. - BECKER, Klaus Dieter - HEITJANS, Paul. Nonequilibrium structure of Zn<sub>2</sub>SnO<sub>4</sub> spinel nanoparticles. In *Journal of Materials Chemistry*, 2012, vol. 22, no. 7, p. 3117-3126. (5.968 - IF2011). (2012 - Current Contents). ISSN 0959-9428. DOI: 10.1039/c2jm15427g

**ADCA50** LODEWYCKX, Peter - RAYMUNDO-PIÑERO, Encarnación - VÁCLAVÍKOVÁ, Miroslava - BREZOVSKA, Inna - THOMMES, Matthias - BÉGUIN, Francois - DOBOS, Gábor. Suggested improvements in the parameters used for describing the low relative pressure region of the water vapour isotherms of activated carbons. In *Carbon*, 2013, vol. 60, p. 538-561. (5.868 - IF2012). (2013 - Current Contents). ISSN 0008-6223. DOI: 10.1016/j.carbon.2013.4.006

**ADCA07** BALÁŽ, Matej. Eggshell membrane biomaterial as a platform for applications in materials science. In *Acta biomaterialia*, 2014, vol. 10., no. 9, p. 3827-3843. (5.684 - IF2013). ISSN 1742-7061.

**ADCA72** ŠIMŠÍKOVÁ, Michaela - ČECHAL, Jan - ZORKOVSKÁ, Anna - ANTALÍK, Marián - ŠIKOLA, Tomáš. Preparation of CuO/ZnO nanocomposite and its application as a cysteine/homocysteine colorimetric and fluorescence detector.

- In *Colloids and Surfaces B - Biointerfaces*, 2014, vol. 123, p. 951-958. (4.287 - IF2013). (2014 - Current Contents, WOS, SCOPUS). ISSN 0927-7765.
- ADCA20 BUJŇÁKOVÁ, Zdenka - BALÁŽ, Peter - ZORKOVSKÁ, Anna - SAYAGUÉS, Mária Jesús - KOVÁČ, Jozef - TIMKO, Milan. Arsenic sorption by nanocrystalline magnetite: An example of environmentally promising interface with geosphere. In *Journal of Hazardous Materials*, 2013, vol. 262, p. 1204-1212. (3.925 - IF2012). (2013 - Current Contents, WOS, SCOPUS). ISSN 0304-3894.
- ADCA34 FABIÁN, Martin - BOTTKE, Patrick - GIRMAN, Vladimír - DÜVEL, A. - DA SILVA, K. L. - WILKENING, Martin - HAHN, Horst - HEITJANS, Paul - ŠEPELÁK, Vladimír. A simple and straightforward mechanochemical synthesis of the far-from-equilibrium zinc aluminate,  $\text{ZnAl}_2\text{O}_4$ , and its response to thermal treatment. In *RSC Advances*, 2015, vol. 5, no. 67, p. 54321-54328. (3.840 - IF2014). (2015 - Current Contents). ISSN 2046-2069.
- ADCA69 ŠEPELÁK, Vladimír - BÉGIN-COLIN, Sylvie - LE CAËR, Gérard. Transformations in oxides induced by high-energy ball-milling. In *Dalton Transactions*, 2012, vol. 41, no. 39, p. 11927-11948. (3.838 - IF2011). (2012 - Current Contents). ISSN 1477-9226.
- ADCA24 BUJŇÁKOVÁ, Zdenka - DUTKOVÁ, Erika - BALÁŽ, Matej - TURIANICOVÁ, Erika - BALÁŽ, Peter. Stability studies of  $\text{As}_4\text{S}_4$  nanosuspension prepared by wet milling in Poloxamer 407. In *International Journal of Pharmaceutics*, 2015, vol. 478., p. 187-192. (3.650 - IF2014). (2015 - Current Contents). ISSN 0378-5173.
- ADCA63 STREČKOVÁ, Magdaléna - SOPČÁK, Tibor - MEDVECKÝ, Ľubomír - BUREŠ, Radovan - FÁBEROVÁ, Mária - BAŤKO, Ivan - BRIANČIN, Jaroslav. Preparation, chemical and mechanical properties of microcomposite materials based on Fe powder and phenol-formaldehyde resin. In *Chemical Engineering Journal*, 2012, vol. 180, p. 343-353. (3.461 - IF2011). (2012 - Current Contents, WOS, SCOPUS). ISSN 1385-8947.
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### 2.1.3 List of monographs/books published abroad

#### ABC Chapters in scientific monographs published abroad

- ABC01 ACHIMOVIČOVÁ, Marcela - BALÁŽ, Peter. Nanocrystalline Metal Selenides: Mechanochemical Synthesis and Utilizable Properties. In *Milling: Fundamentals, Processes and Technologies*. - N.Y.: NOVA Science Publishers Inc., 2015, p. 71-122. ISBN 978-1-63483-022-5.
- ABC02 OROLÍNOVÁ, Mária - ĎURIŠIN, Juraj - DANKOVÁ, Zuzana - ĎURIŠINOVÁ, Katarína - BESTERCI, Michal. Analyse of microstructure and thermal stability of Al-Al<sub>4</sub>C<sub>3</sub> composites. In BESTERCI, Michal. *Nanostructural Al composites: Mechanical alloying, microstructure and mechanical properties of micro- and nanostructural Al-Al<sub>4</sub>C<sub>3</sub> composites*. - Saarbrücken : LAP LAMBERT Academic Publ., 2015, p. 51-84. ISBN 978-3-659-77387-7.

### 2.1.4. List of monographs/books published in Slovakia

#### AAB Scientific monographs published in Slovak publishing houses

- AAB01 BALÁŽ, Peter - BALÁŽ, Matej - TURIANICOVÁ, Erika. *Chémia materiálov. (Chemistry of Materials)*. Bratislava: VEDA publisher of SAS, 2014. 200 pages. ISBN 978-80-224-1360-2.
- AAB02 BÁLINTOVÁ, Magdaléna - LUPTÁKOVÁ, Alena. *Úprava kyslých banských vôd. (Acid Mine Drainage Treatment)*. Košice: Technical university in Košice, Faculty of Civil Engineering, 2012. 131 pages. ISBN 978-80-553-0868-5.
- AAB03 VRÁBEL, Viktor - BRIANČIN, Jaroslav. *Nauhličovanie kompaktných a spekaných ocelí v atmosférach. (Carburizing of Compact and Sintered Steels in Atmospheres)*. Košice: EQUILIBRIA, s.r.o., 2012. 303 pages. ISBN 978-80-8143-013-8.

#### ABD Chapters in scientific monographs published in Slovak publishing houses

- ABD01 MÚČKOVÁ, Marta - BEDNÁRIKOVÁ, Monika - BARTOŠ, P. - KONERACKÁ, Martina - ZÁVIŠOVÁ, Vlasta - TOMAŠOVIČOVÁ, Natália - JURÍKOVÁ, Alena - KOPČANSKÝ, Peter - TIMKO, Milan - FABIÁN, Martin - LANCZ, Gábor. Taxol loaded polymer nanospheres for magnetic drug targeting - in vitro studies. In *Transformation of knowledge and technologies to the praxis obtained by research and development in the earth resources area*. - Bratislava : Slovak Physical society, 2013, chapter 3, p. 74-94. ISBN 978-80-970625-6-9.

### 2.1.5. List of other scientific outputs specifically important for the institute, max. 10 items

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- LABAŠ, Milan - KREPELKA, František - IVANIČOVÁ, Lucia. Assessment of abrasiveness for research of rock cutting. In *Acta Montanistica Slovaca*, 2012, vol. 17, no. 1, p. 66-73. (0.084 - IF2011). ISSN 1335-1788. ADNA11
- ŠTEFUŠOVÁ, Katarína - VÁCLAVÍKOVÁ, Miroslava - LOVÁS, Michal - HREDZÁK, Slavomír. Use of magnetic filtration in waste water treatment. In *Acta Montanistica Slovaca*, 2012, vol. 17, no. 1, p. 81-84. (0.084 - IF2011). ISSN 1335-1788. ADNA15
- VEREŠ, Ján. Determination of zinc speciation in metallurgical wastes by various analytical methods. In *International Journal of Chemical and Environmental Engineering*, 2014, vol. 5, no. 5, p. 313-317. ISSN 2078-0737. ADEA02
- FICERIOVÁ, Jana - DUTKOVÁ, Erika. Non-cyanide leaching and electrolysis of gold. In *XVI Balcan Mineral Processing Congress : proceedings of Congress Belgrade, Serbia*,

June 17-19, 2015. II. - Belgrade, Serbia: Colorgrafix, 2015, p. 757-759. ISBN 978-86-82673-11-8. BEE3

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**2.1.6. List of patents, patent applications, and other intellectual property rights registered abroad, incl. revenues**

None (see Supplementary information to Chapter 2.1.)

**2.1.7. List of patents, patent applications, and other intellectual property rights registered in Slovakia, incl. revenues**

None (see Supplementary information to Chapter 2.1.)

**2.1.8. Table of research outputs (as in annual reports).**

| Scientific publications                                                                                                            | 2012   |           |                     | 2013   |           |                     | 2014   |           |                     | 2015   |           |                     | total  |                          |               |                         |
|------------------------------------------------------------------------------------------------------------------------------------|--------|-----------|---------------------|--------|-----------|---------------------|--------|-----------|---------------------|--------|-----------|---------------------|--------|--------------------------|---------------|-------------------------|
|                                                                                                                                    | number | No. / FTE | No. / salary budget | number | No. / FTE | No. / salary budget | number | No. / FTE | No. / salary budget | number | No. / FTE | No. / salary budget | number | averaged number per year | av. No. / FTE | av. No. / salary budget |
| Scientific monographs and monographic studies in journals and proceedings published abroad ( <i>AAA, ABA</i> )                     | 0.0    | 0.000     | 0.000               | 0.0    | 0.000     | 0.000               | 0.0    | 0.000     | 0.000               | 0.0    | 0.000     | 0.000               | 0.0    | 0.0                      | 0.000         | 0.000                   |
| Scientific monographs and monographic studies in journals and proceedings published in Slovakia ( <i>AAB, ABB</i> )                | 2.0    | 0.048     | 0.005               | 1.0    | 0.023     | 0.002               | 1.0    | 0.022     | 0.002               | 0.0    | 0.000     | 0.000               | 4.0    | 1.0                      | 0.023         | 0.002                   |
| Chapters in scientific monographs published abroad ( <i>ABC</i> )                                                                  | 0.0    | 0.000     | 0.000               | 0.0    | 0.000     | 0.000               | 0.0    | 0.000     | 0.000               | 2.0    | 0.044     | 0.004               | 2.0    | 0.5                      | 0.011         | 0.001                   |
| Chapters in scientific monographs published in Slovakia ( <i>ABD</i> )                                                             | 0.0    | 0.000     | 0.000               | 0.0    | 0.000     | 0.000               | 0.0    | 0.000     | 0.000               | 0.0    | 0.000     | 0.000               | 0.0    | 0.0                      | 0.000         | 0.000                   |
| Scientific papers published in journals registered in Current Contents Connect ( <i>ADCA, ADCB, ADDA, ADDB</i> )                   | 18.0   | 0.436     | 0.044               | 20.0   | 0.455     | 0.044               | 35.0   | 0.754     | 0.078               | 17.0   | 0.371     | 0.037               | 90.0   | 22.5                     | 0.507         | 0.051                   |
| Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS ( <i>ADMA, ADMB, ADNA, ADNBN</i> ) | 21.0   | 0.508     | 0.051               | 8.0    | 0.182     | 0.018               | 13.0   | 0.280     | 0.029               | 18.0   | 0.392     | 0.039               | 60.0   | 15.0                     | 0.338         | 0.034                   |
| Scientific papers published in other foreign journals (not listed above) ( <i>ADEA, ADEB</i> )                                     | 5.0    | 0.121     | 0.012               | 9.0    | 0.205     | 0.020               | 6.0    | 0.129     | 0.013               | 13.0   | 0.283     | 0.028               | 33.0   | 8.3                      | 0.186         | 0.019                   |
| Scientific papers published in other domestic journals (not listed above) ( <i>ADFA, ADFB</i> )                                    | 6.0    | 0.145     | 0.015               | 5.0    | 0.114     | 0.011               | 4.0    | 0.086     | 0.009               | 0.0    | 0.000     | 0.000               | 15.0   | 3.8                      | 0.084         | 0.008                   |
| Scientific papers published in foreign peer-reviewed proceedings ( <i>AEC, AECA</i> )                                              | 36.0   | 0.871     | 0.087               | 25.0   | 0.569     | 0.055               | 32.0   | 0.690     | 0.071               | 0.0    | 0.000     | 0.000               | 93.0   | 23.3                     | 0.524         | 0.052                   |
| Scientific papers published in domestic peer-reviewed proceedings ( <i>AED, AEDA</i> )                                             | 10.0   | 0.242     | 0.024               | 5.0    | 0.114     | 0.011               | 15.0   | 0.323     | 0.033               | 0.0    | 0.000     | 0.000               | 30.0   | 7.5                      | 0.169         | 0.017                   |
| Published papers (full text) from foreign and international scientific conferences ( <i>AFa, AFC, AFBA, AFDA</i> )                 | 3.0    | 0.073     | 0.007               | 7.0    | 0.159     | 0.015               | 3.0    | 0.065     | 0.007               | 23.0   | 0.501     | 0.050               | 36.0   | 9.0                      | 0.203         | 0.020                   |
| Published papers (full text) from domestic scientific conferences ( <i>AFB, AFD, AFBB, AFDB</i> )                                  | 23.0   | 0.557     | 0.056               | 21.0   | 0.478     | 0.046               | 2.0    | 0.043     | 0.004               | 19.0   | 0.414     | 0.041               | 65.0   | 16.3                     | 0.366         | 0.037                   |

- **Supplementary information and/or comments on the scientific outputs of the institute.**

The main staff efforts in 2012-2014 were devoted to the implementation of 7 major ERDF projects known by their heavy administration, which consumed significant scientific capacity of researchers. These projects significantly improved the research infrastructure of the Institute and thus boosted competitiveness of IGT SAS within the highly ranked research programmes such as FP7, H2020, NATO, COST and etc. These efforts resulted in the new research consortia FP7-WaSClean (coordinated by IGT SAS), NATO as well as new collaborations with companies from Japan, Chile, Slovakia, UK, Greece, Kazakhstan.

Despite of the heavy and intensive administration delivered by the researchers while implementing the ERDF project and purchasing the equipment essential for their future work, the publication activity has shown substantially growing trend (number of publications in CC journals increased by 55% compared to previous assessment period). Moreover, the new infrastructure provided more invitations to 6 new project consortia within H2020 proposals.

Publishing activities of IGT SAS in journals registered in CCC reached 91 papers, where 56% was generated by Department of Mechanochemistry, 24% by Department of Physical and Physico-Chemical Methods of Mineral Processing, 13% by Department of Mineral Biotechnologies, and 6% by the Department of Environment and Hygiene in Mining. In other categories of scientific publications, the results of all departments are comparable with minor prevailing of the Department of Mineral Biotechnologies. In previous assessment period Department of Mechanochemistry covered almost 76% of CCC outputs. Current shares on outputs confirm the successful implementation of new management policy of IGT SAS.

Four research projects with industries have restricted the publication of results due to possible IPR issues; however there is a strong intent to patent the technology in the near future.

It is most likely that FP7 WaSClean project will generate substantial intellectual property, which will be protected by filing patent applications. The WaSClean IPR policy is a part of Consortium Agreement and contains provisions for ownership of the pre-existing knowledge or know-how (background knowledge), foreground knowledge, and intellectual property protection, publication and dissemination activities, promotion and exploitation of the results and IPR issues beyond the end of the contract. Since existing industrial collaboration within WaSClean consortium is pretty young, the patent activities, which require semi-pilot or pilot scale experiments and/or in-situ experiments are expected in later stage.

The IGT SAS is also establishing partner of Development and Realisation Workplace of Raw Materials Extracting and Treatment (VRP), as well as partner of National Platform for Research, Development and Innovations of Resources (a member of The European Technology Platform on Sustainable Mineral Resources), which strongly supports the collaboration with industries active in mining, metallurgy, construction, tunnelling etc.

On the top of that the IGT SAS share facilities of PROMATECH - Research Centre of Progressive Materials and Technologies for Current and Future Applications funded by ERDF funds, which brings together four institutes of SAS and two universities. PROMATECH provides the unique platform to share knowledge within the consortium with the aim of development of new technologies and knowledge transfer to industries.

## 2.2. Responses to the research outputs (citations, etc.)

### 2.2.1. Table with citations per annum.

*Citations of papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) have to be listed separately.*

| Citations, reviews                                                                  | 2011   |           | 2012   |           | 2013   |           | 2014   |           | total  |                          |               |
|-------------------------------------------------------------------------------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------------------|---------------|
|                                                                                     | number | No. / FTE | number | No. / FTE | number | No. / FTE | number | No. / FTE | number | averaged number per year | av. No. / FTE |
| Citations in Web of Science Core Collection (1.1, 2.1)                              | 386.0  | 9.344     | 453.0  | 10.307    | 470.0  | 10.127    | 550.0  | 11.988    | 1859.0 | 464.8                    | 10.470        |
| Citations in SCOPUS (1.2, 2.2) if not listed above                                  | 54.0   | 1.307     | 86.0   | 1.957     | 87.0   | 1.875     | 139.0  | 3.030     | 366.0  | 91.5                     | 2.061         |
| Citations in other citation indexes and databases (not listed above) (3.2,4.2,9,10) | 0.0    | 0.000     | 0.0    | 0.000     | 0.0    | 0.000     | 1.0    | 0.022     | 1.0    | 0.3                      | 0.006         |
| Other citations (not listed above) (3, 4, 3.1, 4.1)                                 | 44.0   | 1.065     | 44.0   | 1.001     | 64.0   | 1.379     | 133.0  | 2.899     | 285.0  | 71.3                     | 1.605         |
| Reviews (5,6)                                                                       | 0.0    | 0.000     | 0.0    | 0.000     | 0.0    | 0.000     | 0.0    | 0.000     | 0.0    | 0.0                      | 0.000         |

### 2.2.2. List of 10 most-cited publications, with number of citations, in the assessment period (2011 – 2014).

BALÁŽ, Peter. *Mechanochemistry in Nanoscience and Minerals Engineering*. Berlín: Springer-Verlag Berlín Heidelberg, 2008. 413 p. ISBN 978-3-540-74854-0. (137 citations)

ŠEPELÁK, Vladimír - BERGMANN, Ingo - FELDHOFF, Armin - HEITJANS, Paul - KRUMEICH, F. - MENZEL, Dirk - LITTERST, F.J. - CAMPBELL, S.J. - BECKER, Klaus Dieter. Nanocrystalline nickel ferrite,  $\text{NiFe}_2\text{O}_4$ : mechanosynthesis, nonequilibrium cation distribution, canted spin arrangement, and magnetic behavior. In *Journal of Physical Chemistry C*, 2007, vol. 111, no. 13, p. 5026-5033. (2007 - Current Contents, SCOPUS). ISSN 1932-7447. (69 citations)

VÁCLAVÍKOVÁ, Miroslava - GALLIOS, G.P. - HREDZÁK, Slavomír - JAKABSKÝ, Štefan. Removal of arsenic from water streams: An overview of available techniques. In *Clean Technologies and Environmental Policy*, 2008, vol. 10, no. 1, p. 89-95. ISSN 1618-954X. (61 citations)

SALAZAR-ALVAREZ, G. - QIN, J. - ŠEPELÁK, Vladimír - BERGMANN, Ingo - VASILAKAKI, M. - TROHIDOU, K.N. - ARDISSON, J.D. - NOGUÉS, J. Cubic versus spherical magnetic nanoparticles: The role of surface anisotropy. In *Journal of the American Chemical Society*, 2008, vol. 130, no. 40, p. 13234-13239. ISSN 0002-7863. (52 citations)

BALÁŽ, Peter. *Extractive metallurgy of activated minerals*. Amsterdam : Elsevier Science B.V., 2000. 278 p. Process Metallurgy, 10. ISBN 978-0-444-50206-3. (48 citations)

TKÁČOVÁ, Klára. *Mechanical activation of minerals*. Elsevier. Amsterdam – Oxford – New York – Tokyo, 1989. 158 p. ISBN 80-224-0007-6. (45 citations)

MOCKOVČIAKOVÁ, Annamária - DANKOVÁ, Zuzana - ŠKVARLA, Jiří. Enhancement of the bentonite sorption properties. In *Journal of hazardous materials*, 2010, vol.180, no.1-3, p. 274-281. (4.144 - IF2009). (2010 - Current Contents). ISSN 0304-3894. (34 citations)

BALÁŽ, Peter - ACHIMOVIČOVÁ, Marcela - BALÁŽ, Matej - BILLIK, Peter - CHERKEZOVA-ZHELEVA, Zara - CRAIDO, José Manuel - DELOGU, Francesco - DUTKOVÁ, Erika - GAFFET, Eric - GOTOR, Francisco José - KUMAR, Rakesh - MITOV, Ivan - ROJAC, Tadej - SENNA, M. - STRELETSKII, Andrey - WIECZOREK-CIUROWA, Krystyna. Hallmarks of mechanochemistry: from nanoparticles to technology. In *Chemical Society Reviews*, 2013, vol. 42, p. 7571-7637. (24.892 - IF2012). (2013 - Current Contents). ISSN 0306-0012. (32 citations)

VASEASHTA, A. - VÁCLAVÍKOVÁ, Miroslava - VASEASHTA, S. - GALLIOS, G.P. - ROY, P. - PUMMAKARNCHANA, O. Nanostructures in Environmental pollution detection, monitoring, and remediation. In *Science and technology of advanced materials*, 2007, vol. 8, no. 1-2, p. 47-59. ISSN 1468-6996. (30 citations)

BALÁŽ, Peter - ACHIMOVIČOVÁ, Marcela. Selective leaching of antimony and arsenic from mechanically activated tetrahedrite, jamesonite and enargite. In *International Journal of Mineral Processing*, 2006, vol. 81, p. 44-50. ISSN 0301-7516. (30 citations)

### 2.2.3. List of most-cited authors from the Institute (at most 10 % of the research employees with university degree engaged in research projects) and their number of citations in the assessment period (2011– 2014).

| The most-cited authors from IGT SAS   | Number of citations |
|---------------------------------------|---------------------|
| Peter Baláž, prof., RNDr., DrSc.      | 907                 |
| Šepelák Vladimír, prof., RNDr., DrSc. | 745                 |
| Marcela Achimovičová, Mgr., PhD.      | 249                 |
| Erika Dutková, RNDr., PhD.            | 245                 |
| Miroslava Václavíková, Ing., PhD.     | 176                 |

As supplementary information, also other frequently cited authors are presented in the following table. Citations of the publications from the IGT SAS former researchers are listed in the Questionnaire only in case of their affiliation to the Institute of Geotechnics SAS. Compared to the previous Assessment Period, young researchers boosted their publication activity and moreover became recognized in their fields of research.

|                                                      |     |
|------------------------------------------------------|-----|
| Štefan Jakabský, Ing., PhD.                          | 173 |
| Annamária Mockovčiaková, RNDr., PhD.                 | 148 |
| Slavomír Hredzák, Ing., PhD.                         | 135 |
| Zuzana Danková, Ing., PhD.                           | 120 |
| Klára Tkáčová, prof., RNDr., DrSc. (retired in 1997) | 118 |
| Martin Fabián, RNDr., PhD.                           | 105 |
| Alena Luptáková, Ing., PhD.                          | 100 |

- **Supplementary information and/or comments on responses to the scientific output of the institute.**

Indirect positive responses to the research activities of IGT SAS involve the substantial positive recognition of the Institute by the following:

- long-term research partnerships with Slovak industrial partners, such as Environcentrum, s.r.o., Košice, SMZ, a.s. Jelsava, Tesla Stropkov, a.s., CAD-ECO, a.s. Bratislava, workplace Žilina, VSK Minerals, s.r.o. Košice, GEO Slovakia, s.r.o. Košice.,
- new research partnerships with foreign industrial partners that have arisen from responses to the quality of research of IGT SAS, such as Cristalerias de Chile S.A., Nihon Seiko Co. Ltd, Tokyo, Japan, HERMES S.A., Greece, MAST Carbon Intl, UK, EKODOR LLC, Kazakhstan, Newmont Technologies Ltd, USA, etc.,
- increased number of invitations in international (FP7, H2020, NATO, COST) and national (ERDF, SRDA/APVV) research projects consortia,
- 25 invited lectures to international conferences/scientific events during reported period and 19 invited presentations for international scientific institutions,
- regular requests for reviews: 252 elaborated reviews of scientific papers, 7 reviews of monographs, 57 reviews of international and national project, of expert studies and project proposals requested by editorial boards of journals and research funding agencies (see table Reviews of publications and project proposals in Supplementary information to Chapter 2.3.),
- numerous awards granted to IGT researchers (see the list of awards below):

#### **National and International Awards**

During the assessment period, several outstanding scientists of the IGT SAS have been awarded for their scientific activities:

##### **Dr. h. c. prof. dr. Ing. František Špaldon, DrSc.**

- 2013 During the 20th Anniversary of the formation the Slovak Republic, the President of the Slovak Republic Ivan Gašparovič granted state awards to important personalities of Slovakia. Prof. Špaldon as former researcher and Scientific Board Chairman of the IGT SAS was awarded the Second Class of the Order of Ludovit Stur for his special achievements and outstanding contribution to the field of process control in industry and life-long scientific and educational activities.

##### **Prof. RNDr. Peter Baláž, DrSc.**

- 2012 Award of Presidium of Slovak Academy of Sciences,  
Price for monography "Mechanochemistry in Nanoscience and Minerals Engineering"
- 2012 Award for excellent scientific response per publication in category Technical Science and Geoscience, Literature Fund Bratislava, Slovakia, Section for Scientific and Technical Literature and Computer Programs, for responses to publication "Extractive Metallurgy of Activated Minerals"
- 2013 Medal awarded at 60<sup>th</sup> Anniversary of SAS, by President of SAS, for top team led by Prof. Balaz and for Department of Mechanochemistry of IGT SAS
- 2014 Award for excellent scientific response per publication in category Technical Science and Geoscience, Literature Fund Bratislava, Slovakia, Section for Scientific and Technical Literature and Computer Programs, for responses to publication "Mechanochemistry in Nanoscience and Minerals Engineering, Springer-Verlag Berlin Heidelberg 2008"

- 2015 Award for scientific and technical literature for 2014, awarded by Literature Fund in category natural and technical science for book "Material Chemistry"

**RNDr. Martin Fabián, PhD.**

- 2012 Price of Ministry of Education, Science, Research and Sports of Slovak Republic for science and technology in category "Young Researcher's Award" (under 35 years), for Development of Mechanochemistry in Synthesis of Metastable Nanocrystalline Oxides.

**Ing. Vítězoslav Krúpa, DrSc.**

- 2012 Golden Jubilee Commemorative Medal at 60<sup>th</sup> Anniversary of Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University in Kosice
- 2014 Diploma of Recognition for long-term activities within the Slovakian Mining Society awarded by Presidium of SMS
- 2015 Acknowledgement Letter for active work in the national project National Qualification System, Sector Council for Mineral Exploitation, Processing and Geology.

**Prof. RNDr. Vladimír Šepelák, DrSc.**

- 2013 Honorary plaque of Aurel Stodola for merit in technical science, awarded by Slovak Academy of Sciences
- 2013 Award for Distinguished Researcher involved in development of SAS awarded at 60<sup>th</sup> Anniversary of SAS
- 2013 Award for excellent scientific response per publication by Literature Fund Bratislava, Slovakia
- 2014 Price of Slovak Academy of Sciences awarded by Presidium of SAS
- 2014 ICDD Recognition Award by The International Centre for Diffraction Data

**Ing. Slavomír Hredzák, PhD.**

- 2015 Award and Medal of Merit for long-term activities within the Slovakian Mining Society awarded by the Presidium of SMS

**Ing. Zuzana Danková, PhD.**

- 2013 Commemorative Letter of the Minister of Education, Science, Research and Sports awarded for young R&D workers under 35 years

**RNDr. Matej Baláž, PhD.**

- 2015 Fellowship of S. Schwarz awarded by SAS
- 2015 Award for scientific and technical literature for 2014, awarded by Literature Fund in category natural and technical science for book "Material Chemistry"

**Mgr. Zdenka Bujňáková, PhD.**

- 2015 3<sup>rd</sup> place in Young Researchers Contest under 35 years awarded by SAS for "Arsenic Sulfide Nanosuspensions, Their Properties and Anti-Cancer Effects"

**RNDr. Erika Turianicová, PhD.**

- 2015 Award for scientific and technical literature for 2014, awarded by Literature Fund in category natural and technical science for book "Material Chemistry"

**Ing. Jana Jenčárová, PhD.**

- 2015 Award of S. Gazda for the best poster of young researchers at the conference Geochemistry 2015 awarded by Slovak Association of Geochemists, Bratislava for the poster "Bioprecipitation of Metal Sorbents Using the Sulphate Reducing Bacteria".

Another major response to scientific activity of IGT SAS during assessed period were the responses to the book published by Springer earlier in 2010 “Water Treatment Technologies for the Removal of High-Toxicity Pollutants” edited by M. Václavíková, G. Gallios, K. Vitale and L. Ivaničová. The book has been among **the top 25% most downloaded eBooks of Springer publisher in 2014 and 2015** proving its high potential for readers.

## Availability of and results for your eBook

Since its online publication there has been **a total of 36,593 chapter downloads** for your eBook on SpringerLink. The table to the right shows the download figures for the last year(s).

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As you can see, the electronic version reaches a broad readership and provides increased visibility for your work. This is especially noticeable in the long run: statistical data show that the usage of electronic publications remains stable for years after publication.

| Year | Chapter Downloads |
|------|-------------------|
| 2015 | 9,984             |
| 2014 | 12,226            |
| 2013 | 8,112             |
| 2012 | 1,407             |
| 2011 | 2,491             |
| 2010 | 2,144             |
| 2009 | 229               |

## 2.3. Research status of the institute in international and national contexts

- **International/European position of the institute**

- 2.3.1. List of the most important research activities demonstrating the international relevance of the research performed by the institute, incl. major projects (details of projects should be supplied under Indicator 2.4). Max. 10 items.**

Institute of Geotechnics SAS has cooperated with many universities, scientific institutes and companies abroad. Cooperation runs in bilateral and multi-lateral projects, in joint organizing of scientific conferences, joint preparation and processing of mineral and material samples, in analyses and determination of samples properties, joint experiments and publications. The research activities of the IGT SAS were implemented via research projects, out of which 10 crucial ones are listed below:

**[1] Water and Soil Clean-Up from Mixed Contaminants (10/2013 – 09/2017)**

FP7-PEOPLE-2013-IAPP-612250-WaSClean

Project coordinator: Ing. Miroslava Václavíková, PhD.

Partner organizations: IGT SAS (co-ordinator), Aristotle University of Thessaloniki, Greece; University of Brighton, UK; Nazarbayev University, Astana, Kazakhstan; Environcentrum s.r.o., Kosice, Slovakia; HERMES S.A., Thessaloniki, Greece; MAST Carbon International Ltd, Basingstoke, UK; Ekodor SK TOO, Temirtau, Kazakhstan.

Based on long-term cooperation with Aristotle University of Thessaloniki, Greece and upon the post-doc activities of Dr Václavíková at University of Brighton, UK, several proposals of FP7 projects were prepared and in 2013, the project focused on „Water and Soil Clean-Up from Mixed Contaminants“ was approved for financing. The WaSClean project aims to stimulate intersectoral collaboration to develop and scale-up comprehensive technology for the remediation of contaminated land from heavy metals (e.g. Pb, As, Cr, Cd, Hg), persistent organic pollutants (lindane, atrazine, obsolete pesticides), and synthetic dyes (reactive blue, red, black from textile industry). Transfer of knowledge and scientific training are implemented via numerous secondments from IGT SAS to industrial partners and vice versa. WaSClean project brought together a consortium of 8 partner organizations from 4 countries (Slovakia, Greece, United Kingdom, Kazakhstan) across 2 continents, with 2 workshops, 1 autumn school and 49 secondments delivered so far, out of which 15 were from IGT SAS. Dr Václavíková is coordinator of the project consortium. Transfer of knowledge was represented by materials production and characterisation methodologies shared between industrial and academic partners allowing academic researchers a view of industrial processes and procedures, transfer of knowledge of techniques for materials characterisation using high cost equipment within academic institutions not previously available to industrial colleagues e.g. electron microscopy, GC/MS, ICP-OES, MS, LC-MS, TOC, respiratory measurements, etc.

**[2] NATO project „Technical Advances to Detect and Remove Contaminants from Water for Safety and Security“ (11/2012-10/2015)**

Principal investigator at IGT SAS: Ing. Miroslava Václavíková, PhD.

NATO SPS Multi-Year Project No: EAP.SFPP 984403

Partner organizations: Institute for Advanced Science Convergence, Norwich University Applied Research Institutes, Herndon, USA (coordinator), Aristotle University of Thessaloniki, Greece; Academy of Sciences of Moldova, Chisinau; State Engineering University of Armenia, Yerevan; IGT SAS

The project seeks to use advanced (nano) technology to detect and mitigate inadvertent and intentional, chemical-biological-radiological-nuclear (CBRN) contamination of water supplies, develop a stand-alone technology to supply a clean water, and develop a GPS/GIS Contamination and Identification and Level Monitoring Electronic Display System (CILM-EDS) prototype to spatially monitor contaminants and water level, in event

of natural catastrophe. Project supporting a NATO's mission to enhance security of critical water infrastructure put together experts from Norwich University Applied Research Institute, USA (project leader), Institute of Geotechnics SAS, Aristotle University of Thessaloniki, Greece, Academy of Sciences of Moldova, Chisinau, Moldova State Engineering University of Armenia, Yerevan, Armenia. The role of IGT SAS was to develop and characterize materials with high affinity towards the contaminants in waters and well as describe the nature of mechanism during the decontamination process.

**[3] Mechanochemical synthesis of nanomaterials in cooperation with Karlsruhe Institute of Technology (KIT), Germany**

Scientist-in-charge: Prof RNDr. Vladimír Šepelák, DrSc.

Partner organizations: IGT SAS, KIT

Based on long-term collaborative research activities of the IGT SAS Department of Mechanochemistry and Prof. Šepelák with the KIT, excellent conditions for mobility of postdocs were created and hence two researchers from IGT SAS were able to enjoy the DFG (German Research Foundation) funding at KIT for their several months long research stays. Dr M. Fabián was seconded to KIT for 6 months from October 2014 and for 3 months in 2015 focusing on study of relations between the structure and physical properties of nanocrystalline oxides. Dr E. Turianicová was seconded to Institute of Nanotechnologies of KIT, where she contributed to the mechanosynthesis of lithium containing nanocomplexes with characterization of prepared materials by physico-chemical and spectroscopic methods (XRD, <sup>57</sup>Fe Mössbauer and <sup>7</sup>Li NMR spectroscopy). She also discussed the results with Prof. P. Heitjans (Leibniz University Hannover), Prof. K.D. Becker (TU Braunschweig) and Prof. W. Bensch (Christian-Albrecht University Kiel).

**[4] Hydrometallurgical Technology of Antimony Recovery from Antimonite Concentrates (2013-2014) and Mechanochemical Technology for Preparation of Nanocrystalline Material (2014-2015)**

Principal investigator: prof. RNDr. Peter Baláž, DrSc.

Partner organizations: IGT SAS, Nihon Seiko Co. Limited, Tokyo, Japan, Technische Universität Clausthal, Germany

Based on excellent results of the team of Department of Mechanochemistry, two contracted projects of applied research financed from external resources have been set up with Japanese company Nihon Seiko Co., Limited. The tests of hydrometallurgical treatment of supplied materials defined in Contract with Japanese company were performed. Results are confidential according to the requirement of the Japanese company.

**[5] Development of in-situ bioleaching method to clean quartz sands and application through testing prototype pilot plant (01/2014-12/2016)**

Principal investigator: Ing. Iveta Štyriaková, PhD.

Partner organizations: IGT SAS, Cristalerias de Chile S.A.

Collaborative project of applied research for development of innovation technologies was funded by the Chilean Economic Development Agency CORFO between the IGT SAS and company Cristalerias de Chile S.A. (Project CORFO I+D Cod. 13IDL2 – 23505). The cooperation has been induced as the result of responses to the previous publications of the Department of Mineral Biotechnologies IGT SAS.

Cristalerias de Chile SA is a company engaged in the production of glass containers and uses raw silica sand, which does not fulfil the purity necessary for creating quality glass. The research and development of new technologies within the biotransformation of silicate minerals by heterotrophic bacteria is one of the scientific activities of IGT SAS which may serve to develop the bioleaching technology for the purification of quartz sand in Chile. Laboratory tests in the first year of project solutions were carried out with aim to find active microorganisms in Chile for the iron mineral removal from quartz sands in EL TURCO deposit. Unsterile condition of selected localities in El Turco, Atacama, Yerba Loca, and Coronel in Chile gave a phylogenetic diversity of Fe-reducing bacteria and microorganisms. Iron dissolution and removal from quartz sands was best with the most active microorganisms from Yerba Loca. The extent of iron coatings removal from Chile's

quartz sands depended on way and conditions of bioleaching. Columns bioleaching of quartz sands with percolation of media was better than flasks bioleaching under stationary condition. That is why the heap bioleaching by percolation of media will be more compatible than the tanks bioleaching. The heap bioleaching with the recycling of leachates provides the development of new economic technology suitable for the quality improvement of QS for the company from Chile.

The detailed results of the projects are prevented from publishing due to confidentiality required by the company.

**[6] Liberalization of Ag/Au particles from silicate matrix by bioleaching (05/2012-05/2013)**

Principal investigator: Ing. Iveta Štyriaková, PhD.

Partner organizations: IGT SAS, Newmont Technologies Limited, Denver, USA.

Upon the responses to the previous work of the Department of Mineral Biotechnologies, the cooperation with company Newmont Technologies Limited, Denver, USA was set up by external contract funding of the research focused on liberalization of Ag/Au particles from silicate matrix by bioleaching. The laboratory tests were carried out with aim of the yield increasing of silver and gold from the ore material heaps. The bioleaching process of coarse-grained raw materials was verified in laboratory by indigenous bacteria which caused decomposition of mineral matrix in which the silver minerals are locked. The main requirement of the company was to prevent the dissolution of mercury presented in the raw material in order to protect the environment during the use of biotechnology in heaps pretreatment, which was resolved right choice of media composition used in the bioleached process. The detailed results of the projects were prevented from publishing due to confidentiality required by the company.

**[7] Development of combined biohydrometallurgical and physico-chemical approaches for removal of heavy metals from acid mine drainage waters (2012-2015)**

Principal investigator: Ing. Alena Luptáková, PhD.

Partner organizations: IGT SAS, Institute of Environmental Geology and Geoengineering, CNR, Rome, Italy.

Long-term active cooperation within bilateral projects with the Institute of Environmental Geology and Geoengineering, CNR, Rome, Italy followed also through the Assessment Period. Project of bilateral cooperation Application of physical-chemical and biological-chemical methods for metals removal from acid mine drainage delivered several papers on research carried out via short-term research stays. From 2013 to 2015, the cooperation with CNR was focused on Development of innovation processes for beneficiation of used batteries.

**[8] Cooperation with VSB-Technical University of Ostrava, Czech Republic (2012-2015)**

Long-term cooperation with VSB-Technical University of Ostrava has moved further by deploying several joint research and mobility projects, as well as teaching and PhD supervising activities of IGT SAS researchers in Ostrava in the field of environmental biotechnology and mineral processing. Methodical joint cooperation in the use of specific methods and instrumentation formed a base for bilateral projects, such as Utilization of liquid pyrolysis products of waste materials as collectors in the coal flotation. The project APVV-SK-CZ-2013-0233 is focused on the application of pyrolysis oils after the process of pyrolysis of selected types of waste and biomass as floating collectors in the flotation process of coal. Liquid pyrolysis products after microwave extraction of coal in dichloromethane were identified by GC-MS. The presence organic compounds with carbon numbers C12, C13, C15, C20 was confirmed in the extract. It was also carried out research to flotation agents Montanol 800 and flotation agent on pyrolytic oil base P550 in the flotation of black hard coal from locality of Darkov, Czech Republic. Hard coal flotation was tested in a closed circuit. At the same time, the flotation froth of concentrate was observed, as it represents a significant problem during its dewatering in the operation conditions.

Active cooperation was set up also during organizing of international conferences: Conference on Environment and Mineral Processing (annually in June 2012-2015) and mainly of the Waste Recycling Conference Series, where in the year 2013 the IGT SAS was the main organizer.

**[9] Mechanochemical activation, mechanosynthesis of new oxides with significant physico-chemical properties**

Department of Mechanochemistry collaborated with Prof. Marmoru Senna, president of International Mechanochemistry Association, during his short-term research stays in 2012, 2013, 2014 and 2015 at the IGT SAS, where he worked with Dr. Fabián, Dr. Turianicová and prof. Šepelák on issues of incorporation of fluorine to the oxide structure during mechanochemical activation and mechanosynthesis of oxides with significant physico-chemical properties.

**[10] Structure-Function Relationship of Advanced Nanooxides for Energy Storage Devices (10/2015-09/2018)**

V4-JST Japan project, Principal investigator at IGT SAS: Prof. RNDr. Vladimír Šepelák, DrSc.

Partner organizations: Research Institute of Electronics, Shizuoka University, Japan; Nagoya Institute of Technology, Nagoya, Japan; National Institute for Fusion Science, Tokyo, Japan; J. Heyrovsky Institute of Physical Chemistry, Dept. of Electrochemical Materials, Czech Republic; Warsaw University of Technology, Faculty of Materials Science and Engineering, Poland

The main objective of the project is focused on the development of novel and sophisticated chemical routes towards energy harvesting materials within multidisciplinary oriented approach in the field of solid state chemistry. Basic concept includes (i) to obtain well-defined complex oxide materials by starting from well-designed precursors, (ii) to utilize phenomena at the solid interfaces, particularly those between inorganic – organic solids, (iii) to utilize unique features of non-conventional processes, i.e. mechanical activation and microwave technology, and (iv) to characterize the products under well-defined and reproducible conditions, without restriction to the properties of the end use, e.g. the capacity fade of the complete Li-ion and Na-ion batteries. The target materials include (i) Li- and Na- containing nanocrystalline complex oxides mostly with structure of spinels, garnets, pyroxenes, olivines and orthosilicates and (ii) partially reduced and partially anion exchanged oxide nanoparticles ( $\text{SiO}_2$ ,  $\text{SnO}_2$  and  $\text{TiO}_2$ ). Non-conventionally synthesized oxides are expected to possess modified/enhanced structural and electrochemical properties. In the context of the proposed project, special effort will be focused on the systematic study of the structure-related functional properties directly connected towards energy storage applications. The final goal of the project is the optimization and prediction of the real structure of the products possessing e.g. the highest possible  $\text{Li}^+$  ( $\text{Na}^+$ ) ion conductivity by systematically introduced additives and the application of preparative processes of highest precision.

**2.3.2. List of international conferences (co)organised by the institute.**

Institute of Geotechnics SAS organized 16 international conferences (4 conferences as main organizer, 12 as co-organizer) in the Assessment Period.

**[1] Geotechnics 2012 – Construction, technologies and hazards of geotechnical constructions, Vysoké Tatry, Slovakia, 26.-29.09.2012**

IGT SAS co-organized the international conference Geotechnics 2012 as part of conference series in Slovakia, Czech republic and Poland focused on geotechnical issues in construction of underground structures. 60 participants.

**[2] Waste Recycling XVI., Ostrava, Czech Republic, 29.11.2012**

IGT SAS co-organized the international conference focused on scientific and technical findings in the field of recycling of industrial, agricultural and municipal waste. 70 participants.

**[3] Structure and Properties of Nonequilibrium and Nanocrystalline Materials 2013, Stará Lesná, Slovakia, 24.02.-02.03.2013**

IGT SAS organized the seminar along with Slovakian Mining Society, Slovak Mechanochemistry Association, with financial support of Slovak Research and Development Agency APVV. Experts from Slovakia, Czech republic, Germany, Japan, Poland and Greece presented 26 papers on synthesis and properties of nanomaterials and nanotechnological applications in industry and environment. 71 participants.

**[4] Preparation of Ceramic Materials, Herľany, Slovakia, 18.-20.06.2013**

New findings from the field of fireproof materials, construction and fine progressive ceramics, glass-ceramics and its application in industry were presented by researchers from 6 countries. 64 participants.

**[5] The New Mineral Policy - Progressive Technologies in Mining, Geology and Environment, Hotel Repiská – Demänovská dolina, Slovakia, 10.-11.10.2013**

IGT SAS co-organized the regular annual event of international conference series with 26 presentations from 5 countries. 65 participants.

**[6] Waste Recycling XVII., Košice, Slovakia, 21.-22.11.2013**

IGT SAS organized the 17<sup>th</sup> international conference on Waste Recycling focused on the transfer of knowledge in the field of remediation, recycling technologies, and waste disposal focused on Visegrad-4 region. Ing. Miroslava Václavíková, PhD. works as a conference guarantee for Slovakia. Presentations from 7 countries, 82 participants.

**[7] Structure and Properties of Nonequilibrium and Nanocrystalline Materials 2013, Zemplínska Šírava, Slovakia, 28.-31.07.2014**

International workshop on nanomaterials was organized with support of Slovak R&D Agency APVV within the project APVV-0528-11. Young researchers got into contact with experienced experts in the field of nanoscience to initialize their cooperation. During the workshop, professor Senna from Japan was awarded the Medal of Slovak Academy of Sciences for the support of science. 37 participants.

**[8] 3<sup>rd</sup> International Conference Biotechnology and Metals 2014, Košice, Slovakia, 17.-19.09.2014**

IGT SAS co-organized the conference within the series devoted to the latest trends in application of biotechnologies for acquisition of metals from difference raw materials and waste in the form convenient for further industrial processing, as well as biotechnology applications in the metal removal from environment. 52 participants.

**[9] Geotechnics 2014 - Construction, Technologies and Hazards of Geotechnical Constructions, Vysoké Tatry, Slovakia, hotel Bellevue, 02.-03.10.2014**

14<sup>th</sup> bi-annual conference co-organized by IGT SAS delivered 40 presentations focused on geotechnical prospecting, slope deformations and their improvements, geotechnical monitoring for transport communications, tunnel construction. 110 participants.

**[10] 1<sup>st</sup> WaSClean Workshop, Košice, Slovakia, 02.-03.10.2014**

IGT SAS organized an international workshop focused on water and soil clean-up from mixed contaminants, delivering 15 lectures of experts from 5 countries active in the field of remediation technologies, environmental chemistry, mineral biotechnologies, treatment of industrial, ground and surface waters, and chemical aspects of water and soil treatment. The workshop was organized with financial support of projects FP7-People-IAPP-612250-WaSClean and APVV-0252-10, co-organized by company Environcentrum s.r.o. and Slovakian Mining Society. 40 participants.

**[11] Waste Recycling XVIII., Miskolc, Hungary, 09.-10.10.2014**

IGT SAS co-organized the 18th international conference on Waste Recycling focused on the transfer of knowledge in the field of remediation, latest trends in recycling technologies, and support in waste disposal in Visegrad-4 region, critical metals in wastes, decontamination, etc. Ing. Miroslava Václavíková PhD. works as a conference guarantee for Slovakia. Co-organizers: Institute of Raw Material Preparation and

Environmental Processing, University of Miskolc, Hungary; Institute of Geotechnics, Slovak Academy of Sciences, Slovakia; Institute of Environmental Engineering, VSB Technical University of Ostrava, Czech republic; AGH University of Science and Technology, Krakow, Poland; University of Technology Krakow, Poland in cooperation with Hungarian Chemical Society, Hungarian Compost Association, Hungarian Mining and Metallurgical Society, Scientific Society of the Silicate Industry, Hungary, Hungarian Geological Society, Hungarian Natural Science Association, the TÁMOP-4.2.2.A-11/1/KONV-2012-0005 – CriticEI RESEARCH project. Presentations from 7 countries, 101 participants.

**[12] The New Mineral Policy - Progressive Technologies in Mining, Geology and Environment, Hotel Repiská – Demänovská dolina, Slovakia, 13.-14.11.2014**

IGT SAS co-organized the conference under auspices of the Ministry of Economy of Slovakia with 18 lectures from 5 countries. 56 participants.

**[13] XI International Conference on Preparation of Ceramic Materials, Herľany, Slovakia, 09.-11.06.2015**

IGT SAS co-organized the conference focused on presentations of fireproof materials, construction, fine ceramics, glass-ceramics, their properties and applications. 52 participants.

**[14] International Conference on the Present and Future of the Mining, Hotel Repiská – Demänovská dolina, Slovakia, 08.-09.10.2015**

Conference co-organized by IGT SAS was focused on analyses of current state of mining in Slovakia, main causes of stagnation, reviving of mining activities, potential of mineral resources, mining and engineering operations, and termination of mining factories. 56 participants.

**[15] Autumn School on Advanced Adsorption and Oxidation Techniques for the Removal of Xenobiotics and 2<sup>nd</sup> Workshop on Water and Soil Clean-up from Mixed Contaminants, Thessaloniki, Greece, 12.-14.10.2015**

IGT SAS co-organized the 2<sup>nd</sup> workshop of the WaSClean project connected with the Autumn School organized by project partners Aristotle University of Thessaloniki and Hermes S.A. company. International event attracted students and experts active in advanced oxidation processes, detoxication of organic compounds, dyes, pesticides, and oil products, electrochemical oxidation, nanosorbent preparation and remediation of contaminated areas. 100 participants.

**[16] Waste Recycling XIX, Krakow, Poland, 22.-23.10.2015**

IGT SAS co-organized the 19<sup>th</sup> international conference on Waste Recycling focused on the transfer of knowledge in the field of remediation, latest trends in recycling technologies, and support in waste disposal in Visegrad-4 region, critical metals in wastes, decontamination, etc. Ing. Miroslava Václavíková PhD. works as a conference guarantee for Slovakia. 50 participants.

### **2.3.3. List of edited proceedings from international scientific conferences.**

- [1] 17th International Conference on Waste Recycling. Eds. Jenčárová, J., Václavíková, M., Ivaničová, L., Štefušová, K. Košice: Institute of Geotechnics SAS, Košice, November 2013. ISBN 978-80-970034-6-3.
- [2] Workshop on Water and Soil Clean-up from Mixed Contaminants: book of abstracts. 1st. Ed. Václavíková Miroslava. Košice: Institute of Geotechnics, Slovak Academy of Sciences Košice, 2014
- [3] Biotechnology and Metals 2014: 3rd International Conference, Sept. 17-19, 2014 Košice. Eds. Kaduková, J., Luptáková, A., Velgosová, O. Košice: Faculty of Metallurgy of Technical University in Košice Institute of Geotechnics of Slovak Academy of Science, 2014. CD ROM. ISBN 978-80-553-1786-1.

- [4] Biotechnology and Metals 2014: Book of Abstracts 3rd International conference, Košice, Sept. 17-19, 2014. Eds. Kaduková, J., Luptáková, A., Velgosová, O. Košice: Faculty of Metallurgy, Technical University of Košice & Institute of Geotechnics, Slovak Academy of Sciences, 2014. 96p. ISBN 978-80-553-1787-8.

#### **2.3.4. List of journals edited/published by the institute:**

##### **2.3.4.1. WOS (IF of journals in each year of the assessment period)**

###### **Acta Montanistica Slovaca, ISSN 1335-1788 (until 2014)**

Acta Montanistica Slovaca is an international scientific journal published jointly by the Union of Metallurgy, Mining Industry and Geology of Slovak Republic, Slovak Mining Society, the Faculty of Mining, Ecology, Process Control and Geotechnologies (FBERG) of the Technical University of Kosice (Slovakia), Institute of Geotechnics SAS, and the Faculty of Mining and Geology (HGF) of the VSB Technical University of Ostrava (Czech Republic). Acta Montanistica Slovaca publishes high quality articles on basic and applied research in such fields: geology and geological survey, mining, Earth resources, underground engineering and geotechnics, mining mechanization, mining transport, deep hole drilling, ecotechnology and mineralurgy, process control, automation and applied informatics in raw materials extraction, utilization and processing, and other similar fields. IF2011: 0.084, IF2012: 0.094, IF2013: 0.053, IF2014: 0.329.

Acta Montanistica Slovaca is the only scientific journal of this kind in Central, Eastern and South Eastern Europe.

##### **2.3.4.2. SCOPUS**

##### **2.3.4.3. other databases**

###### **Acta Geoturistica, ISSN 1338-2292**

Acta Geoturistica is open-access international research journal devoted to geotourism and mining heritage, as well as tourism, natural heritage protection and preservation. The journal is published jointly by the Institute of Geotourism, International Association for Geotourism (IAGt), Institute of Geotechnics SAS, Faculty of Mining, Ecology, Process Control and Geotechnologies (FBERG) of the Technical University of Košice and the Faculty of Science of the Pavol Jozef Šafárik University in Košice.

##### **2.3.4.4. not included in databases**

- **National position of the institute**

#### **2.3.5. List of selected projects of national importance**

In the Assessed Period, 7 granted ERDF projects were extremely beneficial for IGT SAS and helped the institute to increase its publishing activities and boost the international collaboration due to new laboratories and equipment purchased during the implementation of the projects. Nevertheless, the main support for direct research costs was covered by 5 national projects of Slovak research and Development Agency SRDA/APVV.

**Centre of Excellence for Research and Treatment of Earth Resources CEV-I (ASFEU ITMS 26220120017)** Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (05/2009 – 04/2012).

**Centre of Excellence for Research and Treatment of Earth Resources – 2<sup>nd</sup> Stage CEV-II. (ASFEU ITMS 26220120038).** Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (03/2010 – 06/2014)

**Infrastructure Development of the Center of Excellence for Progressive Materials with Nano and Submicron Structure NanoCEXmat2** (ASFEU ITMS 262201200350). Principal investigator: prof. RNDr. Ján Dusza, DrSc., Institute of Material Research SAS, responsible for IGT SAS: prof. RNDr. Peter Baláž, DrSc., (05/2010 – 04/2013)

**Slovak Research and Innovation Platform for Sustainable Mineral Resources** (ASFEU ITMS 26220220053). Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (01/2010 – 06/2013)

**Centre of Excellence for Integrated Research of Geosphere GEOCEX** (ASFEU ITMS 26220120064). Principal investigator: Assoc. Prof. RNDr. Ján Soták, DrSc., Earth Science Institute SAS, responsible for IGT SAS: MVDr. Daniel Kupka, PhD., 09/2010 – 02/2015

**Research Center of Progressive Materials and Technologies for Current and Future Applications PROMATECH** (ITMS 26220220186). Principal investigator: prof. RNDr. Ján Dusza, DrSc., Institute of Material Research SAS, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD. (08/2013 – 12/2015)

**The Institutes of Slovak Academy of Sciences in Košice – The Development of Infrastructure and Internal Equipment of Teaching Facilities to Improve Education Conditions** (ASFEU ITMS 26250120013). Project leader: JUDr. Glória Gajdošová, responsible for IGT SAS: Ing. Lucia Ivaničová, PhD. (08/2009 – 06/2014)

**Development of Advanced Water Treatment Technologies for the Removal of Inorganic Pollutants** (APVV-0252-10), principal investigator: Ing. Miroslava Václavíková, PhD., (05/2011 – 10/2014)

**Mechanochemical Modification of Minerals for Advanced Nanotechnology Applications** (APVV-0189-10), principal investigator: prof. RNDr. Peter Baláž, DrSc., (05/2011 – 10/2014)

**Physical and Electrochemical Behavior of Mechanochemically Prepared Nanooxides** (APVV-0528-11), principal investigator: prof. RNDr. Vladimír Šepelák, DrSc., (07/2012 – 12/2015)

**Mechanochemistry of Semiconductor Nanocrystals: from Minerals to Materials and Drugs**, (APVV-14-0103), principal investigator: prof. RNDr. Peter Baláž, DrSc., (07/2015 – 06/2019)

**Arsenic Minerals in Advanced Applications** (APVV-LPP-0107-09), principal investigator: prof. RNDr. Peter Baláž, DrSc., (09/2009 – 8/2013)

#### **2.3.6. Projects of the Slovak Research and Development Agency (APVV)**

Only national projects of SRDA/APVV Agency are listed in this chapter. International projects of SRDA/APVV are listed in the Chapter 2.4.4.

- [1] **Development of Advanced Water Treatment Technologies for the Removal of Inorganic Pollutants** (APVV-0252-10), principal investigator: Ing. Miroslava Václavíková, PhD., (05/2011 – 10/2014)
- [2] **Mechanochemical Modification of Minerals for Advanced Nanotechnology Applications** (APVV-0189-10), principal investigator: prof. RNDr. Peter Baláž, DrSc., (05/2011 – 10/2014)
- [3] **Physical and Electrochemical Behavior of Mechanochemically Prepared Nanooxides** (APVV-0528-11), principal investigator: prof. RNDr. Vladimír Šepelák, DrSc., (07/2012 – 12/2015)
- [4] **Mechanochemistry of Semiconductor Nanocrystals: from Minerals to Materials and Drugs**, (APVV-14-0103), principal investigator: prof. RNDr. Peter Baláž, DrSc., (07/2015 – 06/2019)

- [5] **Arsenic Minerals in Advanced Applications** (APVV-LPP-0107-09), principal investigator: prof. RNDr. Peter Baláž, DrSc., (09/2009 – 8/2013)

### **2.3.7. Projects of the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA)**

VEGA projects represent smaller, lower budgeted research projects funded directly by SAS, which are however extremely helpful for starting up the research career for young scientists and to cover the research material, consumables and conferences:

- [1] **Development of New Composite Materials Based on Fly Ash** (01/2010 – 12/2012), principal investigator: Ing. Mária Praščáková, PhD., VEGA 2/0086/10
- [2] **Mechanochemical Synthesis of Environmentally Friendly Ferroelectric Nanomaterials** (01/2010 – 12/2012), principal investigator: RNDr. Martin Fabián, PhD., VEGA 2/0139/10
- [3] **The Innovation of Thermal Conversion of Energetic Raw Materials by the Application of Microwave Energy** (01/2010 – 12/2012), principal investigator: RNDr. Silvia Dolinská, PhD., VEGA 2/0141/10
- [4] **High-Energy Milling Preparation of Nanocrystalline Semiconductors on the Basis of Selenides** (01/2011 – 12/2013), principal investigator: Mgr. Marcela Achimovičová, PhD., VEGA 2/0043/11
- [5] **Mechanical Activation of Minerals for Environmental, Materials and Therapeutic Application** (01/2011 – 12/2013), principal investigator: prof. RNDr. Peter Baláž, DrSc., VEGA 2/0009/11
- [6] **Research of Abrasiveness and Other Rock Parameters Affecting the Tool Wear in Rock Disintegration by Direct and Indirect Methods** (01/2011 – 12/2013), principal investigator: Ing. Milan Labaš, PhD., VEGA 2/0142/11
- [7] **Nonequilibrium Structure of Surfaces/Interfaces in Nanooxides Prepared by Mechanochemical Routes** (01/2011 – 12/2013), principal investigator: prof. RNDr. Vladimír Šepelák, DrSc., VEGA 2/0174/11
- [8] **Study on Heavy Metals, Harmful Mineral Substances and Their Deposition in the Selected Components of Environment in the Areas of Mining and Metallurgical Industry in the Eastern Slovakia** (01/11 – 12/2014), principal investigator: Ing. Jozef Hančulák, PhD., VEGA 2/0187/11
- [9] **Interaction of Physical Fields with Fine-Grained Mineral Materials in Mineralurgical Processes** (01/2011 – 12/2014), principal investigator: Ing. Slavomír Hredzák, PhD., VEGA 2/0175/11
- [10] **Study of Positive and Negative Influences of Sulphuretum in the Environment and Industry** (1/2011 – 12/2014), principal investigator: Ing. Alena Luptáková, PhD., VEGA 2/0166/11
- [11] **Stimulation of Biochemical Processes of Raw Material and Waste Treatment** (01/2011 – 12/2014), principal investigator: Ing. Iveta Štyriaková, PhD., VEGA 2/0109/11
- [12] **Study of the Properties of Bentonite, Quartz Sand and Bacterial Cells Based Composites** (01/2012 – 12/2014), principal investigator: Ing. Zuzana Danková, PhD., VEGA 2/0115/12
- [13] **Energy Interpretation of Rock Mass Strength Properties** (01/2012 – 12/2014), principal investigator: Ing. Edita Lazarová, PhD., VEGA 2/0105/12
- [14] **The Mechanochemical of Nanocrystalline Ceramic Materials for Industrial and Environmental Applications** (01/2013 – 12/2015), principal investigator: RNDr. Martin Fabián, PhD., VEGA 2/0097/13

- [15] **Microwave Energy Application for Intensification of Extraction and Pyrolytic Processes of Coal and Wastes** (01/2013 – 12/2016), principal investigator: RNDr. Silvia Dolinská, PhD., VEGA 2/0114/13
- [16] **Hydrometallurgical Extraction of Gold from White Hill (Detva) Deposit and Wastes with the Application of Electrolysis, Mechanical Activation and Sorption** (01/2014 – 12/2016), principal investigator: Ing. Jana Ficeriová, PhD., VEGA 2/0051/14
- [17] **Mechanosynthesis of Lithium Nanosilicates with Attractive Electrochemical and Magnetic Properties** (01/2014 – 12/2016), principal investigator: RNDr. Erika Turianicová, PhD., VEGA 2/0064/14
- [18] **Mechanochemistry of Solids for Application in Nanotechnology** (01/2014 – 12/2017), principal investigator: prof. RNDr. Peter Baláž, DrSc., VEGA 2/0027/14
- [19] **Magnetic behavior of Nonequilibrium Nanooxides Prepared by Mechanochemical Routes** (01/2014 – 12/2017), principal investigator: prof. RNDr. Vladimír Šepelák, DrSc., 2/0097/14
- [20] **The Study of Atmospheric Deposition, Particulate Matters and Contamination of Selected Environment Components in Industrial and Urban Area of Košice and Middle Spiš** (01/2015 – 12/2018), principal investigator: Ing. Jozef Hančulák, PhD., VEGA 2/0194/15
- [21] **Prediction of Drillability of Intact Rock and Rock Mass** (01/2015 -12/2018), principal investigator: Ing. Lucia Ivaničová, PhD., VEGA 2/0160/15
- [22] **Bacterial Transformation of Sulphur Compounds in Processes of Materials Synthesis and Degradation** (01/2015 – 12/2018), principal investigator: Ing. Alena Luptáková, PhD., VEGA 2/0145/15
- [23] **The Development of Bioremediation Technology of Metals Removing from Soil and Sediment** (01/2015 – 12/2018), principal investigator: Ing. Iveta Štyriaková, PhD., VEGA 2/0049/15
- [24] **Microwave-Assisted Synthesis of Polycomponent Materials for Mineral Processing and Environmental Technologies** (01/2015 – 12/2018), principal investigator: RNDr. Anton Zubrik, PhD., VEGA 2/0158/15

### **2.3.8. Projects of SAS Centres of Excellence**

- [1] **Center of low temperature physics and materials research in extremal conditions** CFNTMVEP (04.08.2011 - 03.08.2015), principal investigator: prof. RNDr. Peter Samuely, DrSc., principal investigator for IGT SAS: prof. RNDr. Peter Baláž, DrSc.

### **2.3.9. National projects supported by EU Structural Funds**

Seven ERDF projects granted to IGT SAS enabled to purchase new high-tech laboratory equipment, which delivered strong position of IGT SAS in applying for international project consortia.

- [1] **Centre of Excellence for Research and Treatment of Earth Resources CEV-I** (ASFEU ITMS 26220120017) Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (05/2009 – 04/2012). Total budget: 1,297,500.5 €, Budget for IGT SAS: 270,120.46€.
- [2] **Centre of Excellence for Research and Treatment of Earth Resources – 2<sup>nd</sup> Stage CEV-II.** (ASFEU ITMS 26220120038). Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (03/2010–06/2014) Total budget: 2,789,900 €, Budget for IGT SAS: 548,321 €

- [3] **Infrastructure Development of the Center of Excellence for Progressive Materials with Nano and Submicron Structure NanoCEXmat2** (ASFEU ITMS 262201200350). Principal investigator: prof. RNDr. Ján Dusza, DrSc., Institute of Material Research SAS, responsible for IGT SAS: prof. RNDr. Peter Baláž, DrSc., (05/2010 – 04/2013) Total budget: 2,563,673.79 €, Budget for IGT SAS: 266,331.63 €
- [4] **Slovak Research and Innovation Platform for Sustainable Mineral Resources** (ASFEU ITMS 26220220053). Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., 01/2010–06/2013 Total budget: 520,920 €, Budget for IGT SAS: 45,409 €
- [5] **Centre of Excellence for Integrated Research of Geosphere GEOCEX** (ASFEU ITMS 26220120064). Principal investigator: Assoc. Prof. RNDr. Ján Soták, DrSc., Earth Science Institute SAS, responsible for IGT SAS: MVDr. Daniel Kupka, PhD., 09/2010 – 02/2015, Total budget: 3,975,039.6 €, Budget for IGT SAS: 1,289,192.50 €
- [6] **Research Center of Progressive Materials and Technologies for Current and Future Applications PROMATECH** (ITMS 26220220186). Principal investigator: prof. RNDr. Ján Dusza, DrSc., Institute of Material Research SAS, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD. (08/2013 – 12/2015), Total budget: 22,192,045.17 €, Budget for IGT SAS: 145,500.00 €, including personal 40,500 € and devices)
- [7] **The Institutes of Slovak Academy of Sciences in Košice – The Development of Infrastructure and Internal Equipment of Teaching Facilities to Improve Education Conditions** (ASFEU ITMS 26250120013). Project leader: JUDr. Glória Gajdošová, responsible for IGT SAS: Ing. Lucia Ivaničová, PhD., (08/2009–06/2014) Total budget: 4,978,841.27 €, Budget for IGT SAS: 459,893.14 €

**2.3.10. List of journals (published only in the Slovak language) edited/published by the institute:**

- 2.3.10.1. WOS (IF of journals in each year of the assessment period)**
- 2.3.10.2. SCOPUS**
- 2.3.10.3. Other databases**
- 2.3.10.4. Not included in databases**

- **Position of individual researchers in an international context**

**2.3.11. List of invited/keynote presentations at international conferences, as documented by programme or invitation letter**

**Invited presentations at international conferences**

- [1] BALÁŽ, P.: Arsenic mechanochemistry: from minerals engineering to cancer treatment. VI. International conference "Quo Vadis Hydrometallurgy", Herľany, 4. 6. 2012, Slovakia.
- [2] ŠEPELÁK, V.: Highly Nonequilibrium Nanooxides. The 19th International Symposium on Metastable Amorphous and Nanostructured Materials, ISMANAM 2012, 18. – 22. 6. 2012, Moscow, Russia.
- [3] VÁCLAVÍKOVÁ, M.: Advanced Adsorbents for Water Remediation. NATO ARW on Technological Advances in CBRNE Sensing and Detection for Safety, Security, and Sustainability, 28. 9 – 1. 10. 2012, Yerevan, Armenia,
- [4] BALÁŽ, P.: Realgar nanoparticles Physico-chemical properties and anticancer effects. World Cancer Congress 2013, 23.-25. 5. 2013., Xí'an, China.
- [5] BALÁŽ, P.: Properties and bioaccessibility of arsenic sulphide suspensions prepared by nanomilling. Workshop on Structure and Properties of Non-equilibrium and Nanocrystalline Materials 2013, 24.02.-02.03.2013, Stará Lesná, Slovakia.

- [6] DANKOVÁ, Z.: Structure and properties of clay-iron oxides composites. Workshop on Structure and Properties of Nonequilibrium and Nanocrystalline Materials 2013, 24.02. - 02.03. 2013, Stará Lesná, Slovakia.
- [7] FABIÁN, M.: Mechanochemical synthesis of selected nanocrystalline oxides. Workshop on Structure and Properties of Nonequilibrium and Nanocrystalline Materials 2013, 24.02. - 02.03. 2013, Stará Lesná, Slovakia.
- [8] ŠEPELÁK, V.: Mechanochemical reactions and syntheses of oxides. 4th International Conference on Fundamental Bases of Mechanochemical Technologies (FBMT-2013), June 25-28, 2013, Novosibirsk, Russia.
- [9] ŠEPELÁK, V.: Magnetic behavior of nanostructured and nonequilibrium ferrites. 5th Seeheim Conference on Nanomagnetism (SCM 2013), September 29 - October 3, 2013, Frankfurt, Germany.
- [10] ŠEPELÁK, V.: Mechanochemical reactions and syntheses of oxides. 5th International Conference NANOCON 2013, October 16-18, 2013, Brno, Czech Republic.
- [11] VÁCLAVÍKOVÁ, M.: Embedding of Fe/Cu-NPs into Porous Materials for Environmental Applications. Workshop on Structure and Properties of Nonequilibrium and Nanocrystalline Materials 2013, 24.02.-02.03.2013, Stará Lesná, Slovakia
- [12] VÁCLAVÍKOVÁ, M.: Fe/Cu Carbon Composites for Water and Soil Clean-up. NANOSMAT conference, 22-25.09.2013, Granada, Spain.
- [13] VEREŠ, J.: Characterization of iron and steelmaking wastes and zinc removal by microwave extraction. Workshop on Structure and Properties of Nonequilibrium and Nanocrystalline Materials 2013, 24.02. - 02.03. 2013, Stará Lesná, Slovakia.
- [14] BALÁŽ, P.: Mechanochemistry of Solids: New Prospects for Extractive Metallurgy, Materials Science and Medicine, 8th International Conference on Mechanochemistry and Mechanical Alloying (INCOME 2014), June 22-26, 2014, Krakow, Poland.
- [15] HREDZÁK, S.: An Assessment of Separation Efficiency as Exemplified by Secondary Serpentine Material Upgrading. Plenary Session of the 18th International Scientific Conference on Waste Recycling XVIII, 9.10.2014, Miskolc, Hungary.
- [16] KUPKA, D.: Soil and Water Clean-up from Inorganic and Organic Contaminants. Erasmus Summer School on Environmental Technologies in Mining and Waste Management. 30.6- 12.7.2014, Košice, Slovakia.
- [17] ŠEPELÁK, V.: The mechanically induced structural disorder in barium hexaferrite,  $\text{BaFe}_{12}\text{O}_{19}$ , and its impact on magnetism, Faraday Discussions 170, May 21-23, 2014, Montreal, Canada.
- [18] ŠEPELÁK, V.: Magnetic behavior of nanooxides prepared by mechanochemical routes, 8<sup>th</sup> International Conference on Mechanochemistry and Mechanical Alloying (INCOME 2014), June 22-26, 2014, Krakow, Poland.
- [19] ŠTYRIAKOVÁ, I.: Bacterial decomposition of the rocks and minerals with the possibilities of industrial utilization - Workshop CORFO - CRISTALERIAS, 23. 2. 2014, Padre Hurtado, Chile.
- [20] ŠTYRIAKOVÁ, D.: Potential raw material of quartz sands, their mineralogical composition and removal of iron minerals by bioleaching - Workshop CORFO - CRISTALERIAS, 23. 2. 2014, Padre Hurtado, Chile.
- [21] VÁCLAVÍKOVÁ, M.: Fe/Cu Carbon Composites for Water Decontamination. NATO ASI on Nanoscience Advances in CBRN Agents Detection, Information and Energy Security. 29.5. - 6.6.2014, Sozopol, Bulgaria.
- [22] BALÁŽ, M.: Eggshell membrane: A unique waste biomaterial with multidisciplinary applications. XVI European Symposium on the Quality of Eggs and Egg Products, 10.-13.5.2015, Nantes, France.
- [23] ŠEPELÁK, V.: Separation of surface effects from bulk effects in oxide nanoparticles. Kolloquium "Physikalische Festkörperchemie", 13.2.2015, Braunschweig, Germany.

[24] ŠEPELÁK, V.: Nonconventional mechanosynthesis of oxides. Summer School of the Collaborative Research Center 1109 "Understanding of Metal Oxide/Water Systems at the Molecular Scale: Structural Evolution, Interfaces, and Dissolution", 31.8.-3.9.2015, Erkner, Germany.

#### **Invited presentations at important foreign scientific institutions**

- [1] BALÁŽ, P.: Theory and Practice in Mechanical Activation, University of Miskolc, Hungary, 10.05.2012.
- [2] BALÁŽ, P.: Mechanochemistry in Minerals Engineering: from Minerals to Nanomaterials and Drugs, McGill University, Montreal, Canada, 05.10.2012.
- [3] FABIÁN, M.: Mechanochemical synthesis of selected nanocrystalline oxides, Institute of Catalysis of Bulgarian Academy of Sciences, Sofia, Bulgaria, 22. 6. 2012.
- [4] BALÁŽ, P.: Realgar Nanoparticles: Properties and Anticancer Effects, National Health Research Institutes, Zhunan Town, Miaoli County, Taiwan, 28.05.2013
- [5] BALÁŽ, P.: Mechanochemistry in Chemical Engineering: from Minerals to nanomaterials and drugs, Tamkang University, Teipei, Taiwan, 31.05.2013
- [6] JABLONOVSKÁ, K.: Environmental problem of abandoned mine working Smolník. Biology Centre AS CR - Institute of Soil Biology, v. v. i., České Budějovice, Czech Republic, 26.09.2013.
- [7] KOVAŘÍK, M.: Isolation and cultivation of bacterial species from Acid Mine Drainage. Biology Centre AS CR - Institute of Soil Biology, České Budějovice, Czech Republic, 26.09.2013.
- [8] KUPKA, D.: Bacterial oxidation-reduction processes of iron and sulphur compounds. Biology Centre AS CR - Institute of Soil Biology, České Budějovice, Czech Republic, 26.09.2013.
- [9] LUPTÁKOVÁ, A.: Positive and negative influences of sulfate reducing bacteria in environment, University of Paris-EST, Laboratory Geomaterials and Environment, France, 23.05.2013.
- [10] ŠTEFUŠOVÁ, K.: Use of Fe-based materials for removal of toxic oxyanions from water. Chuiko Institute of Surface Chemistry of NAS, Kiev, Ukraine, 15.10.2013.
- [11] BALÁŽ, P.: Mechanochemistry of solids: from minerals to nanomaterials and drugs, Friedrich Schiller Universität Jena, Germany, 12.06.2014.
- [12] KOTULIČOVÁ, I.: Zoobenthos as bioindicator of water quality. IGAG CNR, Rome, Italy, 07.10.2014.
- [13] KUPKA, D.: Soil and Water Clean-up from Inorganic and Organic Contaminants. Nazarbayev University, 13.11.2014, Astana, Kazakhstan.
- [14] LUPTÁKOVÁ, A.: Biohydrometallurgical research within the cooperation between Slovak Academy of Sciences and Environmental Geology and Geoengineering of CNR, IGAG CNR, Rome, Italy, 07.10.2014.
- [15] BALÁŽ, P.: Mechanochemistry in Chemical Engineering: from Minerals to Nanomaterials and Drugs - part I. Al-Farabi National Kazakh University, Almaty, Kazakhstan, 27.11.2015.
- [16] BALÁŽ, P.: Mechanochemistry in Chemical Engineering: from Minerals to Nanomaterials and Drugs - part II. Al-Farabi National Kazakh University, Almaty, Kazakhstan, 30.11.2015.
- [17] ŠTYRIAK, I.: The effect of bacteria genus *Bacillus* during the quality improvement of different raw materials from Slovakia, State Research Institute, Center for Physical Sciences and Technology, Savanoriu, Vilnius, Lithuania, 06.04.2015.

### 2.3.12. List of researchers who served as members of the organising and/or programme committees

| <b>2012</b>           |                                                                                                                                                           |                            |                |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------|
| <b>Researcher</b>     | <b>Conference title</b>                                                                                                                                   | <b>Member of committee</b> |                |
|                       |                                                                                                                                                           | <b>organising</b>          | <b>program</b> |
| Jaroslav Briančin     | Particulate Solids in Science, Industry and the Environment 2012, Herľany                                                                                 | -                          | yes            |
| Slavomír Hredzák      | 44 <sup>th</sup> International October Conference on Mining and Metallurgy, Bor, Serbia                                                                   | -                          | yes            |
| Slavomír Hredzák      | Waste Recycling XVI, Ostrava, Czech republic                                                                                                              | -                          | yes            |
| Víťazoslav Krúpa      |                                                                                                                                                           | -                          | yes            |
| Miroslava Václavíková |                                                                                                                                                           | -                          | yes            |
| Slavomír Hredzák      | XX. International Scientific and Professional Meeting "Ecological Truth" ECO-IST '12, Zajecar, Serbia                                                     | -                          | yes            |
| Miroslava Václavíková |                                                                                                                                                           | -                          | yes            |
| Víťazoslav Krúpa      | Geotechnics 2012, Vysoké Tatry, Slovak republic                                                                                                           | -                          | yes            |
| Víťazoslav Krúpa      | Progressive technologies of exploration, extraction and beneficiation of mineral deposits, and environment protection, Demänovská dolina, Slovak republic | yes                        | yes            |
| Miroslava Václavíková | NATO Advanced Research Workshop Technological Advances in CBRNE Sensing and Detection for Safety, Security, and Sustainability, Yerevan, Armenia          | yes                        | yes            |
| <b>2013</b>           |                                                                                                                                                           |                            |                |
| <b>Researcher</b>     | <b>Conference title</b>                                                                                                                                   | <b>Member of committee</b> |                |
|                       |                                                                                                                                                           | <b>organising</b>          | <b>program</b> |
| Silvia Dolinská       | Waste Recycling XVII, Košice, Slovak republic                                                                                                             | yes                        | yes            |
| Lucia Ivaničová       |                                                                                                                                                           | yes                        | -              |
| Jana Jenčárová        |                                                                                                                                                           | yes                        | -              |
| Slavomír Hredzák      |                                                                                                                                                           | yes                        | yes            |
| Víťazoslav Krúpa      |                                                                                                                                                           | yes                        | yes            |
| Alena Luptáková       |                                                                                                                                                           | yes                        | -              |
| Lenka Oroszová        |                                                                                                                                                           | yes                        | -              |
| Tomáš Schutz          |                                                                                                                                                           | yes                        | -              |
| Katarína Stuchlá      |                                                                                                                                                           | yes                        | -              |
| Katarína Štefušová    |                                                                                                                                                           | yes                        | -              |
| Mirka Václavíková     |                                                                                                                                                           | yes                        | yes            |
| Ján Vereš             |                                                                                                                                                           | yes                        | -              |
| Ingrid Znamenačková   |                                                                                                                                                           | yes                        | -              |
| Anton Zubrik          |                                                                                                                                                           | yes                        | -              |
| Jaroslav Briančin     | X. international conference Preparation of Ceramic materials, Herľany                                                                                     | yes                        | -              |
| Slavomír Hredzák      | 8 <sup>th</sup> Symposium and 2 <sup>nd</sup> Student Symposium "Recycling Technologies and Sustainable Development", Borske Jezero, Serbia               | yes                        | yes            |
| Slavomír Hredzák      | Structure and Properties of Nonequilibrium and Nanocrystalline Materials 2013, Stará Lesná, Vysoké Tatry, Slovak republic                                 | yes                        | yes            |
| Katarína Stuchlá      |                                                                                                                                                           | yes                        | yes            |
| Vladimír Šepelák      |                                                                                                                                                           | yes                        | yes            |
| Katarína Štefušová    |                                                                                                                                                           | yes                        | yes            |
| Janette Žaková        |                                                                                                                                                           | yes                        | yes            |
| Slavomír Hredzák      | XXI. Scientific and Professional Meeting "Ecological Truth" Eco Ist '13, Bor Lake, Bor, Serbia                                                            | yes                        | yes            |
| Víťazoslav Krúpa      | The New Mineral Policy and Progressive Technologies In Mining, Geology And Environment, Hotel Repiská – Demänovská dolina, Slovak republic                | -                          | yes            |

| <b>2014</b>           |                                                                                                                                          |                            |                |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------|
| <b>Researcher</b>     | <b>Title of conferences</b>                                                                                                              | <b>Member of committee</b> |                |
|                       |                                                                                                                                          | <b>organising</b>          | <b>program</b> |
| Peter Baláž           | Processing of Lean Grade and Urban Ores Jamshedpur, India                                                                                | -                          | yes            |
| Peter Baláž           | VIII. International Conference on Mechanochemistry and Mechanical Alloying Poland, Krakow                                                | -                          | yes            |
| Slavomír Hredzák      | International Multidisciplinary Scientific GeoConference SGEM2014, Albena, Bulgaria                                                      | yes                        | yes            |
| Slavomír Hredzák      | Waste Recycling XVIII, Miskolc, Hungary                                                                                                  | yes                        | yes            |
| Vítázoslav Krúpa      |                                                                                                                                          | yes                        | yes            |
| Miroslava Václavíková |                                                                                                                                          | -                          | yes            |
| Slavomír Hredzák      | 1st Workshop on Water and Soil Clean-up from Mixed Contaminants, Košice, Slovak republic                                                 | yes                        | -              |
| Lucia Ivaničová       |                                                                                                                                          | yes                        | yes            |
| Jana Jenčárová        |                                                                                                                                          | yes                        | -              |
| Daniel Kupka          |                                                                                                                                          | yes                        | -              |
| Lenka Oroszová        |                                                                                                                                          | yes                        | -              |
| Mária Praščáková      |                                                                                                                                          | yes                        | -              |
| Tomáš Schutz          |                                                                                                                                          | yes                        | -              |
| Jana Tomčová          |                                                                                                                                          | yes                        | -              |
| Miroslava Václavíková |                                                                                                                                          | yes                        | yes            |
| Slavomír Hredzák      | 46th International October Conference on Mining and Metallurgy, Bor Lake, Serbia                                                         | yes                        | yes            |
| Slavomír Hredzák      | 9th Symposium and 3rd Student Symposium on Recycling Technologies and Sustainable Development Hotel „Srbija-TIS“ u Zajčaru, Serbia       | yes                        | yes            |
| Slavomír Hredzák      | The New Mineral Policy - Progressive Technologies In Mining, Geology And Environment, Hotel Repiská – Demänovská dolina, Slovak republic | yes                        | -              |
| Slavomír Hredzák      | The 3rd International Scientific Conference: Biotechnology and Metals 2014 Košice, Slovak republic                                       | yes                        | -              |
| Jana Jenčárová        |                                                                                                                                          | yes                        | -              |
| Alena Luptáková       |                                                                                                                                          | yes                        | -              |
| Eva Mačingová         |                                                                                                                                          | yes                        | -              |
| Mária Praščáková      |                                                                                                                                          | yes                        | -              |
| Oľga Šestinová        |                                                                                                                                          | yes                        | -              |
| Slavomír Hredzák      | XXII. Scientific and Professional Meeting "Ecological Truth" Eco Ist ´14, Bor Lake, Bor, Serbia                                          | yes                        | yes            |
| Vítázoslav Krúpa      | 14th International Conference Geotechnics – constructions, technologies, risks, Horný Smokovec, Slovak republic                          | -                          | yes            |
| <b>2015</b>           |                                                                                                                                          |                            |                |
| <b>Researcher</b>     | <b>Conference title</b>                                                                                                                  | <b>Member of committee</b> |                |
|                       |                                                                                                                                          | <b>organising</b>          | <b>program</b> |
| Slavomír Hredzák      | 15th International Multidisciplinary Scientific GeoConference SGEM2015 Albena, Bulgaria                                                  | -                          | yes            |
| Slavomír Hredzák      | 19th Conference on Environment and Mineral Processing and Workshop “Critical Raw Materials for the EU, Ostrava, Czech republic           | -                          | yes            |
| Slavomír Hredzák      | 47th International October Conference on Mining and Metallurgy, Bor, Serbia                                                              | -                          | yes            |
| Slavomír Hredzák      | The Present and Future of the Mining, Hotel Repiská, Demänovská dolina, Slovak republic                                                  | -                          | yes            |
| Slavomír Hredzák      | Waste Recycling XIX, Krakow, Poland                                                                                                      | -                          | yes            |
| Miroslava Václavíková |                                                                                                                                          | -                          | yes            |

|                       |                                                                                                                                                                                       |     |     |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| Slavomír Hredzák      | X. International Symposium on Recycling Technologies and Sustainable Development, Bor, Serbia                                                                                         | -   | yes |
| Slavomír Hredzák      | XXIII International Conference " Ecological Truth" Eco-Ist'15, Hotel "Putnik", Kopaonik, Serbia                                                                                       | yes | yes |
| Lucia Ivaničová       | Autumn School on Advanced Adsorption and Oxidation Techniques for the Removal of Xenobiotics & 2 <sup>nd</sup> Workshop on Water and Soil Clean-up from Mixed Co Thessaloniki, Greece | -   | yes |
| Daniel Kupka          |                                                                                                                                                                                       | -   | yes |
| Miroslava Václavíková |                                                                                                                                                                                       | yes | yes |
| Víťazoslav Krúpa      | International Conference of Engineering Sciences and Technologies (ESaT 2015), Tatranská Štrba, Slovak republic                                                                       | -   | yes |
| Víťazoslav Krúpa      | Young Scientist 2015 Jasná, Nízke Tatry, Slovak republic                                                                                                                              | -   | yes |
| Jaroslav Briančin     | Particulate Solids in Science, Industry and the Environment 2015, Herľany, Slovak republic                                                                                            | yes | yes |
| Vladimír Šepelák      |                                                                                                                                                                                       | -   | yes |
| Miroslava Václavíková | 2 <sup>nd</sup> Workshop on Water and Soil Clean-up from Mixed Contaminants, Thessaloniki, Greece                                                                                     | yes | yes |

Moreover Dr. S. Hredzák is a member-corresponding of the International Organizing Committee of the International Coal Preparation Congresses on behalf of the Slovak republic (since 2009).

Dr M. Václavíková is a guarantee for Waste Recycling conference series for Slovakia.

- **Position of individual researchers in a national context**

**2.3.13. List of invited/keynote presentations at national conferences, as documented by programme or invitation letter**

[1] HANČULÁK, J. - ŠESTINOVÁ, O. - ŠPALDON, T. - FINDORÁKOVÁ, L. - KURBEL, T.: The study selected components of atmospheric deposition in the specified loading areas of eastern Slovakia. Scientific Conference Geochemistry 2012, Bratislava, 06.–07.12. 2012.

[2] KUPKA, D.: Experience in ion chromatography: "Contribution to the problem of water treatment intended for human consumption by Ion-exchange resins". Presentation at the workshop Thermo Fisher DIONEX DAY – Information in Ion Chromatography 2012 BestWestern – Hotel TeleDom Košice, 18.10.2012.

[3] JÁGER, D.: Qualification and quantification of triazine pesticides and their degradation products. Presentation at the workshop Thermo-Fisher DIONEX DAY-2014, Hotel Teledom, Košice, 11.11.2014.

[4] VÁCLAVÍKOVÁ, M.: We are a successful project: Water and Soil Clean-up from Mixed Contaminants. Information day - Marie Skłodowska Curie Mobility Projects, Horizon 2020, Košice, 28.03.2014.

[5] KUPKA, D.: Contribution to the problem of anions analysis by ion chromatography. Presentation at the workshop Thermo Fisher DIONEX DAY - 2015, Teledom, Košice, 12.05.2015.

### 2.3.14. List of researchers who served as members of organising and programme committees of national conferences

IGT SAS organizes annual national Scientific Symposium connecting the experts on environmental issues from Slovakia and Czech republic (series guarantee: Dr. Slavomír Hredzák).

#### National Conference Series

#### Scientific Symposium "Situation in Ecologically Loaded Regions of Slovakia and Central Europe"

Apart from 16 successful international conferences (co)organized by the IGT SAS listed in the chapter 2.3.2, the Institute organized regular annual series of national conferences Scientific Symposium with International Participation "Situation in Ecologically Loaded Regions of Slovakia and Central Europe" held in Hrádok pri Jelšave, Slovakia.

- 21<sup>st</sup> Symposium: 25.-26.10.2012, 48 participants,
- 22<sup>nd</sup> Symposium: 24.-25.10.2013, 39 participants,
- 23<sup>rd</sup> Symposium: 23.-24.10.2014, 40 participants,
- 24<sup>th</sup> Symposium: 22.-23.10.2015, 32 participants.

The Symposia were focused on three main areas:

1. Effects of emissions and immissions to air, soil, water, plants, animals, forestry, food chain and human population in the regions of Slovakia and Central Europe.
2. Theoretical and practical aspects of research of individual compounds of environment.
3. Technologies and materials for environmental protection and ecology-friendly procedures of production in the environmentally loaded regions.

Symposia bring together scientists and representatives of the regional and national authorities, policy makers, and remediation companies discussing the transfer of knowledge in the above mentioned areas.

| 2012               |                                                                                                                                                          |                       |           |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------|
| Researcher         | Conference title                                                                                                                                         | Members of committees |           |
|                    |                                                                                                                                                          | organising            | programme |
| Jozef Hančulák     | The XXI Scientific Symposium:<br>Situation in Ecologically Loaded<br>Regions of Slovakia and Central<br>Europe, Hrádok pri Jelšave, 25.-<br>26.10.2012   | yes                   | yes       |
| Slavomír Hredzák   |                                                                                                                                                          | yes                   | -         |
| Vítazoslav Krúpa   |                                                                                                                                                          | -                     | yes       |
| Katarína Stuchlá   |                                                                                                                                                          | yes                   | -         |
| Oľga Šestinová     |                                                                                                                                                          | yes                   | -         |
| Katarína Štefušová |                                                                                                                                                          | yes                   | -         |
| Ján Vereš          |                                                                                                                                                          | yes                   | -         |
| 2013               |                                                                                                                                                          |                       |           |
| Researcher         | Conference title                                                                                                                                         | Members of committees |           |
|                    |                                                                                                                                                          | organising            | programme |
| Jozef Hančulák     | The XXII Scientific Symposium:<br>Situation in Ecologically Loaded<br>Regions of Slovakia and Central<br>Europe, Hrádok pri Jelšave, 24.-<br>25.10.2013  | yes                   | yes       |
| Slavomír Hredzák   |                                                                                                                                                          | yes                   | -         |
| Vítazoslav Krúpa   |                                                                                                                                                          | -                     | yes       |
| Katarína Stuchlá   |                                                                                                                                                          | yes                   | -         |
| Oľga Šestinová     |                                                                                                                                                          | yes                   | -         |
| Katarína Štefušová |                                                                                                                                                          | yes                   | -         |
|                    |                                                                                                                                                          | yes                   | -         |
| 2014               |                                                                                                                                                          |                       |           |
| Researcher         | Conference title                                                                                                                                         | Members of committees |           |
|                    |                                                                                                                                                          | organising            | programme |
| Jozef Hančulák     | The XXIII Scientific Symposium:<br>Situation in Ecologically Loaded<br>Regions of Slovakia and Central<br>Europe, Hrádok pri Jelšave, 23.-<br>24.10.2014 | yes                   | yes       |
| Slavomír Hredzák   |                                                                                                                                                          | yes                   | -         |
| Vítazoslav Krúpa   |                                                                                                                                                          | -                     | yes       |
| Katarína Stuchlá   |                                                                                                                                                          | yes                   | -         |
| Oľga Šestinová     |                                                                                                                                                          | yes                   | -         |
| Anton Zubrik       |                                                                                                                                                          | yes                   | -         |
|                    |                                                                                                                                                          | yes                   | -         |

| 2015             |                                                                                                                                                         |                       |           |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------|
| Researcher       | Conference title                                                                                                                                        | Members of committees |           |
|                  |                                                                                                                                                         | organising            | programme |
| Jozef Hančulák   | The XXIV Scientific Symposium:<br>Situation in Ecologically Loaded<br>Regions of Slovakia and Central<br>Europe, Hrádok pri Jelšave, 22.-<br>23.10.2015 | yes                   | yes       |
| Slavomír Hredzák |                                                                                                                                                         | yes                   | -         |
| Vítazoslav Krúpa |                                                                                                                                                         | -                     | yes       |
| Katarína Stuchlá |                                                                                                                                                         | yes                   | -         |
| Oľga Šestinová   |                                                                                                                                                         | yes                   | -         |
| Anton Zubrik     |                                                                                                                                                         | yes                   | -         |

- **Supplementary information and/or comments documenting the international and national status of the Institute**

As referred in the chapters above, the IGT SAS possess significant international and national reputation in all its research activities. The Institute offers a scientific group with a strong interdisciplinary background, which comprises senior scientists, junior research fellows, PhD students and technicians. IGT SAS provides favourable climate to perform high level research on both international and national level, respectively. IGT SAS successfully competed and coordinated substantial number of national and international research projects such as FP7, NATO, APVV, VEGA as well as industrial projects on demand (as documented in Chapters 2.3.5-2.3.9).

Institute of Geotechnics SAS has been asked frequently to provide testing, measurements, assessment reports, etc. by the Slovak companies active in civil engineering, chemistry, environment, etc., see list in the Chapter 2.6.3.

Moreover, individual researchers of IGT SAS were awarded for their activities by several national and international awards (see Supplementary Information to the Chapter 2.2.). They are regularly invited for expert reviews on international and national project proposals, expert reports from regional authorities, asked for reviews of scientific papers, they act as members of program committees of major scientific conferences, they are members of decision-taking bodies, etc. (see further lists).

### Reviews of publications and project proposals

Institute of Geotechnics SAS elaborated numerous reviews on scientific papers, monographs, books, and project proposals during the assessed period.

|                                             | 2012 | 2013 | 2014 | 2015 | total |
|---------------------------------------------|------|------|------|------|-------|
| Reviews of scientific papers                | 53   | 34   | 74   | 91   | 252   |
| Reviews of books and monographs             | 2    | 2    | 0    | 3    | 7     |
| Reviews of national projects proposals      | 8    | 8    | 12   | 5    | 33    |
| Reviews of international projects proposals | 10   | 2    | 12   | 0    | 24    |

Dr. Slavomír Hredzák was invited by European Commission as evaluator of the 7FP-NMP-LARGE Collaborative Projects 7FP, 2011-2012 – 5 of 5 projects in the second round (2012).

### Active Participation of IGT SAS Researchers at Conferences

| Oral presentations and posters | 2012 | 2013 | 2014 | 2015 | total |
|--------------------------------|------|------|------|------|-------|
| International conferences      | 56   | 63   | 70   | 54   | 243   |
| Domestic conferences           | 20   | 13   | 23   | 31   | 87    |

### Members of editorial boards of scientific journals

| Name        | Position                  | Journal                          |
|-------------|---------------------------|----------------------------------|
| Peter Baláž | member of Editorial Board | Acta Montanistica Slovaca        |
|             | member of Editorial Board | The Open Crystallography Journal |
|             | member of Editorial Board | Nanoscience & Nanotechnology     |
|             | Guest Editor              | Journal of Hazardous Materials   |

|                       |                                    |                                                                     |
|-----------------------|------------------------------------|---------------------------------------------------------------------|
| Jaroslav Briančin     | member of Editorial Board          | Powder Metallurgy Progress                                          |
| Lenka Findoráková     | member of Editorial Board          | Journal of Tethys                                                   |
| Slavomír Hredzák      | member of Editorial Board          | Acta Montanistica Slovaca                                           |
|                       | member of Editorial Board          | Bulletin Brown Coal                                                 |
|                       | member of Editorial Board          | Waste Forum                                                         |
| Vítazoslav Krúpa      | member of Editorial Board          | Acta Geoturistica                                                   |
|                       | member of Editorial Board          | Acta Montanistica Slovaca                                           |
|                       | member of Editorial Board          | Roads and Tracks                                                    |
| Mária Kušnierová      | member of Editorial Board          | Bulletin Brown Coal                                                 |
| Edita Lazarová        | member of Editorial Board          | Acta Montanistica Slovaca                                           |
|                       | member of Editorial Board          | Arhiv za Tehničke Nauke                                             |
| Milan Labaš           | member of Editorial Board          | Slovak Association of Aggregates Procedures journal for specialists |
| Vladimír Šepelák      | member of Editorial Board          | International Scholarly Research Notices Nanotechnology             |
|                       | member of Editorial Board          | Journal of Nanomaterials                                            |
|                       | member of Editorial Board          | GeoScience Engineering                                              |
|                       | Associate Editor                   | Nanomaterials and Nanotechnology                                    |
| Miroslava Václavíková | member of Editorial Advisory Board | Nanomaterials and the Environment                                   |

| Members of advisory governmental bodies, decision-taking bodies, etc. |                                                                                         |                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name                                                                  | Position                                                                                | Committee                                                                                                                                                                                                                                                                                                                                                 |
| Peter Baláž                                                           | Chairman of Committee for the defence of doctoral thesis in the scientific field Mining | Slovak Committee for Scientific Degrees, Committee for the Defence of doctoral thesis in the scientific field Mining 020801-020805                                                                                                                                                                                                                        |
|                                                                       | member                                                                                  | SRDA/APVV Board for Technical Sciences                                                                                                                                                                                                                                                                                                                    |
| Vítazoslav Krúpa                                                      | member of Board of Supervisors                                                          | Slovak Mining Chamber                                                                                                                                                                                                                                                                                                                                     |
| Jozef Hančulák                                                        | member of Expert Work Group                                                             | member of Work Group for Identification of Possible Hazards Issuing from Geological Prospecting for Survey of Jahodná-Kurišková Uranium Deposit. Elaboration of expert report „Elaboration of Opinion for Town of Košice to the Intention of Exploitation and Processing of Uranium in the Jahodná-Kurišková Site“ordered from the Mayor of Košice (2013) |
| Peter Baláž                                                           | member                                                                                  | SAS Committee for International Projects Evaluation                                                                                                                                                                                                                                                                                                       |
| Jozef Hančulák                                                        | member                                                                                  | SAS Committee for Environment                                                                                                                                                                                                                                                                                                                             |
| Peter Baláž                                                           | member                                                                                  | Committee VEGA no. 6                                                                                                                                                                                                                                                                                                                                      |
| Jozef Hančulák                                                        | member                                                                                  | Committee VEGA no. 6                                                                                                                                                                                                                                                                                                                                      |
| František Krepelka                                                    | member                                                                                  | Committee VEGA no. 6                                                                                                                                                                                                                                                                                                                                      |
| Edita Lazarová                                                        | member                                                                                  | Committee VEGA no. 6                                                                                                                                                                                                                                                                                                                                      |
| Slavomír Hredzák                                                      | member                                                                                  | Scientific Council of the Slovak Academy of Sciences for the Earth and Space Sciences                                                                                                                                                                                                                                                                     |
|                                                                       | member                                                                                  | Presidium of National Technological Platform for Research, Development and Innovation of Raw Materials                                                                                                                                                                                                                                                    |
|                                                                       | vicepresident                                                                           | Slovak Mining Society                                                                                                                                                                                                                                                                                                                                     |

## 2.4. Tables of project structure, research grants and other funding resources

- **International projects and funding**

**2.4.1. Major projects within the European Research Area and other important project – Framework Programmes of the EU, ERA-NET, European Science Foundation, NATO, COST, INTAS, etc. (here and in items below please specify: type of project, title, grant number, duration, total funding and funding for the institute, responsible person in the institute and his/her status in the project, e.g. coordinator “C”, work package leader “W”, investigator “I”)**

|      | Project title                                                                         | Typ / Project number          | Duration in months | Funding for the Institute (EUR) | Role of the Institute / Responsible person |
|------|---------------------------------------------------------------------------------------|-------------------------------|--------------------|---------------------------------|--------------------------------------------|
| 2012 | Technical Advances to Detect and Remove Contaminants in Water for Safety and Security | NATO / EAP.SFP. 984403        | 11/2012-04/2016    | 10 433.93                       | W / M. Vaclavikova                         |
| 2013 | Water and Soil Clean-up from Mixed Contaminants                                       | FP7-PEOPLE-2013-IAPP / 612250 | 10/2013-09/2017    | 554 572.76                      | C / M. Vaclavikova                         |

Project FP7-PEOPLE-2013-IAPP / 612250 Water and Soil Clean-up from Mixed Contaminants delivered active transfer of knowledge between the 4 academic and 4 industrial partners (see 2.3.1.). The consortium has provided the Marie Curie Fellows with a range of training opportunities including complementary skills acquisition, in-house training in a range of analytical techniques at partners institutions, opportunities for young researchers to present their work at project meetings and the two WaSClean events, opportunities for fellows to liaise and work with experts in disciplines outside of their field of expertise: chemists, geochemists, geologists, materials scientists, nanotechnologists, water engineers, academics, industrialists – cross-disciplinary knowledge transfer.

Fifteen secondments from IGT SAS (4x early-stage researchers, 1x experienced researcher, 10x senior scientists) and three to IGT SAS were implemented during the assessed period.

### 2.4.2. Other international projects, incl. total funding and funding for the institute

Other international projects involve collaboration projects based on agreements between SAS and foreign academies (MAD projects) providing inter-academic mobility of researchers and covering reimbursement of travel costs. Bilateral cooperation projects supported by SRDA/APVV Agency are presented, along with other types of financial support of international projects:

**[1] Development of Suitable Physicochemical and Biological-Chemical Processes for the Remove of Metals and Metalloids from the Waters and Soils (01/2010 – 12/2012)**

Bilateral International Cooperation (MAD) Agreement between Academies of Sciences (SAS – Italy)

Cooperating partner: CNR Italy

Total funding: refunding of travel costs 150 €

Funding for the Institute: refunding of travel costs 150 €

Responsible person in the organisation: Ing. Alena Luptáková, PhD.

**[2] Arsenic in Cancer Treatment: Mechanisms of Action and New Forms of Delivery (01/2011 – 12/2013)**

Bilateral International Cooperation (MAD) Agreement between Academies of Sciences (SAS-NSC), SAS-NSC JRP 2010/03

Cooperating partner: Academia Sinica, Taiwan

Total funding: 18899 €

Funding for the Institute: 18899 €

Responsible person in the organisation: prof. RNDr. Peter Baláž, DrSc.

**[3] Advanced Materials for the Removal of Toxic Pollutants from Water (01/2011 – 12/2013)**

Bilateral International Cooperation (MAD) Agreement between Academies of Sciences (SAS-NANU)

Cooperating partner: NANU Ukraine

Total funding: refunding of travel costs 372 €

Funding for the Institute: refunding of travel costs 372 €

Responsible person in the organisation: Ing. Miroslava Václavíková, PhD.

**[4] Mechanochemically Synthesized Nanomaterials, their Characterization, Photocatalytic and Anticancer Properties (01/2012 – 12/2014)**

Bilateral International Cooperation (MAD) Agreement between Academies of Sciences (SAS-BAS)

Cooperating partner: Bulgarian Academy of Science

Total funding: refunding of travel costs 1395 €

Funding for the Institute: refunding of travel costs 1395 €

Responsible person in the organisation: RNDr. Martin Fabián, PhD.

**[5] Development of Innovative Processes for the Valorization of Spent Batteries (01/2013 – 12/2015)**

Bilateral International Cooperation (MAD) Agreement between Academies of Sciences (SAS-CNR)

Cooperating partner: CNR Italy

Total funding: refunding of travel costs 527 €

Funding for the Institute: refunding of travel costs 527 €

Responsible person in the organisation: Ing. Alena Luptáková, PhD.

**[6] Mechanochemical Synthesis, Activation and Characterization of Inorganic Chemical Systems: Mixed Oxides, Sulphides, Selenides and Carbonates (01/2012 – 12/2013)**

Bilateral International Cooperation - APVV- SK-BG-0031-10

Cooperating partner: Bulgaria

Total funding: 4046 €

Funding for the Institute: 4046 €

Responsible person in the organisation: prof. RNDr. Peter Baláž, DrSc.

**[7] Microwave Assisted Extraction of Inorganic and Organic Materials from Biomass (01/2013 – 12/2014)**

Bilateral International Cooperation- APVV- SK-RO-0026-12

Cooperating partner: Romania

Total funding: 4582 €

Funding for the Institute: 4582 €

Responsible person in the organisation: RNDr. Silvia Dolinská, PhD.

**[8] Utilization of Liquid Pyrolysis Products of Waste Materials as Collectors in the Coal Flotation (01/2014 – 12/2015)**

Bilateral International Cooperation - APVV- SK-CZ-2013-0233

Cooperating partner: Czech Republic

Total funding: 1496 €

Funding for the Institute: 1496 €

Responsible person in the organisation: RNDr. Silvia Dolinská, PhD.

**[9] Mechanochemically-Nanostructured Arsenicals with Guided Anticancer Functionality: from Ab-initio Quantum Chemical Modelling to Experimental Verification (09/2015 – 12/2016)**

Bilateral International Cooperation - APVV-SK-UA-2013-0003

Cooperating partner: Ukraine

Total funding: 1685 €  
Funding for the Institute: 1685 €  
Responsible person in the organisation: prof. RNDr. Peter Baláž, DrSc.

**[10] Industrial Synthesis of Metal Sulphides by Mechanical Activation in Vibration Mills (11/2015 – 10/2017)**

Bilateral International Cooperation: IB-COMSTRUC-010

Cooperating partner: Germany

Total funding: 0 €

Funding for the Institute: 0 €

Responsible person in the organisation: prof. RNDr. Peter Baláž, DrSc.

**[11] Mechanochemical Activation and Synthesis – an Ecological Friendly Process in the Production of Materials for Photocatalytic Air and Water Purification (01/2015 – 12/2018)**

Bilateral International Cooperation - MAD - agreement between Academies of Sciences (SAS-BAS)

Cooperating partner: Bulgaria

Total funding: refunding of travel costs 1170 €

Funding for the Institute: refunding of travel costs 1170 €

Responsible person in the organisation: RNDr. Martin Fabián, PhD.

**[12] Project co-financed by the European Union from the European Social Fund under Action 2 Development of Didactic Potential of Faculty of Chemical Engineering and Technology of the Cracow University of Technology. "Cracow University of Technology of the XXI century – Development Program – The Highest Quality Teaching for the Future of Polish Engineers Project" (10/2012 – 12/2012, 09/2014 – 11/2014)**

Bilateral International Cooperation – UDA-POKL 04.01.01-00-029/10

Cooperating partner: Poland

Total funding: 3913 € + 2633 €

Funding for the Institute: 3913 € + 2633 €

Responsible person in the organisation:

Ing. Olga Šestínová, PhD. (10/2012 – 12/2012)

Ing. Alena Luptáková, PhD. (09/2014 – 11/2014)

**2.4.3. Other important, international projects and collaborations without direct funding (max. 10 projects)**

From IGT SAS:

**[1] Mgr. Marcela Achimovičová, PhD.**

The cooperation between IGT SAS and Institute of Mineral and Waste Processing, Waste Disposal and Geomechanics, TU Clausthal, Germany has a long history with several projects. From 07/2011, Dr. Marcela Achimovičová was offered to participate in the project Production of Titanium and Titanium Alloys with Minimised Process Stages (Funding by DFG Group of Researchers Nr. 1372/1). During her working stay in Clausthal, several new projects were applied with her and/or IGT participation:

- Examination studies of tin sulphide production by mechanochemical reaction in an ESM 324 industrial mill, ordered by Nihon Seiko Co. Ltd. Japan (11/2014-09/2015)
- Bilateral Germany-Slovak project INHEMES: Industrial production of metal sulphides by mechanochemical activation in vibration mills, BMBF 01DS15022 (10/2015-10/2017)
- Low-emission synthesis of titanium alloys, DFG Erkenntnistransferprojekt GO 383/29-1 (04/2016-12/2018)

Her working stay there delivered benefits for both IGT SAS as well for TU Clausthal. Dr. Achimovičová has very good knowledge in basic research of mechanochemical processes, which she acquired at IGT SAS. On the other hand, after her return to IGT

SAS she will be able to apply the experience with industrial milling trained at TU Clausthal, which shall result in the future collaboration on project proposals within basic and applied research.

**[2] Ing. Ján Vereš, PhD.**

The cooperation between IGT SAS and VŠB - Technical University of Ostrava, Ostrava, Czech Republic has a long history. Dr. Vereš applied for post-doc position at Energy Research Center, VŠB. The project Biomass energy utilization and process safety in industry (05/2013-11/2016) allowed for the expansion of the foundation of research teams in relation to the research field defined by VŠB - Technical University of Ostrava and IGT SAS:

- raw materials, energy, and ecology,
- information technology,
- new materials, construction, and technology.

This facilitated not only the coordination of research efforts, but also primarily the determination of measurable results. Moreover, it allowed integration into international scientific research structures.

**[3] RNDr. Erika Turianicová, PhD.**

DFG Fellowship from IGT SAS

Hosting organization: Institute of Nanotechnology, Karlsruhe Institute of Technology, Germany

Project title: Mechano-synthesis of Li-containing complex oxides (04/2014 – 09/2014)

**[4] RNDr. Martin Fabián, PhD.**

DFG Fellowship from IGT SAS to Institute of Nanotechnology, Karlsruhe Institute of Technology, Germany

Project title: Synthesis and characterization of novel complex oxides (10/2014 – 03/2015)

**[5] RNDr. Martin Fabián, PhD.**

Slovak Academic Information Agency: Action Austria-Slovakia

Hosting organization: Graz University of Technology, Austria

Project title: Mechano-synthesis of nanocrystalline oxides (02/2014 – 06/2014)

**[6] RNDr. Martin Fabián, PhD.**

DAAD fellowship

Hosting organization: Institute of Nanotechnology, Karlsruhe Institute of Technology, Germany

Project title: Mechanochemically prepared complex oxides (11/2013 – 01/2014)

**[7] Mgr. Lenka Oroszová**

National Scholarship Programme of Slovak Republic

Hosting organization: Aristotle University of Thessaloniki

Project title: Synthesis and Characterization of Fe-based Micro/Nanomaterials for Environmental Application (02/2012 – 04/2012)

To IGT SAS

**[1] Irina Voinovschi**

National Scholarship Programme of Slovak Republic

Sending organization: Aristotle University of Thessaloniki

Project title: Treatment of Textile Wastewaters: Analysis of Final Products (05/2013 – 07/2013)

- **National projects and their funding**

National projects involve ERDF projects (Structural Funds), projects of Slovak R&D Agency SRDA/APVV, and VEGA projects of Slovak Academy of Sciences and Ministry of Education.

#### 2.4.4. Projects supported by the Slovak Research and Development Agency (APVV)

Role of the Institute e.g. coordinator "C", investigator "I".

|      | Project title                                                                                | Typ / Project number | Duration in months | Funding for the Institute (EUR) | Role of the Institute / Responsible person |
|------|----------------------------------------------------------------------------------------------|----------------------|--------------------|---------------------------------|--------------------------------------------|
| 2012 | Development of Advanced Water Treatment Technologies for the Removal of Inorganic Pollutants | APVV-0252-10         | 05/2011 – 10/2014  | 187 409                         | "C"/Ing. Miroslava Václavíková, PhD.       |
|      | Mechanochemical Modification of Minerals for Advanced Nanotechnology Applications            | APVV-0189-10         | 05/2011 – 10/2014  | 250 000                         | "C"/prof. RNDr. Peter Baláž, DrSc.         |
|      | Physical and Electrochemical Behavior of Mechanochemically Prepared Nanooxides               | APVV-0528-11         | 07/2012 – 12/2015  | 199 990                         | "C"/prof. RNDr. Vladimír Šepelák, DrSc.    |
|      | Arsenic Minerals in Advanced Applications                                                    | LPP-0107-09          | 09/2009 – 08/2013  | 83 000                          | "C"/prof. RNDr. Peter Baláž, DrSc.         |
| 2015 | Mechanochemistry of Semiconductor Nanocrystals: from Minerals to Materials and Drugs         | APVV-14-0103         | 7/2015 – 06/2019   | 250 000                         | "C"/prof. RNDr. Peter Baláž, DrSc.         |

#### 2.4.5. Projects supported by the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA) for each year, and their funding

| VEGA                      | 2012  | 2013  | 2014  | 2015                |
|---------------------------|-------|-------|-------|---------------------|
| Number                    | 13    | 12    | 12    | 11                  |
| Funding in the year (EUR) | 93335 | 88185 | 97888 | 106801 <sup>1</sup> |

- **Summary of funding from external resources**

#### 2.4.6. List of projects supported by EU Structural Funds

- [1] **Centre of Excellence for Research and Treatment of Earth Resources CEV-I** (ASFEU ITMS 26220120017) Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (05/2009 – 04/2012). Total budget: 1,297,500.5 €, Budget for IGT SAS: 270,120.46€.
- [2] **Centre of Excellence for Research and Treatment of Earth Resources – 2<sup>nd</sup> Stage CEV-II.** (ASFEU ITMS 26220120038). Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., (03/2010 – 06/2014) Total budget: 2,789,900 €, Budget for IGT SAS: 548,321 €

<sup>1</sup> Excluding projects for the popularisation of science

- [3] **Infrastructure Development of the Center of Excellence for Progressive Materials with Nano and Submicron Structure NanoCEXmat2** (ASFEU ITMS 262201200350). Principal investigator: prof. RNDr. Ján Dusza, DrSc., Institute of Material Research SAS, responsible for IGT SAS: prof. RNDr. Peter Baláž, DrSc., (05/2010 – 04/2013) Total budget: 2,563,673.79 €, Budget for IGT: 266,331.63 €
- [4] **Slovak Research and Innovation Platform for Sustainable Mineral Resources** (ASFEU ITMS 26220220053). Principal investigator: Assoc. Prof. Ing. Ján Spišák, PhD., Faculty BERG – Technical University in Košice, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD., 01/2010 – 06/2013 Total budget: 520,920 €, Budget for IGT SAS: 45,409 €
- [5] **Centre of Excellence for Integrated Research of Geosphere GEOCEX** (ASFEU ITMS 26220120064). Principal investigator: Assoc. Prof. RNDr., Ján Soták, DrSc., Earth Science Institute SAS, responsible for IGT SAS: MVDr. Daniel Kupka, PhD., 09/2010 – 02/2015, Total budget: 3,975,039.6 €, Budget for IGT SAS: 1,289,192.5 €
- [6] **Research Center of Progressive Materials and Technologies for Current and Future Applications PROMATECH** (ITMS 26220220186). Principal investigator: prof. RNDr. Ján Dusza, DrSc., Institute of Material Research SAS, responsible for IGT SAS: Ing. Slavomír Hredzák, PhD. (08/2013 – 12/2015), Total budget: 22,192,045.17 €, Budget for IGT SAS: 145,500.00 €, including personal 40,500 € and devices)
- [7] **The Institutes of Slovak Academy of Sciences in Košice – The Development of Infrastructure and Internal Equipment of Teaching Facilities to Improve Education Conditions** (ASFEU ITMS 26250120013). Project leader: JUDr. Glória Gajdošová, responsible for IGT SAS: Ing. Lucia Ivaničová, PhD., (08/2009–06/2014) Total budget: 4,978,841,27 €, Budget for IGT SAS: 459,893.14 €

#### 2.4.7. Summary of external resources of the EU Structural Funds (ERDF/ESF)

Role of the Institute in the project, e.g. coordinator “C”, work package leader “W”, investigator “I”.

| Year | Project title                                                                                                                                                            | Project number | Duration in months | Funding for the Institute (EUR) | Role of the Institute |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------|---------------------------------|-----------------------|
| 2012 | Centre of Excellence for Research and Treatment of Earth Resources (CEV-I)                                                                                               | 26220120017    | 05/2009 – 04/2012  | 270,120.46                      | partner               |
|      | The Institutes of Slovak Academy of Sciences in Košice – The Development of Infrastructure and Internal Equipment of Teaching Facilities to Improve Education Conditions | 26250120013    | 08/2009 – 06/2014  | 459,893.14                      | partner               |
|      | Slovak Research and Innovation Platform for Sustainable Mineral Resources                                                                                                | 26220220053    | 01/2010 – 06/2013  | 45,409.00                       | partner               |
|      | Centre of Excellence for Research and Treatment of Earth Resources – 2nd Stage (CEV-II)                                                                                  | 26220120038    | 03/2010 – 06/2014  | 548,321.00                      | partner               |
|      | Infrastructure Development of the Center of Excellence for Progressive Materials with Nano and Submicron Structure (NanoCEXmat 2)                                        | 26220120035    | 05/2010 – 04/2013  | 266,331.63                      | partner               |
|      | Centre of Excellence for Integrated Research of Geosphere (GEOCEX)                                                                                                       | 26220120064    | 09/2010 – 02/2015  | 1,289,192.50                    | partner               |
| 2013 | Research Center of Progressive Materials and Technologies for Current and Future Applications - „PROMATECH“                                                              | 26220220186    | 08/2013 – 12/2015  | 145,500.00                      | partner               |

| <b>External resources</b>                                                                | <b>2012</b> | <b>2013</b> | <b>2014</b> | <b>2015</b> | <b>total</b> | <b>average</b> |
|------------------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|--------------|----------------|
| <b>External resources (milions of EUR)</b>                                               | 0.348       | 0.679       | 0.253       | 0.367       | <b>1.647</b> | <b>0.412</b>   |
| <b>External resources transferred to cooperating research institute (milions of EUR)</b> | 0.000       | 0.000       | 0.000       | 0.000       | <b>0.000</b> | <b>0.000</b>   |

- **Supplementary information and/or comments on research projects and funding sources**

High success rate of IGT SAS in ERDF projects with funding over 3 million Euros is considered an important milestone in the status of IGT SAS on the national and international level. New high-tech infrastructure and new labs brought new complementary skills for individual researchers and institute, respectively. It has been already reflected in increasing trend of their research outputs and significantly increased number of invitations to participate on FP7, H2020 and NATO SPS proposals.

Moreover, the institute became the coordinator of the project within the 7th Framework Programme of EU, which shows a high-level expertise of individuals with independent thinking and leadership skills as well as potential to conduct and deliver high level scientific projects. It also reflects the competence of the institute and individual researchers to manage international projects with industries. The IGT SAS group also leads a work package related to water security within the NATO project. Both FP7-WaSClean and NATO project received additional funding (MVTs) of 35,597 € provided by Presidium of SAS to support the research activities to these highly recognized projects.

| <b>Number of submitted project proposals</b>                                                                                                | <b>2012</b> | <b>2013</b> | <b>2014</b> | <b>2015</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|
| FP7/Horizon 2020                                                                                                                            | 4/0         | 3/0         | 0/1         | 0/4         |
| ERDF Projects (Program period 2007-2013)                                                                                                    | 1           |             |             |             |
| Multilateral projects (COST, ERANET, INTAS, EUREKA, PHARE, NATO, UNESCO, CERN, IAEA, ESF (European Science Foundation), ERDF, ESA and other | 1           | 1           |             | 1           |
| Programme SASPRO                                                                                                                            |             |             |             | 2           |
| Projects of the Slovak Research and Development Agency (APVV)                                                                               |             | 5           | 7           | 7           |
| Bilateral International Projects (APVV)                                                                                                     | 3           | 2           |             |             |
| Bilateral International Projects (MAD)                                                                                                      | 1           | 1           | 1           | 1           |
| Projects of the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA)                              |             | 3           | 5           | 3           |
| Other types of projects (DAAD Fellowships, National Stipends, Industry, etc.                                                                |             | 4           | 2           | 5           |

For summarizing, IGT SAS has been involved in cooperation with 23 international universities, 9 academic and research centers and 10 foreign companies within joint projects, basic and applied research, education, and transfer of knowledge, as listed below:

#### **Collaborating universities, academies and research centers**

VSB-Technical University of Ostrava, Czech Republic

Faculty of Science, Masaryk University, Brno, Czech Republic

Budapest University of Technology and Economics, Hungary

University of Brighton, United Kingdom

Royal Military Academy, Brussels, Belgium

Aristotle University of Thessaloniki, Greece  
 Technical University of Miskolc, Hungary  
 Nazarbayev University, Astana, Kazakhstan  
 Al-Farabi Kazakh National University, Almaty, Kazakhstan  
 Kazakh National Research Technical University K.I. Satpayev, Almaty, Kazakhstan  
 Institute of Organic Chemistry and Biochemistry, Academy of Sciences of Czech Republic  
 Institute for Advanced Science Convergence, Norwich University Applied Research Institutes, Herndon, USA  
 Academy of Sciences of Moldova, Chisinau, Moldova  
 State Engineering University of Armenia, Yerevan, Armenia  
 Institute of Environmental Geology and Geoengineering, CNR, Rome, Italy  
 AGH University of Science and Technology, Krakow, Poland  
 Cracow University of Technology, Krakow, Poland  
 Institute of Catalysis, Institute of Mineralogy and Crystallography, Bulgarian Academy of Science, Sofia, Bulgaria  
 Institute of Biomedical Sciences, Academia Sinica, Taiwan  
 National Institute Research and Development for Electrochemistry and Condensed Matter, Timisoara, Romania  
 University of Paris - EST, Laboratory Geomaterials and Environment, France  
 University of Clausthal, Clausthal-Zellerfeld, Germany  
 Karlsruhe Institute of Technology, Germany  
 Institute of Physics, Jan Dlugosz University, Czestochowa, Poland  
 Jožef Stefan Institute, Ljubljana, Slovenia  
 Institute of Chemistry, SS. Cyril and Methodius University, Skopje, Macedonia  
 Hacettepe University, Ankara, Turkey  
 Institute of Materials Science of Sevilla, Spain  
 Institute for Chemistry and Technology of Materials, Graz University of Technology, Austria  
 Department of Physics, State University of Maringa, Brazil  
 Vinca Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia  
 Keio University, Yokohama, Japan

#### **Collaborating companies**

Cristalerias de Chile S.A., Chile  
 Nihon Seiko Co., Limited, Tokyo, Japan  
 Newmont Technologies Limited Denver, USA  
 MAST Carbon International, Ltd., Basingstoke, United Kingdom  
 HERMES, S.A., Greece  
 EKODOR, LLC, Temirtau, Kazakhstan  
 Institute of Batteries, LLC., Astana, Kazakhstan  
 Conculcont s.a.c., Lima, Peru  
 Smallvill s.a.c., Lima, Peru  
 Scientific Research Company Carat, Lviv, Ukraine

## 2.5. PhD studies and educational activities

IGT SAS as an external education organization, which actively participates on the PhD study in cooperation with Faculty of Metallurgy of Technical University of Košice. It offers the PhD in accredited study programme **5.2.40 Metallurgy of Metals**. The PhD programme covers wide range of topics related to Metallurgy of Metals, such as mineral processing, separation technologies, mineral biotechnologies, development of new materials based on metals, environmental remediation of industrial areas contaminated by metals, organics and other substances, water and soil clean-up, determination of metallic and other contaminants, monitoring of environment and environmental indicators, etc. IGT SAS is well-equipped experimentally based institution with substantial number of highly qualified PhD supervisors to provide high quality research training, to identify and analyse the high priority issues to be investigated, to analyse and discuss the research data and help students to enhance their publication, presentation, communication and language skills.

### 2.5.1. List of accredited programmes of doctoral studies, period of validity

Study programme Metallurgy of Metals in study field **5.2.40 Metallurgy of Metals** in collaboration with Faculty of Metallurgy Technical University of Košice – accredited up to 2015.

In 2015, the IGT SAS submitted new application to be accredited in the study programme **5.2.39 Metallurgy**, which was already approved from 2016 by Ministry of Education, Science, Research and Sport of the Slovak Republic.

### 2.5.2. Summary table on doctoral studies (number of internal/external PhD students; number of foreign PhD students, number of students who successfully completed their theses, number of PhD students who quit the programme)

| PhD study                                                   | 31.12.2012 |                 |                  | 31.12.2013 |                 |                  | 31.12.2014 |                 |                  | 31.12.2015 |                 |                  |
|-------------------------------------------------------------|------------|-----------------|------------------|------------|-----------------|------------------|------------|-----------------|------------------|------------|-----------------|------------------|
| Number of potential PhD supervisors                         |            |                 |                  |            |                 |                  |            |                 |                  |            |                 |                  |
| PhD students                                                | number     | defended thesis | students quitted | number     | defended thesis | students quitted | number     | defended thesis | students quitted | number     | defended thesis | students quitted |
| Internal                                                    | 7.0        |                 | 1.0              | 9.0        | 1.0             |                  | 9.0        | 2.0             |                  | 9.0        | 2.0             |                  |
| External                                                    | 1.0        | 1.0             |                  |            |                 |                  | 1.0        |                 |                  | 1.0        |                 |                  |
| Other supervised by the research employees of the institute |            |                 |                  |            |                 |                  |            |                 |                  |            |                 |                  |

Note: Due to error in the second row of Table 2.5.2 we were unable to enter the data for supervisors, which are entered in the following table.

| PhD study                           | 31.12.2012 | 31.12.2013 | 31.12.2014 | 31.12.2015 |
|-------------------------------------|------------|------------|------------|------------|
| Number of potential PhD supervisors | 16         | 16         | 20         | 22         |

### 2.5.3. Summary table on educational activities

| Teaching                                                   | 2012 | 2013 | 2014 | 2015 |
|------------------------------------------------------------|------|------|------|------|
| Lectures (hours/year) <sup>2</sup>                         | 44   | 64   | 55   | 42   |
| Practicum courses (hours/year) <sup>2</sup>                | 26   | 26   | 38   | 26   |
| Supervised bachelor theses (in total)                      | 3    | 2    | 0    | 2    |
| Supervised diploma theses (in total)                       | 0    | 5    | 9    | 8    |
| Supervised PhD theses (in total)                           | 7    | 12   | 12   | 12   |
| Members in PhD committees (in total)                       | 49   | 41   | 35   | 29   |
| Members in DrSc. committees (in total)                     | 0    | 0    | 0    | 0    |
| Members in university/faculty councils (in total)          | 2    | 2    | 2    | 2    |
| Members in habilitation/inauguration committees (in total) | 2    | 3    | 3    | 3    |

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### 2.5.4. List of published university textbooks

BCI01 LUPTÁK, Miloslav - MÁDR, Vilém - LUPTÁKOVÁ, Alena. Scanning of Material Cutting Process in Non-conventional Technologies, Ostrava, Czech Republic: VŠB - Technical university Ostrava, 2014. 131 pages. ISBN 978-80-248-3637-9. (in Slovak / Czech)

### 2.5.5. Number of published academic course books

### 2.5.6. List of joint research laboratories/facilities with universities

[1] The Institute is a member of national research consortium **PROMATECH - Research Centre of Progressive Materials and Technologies for Current and Future Applications** funded by ERDF funds, which brings together four institutes of SAS and two universities. PROMATECH provides the unique platform to share knowledge within the consortium with the aim of development of new technologies and knowledge transfer to industries. PROMATECH project connected several academic institutions, such as Institute of Geotechnics SAS, Institute of Material Research SAS, Institute of Experimental Physics SAS, Institute of Materials and Machine Mechanics SAS and the universities located in Košice: University of P. J. Šafárik and Technical University in Košice

In the newly-constructed PROMATECH building in the SAS Campus in Košice, IGT SAS has established 4 new laboratories:

- Mechanochemical Laboratory is dedicated to developing new attractive nanomaterials on the base of minerals and inorganic substances.
- Laboratory of Solid State Aerosols and Sediments is focused on the research of solid phase aerosols and contaminants in nature and work environments, atmospheric deposition and bottom sediments in rivers and reservoirs.
- Laboratory of Mineral Biotechnology is dedicated to the study of biotic components activities in geochemical processes in the top of Earth's geosphere.
- Physico-Chemical Laboratory focuses on research in the field of sorption technologies, i.e. for preparation and testing of mineral sorbents.

<sup>2</sup> Do not include time spent with bachelor, diploma or PhD students during their supervising

[2] **Joint laboratory of Transmission Electron Microscopy (TEM)** and laboratory for samples preparation is located in the Institute of Physics in the Faculty of Science UPJŠ. Currently, the study of relation between the structure and physical properties of amorphous metallic glasses and nanocrystalline metals prepared by primary crystallization of amorphous metals is crucial. Knowledge of the details of the structure of prepared materials is therefore a prerequisite for using electron microscopy for fulfilling of realised research. The expansion of research on other unconventional materials (eg. a thin films or powder materials) is planned in the near future, which will have a great potential for practical application. Sophisticated transmission electron microscope JEOL JEM-2100F UHR is designed for ultra-high resolution with excellent analytical capabilities.

[3] The Institute is establishing partner of **Development and Realisation Workplace of Raw Materials Extracting and Treatment (VRP)**, as well as a partner of National Platform for Research, Development and Innovations of Raw Materials, established by Technical University of Košice (a member of The European Technology Platform on Sustainable Mineral Resources), which strongly supports the collaboration with industry. The laboratories of IGT SAS are open for universities (Technical University Košice, Department of Geology of Mineral Deposits, Faculty of Natural Sciences, Comenius University Bratislava) and industrial members of VRP for consulting and joint research activities.

- **Supplementary information and/or comments on doctoral studies and educational activities**

Multidisciplinary research performed at the IGT SAS has required acceptance of future PhD students from various scientific fields like mining, metallurgy, natural and environmental sciences, etc. In this connection our Institute serves as a hub for perspective young scientists from Slovak universities, which also shows good cooperation between Academia and Universities. Apart from regular conference participation and research secondments to foreign institutes and universities, PhD students also participate in popularization activities of the IGT in order to acquire science-promoting skills.

**List of PhD study themes during assessed period:**

[1] **The forms study occurrence of metals in the sediments from the water reservoir Ružín No. I and their phytotoxicity and genotoxicity (10/2007 – 05/2012)**

Ing. Oľga Šestinová, supervisor: Ing. Alena Luptáková, PhD.

[2] **Application of Mechanochemistry at Utilization of Arsenic and Its Compounds (09/2009 – 08/2013)**

Mgr. Zdenka Bujňáková, supervisor: prof. RNDr. Peter Baláž, DrSc.

[3] **The Study of Properties of Solid Phase and Atmospheric Deposition of Industrial Aerosols and Their Interaction with Selected Components of Living and Working Environment (09/2009 – 02/2012)** Mgr. Jarmila Remiášová, supervisor: Ing. Jozef Hančulák, PhD.

[4] **Metal Mobilization in Natural Environment in Relation to Bacterial Reductive Processes (09/2010 – 08/2014)**

Mgr. Michal Kovařík, supervisor: MVDr. Daniel Kupka, PhD.

[5] **Preparation of Iron Oxide Based Materials for Environmental Applications (09/2010 – 08/2014)**

Mgr. Lenka Oroszová, supervisor: Ing. Miroslava Václavíková, PhD.

- [6] **The Study of Sorption on Modified Natural Materials** (09/2010 – 08/2014)  
Ing. Tomáš Schütz, supervisor: RNDr. Silvia Dolinská, PhD.
- [7] **Utilization of Biomaterials in Metallurgy** (09/2011 – 08/2015)  
RNDr. Matej Baláž, supervisor: RNDr. Erika Dutková, PhD.
- [8] **Influence of Inorganic Pollutants in Mine Waters to Surrounding Biotope and Possibilities of their Biological Removal** (09/2011 – 08/2015)  
Mgr. Ingrida Kotuličová, supervisor: Ing. Alena Luptáková, PhD.
- [9] **The Study of Selected Pollutants' Solid Phase of Industrial Aerosols in Atmospheric Deposition** (09/2011 – 08/2015)  
Mgr. Tomáš Kurbel, supervisor: Ing. Jozef Hančulák, PhD.
- [10] **The Use of Magnesite in Water Purification** (09/2013 – 08/2017)  
Mgr. František Bendek, supervisor: Ing. Miroslava Václavíková, PhD.
- [11] **Determination of Industrial Persistent Pollutants by Mass Spectrometry** (09/2013 – 08/2017)  
Mgr. Dávid Jáger, supervisor: MVDr. Daniel Kupka, PhD.
- [12] **Bioremediation of Environmental Contamination by Autochthonous Bacteria** (09/2013 – 08/2017)  
Ing. Darina Štyriaková, supervisor: MVDr. Daniel Kupka, PhD.
- [13] **Biodiversity of Culturable and Non-Culturable Bacteria in Matrices Contaminated with Metals and Organic Pollutants** (09/2014 – 08/2018)  
Mgr. Lenka Hagarová, supervisor: MVDr. Daniel Kupka, PhD.
- [14] **Utilization of the Iron Cycle in Bioleaching and Bioremediation Processes** (09/2014 – 08/2018)  
Ing. Jaroslav Šuba, supervisor: Ing. Iveta Štyriaková, PhD.
- [15] **Removal of Xenobiotics from Industrially Contaminated Soils and Waters** (09/2014 – 08/2018)  
MVDr. Jana Tomčová, supervisor: Ing. Miroslava Václavíková, PhD.
- [16] **Synthetic Nanoparticles in Water and Soil Clean-up and Their Interaction with Environment** (09/2015 – 08/2019)  
Ing. Dominika Behunová, supervisor: Ing. Miroslava Václavíková, PhD.
- [17] **Removal of Organic Pollutants from Industrial Waste Waters by Selected Species of Sulphur Bacteria** (09/2015 – 08/2019)  
Ing. Dominika Rudzanová, supervisor: Ing. Alena Luptáková, PhD.
- [18] **Mechanochemical Processing of Natural and Synthetic Minerals** (09/2015 – 08/2019)  
Ing. Matej Tešínský, supervisor: prof. RNDr. Peter Baláž, DrSc.

An international position of IGT SAS in PhD. study was strengthened by fellowships as introduced in Table below.

| List of PhD fellows seconded from IGT SAS |                                                                                      |                                              |                       |                                                          |
|-------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------|-----------------------|----------------------------------------------------------|
| Name of PhD student                       | Hosting institution                                                                  | Dates                                        | Number of days        | Project involved                                         |
| Ing. Ingrida Kotuličová                   | Institute of Environmental Geology and Geoinengineering, CNR, Rome, Italy            | 11.09 – 17.09. 2012                          | 7                     | Inter-Academic Bilateral Agreement                       |
| Ing. Ingrida Kotuličová                   | Institute of Environmental Geology and Geoinengineering, CNR, Rome, Italy            | 13.09. – 23.09. 2013                         | 10                    | Inter-Academic Bilateral Agreement                       |
| Ing. Ingrida Kotuličová                   | Institute of Environmental Geology and Geoinengineering, CNR, Rome, Italy            | 29.09. – 08.10. 2014                         | 10                    | Inter-Academic Bilateral Agreement                       |
| Ing. Lenka Oroszová                       | School of Chemistry, Aristotle University of Thessaloniki, Greece                    | 01.02. – 30.04. 2012                         | 90                    | National Scholarship Programme of Slovakia               |
| Ing. Lenka Oroszová                       | MAST Carbon International, Ltd., Basingstoke, United Kingdom                         | 05.05. – 06.07. 2014                         | 63                    | FP7-PEOPLE-2013-IAPP WaSClean                            |
| Ing. Tomáš Schüz                          | MAST Carbon International, Ltd., Basingstoke, United Kingdom                         | 05.05. – 06.07. 2014                         | 63                    | FP7-PEOPLE-2013-IAPP WaSClean                            |
| Ing. Lenka Oroszová                       | Hermes S.A., Oreokastro, Thessaloniki, Greece                                        | 07.07. – 07.08. 2014<br>01.12. – 29.12. 2014 | 61                    | FP7-PEOPLE-2013-IAPP WaSClean                            |
| Ing. Darina Štyriaková                    | Cristalerias Chile S.A, Santiago, Chile                                              | 22.02. – 06.03. 2014                         | 13                    | PROJECTO CORFO I + D Cod. 13IDL2 - 23505                 |
| Ing. Jaroslav Šuba                        | Cristalerias Chile S.A, Santiago, Chile                                              | 22.02. – 06.03. 2014                         | 13                    | PROJECTO CORFO I + D Cod. 13IDL2 - 23505                 |
| Mgr. Dávid Jáger                          | Ekodor SK TOO, Astana, Kazakhstan                                                    | 05.05. – 04.07. 2015                         | 61                    | FP7-PEOPLE-2013-IAPP WaSClean                            |
| List of PhD fellows seconded to IGT SAS   |                                                                                      |                                              |                       |                                                          |
| Name of PhD student                       | Sending institution                                                                  | Dates                                        | Number of days        | Project involved                                         |
| Konstantin Babič                          | Faculty of Mining and Geology, VŠB - Technical University of Ostrava, Czech republic | 01.11.2011 – 31.01.2012                      | 31 in assessed period | Agreement between FM&G VŠB-TU Ostrava and IGT SAS Košice |
| Lukáš Pjura                               | Faculty of Mining and Geology, VŠB - Technical University of Ostrava, Czech republic | 01.11.2011 – 31.01.2012                      | 31 in assessed period | Agreement between FM&G VŠB-TU Ostrava and IGT SAS Košice |

|                   |                                                                                                 |                         |                       |                                                                               |
|-------------------|-------------------------------------------------------------------------------------------------|-------------------------|-----------------------|-------------------------------------------------------------------------------|
| Zuzana Mindášová  | Faculty of Mining and Geology, VŠB - Technical University of Ostrava, Czech republic            | 01.11.2011 – 31.01.2012 | 31 in assessed period | Agreement between FM&G VŠB-TU Ostrava and IGT SAS Košice                      |
| Dagmara Malina    | Faculty of Chemical Engineering and Technology, Cracow University of Technology, Cracow, Poland | 1.10. – 31.12.2012      | 90                    | European Social Fund & the Ministry of Science and Higher Education of Poland |
| Grzegorz Kurowski | Faculty of Chemical Engineering and Technology, Cracow University of Technology, Cracow, Poland | 02.09. – 30.11.2014     | 90                    | European Social Fund & the Ministry of Science and Higher Education of Poland |
| Irina Voinovschi  | School of Chemistry, Aristotle University of Thessaloniki, Greece                               | 01.05. – 31.07.2013     | 90                    | National Scholarship Programme                                                |
| Oleh Shpotyuk     | Lviv Institute of Materials of SRC, Lviv, Ukraine                                               | 01.03.-30.11. 2015      | 270                   | Slovak Academic Information Agency                                            |

As the researchers of IGT SAS increase their qualification, the numbers of potential PhD supervisors increased as well during the assessed period (see Table 2.5.2).

The IGT SAS researchers also supervise the bachelor and diploma theses as principal or consulting supervisors at collaborating universities.

#### **List of supervised-consulted bachelor theses**

##### **MVDr. Daniel Kupka, PhD.**

- Andrea Lorincová: Analysis of possibility of selected ions removal from water by membrane technology in combination with ion exchange method. Faculty of Mining, Ecology, Process Control and Geotechnology, Technical University of Košice, 2012
- Dominika Behúnová: Analysis of physico-chemical factors of bacterial adhesion on solid surfaces. Faculty of Mining, Ecology, Process Control and Geotechnology, Technical University of Košice, 2012-2013

##### **Ing. Alena Luptáková, PhD.**

- Eva Uhorščáková: Resistance of cement composites based on zeolites in sulphate environment. Faculty of Civil Engineering, Technical University of Košice, 2012

##### **Prof. RNDr. Vladimír Šepelák, DrSc.**

- Janette Žáková: Electrochemical properties of nanoxides prepared by mechanochemical processes. Faculty of Metallurgy, Technical University of Košice, 2013

##### **RNDr. Erika Fedorová, PhD.**

- Zuzana Szabová: Atmospheric deposition of heavy metals in selected environmentally polluted areas of Slovakia. Institute of Ecology and Environmental Sciences, University of Central Europe, Skalica, 2015

## **List of supervised-consulted diploma (master) theses**

### **MVDr. Daniel Kupka, PhD.**

- Bc. Andrea Lorincová: Removal of selected ions from waters by ion Exchange method. Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Košice, 2013-2015
- Bc. Dominika Behunová: Kinetic of bacterial oxidation of elementary sulphur. Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Košice, 2014-2015
- Bc. Petra Hrbáčňová: Experimental valuation of selected parameters of surface waters quality – case study of water flow. Institute of Ecology and Environmental Sciences, University of Central Europe, Skalica, 2014
- Bc. Anna Ballóková: Utilization of spectral and separation methods for drinking and waste water analyses. Faculty of Sciences, University of P.J. Šafárik, Košice, 2014-2015
- Bc. Daniela Sabolová: Trace and ultra trace analysis of elements for the field of ecological and biotechnological interesting sample matrices. Faculty of Sciences, University of P.J. Šafárik, Košice, 2014-2015

### **Ing. Alena Luptáková, PhD.**

- Bc. Eva Uhorščáková: Resistance of cement composites based on zeolites in sulphate environment. Faculty of Civil Engineering, Technical University of Košice, 2013-2014
- Bc. Gréta Mruzová: Biocorrosion of special cement composites. Faculty of Civil Engineering, Technical University of Košice, 2013-2014
- Bc. Katarína Britanová: Comparison of biodegradation of cement composites with binder alternative by selected wastes. Faculty of Civil Engineering, Technical University of Košice, 2015

### **Ing. Milan Labaš, PhD.**

- Bc. Lýdia Hoborová: Assessment of the mechanical and technological parameters of the andesites from Eastern Slovakian quarries, FBERG TU Košice, 2014

### **Ing. Iveta Štyriaková, PhD.**

- Bc. Darina Štyriaková: Potential raw materials of quartz sand, their mineralogical composition and release of iron minerals by bacterial reduction. Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Košice, 2013
- Bc. Jaroslav Šuba: Bacterial mobilization of iron minerals in sediments and soils of Ružín Dam. Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Košice, 2013

### **RNDr. Matej Baláž**

- Barbora Selepová: Nanopharmacy. University of Veterinary Medicine and Pharmacy, Košice, 2014-2015
- Miriama Balážová: The biosynthesis of nanoparticles by plant extracts. University of Veterinary Medicine and Pharmacy, Košice, 2015

### **Prof. RNDr. Vladimír Šepelák, DrSc.**

- Bc. Janette Žáková: Mechano-synthesis of oxides. Faculty of Metallurgy, Technical University of Košice, 2015

**Scientific Board of IGT SAS** organized following seminars, scientific presentations and lectures during the assessed period:

## **2012**

- Seminar of PhD students of IGT SAS: 9 lectures - 7 internal PhD students (Mgr. Zdenka Bujňáková, Mgr. Michal Kovařík, Mgr. Lenka Oroszová, Ing. Tomáš Schütz, Mgr. Matej Baláž, Mgr. Bc. Ingrida Kotuličová, Mgr. Tomáš Kurbel) and 2 foreign PhD students (MSc. Eng. Dagmara Malina – Krakow University of Technology, Poland; Inna Melnyk, NANU, Kiev, Ukraine),
- Lecture of prof. Dr. G. Kadimov, Bulgarian Academy of Science, Sofia, Bulgaria. Title: "Infrared spectroscopy in heterogeneous catalysis",
- Lecture of Ing. Olga Šestinová, external PhD student. Lecture before the PhD defence. Title: The forms study occurrence of metals in the sediments from the water reservoir Ružín No.I and their phytotoxicity and genotoxicity.

## **2013**

- Presentation of MSc. Irina Voinovschi, visiting researcher from School of Chemistry, Aristotle University Thessaloniki, Greece. Title: Electrochemical Treatment of Textile Wastewater,
- Presentation of Ing. Katarína Feriančíková, PhD., new employee. Title: Use of Accessory Vibro-Acoustic Emissions for Process Control,
- Presentation of Ing. Veronika Kmecová, new employee. Title: Effects of Superplasticizer and Basalt Dust on Properties of Cement Composites,
- Presentation of Ing. Mária Kruláková, new employee. Title: Automated Digitization of Large-Scale Templates and Its Further Applications,,
- Lecture of Mgr. Zdenka Bujňáková / internal PhD student / lecture before the PhD defence / Title: Application of mechanochemistry at the utilization of arsenic and its compounds,
- Lecture of Prof. RNDr. Jaroslav Briančin, CSc. / Title: Microscopic methods at the Institute of Geotechnics of SAS,
- Presentation of Dr. Oksany A. Dudarko / the visiting researcher from Chuiko Institute of Surface Chemistry, National Academy of Sciences of Ukraine, Kiev, Ukraine / Synthesis of Functionalized Hierarchical Materials with Tailored Porosity and Surface Chemistry as Representatives of a New Generation of Adsorbents,
- Seminar of PhD students / 9 lectures of internal PhD students: Mgr. Michal Kovařík, Mgr. Lenka Oroszová, Ing. Tomáš Schütz, RNDr. Matej Baláž, Mgr. Bc. Ingrida Kotuličová, Mgr. Tomáš Kurbel, Mgr. Dávid Jáger, Mgr. František Bendek, Ing. Darina Štyriaková.

## **2014**

- Lecture of prof. George Gallios / Aristotle University of Thessaloniki, Greece / Title: Adsorption and advanced oxidation methods in water treatment,
- Presentation of RNDr. Martin Fabián, PhD. / Title: The possibilities of Transmission electron microscopy (TEM) for the Institute of Geotechnics of SAS requirements,
- Presentation of Ing. Jana Jenčárová, PhD. / Title: Analyzer of the size distribution and count of particles - MULTISIZER 4 Beckman Coulter,
- Lecture of Mgr. Lenka Oroszová / internal PhD student / lecture before the PhD defence / Title: Preparation of Materials based on Iron Oxides for Environmental Applications,
- Lecture of Ing. Tomáš Schütz / internal PhD student / lecture before the PhD defence / Title: The Study of Sorption on Modified Natural Materials
- Presentation of Mgr. Inž. Grzegorz Kurowski / the visiting researcher from Kościuszko Krakow University of Technology, Krakow, Poland /Title: Using waste products for paint strippers production,
- Seminar of PhD students / 9 lectures of internal PhD students: RNDr. Matej Baláž, Mgr. Bc. Ingrida Kotuličová, Mgr. Tomáš Kurbel, Mgr. Dávid Jáger, Mgr. František Bendek, Ing. Darina Štyriaková, Mgr. Hagarová Lenka, Ing. Šuba Jaroslav, MVDr. Tomčová Jana.

**2015**

- Lecture of RNDr. Matej Baláž / internal PhD student / lecture before the PhD defence / Title: Utilization of biomaterials in metallurgy,
- Lecture of Mgr. Bc. Ingrida Kotuličová / internal PhD student / lecture before the PhD defence / Title: Influence of the inorganic pollutants in mine waters to the surrounding biotope and possibilities of their biological removal,
- Seminar of PhD students / 9 lectures of internal PhD students: Mgr. Dávid Jáger, Mgr. František Bendek, Ing. Darina Štyriaková, Mgr. Hagarová Lenka, Ing. Šuba Jaroslav, MVDr. Tomčová Jana, Ing. Dominika Behúnová, Ing. Dominika Rudzanová, Ing. Matej Tešínský.

## **2.6. Social impact**

### **2.6.1. List of the most important results of applied research projects. Max. 10 items**

The Institute of Geotechnics SAS has implemented several applied research projects with foreign companies focused on transfer of knowledge. These projects involved Intellectual Property Rights (IPR) protection and hence the results are confidential and were not published. Such projects however delivered supplementary financial support to the Institute and also increased the credibility of the Institute. Therefore, the projects' scopes are only outlined in the Questionnaire.

#### **[1] Liberalization of Ag/Au particles from silicate matrix by bioleaching (05/2012-05/2013)**

Principal investigator: Ing. Iveta Štyriaková, PhD.

Partner organizations: IGT SAS, Newmont Technologies Limited, Denver, USA.

Upon the responses to the previous work of the Department of Mineral Biotechnologies, the cooperation with company Newmont Technologies Limited, Denver, USA was set up by external contract funding of the research focused on liberalization of Ag/Au particles from silicate matrix by bioleaching. The laboratory tests were carried out with aim of the yield increasing of silver and gold from the ore material heaps. The bioleached process of coarse-grained raw materials was verified in laboratory by indigenous bacteria which caused decomposition of mineral matrix in which the silver minerals are locked. The main requirement of the company was to prevent the dissolution of mercury presented in the raw material in order to protect the environment during the use of biotechnology in heaps pretreatment, which was resolved right choice of media composition used in the bioleached process. The detailed results of the projects were prevented from publishing due to confidentiality required by the company.

#### **[2] Hydrometallurgical Technology of Antimony Recovery from Antimonite Concentrates (2013-2014)**

Principal investigator: prof. RNDr. Peter Baláž, DrSc.

Partner organizations: IGT SAS, Nihon Seiko Co. Limited, Tokyo, Japan

Based on excellent results of the team of Department of Mechanochemistry, the contracted project of applied research financed from external resources has been set up with Japanese company Nihon Seiko Co., Limited. The tests of hydrometallurgical treatment of supplied materials defined in Contract with Japanese company were performed. Results are confidential according to the requirement of the Japanese company.

#### **[3] Mechanochemical Technology for Preparation of Nanocrystalline Material (2014-2015)**

Principal investigator: prof. RNDr. Peter Baláž, DrSc.

Partner organizations: IGT SAS, Nihon Seiko Co. Limited, Tokyo, Japan, Technische Universität Clausthal, Germany

Based on previous results dealing with antimony leaching, the contracted project of applied research financed from external resources has been set up with Japanese company Nihon Seiko Co., Limited. The nanocrystalline material as defined in Contract with Japanese company was performed. Results are confidential according to the requirement of the Japanese company

#### **[4] Development of In-situ Bioleaching Method to Clean Quartz Sands and Application through Testing Prototype Pilot Plant (01/2014-12/2016)**

Principal investigator: Ing. Iveta Štyriaková, PhD.

Partner organizations: IGT SAS, Cristalerías de Chile S.A.

Collaborative project of applied research for development of innovation technologies was funded by the Chilean Economic Development Agency CORFO between the IGT SAS and company Cristalerías de Chile S.A. (Project CORFO I+D Cod. 13IDL2 – 23505). The cooperation has been induced as the result of responses to the previous publications of the Department of Mineral Biotechnologies IGT SAS.

Cristalerías Chile SA is a company engaged in the production of glass containers and uses raw silica sand, which does not fulfill the purity necessary for creating quality glass. The research and development of new technologies within the biotransformation of silicate minerals by heterotrophic bacteria is one of the scientific activities of IGT SAS which may serve to develop the bioleaching technology for the purification of quartz sand in Chile. Laboratory tests in the first year of project solutions were carried out with aim to find active microorganisms in Chile for the iron mineral removal from quartz sands in EL TURCO deposit. Unsterile condition of selected localities in El Turco, Atacama, Yerba Loca, and Coronel in Chile gave a phylogenetic diversity of Fe-reducing bacteria and microorganisms. Iron dissolution and removal from quartz sands was best with the most active microorganisms from Yerba Loca. The extent of iron coatings removal from Chile's quartz sands depended on way and conditions of bioleaching. Columns bioleaching of quartz sands with percolation of media was better than flasks bioleaching under stationary condition. That is why the heap bioleaching by percolation of media will be more compatible than the tanks bioleaching. The heap bioleaching with the recycling of leachates provides the development of new economic technology suitable for the quality improvement of QS for the company from Chile. The detailed results of the projects are prevented from publishing due to confidentiality required by the company.

#### **[5] Biocorrosion of Cement Composites (2014-2015)**

Principal investigator: prof. RNDr. Adriana Eštoková, PhD. at Faculty of Civil Engineering, Technical University of Košice

Principal investigator of the IGT SAS: Ing. Alena Luptáková, PhD.

Partner organizations: Považské cementárne a.s., Ladce (N.W. Slovakia), Faculty of Civil Engineering, Technical University of Košice

The cooperation with the cement-producing company Považské cementárne a. s., Ladce has been established within the project VEGA 2/0166/11. The cooperation has been focused on the bio-corrosion resistance testing of the cement composites with various compositions. Five types of cement composites with various percentage of special slag-based additives as well as composites with new-developed cement by Považské cementárne a.s. were studied. Sulphur-oxidizing bacteria *Acidithiobacillus thiooxidans*, isolated from AMD-Pech / Smolník, were used to simulate the bio-corrosion process. The outcomes revealed a different behaviour of the new-developed cement based composites compared with the other samples and the reference sample as well. Results are confidential according to the requirement of the company.

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As shown above, IGT SAS has developed several techniques to be implemented in applied research with the aim to employ unconventional technologies in the industrial application. Beside the direct impact to the Institute's budget, these technologies bring number of technical and economic advantages, which have also substantial social impact.

Biological methods, which can be successfully applied in mineral processing, enable the processing/utilization of raw materials, which are not possible to be processed by conventional methods and thus it would not be possible to utilize them. Application of new approaches in industrial processes usually decreases the process costs and thus improves the economy and sustainability of the company. Moreover, new unconventional technologies may enable opening of new mining site, which will provide primary and secondary job positions and therefore improve the regional social/economic conditions.

Bio-hydrometallurgical processes in mineral processing allow to simplify/reduce some technological steps, which require aggressive chemical reagents, which has significant impact on the environment. The added value of the elimination of particular technological steps is the substantial economy impact, as the cost of new mining site and respective devices will be significantly lower as compared to classic methods using aggressive chemicals.

On the top of that, biological methods can be applied in quality control of specific new products i.e. cements. New special cements contribute to product diversification and competitiveness of industrial companies, which results in employment sustainability and/or in increasing of job positions.

Mechanochemical synthesis of new nanocrystalline materials developed at IGT SAS contributes to the development and/or innovation of industrial processes, which also brings positive impact on employment rate and generally increases level of the life.

New hydrometallurgical approach of antimony processing from domestic Sb-ores (often a part of sulphide-oxide-carbonaceous complexes), which are quite complicated ores from both mineral (tetrahedrite) and chemical (isomorphous impurities of Sb-minerals) composition point of view. The collaboration with Japanese company allowed additional testing and investigation of this approach. It is important to say that antimony belongs to priority critical elements and previous and recent experience of the IGT SAS group with Sb minerals refers to significant advantage of IGT SAS in the field of Sb research as Slovakia Sb deposits represent considerable resources of Sb in Europe. **The significant impact on less favourable regions of Slovakia**, where deposits are located, is expected. Moreover the **substantial decrease of import of Sb minerals to EU is expected and EU dependence on import will be significantly eliminated**.

The impact of research outputs of IGT SAS are far beyond the borders of Slovakia. In the assessed period most of the know-how of IGT SAS was applied/implemented in foreign countries (USA, Japan, Chile). IGT SAS is ready to boost its activities and collaboration with industries on the national level, however business opportunities and mechanisms of investments of commercial companies to the research need to be improved and supported by Slovak government. Moreover, the mining legislation needs to be updated to the appropriate EU level to secure sustainable development of Slovakia and provide favourable climate for research and innovations. In such **case IGT SAS has unique position for transfer of knowledge from academia to industry in the field of mining, mineral processing and environmental remediation**.

#### **2.6.2. List of the most important studies commissioned for the decision-making authorities, the government and NGOs, international and foreign institutes**

The employees of the IGT SAS participate in meetings of national committees, as members of advisory government bodies and experts for decision-making authorities, etc.:

##### **prof. RNDr. Peter Baláž, DrSc.:**

- member of Board for Technical Science of the Slovak Research and Development Agency (SRDA) – member (until 2012)
- Chairman of the Slovak Committee for Scientific Degrees, Committee for the Defence of doctoral thesis in the scientific field Mining 020801-020805 (all assessed period)

##### **Ing. Vítazoslav Krúpa, DrSc.:**

- Slovak Mining Chamber – a member of Supervisory board (all assessed period)
- Opposition procedure of Feasibility Study on Technological Processing of Slovak Magnesite, Usable Waste from its Exploitation and Beneficiation, as well as Magnesium-Bearing Metalliferous Waste Conformable with Innovation Trends in the World, EU and Slovak republic. – an evaluator and a member of ad hoc Opposition board appointed by the Minister of Education, Science, Research and Sport of the Slovak Republic (2014)
- Sector Board “Mineral Exploitation and Processing & Geology” for creation of the National system of qualification – a member of Sector Board (2014-2015)
- Elected by the proposal of Slovak Mining as the Chair of ad hoc Selection Board established by District Bureau of Mines in Košice for the assessment of proposals on lease assignment of mining areas „Pusté Čemerné“ and „Pusté Čemerné I“ to other organizations submitted in selection procedure (2015).

**MVDr. Daniel Kupka, PhD.:**

- Member of Working Group for Foregrounding of the National Implementation Plan of Stockholm Convention on Persistent Organic Pollutants under gestion of the Ministry of Environment of the Slovak republic – a member of expert working group in behalf of Slovak Academy of Sciences (all assessed period).

**Ing. Jozef Hančulák, PhD.:**

- member of Working Group for Identification of Possible Hazards Issuing from Geological Prospecting for Survey of Jahodná-Kurišková Uranium Deposit. Elaboration of expert report „Elaboration of Opinion for Town of Košice to the Intention of Exploitation and Processing of Uranium in the Jahodná-Kurišková Site“ as ordered from the Mayor of Košice to the project on Uranium Exploitation and Processing in the Jahodná – Kurišková locality for the Košice-city (2013). .

**Ing. Slavomír Hredzák, PhD.:**

- Selection procedure of contractor for elaboration of feasibility study on Slovak magnesite finalization - a member of ad hoc Expert board appointed by the Minister of Education, Science, Research and Sport of the Slovak Republic (2014)
- Opposition procedure of Feasibility Study on Technological Processing of Slovak Magnesite, Usable Waste from its Exploitation and Beneficiation, as well as Magnesium-Bearing Metalliferous Waste Conformable with Innovation Trends in the World, EU and Slovak republic. – a member of ad hoc Opposition board appointed by the Minister of Education, Science, Research and Sport of the Slovak Republic (2014)

**2.6.3. List of contracts and research projects with industrial and other commercial partners, incl. revenues**

IGT SAS participated in 5 major applied research projects, as presented in Chapter 2.6.1.:

**[1] Liberalization of Ag/Au Particles from Silicate Matrix by Bioleaching** (2012-2013), Contract research with Newmont Technologies Limited Denver, USA, Principal investigator at IGT SAS: Ing. Iveta Štyriaková, PhD., budget 65,000.00 €

**[2] Hydrometallurgical Technology of Antimony Recovery from Antimonite Concentrates** (2013-2014), Contract research with Nihon Seiko Co. Limited, Tokyo, Japan, Principal investigator at IGT SAS: prof. RNDr. Peter Baláž, DrSc. (JMELT); budget 21,794.41 €

**[3] Mechanochemical Technology for Preparation of Nanocrystalline Material** (2014-2015), Contract research with Nihon Seiko Co. Limited, Tokyo, Japan, Principal investigator at IGT SAS: prof. RNDr. Peter Baláž, DrSc. (JATIS); budget 20,000.00 €

**[4] Development of In-situ Bioleaching Method to Clean Quartz Sands and Application through Testing Prototype Pilot Plant**, (2014-2016), Contract research project: CORFO I + D Cod. 13IDL2 - 23505, Principal investigator at IGT SAS: Ing. Iveta Štyriaková, PhD., budget 73,000.00 €

**[5] Biocorrosion of Cement Composites**, (2014-2015), Contract research with Považské cementárne a.s., Ladce, Slovak republic, Principal investigator of the IGT SAS: Ing. Alena Luptáková, PhD., a.s., Ladce, Slovak republic, Faculty of Civil Engineering, Technical University of Košice, budget 620.00 €

IGT SAS elaborated 27 expert reports, technical services, chemical analyses etc upon requests by industrial companies:

| <b>EXPERT REPORTS</b> |                                         |                                                                                                                                                                                                                                                                                  |
|-----------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <b>Contractor</b>                       | <b>Task of the IGT SAS</b>                                                                                                                                                                                                                                                       |
| <b>2012</b>           |                                         |                                                                                                                                                                                                                                                                                  |
| [1]                   | SMZ, a.s. Jelšava                       | Determination of total sulphur content in samples of magnesite inlet for furnace for assessment of emission limits (250 €)                                                                                                                                                       |
| [2]                   | CAD-ECO a.s., Žilina                    | Determination of rock abrasivity for rock drillability assessment during construction of the road tunnel Krásno nad Kysucou, Slovakia. (300 €)                                                                                                                                   |
| [3]                   | VSK Mineral, s.r.o. Košice              | Determination of rock abrasivity of the samples taken from Slovak andesite quarries owned by the company for rock quality assessment. (300 €)                                                                                                                                    |
| [4]                   | Panasonic Slovakia s.r.o., Trstená      | Measurement of purity of supplied metal covers for shielding of tuners in completion of the final electrotechnical product. (428 €)                                                                                                                                              |
| <b>2014</b>           |                                         |                                                                                                                                                                                                                                                                                  |
| [5]                   | ENEL, a.s. Vojany                       | Assessment of technical condition of material for piping of steam boiler MPR3 of pressure complex boiler FK5 and FK6 (936 €)                                                                                                                                                     |
| [6]                   | CEIT Slovakia Košice                    | Measurement of parameters of supplied liquid samples (196.80 €)                                                                                                                                                                                                                  |
| [7]                   | Tesla Stropkov a.s.                     | Granulometry measurement of supplied powder samples (128 €)                                                                                                                                                                                                                      |
| [8]                   | Magnetti Marelli, s.r.o. Kechnec        | Chemical analysis of impurities (98.60 €)                                                                                                                                                                                                                                        |
| [9]                   | CAD-ECO a.s. Žilina                     | Determination and assessment of rock abrasiveness of supplied rock samples for construction of highway tunnels, May 2014 (550 €)                                                                                                                                                 |
| [10]                  | CAD-ECO a.s. Žilina                     | Determination and assessment of rock abrasiveness of supplied rock samples for construction of highway tunnels, June 2014 (650 €)                                                                                                                                                |
| [11]                  | Žilinská teplárenská a.s. Žilina        | Determination of brown coal abrasivity for assessment of their effect on technological devices of the company, October 2014 (320 €)                                                                                                                                              |
| [12]                  | Žilinská teplárenská a.s. Žilina        | Determination of brown coal abrasivity for assessment of their effect on technological devices of the company with specified requirements, November 2014 (320 €)                                                                                                                 |
| [13]                  | Institute of Parasitology SAS           | Determination of Hg concentration in biological samples (995 €)                                                                                                                                                                                                                  |
| [14]                  | SABAR, s.r.o. Markušovce                | Analysis of siderite particles distribution for improvement of technological process in the company SABAR (77.40 €)                                                                                                                                                              |
| [15]                  | VRP ZaSS F BERG TU KE                   | Analysis of the products of magnesite processing (900 €)                                                                                                                                                                                                                         |
| [16]                  | VSK Mineral, s.r.o. Košice              | Analysis of carbonates of the company quarries                                                                                                                                                                                                                                   |
| <b>2015</b>           |                                         |                                                                                                                                                                                                                                                                                  |
| [17]                  | Tesla Stropkov a.s.                     | Service works (294 €)                                                                                                                                                                                                                                                            |
| [18]                  | CEIT Biomedical Engineering, s.r.o      | Service works (466 €)                                                                                                                                                                                                                                                            |
| [19]                  | Tesla Stropkov a.s.                     | Service works (200 €)                                                                                                                                                                                                                                                            |
| [20]                  | USSteel, s.r.o. Košice                  | Service works (1016 €)                                                                                                                                                                                                                                                           |
| [21]                  | Slovzink a.s. Košeca                    | Determination of particle size distribution ranging 0.9–170 µm (70 €)                                                                                                                                                                                                            |
| [22]                  | GGB Slovakia s.r.o. Sučany              | Chemical analysis of dust coat from process of tin coating of bearing parts (155.50 €)                                                                                                                                                                                           |
| [23]                  | Profesionálna servisná, s.r.o. Hencovce | Chemical analysis of supplied samples                                                                                                                                                                                                                                            |
| [24]                  | GEO Slovakia, s.r.o. Košice             | Microbiological analyses of number of oil and heterotrophic bacteria in organically contaminated soil and groundwater samples. Expert report for process of bioaugmentation and biostimulation application in remediation of the site Plešivec – rail depo, Cargo a.s. (7783 €). |
| [25]                  | TRIX, s.r.o. Trstená                    | Chemical analyses of supplied samples (495 €).                                                                                                                                                                                                                                   |
| [26]                  | ŽTS, a.s. Sabinov                       | Chemical analyses of supplied samples (260 €).                                                                                                                                                                                                                                   |
| [27]                  | U.S.Steel, s.r.o. Košice                | Measurement of abrasivity of supplied mixtures of metalliferous byproducts (490 €).                                                                                                                                                                                              |

#### **2.6.4. List of licences sold abroad and in Slovakia, incl. revenues**

None

#### **2.6.5. List of most important social discourses under the leadership or with significant participation of the institute (max. 10 items)**

IGT SAS as a member of Slovak Mining Society and Slovak Mining Chamber actively participates in panel discussions on new “Mineral Policy of Slovak Republic” with all stakeholders in Slovakia within the regular meetings and conferences.

The New Mineral Policy will represent a vision of mining enterprise / business focused on critical minerals, base and precious metals and industrial minerals considering the affordability of mineral raw materials for the smooth performance of the EU's Economy.

A considerable social part of the prepared policy gives attention to Slovak developing territories, especially in areas of former mining activities, characterized by high percentage of unemployed population. Thus, a concept of “small mine” has been recently discussed and in such way a revitalization of mining is proposed with the aim to:

- exploit remaining proven reserves,
- verify and develop reserves especially of critical minerals and precious metals,
- gradually transform old mine to museum and/or synergic coexisting museum and active part of mines.

Based on such conditions and upon implementation of the proposal, a significant reduction of unemployment is expected based on verified statistical fact that 1 active employed miner generates in average 4 other job positions.

#### **2.6.6. Summary of relevant activities, max. 300 words**

The Institute takes part on the projects related to the recovery of the environment and development of new materials and technologies. Such projects significantly improve the environmental conditions as well as health and quality of life of humans and thus indirectly increase the social and economic level of society. Moreover, these projects correspond to the priority areas of RIS3 strategy as well as with the strategy of sustainable development.

Long-term cooperation with geological and remediation company Environcentrum, s.r.o. Košice has resulted in successful application for joint research project of **FP7-PEOPLE-2013-IAPP/612250 Water and Soil Clean-Up from Mixed Contaminants**, bringing together other 3 industrial partners (nanomaterials producing company MAST Carbon International, Basingstoke, UK; textile dyeing factory HERMES S.A., Thessaloniki, Greece; construction company Ekodor LLC, Temirtau, Kazakhstan) and 3 other academic partners (Aristotle University of Thessaloniki, Greece; University of Brighton, United Kingdom; Nazarbayev University, Astana, Kazakhstan). The project has been meanwhile assessed very positively by EU-REA officers in Mid-Term Review Meeting on October 15, 2015. This project has brought substantial and very active transfer of knowledge from academic to industrial partners and vice versa, and also very frequent exchange of staff between the partners. Thus the PhD students, young and experienced researchers have got a chance to get a glance of working in industrial conditions and received intensive training in transfer of knowledge.

IGT SAS worked on **five major contracted applied research projects** with Japan (2x), Chile, Slovakia and USA (see list in 2.6.3). IGT SAS elaborated **27 expert reports** on testing, measurements, assessment, etc. for Slovak companies active in civil engineering, chemistry, environment, electrotechnics, as shown in the list in Chapter 2.6.3.

## 2.7. Popularisation of Science (outreach activities)

### 2.7.1. List of the most important popularisation activities, max. 20 items

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Paper in the journal SAS News, 9.1.2012, 10.7.2012</b><br>Prof. Baláž discussed the „Possibilities of Nanoparticles Application“ and the „Mechanochemistry Around Us“ in the print SAS News.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>10<sup>th</sup> Exhibition of stone industry and geology Kamenar, Trenčín, Slovakia, 16.2.2012</b><br>Four researchers (Luptáková, Jenčárová, Kotuličová, Kurbel) presented their research within several national and ERDF projects focused on study of positive and negative effects of sulfuretum in environment and remediation of mining areas contaminated by heavy metals and other pollutants at the Kamenar 2012 Exhibition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Researcher's Night, OptimaShopping Mall, Košice, Slovakia, 28.9.2012</b><br>IGT SAS participated on everyone's favourite event Researcher's Night also in 2012, as every year since 2010. Seven topics were presented by PhD students and researchers, covering all aspects of the research provided by IGT SAS: 1. <i>What Is Under Your Feet?</i> (geotechnics), 2. <i>Liquid Mirage</i> (mineral processing), 3. <i>From Macro to Nano</i> (mechanochemistry), 4. <i>Strange Stories From Chemistry Lab</i> (mineral processing), 5. <i>Microwaves In Action</i> (mineral processing), 6. <i>Where Can You Breath Well?</i> (environment protection), 7. <i>Bacteria, Beneficial and Harming</i> (mineral biotechnologies). All of the above mention interactive expositions were met with live interest of visiting children, students and parents. (Ivaničová, Bujňáková, Dolinská, Fabián, Jablonovská, Jenčárová, Kotuličová, Mačingová, Oroszová, Schutz, Štefušová, Turianicová, Vereš)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>TV Series Science Spectrum, STV2, 9.10.2012</b><br>prof. RNDr. Peter Baláž, DrSc. and Ing. Vítazoslav Krúpa, DrSc. STV2 participated in the TV series "Science Spectrum" concerning the research at the Institute.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Incheba EXPO Bratislava, 7.11.2012</b><br>D. Kupka promoted the results achieved by the research performed in the Excellence Centre GEOCEX at the international exhibition Incheba EXPO in Bratislava.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Tv Interview, Ostrava, Czech Republic, 29.11.2012</b><br>Ing. S. Hredzák, PhD. was interview during the international conference on Waste Recycling, discussing the issues of waste management and recycling in Slovakia.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Researcher's Night, OC Optima, Košice, Slovakia, 27.9.2013</b><br>Five presentations were prepared by IGT SAS researchers and PhD students.<br>1. <i>Know the Stone by Its Voice</i> (Ivaničová, Feriančíková, Kruľáková). Acoustic effects of rock drilling, measurements of strength properties of rocks. Exhibition of different rocks and fossils.<br>2. <i>Cinderella Game</i> . (Dolinská, Znamenáčková, Oroszová, Schutz). Methods of mineral separation using gravitation, magnetic and electrostatic fields. Separation of minerals in ferromagnetic liquid.<br>3. <i>Road to Nanoworld</i> . (Baláž, Bujňáková, Fabián, Turianicová).<br>World of nanoparticles in videos and real nanomaterials. Explanation of concepts of mechanochemistry and its use in synthesis of new materials.<br>4. <i>How Rockbiters Work</i> (Jenčárová, Luptáková, Mačingová, Štyriaková). Examples of bacterial corrosion of minerals, rocks, concrete shown on the macro- and micro-samples. Presentation of mechanism of acid mine drainage formation.<br>5. <i>Can You Find a Clear Air?</i> (Hančulák, Kurbel). Presentation of air pollution in Kosice and Eastern Slovakia by the results of research of atmospheric deposition, presentation of maps of contamination. Showcase of samples of dust deposits and real-time measurement of dust size and concentration.<br>As every year, the interactive exhibitions of IGT SAS attracted many visitors who then rewarded the researchers by their real interest and curiosity. |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Open Door Day, 14.11.2013, IGT SAS, excursion, radio interview, SAS news</b></p> <p>Open Door Day was organized to attract wide public, mainly students of elementary schools to the IGT SAS and to present them the laboratory equipment, methods and procedures applied in the research. (Ivaničová, Baláž M., Briančin, Hančulák, Kupka, Labaš, Lovás, Oroszová, Schutz, Štefušová, Znamenáčková)</p> <p>L. Ivaničová promoted the activities of IGT SAS during the live interview at Radio Regina and later by the SAS News.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p><b>Bulletin of Slovakian Mining Society, 12/2013</b></p> <p>Activities of IGT SAS were widely promoted by the Bulletin of of Slovakian Mining Society published in December 2013. The major contribution of the Institute was acknowledged by references to several scientific events and research projects. IGT SAS was honoured to host the Assembly of Presidium of Slovakian Mining Society on 28.08.2013.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p><b>Seminar for chemistry and physics teachers “Basics of nanoscience and nanotechnology”, 14.03.2014, IGT SAS</b></p> <p>Seven researchers of the Institute prepared the educational seminar “Basics of nanoscience and nanotechnology” for 12 chemistry and physics teachers of basic and high schools of Eastern Slovakia region in cooperation with Methodical pedagogical center within their ESF project. Lectures and presentation of the laboratories were focused on the issues of nanotechnologies and all their aspects investigated at the IGT SAS. (Ivaničová, Baláž M., Briančin, Bujňáková, Hančulák, Kupka, Štefušová)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>Information Day on H2020 Marie Curie Sklodowska Actions, 28.03.2014</b></p> <p>Ing. Miroslava Václavíková, PhD. was invited to promote the FP7 project by contribution “Presenting the successful project (FP7-PEOPLE-2013-IAPP-612250-WaSClean)” during the Information Day on H2020 Marie Curie Sklodowska Actions, 28.03.2014</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p><b>Publication Top scientific teams and personalities of SAS, 15.6.2014</b></p> <p>prof. RNDr. Peter Baláž, DrSc. contributed to the publication “Top scientific teams and personalities of Slovak Academy of Sciences”, prepared by publishing house VEDA SAV Bratislava</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p><b>Researcher's Night, OC Optima, Košice, Slovakia, 26.9.2014</b></p> <p>IGT SAS presented 4 thematic exhibitions:</p> <ol style="list-style-type: none"> <li><i>1. How to Clean Water from Pollutants?</i> Elimination of pollutants using adsorbents. Demonstration of sorption experiments and treatment of dyes-contaminated wastewater using electrolysis. Assessment of water purity by animal bio-indicators. FP7 WaSClean project was promoted as well by experiments of water and soil cleaning from mixed contaminants (Bendek, Kotuličová, Jenčárová, Oroszová, Schutz, Tomčová)</li> <li><i>2. Invisible Dust Around Us.</i> On site measurement of size and contentration of dust particles in the air by laser spectrometer. Explanation of the effect of dust on human health depending on clima conditions and movement of the visitors at the exhibition. (Hančulák, Fedorová)</li> <li><i>3. Stone Secrets.</i> Rock cycle with own eyes, rocks and fossils exhibition. Portable measurement of rock strength and abrasivity. Presentation of drilling bits. (Ivaničová, Kruľáková, Feriančíková)</li> <li><i>4. Mysteries in the Chemical Lab.</i> Chemical reactions with color changes and titration concept. Change in color of pH paper using conventional household liquids. Fade of objects in oils. Observation of UV-illuminated substances. Mills and balls as basic mechanochemist's tools. (Bujňáková, Baláž M., Fabián)</li> </ol> <p>L. Ivaničová and M. Fabián were interviewed for radio discussion promoting the Researcher's Night event.</p> |
| <p><b>TV and radio interview, Miskolc, Hungary, 09.10.2014</b></p> <p>M. Václavíková was interviewed by Europa radio and Miskolc TV in Hungary on the issues of IGT SAS participation in European projects and about the organization of joint conferences within Visegrad region in cooperation with University of Miskolc.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Activities within the initiative “Science Wants to Live”, October, November 2014</b></p> <p>Researchers from IGT SAS participated actively in organizing the public discussions and meetings within the initiative “Science Wants to Live” in Kosice to support the research within the SAS while negotiating the SAS budget with government. Several researchers gave radio and newspaper interviews concerning the goals of the Initiative.</p> <p>Paper in Pravda Daily Journal, 04.11.2014: Resort of Inner Affairs Does Not Understand What Science Needs, Academics Say (Director S. Hredzák was interviewed along with other representatives of SAS).</p> <p>P. Baláž was interviewed by Slovak Radio within the discussion on the initiative Science Wants to Live (26.11.2014)</p> <p>L.Ivaničová was interviewed by TASR (The News Agency of the Slovak Republic) for TV and print discussion within the initiative Science Wants to Live, as the main organizer of the public meeting organized in Košice. (27.11.2014).</p> <p>S. Hredzák was interviewed by TV Region about the issues of public protests at SAS on 28.11.2014.</p> |
| <p><b>Interview in Quark journal, 1.12.2014</b></p> <p>prof. RNDr. Vladimír Šepelák, DrSc. Quark journal paper “The Road to the Aim Is Important as Well”, paper in Quark journal 12/2014, p.18-19</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p><b>Seminar for chemistry and physics teachers “Basics of nanoscience and nanotechnology”, 03.02.2015, IGT SAS</b></p> <p>Six researchers of IGT SAS prepared the educational seminar “Basics of nanoscience and nanotechnology” for 11 chemistry and physics teachers at elementary and high schools of Eastern Slovakia region in cooperation with Methodic pedagogical center within their ESF project. Five lectures and presentation of the laboratories were focused on the issues of nanotechnologies and all their aspects investigated at the IGT SAS. (Baláž M., Baláž P., Hredzák, Kupka, Zubrik).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p><b>Science Café, SPOTS, Košice, 16.06.2015</b></p> <p>Science in Library, Slovakia Reads to Kids, Kulturpark, Košice, 05.06.2015</p> <p>I.Štyriaková presented “Use of Bacteria in Mineral Degradation” within the public discussion series of Science Café events in Košice.</p> <p>Lectures “Dust Around Us” and “Quartz Sands Cleaning by Bacteria” for the students of elementary schools, Kulturpark, Košice. (05.06.2015 Fedorová, Bekenyiová, Szabová)</p> <p>Lecture “Comparison of Selected Components of Atmospheric Depositions in Košice and Showcase of Dust Filters” for the students of elementary schools, Youth Library, Košice-Západ. (11.11.2015 Fedorová, Szabová)</p> <p>Lectures “Slovak Minerals and Ores” and “Work in Chemical Laboratory”. ( 24.11.2015 Znamenáčková, Szabová)</p>                                                                                                                                                                                                                                                                                                                                        |
| <p><b>Researcher’s Night, OC Optima, Košice, Slovakia, 25.9.2015</b></p> <p>11 researchers and PhD students promoted their research to many visitors of annual Researcher’s Night in Optima Shopping Mall.</p> <p><i>1.Hard Rock Party.</i> Different rock types were presented with interactive strength measurements. Acoustic effects of rock drilling. UV-fluorescence of minerals, rocks and fossils under black light was shown as well. (Ivaničová, Feriačiková, Kruľáková)</p> <p><i>2.Road to Nanoworld.</i> Mechanochemical reactor, milling chambers, mill balls and synthesis of nanoparticles were demonstrated. (Baláž M., Tešínský, Mrážiková, Bujňáková)</p> <p><i>3.Minerals in Nature and Lab.</i> Mineral resources of Slovakia, experiments with mineral separation, water and soil cleaning from mixed contaminants. (Znamenáčková, Dolinská, Kováčová, Zubrik)</p>                                                                                                                                                                                                                                                               |
| <p><b>Open Door Day, IGT SAS, 12.11.2015</b></p> <p>Open Door Day attracted students of three schools to IGT SAS, where the researchers presented the laboratories and research running at the Institute (Baláž, Dolinská, Znamenáčková, Lovás, Feriančíková).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

### 2.7.2. Table of outreach activities according to institute annual reports

| Outreach activities                                                                                                   | 2012 | 2013 | 2014 | 2015 | total |
|-----------------------------------------------------------------------------------------------------------------------|------|------|------|------|-------|
| Articles in press media/internet popularising results of science, in particular those achieved by the Institute       | 4    | 1    | 3    | 0    | 8     |
| Appearances in telecommunication media popularising results of science, in particular those achieved by the Institute | 3    | 1    | 7    | 0    | 11    |
| Public popularisation lectures                                                                                        | 6    | 2    | 5    | 12   | 25    |

- **Supplementary information and/or comments on popularisation activities, max. 300 words**

The Institute actively participates in popularization activities within the European Science Week in November by opening its laboratories during the Open Door Days, attracting students from elementary and high schools, universities and also wide public.

Every year, the exhibition kiosks of IGT SAS at European Researcher's Night at Optima Shopping Mall are very popular among the visitors, bringing them possibility to touch the real science.

Our researchers are invited to give public talks and join the discussions in TV and radio, and participate actively in the Science Café activities in Košice.

## 2.8. Background and management. Human resources and implementation of recommendations from previous assessment

### 2.8.1. Summary table of personnel

| Personnel                                                | 2012   | 2013   | 2014   | 2015   |
|----------------------------------------------------------|--------|--------|--------|--------|
| All personnel                                            | 60.0   | 63.0   | 62.0   | 62.0   |
| Research employees from Tab. Research staff              | 38.0   | 38.0   | 41.0   | 40.0   |
| FTE from Tab. Research staff                             | 34.310 | 36.290 | 37.410 | 38.220 |
| Average age of research employees with university degree | 41.7   | 40.6   | 41.3   | 41.7   |

#### 2.8.1.1. Professional qualification structure (as of 31.12. 2015) FEMALE

| FEMALE                      | AGE  |         |         |         |         |         |         |         |      |
|-----------------------------|------|---------|---------|---------|---------|---------|---------|---------|------|
| Number of                   | < 30 | 31 - 34 | 35 - 39 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | > 65 |
| DrSc. / prof.               |      |         |         |         |         |         |         |         |      |
| II.a / Assoc. prof.         |      | 1       | 4       | 1       | 4       | 3       |         |         |      |
| Other researchers PhD./CSc. |      | 6       | 4       |         |         | 1       | 1       |         |      |
| doc. / Assoc. prof.         |      |         |         |         |         |         |         |         |      |

#### 2.8.1.2. Professional qualification structure (as of 31.12. 2015) MALE

| MALE                        | AGE  |         |         |         |         |         |         |         |      |
|-----------------------------|------|---------|---------|---------|---------|---------|---------|---------|------|
| Number of                   | < 30 | 31 - 34 | 35 - 39 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | > 65 |
| DrSc. / prof.               |      |         |         |         |         | 1       |         | 1       | 2    |
| II.a / Assoc. prof.         |      | 2       |         |         | 2       | 2       | 1       |         |      |
| Other researchers PhD./CSc. | 1    |         | 1       |         | 1       |         | 1       |         |      |
| doc. / Assoc. prof.         |      |         |         |         |         |         |         |         |      |

### 2.8.2. Postdoctoral and mobility scheme

In 2014 and 2015 the project **FP7-PEOPLE-2013-IAPP WaSClean** has brought active transfer of knowledge (ToK) from academia to industry and vice versa between 8 project partners (4 academic and SME partners). ToK activities are carried out through secondments of researchers. All fellows are given complementary training and the opportunity to present their results at events organised by consortium as well as at international scientific events. Fellows from academia are given access to the SMEs facilities. They are introduced and trained in industrial processes in order to learn how to scale up technologies. After the secondment, fellows are reintegrated to their positions at home institutions and utilize their new knowledge. Till the end of assessment period 49 ToK secondments (15 from IGT SAS, 3 accepted to IGT SAS) were done to partner organisations in 4 countries (Kazakhstan, Greece, UK, Slovakia).

In October 2015, the WaSClean project has passed the Mid-term revision by REA and external specialist, where the WaSClean project consortium and its work progress has got very positive feedback and the project was rated among the excellent ones.

Long-term strategic links were established among all partners in the Consortium. The consortium agreed on joint IP ownership. New and complementary knowledge with immediate and long-lasting benefits was achieved within the Consortium.

One of the significant outreach activities of this project is the periodic organisation of the Workshop on Water and Soil Clean-up from Mixed Contaminants, with average attendance around 50 participants from both academic and industrial organisations. All of the above presented issues helped to deliver a possibility of sharing knowledge and culture of West-, East-, South-Europe and Central Asia.

#### **2.8.2.1. Postdoctoral positions supported by national and international resources**

Eight postdoctoral positions were supported by ERDF projects as introduced below. All full-time jobpositions cover a part of assessed period:

- [1] Ing. Katarína Štefušová, PhD. (1.3.2010 – 31.12.2012), ITMS code of ERDF project: 26220120038
- [2] Ing. Ján, Vereš, PhD. (1.10.2011 – 31.12.2012), ITMS code of ERDF project: 26220120038
- [3] RNDr. Zuzana Dakos, PhD., (01.10.2011 – 31.03.2012), ITMS code of ERDF project: 26220120064
- [4] Ing. Jana Jenčárová, PhD., (01.10.2011 – 31.08.2013), ITMS code of ERDF project: 26220120064
- [5] RNDr. Katarína Jablonovská, PhD., (01.01.2011 – 31.12.2013), ITMS code of ERDF project: 26220120064
- [6] RNDr. Eva Mačingová, PhD., (01.01.2011 – 31.12.2013), ITMS code of ERDF project: 26220120064
- [7] RNDr. Lenka Findoráková, PhD., (01.04.2012 – 31.08.2013), ITMS code of ERDF project: 26220120064
- [8] RNDr. Lenka Findoráková, PhD., (01.09.2013 – 31.07.2015), ITMS code of ERDF project: 26220220186

Based on financial sources in APVV project (APVV-14-0103) postdoctoral position has been awarded to RNDr. Matej Baláž, PhD., after successful defence of his PhD thesis for period 01.09.2015 – 30.06.2019.

Moreover, the APVV-252-10 project covered the salaries of following 5 postdoctoral research fellows: Jana Jenčárová (09/2013-10/2014), Oľga Šestinová (09/2013-11/2013; 04/2014-07/2014), Katarína Štefušová (04/2014-07/2014), Lenka Oroszová (08/2014-10/2014), Alena Luptáková (08/2014-10/2014).

#### **2.8.2.2. Postdoctoral positions supported by external funding**

none

#### **2.8.2.3. SAS stipends and SASPRO stipends**

In 2015, the IGT SAS took part in the preparation of two applications of SASPRO programme. Both applicants pass the threshold and were invited to final interviews.

The successful applicant Dr. Inna Melnyk (Ukraine) started to implement her SASPRO project on "Bi-functional Silica and Magnetite Spherical Particles with Tailored Porosity and Surface Chemistry for Complex Water Treatment" from March 2016.

#### **2.8.2.4. Internal funding - the Slovak Academy of Sciences Supporting Fund of Stefan Schwarz**

Several young researchers applied for SAS Supporting Fund of Stefan Schwarz in Assessed Period, and three of them received the funding:

1. Ing. Zuzana Danková, PhD. 01.01.2011 – 31.12.2015
2. RNDr. Martin Fabián, PhD. 01.06.2012 – 17.02.2016
3. RNDr. Matej Baláž, PhD. 01.01.2016 – 31.12.2019 (submitted in 2015)

#### **2.8.3. Important research infrastructure (max. 2 pages)**

Research infrastructure has been significantly improved by implementation of ERDF projects, which helped to raise new collaborations and initiate the project proposals and increase mobility of researchers. It is shared among the institutes of SAS, universities, PhD students and researchers coming from abroad working on joint research projects (Chapters 2.5.6). It has to be noted here, that the use of research infrastructure purchased mainly from ERDF projects is excluded from any commercial activities in terms of the ERDF regulations. Yet we do provide consultations and training for industrial partners within joint research projects and tasks.

In the following text, the devices purchased during the Assessed period have been marked as **NEW**.

##### **1. Elemental and mineralogical analysis**

- Atomic Absorption Spectrometer (Varian, Australia)
- Inductively coupled plasma mass spectrometer ICP-MS Agilent 7700 **NEW**
- Elementar Vario Macro Cube for CHNS analysis (Elementar Analysensysteme GmbH, Germany)
- TOC/TN analyzer Vario TOC Cube (Elementar Analysensysteme GmbH, Germany) **NEW**
- Trace and ultra-trace mercury analyzer DMA-80 Tricell (Milestone) **NEW**
- Portable mercury vapour analyser JEROME 431-X
- Spectro Xepos X-ray fluorescence spectrometer model XEPO3 (Spectro Analytical Instruments, Germany) **NEW**
- D8 Advance XRD diffractometer (Bruker, Germany)

##### **2. Microscopy and spectroscopy**

- Scanning electron microscope FE MIRA 3 (TESCAN, Czech Republic) equipped with energy dispersive and wavelength dispersive X-ray microanalysis system (EDX, WDX – Oxford Instruments) **NEW**
- Fluorescence microscope Leica DM 6000
- Optical microscope Nikon Eclipse 400
- UV-VIS spectrophotometer Helios Gamma (Thermo Electron Corporations, Great Britain)
- PC1 – Photon Counting Spectrofluorimeter (ISS, USA) **NEW**
- FTIR Spectrometer Tensor 27 (Bruker Optik GmbH, Germany)
- Portable spectrometer DR 1900 with thermal reactor DRB 200 (Hach Lange GmbH, Germany)

##### **3. Chromatography**

- Liquid chromatograph UHPLC Dionex Ultimate 3000 (Thermo Fisher Scientific Inc., USA) with DAD detector and mass spectrometer Q-TOF (micrOTOF-Q II™ Bruker Daltonics, GmbH, Germany)
- Two-channel ion chromatograph Dionex ICS 5000
- GC-MS gas chromatograph Agilent 7890A with mass spectrometer Agilent 5975C **NEW**

##### **4. Surface and particle size analysis**

- Surface area and pore size Analyzer Quantachrome NOVA 1200e (Quantachrome Instruments, USA) **NEW**
- Gemini 2360 (Micromeritics, USA)
- Zetasizer Nano ZS (Malvern, Great Britain)
- Diffraction Spectrometer Helos 12 LA with a wet dispersion unit Rodos (Sympatec, Germany)
- Nanophox Particle Sizer – Photon Cross Correlation Spectrometer (Sympatec, Germany)

- Particle size, volume and number distribution analyzer Beckman Coulter® Multisizer IV (Beckman Coulter, USA) **NEW**

## **5. Thermal analysis and processes**

- Thermal analyzer STA 449 F3 Jupiter and mass spectrometer QMS 403 C Aëolos (Netzsch, Germany) **NEW**
- Laboratory tube oven operating at different atmospheres (maximum temperature 1200 °C)
- Muffle oven CE-4 (maximum temperature 1150 °C)
- High-temperature laboratory chamber furnace VP 02/16 (LAC, Czech Republic)

## **6. Biotechnology and molecular biology**

- Microfluidic chip bioanalyzer Agilent Bioanalyzer 2100 **NEW**
- Real-Time PCR (Q-PCR) system Light Cycler 2.0 Roche
- Electrophoresis for the PCR products separation
- Gel documentation system
- BBL Crystal Bacterial Identification System (Becton-Dickinson, USA)
- SureCycler 8800 Thermal cycler (Agilent), Thermal cycler Techne
- Flow-through respirometric equipment for the measurements of metabolic activity with paramagnetic oxygen analyzer PA-10A (Sable Systems, USA), carbon dioxide analyzer with IR sensor (Sable Systems, USA) and eight-channel gas multiplexer RM-8 (Sable Systems, USA)
- Bioreactors – anaerobic and aerobic bacterial cultivation, biological thermostats
- Laboratory autoclave Tuttnauer, aseptic box Biosan, aseptic box Fatran

## **7. Magnetic Properties Analyses**

- Kappabridge KLY-2 for magnetic susceptibility measurements (Geofyzika, Czech Republic)
- Dielectric permittivity measuring instrument MP-1 with generator HM8135 3GHz HF Synthesizer and Spectrum Analyzer HM 5530

## **8. Geotechnics**

- experimental horizontal laboratory drilling rig for rotary drilling of rocks with bits of diameters up to 70 mm with automated systems of control and monitoring, designed and constructed at the IGT SAS
- 4-channel dynamometer and multichannel amplifier Kistler for multi-component force measurement during drilling (3 force components and torque)
- accelerometers and automated system Adash 3900-II for monitoring of the vibration acceleration during drilling, installed on the drilling rig
- experimental press INSTRON 1000 RD (load up to 5 MN) for testing the strength and deformation characteristics of rocks **NEW**
- Point Load Tester PLT-100 (GCTS) for measurement of the point load strength of rocks
- Schmidt hammer SilverSchmidt PC/N (Proceq) for measurement of rock rebound hardness
- abrasionmeters (CERCHAR by ErgoTech), ON 441121 of own construction, LCPC of own construction,
- circular saws, grinders and sanders for the preparation of rock samples

## **9. Mineral Processing**

### **9.1 Crushing, Milling and Classifying**

- Planetary mills Pulverisette 7 Premium Line (Fritsch, Germany) **NEW**
- Planetary mill Pulverisette 6 Classic Line (Fritsch, Germany)
- Stirred ball mill Attritor Molinex PE/075 (Netzsch, Germany)
- Circulation mill MiniCer (Netzsch, Germany)
- Cryomill Freezer Mill SPEX 6870 (CertiPrep, USA)
- Jaw crusher PS D-160, roll crusher, laboratory biomass crusher FDV
- Vibrating jaw grinder VCM-3
- Jewel vibrating pulverizer KM-1
- Universal laboratory ball and bar mill LP (porcelain, metallic), attrition mill, vibrating mill VM-1 (KSMH-Hranice)
- Air classifier Alpine 100MRZ, vibrating classifier TE-III
- Sample splitters RT 6.5 (Retsch)
- Vibratory sieve shaker AS 200 (Retsch), different mesh size of sieves from 40 µm to 50 mm, mesh size of sieves for microclassifying in ultrasonic bath from 5 to 45 µm

## 9.2 Physical Separation

- Pilot hydrocyclone station
- High-intensity magnetic separator MECHANOBm, low-intensity magnetic separator LAURILA, universal laboratory magnetic separator JONES
- Magnetohydrostatic separator MHR-1 (separation in ferrofluid)
- Magnetohydrostatic separator FGS-2 (separation in ferrofluid)
- Electrostatic corona separator STURTEVANT – O.H.

## 10. Devices For Particulate Matters Sampling And Analysis

- Programmable automatic samplers for sampling of particulate matter (PM10, PM2.5, TSP) and pollutants in ambient air (Digitel DH77, Echo High Volume Tecora, Leckel MVS6, Bravo Tecora PM) **NEW**
- Personal samplers for air sampling in the working environment (Apex Casella)
- Portable laser aerosol spectrometer Grimm 1109 **NEW**

### 2.8.4. Description of how the results and suggestions of the previous assessment were taken into account

In the previous assessment (2008-2011) Institute obtained “B” category. In order to improve the IGT SAS position to category “A”, the management body carefully revised the situation and together with Scientific Board of IGT SAS established the new procedure for:

- annual evaluation of scientific outputs of researchers, where priority is given to publication activity, citations, project proposals, teaching activities, collaborations with industry, popularization, presentations, reviews of proposals and scientific articles;
- supporting the international collaboration;
- supporting of FP7, H2020, NATO, COST, APVV and other proposals;
- supporting the collaboration with industry and of transfer of knowledge between industry and academia;
- organizing the annual seminar of PhD students in English to improve the communication and presentation skills of research community;
- supporting international mobility;
- motivating young researchers to apply for prestigious international individual fellowships.

As documented throughout the whole Questionnaire, the Institute of Geotechnics SAS achieved the results on appropriate international level comparable with similar institutions worldwide. Compared to previous assessment, beside the Mechanochemistry group at least three other research departments increased significantly their research outputs, which were delivered in the fields of mineral processing, mineral biotechnologies and environmental technologies.

Publishing activities of IGT SAS in journals registered in CCC reached 91 papers, where 56% was generated by Department of Mechanochemistry, 24% by Department of Physical and Physico-Chemical Methods of Mineral Processing, 13% by Department of Mineral Biotechnologies, and 6% by the Department of Environment and Hygiene in Mining. In other categories of scientific publications, the results of all departments are comparable with minor prevailing of the Department of Mineral Biotechnologies. In previous assessment period Department of Mechanochemistry covered almost 76% of CCC outputs. Current shares on outputs confirm the successful implementation of new management policy of IGT SAS diminishing the discrepancies between research groups.

### **Suggestions of previous assessment:**

**Comments, objections to organization's activities in form of suggestions and specific tasks which must be performed by organization before next regular evaluation, etc.**

- 1) Redirect adequate research activities towards recycling according to EU priority. Adequate knowledge of the institute in this field is well demonstrated.
- 2) The panel recommends to learn from success cases from other institutes in applications for the EU projects.
- 3) Improve significantly the activities to transfer knowledge to industry.
- 4) Special care should be given to use the new equipments effectively, both from the point of view of managing them personally and finding some new attractive and perspective research problems.
- 5) Acquired laboratory infrastructure should be open to other research institutes and industrial partners.

Approved in Bratislava, October 5, 2012

1. *Redirect adequate research activities towards recycling according to EU priority. Adequate knowledge of the institute in this field is well demonstrated.*

Recycling as one of top issues of EU strategy, has been a substantial focus of IGT SAS research in the assessed period. We have to think of recycling as a re-introduction of used resources back to further utilization. IGT SAS has devoted many efforts to remediation of contaminated areas from old mining loads in Slovakia, covering the investigation of heavy metals recovery from acid mine drainage, investigation of technology for water and soil clean-up from mixed contaminants.

In Slovakia, critical environmental loads involve old dumps and reservoirs of residues after mineral and metallurgical processing, which still contain considerable concentrations of metals such as Fe, Al, Cu, Pb, Zn, Cr, Ti, V, Sb, Ga, In, and rare earth elements (REE). Currently, the remediation of dumps only involve their covering with grass or fast-growing trees on the surface, which however does not eliminate these dumping sites as ecological time-bombs. Our research in this field has been focused on investigating the possibilities and technologies for secondary processing of such hydrometallurgical wastes with a view to acquire the metals in reasonable form for further processing/re-use.

In recent years one can register the changes in approach of EU authorities towards the use of national and European raw materials, which turned into one of the first 4 priorities of EU (raw materials, health, climatic changes, information technologies), which should deliver self-sufficiency of EU in raw materials. Currently, the EU member states depend on import of raw materials, omitting the use of national primary resources, and processing of by-products and mineral wastes as secondary resources. In 2015, IGT SAS took part on project application within the H2020-SME Instrument on "First Europe's Producer of Iron Pellets from Red Mud".

In accordance with new policy of European Union „New Approach of EU in the Use of Natural Resources – Strategy on the Sustainable Use of Natural Resources“, the Institute focused back on our traditions in mineral processing, mining-related environmental issues and rock disintegration. Current potential of non-renewable resources of Slovakia resides mainly in deposits of carbonates and silicates (magnesite, dolomite, limestone, talc, sands, clays, etc.). The main drawbacks of their use are the outdated processing technologies, which imply insufficient finalization thus lowering the diversification of their further use. Due to low measure of the finalization they represent significant export article. The Institute as a member of VRP (see Chapter 2.5.6 and 2.6.3.) initiated the research of projects of mining and metallurgical waste and by-products, which are considered the new raw materials resources of the future.

The list of projects concerning the issues of recycling and remediation is shown throughout the Chapter 2.4.

2. *The panel recommends to learn from success cases from other institutes in application for the EU projects.*

New connections and invitations to international project consortia helped to raise the motivation of IGT researchers to put major efforts for submitting 11 FP7/H2020 project proposals (as documented in the Table 3.2, and in the list of submitted unsuccessful projects in the Chapter 4). Since 2013, young researcher Dr Vaclavikova has become the coordinator of the project WaSClean FP7-PEOPLE-2013-IAPP with 4 academic and 4 industrial partners from 4 countries across Europe and Central Asia. Every even unsuccessful application comes back with detailed feedback from thus helping the IGT's applicants to improve their project writing skills and to encourage them to re-apply improved proposals again.

3. *Improve significantly the activities to transfer knowledge to industry.*

Activities of the Institute in transfer of knowledge have increased significantly. Five major applied research projects were induced directly from industrial partners (1 from Slovakia, 4 foreign companies – USA, Chile, Japan, see Chapter in 2.6.1.).

Due to remaining problems after financial crisis, the Slovak companies usually do not support the applied research projects with large financial requirements, however it is inevitable for us to stay in active contact and deliver expert analyses, reports, consultancy and services (see Chapter 2.6.3.). IGT SAS has good reputation among the companies active in underground construction, mining, chemical engineering, electrotechnics, which forms a sound base for future collaboration in larger projects.

Long-term cooperation with company Environcentrum, s.r.o., Košice has resulted in successful application for joint research project of FP7-PEOPLE-2013-IAPP/612250 Water and Soil Clean-Up from Mixed Contaminants, bringing on board 3 other industrial partners (nanomaterials producing company MAST Carbon International, Basingstoke, UK; textile dyeing factory HERMES S.A., Thessaloniki, Greece; construction and recycling company Ekodor LLC, Temirtau, Kazakhstan). The WaSClean project is based mainly on transfer of knowledge from industry to academia and vice versa and it delivered so far 15 secondments of IGT fellows to the above-mentioned companies and 3 seconded fellows from companies to the institute (see Chapter 2.3.1.).

Transfer of knowledge is determined not only by the actual activity of the Institute, but also by active approach of potential industrial partners. Within Slovakia, there are only few possibilities for such cooperation in the area of mining-related companies. Usually, the mining companies are quite cautious and not very willing to invest into development of new technologies of mineral processing due to difficulty to open new mining projects in Slovakia. It is however anticipated that with new policy on raw materials and new mineral policy of Slovakia, the legislation for terminating the attenuation of mining in Slovakia will be revised.

IGT SAS is an active member of VRP (see Chapter 2.5.6 and 2.6.3.) and thus we have been regularly invited by mining and industrial companies for formation of consortia and preparation of project proposals for next programme period of ERDF funds.

4. *Special care should be given to use the new equipment effectively, both from the point of view of managing them personally and finding some new attractive and perspective research problems.*

Excellent structure of laboratory equipment, which has been built-up by substantial contribution of ERDF projects (2.3.1.) for recent 8 years, provided the Institute with a higher chance to enter new international and national consortia. This has been manifested so far by increase of publications quality and in increased number of submitted project proposals. New research problems and new PhD themes were raised immediately after purchase of the infrastructure. This induced also several changes involving new research tasks in the Research Scope of the Institute approved by the Scientific Board.

Apart from supporting the purchase of infrastructure, the ERDF projects also enabled to cover the salaries of 8 postdoc positions along with other 6 postdocs supported by APVV projects, which helped to secure the operation of new devices: training of young researchers in gaining skills for operation of the new research devices. Often, the access to high-tech devices was a motivation for young researchers to stay at the Institute after their PhD and to encourage them in their research careers.

*5. Acquired laboratory infrastructure should be open to other research institutes and industrial partners.*

Several joint research laboratories were created during the assessed period, such as 4 laboratories within the PROMATECH consortium, 1 TEM laboratory and VRP (see detailed descriptions in Chapter 2.5.6. and 2.6.3.). These laboratories provide direct sharing of research infrastructure among universities and industrial partners, giving access to all members of the consortia. Sharing of research infrastructure, purchased mainly from ERDF projects, is however complicated with industrial partners, as it is excluded from any commercial activities in terms of the ERDF regulations. Yet we provide consultations and training for industrial partners within joint research projects and tasks.

All IGT laboratories are also open for international cooperation with high mobility of scientists from and to the Institute (see list of foreign collaborating institutions and companies in Supplementary information to Chapter 2.4.). Geotechnical laboratory and unique experimental drilling rig are accessible for students and teachers of Faculty of Civil Engineering as well as Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University in Košice.

- **Supplementary information and/or comments on management, research infrastructure, and trends in personnel development**

## **Management**

Institute of Geotechnics SAS changed its management after elections of director in 2014. The new directoriat is shown in Table 1.3. Due to limited salary budget, 10 experienced researchers had to retire mainly in 2012 and 2013, which caused a certain generation gap. However, this enabled to attract young researchers and postdocs, and so the IGT SAS remained one of the “youngest” institutes of SAS with average age of research staff only 41.3 years of age.

ERDF projects delivered substantial financial support for 8 post-doc positions, combined with six other post-doc positions supported by SRDA/APVV and two post-docs supported by SAS Fund of Stefan Schwarz (see 2.8.2.1-2.8.2.4.).

The migration of staff using various mobility schemes, such as inter-academic agreements (MAD), bilateral mobility projects SRDA/APVV, DFG and DAAD fellowships, national NSP and SAIA stipends provided especially the young researchers with chance to get involved in top research at foreign institutes and universities and thus to acquire new skills and train their communication and presentation of the outcomes, nevertheless to improve their English as well.

FP7 project WaSClean supported the exchange of staff between the academic organizations and industrial partners, providing 15 secondments from IGT SAS and 3 received fellows from industrial partners, within the assessed period (see 2.4.1.).

In 2012, newly elected Scientific Board of IGT SAS started new method of annual assessment of researcher's activities, which is now based not only on their publishing activity, but also considers other aspects of scientific work: project involvement, writing of project proposals and involvement in projects, education and pedagogical activity, elaboration of expert reports, reviews, involvement of industrial contracts, popularization, and other activities beneficiary for the institute. This helped substantially to appreciate the whole-year work of all research staff.

## **Trends in personal development**

All researchers are supported and encouraged to increase their qualification by promoting to higher qualification degrees. Five young researchers received the Senior Scientist degree (IIa by SAS), eight PhD students defended their dissertation theses.

**Qualification improvement** is documented in the following list:

### **2012**

- RNDr. Martin Fabián, PhD. - Senior Scientist IIa at SAS
- Ing. Oľga Šestínová - PhD. – joint PhD. study at IGT SAS and Faculty of Metallurgy, Technical University of Košice
- Mgr. Matej Baláž – RNDr. at Faculty of Sciences UPJS, Kosice

### **2013**

- doc. RNDr. Jaroslav Briančin, CSc. – Professor at Faculty of Metallurgy, Technical University of Košice
- Ing. Zuzana Danková, PhD. – Senior Scientist IIa at SAS
- RNDr. Anton Zubrik, PhD. – Senior Scientist IIa at SAS
- Janette Žáková – Bc. at Faculty of Metallurgy, Technical University of Košice
- Ing. Veronika Kmecová – PhD., Faculty of Civil Engineering, Slovak Technical University, Bratislava
- Mgr. Zdenka Bujňáková – PhD., joint PhD at IGT SAS and Faculty of Metallurgy, Technical University of Košice
- Ing. Mária Kruláková – PhD., Faculty of Mining, Ecology, Process Control and Geotechnology, Technical University of Košice
- Bc. Miroslava Nosáľová – Ing. at Faculty of Mechanical Engineering, Technical University of Košice

### **2014**

- RNDr. Lenka Findoráková, PhD. – Senior Scientist IIa at SAS
- RNDr. Erika Turianicová, PhD. – Senior Scientist IIa at SAS
- Mgr. Lenka Oroszová – PhD., joint PhD study at IGT SAS and Faculty of Metallurgy, Technical University of Košice
- Ing. Tomáš Schütz – PhD., joint PhD study at IGT SAS and Faculty of Metallurgy, Technical University of Košice

### **2015**

- RNDr. Matej Baláž – PhD., joint PhD study at IGT SAS and Faculty of Metallurgy, Technical University of Košice
- Mgr. Ingrida Kotuličová – PhD., joint PhD study at IGT SAS and Faculty of Metallurgy, Technical University of Košice
- Zuzana Szabová - Bc. at at University of Central Europe, Skalica
- Bc. Janette Žáková – Ing. at Faculty of Metallurgy, Technical University of Košice

## **Research infrastructure**

In the assessed period, IGT SAS has successfully used its chance to improve the research infrastructure by substantial financial support of ERDF projects (2.8.3.). The Institute also applied for H2020 projects, and recently, as the new program period for ERDF funds started and calls focused mainly on raw materials and mineral resources were only published in 2015 and 2016, we already applied for several projects, which after successful competition would support the purchasing of new research infrastructure heavily.

Two issues to solve however remain: active search and applying for projects that might deliver financial support for cost-consuming operation of new high-tech devices, and searching for financial sources for supporting the salaries of highly-skilled personnel for operation of research devices.

### **3. Research strategy and future development of the institute for the next five years (2016-2020)** (Recommended 3 pages, max. 5 pages)

#### **3.1. Present state of the art in both the national and the international contexts**

After the regression in mining industry and severe budget cuts (in early 1990s, when revealed from communism), the IGT SAS had to revise its position at the national, European and world research area, as well as its business opportunities on highly competitive market. Thus, the IGT SAS carefully identified its priority areas connected to the traditional mining and mineral processing disciplines, and it has begun the transition to the new “more sexy” research activities such as:

- tunnelling and underground constructions,
- environmental remediation of mining and industrial areas,
- material development for environmental applications,
- mechanosynthesis and mechanochemical activation of materials for environmental, energy, and medicine applications ,
- water and soil clean-up technologies,
- biotechnologies for mineral processing, separation and remediation processes, stabilization of solid wastes.

Nowadays, only after two decades **IGT SAS claims the stable and strong position with sustainable growth** on both national and international level. This could only happen by substantial external funding brought by research teams and/or individual researchers. External funding mainly from ERDF, FP7 and APVV funds are inevitable for Institute's existence. In current assessment period only about 50% was funded from state budget and 50% was funded from external sources. Moreover the growing interest of national and international industries has been recorded in last four years (see chapter 2.4), which indicates that the approach of IGT SAS has got a right direction and thus the research activities mentioned above will be the main Institute's R&D activities in next four years as well. The Institute's highly skilled research staff, experienced leaders and high-tech infrastructure ensures the success of IGT SAS in extremely competitive European research area, especially in future H2020 applications. Moreover, growing demand on the R&D activities with SME industries is expected as well.

#### **3.2. Research strategy of the institute in the national and the international contexts, objectives and methods**

| <b>Project proposals submitted to 7RP or H2020</b> | <b>2012</b> | <b>2013</b> | <b>2014</b> | <b>2015</b> |
|----------------------------------------------------|-------------|-------------|-------------|-------------|
| <b>Institute as coordinator</b>                    | 0           | 1           | 0           | 0           |
| <b>Institute as participant</b>                    | 4           | 1           | 1           | 4           |

In November 2013, the Government of Slovakia published the document on Smart Specialisation Strategy for the Slovak Republic (the RIS3 document). The RIS3 document is the national research and innovation (R&I) strategy for 2014-2020. Its main objective is to boost the innovation potential of Slovak economy via enhanced collaboration of industries with research organizations. The specified priority research areas of RIS3 Slovakia are:

- Material research and nanotechnologies
- Information-communication technologies
- Biotechnologies and biomedicine
- Agriculture and environment, including environment-friendly modern chemical technologies
- Sustainable energy

The interdisciplinary background of IGT SAS ensures the ability to take part on the collaborative research defined by RIS3. In July 2016, the IGT SAS already participated on two project applications with industry within the recent ERDF calls for projects: 1. “Development of R&D

Centre of Raw Materials” coordinated by GreenView, s.r.o. Bratislava and 2. “Development of R&D Centre of Advanced Methods for the Removal of Persistent Organic Pollutants from the Environment” coordinated by Environcentrum, s.r.o. Košice.

Beside that, the research priorities of IGT SAS are in line with the „ **New Approach of EU in the Use of Natural Resources – Strategy on the Sustainable Use of Natural Resources**“. The Institute is also a partner of Development and Realisation Workplace of Raw Materials Extracting and Treatment (VRP), as well as a partner of National Platform for Research, Development and Innovations of Resources (a member of The European Technology Platform on Sustainable Mineral Resources), which strongly supports the collaboration with industry and prepares several projects mainly within the ERDF and H2020 calls.

The Research Strategy of the Institute has been published by Scientific Board of IGT SAS in the document “Research Focus of the IGT SAS 2014-2017”. In 2017 Scientific Board of IGT SAS will prepare a new research strategy for the period 2018-2021 with the main objectives in line with priorities defined in RIS3 and Europe 2020 documents.

As mentioned above, the Institute performs the interdisciplinary research supporting the intensive collaborations across all departments. In order to secure sustainable growth in long-term scale, the managing body of the institute carefully identifies (every year) the strong and weak points (SWOT) of the research community and tries to fill the gaps in skills by opening new PhD positions and /or new Post Doc positions as well as improve training to gain language, presentation, leadership skills of researchers along with the improvement of research infrastructure. Moreover, researchers and PhD students are assessed annually not only by their publication activities, but by covering all aspects of their scientific activities (publishing, responses, project involvement and proposals, education, contracts, popularization, etc.).

In particular, the overview of the future research activities of IGT SAS is defined across the main research areas of the Institute.

#### **Priority objectives and methods include:**

##### **1. Material research and nanotechnologies**

- synthesis of new nanomaterials including multifunctional composite micro/nano materials for various applications – environmental applications (adsorbents for water and soils clean-up), electronics (semiconductors and photovoltaic/solar cells), sensors, medical applications (drug delivery, cancer therapy), cosmetics, chemical and many more special purposes;

##### **Methods:**

- controlled partial hydrolysis, precipitation, organic synthesis, chemical vapor deposition;
- mechanochemical synthesis – reduces the number of technological steps, excluding the operations that involve the use of solvents and gases and the possibility of obtaining a product in the metastable state which is difficult or impossible to obtain using traditional technological methods;
- power ultrasound synthesis - ultrasonic hydrothermal synthesis for composite development and better distribution of nanoparticles inside the porous materials as well as for more effective time and energy processes;
- pyrolysis, microwave pyrolysis
- biogenic synthesis- synthesis of biogenic monometallic and/or bi-metallic nanoparticles, which employs non-toxic reactants derived from the biological sources ranging from unicellular organisms to higher plants;
- full material characterisation;
- lab scale testing of materials for environmental, medical and other applications, testing of biocompatibility, adsorption capacity, life time, etc.
- investigation of fate and migration of engineered nanoparticles in the environment.

##### **2. Mineral processing, hydrometallurgy and waste utilization**

- separation of minerals from ores by classical mineral processing methods;
- microwave assisted mineral processing
- leaching of metals from concentrates, mechanically activated minerals, wastes and raw materials;

- recovery of critical minerals from environmental loads after mining, metallurgy and coal-fired power industry;
- recovery of metals from industrial wastes;
- stabilisation of solid wastes such as fly ash etc.

Methods:

- crushing and grinding, magnetic, magnetohydrostatic, electrostatic, and hydrocyclone separation, flotation;
- extraction – conventional leaching, microwave extraction, bioleaching, electrochemical leaching;
- mechanochemical activation of minerals and raw materials.

### **3. Environmental technologies:**

- development and/or scale-up of comprehensive technology for the remediation of contaminated land from representative heavy metals, persistent organic pollutants (POPs) and synthetic dyes – specifically developing novel Fe/Cu/carbon clean-up devices, as well as utilising sulphate-reducing bacteria (SRB), sulphate-oxidising bacteria (SOB), iron sulphate-oxidising bacteria (FeSOB) and advanced oxidation techniques for treatment of contaminated land and waters.
- monitoring of contaminated soils and sediments in the areas loaded by the industrial and historical mining activities

Methods:

- development of novel sorbent materials by incorporating Fe and Fe/Cu nanoparticles (NPs) into activated carbon (AC) hosts with good sorption affinity for both metals and organic pollutants;
- study and optimization of the sorption parameters of the novel sorbents for efficient removal of emerging organic contaminants (POPs and synthetic dyes) and metallic pollutants first at lab-scale and then in situ from soils and groundwaters;
- degradation of non-bio-degradable recalcitrant organic contaminants (i.e. synthetic dyes) by advanced oxidation techniques;
- determination of pollutants by advanced analytical techniques
- risk, sustainability and environmental impact assessment

### **4. Mineral biotechnologies**

- research of biogeochemical processes related to weathering of the earth crust, mineral transformation, element cycle and formation of mineral deposits; impact of microbial activity on the performance of deep geological repositories for used nuclear fuel and other toxic wastes
- geomicrobiology research of the rock environment of underground hydrogen storage and the impact of methanogenic microbial communities on gas deterioration
- application of bacterial oxidation-reduction processes in reuse of the earth resources and wastes and in environmental protection;
- biosorption and bioprecipitation of toxic metallic species from soils and groundwaters;
- biodegradation of representative POPs by mixed microbial populations;
- biodeterioration/ biodegradation related to material research of biodegradable plastics, and bio-corrosion of building and construction materials

Methods:

- conventional and molecular biology in assessment of biodiversity of observed ecosystems;
- implementation of sophisticated analytical instruments of high resolution and accuracy in monitoring the environmental components in order to improve the life quality and health protection of population.
- toxicity and biodegradability assessment of the contaminants and their degradation/transformation products

## **5. Geotechnics**

- study of rock cutting process by rotary drilling, sawing and TBM excavating;
- assessment of interaction of tool-rock and energetic interpretation of strength properties of rock mass;
- definition of rock drillability as a physical property;
- monitoring and optimization of rock cutting processes;
- study of the accompanying vibration and acoustic signal for the optimization of rock cutting process.

### **Methods:**

- experimental studies on the laboratory drilling rig with the monitoring of input and output data, including vibration and acoustic signal;
- collection and evaluation of data sets of technology, strength and deformational parameters for drillability definition
- application of the means of artificial intelligence, fuzzy methods, statistical mathematics, frequency analysis and black box method in rock cutting;
- elaboration of physical interpretation of selected rock characteristics
- application of the patterns of fracture mechanics into rock mechanics in rock cutting processes.

## **Summary of main highlights for the sustainable growth of IGT SAS**

- Increase the activity of leaders and individual researchers in project applications within the H2020, ERDF, APVV, NATO, COST, etc;
- Encourage young and experienced researchers to apply for prestigious individual fellowships within the H2020 Marie Skłodowska-Curie Action, ERC scheme, Fulbright fellowships, Humboldt fellowships, DAAD, National Scholarship Programme of SR, etc;
- Support the international mobility of researchers to establish new research contacts and collaborations;
- Search for funding to create a new Post Doc positions;
- Motivate and encourage researchers to increase their qualification by promoting to Professor (prof.) and/or Doctor of Sciences (DrSc);
- Motivate researchers to protect the intellectual property and apply for patents;
- Develop the IPR policy of the Institute.

#### **4. Other information relevant for the assessment**

The Institute of Geotechnics of Slovak Academy of Sciences, although included in SAS Section I: Technical Sciences, is more oriented to the field of Earth sciences. Dominant part of the research is focused on mineral exploitation, processing and utilization of Earth resources. According to the ranking agency ARRA 2012, the research scope of the IGT SAS is distributed in the following scientific fields: 30% - Geosciences; 20% - Environment; 20% - Chemistry; 20% - Materials Science; 10% - Biology and Biochemistry.

The activity of Institute in this four-year assessment period (2012-2015) compared with the previous accreditation period (2008-2011) raised significantly in most indicators. **The number of publications in CC journals increased by 55%, the WOS citations by 70%, the number of SCOPUS citations by 103%. The amount of funding obtained from the international scientific projects increased by 93%.**

Rate of success of young researchers activities has increased dramatically compared to previous period: Dr. Miroslava Václavíková was granted funding for two major projects: NATO SPS project in 2012, and the FP7-WaSClean project in 2013.

Several young researchers were recognized by various awards (see complete list in Supplementary information to Chapter 2.2: Dr. Martin Fabián was awarded by the Price of Ministry of Education “Young Researcher’s Award” for Development of Mechanochemistry in Synthesis of Metastable Nanocrystalline Oxides, in 2012. Dr. Zuzana Danková received Commemorative Letter of the Minister of Education, awarded for young R&D researchers under 35, in 2013.

It is important to emphasize that the huge amount of work of all researchers related to the preparation and writing of project proposals involves tremendous administration and financial management load. Nowadays, due to a lack of personnel in administration as well as significant lack of budgets, researches had to become also project managers, accountants, HR managers and often even lawyers, which consumes a lot of their time and energy, which in long term may result in loss of interest and drop of scientific outputs.

Many of submitted projects were successful and granted; however still many of them received high rank (90-95%) and even they easily passed threshold they did not receive funding. Efforts of these researchers are highly appreciated as well. Thus, the list of unsuccessful project proposals is given below:

- [1] FP7-NMP-2012-LARGE-6 “Nanoparticles Sensorization during the in-situ soil remediation”, Proposal No: 310150-1 NANOSENS CP-IP, Coordinator: TEKNIKER, Spain.
- [2] FP7-PEOPLE-2012-IAPP “Advanced Technologies for Clean-up of Soils from Xenobiotics”, Proposal No: 324540 XenoClean, Coordinator: Aristotle University of Thessaloniki, Greece.
- [3] FP7-PEOPLE-2012-ITN “Interface Science in Mineral Processing and Mineral Bioprocessing”, Proposal No: 317071 INTERFACES. Coordinator: Luleå University of Technology, Sweden.
- [4] FP7-PEOPLE-2013-IEF „Structure-Properties Relationship in Mechanochemically Synthesized Oxides“, individual fellowship, coordinator: KIT, Germany
- [5] FP7 - Research & Innovation, Research Fund for Coal and Steel : „Novel Approaches to Lowering Air Emissions from Sinter Plants“, Cooperation: INCAR Spain, Arcelor Mittal Spain, FLSMidt Denmark, IGT SAS .
- [6] Horizon 2020: SC5-11a-2014 "Sustainable Mining And Recovery Technologies for Critical Raw Materials in Europe", Coordinator: Universtità di Roma “La Sapienza” Italy.
- [7] Horizon 2020: SC5-11e-2015 "The Innovative, Zero-waste Production of Phosphoric Acid using Hydrochloric Acid and the Valorisation of Phosphogypsum Wastes", Coordinator: Universtità di Roma “La Sapienza” Italy.
- [8] Horizon 2020: H2020-MSCA-ITN-2015 “Interface Science in Mineral Processing and Mineral Bioprocessing”, Topic: MSCA-ITN-2015-ETN), Proposal No: 676277 INTERFACES, Coordinator: Norwegian University of Science and Technology, Trondheim, Norway.

- [9] Horizon 2020: H2020-MSCA-RISE-2015 "Nanoporous and Nanostructured Materials for Medical Applications", Topic: MSCA-RISE-2015), Proposal No: 691123 NANOMED, Coordinator: University of Alicante, Alicante, Spain.
- [10] Horizon 2020: Research Fund for Coal & Steel: „Innovative Management of COAL BY-PRODUCTS Leading also to CO<sub>2</sub> Emissions Reduction - COALBYPRO", Coordinator: Centre for Research & Technology Hellas (CERTH).
- [11] Programme: CIP Eco-innovation Call identifier: CIP-EIP-Eco-Innovation-2012 "Wastewater Treatment Using Bionanomagnetite", Proposal No: 608089 Bionanomag. Coordinator: Italveco srl., ITALY
- [12] COST – „European network on understanding biogenic sulfuric acid impact on sewer pipe materials durability", Coordinator: IGT SAS
- [13] COST OC 2015-1-19345 „Solution for Critical Raw Materials Under Extreme Conditions“, Coordinator: Universita Politecnica delle Marche, Ancona, Italy.
- [14] Project BMBF, IB-COMSTRUC-010 „Industrial production of metal sulphides by mechanical activation in vibration mills“, 2015-2017. Cooperation: IGT SAS, TU-Clausthal, Germany.
- [15] ERDF/ASFEU: OPVaV-2012/1.1./01-SORO, (NFP 26210120063) „Enhancement of Quality of Research at IGT SAS by Modernization of Technical Infrastructure“.
- [16] ERDF/ASFEU: OPVaV-2013/1.1./02-SORO, (NFP 26210120099) „Improvement of Quality Research at IGT SAS by Modernization of Technical Infrastructure“.
- [17] Bilateral SRDA/APVV Project SK-UA-2013-0003 "Nanostructural Mechanichemically Modified Compounds of Arsenic with Anti-Cancer Effect: from Ab-Initio Quant-Mechanical Models to Experimental Verification".
- [18] Project of EU strategy for the Danube Region - START-Danube Region Project Fund "Strengthening of Danube Region Strategic Partnership in Advanced Nanomaterials Research".
- [19] Project of Visegrad Fund "V4 – Waste Recycling", 2013, Coordinator: IGT SAS, Partners: VSB-TU Ostrava, Czech republic, Technical University in Miskolc, Hungary, AGH Krakow, Poland
- [20] Project SASPRO: "Application of Microwave Energy in Metallurgical Waste Treatment". 3<sup>rd</sup> Call of SASPRO project, funded by SAS, cofunded by FP7-MCA-609427.
- [21] Bilateral SRDA/APVV project SK-UA-2013-0043 "Multifunctional Magnetic Adsorbents for Water Treatment and Cleaning".
- [22] DAAD-PPP Fellowship „Mechanosynthesis, Structure and Functional Behavior of Li-based Silicate Nanomaterials“
- [23] MAD SK-BG "Mechanochemical Synthesis - an Ecological Friendly Process in the Production of Materials for Photocatalytic Air and Water Purification".
- [24] APVV SK-PL-0055-12 „Diversification Evaluation of Contaminated Sediments and Sludges by Phytotoxic tests“.
- [25] APVV SK-CN-0030-12 „ Microwave Energy Application in Metallurgical Waste Treatment APVV-SK-SRB-2013-0035 „Mechanochemical Synthesis of Doped Sulfur Dioxide and Study Their Physical-Chemical Properties“.
- [26] APVV-SK-BG-2013-0011 „Photocatalytic Treatment of Contaminated Water and Air Using Nanomaterials“.
- [27] APVV-0706-12 „Global Monitoring for Efficient Estimation and Response of Emergency Situations During the Combustion of Coal and Biomass“.
- [28] APVV-0482-12 „Application of Spectroscopic and Electrochemical Methods for the Determination of Potentially Toxic Substances for the Principles of Green Chemistry“.
- [29] APVV-0145-12 „Application of Environmental Processes for the Extraction of Metals of Acid Mine Drainage at the Old Mine Loading Smolník“.
- [30] APVV-0470-12 „Bioremediation of Sediments and Soils Contaminated by Heavy Metals by Bacterial Leaching“.

- [31] APVV-0688-12 „The Use of Experimental Research, Mathematical and Computational Methods for the Definition New Methods to Improve the Quality of Mine Conveyor Belts”.
- [32] APVV-14-0513 "Migration and Nanoparticles Cycle in Soil Environment in Different Geochemical Conditions”.
- [33] APVV-14-0882 "Identification and Quantification of Mechanical Rock Cutting Process Using Progressive Non-standard Methods “.
- [34] APVV-14-0421 "The Development of Biotechnology in the Remediation Process of Pollution and Elimination of Wastes”.
- [35] APVV-14-0771 "Preparation of Progressive Composite Ceramic Materials on the Base of Energetic Wastes by the Application of Microwave Energy”.
- [36] APVV-14-0103 "Mechanochemistry of Semiconductor Nanocrystals: from Minerals to Materials and Drugs”.
- [37] APVV-14-0168 "New Composite Structures and Their Properties in External Electromagnetic Magnetic Fields“.
- [38] APVV-14-0697 "The Application Possibilities of Mine Drainage as a Secondary Raw Material Sources of Metals and Metalloids“.
- [39] APVV-15-0312 "Structural and Functional Properties of Novel High-Nonequilibrium Oxides, Carbides and Nitrides Prepared by Unconventional Mechanochemical Methods”.
- [40] APVV-15-0421 "Progressive Composite Ceramic Materials Based on Energetic Wastes Prepared by the Application of Conventional and Microwave Heating“.
- [41] APVV-15-0430 "Research of parameters of mechanical rock cutting for rock drillability prediction“.
- [42] APVV-15-0281 "Migration and Nanoparticles Cycle in Soil Environment in Different Geochemical Conditions”.
- [43] APVV-15-0394 "Progressive Methods for the Treatment of Mine Waters as a Secondary Raw Material Sources of Metals and Metalloids“.
- [44] APVV-15-0100 "The development of Biotechnology in the Remediation Process of Contaminated Environment“.
- [45] APVV-15-7053 „The Developing System for Continuous Monitoring of the Pollution on the High-Voltage Insulation“.

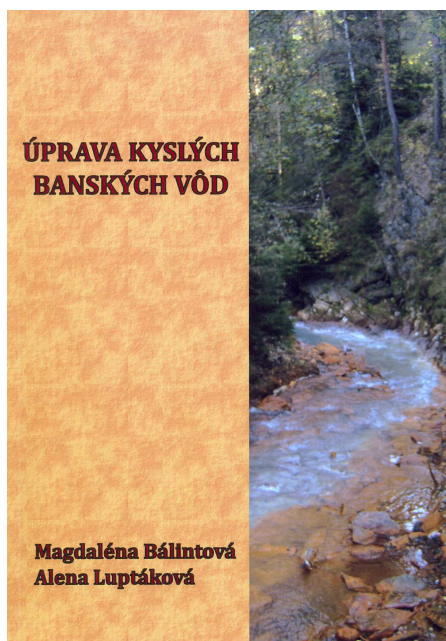
Note: All submitted and unsupported SRDA/APVV projects received assessment above 90%.

Košice, 04.08.2016

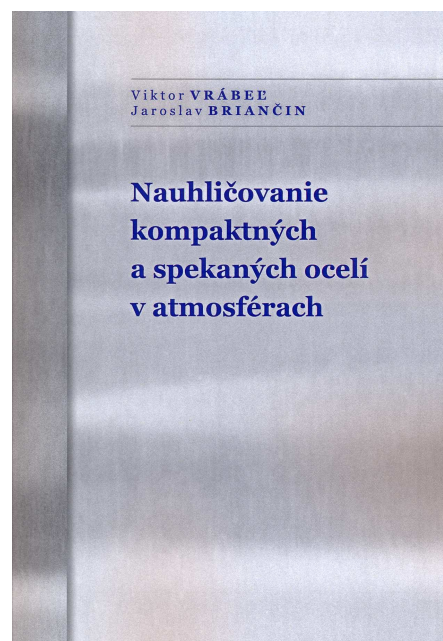
Ing. Slavomír Hredzák, PhD.  
Director of IGT SAS

## ANNEX

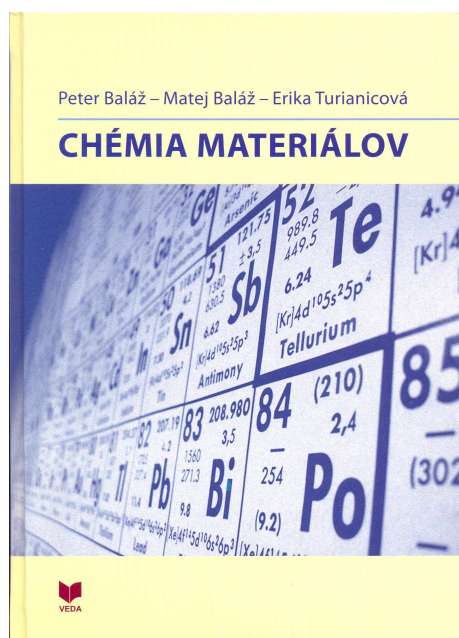
### Selected Monographs / Chapters in Monographs:



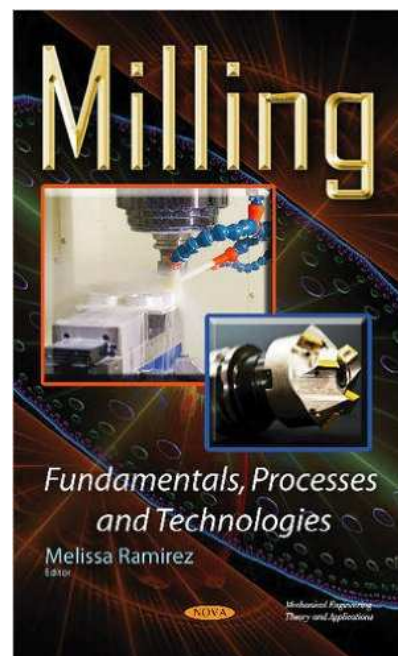
BÁLINTOVÁ, Magdaléna - LUPTÁKOVÁ, Alena. Acid Mine Drainage Treatment). Košice: Technical university in Košice, Faculty of Civil Engineering, 2012. 131 pages. ISBN 978-80-553-0868-5. (in Slovak)



VRÁBEL', Viktor - BRIANČIN, Jaroslav. Carburizing of Compact and Sintered Steels in Atmospheres). Košice: EQUILIBRIA, s.r.o., 2012. 303 pages. ISBN 978-80-8143-013-8. (in Slovak)

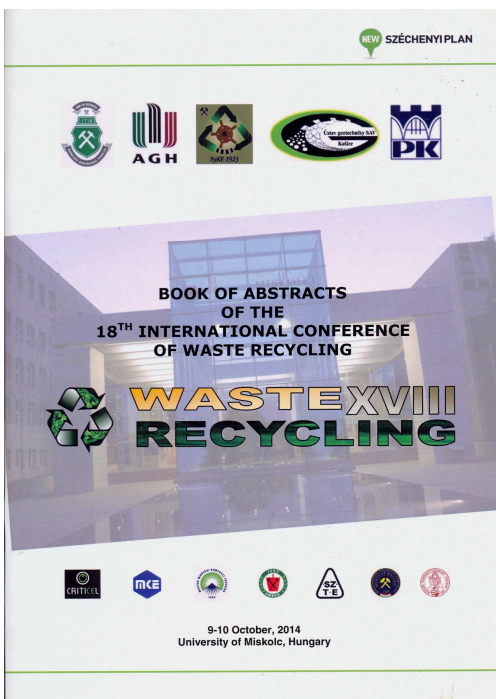
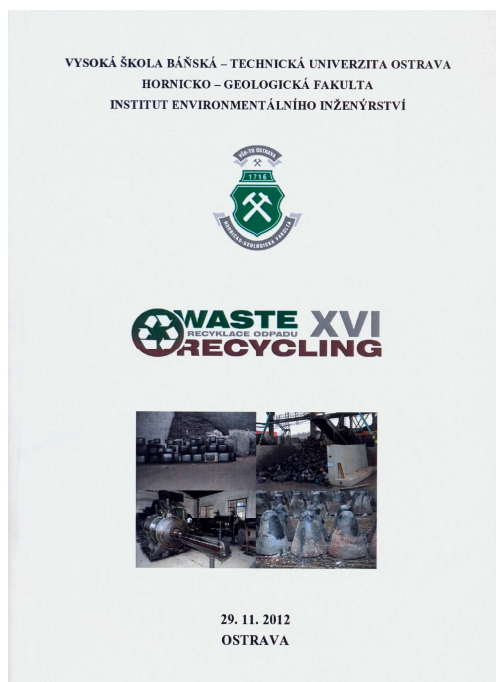


BALÁŽ, Peter - BALÁŽ, Matej - TURIANICOVÁ, Erika. Chemistry of Materials. Bratislava: VEDA publisher of SAS, 2014. 200 pages. ISBN 978-80-224-1360-2. (in Slovak)



ACHIMOVÍČOVÁ, Marcela - BALÁŽ, Peter. Nanocrystalline Metal Selenides: Mechanochemical Synthesis and Utilizable Properties. In *Milling: Fundamentals, Processes and Technologies* (ed. Melissa Ramirez). - N.Y.: NOVA Science Publishers Inc., 2015, p. 71-122. ISBN 978-1-63483-022-5.

## Conference Proceedings



**Waste Recycling Conference Series**  
Ostrava 2012 (Czech Republic), Košice 2013,  
Miskolc 2014 (Hungary), Cracow 2015 (Poland)

Institute of Geotechnics, Slovak Academy of Sciences  
Slovak Mining Society  
Environcentrum s.r.o.

## 1<sup>st</sup> Workshop on Water & Soil Clean-up from Mixed Contaminants

October 2-3, 2014 Košice, Slovakia

### Book of Abstracts

#### Workshop Topics

1. Degradation of toxic organic compounds
2. Removal of heavy metals from water and soil media
3. Adsorbents
4. Determination of toxic components by analytical techniques
5. Remediation of contaminated sites

Supporting organizations  
Aristotle University, Thessaloniki, Greece \* Hermes, Greece  
University of Brighton, United Kingdom \* MAST Carbon International Ltd, United Kingdom  
Nazarbayev University, Astana, Kazakhstan \* Ekodor, Kazakhstan  
Slovak Research & Development Agency \* Slovak Mining Society



Aristotle University of Thessaloniki, Greece  
Hermes SA, Greece  
Institute of Geotechnics SAS, Slovakia

## Autumn School Advanced Adsorption and Oxidation Techniques for the Detoxication of Xenobiotics & 2<sup>nd</sup> Workshop on Water & Soil Clean-up from Mixed Contaminants

12 - 14 October, 2015 Thessaloniki, Greece

### Book of abstracts

#### Topics

|                                                                                                      |                                                  |
|------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Advanced oxidation processes                                                                         | Fenton reagent                                   |
| Destruction/detoxication of toxic organic substances (dyes, VOCs, pesticides, PAHs, oil by-products) | Ozone                                            |
| Power ultrasounds                                                                                    | Electrochemical oxidation                        |
| Photochemical oxidation                                                                              | Novel sorbents, nanosorbents & activated carbons |

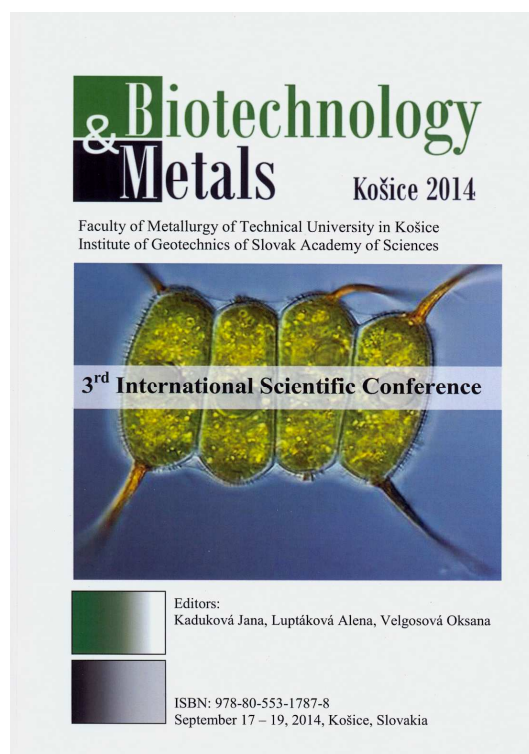
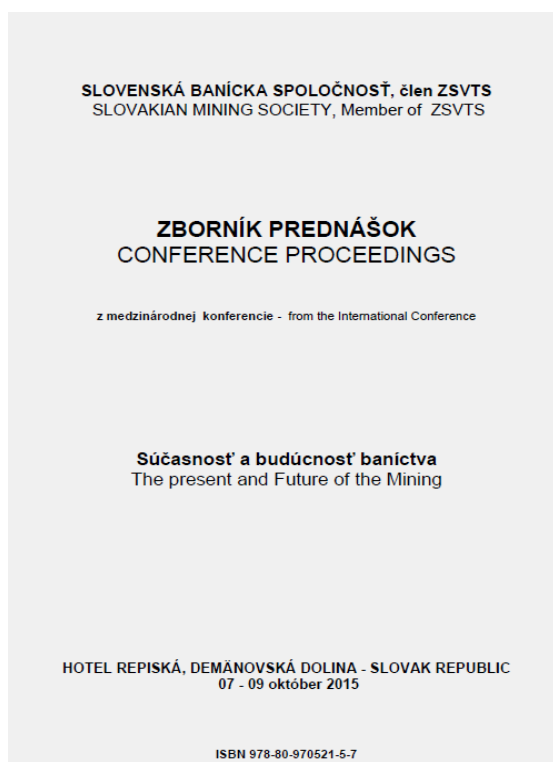
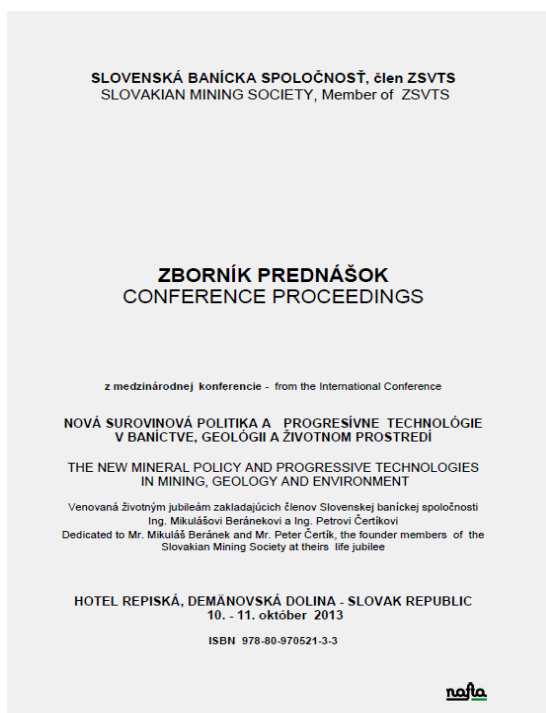
Supporting organizations  
University of Brighton, United Kingdom \* MAST Carbon International Ltd, United Kingdom  
Nazarbayev University, Kazakhstan \* Ekodor, Kazakhstan \* Environcentrum, s.r.o., Slovakia  
Slovak Mining Society



### Series of FP7 WaSClean Workshops

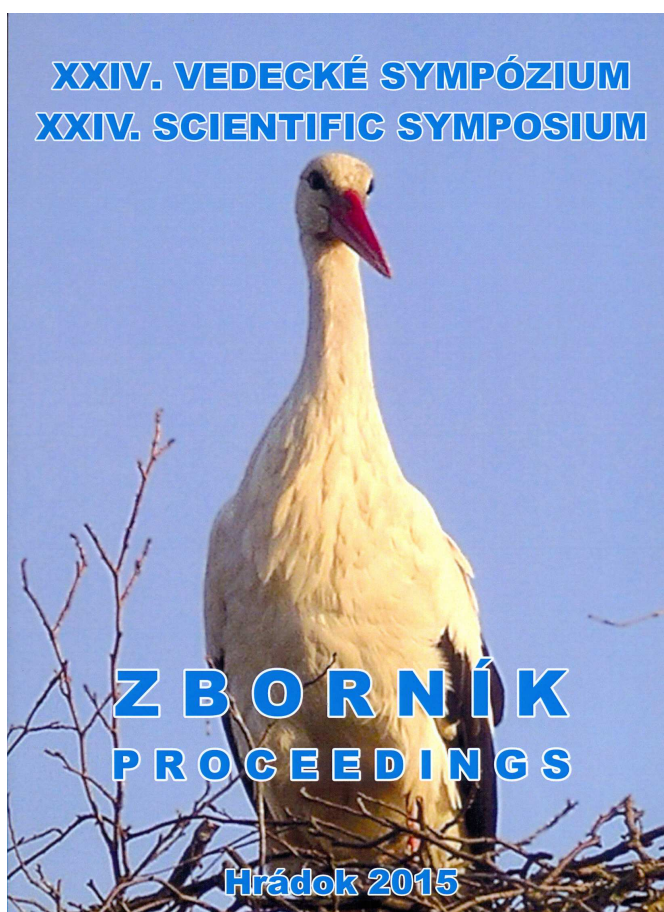
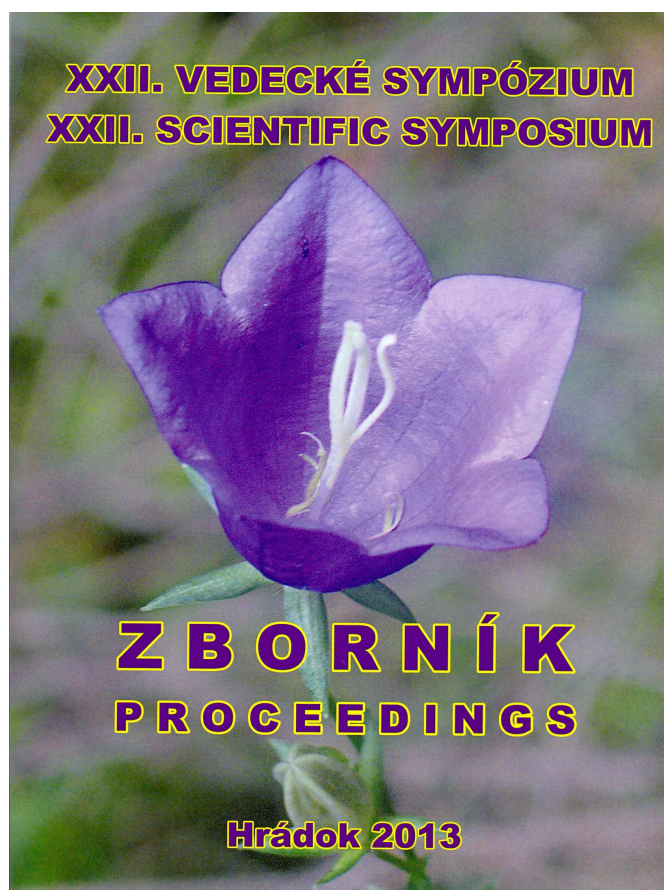
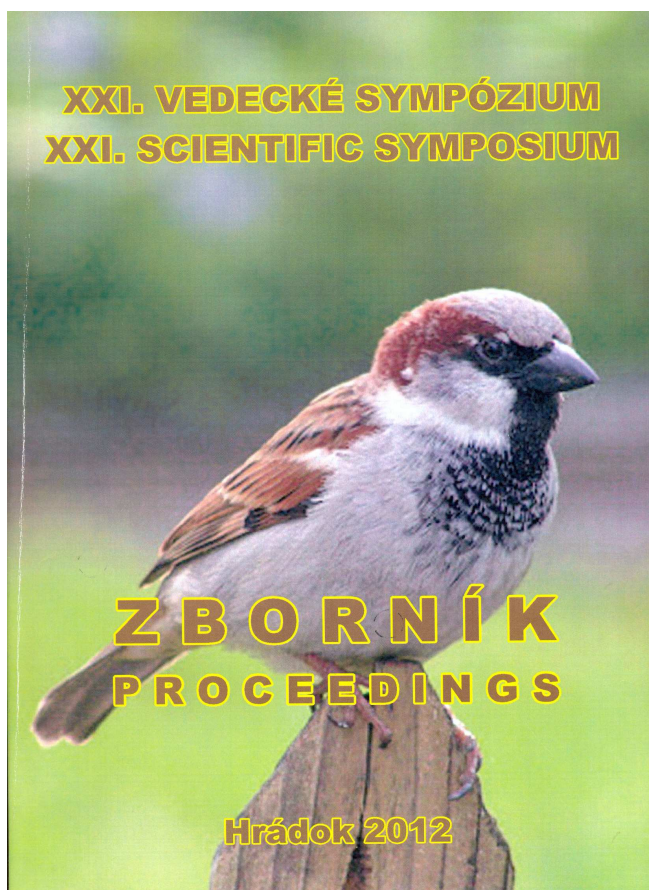
1<sup>st</sup> Workshop on Water and Soil Clean-Up from Mixed Contaminants, 2-3 October, 2014, Košice, Slovakia:

2<sup>nd</sup> Workshop on Water and Soil Clean-Up from Mixed Contaminants & Autumn School on Advanced Adsorption and Oxidation Techniques for the Detoxication of Xenobiotics, 12-14 October, 2015, Thessaloniki, Greece



International Annual Conference Series on Mining, Geology, Mineral Policy, Progressive Technologies.  
Hotel Repiská, Demänovská Dolina, The Low Tatras, Slovakia

International Conference Series:  
Biotechnology and Metals, Košice  
The 4<sup>th</sup> International Scientific Conference will be held in November 10-11, 2016 in Košice



## Recognitions and Awards

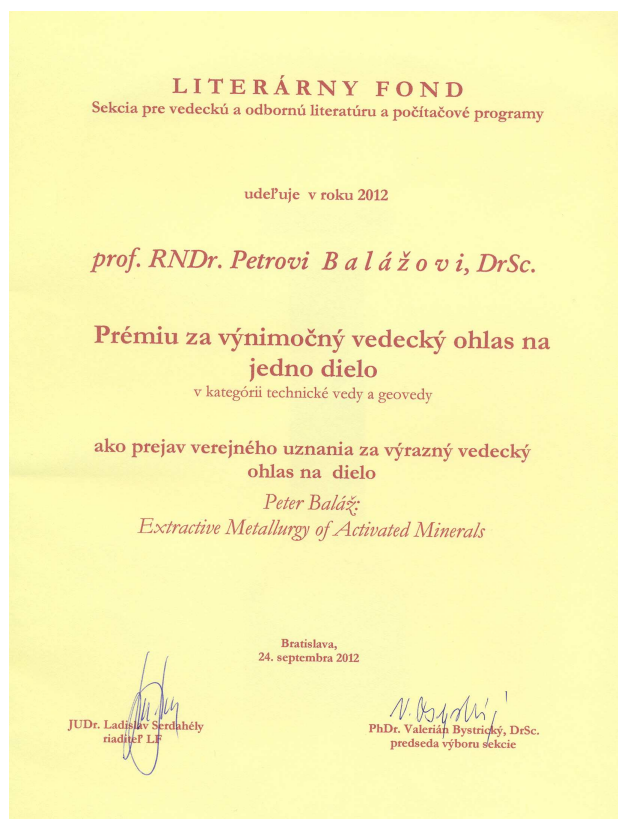
### The most significant award



State award of Second Grade of the Order of Ľudovít Štúr awarded by President of the Slovak Republic to Prof. Ing. František Špaldon, DrSc., corresponding member of the Slovak Academy of Sciences (\*20.07.1920 – †25.12.2013), for his exceptional achievements and outstanding contribution to the field of process control in industry and life-long scientific and educational activities to important personalities of Slovakia. Prof. Špaldon was former Scientific Board Chairman of the IGT SAS.



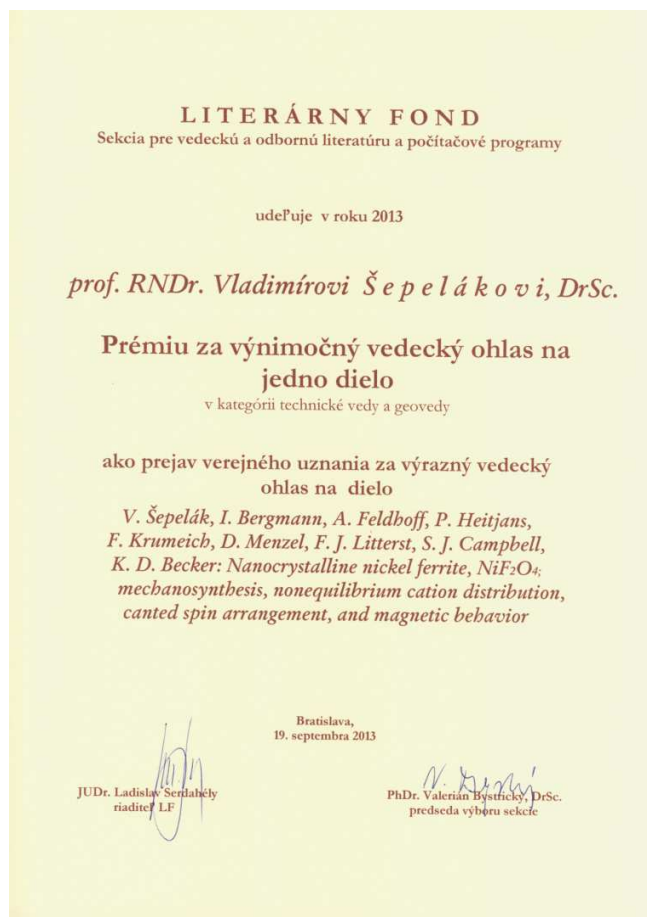
Golden Jubilee Commemorative Medal at 60th Anniversary of Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University in Kosice



Award to Prof. RNDr. Peter Baláž, DrSc. for excellent scientific response per publication in category Technical Science and Geoscience, Literature Fund Bratislava, Slovakia, Section for Scientific and Technical Literature and Computer Programs, for responses to publication "Extractive Metallurgy of Activated Minerals"

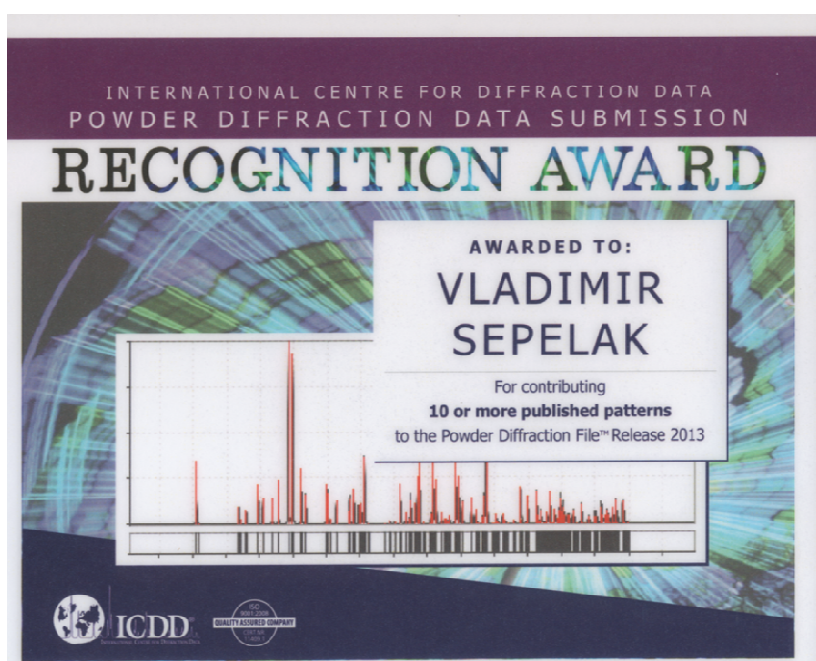


Commemorative Letter of Minister of Education, Science, Research and Sport of the Slovak Republic awarded to Ing. Zuzana Danková, PhD. for young R&D workers under 35 years

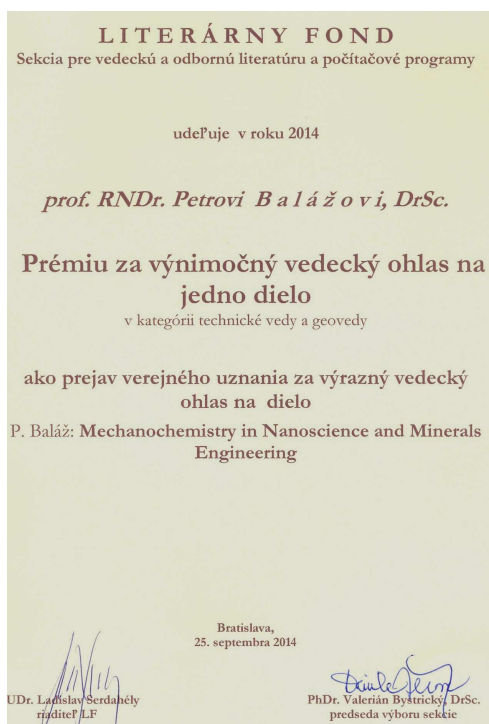


Award to Prof. RNDr. Vladimír Šepelák, DrSc. for excellent scientific response per publication in category Technical Science and Geoscience, Literature Fund Bratislava, Slovakia, Section for Scientific and Technical Literature and Computer Programs, for responses to publication „Nanocrystalline nickel ferrite,  $\text{NiFe}_2\text{O}_4$ , machanosynthesis, nonequilibrium cation distribution, canted spin arrangement, and magnetic behaviour”

Award for Distinguished Researcher involved in development of SAS awarded at 60th Anniversary of SAS

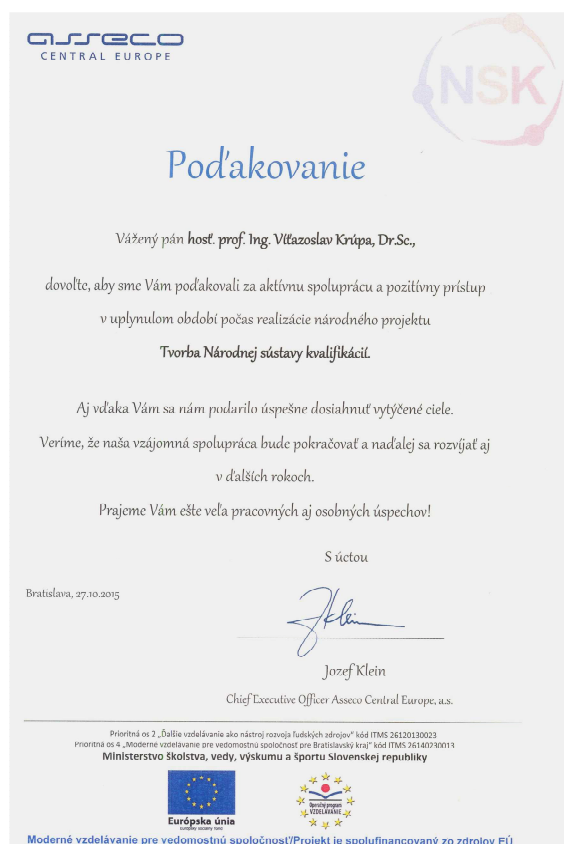


ICDD Recognition Award to Prof. RNDr. Vladimír Šepelák, DrSc. by The International Centre for Diffraction Data

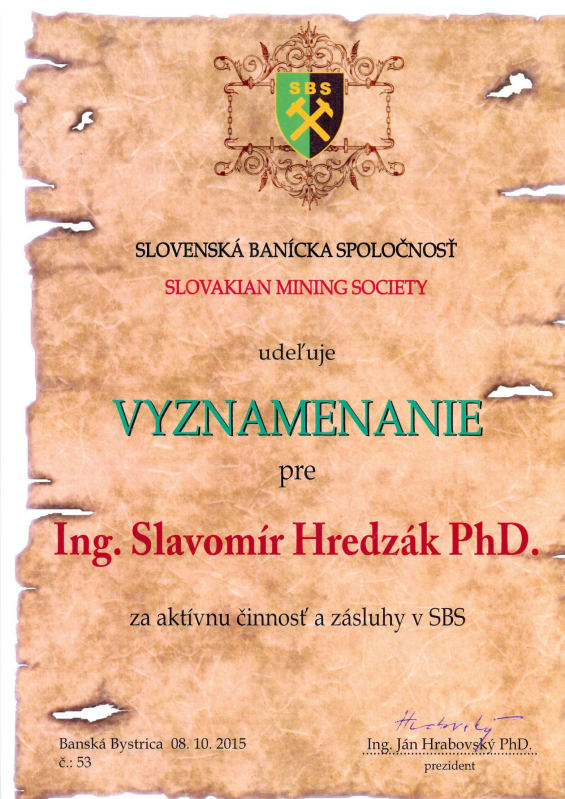


Price of Slovak Academy of Sciences awarded to Prof. RNDr. Vladimír Šepelák, DrSc. by Presidium of SAS

Award to Prof. RNDr. Peter Baláž, DrSc. for excellent scientific response per publication in category Technical Science and Geoscience, Literature Fund Bratislava, Slovakia, Section for Scientific and Technical Literature and Computer Programs, for responses to publication "Mechanochemistry in Nanoscience and Minerals Engineering, Springer-Verlag Berlin Heidelberg 2008"



Acknowledgement Letter to Ing. Vítázoslav Krúpa, DrSc. for active work in the national project National Qualification System, Sector Council for Mineral Exploitation, Processing and Geology.



Award and Medal of Merit to Ing. Slavomír Hredzák, PhD. for long-term activities within the Slovakian Mining Society awarded by the Presidium of SMS

**LITERÁRNY FOND**  
Sekcia pre vedeckú a odbornú literatúru a počítačové programy

u d e ŕ u j e

**Prémiiu za vedeckú a odbornú literatúru za rok 2014**  
v kategórii prírodné a technické vedy

***prof. RNDr. Petrovi Balážovi, DrSc.,***  
RNDr. Matejovi Balážovi a RNDr. Erike Turianicovej, PhD.

za dielo  
**Chémia materiálov**

JUDr. Ladislav Serdahely  
riaditeľ LF

Bratislava,  
24. septembra 2015

prof. MUDr. Marián Bernadič, CSc.  
predseda výboru sekcie

**LITERÁRNY FOND**  
Sekcia pre vedeckú a odbornú literatúru a počítačové programy

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**Prémiiu za vedeckú a odbornú literatúru za rok 2014**  
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***RNDr. Erike Turianicovej,***  
prof. RNDr. Petrovi Balážovi, DrSc. a RNDr. Matejovi Balážovi

za dielo  
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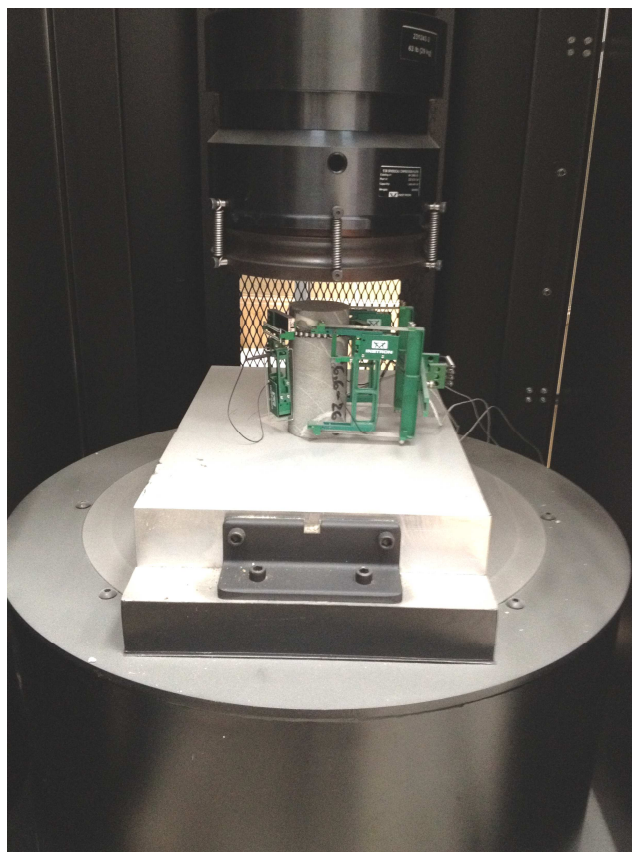
Award for scientific and technical literature for 2014,  
awarded by Literature Fund in category natural and  
technical science for book "Material Chemistry"



Delivery of Medal of the Slovak Academy of Sciences for merit to science „Nummum Academiae Memorialem Tribuit“ awarded by the Scientific Board of SAS to prof. Mamoru Senna by director of IGT SAS Ing. Slavomír Hredzák

Prof. Mamoru Senna, Keio University, Yokohama, Japan

## Selected new devices



Hydraulic Press INSTRON 1000 RD, L 7072 up to 4,500 kN



ICP-MS spectrometer Agilent 7700 for element detection  
in the range of 2–260 amu, a possibility ultratrace analysis with sensibility of ppt units



Thermal analyzer STA 449 F3 Jupiter (DTA/TG-DTG-DSC analyses) and mass spectrometer QMS 403 C Aëolos (Netzsch, Germany) for analysis of thermal decomposition products



Spectro Xepos X-ray fluorescence spectrometer model XEPO3 (Spectro Analytical Instruments, Germany) with a range of  $_{11}\text{Na}$  –  $_{92}\text{U}$



Particle size, volume and number distribution analyzer Beckman Coulter ® Multisizer IV (Beckman Coulter, USA)



Surface area and pore size Analyzer Quantachrome NOVA 1200e (Quantachrome Instruments, USA)