

## **Questionnaire**

### **Summary of the main activities of a scientific Organisation of the Slovak Academy of Sciences**

*Period: January 1, 2007 - December 31, 2011*

#### **I. Formal information on the assessed Organisation:**

##### **1. Legal name and address**

**Geological Institute Slovak Academy of Sciences  
Dúbravská cesta 9, P.O.Box 106, 840 05 Bratislava**

##### **2. Executive body of the Organisation and its composition**

<b>Directoriat</b>	<b>name</b>	<b>age</b>	<b>years in the position</b>
<b>director</b>	RNDr. Igor Broska, CSc.	57	2010 -
<b>deputy director</b>	RNDr. Pavol Siman, PhD.	49	2010 -
<b>scientific secretary</b>	RNDr. Igor Petrík, CSc.	60	2010 -

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

RNDr. Marián Janák, DrSc.

##### **4. Basic information about the research personnel**

- i. **Number of employees with a university degree (PhD students excluded) engaged in research and development and their full time equivalent work capacity (FTE) in 2007, 2008, 2009, 2010, 2011 and average number during the assessment period**

**ii. Organisation units/departments and their FTE employees with the university degree engaged in research and development**

Research staff	2007		2008		2009		2010		2011		average	
	No.	FTE	No.	FTE								
organisation in whole	23,0	20,4	22,0	20,7	24,0	20,7	24,0	19,9	26,0	20,0	23,8	20,4
unit Bratislava	13,0	11,6	12,0	11,6	14,0	11,4	14,0	11,5	14,0	11,5	13,4	11,5
unit Banská Bystrica	10,0	8,8	10,0	9,1	10,0	9,3	10,0	8,5	12,0	8,5	10,4	8,8

**5. Basic information on the funding**

**i. Total salary budget<sup>1</sup> of the Organisation allocated from the institutional resources of the Slovak Academy of Sciences (SAS) in 2007, 2008, 2009, 2010, 2011 and average amount for the assessment period**

Salary budget	2007	2008	2009	2010	2011	average
total salary budget (milions of EUR )	0,388	0,309	0,408	0,415	0,398	0,384

**6. URL of the Organisation's web site**

<http://www.geol.sav.sk/>

***II. General information on the research and development activity of the Organisation:***

**1. Mission Statement of the Organisation as presented in its Foundation Charter**

- a) The Institute is oriented to the complex research of the geological structure, rock compositions and geodynamic evolution of the Western Carpathians including interpretation of deep structure based on geophysics and other scientific methods. The Institute develops basic research within the framework of Earth and environmental sciences (including raw material sources) by means of regional study of the Slovak territory, its regions and other areas with comparable geological structure.
- b) Institute develops Earth sciences by solving of scientific projects and research tasks. It takes part in international scientific projects and collaborates with Earth science institutions abroad. It participates in the transfer of scientific information to the praxis. By popularizing and pedagogical activities it contributes to the growth of knowledge and cultural level of Slovakia's population.

<sup>1</sup> Objem mzdových prostriedkov bez odvodov do poisťovní so započítaním sumy miezd pracovníkov THS, ktorú organizácii poskytne ETO Úradu SAV. Rozpočet v Sk prepočítajte na eurá podľa konverzného kurzu 1€ = 30,126. (Podobne aj v ďalších tabuľkách.)

- c) The Institute is publisher of journal *Geologica Carpathica* (ISI)
- d) The Institute realises PhD. and postdoctoral studies in the sense of valid legislative norms.

## 2. Summary of R&D activity pursued by the Organisation during the assessed period, from both national and international aspects and its incorporation in the European Research Area (max. 10 pages)

The research activities of the Geological Institute have been aimed to the fields of **(1) petrology and mineralogy (2) paleobiology and sedimentology and (3) metallogeny and environmental geochemistry**. Most of the Institute's projects have international dimension and are carried out in collaboration with foreign colleagues mainly from countries of the European Union, Norway, Ukraine, Russia, USA and China.

### (1) Petrology and mineralogy:

#### *Granitoid rocks of the Western Carpathians.*

New geochronological results obtained in the last years from monazite and zircon shifted the beginning of I-type granite magmatism to the Late Devonian (365 Ma; Broska et al. submitted) and confirmed a major Early Carboniferous granite-forming event (ca. 350 Ma, Petrik and Konečný 2009). The most significant research output regarding the I-type granitoids is interpretation of the role of their Fe-Ti oxides and microgranular mafic enclaves as evidence of mixing of mantle- and crust-derived sources yielding the I-type character to this granitoid suite (Broska and Petrik 2011). A specific feature of the I-type magmatism was identified and quantified – a late oxidation responsible for the dominant (e.g. magnetic) properties of this granitoid type (Petrik 2012). It was suggested that due to this process the present dominant characteristic mineral assemblage has formed in the latest stages of magma solidification and after that replacing an earlier, more reduced paragenesis.

The most informative group of granitic minerals – accessory minerals – was characterised in a summarizing monograph (Broska et al. 2012) where all aspects of geochemistry, P-T-X conditions and magma evolution recorded by accessory minerals are presented. A special emphasis was given especially to phosphates (Broska and Petrik 2008) and oxides (Broska and Petrik 2011).

The investigation of an evolved I-type granitoids rich in feldspars, titanite and apatite in the area of Harmónia (Malé Karpaty Mts.) revealed the probable process of flowage differentiation as a main mechanism of the deuterosyenite vein formation in veins locally enriched in titanite and apatite (Broska et al. 2008). We extended the investigation of mobility and fluid path ways in feldspars on examples on tonalites from the Tatra Mts. (Leichmann et al. 2009).

New ideas were proposed to account for evolution of specialized S-type granites enriched in Sn, Rb, Nb, Ta and W typically occurring in the Gemeric unit (Kubiš and Broska 2010). Special attention was paid to the Betliar area with characteristic occurrences of granite porphyry and equigranular granites. The evolved Betliar granite concentrated trace element contents from former fluid-rich hydromagmas formed under a carapace of fine-grained granites on top of the granite massif. Such overpressured melts can abruptly escape emplacing into shallow crustal level where they become easily greisenised. The equigranular granites were followed by granite-porphyrries tapped from bottom parts of the magmatic chamber (Kubiš and Broska 2010). The evolved granites and granite-porphyrries in the vicinity form the composite granite body

The unique Permian granite occurring in the Hnilec area was also studied in detail: a Li-F-P rich granite provided a wealth of new information and a number of heretofore unknown minerals (Petrík et al. 2011). In the evolved Li-F-P granite system Li micas (zinnwaldite accompanied by Li-phengite) was identified as sole Li carriers. Besides the Li-micas, special rare phosphates: arrojadite, lacroixite, viitaniemiite, gorceixite and goyazite were found. Some were described in granites for the first time (Petrík et al. 2011).

Researchers of our Institute were involved to geochronological dating (monazite CHIME and in-situ U/Pb zircon SHRIMP data) of the West-Carpathian metaigneous rocks which definitely confirmed Cambrian and Ordovician magmatic events (Putiš et al. 2008, 2009a, Siman et al. 2010, Siman and Putiš 2011).

First  $Ar^{39}/Ar^{40}$  data across the Central Western Carpathians main tectonic and shear zones (Putiš et al. 2009b) were obtained from white micas measured at our Institute (CEAL). Results indicate that formation of collision wedge started in the S due to closure of the Neotethyan Triassic Meliata-Hallstadt Ocean and S-ward subduction of its oceanic crust. It prograded towards the N in the passive and then in an active continental margin between 150 and 40 Ma. The NW-ward thrusting of the Gemic over the South-Veporic unit occurred before 100 Ma. The NE-SW trending sinistral transpression, combined with a top-to-the SE extension was dated at 100 – 85 Ma in the South-Veporic unit. It was followed by lateral extrusion of the Tatric unit towards the NE occurred in Early Eocene, at ca. 50 Ma.

#### *Volcanic rocks*

Attention has been paid also to petrology, geochemistry, isotope dating and paleovolcanic reconstruction of the Late-Palaeozoic, Mesozoic, Miocene and Pliocene-Pleistocene volcanism in the Carpathian realm. New model has been proposed concerning the geotectonic position of the Meliata unit and sources of Cr-spinels in Tertiary flysch deposits (Mikuš et al. 2005, 2006; Mikuš and Spišiak 2006). Volcanic forms of the Neogene to Quaternary Carpathian volcanic arc have been reconstructed (Lexa et al. 2010). U-Pb-Th dating of zircons and monazite from maar structures of Lučenec Basin revealed several discrepancies with spatially associated basaltic lava flows dated using K/Ar method (Hurai et al. 2010). U-Pb dating of zircon megacrysts from the Hajnáčka I maar – the type locality of the mammal fauna – proved origin of the maar at 3.43 Ma. Catastrophic eruption that killed the mammal assemblage thriving within the maar was dated at 3.06 Ma (Hurai et al. 2012). Paleovolcanic reconstruction and K-Ar dating has provided a new insight into evolution of volcanic activity in the southern part of the San Salvador metropolitan area – a segment of the Central America volcanic arc (Lexa et al. 2011).

#### *High-pressure and ultrahigh-pressure metamorphism*

Following the first evidence for the ultrahigh-pressure metamorphism in the Eastern Alps on eclogites and garnet peridotites (Janák et al. 2004, 2006) we continued in our research of UHP rocks in the Pohorje Mts. of Slovenia. The field relations show that garnet peridotites and the associated serpentinites and eclogites formed the deepest part of the exposed UHP metamorphic terrain (Kirst et al. 2010), thus suggesting the peridotites may have been of “crustal” type, intruding the lower crust prior to subduction. De Hoog et al. (2011) demonstrated that garnet peridotites are former low-pressure, plagioclase-bearing ultramafic cumulates. The rocks are of oceanic affinity and form the more primitive equivalent to associated eclogitised metagabbros. Janák et al. (2010) found chromian kyanite, magnesiostauroilite and ruby in eclogites associated with metaultramafic rocks. Calculated pressure conditions of 2.2-2.7 GPa and age of metamorphism (92 Ma) for metapelitic gneisses suggest that these rocks most likely have experienced the same UHP conditions as neighbouring eclogites (Janák et al. 2009). In the same samples, study of fluid inclusions (Hurai et al. 2010) documented that fluid-

assisted retrogression led to compositional modification of garnet porphyroblasts and almost total obliteration of original peak-pressure assemblage. Thermodynamic modeling predicted the presence of peak metamorphic, high-pressure aqueous fluid. This may explain the absence of coesite which probably transformed to quartz as a consequence of the fluid-enhanced coesite–quartz transition. In addition, Krenn et al. (2009) distinguished two monazite generations (M1; M2) in these metapelites. They documented that at UHP conditions MREE-rich apatite coexisted with low-MREE M1 monazite and reacted during decompression to Ca-F-apatite plus MREE-rich M2 monazite. This provides strong arguments that REE-partitioning between apatite and monazite is pressure-dependent.

During the last years we have investigated HP and UHP rocks also in other collisional orogenic belts. We discovered UHP eclogites in the Pirin Mts., in the Bulgarian part of the Rhodope massif (Janák et al. 2010) and dated monazite from the diamond-bearing gneiss in the Sidironero unit of the northern Greece (Nagel et al. 2011). These results show that HP to UHP metamorphism is more widespread in the Rhodopes than previously thought. In the Scandinavian Caledonides our research has been carried out in the northern Norway (Tromsø nappe) and central Sweden (Seve nappe complex), respectively. Metamorphic conditions of 750-800 °C and 3-3.5 GPa (Janák et al. 2011; Janák et al. 2011; Majka and Janák 2011) were calculated for kyanite- and phengite-bearing eclogites which shows that the Tromsø and Seve Nappes experienced UHP metamorphism. Cr-rich kyanite, magnesiostauroilite and ruby have been found in retrogressed eclogite associated with metaultramafic rocks (Ravna et al. 2006; Janák et al. 2010). We found eclogites also in the crystalline basement of the Western Carpathians, in the northern parts of the Veporic unit (Janák et al. 2007). Geothermobarometry allowed constraining the maximum pressure and temperature conditions at 2.5 GPa and 700 °C, respectively, thus implying subduction of the crystalline basement to the depth of around 80 km during the Early Variscan time.

These results are very important for the understanding of global geological processes in the collisional orogenic zones. UHP metamorphism records a very deep subduction (>100 km) of the Earth's crust into the upper mantle which is accompanied by recycling of elements facilitated by fluids derived from the subducting slab. Exhumation of UHP rocks is another key topic which has been investigated. We have proposed that UHP rocks were exhumed due to the extraction of the overlying lithosphere that enables a rapid uplift without a necessity of erosion.

#### *Diagenesis and very low-grade metamorphism*

The research was carried out on sedimentary rocks in selected geological units of the Central Western Carpathians. Two principal progressive mineral transformations, involving a sequence of dioctahedral (smectite → mixed-layer illite-smectite → illite → muscovite) and a sequence of trioctahedral (saponite → corrensite → chlorite) clays have been investigated along with fluid inclusion data, stable isotope data and radiometric dating to restore burial and thermal history of Tertiary accretion prism (flysch belt) and forearc basin of the Carpathian arc. PT conditions, depths of burial and geothermal gradients have been precisely determined and zones of methane, oil-condensate, and carbon dioxide stability have been identified (Hurai et al., 2006). Reconstruction of thermal history and depth of burial is of crucial importance for forecasting and identification of the oil- and gas-productive strata. Investigation of the hydrotectonic regime at soles of overthrust sheets revealed high fluid overpressures associated with hydraulic fracturing and dissolution phenomena (Milovský et al. 2012).

## **(2) Paleobiology and sedimentology**

Our Institute performed paleobiological and sedimentological research that was primarily focused on (1) *global and regional environmental perturbation events* preserved in the Mesozoic and Cenozoic marine and freshwater deposits of the Western

Carpathians and in adjacent regions (Michalík 2010; Michalík et al. 2010; Pipík and Bodergat 2007; Pipík et al. 2009; Soták 2010; Tomašových and Siblík 2007) and (2) *evolutionary dynamics of paleoecosystems* in specific groups at regional and global scales (Cziczcer et al. 2009; Tomašových et al. 2008; Tomašových and Schlögl 2008; Tomašových and Kidwell 2009; 2010a; b; 2011; Vršanský et al. 2009; Vršanský 2010, Vršanský et al. 2011). Our researchers were principal investigators in national projects (Slovakian Research and Development Agency APVV, and Slovakian Scientific Grant Agency VEGA), and participated in international projects funded by UNESCO (IGCP projects) devoted to the Jurassic (IGCP 506), Cretaceous (IGCP 555) and the Permian/Triassic boundary.

#### *Global and regional environmental perturbation events*

Paleoecological and sequence stratigraphic analyses of sections in the Western Carpathians, in the Eastern Alps and also at global spatial scales were focused on sequences (1) of the Permian-Triassic transition, (2) of the Carnian, (3) at the Triassic/Jurassic boundary, (4) at the Jurassic/Cretaceous boundary, (5) of the Cretaceous, and (6) the Paleocene-Eocene thermal maximum and the Eocene/Oligocene cooling. These sequences record regional-to-global events that were coupled with substantial environmental and evolutionary perturbations.

ad (2) The Carnian event is represented by two million-years-long humid anomaly that replaced a generally hot and arid Triassic climate. This anomaly was characterized by enormous monsoon-like precipitations. We have analysed sedimentology and isotope stratigraphy of successions that capture the climatic change from high-seasonality humid conditions to low-seasonality arid conditions (Michalík and Szulcz 2008). We suggest that this event corresponds to an increase in terrigenous inputs related to climatic warming, increased humidity and increased monsoonal precipitation that reduced salinity of seawater (documented by conchostracans, lingulide brachiopods) (Soták et al. 2011; Siblík and Soták et al. 2011).

ad (3) Ecosystem changes at the Triassic/Jurassic (T/J) boundary have been studied in in the Western Carpathians and in the Eastern Alps. Oxygen and carbon isotope anomalies in one of the topmost cycles in the Fatra Formation in the Western Carpathians correspond to significant lithological changes, and terrigenous-rich beds close to the T/J boundary record a sudden increase in fresh-water input in uppermost parts of the Fatra Formation (Michalík et al. 2007). The diversity of benthic assemblages decreases in the uppermost parts of the Fatra Formation (Michalík et al. 2010; Ruckwied and Götz 2010.). An abrupt change in ecosystem composition, indicating cessation of the Triassic climatic regime, occurred at about 200 Ma ago. This change caused a widespread destruction of carbonate platforms that flourished for more than 30 Ma, and was accompanied by massive influx of mud and sand from the continent. In the Eastern Alps, this event changed the phylogenetic structure of Early Jurassic benthic communities owing to a removal of higher taxa (superfamilies) that were abundant in the Late Triassic (Tomašových and Siblík 2007). The extinction mainly affected organisms with aragonitic or high-Mg calcitic skeletons and with little physiological control of biocalcification. This extension selectivity suggests that climatic changes were associated with ocean acidification (Hautmann et al. 2008).

ad (4) The documentation and stratigraphic identification of the Jurassic/Cretaceous boundary (JKB) is one of major tasks of the International Stratigraphic Commission. In 2010, our Institute organized an international workshop of the JKB working group in Smolenice, Slovakia, where we presented sections spanning this boundary in the Western Carpathians (see Michalík et al. 2008; 2009; Grabowski et al. 2009; 2010; Michalík and Reháková 2011). Our results show that the Brodno sections captured a complete calpionellid, and nannofossil stratigraphic record, supports the older

paleomagnetic data, and allows sequence stratigraphic and isotopic correlation with other key sections from the Mediterranean Tethys area (Michalík et al. 2008).

ad (5) In collaboration with Austrian and Italian geologists (Soták in Lukeneder et al. 2011), and in the framework of the IGCP 555, the integrated stratigraphy in the Puez section (Austrian Dolomites) allows us to uniquely define boundaries between several Cretaceous stages and to identify oceanic anoxic events (e.g. so-called Faraoni, Linni and Breistrofer). The research of the Upper Cretaceous formations was focused on the oceanic red-bed formations in the Pieniny Klippen Belt, on the revision of the Púchov Marls (Soták 2010), on the definition of the Cenomanian – Turonian boundary, on the identification of the Bonarelli event (Soták et al. 2009), and on the detection of the radiolarian-bearing beds in the Coniacian – Santonian formations (Smrečková and Soták 2010).

ad (6) Stratigraphic marker species, the appearance of unique foraminiferal and nannoplankton taxa, isotope excursion, the presence of diatoms and pyritized pteropods and magnetostratigraphic data allowed us to detect the Paleocene-Eocene Thermal Maximum (PETM) in the Kršteňany section in the Western Carpathians (Soták et al. 2011; Ozdínová and Soták 2009). Our research of the Eocene/Oligocene boundary points to climatic cooling, demise of carbonate platforms, increase of eutrophication, productivity and sapropelitic deposition, and Paratethyan semiisolation. (Soták 2011; Ozdínová 2010). The depositional dynamic of Paleogene has been further improved and revised by new sequence-stratigraphic studies and analyses of hydrodynamic processes and facies architecture (Starek et al. 2010, 2011; Soták and Hudec 2009).

#### *Evolutionary dynamics of paleoecosystems*

This topic was evaluated in (1) several specific groups (insects, ostracods) at broad spatial scales and (2) from the point of view of preservation potential of various ecosystems attributes in the fossil record (diversity and composition).

ad (1) In the course of extensive exploration of terrestrial ecosystems from multiple parts of the world, we have discovered the most primitive social insects (eusocial cockroaches - predecessors of termites, Vršanský 2010) and the earliest Earth's ectoparasites. The earliest Earth's ectoparasites were also assigned to a new major systematic rank (insect order). Comparison of fossil insect assemblages from Mexican and Dominican amber indicates a new, unknown cataclismic event that occurred between depositions of assemblages in these two regions. We have also found a jumping cockroach in the Upper Jurassic Karabastau Formation in Kazakhstan (attributed to a new family Skokidae). This finding demonstrates the immense plasticity of stem cockroaches from which eusocial termites and predatory mantises evolved. Jumping cockroaches are otherwise completely missing in the fossil record, and the first jumping cockroach found alive was described only recently from South Africa. This find was also assigned to the Top 10 discoveries in biology worldwide in 2010.

ad (2) We have studied the ecological and preservation dynamic of the Pleistocene and Holocene subfossil benthic assemblages at global scales, and specifically in warm-temperate environments of the Southern California Bight. Subfossil assemblages are formed by skeletal remains of dead organisms that are presently still exposed on the sea-floor and represent precursors of fossil assemblages. Therefore, we have directly assessed the quality of the fossil record by comparing the composition and diversity of such subfossil assemblages with communities of living organisms inhabiting the same region. We developed stochastic simulation models that quantify the expected contributions of ecological and taphonomic processes to the final composition and diversity of fossil assemblages. Such models are crucial in understanding how much inference can we make out of the fossil record. These studies show that (1) environmental and spatial gradients in marine environments are reasonably captured by subfossil assemblages (Tomašových and Kidwell 2009a, b), (2) diversity of fossil

assemblages is typically higher in subfossil assemblages than in contemporaneous communities collected alive, in spite of that fact that fossil assemblages are incomplete (Tomašových and Kidwell 2010a), (3) temporal variation and rate of change in ecosystem composition is reduced among subfossil assemblages owing to their temporal averaging (Tomašových and Kidwell 2010b).

### **(3) Metallogeny and environmental geochemistry**

The obtained results represent a valuable contribution to the theory of orogenic hydrothermal and magmato-hydrothermal systems and to the strategies of exploration.

Detailed fluid inclusion, stable isotope and geochronologic study of siderite-polymetallic veins in the Gemeric unit revealed their multi-stage origin coincidental with north-vergent Late Jurassic-Early Cretaceous compression and Middle-to-Late Cretaceous post-orogenic shearing, transpression and uplift. Crystallization temperatures and oxygen isotope ratios of the siderite-forming fluids increased towards the centre of the Gemeric cleavage fan as a consequence of decreasing water/rock ratio in rock-buffered closed hydrothermal system. Depth of burial during siderite-, barite- and tourmaline substages (6-14 km in north-Gemic veins, up to 16 km in south-Gemic veins) reflect increasing thickness of the Mesozoic accretionary wedge. Predominantly hydrostatic fluid regime of an open system is typical for the superimposed sulphidic associations (Hurái et al. 2008a, b). Different stable isotope signature of siderite and magnesite deposits exclude their coeval precipitation from basinal brines percolating through Permian rift zones, as suggested by previous genetic models (Hurái et al. 2011).

Mineralogical, fluid inclusion and stable isotope studies applied at the Vysoká – Zlatno Cu-Au porphyry-skarn deposit revealed yet unknown skarn mineral assemblages with monticellite, clintonite and hydroxyllestadite to fluorellestadite corresponding to the peak and retrograde skarn stages (Koděra et al. 2009) and mineralizing fluids of magmatic origin with a minor meteoric component that were subject to the liquid-vapor immiscibility during early stages – the data suggest the general pattern of a distant source of magmatic fluids that ascended above a zone of hydraulic fracturing below the temperature of ductile–brittle transition (Koděra et al. 2010).

The same research methods applied to the newly discovered economically important Au porphyry deposit Biely vrch (42 Mt at 0.8 g/t Au) in the central zone of the Javorie stratovolcano revealed many properties common to Au porphyry deposits in general – very low Cu/Au ratio, association with diorite porphyry stock, alteration pattern and vapor dominated fluids. Crystallization of quartz and precipitation of Au was influenced by fluid decompression in a shallow level of the system and reaction of Au-bearing fluids with favorably altered rocks (Koděra et al. 2009, 2010, 2011).

Study of skarn mineralization near Tisovec revealed a unique assemblage of Mn-rich minerals. Mn content in sphalerite was the highest ever recorded in hydrothermal deposits. Fluid inclusion data combined with thermodynamic calculations revealed a deeply eroded, intermediate sulphidation hydrothermal system subjacent to an eroded Neogene volcano (Hurái and Huráiová 2010)

In the field of environmental geochemistry, the contamination of the country components (soil, technogenous sediments, groundwater, surface water, drainage water, plants) was studied at the abandoned Cu-deposits in the surrounding of Banská Bystrica. The geochemical stability of the dump-fields and tailings (the existence of the free sorption capacity of the present natural sorbents, e.g. clay minerals, hydrogoethite etc.; Andráš et al. 2008, 2009) at the investigated mining territories (Ľubietová, Špania Dolina, Staré Hory) was studied in detail (Andráš et al. 2011a). Also the risk of the acidification (formation of AMD), acidity production and the neutralization potential were calculated (Andráš et al. 2008). Very important was the determination of the As and Sb speciation and degree of their toxicity. Plant defense reactions were studied under the influence of stress factors at the dump sites (absence of soil and water, the heavy metal

contamination, mobility of the cohesionless slope material; Andráš et al. 2007). The ability of the drainage water precipitate cementation copper on the iron surface is enabled installation the Fe<sup>0</sup>-barrier in combination with wetland systems for elimination of heavy metals from the water (Andráš et al. 2008a). Determination of <sup>238</sup>U, <sup>232</sup>Th and <sup>40</sup>K activities in rocks of the Malé Karpaty Mts. were used in the civil engineering (Andráš et al. 2011).

#### **(4) Other R&D activities**

Geological Institute SAS cooperated in the field of applied research with the Czech Geological Survey in the framework of their development project in El Salvador (Estudio de Reconocimiento de las Condiciones Geológicas para la Reducción de los Riesgos Naturales en Sectores del Área Metropolitana de San Salvador; Šebesta et al. 2010) and with the State Geological Institute of Dionýz Štúr in Bratislava on the projects “Evaluation of exploration activities and mineral resource potential in the Banská Štiavnica – Hodruša ore field” (Kúšik et al. 2010), “Maps of paleovolcanic reconstruction of rhyolite volcanics in Slovakia and analysis of related hydrothermal processes” (Demko et al. 2010) and “Information system of important geological localities – part Neogene-Quaternary volcanics” (Liščák et al. 2012).

### **3. Concept of R&D activity of the Organisation for the next four years (max. 5 pages)**

The research at our Institute during the next five years will not only cover territory of the Western Carpathians but will be focus more widely in the two major research topics: (1) Transformations of Earth’s lithosphere in collision orogenic belts; (2) Sedimentary archives and fossil ecosystems.

In addition, some researchers are active in the fields of applied sciences – volcanology, metallogeny and environmental mineralogy and geochemistry of past mining activities. Moreover, the joint Energy Geoscience laboratory (EGL) will research energy resources.

#### **i. Present state of knowledge and status of ongoing research related to the subject of the Concept, from both international and national perspective**

##### **(1) Transformations of Earth’s lithosphere in collision orogenic belts**

Orogeny is a fundamental process shaping the Earth crust. Despite the fact that understanding of orogens during the last years has made a great progress, there are still many problems to be solved. Ultrahigh-pressure (UHP) metamorphism is an important type of orogenic metamorphism that was recognised when metamorphic coesite and microdiamond was discovered. In recent years, modern nanoscale techniques (e.g. synchrotron infrared spectroscopy, nanosecond ion mass spectrometry, focused ion beam techniques) have had an increasingly important role in the discovery of new indicator phases for UHPM. Our ongoing research is focused on investigations of metamorphic and magmatic processes taking place in the Earth’s lithosphere, in several collision orogenic belts of the world.

The Scandinavian Caledonides offer one of the best opportunities to study the role of UHP metamorphism during orogenesis. Findings of coesite in the WGR (Smith 1984) followed by that of micro-diamond (Dobrzhinetskaya et al. 1995) and majoritic garnet (Van Roermund and Drury 1998) provided evidence for the UHP metamorphism within the hinterland of the Scandinavian Caledonides. The new identification of UHP metamorphism in the long-transported Caledonian nappes (Tromsø nappe, Ragna and

Roux 2006; Janák et al. 2011) and Seve nappe (Majka and Janák 2011; Janák et al. submitted) has profound implications for unravelling the mode of continental margin subduction and emplacement of UHP rocks, from their generation in the deeply subducted outermost margin of continent Baltica, to their accommodation in the allochthonous units following their transport onto the platform.

Rhodope UHP metamorphic province in northern Greece and southern Bulgaria represents a nappe system that formed during a protracted, Jurassic to Eocene history of subduction and collision events at the southern margin of the European continent. In two areas, the Kimi Complex of the Eastern Rhodopes and the Nestos Shear Zone of the Western and Central Rhodopes, ultrahigh-pressure (UHP) metamorphism was documented by finding of diamond (Mposkos and Kostopoulos 2001). Newly found eclogites from the Pirin Mountains of southwestern Bulgaria (Janák et al. 2011) suggest that the UHP metamorphism in the Rhodopes is more widespread than previously supposed.

The Alpine-Carpathian orogenic belt underwent at least two major orogenic cycles – Variscan and Alpine. The Variscan orogeny resulted from accretion and amalgamation of crustal blocks between Gondwana and Baltica-Laurasia. In the Western Carpathians, Variscan high pressure, eclogite facies metamorphic event has been recognised (Janák et al. 2007, 2009). The Cambro-Ordovician (500 – 450 Ma) magmatic rocks (metabasic and metagranitic orthogneisses) are witnesses of pre-Variscan basement of a Gondwana-derived microcontinent (terrane), which were later intruded by Variscan granitoids (365-300 Ma) (Broska et al. submitted). Alpine orogeny during the Mesozoic time resulted from a subduction-collisional events between the European and Apulian continental domains involving closure of two major oceanic sutures – Meliatic in the south and Penninic in the north. There is new information about the tectono-metamorphic evolution of superficial units (Milovský 2012a, b). Initial study of the hydrotectonic regime at soles of the overthrust sheets suggests that fluid overpressure facilitated the movement and thrusting.

Important information about composition of deep crust has been obtained also from the study of magmatic and crustal xenoliths ejected in Pliocene and Pleistocene alkali basalts in southern Slovakia (Huraiová et al. 1996). This research revealed partial melting and ultra-high temperature modification of gneissic crust induced by underplating of basaltic magma (Huraiová et al. 2005). In western part of Lučenec Basin, alkalic basalts evolved in stagnant lower- and middle-crustal reservoirs to form late-stage syenites (Hurai et al. 1998), which accumulate REE and other incompatible elements (Huraiová et al. 2007). Our ongoing studies revealed that more alkalic varieties of trachybasalts fractionated to carbonated syenites, from which calciocarbonatite melt separated by liquid immiscibility (Hurai et al. 2011). While general aspects of the Alpine-Carpathian orogeny have been already outlined, details on structure, metamorphic P/T paths, granite origin, timing and fluid regime remain unsolved.

## **(2) Sedimentary archives and fossil ecosystems**

The scale and focus of our current and planned projects is related to two major themes. First, the temporal history of Permian, Mesozoic and Cenozoic ecosystems and depositional basins is particularly well preserved in the Western Carpathians, and geological and biological events preserved in these basins are traditionally targeted in our studies. Depositional sequences preserved in the Western Carpathians record a unique archive of the evolutionary and ecosystem changes that occurred at regional to global scales, especially the mass extinction at the Triassic/Jurassic boundary, the Aptian anoxic events, Paleocene-Eocene thermal maximum, a cooling event at the Eocene/Oligocene boundary, and the Miocene climatic optimum (Michalík et al. 2007; 2010; Soták 2010; Tomašových and Siblík 2007). However, the timing of these events and the subsequent ecosystem response remain controversial and are typically well

explored in some regions of the world only. Therefore, much better spatial sampling of such events is required. To identify locations of such events and to infer the effects of such events on ecosystem extinction and recovery, we will focus on microbiostratigraphy (foraminiferal and nannoplankton assemblages), paleoecology, sequence stratigraphy and sedimentology of the Mesozoic and Cenozoic basins of the Western Carpathians and adjacent areas.

Second, models that seek to explain spatial and temporal distribution patterns and diversity of fossil organisms require that diversification rates of individual lineages over long time intervals and at broad spatial scales are properly quantified (Alroy et al. 2008, Hautmann et al. 2008). Presently, most analyses of evolutionary rates and temporal trends in diversity are performed at global scales, but they (1) lack a clear link between environmental conditions and ecosystem composition at regional scales (Tomašových and Kidwell 2009), and (2) are not properly corrected for scaling and preservational artefacts that are generated by fossilization processes (Tomašových and Zuschin 2009; Tomašových and Kidwell 2010a; b). We will mainly focus on ecosystems where highly resolved geochemical proxies can be obtained from unaltered fossils, including the estimates of seasonality in temperature based on high-resolution sampling of skeletal remains. We will thus focus on particular groups of organisms with a very high quality of the fossil record. Such analyses will be executed at broad provincial scales and even at global spatial scales (still constrained to the Mesozoic and Cenozoic). These groups include brachiopods (Tomašových 2008a; b; 2007; Tomašových et al. 2008), calcareous microplankton (Michalík et al. 2009), calcareous nannoplankton, molluscs (Tomašových and Schlögl 2008), foraminifers (Soták 2010), insects (Vršanský and Ansorge 2007; Vršanský 2010), and ostracods (Pipík and Bodergat 2007; Minati et al. 2008; Pipík et al. 2009).

### **(3) Other activities**

In the field of applied volcanology the era of systematic geological mapping of Neogene-Quaternary volcanic fields has been concluded by publication of geological maps 1 : 50 000 and synthesis in the scale 1 : 200 000 (Konečný et al. in Bezák (ed.) 2010). Since that time attention has been turned to paleovolcanic reconstructions (e.g. Konečný and Lexa 2000; 2001; 2002; Konečný et al. 2004; 2010; Lexa et al. 2010; 2011; 2012) and studies of volcanic evolution using isotopic dating (Pécskay et al. 2006; Konečný et al. 2010; Lexa and Pécskay 2010; Balogh et al. in prep., Chernyshev et al. in prep.; Hurai et al. 2010; 2012) including a broader region of the Carpathian volcanic arc and Pannonian basin. Essential aspects of relationship among evolution of volcanics and geodynamic processes have been established (Pécskay et al. 2006; Lexa et al. 2010). Ongoing research will focus on rhyolite and alkali basalt volcanics.

The state of the art metallogeny has been summarized in the Metallogenic map of Slovakia and its explanatory notes (Lexa et al. 2004; 2007). Our own research has been focused on siderite and magnesite mineralizations in the Spiš-Gemer region where a fundamental progress has been reached in understanding of relationship among mineralization and orogenic evolution (Hurai et al. 2008a; b; 2011) and on Neogene volcanic-hosted mineralizations analyzed in the context of magmatic/volcanic evolution and origin (Koděra et al. 2004; 2005; 2007; 2009; 2010; 2011). Ongoing research is focused on epithermal and porphyry type gold mineralizations in cooperation with industry and top specialists abroad.

The environmental research in the field of mineralogy and geochemistry was aimed at study of mining dumps and associated mining waters, commonly occurring around old mining works in Slovakia. The results enabled installation of wetland systems and of Fe<sup>0</sup>-barrier to clean both the contaminated groundwater and surface (drainage) water. In near future surrounding of the dump-fields will be cleaned by phytoremediation.

## **ii. Organisation's role or significance in the overall research effort within the field of the Concept on both the national and international scales**

As documented by the results and publications presented above, the research staff of the Geological Institute is traditionally strong and experienced especially in the fields of metamorphic and igneous petrology, geochemistry as well as paleobiology, stratigraphy and sedimentology on both national and international scale.

The scope of our research is fully in accordance with the Conception of geological research and exploration of the territory of Slovakia in the years 2012-2016 (with outlook to year 2020) approved by the Government of Slovak Republic.

International scope of our work is documented by extensive cooperation with foreign partners and increasing number of publications and citations in the high-rank journals. The ongoing and proposed projects VEGA and APVV have interregional aspects involving foreign co-workers from the Czech Republic, Austria, Germany, Norway, Slovenia, Sweden, France, New Zealand, Japan, USA, Canada, Mexico, Spain, Poland, Hungary, Russia and Ukraine. The quality of research will be significantly improved by data obtained from analytical equipments within Centre of Excellence for Integrative Research of the Earth's Geosphere which is currently under development in Banská Bystrica.

Creation of the tight cooperation with Energy and Geoscience Institute of the University of Utah open new perspectives in research on energy resources also using new laboratory acquisitions of the Centre of excellence in Banská Bystrica (stable isotope ratio mass spectrometer, Raman spectrometer, microthermometric freezing-heating stage).

## **iii. Objectives of the Concept**

### **(1) Transformations of Earth's lithosphere in collision orogenic belts**

The main objective is to understand the evolution of the orogen and to contribute to the knowledge of the orogenic processes in general. We shall focus on the following problems: (1) transformation of continental crust and upper mantle during deep subduction; (2) preservation of (U)HP minerals and their transformation during decompression and exhumation back to the Earth's surface; (3) reconstruction of metamorphic P-T-t paths of crustal and mantle rocks; (4) partial melting and formation of granitoid magma, with particular emphasis on the the role of water and oxidation-reduction conditions and evolution of S- and A-type granite magmatism; (5) the role of mafic (dioritic) magmas in the granite-genesis; (6) geodynamic interpretation of repeated magmatic events from the Ordovician to the Permian; (7) emplacement and transformations of basaltic magma reservoirs in the crust during continental rifting; (8) composition, age and metamorphic modification of thinned continental crust affected by asthenospheric diapirism; (9) fluid-rock interaction at upper mantle/lower crustal levels; (10) emplacement mechanism of the superficial units and the role of fluids in orogenic processes.

The selected working areas described above provide great opportunity to expand knowledge on (a) UHP metamorphism, partial melting and granitoid magmatism related to deep subduction of lithosphere during collision of continents, (b) reconstruction of paleotemperature and subsidence of sedimentary basins and tectonometamorphic processes in the low-temperature metamorphic terranes, and (c) the role of fluids in magmatic, metamorphic, tectonic and metallogenetic processes, in modern and fossil orogenic belts of the world where ongoing (Western Carpathians, Alps, Rhodopes, Scandinavian Caledonides) and forthcoming (Ladakh Himalayas, Belomorian belt) research will be carried out.

## **(2) Sedimentary archives and fossil ecosystems.**

There are two groups of major objectives in this field. First, to upgrade our knowledge of sedimentary formations in the Western Carpathians and to identify the signature of global events in the stratigraphic record of this region, our effort will be focused on: (1) collection of stratigraphic data useful for interregional correlation in the frame of international stratigraphic stage boundaries; (2) identification of global events that can be identified by biochronology, astrochronology, cyclostratigraphy, isotopic stratigraphy, chemostratigraphy, clay mineral composition, and tephrostratigraphy; and (3) analysis of reference sections with well-marked global events in the Mesozoic and Cenozoic formations of the Western Carpathians.

Second, we will attempt to quantify evolutionary rates and rates of change in ecosystem composition the basis of broad-scale field sampling and computer databases at regional and global scales during the Mesozoic and Cenozoic. These analyses will target specific groups of organisms (brachiopods, molluscs, foraminifers, insects, ostracods). The main objectives are (1) to assess the effect of differential preservation of individual species on the measured estimates of diversity and to quantify rates of preservation, (2) to quantify temporal changes in morphological variation in individual lineages through time, (3) to assess the relation between diversity and temporal and spatial gradients in environment (such as latitudinal gradient in temperature), and (4) to quantify seasonal variations in temperature and other environmental variables on the basis of Mg/Ca and stable isotopes preserved in organisms with a relatively high resistance to diagenetic alteration. Importantly, these objectives are coupled with the actual validation of the methods used in the proposed analyses by looking at recent ecosystems.

## **(3) Other activities**

In the field of applied volcanology our objective is paleovolcanic reconstruction of volcanic formations including their timing, thus contributing to understanding of volcanic processes in general. In the nearest future our attention will be focussed on growth of rhyolite extrusive domes and related processes in central Slovakia and Tokaj regions and alkali basalt volcanics of southern Slovakia and northern Hungary

In the field of metallogeny our objective is to contribute to general understanding of epithermal and porphyry type gold mineralizations based on thorough studies of well known and newly discovered deposits in Slovakia.

In the field of environmental mineralogy and geochemistry we shall focus our activities on the heavy metal-contaminated mining areas, phyto remediation (phytoextraction, phytoimmobilization) application as well as on finalization of the wetland systems.

In the cooperation with EGL we will preferentially study the geochemistry of shale and oil gas shists.

## **iv. Proposed strategies and methods to be applied, and time schedule**

### **(1) Transformations of Earth's lithosphere in collision orogenic belts**

Identification of UHP mineral phases requires a systematic study using state-of-art laboratory methods and instruments. Thermodynamic modeling in addition to conventional geothermobarometry will be used for precise determination of metamorphic P-T-t paths of crustal and mantle rocks. Chemical composition and density of the metamorphic fluids will be directly measured in fluid inclusions in critical minerals. The fluid parameters will be used to refine the P-T-X conditions of metamorphism and magmatism. Thermodynamic modeling can predict the presence of peak metamorphic fluid which may explain the absence of coesite that probably transformed to quartz as a consequence of the fluid-enhanced coesite-quartz transition. The knowledge of

compositions of metamorphic fluids ( $H_2O/CO_2$  ratio) is critical both for classical and pseudosection modelling. Origin and stability of accessory minerals under different P-T conditions will be investigated in both magmatic and metamorphic systems using modern laboratory techniques. The main emphasis during the first two years will be given to phosphates (apatite, monazite, xenotime), silicates (allanite, zircon, titanite) and Fe/Ti oxides.

A complex field and laboratory research involving modern methods (microprobe analyses, X-ray diffraction, Raman, infrared and mass spectrometry) will be employed. Geochemical study will use the major, trace elements, isotopes and maturity of organic matter. Geochronological dating employing the U-Pb, Sm-Nd, Lu-Hf and other isotopic systems will be performed in collaboration with foreign partners. (Bonn, Salzburg, Wien, Stockholm, Uppsala, Potsdam, Praha, Kraków, Tromsø, Clermont-Ferrand, Waikato) The outcome of our research will be published in the international journals and present at international conferences and meetings.

## **(2) Sedimentary archives and fossil ecosystems.**

Analyses of ecological and evolutionary dynamic of lineages, ecosystems, and environments require an integrated approach that combines outputs from multiple disciplines.

(1) Paleobiological, sedimentological and stratigraphic research of the Western Carpathians that will concentrate on identification of global events will require the application of multiple approaches that can detect them, including biochronology, astrochronology, cyclostratigraphy, climatostratigraphy, isotopic stratigraphy, chemostratigraphy, clay mineral composition, and tephrostratigraphy. An important part of our research is devoted to the selection of Global Stratotype Sequence and Points (GSSP) and to the determination of their age. Our opportunity is mainly in the integrated study of the Carnian/Norian, Triassic/Jurassic and Jurassic/Cretaceous boundaries in the Western Carpathians. As a subject of high interest, we will focus on the microorganisms that are prerequisite for high-resolution stratigraphy (HIRES), biostratigraphic zonation, and for detection of adaptive morphogenesis and evolutionary radiations.

(2) Ecological, biogeographic and evolutionary analyses of Mesozoic-Cenozoic groups with a good fossil record (brachiopods, calcareous microplankton, calcareous nannoplankton, molluscs, foraminifers, insects, and ostracods) at broader spatial scales will require a combination of field campaigns, the use of international collaborative databases (Paleobiology Database), computer-intensive stochastic modeling of ecology, evolution and preservation, geochemical laboratory analyses (stable isotopes, Mg/Ca ratio), taphonomic analyses (amino acid racemization and radiometric dating), and the study of type collections in natural history museums. In the course of the next years, our current projects have planned field campaigns devoted to sampling of mollusks and brachiopods (Italy, Poland, Morocco, California), insects and arthropods (Mexico, China), and ostracods (Central Europe).

## **(3) Other activities**

Paleovolcanic reconstructions are based on systematic field investigations and laboratory investigations including optical microscopy, microprobe analyses and chemical analyses. Structural analyses and magmatic anisotropy studies will be applied to rhyolite extrusive domes in cooperation with specialists from Czech Republic. A newly established cooperation with volcanologists of the Massey University, New Zealand shall be used for a necessary confrontation with active volcanoes and their products. The established cooperation with the K-Ar laboratory in Debrecen, Hungary, isotopic dating laboratory in Moscow (Russia) shall be used to improve timing of volcanic activity.

Metallogenetic research of volcanic hosted gold-bearing mineralizations is carried out in a close cooperation with the staff of the Natural Sciences Faculty of the Comenius

University in Bratislava using optical microscopy, XRD, microprobe, fluid inclusions and stable isotope analyses. Access to samples is guaranteed by cooperation with relevant exploration companies. Access to advanced laboratory techniques is secured via international cooperation (SUERC Glasgow, Kingston Univ. London, Technical University Zurich etc.). The research is covered by ongoing APVV project.

The environmental research and energy resources prospecting will fully use the newly established techniques in laboratories in Banská Bystrica. The ongoing environmental geochemical research will focus on research on places with cooper historical mining activities trying remedial the dump areas.

### **III. Partial indicators of the main activities:**

#### **1. Research output**

**i. List of the selected publications documenting the most important results of basic research. Total number of publications in the whole assessed period should not exceed the average number of the research employees**

- [1] ALROY, John - ABERHAN, Martin - BOTTJER, David J. - FOOTE, Michael - FÜRSICH, Franz T. - HARRIES, Peter J. - HENDY, Austin J. W. - HOLLAND, Steven M. - IVANY, Linda C. - KIESSLING, Wolfgang - KOSNIK, Matthew A. - MARSHALL, Charles R. - MCGOWAN, Alistair J. - MILLER, Arnold I. - OLSZEWSKI, Thomas D. - PATZKOWSKY, Mark E. - PETERS, Shanan E. - VILIER, Loik - WAGNER, Peter J. - BONUSO, Nicole - BORKOW, Philip S. - BRENNIS, Benjamin - CLAPHAM, Matthew E. - FALL, Leigh M. - FERGUSON, Chad A. - HANSON, Victoria L. - KRUG, Andrew Z. - LAYOU, Karen M. - LECKEY, Erin H. - NÜRNBERG, Sabine - POWERS, Catherine M. - SESSA, Jocelyn A. - SIMPSON, Carl - TOMAŠOVÝCH, Adam - VISSAGI, Christy C. Phanerozoic trends in the global diversity of marine invertebrates. In *Science*, 2008, vol. 321, p. 97-100. (26.372 - IF2007). ISSN 0036-8075.
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- [3] HURAI, Vratislav - JANÁK, Marian - THOMAS, Rainer. Fluid-assisted retrogression of garnet and P-T history of metapelites from HP/UHP metamorphic terrane (Pohorje Mountains, Eastern Alps). In *Contributions to Mineralogy and Petrology*, 2010, vol. 160, no. 2, p. 203-218. (3.497 - IF2009). ISSN 0010-7999.
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- [5] DE HOOG, Cees-Jan - JANÁK, Marian - VRABEC, Mirijam - FROITZHEIM, Nikolaus. Serpentinised peridotites from an ultrahigh-pressure terrane in the Pohorje Mts. (Eastern Alps, Slovenia): Geochemical constraints on petrogenesis and tectonic setting. In *Lithos*, 2009, vol. 109, no. 3-4, p. 209-222. (3.303 - IF2008). ISSN 0024-4937.
- [6] HURAI, Vratislav. Fluid inclusion geobarometry: Pressure corrections for immiscible H<sub>2</sub>O-CH<sub>4</sub> and H<sub>2</sub>O-CO<sub>2</sub> fluids. In *Chemical Geology*, 2010, vol. 278, no. 3-4, p. 201-211. (3.407 - IF2009). (2010 - Current Contents). ISSN 0009-2541.

- [7] TOMAŠOVÝCH, Adam - KIDWELL, Susan M. Accounting for the effects of biological variability and temporal autocorrelation in assessing the preservation of species abundance. In *Paleobiology*, 2011, vol. 37, p. 332-354. (3.045 - IF2010). ISSN 0094-8373.
- [8] TOMAŠOVÝCH, Adam - KIDWELL, Susan M. Fidelity of variation in species composition and diversity partitioning by death assemblages: time-averaging transfers diversity from beta to alpha levels. In *Paleobiology*, 2009, vol. 35, no. 1, p. 94-118. (2.800 - IF2008). (2009 - Current Contents). ISSN 0094-8373.
- [9] HURAI, Vratislav - PROCHASKA, Walter - LEXA, Ondrej - SCHULMANN, Karel - THOMAS, Rainer - IVAN, Peter. High-density nitrogen inclusions in barite from a giant siderite vein: implications for Alpine evolution of the Variscan basement of Western Carpathians, Slovakia. In *Journal of Metamorphic Geology*, 2008, vol. 26, no. 4, p. 487-498. (2.753 - IF2007). ISSN 0263-4929.
- [10] JEŘÁBEK, Petr - JANÁK, Marian - FARYAD, Shah Wali - FINGER, Friedrich - KONEČNÝ, Patrik. Polymetamorphic evolution of pelitic schists and evidence for Permian low-pressure metamorphism in the Vepor Unit, West Carpathians. In *Journal of Metamorphic Geology*, 2008, vol. 26, no. 4, p. 465-485. (2.753 - IF2007). ISSN 0263-4929.
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- [17] BROSKA, Igor - PETRÍK, Igor. Accessory Fe-Ti oxides in the West-Carpathian I-type granitoids: witnesses of the granite mixing and late oxidation processes. In *Mineralogy and Petrology*, 2011, vol. 102, p. 87-97. (1.287 - IF2010). ISSN 0930-0708.

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**ii. List of the selected publications documenting the most important results of applied research**

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- [2] ŠUCHA, Vladimír - UHLÍK, Peter - MADEJOVÁ, Jana - PETIT, S. - KRAUS, Ivan - PUŠKELOVÁ, Ľubica. Particle properties of hydrothermal ammonium-bearing illite-smectite. In *Clays and Clay Minerals*, 2007, vol. 55, no. 1, p. 36-44. (1.423 - IF2006). ISSN 0009-8604.
- [3] HURAI, Vratislav - LEXA, Ondrej - SCHULMANN, Karel - MONTIGNY, Raymond - PROCHASKA, Walter - FRANK, Wolfgang - KONEČNÝ, Patrik - KRÁL', Ján - THOMAS, Rainer - CHOVAN, Martin. Mobilization of ore fluids during Alpine metamorphism: evidence from hydrothermal veins in the Variscan basement of Western Carpathians, Slovakia. In *Geofluids*, 2008, vol. 8, no. 3, p. 181-207. (1.333 - IF2007). ISSN 1468-8115.

- [4] NEIVA, Ana - ANDRÁŠ, Peter - RAMOS, Joao M.F. Antimony quartz and antimony-gold quartz veins from northern Portugal. In *Ore Geology Reviews*, 2008, vol. 34, no. 4, p. 533-546. (0.987 - IF2007). ISSN 0169-1368.
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- [7] KRIŽÁNI, Ivan - ANDRÁŠ, Peter - ŠLESÁROVÁ, Andrea. Percolation modeling of the dump and settling pit sediments at the Banská Štiavnica ore-field (Western Carpathians, Slovakia). In *Carpathian Journal of Earth and Environmental Sciences*, 2009, vol. 4, no. 1, p. 109-126. (0.286 - IF2008). ISSN 1842-4090.
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- [9] MAJZLAN, Juraj - CHOVAN, Martin - ANDRÁŠ, Peter - NEWVILLE, Matthew - WIEDENBECK, Michael. The nanoparticulate nature of invisible gold in arsenopyrite from Pezinok (Slovakia). In *Neues Jahrbuch für Mineralogie - Abhandlungen*, 2010, vol. 187, no. 1, p. 1-9. (0.483 - IF2009). ISSN 0077-7757.
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- [11] PIŠŮT, Peter - BŘÍZOVÁ, Eva - ČEJKA, Tomáš - KYŠKA-PIPIK, Radovan. Paleofloristic and paleofaunistic analysis of Dudváh River oxbow and implication for Late Holocene paleoenvironmental development of the Žitný ostrov Island (SW Slovakia). In *Geologica Carpathica*, 2010, vol. 61, no. 6, p. 513-533. (0.963 - IF2009). ISSN 1335-0552.
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### iii. List of monographs/books published abroad

- [1] FEIST-BURKHARDT, Susanne - GÖTZ, Annette - SZULC, Joachim - BORKHATARIA, Ravi - GELUK, Mark - HAAS, János - HORNING, Jens - JORDAN, Peter - KEMPF, Oliver - MICHALÍK, Jozef - NAWROCKI, Jerzy - REINHARDT, Lutz - RICKEN, Werner - RÖHLING, Heinz-Gerd - RÜFFER, Thomas - TÖRÖK, Ákos - ZÜHLKE, Rainer. Triassic. In *The geology of Central Europe : Volume 2 - Mesozoic and Cenozoic*. - London : Geological Society, 2008, p. 749-821. ISBN 978-1-86239-264-9.
- [2] VOIGT, Silke - WAGREICH, Michael - SURLYK, Finn - WALASZCZYK, Ireneusz - ULIČNÝ, David - ČECH, Stanislav - VOIGT, Thomas - WIESE, Frank - WILMSEN, Markus - NIEBUHR, Birgit - REICH, Mike - FUNK, Hanspeter - MICHALÍK, Jozef - JAGT, John W. M. - FELDER, Peter J. - SCHULP, Anne S. Cretaceous. In *The geology of Central Europe : Volume 2 - Mesozoic and Cenozoic*. - London : Geological Society, 2008, p. 923-997. ISBN 978-1-86239-264-9.
- [3] PIENKOWSKI, Grzegorz - SCHUDACK, Michael E. - BOSÁK, Pavel - ENAY, Raymond - FELDMAN-OLSZEWSKA, Anna - GOLONKA, Jan - GUTOWSKI, Jacek - HERNGREEN, G. F. W. - JORDAN, Peter - KROBICKI, Michał - LATHULIERE, Bernard - LEINFELDER, Reinhold R. - MICHALÍK, Jozef - MÖNNIG, Eckhard - NOE-NYGAARD, Nanna - PÁLFY, József - PINT, Anna - RASSER, Michael W. - REISDORF, Achim - SCHMID, Dieter U. - SCHWEIGERT, Günter - SURLYK, Finn - WETZEL, Andreas - WONG, Theo E. Jurassic. In *The geology of Central Europe : Volume 2 - Mesozoic and Cenozoic*. - London : Geological Society, 2008, p. 823-922. ISBN 978-1-86239-264-9.

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

- [1] KRIŽÁNI, Ivan - ANDRÁŠ, Peter - LADOMERSKÝ, Juraj. Banické záťaže Štiavnických vrchov. Zvolen: Technická univerzita vo Zvolene, 2007. 100 s. ISBN 978-80-228-1825-4.
- [2] ELEČKO, Michal - KONEČNÝ, Vlastimil - KRIPPEL, Mikuláš - KUBEŠ, Peter - LEXA, Jaroslav - PRISTAŠ, Ján - ZAKOVIČ, Michal - VASS, Dionýz - VOZÁR, Jozef - VOZÁROVÁ, Anna - BODNÁR, Ján - HUSÁK, Ľudovít - FILO, Miroslav - LACIKA, Ján - LINKEŠ, Vladimír a kol. Geológia Lučenskej kotliny a Cerovej vrchoviny. Bratislava: Geologický ústav Dionýza Štúra, 2007. 277 s. ISBN 978-80-88974-92-5.

- [3] LEXA, Jaroslav - BAČO, Pavel - HURAI, Vratislav - CHOVAN, Martin - KODĚRA, Peter - PETRO, Milan - ROJKOVIČ, Igor - TRÉGER, Milan. Vysvetlivky k metalogenetickej mape Slovenskej republiky 1 : 500 000. Editor Jaroslav Lexa. Bratislava: Štátny geologický ústav Dionýza Štúra, 2007. 153 s. ISBN 978-80-89225-11-8.
- [4] MICHALÍK, Jozef - VASS, Dionýz - HUDÁČKOVÁ, Natália - KOVÁČOVÁ, Marianna - LINTNEROVÁ, Otília - REHÁKOVÁ, Daniela - SOTÁK, Ján - SCHLÓGL, Ján - AUBRECHT, Roman - VOZÁROVÁ, Anna - SLIVA, Ľubomír - LEXA, Jaroslav - KONEČNÝ, Vlastimil - TÚNYI, Igor - POTFAJ, Michal. Stratigrafická príručka: slovenská stratigrafická terminológia, stratigrafická klasifikácia a postupy. Bratislava: Veda, vydavateľstvo SAV, 2007. 168 s. ISBN 978-80-224-0979-7.
- [5] ANDRÁŠ, Peter - GAJDOŠ, Alfonz - KRIŽÁNI, Ivan - RUSKOVÁ, Jana. Monitoring a možnosti remediácie vybraných banských depónii Západných Karpát. Banská Bystrica : Univerzita Mateja Bela, 2009. 235 s. ISBN 978-80-8083-821-8.
- [6] BEZÁK, Vladimír - BIELY, Anton - BROSKA, Igor - BÓNA, Ján - BUČEK, Stanislav - ELEČKO, Michal - FILO, Ivan - FORDINÁL, Klement - GAZDAČKO, Ľubomír - GRECULA, Pavol - HRAŠKO, Ľubomír - IVANIČKA, Ján - JACKO, Stanislav, ml. - JACKO, Stanislav, st. - JANOČKO, Juraj - KALINČIAK, Michal - KOBULSKÝ, Ján - KOHÚT, Milan - KONEČNÝ, Vlastimil - KOVÁČIK, Martin - KOVÁČIK, Martin - LEXA, Jaroslav - MADARÁS, Ján - MAGLAY, Juraj - MELLO, Ján - NAGY, Alexander - NÉMETH, Zoltán - OLŠAVSKÝ, Mário - PLAŠIENKA, Dušan - POLÁK, Milan - POTFAJ, Michal - PRISTAŠ, Ján - SIMAN, Pavol - ŠIMON, Ladislav - TETÁK, František - VOZÁROVÁ, Anna - VOZÁR, Jozef - ŽEC, Branislav. Vysvetlivky k prehľadnej geologickej mape Slovenskej republiky: 1 : 200 000. Bezák Vladimír et al., editor Bezák Vladimír. Bratislava: Štátny geologický ústav Dionýza Štúra, 2009. 534 s. ISBN 978-80-89343-28-7.
- [7] JELEŇ, Stanislav - GALVÁNEK, Juraj - ANDRÁŠ, Peter - BENDÍK, Andrej - BELÁČEK, Boris - BOZALKOVÁ, Irena - GAÁL, Ľ. - GAJDOŠ, Alfonz - HÁBER, Milan - KONEČNÝ, Vlastimil - KRIŽÁNI, Ivan - LUPTÁKOVÁ, Jarmila - MAZÚREK, Jaroslav - MICHAL, P. - SOTÁK, Ján - STAŇOVÁ, Sidónia - ŠIMO, Vladimír - ŠURKA, Juraj - WETTER, Richard. Náučno-poznávací sprievodca po geologických a geografických lokalitách stredného Slovenska. Banská Bystrica: Geologický ústav SAV, 2009. 320 s. ISBN 978-80-970413-4-2.
- [8] ANDRÁŠ, Peter - RUSKOVÁ, Jana - RUSKO, Miroslav - LICHÝ, Adam - KRIŽÁNI, Ivan. Vplyv banskej činnosti v okolí Ľubietovej na krajinu. 1. vyd. Žilina: STRIX, n. f., 2009. 128 s. ISBN 978-80-89281-57-2.
- [9] ANDRÁŠ, Peter. Investigatívna geológia. 1. vyd. Banská Bystrica: Fakulta prírodných vied, Univerzita Mateja Bela, 2010. 139 s. ISBN 978-80-557-0022-9. OK
- [10] VOZÁR, Jozef - EBNER, Fritz - VOZÁROVÁ, Anna - HAAS, János - KOVÁCS, Sándor - SUDAR, Milan - BIELIK, Miroslav - PÉRO, Csaba. Variscan and Alpine terranes of the Circum-Pannonian Region. 1. vyd. Bratislava: Slovak Academy of Sciences, Geological Institute, 2010. 233 p. ISBN 978-80-970578-5-5.

**v. List of other scientific outputs specifically important for the Organisation (normalization, standardization, maps, etc.)**

- [1] BEZÁK, Vladimír - ELEČKO, Michal - FORDINÁL, Klement - IVANIČKA, Ján - KALIČIAK, Michal - KONEČNÝ, Vlastimil - KOVÁČIK, Martin - MAGLAY, Juraj - MELLO, Ján - NAGY, Alexander - POLÁK, Milan - POTFAJ, Michal - BIELY, Anton - BÓNA, Ján - BROSKA, Igor - BUČEK, Stanislav - FILO, Ivan - GAZDAČKO, Ľubomír - GRECULA, Pavol - GROSS, Pavel - HAVRILA, Milan - HÓK, Jozef - HRAŠKO, Ľubomír - JACKO, Stanislav, ml. - JACKO, Stanislav, st. - JANOČKO, Juraj - KOBULSKÝ, Ján - KOHÚT, Milan - KOVÁČIK, Martin - LEXA, Jaroslav - MADARÁS, Ján - NÉMETH, Zoltán - OLŠAVSKÝ, Mário - PLAŠIENKA, Dušan - PRISTAŠ, Ján - RAKÚS, Miloš - SALAJ, Jozef - SIMAN, Pavol - ŠIMON, Ladislav - TETÁK, František - VASS, Dionýz - VOZÁR, Jozef - VOZÁROVÁ, Anna - ŽEC, Branislav. Prehľadná geologická mapa Slovenskej republiky 1: 200 000. Editor Vladimír Bezák. Bratislava: Ministerstvo životného prostredia SR: Štátny geologický ústav Dionýza Štúra, 2008. ISBN 978-80-89343-21-8.
- [2] POLÁK, Milan - PLAŠIENKA, Dušan - KOHÚT, Milan - PUTIŠ, Marián - BEZÁK, Vladimír - FILO, Ivan - OLŠAVSKÝ, Mário - HAVRILA, Milan - BUČEK, Stanislav - MAGLAY, Juraj - ELEČKO, Michal - FORDINÁL, Klement - NAGY, Alexander - HRAŠKO, Ľubomír - NÉMETH, Zoltán - IVANIČKA, Ján - BROSKA, Igor. Geologická mapa Malých Karpát = Geological map of the Malé Karpaty Mts: 1:50 000. Bratislava: Štátny geologický ústav Dionýza Štúra, 2011. ISBN 978-80-89343-45-4.

**vi. Table of research outputs**

*Table **Research outputs** shows research outputs in number of specified entries; these entries are then divided by FTE employees with a university degree (from Tab. Research staff) for all Organisation at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).*

*(and the name of research organisations appears in the list of author)*

Research outputs	2007			2008			2009			2010			2011			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	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
chapters in monographs, books published abroad	0	0,000	0,00	6	0,290	19,42	1	0,048	2,45	1	0,050	2,41	2	0,100	5,03	10	2,0	0,098	5,21
chapters in monographs, books published in Slovakia	0	0,000	0,00	0	0,000	0,00	0	0,000	0,00	0	0,000	0,00	0	0,000	0,00	0	0,0	0,000	0,00
CC publications	16	0,784	41,24	30	1,450	97,09	37	1,785	90,69	24	1,204	57,83	20	1,000	50,25	127	25,4	1,248	66,21
scientific publications indexed by other databases (WOS)	3	0,147	7,73	2	0,097	6,47	3	0,145	7,35	1	0,050	2,41	0	0,000	0,00	9	1,8	0,088	4,69
scientific publications indexed by other databases (Scopus)	2	0,098	5,15	2	0,097	6,47	1	0,048	2,45	1	0,050	2,41	1	0,050	2,51	7	1,4	0,069	3,65
scientific publications indexed by other databases (GeoRef)	18	0,882	46,39	13	0,628	42,07	3	0,145	7,35	9	0,452	21,69	5	0,250	12,56	48	9,6	0,472	25,03
scientific publications in other journals	9	0,441	23,20	5	0,242	16,18	2	0,096	4,90	9	0,452	21,69	2	0,100	5,03	27	5,4	0,265	14,08
publications in proc. of international scientific conferences	7	0,343	18,04	14	0,677	45,31	11	0,531	26,96	8	0,401	19,28	4	0,200	10,05	44	8,8	0,432	22,94
publications in proc. of nat. scientific conferences	16	0,784	41,24	14	0,677	45,31	9	0,434	22,06	21	1,054	50,60	13	0,650	32,66	73	14,6	0,717	38,06
active participations at international conferences	74	3,627	190,72	75	3,625	242,72	74	3,570	181,37	69	3,462	166,27	41	2,050	103,02	333	66,6	3,273	173,62
active participations at national conferences	44	2,157	113,40	38	1,837	122,98	22	1,061	53,92	25	1,254	60,24	21	1,050	52,76	150	30,0	1,474	78,21

## vii. List of registered patents

[1]

## viii. Supplementary information and/or comments on the scientific output of the Organisation

We note in the List of monographs published abroad we have included four chapters from two monographs from renowned publishers because of their large extent.

## 2. Responses to the scientific output

Table **Citations** shows specified responses to the scientific outputs; these entries are then divided by the FTE employees with a university degree (from Tab. Research staff) for all Organisation at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).

Citations	2006			2007			2008			2009			2010			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	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
Web of Science	147	7,2	0,0	203	9,8	0,0	236	11,4	0,0	221	11,1	0,0	305	15,3	0,0	1112	222,4	10,9	0,0
Scopus	20	1,0	0,0	22	1,1	0,0	99	4,8	0,0	22	1,1	0,0	13	0,7	0,0	176	35,2	1,7	0,0
(specify Database 1)	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0,0
in monographs, conf. proceedings and other publications abroad	125	6,1	0,0	52	2,5	0,0	14	0,7	0,0	14	0,7	0,0	86	4,3	0,0	291	58,2	2,9	0,0
in monographs, conf. proceedings and other publications in Slovakia	124	6,1	0,0	87	4,2	0,0	110	5,3	0,0	134	6,7	0,0	71	3,6	0,0	526	105,2	5,2	0,0

**i. List of 10 top-cited publications from staff members since the establishment of the Organisation up to 2010 and number of their citations in the period 2006 - 2010**

- [1] CSONTOS, L. - NAGYMAROSY, András - HORVÁTH, Ferenc - KOVÁČ, Michal. Tertiary evolution of the Intra-Carpathian area: a model. In Tectonophysics, 1992, vol. 208, no. 1-3, p. 221-241. ISSN 0040-1951.

**Citations: 76**

- [2] PLAŠIENKA, Dušan - GRECULA, Pavol - PUTIŠ, Marián - HOVORKA, Dušan - KOVÁČ, Michal. Evolution and structure of the Western Carpathians: an overview. In Geological evolution of the Western Carpathians. - Bratislava: Geocomplex, 1997, p. 1-24. ISBN 80-967018-7-8.

**Citations: 50**

- [3] ALROY, John - ABERHAN, Martin - BOTTJER, David J. - FOOTE, Michael - FÜRŠICH, Franz T. - HARRIES, Peter J. - HENDY, Austin J. W. - HOLLAND, Steven M. - IVANY, Linda C. - KIESSLING, Wolfgang - KOSNIK, Matthew A. - MARSHALL, Charles R. - MCGOWAN, Alistair J. - MILLER, Arnold I. - OLSZEWSKI, Thomas D. - PATZKOWSKY, Mark E. - PETERS, Shanan E. - VILIER, Loik - WAGNER, Peter J. - BONUSO, Nicole - BORKOW, Philip S. - BRENNEIS, Benjamin - CLAPHAM, Matthew E. - FALL, Leigh M. - FERGUSON, Chad A. - HANSON, Victoria L. - KRUG, Andrew Z. - LAYOU, Karen M. - LECKEY, Erin H. - NÜRNBERG, Sabine - POWERS, Catherine M. - SESSA, Jocelyn A. - SIMPSON, Carl - TOMAŠOVÝCH, Adam - VISSAGI, Christy C. Phanerozoic trends in the global diversity of marine invertebrates. In Science, 2008, vol. 321, p. 97-100. (26.372 - IF2007). ISSN 0036-8075.

**Citations: 49**

- [4] KOVÁČ, Michal - KRÁL', Ján - MÁRTON, Emő - PLAŠIENKA, Dušan - UHER, Pavel. Alpine uplift history of the central western Carpathians: geochronological, paleomagnetic, sedimentary and structural data. In Geologica Carpathica, 1994, vol. 45, no. 2, p. 83-96. ISSN 1335-0552.

**Citations: 23**

- [5] JANÁK, Marian - FROITZHEIM, Nikolaus - LUPTÁK, Branislav - VRABEC, Mirijam - RAVNA, Erling J. Krogh. First evidence for ultrahigh-pressure metamorphism of eclogites in Pohorje, Slovenia: Tracing deep continental subduction in the Eastern Alps. In Tectonics, 2004, vol. 23, no. 5, tC5014, doi:10.1029/2004TC001641. (2.308 - IF2003). ISSN 0278-7407.

**Citations: 22**

- [6] BROSKA, Igor - PETRÍK, Igor - WILLIAMS, C. Terry. Coexisting monazite and allanite in peraluminous granitoids of the Tribeč Mountains, Western Carpathians. In American Mineralogist, 2000, vol. 85, p. 22-32. (1.842 - IF1999). ISSN 0003-004X.

**Citations: 20**

- [7] JANÁK, Marian - FROITZHEIM, Nikolaus - VRABEC, Mirijam - RAVNA, Erling J. Krogh - DE HOOG, Cees-Jan. Ultrahigh-pressure metamorphism and exhumation of garnet peridotite in Pohorje, Eastern Alps. In Journal of Metamorphic Geology. - Blackwell Scientific Publications, 2006, vol. 24, no. 1, p. 19-31. (3.083 - IF2005). ISSN 0263-4929.

**Citations: 19**

- [8] KOVÁČ, Michal - NAGYMAROSY, András - SOTÁK, Ján - ŠÚTOVSKÁ, K. Late Tertiary Paleogeographic Evolution of the West Carpathians. In Tectonophysics, 1993, vol. 226, no. 1-4, p. 401-415. (1.276 - IF1992). ISSN 0040-1951.

**Citations: 19**

- [9] HU, Xiumian - JANSA, Luba - WANG, Chengshan - SARTI, Massimo - BAK, Krzysztof - WAGREICH, Michael - MICHALÍK, Jozef - SOTÁK, Ján. Upper Cretaceous oceanic red beds (CORBs) in the Tethys: occurrences, lithofacies, age, and environments. In Cretaceous Research. - Elsevier, 2005, vol. 26, no. 1, p. 3-20. (0.588 - IF2004). ISSN 0195-6671.

**Citations: 18**

- [10] PETRÍK, Igor - BROSKA, Igor - LIPKA, Ján - SIMAN, Pavol. Granitoid allanite-(Ce): substitution relations, redox conditions and REE distributions (on an example of I-type granitoids, Western Carpathians, Slovakia). In Geologica Carpathica, 1995, vol. 46, no. 2, p. 79-94. ISSN 1335-0552.

**Citations: 17**

**ii. List of 10 top-cited publications from staff members published 2000 - 2010 and number of their citations in the period 2006 - 2010**

- [1] ALROY, John - ABERHAN, Martin - BOTTJER, David J. - FOOTE, Michael - FÜRSICH, Franz T. - HARRIES, Peter J. - HENDY, Austin J. W. - HOLLAND, Steven M. - IVANY, Linda C. - KIESSLING, Wolfgang - KOSNIK, Matthew A. - MARSHALL, Charles R. - MCGOWAN, Alistair J. - MILLER, Arnold I. - OLSZEWSKI, Thomas D. - PATZKOWSKY, Mark E. - PETERS, Shanan E. - VILIER, Loik - WAGNER, Peter J. - BONUSO, Nicole - BORKOW, Philip S. - BRENNIS, Benjamin - CLAPHAM, Matthew E. - FALL, Leigh M. - FERGUSON, Chad A. - HANSON, Victoria L. - KRUG, Andrew Z. - LAYOU, Karen M. - LECKEY, Erin H. - NÜRNBERG, Sabine - POWERS, Catherine M. - SESSA, Jocelyn A. - SIMPSON, Carl - TOMAŠOVÝCH, Adam - VISSAGI, Christy C. Phanerozoic trends in the global diversity of marine invertebrates. In Science, 2008, vol. 321, p. 97-100. (26.372 - IF2007). ISSN 0036-8075.

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**iii. List of top-cited authors from the Organisation (at most 10 % of the research employees) and their number of citations in the period 2006 - 2010**

- |     |                                 |     |
|-----|---------------------------------|-----|
| [1] | Broska I. – Number of citation: | 184 |
| [2] | Janák M. – Number of citation:  | 140 |
| [3] | Soták J. – Number of citation:  | 131 |

#### **iv. Supplementary information and/or comments on responses to the scientific output of the Organisation**

We note that in last years an increase in quality of our research output is evident, e.g. number of WOS citations grows and the publications are prepared often for high ranked journals with IF above average (e.g. 2-3), in one case it was journal Science. Important output of the Institution is editing of monography by J. Vozár 2010: Variscan and Alpine terranes of the Circum-Pannonian Region (pp. 1-231).

The major publications of researcher from the Institute were submitted to ISI journals indicating the quality of scientific output. The number of citations from ISI sources grows by ca. 15-30 % per year (from 140 in 2006 to 315 in 2010) and since 2007 their number exceeds the number of citations from other sources. The citations in chapter iii are only those which are accessible from WOS and Scopus and do not involve other sources (monographs, books, manuscripts etc.).

### **3. Research status of the Organisation in the international and national context**

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

- i. **List of the most important research activities documenting international importance of the research performed by the Organisation, incl. major projects (details of projects should be supplied under Indicator 4). Provide the arguments why the selected projects are particularly important and represent the international position of the Organisation ).**

1. Research activities of Geological Institute SAS are very variable, including the solution of various projects within international cooperation, organisation of the international conferences, and participation on wide UNESCO international geological cooperative projects (IGCP).
2. J. Michalík is chairperson of IGCP National committee of UNESCO Commission, Ministry of Foreigner Affairs SR. Moreover, J. Michalik is a voting member in Triassic and Cretaceous subcommissions of the International Commission on Stratigraphy ICS.
3. M. Janák has been asked to participate and subsequently collaborated on study of UHP metamorphism in Rodope through German Science Foundation project led by prof. Froitzheim (University Bonn) and in Scandinavian Caledonides through collaboration with. prof. Erling Krogh Ravn (Univ. Tromso) and prof. D. Gee (Uppsala University). M. Janák is representative of Slovakia in the international committee on UHP metamorphism led by prof. L. Dobrzhinetskaya (USA).
4. J. Lexa as an expert in volcanology solved project on geological hazards in Salvador where the solution for local authorities on protection of urban areas against to local volcanoes have been provided.
5. Our geological research is basically international and most of our projects during the assessment period profit from international collaboration – e.g. A. Tomášových most of his research time in the assessed period spent in USA working on project devoted to bivalves (4 years), and shorter research stays were undertaken by Vršanský (China, Russia).
6. Establishing the Energy Geoscience Laboratory at the Geological Institute SAS, as joint working place of our institution and Energy Geoscience Institute at Utah University (Salt Lake City) manifests the international character of our activities.

7. Publishing of scientific journal *Geologica Carpathica* in cooperation of Geological Institute of Czech Academy of Science and Polish Geological Survey is the other expression of the institutional position in the international frame.
8. At last but not least, also the four months sabbatical of professor N. Froitzheim from Bonn demonstrates the response of our Institution among geological community.
9. Institute established the current cooperation on magnetostratigraphy, microbiostratigraphy with Czech and Polish scientific group solving the problems of Mesozoic stratigraphy.
10. Scientific workers of GI SAS were asked for reviews of tens of manuscripts of articles proposed for publication in high ranked scientific journals such as *American Mineralogist*, *Canadian Mineralogist*, *Lithos*, *Mineralogy and Petrology*, *Mineralogical Magazine*, *International Journal of Geology*, *Sedimentology*, *Cretaceous research*, *Jahrbuch für Paläontologie*, *Acta Geologica Polonica* etc. They also acted as reviewers for many grant applications from abroad.

In following, some international impacts of selected projects solved at Institution will be shown in detail, followed by the list of the most important international conferences where the employees of Institute took part as organising members:

- [1] Projekt 529: **Magneto-, bio-, and carbon isotope stratigraphy of Valanginian and Hauterivian sequence in the Fatric of the Western Tatra Mts and Strazov Mts (PL-SR)**. (2004-2007), Grabowski J. (PIG Warszawa) – coordinator, M. Michalik – project manager - **International impact:** Polish - Slovak cooperation in evaluation of Lower Cretaceous complexes resulted in magnetostratigraphic and sequence stratigraphic correlation of centro-Carpathian units, namely of the Křížna superficial nappe. Moreover, effect of remagnetization was recognized: central part of the Zliechov partial nappe dipping under sharp angle was affected by synthrust remagnetization during Turonian. These results are important from view of complex study of structure and origin of the Alpine – Carpathian mountainous belt. The results were published in two papers in current international journals.
- [2] **The interpretation of genetic and time relations between magmatism and epithermal ore formation in volcanic structures of the Central Slovak Neovolcanic field**. (2005-2007), Černyšev, Kovalenker (IGEM RAN Moskva) – coordinator, Lexa, Jeleň – project manager - **International impact:** One of international projects addressing an important problem of relationship among magmatism and epithermal mineralization, based on the opportunity given by mineralizations of the Central Slovakia Volcanic Field and outstanding results reached in this area by the Slovak team in cooperation with experts from Russia. Results contribute to understanding of metallogenetic processes in general.
- [3] APVT-51-013604 **Lithium in granites of the Western Carpathians: occurrences and perspectives** – I. Petřík – 1.2005-12.2007 - **International impact:** Lithium occurrences are not common and any new information on the Western Carpathian Li bearing granites is important for international correlation with Czech, French, Spanish or other regions with similar rocks. The project helped to discover a new phosphorus rich mineralization heretofore known only from pegmatites. Comparison with Czech localities helped solve the problem.
- [4] **Tectonic control on the Triassic evolution of the carbonate platforms of the Alp-Carpathian-Dinarid region**. (2006-2009), Michalík – project manager - **International impact:** International cooperation on correlation of Triassic carbonate platforms was focused on SE part of the Mediterranean Tethysides, covering the territory of member states of the Carpathian-Balkan Geological Association. The results contributed to knowledge of Triassic lithostratigraphy of the Alpine- Carpathian Orogenetic System.

- [5] ATBI+M All Taxa **Biodiversity Inventory & Monitoring** (2006-2010), Kyška-Pipík – project manager - **International impact:** European Distributed Institute of Taxonomy (EDIT) in the frame of Workpackage WP7 organises 'All Taxa Biodiversity Inventories (ATBIs). The project assesses the biodiversity within the selected protected areas in the Europe with aim to built the web-based tools for species descriptions and identification (“cybertaxonomy”) to accelerate European biodiversity assessments.
- [6] APVV-51-046105 **Ultrahigh-pressure metamorphism in Pohorje and correlation of the eo-Alpine tectonometamorphic evolution of the Eastern Alps and Western Carpathians** – Janák – 03.2006-02.2009 - **International impact:** The project on ultrahigh-pressure metamorphism in the south-eastern part of the Alps (Pohorje Mts.) in cooperation with several international partners (Slovenia, Germany, Austria, Sweden, Norway). Ultrahigh-pressure metamorphism in Pohorje has a profound consequences for unravelling the mode of continental subduction and exhumation in the Alps during the Cretaceous orogeny. This together with new data on Alpine metamorphism in the Western Carpathians enabled better elucidation and correlation of eo-Alpine evolution of the Eastern Alps and Western Carpathians. The outputs have general aspects, providing information on processes in deep orogenic zones, and mode of subduction and exhumation of UHP rocks.
- [7] NSF-EAR 0345897 **Quantifying sedimentary capture of biological information.** (2006-2009), Tomášových (SR) – project manager - **International impact:** The potential of fossil assemblages to capture reliably such ecological patterns is of crucial significance to all paleoecological and evolutionary analyses based on the fossil record. In this project, we thus assessed preservation potential of multiple community-level ecological attributes (alpha and beta diversity) in multiple live-dead benthic datasets sampled at unprecedented (global) scale in present-day environments.
- [8] GA–2/6026/26 **National and regional boundary stratotypes of Mesozoic stages in Western Carpathians – a contribution to the IUGS Programme „Global stratotype sections and points** – Michalík - 01.2006-12.2008 - **International impact:** The Program of IUGS and UNESCO called GSSP is oriented on erection of national and regional stratotype network fixing important boundaries of Global Stratigraphic Scale. In our territory this task is especially needed, as the lithostratigraphy of Mesozoic units in the Carpathians need to be redefined according to ‘the International Stratigraphic Guide. The project contributed to this effort by a series of new data published in important scientific journals with high international impact.
- [9] GA–2/6093/26 **Integrated stratigraphy and global sedimentary records in Upper Cretaceous and Paleogene formations of the Western Carpathians: regional stratotypes and interregional stratigraphic correlations** – Soták - 1.2006-12.2008 - **International impact:** The international impact of the project have been provided by presentations on numerous conferences and symposiums, like 33. International Congress in Oslo, international conference CETEG in Upohlav, workshop of the IGCP 506 project in Tunisia, Paleontological meeting in Warszawa, conference ESSE-WECA in Bratislava.
- [10] GA–2/6002/26 **Evolution of Mesozoic cockroaches in respect to global changes and origin of social termites, and predatory mantids** – Vršanský - 01.2006-12.2008 - **International impact:** The most complex analysis based on 100,000 fossil samples of cockroaches and their relatives from all continents and age (320Ma- today).

- [11] MVTS-UNESCO **Evolutionary patterns and global environmental changes as indicated by cockroaches, mantids and termites**, (2006-2009), Vršanský – coordinator - **International impact:** Analysis of global evolutionary patterns revealed by cockroaches: origin of eusociality, predatory way of life, bioluminescence, parasitisms (including the new insect order, the Nakridletia for pterosaur parasites), jumping specializations, and branching patterns of phylogenetical trees. Analysis of diverse Mesozoic and Tertiary ambers.
- [12] Projekt UNESCO/IGCP 506 **Marine and non-marine Jurassic: Global correlations and Major Geological Events**. (2006–2009), J. Michalík – researcher and coordinator for Central Europe. - **International impact:** Project of International Geoscience Correlation 506 continued in important aspects of its forerunner, IGCP 356 (TRIBE): important workshop was organized also in territory of Slovakia (Stara Lesna). Slovak participants contributed to meetings in Poland (one fieldtrip along Pieniny Klippen Belt during the Congress in Cracovia) and mainly to magnificent Jurassic Congress in Shehong, China (where the Slovak flag was put in the front of the Congress Hall, as an appreciation of Slovak participation). Several important contributions were brought, especially conference talks and impacted papers in international journals.
- [13] Projekt UNESCO/IGCP No. 555 **Rapid environmental/climate change in the Cretaceous Greenhouse World**. (2007-2010), J. Soták – coordinator for SR - **International impact:** The project was focused to the causes, processes, and consequences of rapid environmental changes in the Cretaceous greenhouse world. The results of the IGCP 555 project contribute to understanding of potential variations in the Earth's future climate. This research was carried out within the international scientific team with participation of the Slovak micropaleontologists.
- [14] APVV-SK\_MAD-01106 **Tops of hydrothermal systems related to rhyolite magmatism**. (2007-2008), J. Lexa – coordinator - **International impact:** Based on the opportunity given by eroded epithermal systems of the Central Slovakia Volcanic Field and less eroded systems in Tokaj a common model of such the systems has been elaborated. Results contribute to general understanding of epithermal systems and help exploration activities for precious metals.
- [15] Project MAD s RF **Upper Jurassic Karabastau Formation in Kazakhstan**. (2007-2008), Vršanský – coordinator - **International impact:** The review of the richest world locality with more than 100 species. The discovery of the jumping cockroach was a part of the Top 10 biological discoveries in the world and was popularised in all world media including BBC, National Geographic etc.
- [16] Project 32: **Miocene to recent tectonic activity of Orava-Nowy Targ Basin**. (2007-2012), 12 tis. Sk (2007); Starek (SR), Swierczewska (PL) – coordinators - **International impact:** The Orava-Nowy Targ Intramontane Basin is one of the very few seismically active areas within the Western Carpathians. Polish - Slovak cooperation resulted in reconstruction of the tectonic history of the basin which was formed during three successive stages. The results are accepted to publication in current international journal.
- [17] MVTS - **Mesozoic ambers from France**. (2007-2008), Vršanský – coordinator - **International impact:** The first complex description of any dinosaur-age amber (only 6 in the world) reveal the most primitive eusocial organism of the planet – the eusocial cockroach and 17 important samples including new indigenous family. This material was the first one systematically evaluated using synchrotron in Grenoble.
- [18] APVV-0109-07 **Microevolution, trends of adaptation and paleoenvironmental factors in the radiation of Ostracoda in the Middle and Late Miocene of the**

**Central Paratethys** – Kyška-Pipík - 2.2008 – 12.2010 - **International impact:** With the onset of lacustrine conditions in Late Miocene in Central Paratethys area, surviving polymorphic species settled Lake Pannon and started to adapt on brackish-freshwater condition in relation to depth of water environment. The Early Pannonian regression in less than 0.5 Ma after emergence of the lake eliminated littoral populations which with onset of new transgressive cycle were replaced by neoendemic littoral taxa displaying a limited morphometrical similarity to their ancestors and contemporaneous sublittoral relatives. A settlement of the brackish deltaic environment was conditioned by a rate of sedimentation and local anoxic conditions. Oxic sublittoral environment was predominantly settled by Candoninae displaying a high morphological variability and having occasionally specific anatomical structures homological to marine taxa. Other ostracod groups show low morphometrical change (Cyprideis) in sublittoral conditions, high species variability and high (Leptocytherinae) or low (Hemicytherinae) species diversity.

- [19] APVV-0248-07 **Evaluating and modeling ecological stability and turnover of Jurassic communities** – Tomášových - 02.2008 – 12.2010 - **International impact:** We have constructed one of the first simulation models that quantifies the role and significance of temporal scaling on the stability and turnover of fossil communities. The outputs of this project demonstrate that a high stability of fossil communities observed in empirical datasets can be generated purely by high degree of temporal averaging.
- [20] GA–2/0068/08 **Evolutionary ecology and preservation of macrobenthic ecosystems on the Jurassic pelagic carbonate platforms** – A. Tomášových - 2008-2010 - **International impact:** Tests of temporal stability of fossil communities responding to environmental changes at multiple time scales and over long temporal durations inform us on the strength of resilience and resistance of ecosystems to external changes. In this project, we have quantified stability and temporal changes in species richness, body size and abundance of benthic and pelagic organisms that inhabited unique seamount-like environments of pelagic carbonate platforms in the Western Tethys during the Jurassic.
- [21] GA–2/0072/08 **Tectonic interpretation of West Carpathian Internides based on CELEBRATION 2000 data** – seismic and gravity transects – Vozár - 2008-2010 - **International impact:** Integrated research revealed the deep-crustal structures within central European realm including Eastern Alps, Western Carpathians, Czech massif, Panonian basin and Poland area. The knowledge of Earth lithosphere is important for prediction of the oil, gas and geothermal energy sources.
- [22] SYNTHESYS GB-TAF-4361: **Living and Fossil non-marine Ostracoda of Europe.** (2008), R. Kyška-Pipík – project manager - **International impact:** An investigation of the limnic Miocene deposits reveals an antiquity of the modern European freshwater species going to the Middle Miocene. An uncertainty in the systematic determination of the Miocene species results of high morphological similarity between the extant taxa and the fine diagnostic details in which the taxa differ. This project appreciated a generic and species status of the Paratethyan taxa outside of the Late Miocene Lake Pannon and an endemism of the Lake Pannon.
- [23] Paleontological Society - Sepkoski Grants 2008: **Species-level microevolutionary changes at the transition from marine to lacustrine environments.** (2008-2009), R. Kyška-Pipík – project manager - **International impact:** *Hemicytheria omphalodes* survived two important ecological and geographical turnover in the Miocene of Central Europe within 3.5 Ma. It can be supposed as a species with a wide ecological plasticity, which settled new brackish Lake Pannon and diversified in many species mainly in the southern part of the lake.

- [24] **Comparative mineralogical-geochemical analysis of Au-Ag-Bi-Te-Se mineralization of neovolcanites and crystalline complexes of Ukraine and Slovakia (Carpathian region).** (2008-2010), project manager, Jeleň – coordinator SR - **International impact:** Comparative analysis of telluride occurrences found in the territory of Slovakia and Transcarpathians (Ukraine) has shown that there is distinct difference between the mode of Au-Ag-Bi-Te-Se mineralization of these regions. The number of tellurides in Transcarpathian region of Ukraine is much less in comparison with their numerous varieties, which have been found in Slovakia region. But at the same time, telluride mineralization shows common association with gold occurrences, a lot of which have been found, with;in the territory of Slovakia. As to the tellurides of Transcarpathian gold deposits of Ukraine they are either extremely rare minerals in it (Sauliak) or even absent as a whole (Beregovo). Among known tellurides established within Transcarpathian region of Ukraine there are mostly bismuth tellurides associated with metasomatites of the Vihorlat; Guta ridge. This mineralization has some similarities to occurrences of Bi;tellurides well known in neovolcanites of Slovakia (Poruba pod Vihorlatom, Remetské Hámre).
- [25] NOAA California Sea Grant Program “Urban Oceans” - **Estimating impacts of past natural and anthropogenic disturbances on shelf macrobenthic communities using dead-shell assemblages.** (2008-2009), Kidwell (USA) – coordinator, Tomašových – coordinator SR - **International impact:** This is one of the first studies that estimated the strength of anthropogenic modification in marine shelf ecosystems on the basis of skeletal assemblages of organisms that died in the Southern California Bight over the last several thousands of years. Such assemblages uniquely record the composition of pristine communities (predating the human immigration into this region).
- [26] Projekt P20018-N10 **Macro- and microfossils, isotopes, litho- cyclo-, magneto- and biostratigraphy as tools for investigating the Lower Cretaceous within the Dolomites (Southern Alps, Northern Italy) - the Puez area as a new key region of the Tethyan realm.** (2008-2011), Soták – project manager - **International impact:** Project was focused to stratigraphic study of the Puez section in the Austrian Dolomites, which is believed to represent an important international stratotype section for definition of the Cretaceous stages in the Northern Tethyan region. Therefore, the research team comprised of superior scientists in paleontology, microbiostratigraphy and paleomagnetostatigraphy, which provided a high-resolution study of various fossil groups and analytical methods.
- [27] SYNTHESYS BE-TAF-4362: **Non-marine cosmopolitan and endemic Ostracoda.** (2008), R. Kyška-Pipík – project manager - **International impact:** A morphometrical disparity between the living and fossil species of brackish genus Cyprideis in the world non-marine basins has been evaluated. The evolutionary success of this genus is related with the existence of the long lived lakes, their long term stability and ecological and geographical barriers existed within them and tropical climate.
- [28] Project ACCORD – **Cr-spinels - indicators of the position and sedimentary environment of the rocks in different units of the Western Carpathians and the Alps** NHM London, J. Spišiak, T. Mikuš - **International impact:** Cr-spinels are a part of ophiolite detritus and are of vital importance in the study of geotectonic position of the rocks in which they occur. This study can thus offer an answer to important questions on the sources from which Cr-spinels were derived, migration during transport, tectonic movements of sediments containing Cr-spinels etc. The comparison of spatial and time distribution of Cr-spinels in different geotectonic units of the Western Carpathians and Alps will be of regional importance.

- [29] AMBA framework **Global evolutionary patterns and environmental change indicated by the fossil record of cockroaches, termites and mantises** (2009-2013), Vršanský – coordinator - **International impact:** International cooperation with more than 50 countries aimed at preservation of large scale areas within the framework of recent and future UNESCO sites.
- [30] GA-2/0060/09 **Evolution of the non-marine Ostracoda in climatically and geographically evolving Europe Neogene** – Kyška-Pipík - 01.2009-12.2011 - **International impact:** The highest diversity of the non-marine ostracods at the territory of the Middle Europe existed in the Late Miocene due the presence of two long-lived lakes. The evolution of these faunae was controlled by geographical changes in the lake surrounding. The influence of the climatic change, observed during Neogene, was insignificant. After a disappearance of these lakes, the faunae extinct or, rarely, migrated towards the Eastern Europe and thus their contribution to the Middle Europe fauna diversity is none. The Middle Europe fauna existed as independent entity in the marginal facies of the long-lived lake in that time.
- [31] GA-2/0125/09 **Origin of eusociality: cockroach-termite transition** – Vršanský - 01.2009-12.2012 - **International impact:** Discovery of the earliest eusocial termites from the Jurassic sediments of Siberia, the most primitive eusocial organisms in Mesozoic ambers, description of the stem (for termites) cockroaches, analysis of eusociality as a phenomenon and parallels of eusociality within diverse insects, humans and naked mole rats.
- [32] **Paleovolcanic reconstruction and evolution of silicic volcanic formations in Carpathian-Pannonian region.** (2010-2012), Lexa - coordinator - **International impact:** One of the international projects reflecting our outstanding achievements in the field of volcanology. Results contribute to understanding of rhyolite volcanism in general and its role in evolution of the Central Slovakia Volcanic Field. Our experience is also used to interpret other areas of silicic volcanism in the region. K/Ar dating carried out in international cooperation changed fundamentally our view on the evolution of rhyolite volcanic activity and its relationship to epithermal systems.
- [33] DEB-0919451 **Bivalves in Time and Space: Testing the accuracy of methods to reconstruct ancestral morphology, dates, geography, and diversification patterns.** (2010-2011), Tomášových – project manager - **International impact:** Analyses that attempt to decompose diversification dynamic and community assembly in space are crucial in our understanding of biodiversity patterns and extinction risk. We were testing of the relation between latitudinal gradients in geographic range size and latitudinal gradients in species richness, using a unique global dataset with spatially-explicit occurrences of marine bivalves.
- [34] **Geology and evolution of Au-Ag-Bi-Te-Se of associations of deposits and ore manifestations of Ukraine and Slovakia.** (2011-2013), Jeleň – coordinator - **International impact:** The main task of the project is the determination of formation conditions of minerals of Au-Ag-Bi-Te-Se geochemical association that are genetically associated with neovolcanites of the West and East parts of Carpathian mountains (mainly Vyhorlat-Huta zone with Ilkovtsy, Podulki a Smerekiv Kamin localities, Ukraine and wider vicinity of Poruba pod Vihorlatom, Slovakia). The important results of the project execution will be reconstruction of physical and chemical conditions of the formation of bismuth tellurides and selenides as well as other minerals crystallochemically related to them; revealing of relation existed between Bi-Te-Se mineralization and silver - gold mineralization
- [35] **Climate and biota of the Early Paleogene.** (2011), Soták – coordinator - **International impact:** The research of the CBEP working group is focused to the conditions of instability of the Earth climatic systems since the Cretaceous time. The

research work of this group is attended by numerous specialists in biostratigraphy, environmental micropaleontology, litogechemistry, sedimentology, etc. CBEP meeting 2011 with participation of investigator from our institution was taking place in Salzburg.

## ii. List of international conferences (co-) organised by the Organisation

- [1] **UKV4 – Frontiers of Science Symposium**, Poland Krakow – 20.2.-24. 2. 2007 (convenors: R. Kyška-Pipík, P.Vršanský)
- [2] **8th Czech-Polish-Slovak paleontological conference**, SR, Bratislava – 16-17. 6. 2007 (A. Zlínska, ŠGUDŠ, J. Michalík)
- [3] **International Conference of Graduate Students and Young Scientists**, SR, Herľany - 2–4. 4. 2007, (member of organising committee B. Chalupová)
- [4] Conference **MIMET – Mineral equilibria, metasomatism, and mass transport: Evolution and stabilization of Rock on a fluid-rich world**, SR, Smolenice, 8-11. 4., 2008 (organisers I. Broska, I. Petřík, M. Janák, S. Jeleň).
- [5] **CETeG - 6<sup>th</sup> Meeting of the Central European Tectonic Studies Group**, Úpohlav, 23–26. 4. 2008. (convenors: J. Lexa, CSc., J. Soták, CSc. and N. Halašiová).
- [6] **ESSE WECA - Environmental, Structural and Stratigraphical Evolution of the Western Carpathians**, SR, Bratislava – 4–5. 12. 2008
- [7] **Earth in the trap?** – Analys of environment components, SR, Vyhne - 28–30. 4. 2008. (convenor: P. Andráš).
- [8] **IXth International geological conference of PhD. Students and young scientists**, PL-SR, Zawoja – Herľany – 3.–6.4.2008 (organizer: B.Chalupová)
- [9] **10th Czech-Polish-Slovak paleontological conference**, SR, Čachtický, Banská Bystrica, 13.10.-15.10.2009
- [10] **Conference of young geologists**, SR, Jur pri Bratislave, 29. 4-2. 5.2010 (organizer: B.Chalupová)
- [11] **Stratigraphic context of taphonomy and paleoecology**, Austria, Vienna, 4. 5. 2010
- [12] **16th Conference on the Neogene**, Czech Republic, Brno, 3-4. 06. 2010
- [13] **Bonds and Bridges: Mineral sciences and their applications**. IMA 2010 – Congress of International mineralogical asociation: Hungary, Budapešť, 21-27. 08. 2010; Member of international organising committee: I. Broska
- [14] **V4 Academies**, ČR, Třešť, Academy of Sciences of Czech Republic, 23-24. 9. 2010
- [15] **EGI Corporate Associate European Spring Meeting**, SR, Smolenice, 28.3. -1. 4. 2011
- [16] **4th International workshop on Neogene of Central and Southeast Europe**, SR, Banská Bystrica, 12-16. 09. 2011.

### iii. List of international journals edited/published by the Organisation

- [1] *Geologica Carpathica*  
 2007 – Vol. 58, no 1-6, IF=0.517  
 2008 – Vol. 59, no 1-6, IF= 1.081  
 2009 – Vol. 60, no 1-6, IF= 0.963  
 2010 – Vol. 61, no 1-6, IF= 0.909  
 2011 – Vol. 62, no 1-6, IF= not yet known

### iv. List of edited proceedings from international scientific conferences and other proceedings

- [1] *Mineral Equilibria, Metasomatism and Mass Transport: Evolution and Stabilisation of Rock on a Fluid-Rich World: Proceedings from MIMET 2008 Workshop* Smolenice, Slovak Republic, April 8th – 10th 2008. Editors: Daniel Harlov, Igor Broska. Bratislava: Geological Institute, Slovak Academy of Sciences, 2008. 128 p. ISBN 978-80-969919-6-9.
- [2] *Fossils - Darwin - Evolution: 10th Anniversary Conference of the Czech, Polish and Slovak Paleontologists. Abstracts and Guide of Excursion.* Editors: Radovan Kyška-Pipík, Ján Soták, Sidónia Staňová. Banská Bystrica: Faculty of Natural Sciences, Matej Bel University, 2009. 82 p. ISBN 978-80-8083-807-2.
- [3] *The 4th International Workshop on the Neogene from the Central and South-Eastern Europe: Abstracts and Guide of Excursion, September, 12 - 16, 2011* Banská Bystrica, Slovak Republic. Editors: Radovan Pipík, Dušan Starek, Sidónia Staňová; editor Radovan Pipík, Dušan Starek, Sidónia Staňová. Banská Bystrica: Faculty of Natural Sciences, Matej Bel University Banská Bystrica, 2011. 64 p. ISBN 978-80-557-0216-2.

- **National position of the Organisation**

- i. **List of selected most important national projects (provide the arguments why the selected projects are particularly important and represent the international position of the Organisation)**

**Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA)**

- [1] GA–2/6092/26 - **Relics of eclogite facies metamorphism in the basement of the Western Carpathians** – Janák - 01.2006 - 12.2008 - **International impact:** The aim of a project - study of high-pressure, eclogite facies rocks in the crystalline complexes of the Western Carpathians. P-T conditions and timing of metamorphism and exhumation have been constrained by geochronological methods using different geochronometers (U-Pb, Sm-Nd and Ar-Ar isotopic systems) in cooperation with foreign partners from Canada, USA and Austria. The reconstruction of metamorphic P-T-t paths followed by eclogite facies rocks can decipher the mode and timing of subduction and exhumation. This can provide a fundamental framework for elucidating the overall geodynamic evolution of the orogenic belt with implications for the geological history of the Western Carpathians.

- [2] GA–2/6094/26 **Mineral assemblages of the oxidation zone from Banská Štiavnica – Hodruša ore district** - Jeleň - 01.2006 - 12.2008 - **International impact:** The interesting and varied Mn and Fe mineral association was described in the oxidation zone of the Banská Štiavnica deposit. Besides todorokite was identified also cryptomelane, pyrolusite, vernadite, feroxyhyte and bustamite. Aggregates of minerals are closely connected with the central vein caves, where they fulfil empty area among quartz crystals, but more often form on the mineral surface coatings, which suggest mineral formation in oxidic conditions and supported by bacteria activity. We suppose, that within the oxidation zone, a the stromatolitic texture with higher content of Mn minerals has been formed, by the gradual growth of altered spongy soil tissues. Similarly to normal stromatolites, after they became gradually mineralised, mainly by Mn hydroxides.
- [3] GA–1/2035/05 **Facies analysis of Mesozoic and Tertiary sedimentary sequences – a key to understanding of development of recent environments** – Michalík - 1.2002-12.2007 - **International impact:** Thorough complex study including sequence stratigraphy was oriented on boundary sequence on the Triassic-Jurassic boundary. The results were presented during international workshop meeting of the IGCP Project 356 (TRIBE) in 2003, which we organized in the Stara Lesna. The results contributed to knowledge of end-Triassic extinction of life on the Earth, and also to selection of Triassic – Jurassic Boundary stratotype in Kuhjochgraben, Northern Alps. They were published in several papers in prestigious international journals.
- [4] GA–1/3053/06 **Biodiversity on the territory of the Western Carpathians as a reflection of climatic change in the Late Pleistocene and at beginning of the Holocene** – Kyška-Pipík – 1.2006-12.2008 - **International impact:** The project focused on the radiometric dating of the cave deposits with mammals, taxonomic determination and revision of the new and older findings and paleoenvironmental characteristics. The research team determined two forms of the cave bear in the lastglacial period and index micro- and macro-mammal species.
- [5] GA–1/4048/07 **Formation P-T-X parameters and age of hydrothermal Sb-bearing mineralizations of the Tatric Unit of the Western** - Hurai - 1.2007-12.2009 - **International impact:** Deciphering origin and formation conditions of economically one of the most important mineralizations of the Western Carpathian. Discovery of ultra-high-density inclusions of carbon dioxide in quartz associated with stibnite in the Gemeric tectonic unit. First use of infrared microthermometry in the territory of Western Carpathians.
- [6] GA–2/0040/08 **Source of brines in crystalline basement of the Western Carpathians - reconstruction based on isotopes and thermodynamic modelling of sulphates** – Hurai – 2008-2010 - **International impact:** Integrated genetic model of quartz-siderite-polymetallic mineralization of the Western Carpathians based on stable isotopes, fluid inclusions and radiometric dating. The model emphasizes the role of Early Cretaceous compression in liberating ore-forming brines from Permian-Triassic sedimentary cover, and their infiltration in the subjacent crystalline basement.
- [7] GA-2/0031/09 **Thermodynamic modelling of metamorphic processes in the Veporic unit of the Western Carpathians** – Janák - 01.2009-12.2011 - **International impact:** The pressure–temperature–time conditions have been constrained using pseudosection calculations, conventional geothermobarometry and geochronology in cooperation with foreign partners (Czech Republic, Austria). These enabled geodynamic correlations between the Western Carpathians and the Eastern Alps during Cretaceous (eo-Alpine) orogeny.

- [8] GA-2/0196/09 **Paleoenvironments and biofacies of Mesozoic lithostratigraphic units in the Western Carpathians** – Michalík - 01.2009-12.2011 - **International impact:** Slovak participants organized wide international cooperation contributing to the activity of Berriasian Subcommittee of IUGS (chaired by W.W.Wimbledon from the Bristol University). Especially important are results obtained by a complex study of wide international group of scientists in the Brodno section which serves as a model in the Tethyan JKB correlation. Results from several other sections compiled in several papers in impacted journals are widely respected by international geoscientific community.
- [9] GA-2/0140/09 **High-resolution stratigraphy, sedimentology and paleoenvironmental analysis of the Upper Cretaceous and Paleogene formations of the Western Carpathians** – Soták – 01.2009-12.2011 - **International impact:** The project provided a global results, and therefore it was important for scientific cooperation in study of the global anoxic events (e.g. Selli, Paquier, Breistroffer, Bonarelli, etc.), global hyperthermal events (e.g. PETM), global climatic cooling events (e.g. TEE), global eustatic events, etc. Therefore the project investigators took part in international research programmes dealing with paleoclimatology, environmental micropaleontology, sequence stratigraphy, sedimentology, etc.
- [10] GA-1/0029/10 **Origin and age of megacrysts in alkali basalts of southern Slovakia** – Hurai - 01.2010-12.2012 - **International impact:** First application of U-Pb-Th isotopes in zircon and monazite for dating basaltic maar structures.
- [11] GA-2/0060/10 **Oxidation-reduction conditions and water content in granitoid magmas: the use of biotite and Fe-Ti oxides as petrological indicators** – Petřík - 01.2010-12.2012 - **International impact:** The processes of oxidation-reduction in granitic magmas are general; however their manifestations in the mineral paragenesis and composition of minerals are specific. The Western Carpathian rocks provide an interesting possibility to study this process on variety of minerals.
- [12] GA-1/0388/10 **Tectonosedimentary breccias as tracer of the tectonic events in sedimentary record of the Mesozoic and Paleogene successions of the Western Carpathians** – Soták - 01.2010-12.2012 - **International impact:** The subject of this project, that was the Pieniny Klippen Belt, is an important paleotectonic elements with a great interest of the neighbouring countries. Therefore the research has been carried out in close cooperation of the Slovak-Polish-Austrian group (e.g. Prof. Oszczytko, Prof. Gawlick, etc.).

#### **Agency for the Promotion of Research and development (APVV)**

- [13] APVT-51-013604 **Lithium in granites of the Western Carpathians: occurrences and perspectives** – I. Petřík – 1.2005-12.2007 - **International impact:** Lithium occurrences are not common and any new information on the Western Carpathian Li bearing granites is important for international correlation with Czech, French, Spanish or other regions with similar rocks. The project helped to discover a new phosphorus rich mineralization heretofore known only from pegmatites.
- [14] APVT-51-011305 **Biochronology of the Mesozoic and Cenozoic formations of the Western Carpathians: plankton evolutionary events and their stratigraphic calibration** – J. Soták – 03.2006 – 02.2009 - **International impact:** The project results provide a new basis for definition of the Mesozoic and Cenozoic stratotypes from the Western Carpathians. The stratotypes were studied in purpose of their international correlation and determination of the biotic and climatic events related to the global changes.

- [15] APVV-51-008305 **Evolution of phyllosilicates during low-temperature alteration of rocks** – A. Biroň - 01.2006 – 12.2009 - **International impact:** Project brought results of collaboration between Polish and Slovak Academies of Sciences in the field of the K-Ar dating of diagenetic (thermal) events which occurred during evolution of Central Carpathian Paleogene Basin.
- [16] APVV-LPP-0362-06 **Educational guide round the geological geographical localities in the Central Slovakia** – Jeleň - 10.2006 - 9.2009 - **International impact:** The project tends to point out the worth of inorganic part of regional nature, to enlarge considerably so far published scientific and popular-scientific information from mentioned issue, as well as information about protected forms, objects, areas and about state of protection of inorganic nature in mentioned area for all age categories of inhabitants of Slovakia. In more places are present interesting creations of the nature as a result of endogenous and exogenous processes. Description of selected significant localities will be possible to employ to explanation of geological structure, geomorphology, hydrogeology, palaeontology, mineralogy and economic geology for pedagogues and students of primary, secondary, high schools and universities. During the excursions allows to expose geology in wider context through the mineral, rock, fossil, structure of the mountain up to the formation of deposits of earth materials. To a great extend will proposed geologically-geographical guide be significant amplifying addition to other Slovak and foreign interested persons in the country to the knowledge from botany, forestry, zoology and history of the Central Slovak region.
- [17] LPP-0107-07 **Lower Jurassic trace fossils in carbonate basins of Western Carpathians** – Šimo (Michalík) - 06.2008 – 05.2011 **International impact:** Environment of Lower Jurassic carbonate basins in Western Carpathians is interesting from the point of differentiation of Central Carpathian crustal segment: The origin of Jurassic basins is studied both by Polish and Slovak geoscientists. Several geoscientific meetings were organized during last years (Malogosc, Zakopane, etc.), where the results of the project were accepted by scientific community.
- [18] LPP-0231-07 **Exhibition „Planet, we live on“ – (Vysplan)** – I. Broska - 04.2008 – 12.2010 - **International impact:** The project of exhibition „Planet we live on“ was the main Slovak activity within International Year of planet Earth in 2008. Prof. Werner Janosek from Vienna University – as a member of IYPE international executive committee - took part in the opening ceremony giving the public address. The information and description of exhibition were reported in an international publication summarising world-wide activities within IYPE.
- [19] SK-MAD-011-06 **Tops of hydrothermal systems related to rhyolite magmatism** – Lexa - 06.2007-06.2009 - **International impact:** Based on the opportunity given by eroded epithermal systems of the Central Slovakia Volcanic Field and less eroded systems in Tokaj a common model of such the systems has been elaborated. Results contribute to general understanding of epithermal systems and help exploration activities for precious metals. Results were presented at international conferences.

## ii. List of national scientific conferences (co)-organised by the Organisation

- [1] Conference „Geochemistry 2007“; Bratislava, December 6, 2007; Dr. I. Broska was a member of organising committee and one of guarantees. The Conference is regular annual meeting of geochemists from Slovakia and Czech Republic and Dr. Broska within years 2007-2011 was a member of all organising committee. Lectures presented wide range of geochemist's activities in areas of hydrogeochemistry, environmental and soil geochemistry but also in petrology and mineralogy.

- [2] Conference „Petrology and dating“; Bratislava, May 31<sup>th</sup> 2007. I. Petrík I., M. Janák were guarantees of the Conference organised by the Department of mineralogy and petrology, Faculty of Sciences and Geological Institute, SAS.
- [3] Conference „A responsible approach to mining of raw materials with respect to protection of environment“, Detva, November 12<sup>th</sup> 2007: J. Lexa, was a guarantee of the Conference organised by the Faculty of ecology and environmental sciences of the Technical University, Zvolen, Eastern Mediterranean Resources Slovakia, Ltd., Slovak mining chamber and the town of Detva.
- [4] The III<sup>th</sup> scientific conference “The investigation and management of natural richness of Zvolen basin preservation” October 17<sup>th</sup> 2008, Zvolen, P. Andráš was a guarantee of the Conference.
- [5] Conference “Earth in trap 2008” devoted to the analysis of Environmental Components, Vyhne. April, 28-30<sup>th</sup> 2008 P. Andráš was a guarantee of the Conference.

### iii. List of national journals published by the Organisation

- [1] none

### iv. List of edited proceedings of national scientific conferences/events

- [1] none

### • International/European position of the individual researchers

#### i. List of invited/keynote presentations at international conferences, documented by an invitation letter or programme

- [1] BROSKA I. - JANÁK M. - MAJKA J. - LEICHMANN J. - PETRÍK I.: Remarks on genesis and stability of phosphates in silicic magmatic systems. konferencia „Accessory minerals in situ: microanalytical methods and petrological implications“, Krakow, Poland, September 15-16 2007
- [2] BROSKA I. - UHER P.: The role of typomorphic accessory minerals in the Variscan granitic suites of the Western Carpathians. “Orogenic and platform granites” Bukowina Tatrzanska, Poland, October 19 2007.
- [3] MICHALÍK J.: Evolution of Western Carpathians during the Mesozoic era and its comparison with Eastern Alps. Medzinárodný seminar: “Vienna basin evolution, pre-Neogene basement and structural pattern”, February 16 2007, Bratislava.
- [4] VRŠANSKÝ P.: Evolution of insects - Quo vadis evolution?, 2008
- [5] SIMAN P.: Analytical methods of microstructural study of materials, European Social Fund, April, 18 2008
- [6] KUNDRÁT M.: Developmental innovations in the evolution of theropods and birds, Royal Tyrrell Museum of Paleontology, Drumheller, Canada, 2008
- [7] SOTÁK J.: Climatic, biotic and environmental changes in the Carpathian Flysch Sea: from Peri-Tethyan to Black Sea-type basins. 11. Magyar Őslénytani Vándorgyűlés (11. zjazd Maďarskej paleontologickej spoločnosti). Szögliget, May 24, 2008, Hungary

- [8] KUNDRÁT M.: The life before hatching: Saga of a theropod dinosaur. Goseong Dinosaur World Expo 2009 - Goseong International Dinosaur Symposium, South Korea, April, 11 2009
- [9] KUNDRÁT M.: In ovo imaging of dinosaur embryonic patterns and the reptile-to-bird transition. Paleontological Initiative Meeting, European Synchrotron Radiation Facility, Grenoble, France, October 13, 2009
- [10] BROSKA I. Geological evolution of Western Carpathians – the prerelease of the video presentation. Anniversary symposium of Prof. Corina Ionescu, Babeş-Bolyai University, Cluj Napoca, Romania, October, 8 2010.
- [11] HURAI V. Deep fluids and melts in igneous xenoliths from alkali basalts of Western Carpathians. 3rd Biennial Conference of Asian Current Research on Fluid Inclusions (ACROFI III) and 14th International Conference on Thermobarogeochemistry (TBG XIV): Novosibirsk, Russian Federation, September 9, 2010
- [12] MICHALÍK J. Mesozoic paleogeography and facies of the Northern Mediterranean Tethys from the West Carpathian view. The first International Applied Geological Congress, Mashhad, Iran, April, 26 2010
- [13] TOMÁŠOVÝCH A. Evolutionary changes in brachiopod body size during the Mesozoic. 6<sup>th</sup> International Brachiopod Congress, Melbourne, Australia, February 2, 2010
- [14] VRŠANSKÝ P. Evolution and conservation of animals and ecosystems. V4 Academies Meeting: Research Institutions Forum, Třešť, Czech Republic, September, 24 2010.
- [15] MICHALÍK J. Stabilization and extinction of marine communities in Western Carpathians on the Triassic/Jurassic boundary. EMMM-2011, 3rd Symposium on „Ecological turnovers and the evolution of Phanerozoic biota“, Moscow, Russian Federation, September, 19-22, 2011
- [16] BROSKA I. Geosciences and energetic future. Workshop for young professionals in energy „Where is the energetic future of Central and Eastern Europe?“, Beladice, Slovakia, 16. 12. 2011
- [17] PUTIŠ M. – SIMAN P. – RADVANEC M.: Gondwana origin and pre-Alpine evolution of the West-Carpathian basement dated by U-Pb SHRIMP method on zircon. October 26 2010, Kyoto University.
- [18] PUTIŠ M. – SIMAN P. – RADVANEC M.: Progradation of the Alpidic Central Western Carpathians orogenic wedge related to two subductions: constrained by <sup>40</sup>Ar-<sup>39</sup>Ar ages of white mica from the shear zones. October 27 2010, Kyoto University, November 2, 2010, Okayama University.

**ii. List of employees who served as members of the organising and/or programme committees for international conferences**

- [1] Andráš P. - Earth in the trap? – Analysis of environmental components, SR, Vyhne - 28.–30.4.2008
- [2] Broska I. , Janák, M., Petřík, I., Jeleň S. – MIMET 2008 – Mineral equilibria, metasomatism, and mass transport: Evolution and stabilization of Rock on a fluid-rich world, SR, Smolenice, 8-11.4.2008
- [3] Broska I. - 2nd Central European Mineralogical Conference, Sklarska Poreba, Polsko (2008)



- [11] Soták J. European Union of Geosciences - member  
Carpathian-Balkan Geological Association – vicepresident of the National stratigraphic group  
International Association of Sedimentologists – national correspondent  
International Subcommision on Paleogene Stratigraphy – national delegate  
International Association of Fossil Algae – member  
Slovenský national geological comittee – member  
International Society of Environmental Micropaleontology, Microbiology and Meibenthology - member
- [12] Spišiak J. European Union of Geosciences – member  
Carpathian-Balkan geological association – member  
Society for Luminescence Microscopy and Spectroscopy – member  
Galicia T Group – member  
IMA – International Mineralogical Association - member
- [13] Staňová S. International Association of Sedimentologists – member  
SEPM-CES - member
- [14] Tomášových A. Society for Sedimentary Geology, – member  
Paleontological Society – member  
Paläontologische Gesellschaft – member  
American Society of Naturalists - member
- [15] Vozár J. ÖGG – Geological Soc. of Austria – member  
CBGA – Carpathian-Balkan Geol. Ass. - viceprezident  
SGS – Serbian Geol. Soc. – honorary member
- [16] Vršanský P. Czechoslovak biological society - member

#### **Editorial boards of scientific journals**

- [17] Andráš P. Carpathian Journal of Earth and environmental science, North University, Baia Mare, Rumunsko
- [18] Broska I. Mineralia Polonica (Krakow) - member  
Journal of Geosciences (Prague) - member  
Geologica Carpathica – editor-in-chief
- [19] Hurai V. Geologica Carpathica – member
- [20] Janák M. Geologica Carpathica – member
- [21] Kundrát M. Central European Journal of Biology – editor
- [22] Kyška-Pipík Geological Bulletin of Turkey - member  
Central European Journal of Geosciences, Versita - editor
- [23] Lexa J. Ore Geology Reviews, Elsevier  
Geologica Carpathica – member
- [24] Michalík J. Bulletin of Geosciences, Prague - member  
Iranian Journal of Geosciences - member  
Geologica Carpathica – science editor  
Geological Quaterly – member  
Open Paleontology Journal – member of the Editorial Advisory Board
- [25] Petřík I. Geologica Carpathica – answerable to for eletronic model
- [26] Soták J. Geologica Carpathica – member
- [27] Spišiak J. Geologica Carpathica – member
- [28] Tomášových A. Palaios – editorial Board – Associate Editor



- [8] Michalík, J.  
 [9] Petřík, I.  
 [10] Soták, J.

**iii. List of employees serving in important national scientific bodies (e.g. boards, committees, editorial boards of scientific journals)**

- [1] Andráš P. Slovak association of geochemists – vice-president  
 Slovak geological society - member  
 Slovak association of economic geologists – vice president
- [2] Biroň A. Slovak geological society - member  
 Slovak clay society - member
- [3] Broska I. Slovak mineralogical society – member of council  
 Slovak geological society - member  
 Slovak association of geochemists – member  
 Slovak association of geologists – vice-president
- [4] Chalupová B. Slovak geological society - member  
 Geological club - member
- [5] Janák M. Slovak geological society - member
- [6] Jeleň S. Slovak geological society - member  
 Slovak association of economic geologists – member
- [7] Kyška-Pipík R. Slovak geological society – president Banská Bystrica  
 Slovak limnological society
- [8] Lexa J. Slovak geological society - member  
 Slovak association of geologists – member  
 Slovak association of economic geologists – member
- [9] Luptáková J. Slovak geological society - member  
 Slovak association of economic geologists – member
- [10] Michalík J. Slovak geological society – president of paleontological group
- [11] Petřík I. Slovak geological society - member
- [12] Šiman P. Slovak geological society - member  
 Slovak mineralogical society – member of council
- [13] Soták J. Slovak geological society – committee, member of Banská Bystrica  
 committee  
 Slovak committee of KBGA – member
- [14] Spišiak J. Slovak geological society - member  
 Slovak association of geochemists – member  
 Slovak association of geologists – member
- [15] Štárek D. Slovak geological society - member  
 Geological club - member
- [16] Vozár J. Slovak geological society - member
- [17] Vršanský P. Slovak geological society - member  
 Slovak entomology society – member

**Editorial boards of scientific journals**

- [18] Broska I. Mineralia Slovaca – member  
 Slovak Geological Magazine – member
- [19] Michalík J. Slovak Geological Magazine – member  
 Mineralia slovaca - member
- [20] Šiman P. Slovak Geological Magazine – member  
 Geologické práce, Správy - member
- [21] Soták J. Mineralia slovaca - member
- [22] Spišiak J. Gemologický spravodajca (FPV UKF Nitra) - member

### **Membership in advisory committee of Slovak government, parliament, ministries**

- [23] Janák M. Agency for the Promotion of Research and development – member of committee for Earth and environmental sciences
- [24] Jeleň S. Advisory committee of State environment protection for anorganic nature, Banská Bystrica
- [25] Lexa J. Slovak Geological Board – advisory committee of Ministry of environment SR
- [26] Michalík J. Slovak Geological Board – advisory committee of Ministry of environment SR  
Accreditation committee – advisory committee of Slovak Government, president of committee for Physics and Earth and Space sciences
- [27] Soták J. Commission of Slovak environmental agency for anorganic nature ASFEU
- [28] Vozár J. Agency for the Promotion of Research and development – member of committee for Earth and environmental sciences
- [29] Vršanský P. Advisory board of Ministry of education SR - member

### **Activities in bodies of SAV**

#### **Membership in scientific colleges SAV**

- [1] Michalík J. - secretary of the Scientific College for Earth and Space sciences
- [2] Broska I. - Scientific College for Earth and Space sciences - member
- [3] Vozár J. – member of the Scientific College for Earth and Space sciences until 2008

#### **Membership in committees SAV**

- [4] Michalík J. – vice-chairman of the Accreditation committee SAV (Section I)

#### **Membership in VEGA agency**

- [7] Hurai V. - member of the VEGA commission No. 2 for Earth and Space sciences
- [8] Kyška-Pipík R. - member of the VEGA commission No. 2 for Earth and Space sciences

#### **Membership in Scholarly society SAV**

- [9] Michalík J.

#### **Scientific boards of faculties and universities**

- [10] Andráš P. Faculty of Natural Sciences Matej Bel University, Banská Bystrica
- [11] Broska I. - Faculty of Natural Sciences of Masaryk University, Brno  
Slovak National Museum, Bratislava
- [12] Michalík J. Faculty of Natural Sciences Comenius University, Bratislava
- [13] Soták J. Faculty of Natural Sciences Matej Bel University, Banská Bystrica
- [13] Spišiak J. Faculty of Natural Sciences Matej Bel University, Banská Bystrica
- [14] Vozár J. Faculty of Natural Sciences Comenius University, Bratislava  
Technical University, Košice

#### **iv. List of national awards and distinctions**

- [1] „Kamenár 2007“, the exhibition focused on geology and stone industry; The 1<sup>st</sup> place taken for the best exposition; Certificate.

- [2] Broska I. 2009 – Acknowledgement for organising of exhibition "Earth, we live on", approval by 45th resolution of Presidium of Slovak Academy of Science.
- [3] Vozár J. 2009 - award "Annual scientific celebrity of Slovak Academy of Science", Acknowledgement from Slovak Academy of Science
- [4] Broska I. 2009 – Letter of thanks for popularisation in geology; Awarded from Slovak geological society
- [5] Lexa J. 2009 – Honorary membership; Awarded from Slovak geological society
- [6] Petřík I. 2009 – Award for the best popularising work; Awarded from Slovak geological society
- [7] Vršanský P. 2010 – Winner of competition "Young scientific researcher"; Awarded from Slovak Academy of Science
- [8] Broska I. 2010 as director – Commemorative medal to Institution on the occasion of 70<sup>th</sup> foundation of State Geological Institute D. Štúr.
- [9] Janák M. – Researcher of year of Slovak Republic 2009 – Certificate of merit 2009 from Journalist-Studio
- [10] Lexa J. 2010 - Medal for development of geological research; awarded from State Geological Institute D. Štúr
- [11] Vozár J. 2010 - Medal for development of geological research; awarded from State Geological Institute D. Štúr

**v. Supplementary information and/or comments documenting international and national status of the Organisation**

The research at the Geological Institute of Slovak Academy of Sciences can be considered as highly appreciated in both national and international levels. The results in published papers are a basis for the invitation of researchers from our institution to numerous international projects, organising committees of international conferences, to work in scientific boards at four universities including Czech Republic and Slovak National Museum. Contacts of our researchers with top researcher centers in the world are very wide and resulted in intensive cooperation. In international context our scientific results are comparable at least to those of similar scientific centers in Central European countries taking into account the number of papers and citation/ number of researchers. Informal cooperation underlying the credit of the staff of our institute is also productive and very important for the major part of our scientific output published in international journals. Each VEGA and APVV project solved at our Institution has international dimension and connections. Geological projects shown in the first part "i" are either solved abroad or using samples from abroad (projects of M. Janák in Slovenia; J. Lexa and R. Kýška-Pipík mostly in Hungary; Vršanský in Russia, France, Mexico; Tomášových in the U.S.A., Kundrát in China, Soták in Austria and Italy), or they are solved in coordination with experts from abroad (S. Jeleň with Russians and Ukrainians; J. Michalík with Polish colleagues and partners in IGCP and D. Starek with Poles; T. Mikuš with experts from NHM London; M. Kundrát with experts from Germany and France; J. Vozár with Poles in the Celebration project). Important international output of the Institution is documented also by the multi-author monography (J. Vozár et al. 2010). The national position of Institution is also highlighted by the selected projects. There are shown the scientific projects with international output but combined with educational purposes (I. Broska – exhibition at SNM, S. Jeleň – guide book of localities).

At the national level our experts are also asked for cooperation in many projects e.g. in creating of geological maps originated at the State Geological Institute of Dionýz Štúr (ŠGÚDŠ). In evaluated period two geological maps and several regional maps have been published, all of which included co-authors from our institute. All the mentioned activities speak in favour of the respect the researchers of our Institute in geological community.

#### 4. Project structure, research grants and other funding resources

- **International projects and funding**

- i. **List of major projects within the European Research Area – 6th and 7th Framework Programme of the EU, European Science Foundation, NATO, COST, INTAS, CERN, ESA etc. (here and in items below please specify: type of project, title, grant number, duration, total funding and funding for the Organisation, responsible person in the Organisation and his/her status in the project, e.g. coordinator, work package leader, investigator)**

- [1] **MVTS-UNESCO Evolutionary patterns and global environmental changes as indicated by cockroaches, mantids and termites**, (2006-2009), 30,000 Sk (2007), 30,000 Sk (2008), Vršanský – coordinator
- [2] Project UNESCO/IGCP 506 **Marine and non-marine Jurassic: Global correlations and Major Geological Events**. (2006–2009), J. Michalík – researcher and coordinator for Central Europe. Funds only for mobility
- [3] Project UNESCO/IGCP No. 555 **Rapid environmental/climate change in the Cretaceous Greenhouse World**. (2007-2010), J. Soták – coordinator for SR. Funds only for mobility.
- [4] Project UNESCO/IGCP Projekt 529: **Magneto-, bio-, and carbon isotope stratigraphy of Valanginian and Hauterivian sequence in the Fatric of the Western Tatra Mts and Strazov Mts (PL-SR)**. (2004-2007), Grabowski J. (PIG Warszawa) – coordinator, Michalik – project manager. Funds only for mobility.

- ii. **List of other international projects incl. total funding and funding for the Organisation**

- [1] NSF-EAR 0345897 **Quantifying sedimentary capture of biological information**. (2006-2009), 40,000 USD in 2007, Kidwell (USA), Tomášových (SR) – project manager
- [2] APVV-SK\_MAD-01106 **Tops of hydrothermal systems related to rhyolite magmatism**. (2007-2008), 38,000 Sk (2007), 38,000 Sk (2008), Lexa – coordinator
- [3] Project 32 MAD: **Miocene to recent tectonic activity of Orava-Nowy Targ Basin**. (2007-2012), 12,000 Sk (2007); Starek (SR), Swierczewska (PL) – coordinators
- [4] **Mesozoic ambers from France**. (2007-2008), MVTS, VEGA, RU 60 000,-Sk (2007), Vršanský – coordinator

- [5] **Ecology of the brachiopod *Terebratalia* and morphometry of its pedicle muscle scars.** (2006-2007), University of Washington, Friday Harbor Laboratories, University of Washington, 620 University Road, Friday Harbor, WA 98250 USA (2.500 USD – 75.000 Sk), Paleontological Society, Department of Earth and Environment, Franklin and Marshall College, Lancaster, PA 17604-3003 (500 USD – 15,000 Sk), Tomášových – project manager

### iii. List of other important projects and collaborations without direct funding

- [1] Project ACCORD – Marie Curie Training Site **Can be Cr-spinel useful provenience and petrogenetic indicator?** NHM London, J. Spišiak, T. Mikuš
- [2] FR-TAF-5138 **Permian-Triassic evolution of the local climate over the Central Pangaea based on bone microstructure of continental tetrapods.** (2008), M. Kundrát - coordinator
- [3] **Exploration of the Jurassic Vertebrate Fauna in the Xianjing Province of China: Sino-American Junggar Basin Expedition.** (2008-2009), Xu Xing (China), James (USA) – coordinators, M. Kundrát –project manager
- [4] SYNTHESYS GB-TAF-4361: **Living and Fossil non-marine Ostracoda of Europe.** (2008), travel grant, R. Kyška-Pipík – project manager
- [5] SYNTHESYS BE-TAF-4362: **Non-marine cosmopolitan and endemic Ostracoda.** (2008), travel grant, R. Kyška-Pipík – project manager
- [6] Paleontological Society - Sepkoski Grants 2008: **Species-level microevolutionary changes at the transition from marine to lacustrine environments.** (2008-2009), 1000 USD (2008), R. Kyška-Pipík – project manager
- [7] DE-TAF-5552 **Correlation of neurocranial morphology and postcranial parameters to assess upon specific locomotory adaptations in birds.** (2009) , Sylke Frahnert (Germany) – coordinator, M. Kundrát – project manager
- [8] **Tectonic control on the Triassic evolution of the carbonate platforms of the Alp-Carpathian-Dinarid region.** (2006-2009), J. Michalík – project manager
- [9] ATBI+M **All Taxa Biodiversity Inventory & Monitoring** (2006-2010), R. Kyška-Pipík – project manager
- [10] AMBA framework **Global evolutionary patterns and environmental change indicated by the fossil record of cockroaches, termites and mantises** (2009-2013), P. Vršanský – coordinator
- [11] Project MAD with Russian Federation **Upper Jurassic Karabastau Formation in Kazakhstan.** (2007-2008), P. Vršanský – coordinator
- [12] **Comparative mineralogical-geochemical analysis of Au-Ag-Bi-Te-Se mineralization of neovolcanites and crystalline complexes of Ukraine and Slovakia (Carpathian region).** (2008-2010), financial MAD, Ponomarenko, Grinčenko (IGEM UAV) – project manager, S. Jeleň – coordinator SR
- [13] NOAA California Sea Grant Program “Urban Oceans” - **Estimating impacts of past natural and anthropogenic disturbances on shelf macrobenthic communities using dead-shell assemblages.** (2008-2009), Kidwell (USA) – coordinator, A. Tomášových – coordinator SR

- [14] **Investigation of genetic and temporal relationships of magmatism and epithermal mineralizations in the Central Slovakia volcanics field.** (2008-2011), S. Jeleň - coordinator
- [15] **Understanding of genetical and time relations between magmatism and epithermal ore genesis in volcanic structures of Central Slovakian neovolcanites.** (2008-2011), S. Jeleň - coordinator
- [16] **Geology and evolution of Au-Ag-Bi-Te-Se of associations of deposits and ore manifestations of Ukraine and Slovakia.** (2011-2013), S. Jeleň – coordinator
- [17] **Paleovolcanic reconstruction and evolution of silicic volcanic formations in Carpathian-Pannonian region.** (2010-2012), J. Lexa - coordinator
- [18] **Projekt P20018-N10 Macro- and microfossils, isotopes, litho- cyclo-, magneto- and biostratigraphy as tools for investigating the Lower Cretaceous within the Dolomites (Southern Alps, Northern Italy) - the Puez area as a new key region of the Tethyan realm.** (2008-2011), J. Soták – project manager
- [19] **Climate and biota of the Early Paleogene.** (2011), J. Soták – coordinator
- [20] **DEB-0919451 Bivalves in Time and Space: Testing the accuracy of methods to reconstruct ancestral morphology, dates, geography, and diversification patterns.** (2010-2011), USA – coordinator, A. Tomášových – project manager
- [21] **The interpretation of genetic and time relations between magmatism and epithermal ore formation in volcanic structures of the Central Slovak Neovolcanic field.** (2005-2007), Černyšev, Kovalenker (IGEM RAN Moskva) – J. Lexa – coordinator, S. Jeleň – project manager

- **National projects and funding**

- i. **List of projects supported by the European Social Funds (ESF) and Structural Funds of EU and the role of the Organisation**

- [1] ITMS 26250120034 **Centers of education of Slovak Academy of Sciences in Banská Bystrica and Smolenice** – 06.2010/05.2012 Institute is recipient (project manager R. Kýška-Pipík) – 71 230 €
- [2] ITMS 26220120064 **Centre of excellence for integrated research of the Earth's geosphere** –09.2010/08.2014 Institute is recipient and coordinator (partners: Institute of Geotechnics SAS Košice and Wood Faculty of Technical University Zvolen; project manager J. Soták) – 432 556 €

- ii. **List of projects supported by APVV and the role of the Organisation**

**2007 and earlier**

- [1] APVT-51-0028-04 **Development, Improvement and Application of Progressive Methods of 2D and 3D Gravity Field Interpretation in Geophysics and Geology** – Vozár (Bielik – project leader) - 1.2005/12.2007; 35 882.62 €
- [2] APVT-51-0125-04 **The evolution of Volcanism in Space and Time in the Late-Variscan and Early-Alpine Stages of the Western Carpathians** – Spišiak – 01.2005/12.2007; 11 219.54 €
- [3] APVT-51-0136-04 **Lithium in granites of the Western Carpathians: occurrences and perspectives** – Petřík – 01.2005/12.2007; 10 588.86 €

- [4] APVV-20-0199-05 **Possibilities of acid mining drainage waters elimination at mining dumps** – Andráš (Michalková – project leader) - 10.2006/09.2009; 1 460.53 €
- [5] APVV-51-0083-05 **Evolution of phyllosilicates during low-temperature alteration of rocks** – Biroň - 01.2006/12.2009; 44645.82 €
- [6] APVT-51-0113-05 **Biochronology of the Mesozoic and Cenozoic formations of the Western Carpathians: plankton evolutionary events and their stratigraphic calibration** – Soták – 03.2006/02.2009; 116 743.0 €
- [7] APVV-51-0156-05 **Possibilities of mining landscape remediation in surrounding of Ľubietová based on the study of heavy metal and toxic element distribution in the country** – Andráš - 01.2006/12.2008; 40 828.52 €
- [8] APVV-51-0461-05 **Ultrahigh-pressure metamorphism in Pohorje and correlation of the eo-Alpine tectonometamorphic evolution of the Eastern Alps and Western Carpathians** – Janák – 03.2006/02.2009; 69 906.39 €
- [9] APVV-LPP-0362-06 **Educational guide round the geological geographical localities in the Central Slovakia** – Jeleň - 10.2006/9.2009; 50 612.75 €
- [10] SK-MAD-011-06 **Tops of hydrothermal systems related to rhyolite magmatism** – Lexa - 06.2007/06.2009; 2 522.73 €

## 2008

- [11] LPP-0231-07 **Exhibition „Planet, we live on“ – (Vysplan) – Broska - 04.2008/12.2010; 37409.54 €**
- [12] LPP-0107-07 **Lower Jurassic trace fossils in carbonate basins of Western Carpathians** – Šimo (Michalík – project leader) - 06.2008/05.2011; 43 915.55 €
- [13] APVV-0109-07 **Microevolution, trends of adaptation and paleoenvironmental factors in the radiation of Ostracoda in the Middle and Late Miocene of the Central Paratethys** – Kyška-Pipík - 02.2008/12.2010; 67 649.20 €
- [14] APVV-0248-07 **Evaluating and modeling ecological stability and turnover of Jurassic communities** – Tomášových - 02.2008/12.2010; 88 428.59 €
- [15] APVV 0279-07 **Structural-petrological and geochronological evolution model of the West-Carpathian alpidic shear zones; correlation with analogous zones in the Eastern Alps** – Siman (Putiš – project leader) –02.2008/12.2010; 86 138.22 €
- [16] VVCE-0033/07 **Research and education centre of excellence for solid phase research focused on nanomaterials, environmental mineralogy and material technology** – Hurai (Chovan – project leader) - 07.2008/06.2011; 20 713.01 €

## 2009

- [17] SK-HU-0015-08 **Fault-controlled diagenetic stages at the base of Silica, Martonyi and Telekesoldal Nappes, Inner Western Carpathians** - Milovský - 06.2009/12.2010; 2 987.45 €

## 2011

- [18] 0537-10 **Au-porphyry systems deposit models in the Central Slovakia Neogene Volcanic Field and environmental aspects of their exploitation** – Lexa (Koděra – project leader) - 05.2011/10.2014; 11 835.0 €
- [19] 0644-10 **Assessing taphonomic and geochemical approaches in evaluating spatial and temporal turnover of marine invertebrate paleocommunities** – Tomášových - 05.2011/10.2014; 19 968.0 €

[20] 0091-10 **Meta-ultramafics, indicator of mechanisms of crust-mantle interaction, recycling and exhumation in an orogenic wedge (W. Carpathians and eastern Alpine margin – Siman (Putiš – project leader) - 05.2011/10.2014; 8 679.0 €**

**iii. Number of 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	2007	2008	2009	2010	2011
number	10	15	15	16	14
funding in the year (EUR)	28978	35883	51007	47795	47693

• **Summary of funding from external resources (based on annual financial report of the Organisation)**

External resources	2007	2008	2009	2010	2011	total	average
external resources (milions of EUR)	0,309	0,362	0,205	0,163	1,479	2,518	0,504
external resources transferred to cooperating research organisations (milions of EUR)	0,032	0,054	0,029	0,016	1,063	1,194	0,239
ratio between external resources and total salary budget	0,796	1,172	0,502	0,393	3,716	–	1,316
overall expenditures from external as well as institutional resources (milions of EUR)	1,113	1,286	0,997	1,029	1,263	5,688	1,138

**iv. Supplementary information and/or comments on research projects and funding resources**

The most important funding sources for the research were obtained from the Agency for support research and development (APVV). The investigators granted from APVV fulfilled the planned objectives in their projects in very appropriate and clearly documented scientific output. The VEGA projects help researchers but it should be stressed that without the cooperation with partners from abroad and without getting often expensive high precision data without payment obtained thanks to our cooperation, it would be impossible to complete fulfill project targets. External funding sources are very restricted; minor finances come also from casual economic activities.

IGCP Projects (International Geological Correlation Programme) is in frame of UNESCO activities and therefore shown in part 4i. The correlation was organised through papers, communications and meetings. The participation on meetings of our researchers was refund by Ministry of Finance of Slovak Republic dealing with budget supporting UNESCO activities. "Marine and non-marine Jurassic global correlations and major geological events" were solved by J. Michalík who was researcher and coordinator

for Central Europe. Project UNESCO/IGCP No. 555 "Rapid environmental/climate change in the Cretaceous Greenhouse World" coordinated J. Soták.

The funds given in Projects (4. i.) were fully spent by researchers from the Institute.

## 5. Organisation of PhD studies, other pedagogical activities

### i. List of accredited programmes of doctoral studies (as stipulated in the previously effective legislation as well as in the recently amended Act on the Universities)

till 2010: 12-20-9 Paleontology  
12-26-9 Tectonics

from 2005

[1] Petrology 4.1.32 Petrology

[2] General Geology 4.1.33 Tectonics

### ii. Summary table on doctoral studies (number of internal/external PhD students; number of students who completed their study by a successful thesis defence; number of PhD students who quitted the programme)

PhD study	31.12.2007			31.12.2008			31.12.2009			31.12.2010			31.12.2011		
number of potential PhD supervisors															
PhD students	number	defended thesis	students quitted												
internal	4	1	3	5	2	0	4	2	0	5	1	0	7	0	2
external	1	0	1	1	0	1	0	1	1	0	1	0	0	0	0
supervised at external institution by the research employees of the assessed organisation															

The students who completed PhD scholarship according to years:

2007 – S. Staňová

2008 – V. Šimo, M. Smrečková

2009 – M. Golej, S. Ozdinová, A. Bartakovics (external student from Nafta, Hodonin)

2010 – R. Gregorová (external student from Brno), P. Ledvák

iii. Postdoctoral positions supported by

a) *external funding (specify the source)*

b) *internal funding - the Slovak Academy of Sciences Supporting Fund of Stefan Schwarz*

Vršanský Peter 1.5.2006 - 30.4.2010

iv. Summary table on pedagogical activities in undergraduate programmes for each year

Teaching	2007	2008	2009	2010	2011
lectures (hours/year)	486	320	213	304	448
practicum courses (hours/year)	314	118	182	200	189
supervised diploma works (in total)	20	13	22	13	18
members in PhD committees (in total)	10	10	9	9	7
members in DrSc. committees (in total)	2	2	3	1	1
members in university/faculty councils (in total)	3	4	4	4	3
members in habilitation/inauguration committees (in total)	2	2	2	2	1

v. List of published university textbooks

[1] ANDRÁŠ, Peter. Geochémia pre environmentalistov. Banská Bystrica: Fakulta prírodných vied Univerzity Mateja Bela, 2008. 106 s. ISBN 978-80-8083-583-5.

vi. Number of published academic course books

[1] none

vii. List of joint research laboratories/facilities with the universities

[1] **Joint research clay laboratory** Objectives of the common study are mixed-layered silicates. The laboratory was established in 1994 by the agreement between Geological Institute SAS and Department of economic geology Faculty of Sciences CU in Bratislava. More than 1500 X-ray diffraction records for the joint laboratory in period 2007-2011 were done, which were further elaborated at Faculty of Sciences.

[2] **Energy geoscience laboratory (EGL)**. Joint laboratory of Energy and Geoscience Institute of University Utah and Geological Institute of the Slovak Academy of Sciences was established in 2007. Prospection and studying of energetic resources

is the objective of common activities funded by worldwide oil companies (leader: M. Nemčok).

- [3] **A common laboratory of the Matej Bel University, Botanical and Geological Institute of the SAS.** By the Agreement between Geological Institute, Botanical Institute (SAS) and Matej Bel University signed in 2077 a common laboratory was established named Institute of biology and geology in Banská Bystrica. The activities of the Institute are involve the following collaborations: 1) Preparation and realization of scientific and research projects of basic and applied research in biology and geology; 2) Preparation and realization of study programmes in both disciplines; 3) Education of young scientific workers within postgraduate study; 4) Organising of scientific seminars and conferences; 5) Participation in publishing of periodical and non-periodical scientific publications; 6) Providing scientific study stays for scientific and research workers, mainly university teachers and young scientists; 6) Participation in teaching process at the Matej Bel University.
- [4] **Solipha.** Geological Institute SAS with Faculty of Sciences Comeniu University and Institute of Inorganic chemistry SAS participates in Research Education centre of excellence for the research of solid phase (within framework of obtained project APVV-VVCE-0033-07; Solipha). At present the new X-ray diffractometer Bruker, located at faculty of Sciences, is operated. The Solipha centre will serve as a instrumental platform mainly for environmental problems solved within scientific projects and training of post-graduate students.

#### viii. **Supplementary information and/or comments on doctoral studies and pedagogical activities**

During evalutaed period 18 internal and 4 external PhD students studied at the Geological Institute SAS (one external from Czech Republic; RNDr. Gregorová from Moravian Museum, Brno). After successful PhD. study all students progress at geological work. They continue either as researchers at the Geological Institute of SAS (S. Staňová, V. Šimo and S. Ozdínová) or on post-doc position (P. Ledvák). RNDr. Gregorová, PhD. continues as researcher at the Moravian Museum in Brno, Mgr. Smrečková, PhD. is employed as assistant at the Faculty of Natural Sciences, Matej Bel University, Mgr. M. Golej, PhD. is employed as geologist in the company ALPINE and Mgr. A. Bartakovics, PhD. continued her work at Nafta Hodonín. Mgr. Ružička finished study for PF UK and is employed at faculty. 3 PhD. students in total interrupted study, but Mgr. J. Šurka is preparing his thesis for defence.

## 6. **Applied research**

### i. **List of the most important results of applied research projects and their socio-economic impact**

- [1] 2007 – Evaluation of geothermal drillhole Rapovce GTL-2, as a source of salt thermal water for recreation utilisation in Lučenec region. Work for Geospektrum s.r.o. Bratislava (investigator: J. Soták)
- [2] 2007 – Evaluation of geotechnical works on modernizing of railway track Púchov – Žilina; tunnel Diel (Nimnica) and tunnel Miločov; drilling profiles, stratigraphy, petrography and clay mineral composition Work for Geofos s.r.o. Žilina (investigators: J. Soták, and A. Biroň)

- [3] 2007 - Metalogenetic model of Au-porphyry deposit Biely vrch (Detva). Results helps prospection works on new gold deposit in Slovakia. Work for EMED Mining, Ltd, Cyprus (investigator: J. Lexa).
- [4] 2008 – Results of APVV project „Definition of possibilities how recovery the mining country in area of Ľubietová on the basis of heavy metal distribution and toxic elements in country components” are useful for local for municipality.
- [5] Maps of paleovolcanic reconstruction of rhyolite volcanoes of Slovakia and analysis of magmatic and hydrothermal systems (2006-2011). Results: (1) dominance of freatomagmatic eruption during origin of Jastrabá formation, (2) variability of rhyolite matrix is in dependence of solidification, (3) protrusion of basic melts to relevant magmatic reservoirs and its mixing with rhyolite melt, (4) lateral outflow of fluids within Kremnica hydrothermal system due to hydraulic gradient and participation of fluids in origin of limnoquarcites, (5) increase of reprecipitation and temperatures of limnoquarcites toward to hydrothermal sources, (6) dominant role of glassy rhyolite breccias and glassy rhyolites for evolution of economically interesting depositions. (investigator: J. Lexa).

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

- [1] expertise report for “State Protection of Nature in Slovak Republic” during maintenance of endangered localities – (J. Soták)
- [2] Study for organisation CEPA – Friends of Earth: „Characteristic of micro-region Podpoľanie and Veľký Krtíš district from point of view usage of geothermal energy“
- [3] Statement to Request for extension of municipal dump in clay pit of brickyard Martin. Report for Ministerstvo životného prostredia SR, Sekcia geológie a prírodných zdrojov (investigator: R. Kyška-Pipík)
- [4] Expertise the hazard of exploitation and processing of uranium in SR. Report for Greenpeace and Friends of Earth (investigator: J.Vozár)

**iii. List of patents issued abroad, incl. revenues**

- [1] none

**iv. List of the patents issued in Slovakia, incl. revenues**

- [1] none

**v. List of licences sold abroad, incl. revenues**

- [1] none

**vi. List of licences sold in Slovakia, incl. revenues**

- [1] none

**vii. List of contracts with industrial partners, incl. revenues**

- [1] Elaborating of a metalogenetic model of the newly-found deposit Biely vrch at Detva for company EMED Mining Slovakia, ltd. It was shown that it is, in the Western Carpathians, a unique Au-porphyry type of mineralization. Our results contribute significantly to the knowledge of metallogenesis of the Central Slovak Neovolcanics, and enable the EMED company to rationalize and continue in the survey of the deposit and in exploration of other localities with this mineralization type. The overall income 472,060 Sk, from this 208,700 Sk in 2008
- [2] Geological Institute SAS provided an expert work for engineering-geological survey of highways and tunnels realised by the company GEOFOS, Žilina. The subject of this work was mainly in determining lithology, stratigraphy and clay mineralogy of the geological units occurring along the route of the technical works at the central Váh River and eastern Slovakia. In 2008 three partial reports were elaborated for the tunnel Nimnica, tunnel Miločov and northern bypass Prešov. Thanks to that collaboration researchers from Geological Institute SAS obtained unique drill cores and complete profiles across the beds series (for example Nimnica beds, Tisál beds, Prešov beds and other).
- [3] Contract name: Project of developing aid for El Salvador, partners: Czech Geological Survey, Prague. Beginning of collaboration (following the signed contract): 2008, finishing of collaboration: 2009. Results: Geological map of the southern part of the capitol San Salvador including the evaluation of natural hazards threatening the infrastructure and population. Conclusion: It is very important work, the partner Office for landscape planning of the capitol San Salvador (OPAMSS) immediately uses our basal data at deciding on constructions and prevention measures against natural catastrophes.
- [4] Contract name: Slovzinc, a. s., partners: Slovzinc, a. s. Beginning of collaboration (following the signed contract): 2011. Finishing of collaboration: it continues. Results: according to demands of the partner the industrial products of the company were elaborated by image analysis (SEM) with the aim to evaluate the quality of the products. Conclusion: The partner will decide on the following collaboration in developing proper methods.
- [5] Contract name: Agreement on collaboration. Partners: Hornonitrianske bane Prievidza. Beginning of collaboration (following the signed contract): 2011. Finishing of collaboration: it continues. Results: Mutual agreement on basic principles and conditions of the collaboration of both partners in the project preparation: Non-traditional sources of the Upper Nitra river area – research and possibilities of their use. Conclusion: The collaboration will lead to submitting of the common project financed by enjoin partner.

**viii. List of research projects with industrial partners, incl. revenues**

- [1] none  
ix.

Outreach activities	2007	2008	2009	2010	2011	total
studies for the decision sphere, government and NGOs, international and foreign organisations						0

## 7. Popularisation of Science

### i. List of the most important popularisation activities

#### 2007:

- participation at exhibiton „Kamenár“ in Trenčín 15.-17.11. 2007
- Organisation of exhibition „Dinosaurus from Patagonia“ Aupark (March – May 2007). Exhibiton of sceletons of dinosaurus from South America from Museum Egíd Ferugli in La Plate (Argentína). Opening ceremony J. Michalík, lecturers V.Šimo a P. Ledvák.
- „Mammoths from Slovakia“ v SNM MAK Martine (25.1.-17.6.2007, during vernisage 25.1.2007.
- Michalík J. as a: guest of night pyramide at Slovak radio 22.30 90 min moderator: Grebeňová Mária, 19.3.2007
- Vozár J.: Problems with exploitation of gold in Kremnica. Slovak radio - 27.6.2007, Rádiožurnál; 12.00; 2 min.;
- Jeleň S.: within European week chat with children at Oncology center of Roosvelt hospital Banská Bystrica; 14.11.2007
- Jeleň S. Historical mining districts in central Slovakian neovolcanics 27.10.2007 Excursion 45 participants

#### 2008:

- participation at exhibiton „Kamenár“ in Trenčín: 20.-22.11.2008
- Petrík I.: Pumice and bronze. Veda, Bratislava 2008. ISBN 978-80-224–1018-2, 281 pp. introduction of popular book
- Michalík J.: Geology of Mars. Slovak National Museum in Bratislava 22.4.2008 o 17.00 and Slovak Museum of caves, Liptovský Mikulaš, 11.11.2008 o 14.00
- Michalík J.: International day against to extension of deserts. Slovak radion 17.6.2008 o 13.00 moderator: K. Kacerová)
- Soták J.: Discovery of archaic tree on Upper Nitra. Slovak Television 24.9.2008
- Broska I.: Toward International Year of Planet Earth. Slovak broadcast “Afternoon with radio” (moderator Vasilová E.; 22.4.2008; 20 min.)

#### 2009:

- participation at exhibition „Kamenár“ in Trenčín
- exhibition „Planet, we live on“ Slovak National Museum in Bratislava; vernissage 26.11.2008, duration of show untill 2.7.2009; Broska I. and Michalík J. took a part in opening ceremony as authors
- Michalík J.: Meteorites on Slovakia. Televízna stanica STV1, Správy. 23.2.2009
- Soták J.: Interview to conference Darwin – fossils and revolutions. Slovak radio 14.10.2009

#### 2010:

- participation at exhibiton „Kamenár“ in Trenčín: 27.3.2010
- SIMAN, P. - Interview with redactor Richard Filipko – The Famous people children cycle - ŽIVOT - No. 36 - 4.9.2010
- exhibition „Planet, we live on“ Spiš Museum in Spišská Nová Ves; vernissage 14.1. 2010 Nová Ves, Múzeum Spiša, Letná 50; Broska I. and Michalík J. took a part in opening ceremony as authors
- Jeleň S. „Green revue“. Talk about primary and secondary raw materials. moderator S. Lupták STV 2, 20.11.2010, 16,25 hod
- Jeleň S.: introduction of popular book:  
JELEŇ, Stanislav - GALVÁNEK, Juraj - ANDRÁŠ, Peter - BENDÍK, Andrej - BELÁČEK, Boris - BOZALKOVÁ, Irena - GAÁL, Ľ. - GAJDOŠ, Alfonz - HÁBER, Milan - KONEČNÝ, Vlastimil - KRIŽÁNI, Ivan - LUPTÁKOVÁ, Jarmila - MAZÚREK, Jaroslav - MICHAL, P. - SOTÁK, Ján - STAŇOVÁ, Sidónia - ŠIMO, Vladimír - ŠURKA, Juraj - WETTER, Richard. Náučno-poznávací sprievodca po geologických a geografických

lokalitych stredného Slovenska. Banská Bystrica: Geologický ústav SAV, 2009. 320pp. ISBN 978-80-970413-4-2.

#### 2011:

- participation at exhibiton „Kamenár“ in Trenčín: 31.3.2011
- exhibition „Planet, we live on“ Danube Museum Komárno. Broska I. took part at opening ceremony, duration: 30.4.2011 - 20.8.2011
- exhibition „Planet, we live on“ Slovak National Museum in Martin since 30.11.2011 Slovak National Museum in Martin. Jeleň S. took part in opening ceremony.
- Jeleň S. and Ozdínová S.: Organisation of open doors in Bratislava and Banská Bystrica 7.-11.11.2011
- Vršanský P.: What hide Mexician amber? journal SME
- Vršanský P.: The most important annual discovery in 2010, Slovak television, TV JOJ, TV Markíza, TV Bratislava
- Michalík J.: Lecture on „Chines feathered dragons“ – dinosaurs from China

#### ii. Summary of outreach activities

Popularisation of science	2007	2008	2009	2010	2011	total
articles in press media/internet popularising results of science, in particular those achieved by the Organization	18	25	17	8	11	79
appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	10	17	11	4	4	46
public popularisation lectures	19	19	9	14	28	89

#### iii. Supplementary information and/or comments on popularisation activities

The most important popularization activity at our Institution within reviewed period 2007-2011 was the organising of the exhibition “Planet, we live on” installed at Slovak National Museum in Bratislava on more than 500 m<sup>2</sup>. The exhibition was a main activity of Slovak geologists to the International Planet of Year in 2008 prepared by Geological Institute SAS under leadership of I. Broska in cooperation with Slovak National Museum, geologists and specialists from the Comenius University and the Geophysical Institute of SAS. Funding was through the LPP project from APVV and from the grant of Ministry of Culture of SR and by the grant of the Envirofond from the budget of Environmental Ministry SR. The total cost of the exhibition was ca. 3 milion Sk (ca. 0.1 mil €). During six months the exhibition received in total 49 600 visitors at the Slovak National Museum in Bratislava. Afterward the part of exhibition was re-installed in the Museum of Spiš in Spišská Nová Ves where 6000 visitors came in total. Then the exhibition continued the Danube regional Museum in Komárno, and currently it is open at the Slovak National Museum in Martin. Many accompanying activities were prepared for public (series of popular lectures, excursions etc.).

Traditional popularization activities at the Institute are anually Open door days and geological excursions during the Week of science which are organised by S. Jeleň from Banská Bystrica working place in surroundings of the town, a classic mining area. More than hundred students took part in such activities in total last year.

A number of interviews on geological topics were provided for many radio and TV companies. Such interest is usually caused by a new volcanic activity in the world. A wide interest was attracted also by the information about the most important biological discoveries in 2010 when a jumping cockroach was on top of the list: A living species of the fossil described by our scientist was discovered during German expedition in South Africa. P. Vršanský offered several interviews for the most important media with wide response.

## 8. Background and management. Staffing policy and implementation of findings from previous assessments

### i. Summary table of personnel

Personnel	2007	2008	2009	2010	2011
all personnel	54	54	46	47	46
research employees from Tab. Research staff	23	22	24	24	26
FTE from Tab. Research staff	20,4	20,69	20,73	19,93	20
average age of research employees with university degree	42,48	43,67	44,1	44,6	45,5

### ii. Professional qualification structure

Number of	2007	2008	2009	2010	2011
vedúci vedecký pracovník DrSc./ research professor DrSc.	3	3	4	5	5
vedúci vedecký pracovník CSc., PhD/research professor CSc., PhD	4	3	3	1	1
samostatný vedecký pracovník/ senior scientist	8	9	9	9	9
vedecký pracovník/research scientist	8	9	9	10	10
profesor/professor	0	0	0	0	1
docent/assoc. prof.	3	3	3	3	3

*Vyplňte podľa prílohy A, správy o činnosti organizácie.*

**iii. Status and development of research infrastructure incl. experimental, computing and technical base (description of the present infrastructure, premises, and material and technical resources. Infrastructure, instrumentation and major technical equipment necessary for the achievement of the objectives specified in the research Concept)**

The infrastructure of the Geological Institute SAS includes essential techniques necessary for geological, mineralogical, petrological and paleontological research. The computing technique is available for all staff including postgraduate students. The computer network, full high speed fibre internet connection and working stations are checked and serviced by the Computing Centre of the Slovak Academy of Science. During 2011 digitalized telephone links were also open through the server at the Computing centre.

Instrumental infrastructure of Geological Institute during last four years has been significantly improved. The institute according to plan completed the sample preparation laboratory in Bratislava by purchase of the latest automatic device set from Logitech in 2009. The laboratory covers special requirements of the geologists and palaeontologists in whole domain of trimming, lapping and polishing of materials, preparation of polished and covered thin sections, 1" rounded polished specimens, as well as special oriented specimens and thin section for fluid-inclusions study. Devices are designed and used mostly for thin-sections preparation – we use the latest model of lapping machine Logitech PM-5, and polishing machine Logitech CP-50. Moreover, precise trim saw Logitech CS-30 and vacuum impregnation unit STRUERS was established in the laboratory at the working place in Valašská Street. In the present days is the best equipped and modern in Slovak Republic. In Bratislava we operate X-ray diffraction laboratory equipped with high quality diffractometer Philips PW oriented to identification and phase analyses of powder samples. Oriented samples are used for research of clay minerals. Pneumatic fossil preparation tools are available for paleontologists. The Central European Ar-Laboratory / CEAL in Bratislava began operations in 2004, after moving equipment from Geozentrum Vienna. Routine geochronological Ar/Ar measurements started after few months of improving the laboratory conditions. Equipped with VG 5400 Noble Gas Mass Spectrometer and special own-built extraction line is CEAL suitable for precious Ar/Ar geochronological dating of various kinds of geological samples. However, now is working in controlling mode because a problem was occurred in vacuum unit.

Geological Institute is a leader of EU project of structural fund "Center of excellence for integrated research of Geosphere" and 9 laboratories will be establish within project.

A similar preparation laboratory as in Bratislava has now been established in Banská Bystrica working place, also. Following new machines have been installed in 2011: electronically-controlled diamond saw, grinding/polishing rotary machine, vacuum impregnating vessel, electromagnetic separator, sieve shaker, ultrasonic bath, rotary disk mill, drying oven, centrifuge, ultrasonic sieve cleaner, and pneumatic fossil preparation tools.

Within frame of the project an X-ray device for crystallographical laboratory was also already installed. RTG diffractometer D8 Advance SolXE (Bruker) is employed for mineral identification, analysis of structural state, polymorphism, clay mineral studies and whole-rock mineral composition. The scanning electron microscope JEOL JSM-6390LV (purchased in 2007 as a joint investment with Faculty of Natural Science, Matej Bell University and Forestry Faculty of Technical University) was equipped by an energy-dispersive spectrometer (EDS) OXFORD Instruments Ltd., Inca X-Act enabling elemental analysis of studied objects, cathodoluminescence spectral imaging system CLue (Horiba Jobin-Yvon) and new sputter coaters for coating samples with carbon or gold. The stable isotope laboratory is dedicated to analysis of light stable isotopes (H, C,

O, N, S, Si) in any geological material. It consists of state-of-the-art magnetic sector mass spectrometer MAT 253 (Thermo Scientific), coupled to several preparation devices, that may however act as well as standalone analysers: gas chromatograph with ion-trap mass spectrometer for molecular identification of organic compounds, elemental analyser of H,C,O,N,S, and automatic preparation unit for carbonate and water samples. In near future the lab will be supplemented by laser ablation unit for in-situ isotope microanalysis of O, C, S and Si from any matrix.

In just moment we are preparing to install confocal Raman and infrared micro spectroscopy laboratory equipped with LabRam HR 800 (Horiba Jobin-Yvon). There is intended for mineral and molecular identification, material characterization, fluid inclusion analysis and, perspective in future time-resolved photoluminescence studies.

It is necessary to emphasise that in Banská Bystrica already succesfully operates total Carbon analyzer Strohlein useful for prospecting of energetic sources.

#### **iv. Status and development of bibliographic resources, activities of the Organisation's library and/or information centre**

The library of Geological Institute of Slovak Academy of Sciences is a public scientific geologically specialised library. The library is part of Slovak Academy Information System and the central library checks the work of our library, organises access to databases and is also methodical working place for us. The library at Geological Institute SAS except of carrying on the library fund is also an information centre giving together bibliographical output of institutional staff for annual reports of the Institute or for preparing various central projects. Since the last evaluation the access to fulltext databases of journals was significantly extended. Currently 48 journals are accessible in GeoscienceWorld, 130 journals in ScienceDirect within the collection Earth and Planetary Sciences, 196 journals in Earth and Environmental Sciences from Springer and 113 journals from Wiley.

The library of Institute is located in Bratislava main buiding but the new entries are regularly sent also to Banská Bystrica working place for two weeks. Currently the institutional library registers 21,691 book items. According to librarian statistics within period 2007 and 2011 there has been realised 10,624 borrowings in total and from that amount 6,884 was borrowings of journals. The library agenda is organised by a specialist – librarian, E. Luptáková.

#### **v. Describe how the results and suggestions of the previous assessment were taken into account**

Suggestions dated from July 17th 2007 were checked and the following text is organised according to the items from the statement of Commission signed by Prof. RNDr. Š. Olejník, DrSc:

- Increased quality of research in our institution is clearly visible in the number of research papers published in higher impacted journals than in previous assessment period - usually above the median within geological sciences.
- Qualification of director and senior researchers has significantly increased and following DrSc. graduation were achieved:
  - J. Spišiak 29. 4. 2008 (currently employed at UMB Banská Bystrica)
  - M. Nemčok, 16.10. 2008
  - V. Hurai 18. 6. 2009
  - J. Soták 6. 7. 2010
  - I. Broska and I. Petřík (DrSc. graduation process in progress)

- Intensification of our international cooperation is well documented in the common research with the German group lead by Prof. N. Froitzheim (Univ. Bonn), the group from Tromsø University headed by Prof. E. Krog - Ravna, and Dr. K. Kullerud, University of Uppsala in Sweden (Prof. P.Lazor, Prof. D. Gee, Dr. J. Majka) and the group from Limnological Institute of Austrian Academy of Sciences in Mondsee leaded by Prof. Danielopol. New collaboration began along with Japanese metamorphic petrologists (Prof. T. Hirajimoa). An academic exchange programme started with India, Kumaun University in Naintal (Prof. S. Kumar) and Bulgarian Academy of Sciences (Dr. Ognjanova). Dr. S. Jeleň cooperated with IGEM RAN Moscow (Dr. Kovalenker and Dr. Chernyshev) and with universities in Kyev and Lvov.
- Our Institute is traditionally very active in teaching programmes at universities. Numerous lectures and courses were organised at the Comenius University Bratislava, Matej Bel University Banská Bystrica, Charles University Prague and Masaryk University Brno. Total hours of lectures at the universities was 448 (year 2011) and 189 courses.
- Several new postdoctoral positions have been opened at the institute: V. Šimo, 2008; M. Golej, 2009; P. Ledvák, 2010; S. Ozdínová, 2010; A. Čerňanský 2011.
- Popularisation activity significantly increased in our Institute. A new marker was created at the institutional web page where some actual topics from research are shown in a popular form.
- Environmental research was focused on the region of old mining activity in Ľubietová, Špania Dolina, Staré Hory and Malachov area near Banská Bystrica. The results enabled installation of wetland systems and of Fe<sup>0</sup>-barrier to clean both the contaminated groundwater and surface (drainage) water. In near future the surroundings of the dump-fields will be cleaned by method of fyto remediation.
- Improvement of preparation laboratory in Bratislava working place during 2008 and the establishment of new SEM laboratory at 2008 in Banská Bystrica triggered the modernisation of Institutional laboratories. Thanks to structural funds a new X-ray laboratory during 2011 was prepared, new EDS system on SEM and currently within 2012 several new laboratories is organising (see infrastructure).

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

The Geological Institute of Slovak Academy of Sciences consists of two working places, in Bratislava and in Banská Bystrica, which was established in 1981. On the head of each working place is a leader. Director, deputy director, assistant of director along with head of accounting office and leaders of working places form the main organising body of the institution. At present the institute's structure does not include research departments. The management board and several other commissions (library, damage, stock-taking) help director in his decision process. The research plans and activities as well as basic personal policy are in competency of the Scientific board of the Institution. The institutional budget is centralised. The central budget basically covers salaries of the staff and partly run costs, mainly expences on energy. The budget is formed by central allowance, project funds (20 % indirect cost), rental and economical activities. The Institute is the "contribution organisation" since 1993, a legal entity with independent accounting.

Research infrastructure is in the process of fundamental improvement and new possibilities are expected thanks the facilities purchased through European structural funds. The created open laboratories offer the use of the technique to all researchers from Slovakia but we expect also interest from abroad. In this moment staff is preparing for routine in running of the new devices.

The personnel development for the next period will be in accordance of the approved plan of scientific board and will follow the concept presented in the Chapter 3. We are going to continue in training of PhD. students in approved research programmes. New experts for running of some devices have to be gained, especially to isotopic laboratory. Moreover, every year new postdoctoral positions is planned to open covering salaries from project budgets. We expect a slight enlargement of the staff of the Geological Institute in accordance with annually checked research output.

**9. Supplementary information and/or comments important for the assessment of organisation which are not explicitly mentioned in the questionnaire (concerning each previously mentioned evaluation criteria, facts not included, evaluation of research teams by ARRA, etc.)**

Annual evaluations of the Institutes within the Section I of SAS performed since 2005 were always positive for our Institute. In some scientometric parameters (CC publications) our institute belongs to the best among the evaluated institutes of the Section I. In the process of identification of Top scientific teams within SAS by ARRA also one our team (leaded by M. Janák) has been included in the wider selection.

The scientific journal *Geologica Carpathica* is published by Institute 6 times per year along with Geological Institute of Czech Academy of Science and Polish geological survey. *Geologica Carpathica* is very well evaluated within SAS keeping a high position among academical journals. A number of visitors registrated in the web site of *Geologica Carpathica* annually increases indicating high quality of articles published in our journal. According to our partner Versita publishers in 2011 the number of full page views increased by 209 % from 2564 to 4595 within years 2010/2011. Abstract views from our *Geologica Carpathica* page reaches from 10 000 to 20 000 per month with 25 papers having in total more than 100 downloads. The impact factor of journal is close to median in geosciences.

## Other information relevant to the assessment

The buildings of Geological Institute within last years passed over large reconstructions. The central building in Patrónka has been modernised inside and thermoinsulated from outside. The building obtained a new facade, roof, new lights in newly designed corridors, wall painting, new pavements and a new session room with kitchen and coffee room. New cooper power lines along with distribution boxes providing stable power in the building. A paleontological laboratory was established for preparation of fossils. The new storage rooms for samples and new rooms for libraries have been created in the technical pavilion. The building in Valašská street has been also modernised. The newly painted corridors with modernised lights and reconstruction of preparatory laboratory were the most important activities, which improved the working place. In the building at Valašská street the Institute provides a room for Institute of Botany and the joint laboratory EGL (managed by Energy Geoscience Institute of the Utah University). The new devices from Struers and Logitech companies for the preparation laboratory were purchased and at present we have the latest thin section preparatory laboratory in Slovakia.

The most important reconstruction was done in Banská Bystrica working place. The newly purchased building on the Ďumbierska Street was fundamentally reconstructed and prepared for installation of new devices. In this moment the Centre of excellence for integrated research of the Earth's geosphere is partly at work. The Institute takes care of its property and provides service also for other institutions of SAS, which have their seat in Ďumbierska Street working place. Except the reconstruction of building a parking place was created and surroundings of the building were partly reconstructed as well. Through two structural funds the working place in Banská Bystrica will belong to the best equipped geological institutions in frame of central Europe.