EARTH SCIENCE INSTITUTE
SLOVAK ACADEMY OF SCIENCES

Earth Science Institute
Slovak Academy of Sciences

Since July 1, 2015

The Earth Science Institute consists of two, Geological and Geophysical research divisions, which descend from the formerly independent Geological Institute and Geophysical Institute of the Slovak Academy of Sciences, both founded in 1953.

Important historical milestones :
1953 Laboratory for the geophysics
1953 Laboratory for the stratigraphy and paleontology
1965 Geophysical Institute
1966 Geological Institute
2015 Earth Science Institute, Slovak Academy of Sciences

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Earth Science Institute
Slovak Academy of Sciences

The Earth Science Institute of the Slovak Academy of Sciences explores and investigates geodynamic evolution of the Earth, its rock composition, evolution of ecosystems, climate and seawater chemistry, interpretation of geophysical fields and seismicity. We use modern approaches and methods and advanced instrumental facilities.

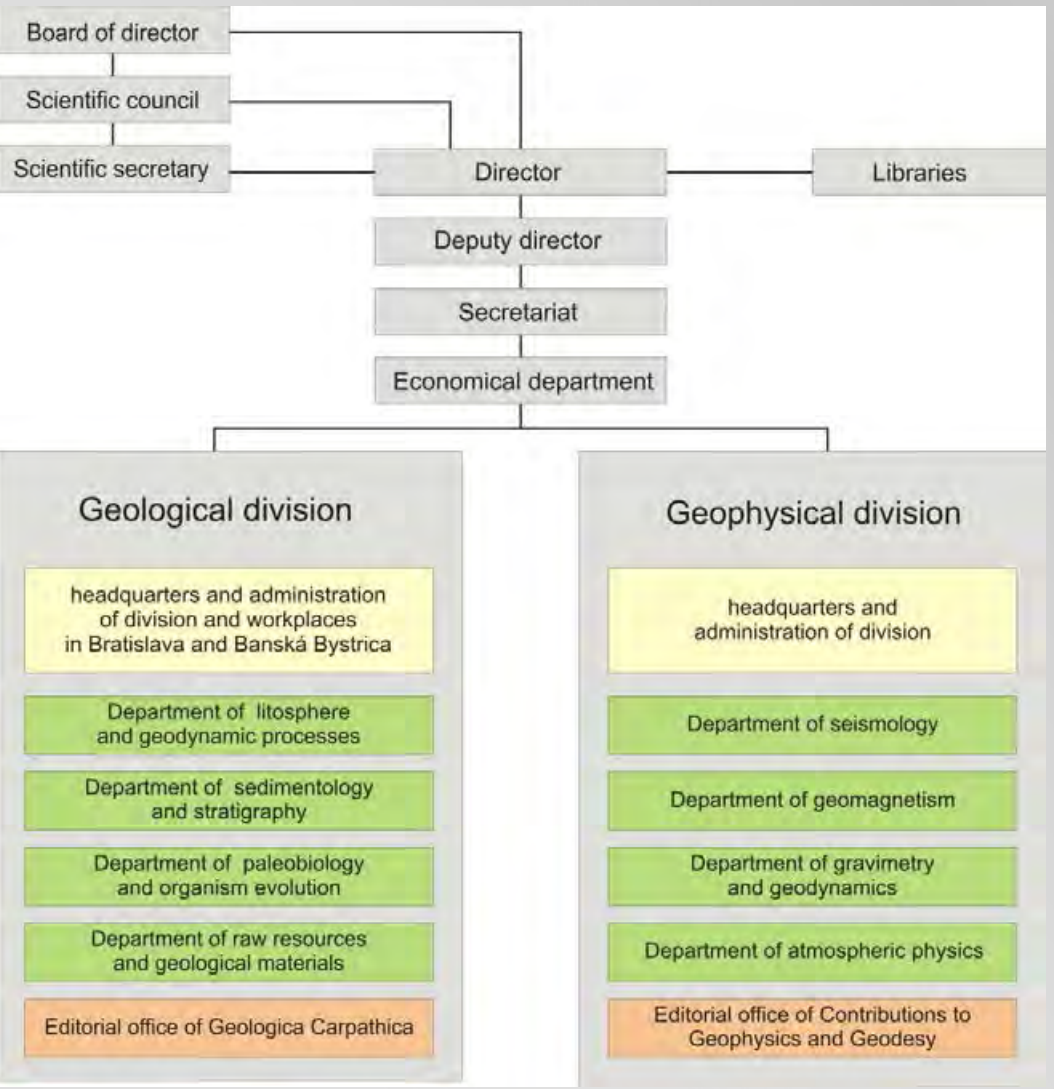
Basic information on the research personel

Research personel	December 31, 2015
Total staff	98
Researchers (DrSc. 9, PhD. 36)	56
PhD students	16

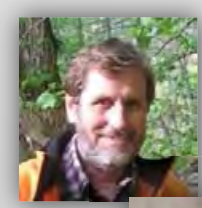
Average age of researchers in 2015: 46,9

Age structure	< 30	31-34	35-39	40-44	45-49	50-54	55-59	60-64	> 65
men	3	9	4	10	5	2	10	5	6
women	2	2	5	3	1	2	0	0	0

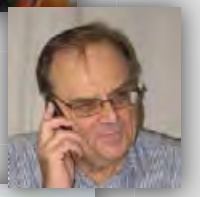
Structure of the institution



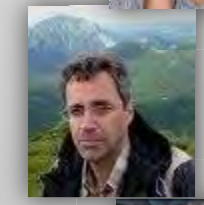
Director:
Igor Broska



Manager of Geophysical division:
Ladislav Brimich



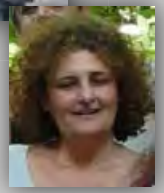
Manager of Geological division:
Ján Madarás



Scientific secretaire:
Adam Tomašových

Chairman of the Scientific council
Marian Janák

Head of Economic department
Adriana Kleinová



Team building 2016 or “Geo” joins us

October 18-19, 2016 – Congress Centre SAS, Smolenice Castle

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Slovak Academy of Sciences

Research strategy
and developing potential

Basic research

- investigation of the physical processes and the dynamics of the Earth's continental lithosphere
- analysis of the physical fields of the Earth
- reconstructing climate, ecosystem, and environmental changes across major global and regional environmental events
- development and improvement of the analytical and numerical methods
- investigation of the origin and evolution of raw material
- analysis of the geo-hazards, the effects of climate change and the factors menacing the environment

Developing potential

Main financial resources

1. Research funded from national and international resources
2. Collaboration with top-ranked research institutions
3. Seismic monitoring
4. Monitoring of magnetic field and deformation of the Earth
5. Partnership with industrial companies (exploration of raw material and energetic sources)
6. Analytical service provided by our laboratories. Maintenance and modernisation of infrastructure and workplaces
7. Development of scientific orientation depending on upcoming challenges

1. Research projects from national resources

SLOVAK RESEARCH AND DEVELOPMENT AGENCY

VEGA projects
(Slovak scientific grant agency)

VÝSKUMNÁ AGENTÚRA

Európska únia

1. Research projects from international resources

Potential Twinning partner for Uppsala University

Project will be oriented on research of ultrahigh pressure phenomena practically, experimentally and theoretically

UPPSALA UNIVERSITET

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Dept. of Earth Sciences
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752 36 Uppsala
Sweden
Tel. +46 18 471 25 56
Mob. +46 70 167 90 42
Fax +46 18 471 25 91
www.geo.uu.se
Peter.Lazor@geo.uu.se

1(1)

Dr. Igor Broska, Director
Earth Science Institute of the Slovak Academy of Sciences
Geological Division
Dúbravská cesta 9, P.O. Box 106, 840 05 Bratislava
SLOVAKIA

October 7, 2016

Dear Dr. Broska,

Work Programme 2016-2017 of the EU's framework *Horizon 2020* aims at spreading research excellence and widening scientific participation of European countries. Specifically, the coming call **WIDESPREAD-05-2017: Twinning** has an objective to address networking gaps between European research institutions by providing means to link defined fields of research between these institutions.

In my opinion, the Twinning call represents an excellent opportunity and platform for strengthening and widening our ongoing collaboration in the field *of ultra-high pressure metamorphism*. I propose that we response to this call by submitting a common proposal (along with the 3rd partner, as required by the call) where we define our project and coordinated research strategies in the 3 years' time horizon.

The call will open on May 11 and close on November 15, 2017. This would provide a good space for the preparation of proposal. Please, find further information about the Twinning call in the attached document.

I am looking forward to hearing a positive response to this initiative.

Sincerely,

Peter Lazor
Professor in Physical Geochemistry
Head of the Program of Mineralogy, Petrology and Tectonics

Partner in EIT RawMaterials

Initiated by the EIT (**European Institute of Innovation and Technology**)
and funded by the European Commission

EIT is bridge between business, research and education.

Coordinator: **Leoben Austria**
Project oriented on bauxite origin from the south-eastern Europe

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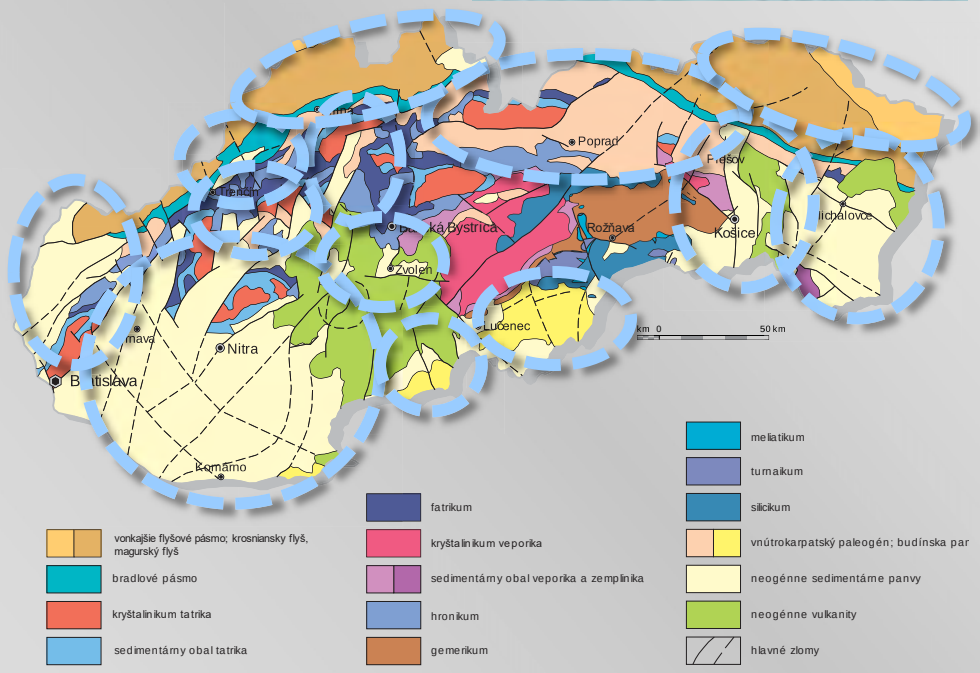
Scientific Program WATERS in collaboration with JRC Brussels and UNESCO; coordinator: Slovak Academy of Sciences

JRC EUROPEAN COMMISSION

UNESCO
United Nations Educational, Scientific and Cultural Organization

- Geological backgrounds of principal water resources in the Western Carpathians
- Groundwater flow modelling
- Climatology and paleoclimatology (reconstruction of temperature and rainfall during the Pleistocene, Holocene and Anthropocene)
- Seismic hazard risk and geothermal potential with relation to groundwater regime



Department of physics of atmosphere and hydrosphere?

1. Research projects from international resources

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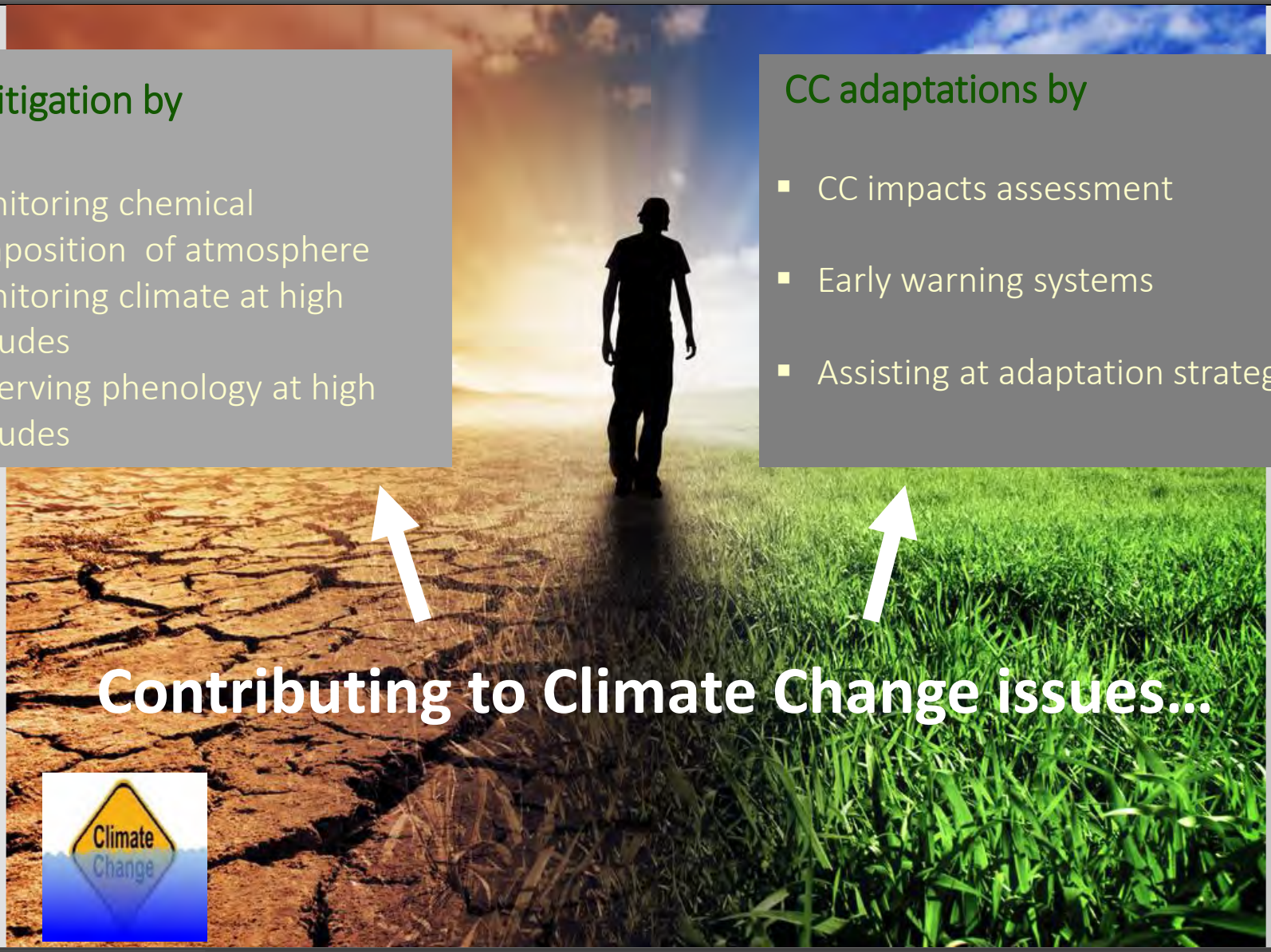
CC mitigation by

- Monitoring chemical composition of atmosphere
- Monitoring climate at high altitudes
- Observing phenology at high altitudes

CC adaptations by

- CC impacts assessment
- Early warning systems
- Assisting at adaptation strategy



COST

2. Collaboration with top-ranked institutions

Our collaborative scientific partners:

Vienna University, Austria

Paris Lodron University of Salzburg, Austria

Montana University of Leoben, Austria

Massay University Palmerstone, North New Zealand

Charles University in Prague, Czech Republic

Jagellonian University, Krakow, Poland

University Blaise Pascal, Clermont – Ferrand, France

National Taiwan Univesity, Taipei

Nordsim Laboratory in Stockholm, Sweden

Uppsala University, Sweden

Lund University, Sweden

The Arctic University of Norway, Tromsø

ATOMKI Nuclear Research Institute, Debrecen, Hungary

Masaryk University, Brno , Czech Republic

Eötvös Loránd University, Budapest, Hungary

University of Chicago, USA

University Utah, USA

University of Texas at Austin, USA

Geomar Kiel, Germany

GFZ Potsdam, Germany

Norwegian Polar Institute, Tromsø

KYOTO University, Japan

Okayama University of Science, Japan

Trinity College, Dublin, Ireland

ISTerre, Grenoble, France

Czech Academy of Sciences, Prague, Czech Republic

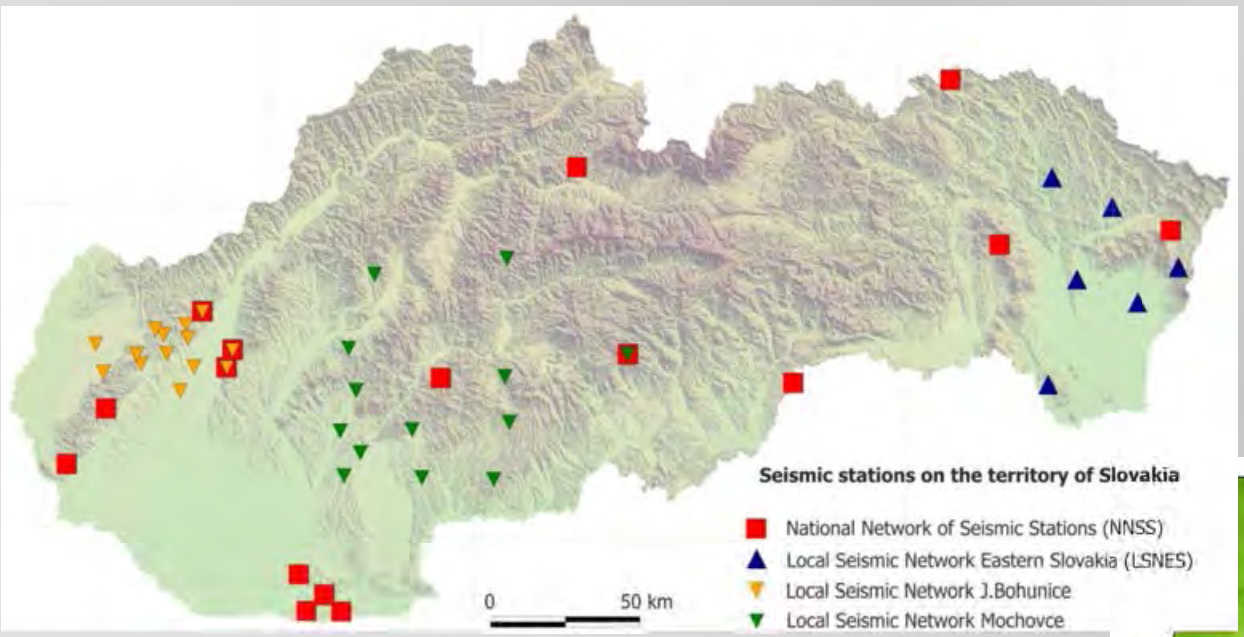
University of Vienna, Austria

Zentralanstalt für Meteorologie und Geodynamik (ZAMG), Austria

KAUST, Thuwal, Saudi Arabia

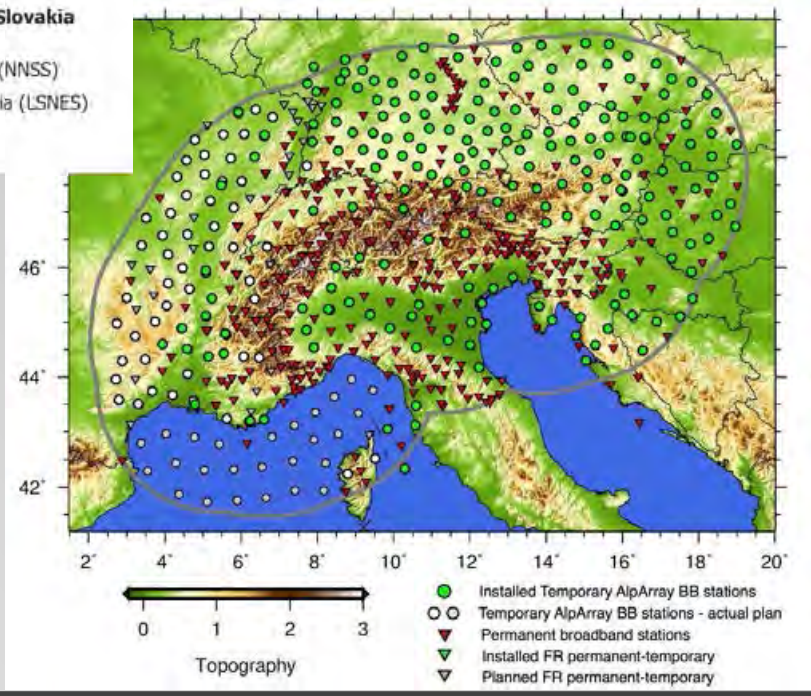
CEA, Cadarache, France

3. Operation of the National Network of Seismic Stations (NNSS)+ National Data Centre of CTBTO



- 3 stations of NNSS are part of EU initiative AlpArray backbone
- we cooperated with Vienna University on installations of 9 seismic stations

- 12 seismic stations operated by our institute plus another 4 in cooperation (with Czech Academy of Sciences and Progseis company)
- close cooperation with institutions operating local seismic networks (Comenius University, Progseis)



4. Permanent monitoring of the magnetic field and deformation of the Earth

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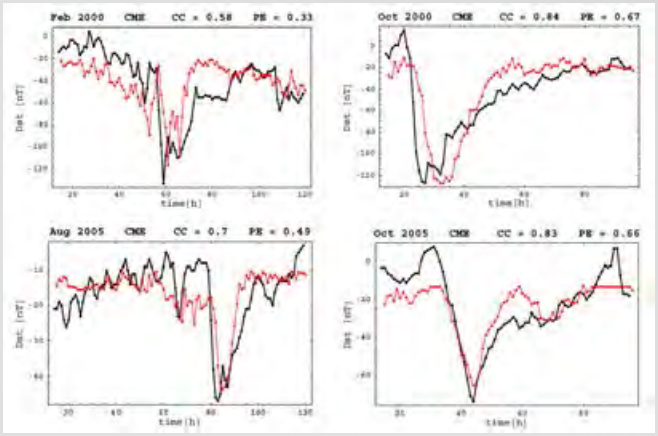
Workplace: Hurbanovo, Geomagnetic Observatory

Geomagnetically induced currents (GICs):

- saturation of high voltage transformers (possible breaking down the electric power systems)
- corrosion in pipelines is increased by GICs (possible ecological tragedy)

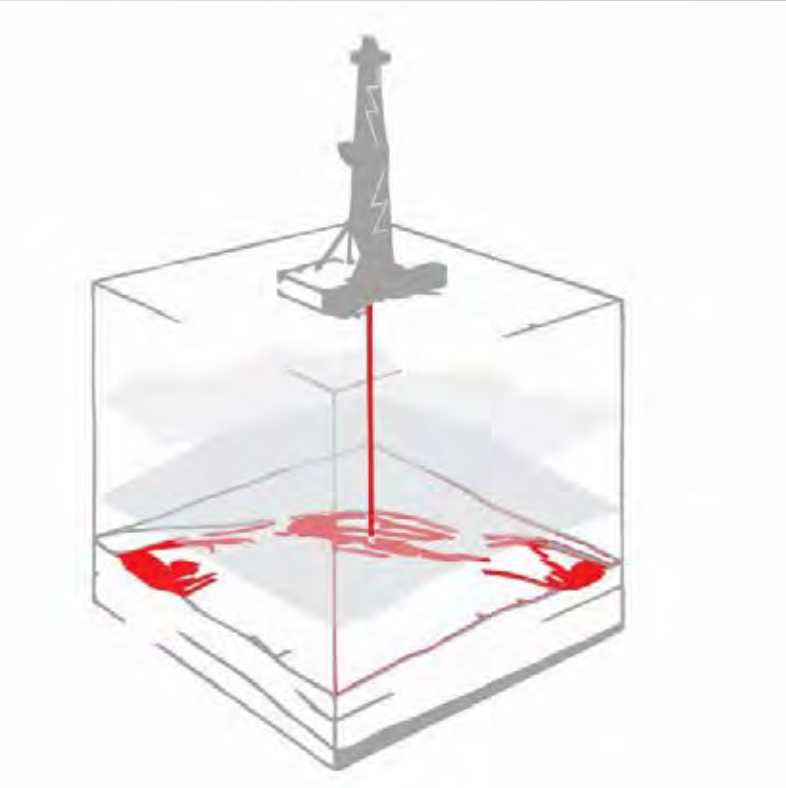
Slow (secular) variations:

- accurate measurements of magnetic declination for navigation purposes in aeronautics (expertise for Slovak Air Force).



Tests of a model for forecasting the geomagnetic activity
(observed Dst index – **black line**, our model – red line)

An example of a record of the horizontal component of the geomagnetic field displayed on the web page of the observatory.
A quiet diurnal variation is visible on the upper graph (Oct 19, 2016).
A magnetic storm is shown on the bottom graph (Oct 13, 2016) – Kp index was 6.



Low capacity hydrocarbon traps

Partners:

Nafta a.s.

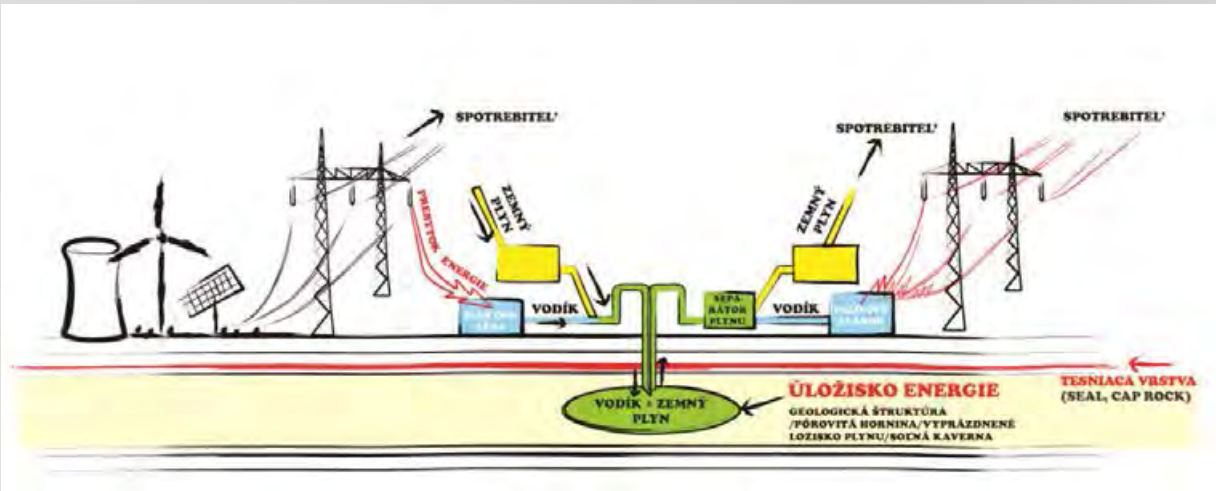
Technical university Košice

Sediment traps for hydrocarbons: buried river system, offshore deposits

Project submitted on June 2016; waiting for decision

Total budget: 5 426 439 €
Institutional budget: 2 701 938 €

Large-scale underground hydrogen energy storage



Partners:

Nafta a.s.

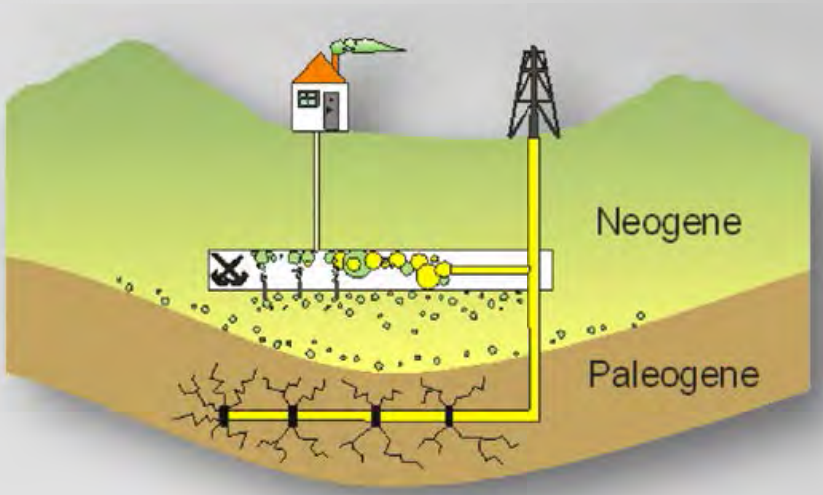
Institute of Inorganic Chemistry SAS

Institute of Geotechnics SAS

Slovak Technical University

- This method uses the electricity for water splitting and injects the resulting hydrogen into the natural gas grid. Hydrogen can be later re-electrified and represents an energy source.
- Our contribution will be to test the suitability of different rock formations for such storage (geological and geophysical methods).
- Planned budget in total: ca. 10 mil €

Transformation of old mines to natural gas storage



Partners:

Mining Corporation Hornonitrianske bane, Prievidza

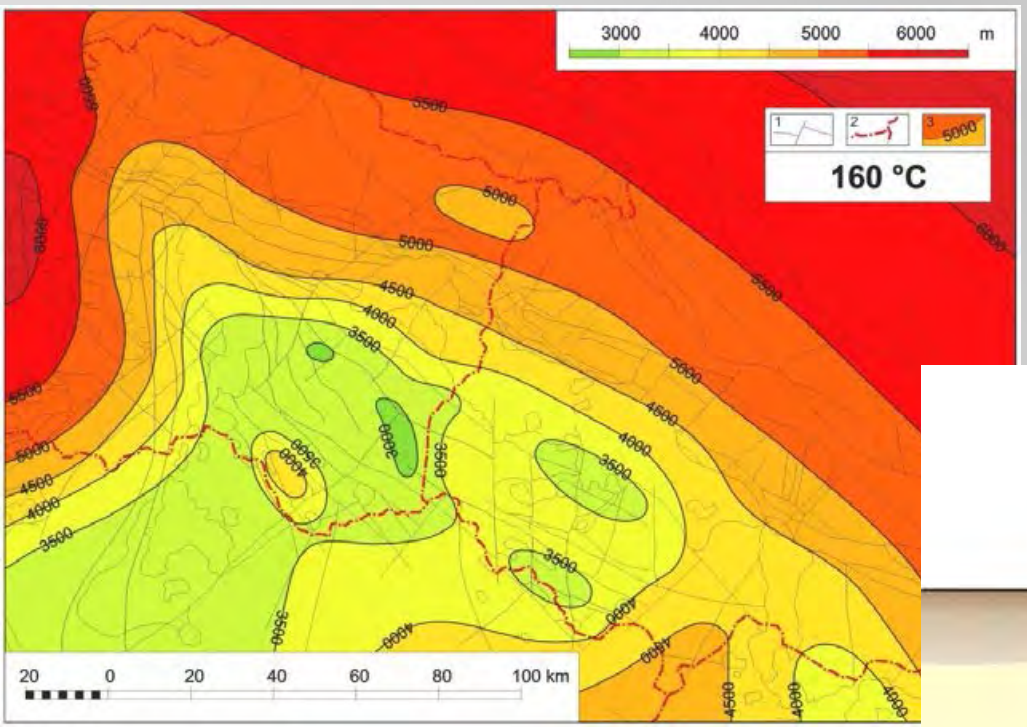
Technical University, Žilina

Large abandoned mining sites at Horná Nitra mining area represent an ideal opportunity for storage of natural gas. The brown-coal mine at Handlova consists of 22 km-long corridors and caverns attaining 109,300 m^3 in volume.

Introductory proposal (Earth Science Institute SAS)

The expected costs for preparation of gas storage: 48.2 million €

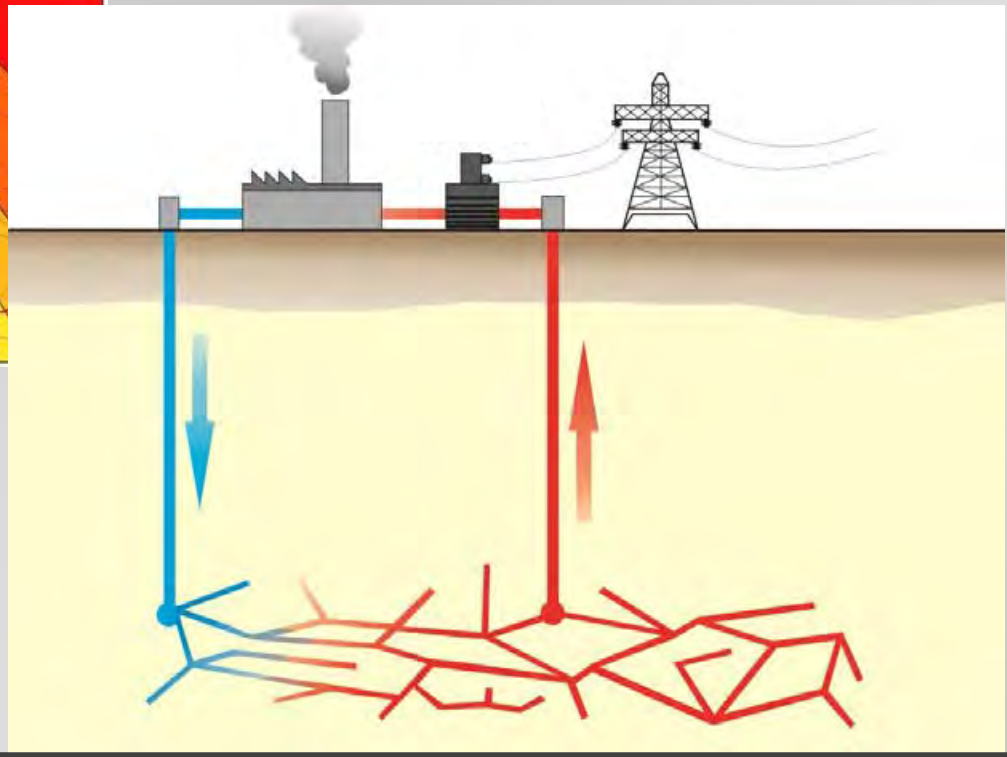
The capacity of underground storage: 26 – 32,5 million m^3 under pressure equal to 8-10 MPa



Depth distribution for required source temperature

Thermal conditions for geothermal energy

Transcarpathian depression & binary geothermal power plants application in the Eastern Slovakia region



6. Maintenance and enhancement of infrastructure and workplaces

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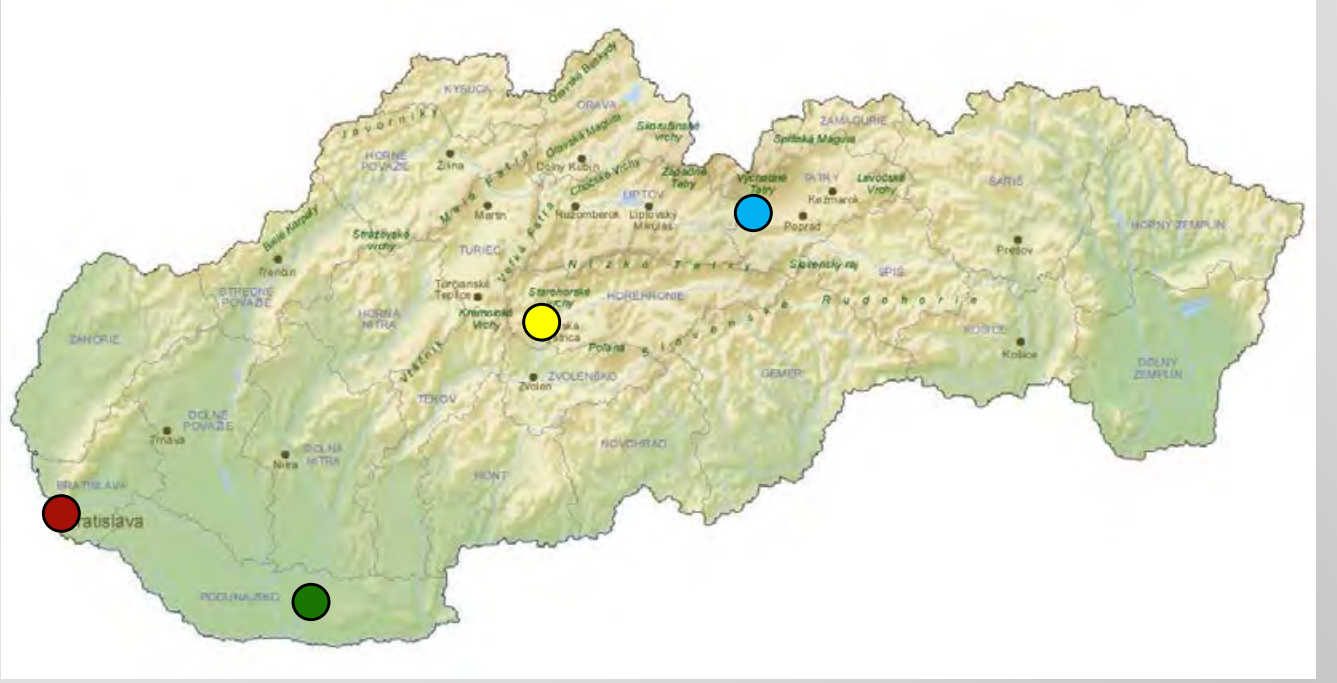
Workplaces of the institute:

- Bratislava (Geological and Geophysical division)
- Banská Bystrica (Geological and Geophysical division)
- Hurbanovo (Geophysical division)
- Stará Lesná (Geophysical division)



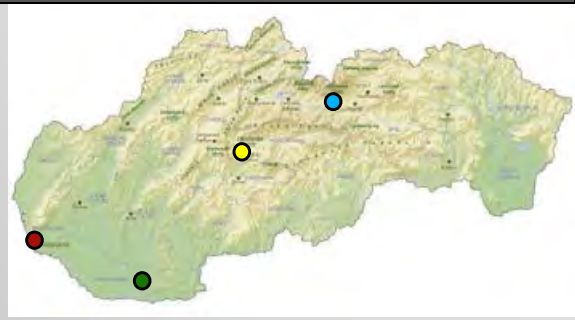
Geological division

Workplace Banská Bystrica

Workplace Bratislava

3 D presentation room

Geophysical division



Workplace Hurbanovo

Workplace Bratislava

Workplace Stará Lesná and Skalnaté pleso (High Tatra Mts.) - Meteorological observation point in the Astronomical Institute SAS

+ 16 observation points on seismology

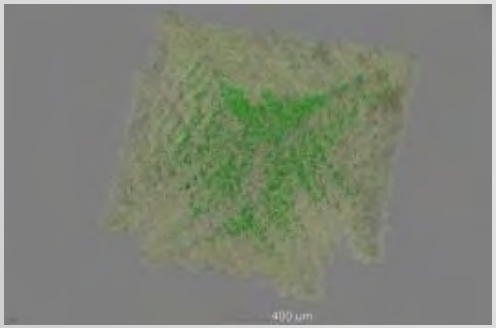
Geochemical and geophysical laboratories

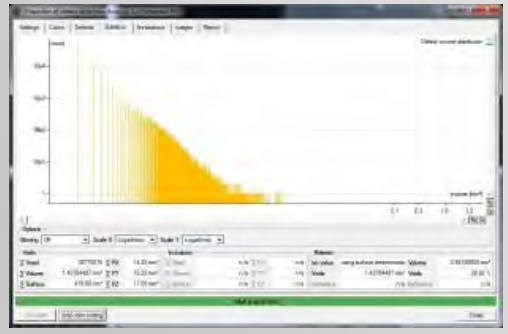
- Computed tomography
- Electron microanalysis (EPMA)
- Electron microscopy (SEM)
- Geofluids and microthermometry
- Isotope and organic geochemistry
- Mineral separation and sample preparation
- Organic carbon analysis
- Laboratory of paleolimnology
- Laboratory of sample preparation
- Vibrational spectroscopy
- X-ray fluorescence spectrometry
- X-ray powder diffraction analysis (BB)
- X-ray diffraction laboratory (Bratislava)
- Earth's tides station Vyhne
- Geomagnetic observatory Hurbanovo
- Geomagnetic observatory Šrobárová
- Gravimetric laboratory Banská Bystrica
- Meteorological observatory Skalnaté Pleso
- Meteorological observatory Stará Lesná
- National network of seismic stations + Data and Analysis Centre of NNSS
- Paleomagnetic laboratory Modra
- Radon emanation station Modra-Piesok

Laboratory of the X-ray tomography

Since 2015

Microtomograph Phoenix v|tome|x L 240 (General Electric) 3D analysis





4 articles in journals in press:

Palaeobiodiversity and Palaeoenvironments

Science of Nature

Zoological Journal of the Linnean

Amphibia-Reptilia

2 articles in preparation

Users:

Archeological Institute SAS
Faculty of Natural Science UK Bratislava
Masaryk University Brno (Czech Republic)
AGH Krakow (Poland)

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Laboratory of stable isotopes

Since 2013

MAT 253 Thermo Scientific with peripherals for isotopes of H, C, N, O, S

Articles:

Majzlan et al. : ***Geologica Carpathica*** 2016

Bella et al. **: *Int. J. of Speleology*** 2016

Orvošová et al. : ***Boreas*** 2014

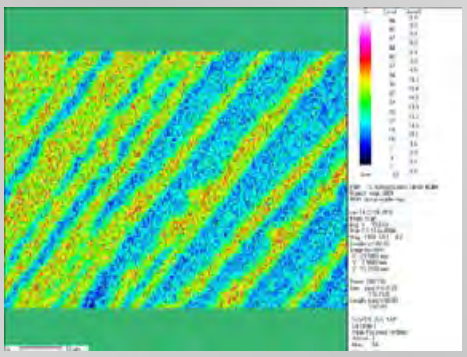
Hurai et al. : ***American Mineralogist*** *2013*

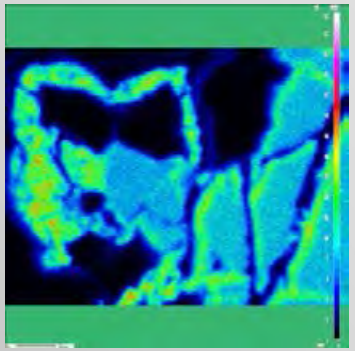
Users: universities, research institutes, applied research of hydrocarbons (Nafta Inc.)

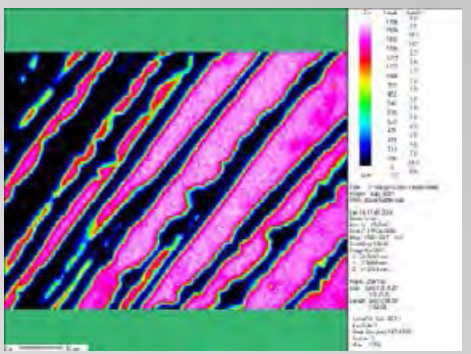
Laboratory of the electron microanalyses

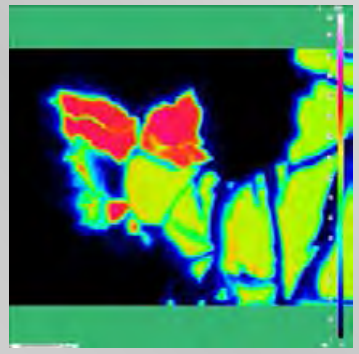
Since 2015

FEG microprobe JEOL JXA-8530F









Articles:

Tomašových, A. et al. : **Terra Nova** 2016

Ferenc Š., et al.: **Bull. Mineral. Petrol.** (online)

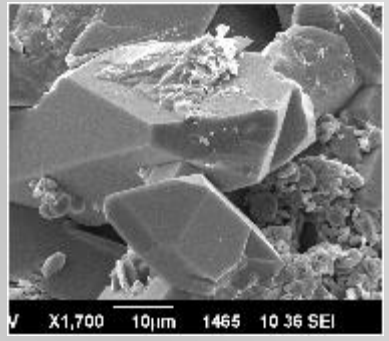
Bakos, F et al. : **Ageos**, in press.

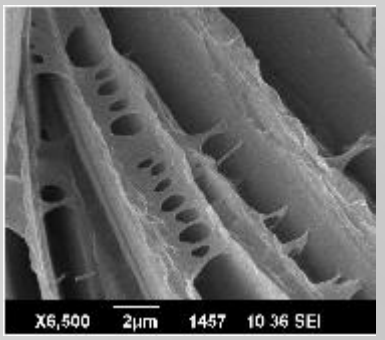
Chovan, M et al. : **Ageos**, in press.

Luptáková, J. et al. 2016: **Ageos**, in press.

Laboratory of the electron microscopy

Electron microscope JEOL JSM-6390LV with EDS spectrometer OXFORD Instruments INCA and Cathodoluminiscence spectrometer HORIBA





6. Maintenance and enhancement of infrastructure and workplaces

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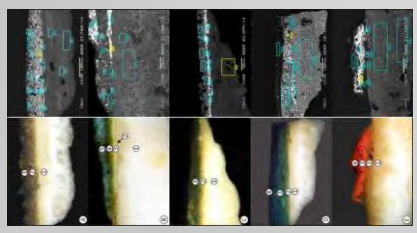
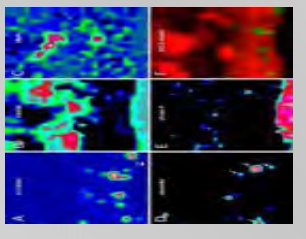
Laboratory of vibrational spectroscopy

Raman spectroscopy LabRAM-HR 800 (Horiba Jobin-Yvon)

Lazurite, 18th century





Research with historians of gothic altar from Levoča

Krásna Hôrka 2014 - Research of fresque and mumies

6. Maintenance and enhancement of existed infrastructure and workplaces

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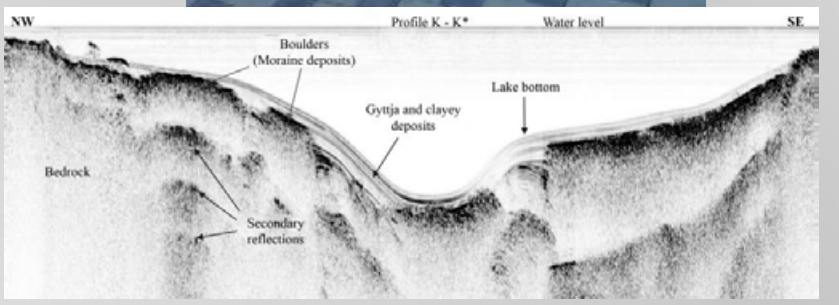
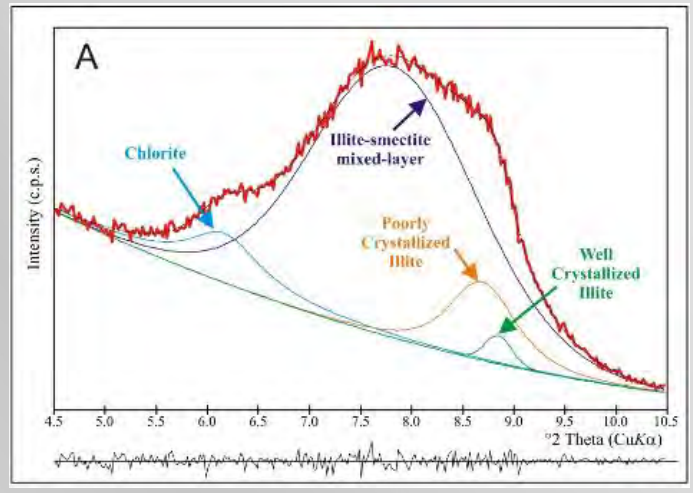
Paleolimnological laboratory

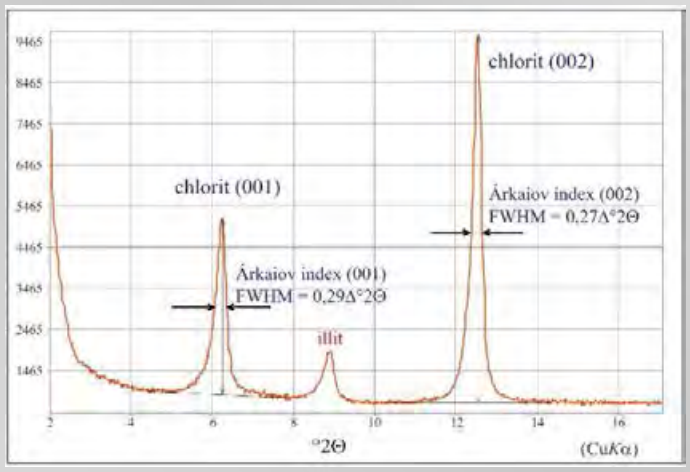
Swimming platform and sonar



Laboratory of X-ray diffraction

X-ray diffractometer D8 Advance (Bruker)





6. Maintenance and enhancement of infrastructure and workplaces

Removal of magnetic laboratory technique from Modra to Banská Bystrica

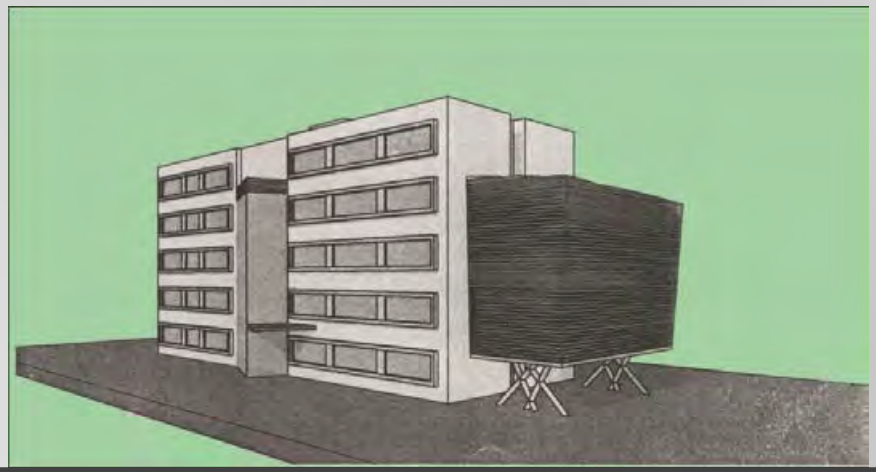
National Network of Seismic Stations Data and Analysis Centre and National Data Centre of CTBTO

Servers and disk array storage

Broadband seismometer STS2 (Streckeisen)

Innovation and upgrade is necessary for:

- Geomagnetic devices in geomagnetic laboratories in Hurbanovo
- New geomagnetic laboratory in Banská Bystrica (instead of Modra)
- Equipment of seismic stations and of Data and analysis centre (NNSS)
- Preparation laboratory in Bratislava
- Completing the isotopic laboratory
- Rebuilding of laboratory for vibrational spectroscopy and X-ray laboratory
- A new building in Bratislava is necessary (6 workplaces in Bratislava integrate into one building)




Thank you for your attention

Geological division
Earth Science Institute SAS

former Geological Institute SAS

director (2010-till now): **RNDr. Igor Broska, DrSc.**

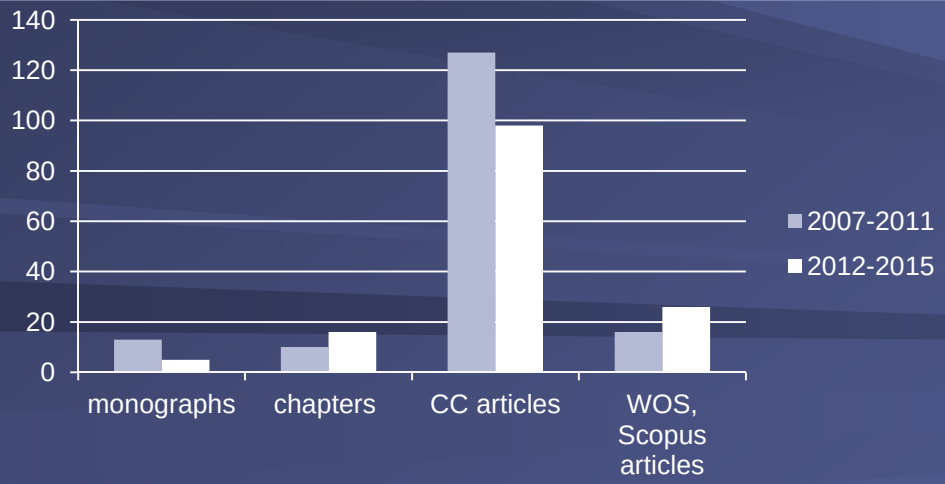
Quality and productivity

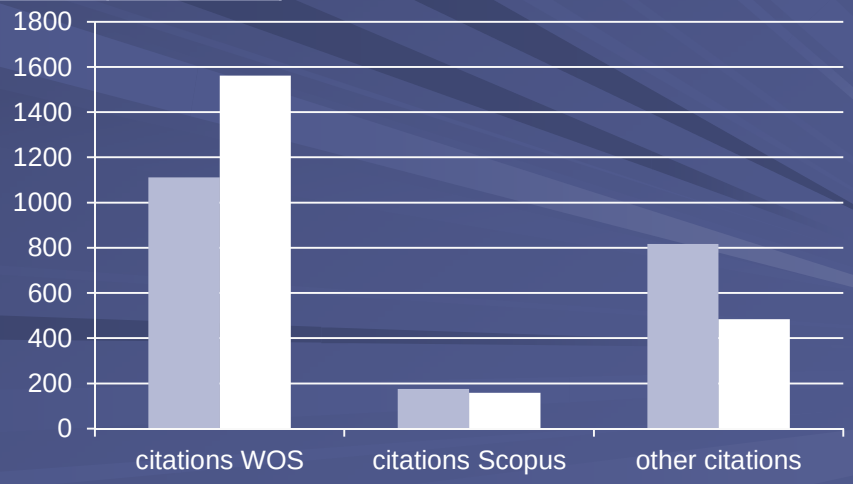
Research output – publications and citations

Geological Institute
Slovak Academy of Sciences

Scientific monographs published abroad	2
Scientific monographs a published in Slovakia	3
Chapters in scientific monographs published abroad	16
Scientific papers published in journals registered in Current Contents Ranking of used journals: Q1–33, Q2–20, Q3–34, Q4–11	98
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS)	26

Citations in WOS	1562
Citation in SCOPUS	159
Other citations	484





Quality and productivity

List of accredited programmes

Geological Institute
Slovak Academy of Sciences

4.1.32 petrology 4.1.33 tectonics

Number of PhD students (31. 12. 2015)	12
Internal (1 from abroad)	9
External	3
Maria-Currie (Horizon 2020)	1

Research output

Geological Institute
Slovak Academy of Sciences

The research activities of the Geological Institute SAS have been directed towards the fields of:

- petrology and mineralogy

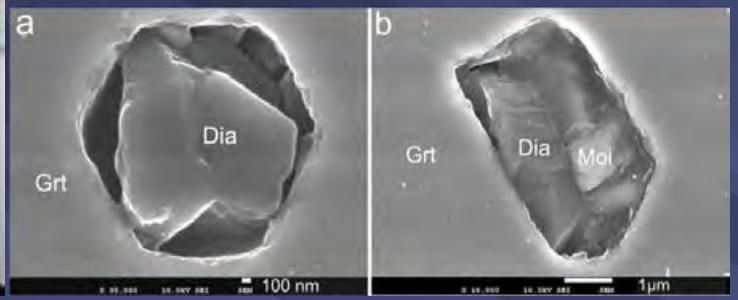
- palaeobiology and sedimentology

- metallogeny and environmental geochemistry

Success stories

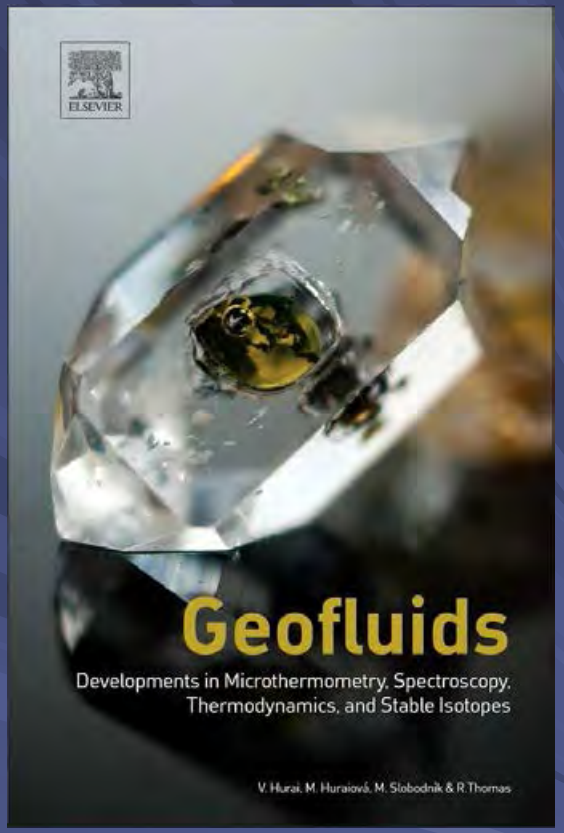
Geological Institute
Slovak Academy of Sciences

CRYSTAL WING AWARD
SLOVAKIA 2013



Diamond discovery; UHP metamorphism

Heat flow and fluid migration



The only textbook
available in the world

Petrology and mineralogy

Geological Institute
Slovak Academy of Sciences

Metamorphic processes

- UHPM: reconstruction of geodynamic processes in continental collision belts: Scandinavian Caledonides: Tromsø Nappe (Norway), Seve Nappe (Sweden), Lofoten (Norway), Eastern Alps: Pohorje (Slovenia); Rhodope (Bulgaria)
- Polymetamorphic evolution: Variscan vs. Alpine (Western Carpathians)

Granitic rocks

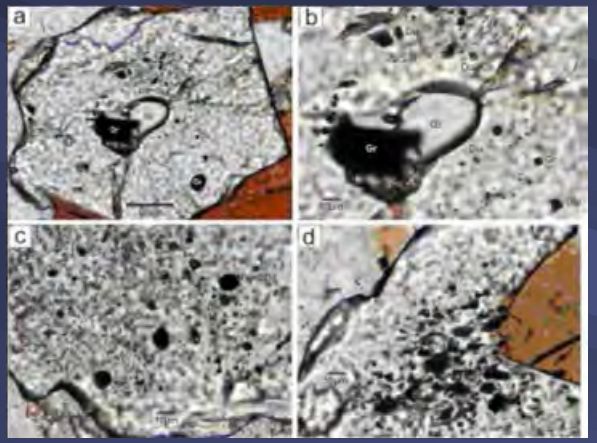
- Evolution of specialised granites (Gemeric unit): petrogenetic model
- Origin of the I-type granites in the W. Carpathians and their age (Nordsim laboratory in Stockholm)
- Discovery of syntectonic Variscan granites in Tribeč Mts.

Volcanic rocks

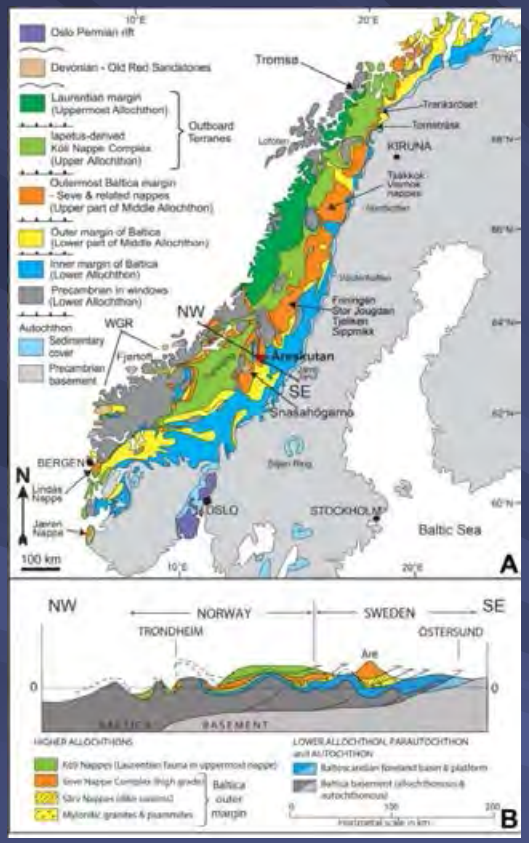
- Age determinations of volcanic eruptions (Laboratoire Magmas et Volcans, Clermont-Ferrand)
- Description of magmatic aragonite
- Refinement of the Štiavnica stratovolcano evolution

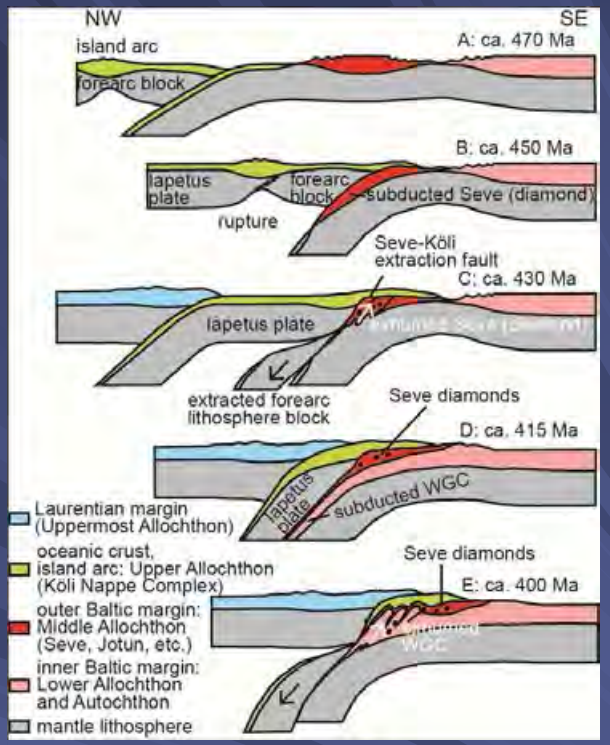
UHP metamorphism in Scandinavian Caledonides

Geological Institute
Slovak Academy of Sciences



Diamond from Tromsø





Geodynamic model of the Scandinavian Caledonides

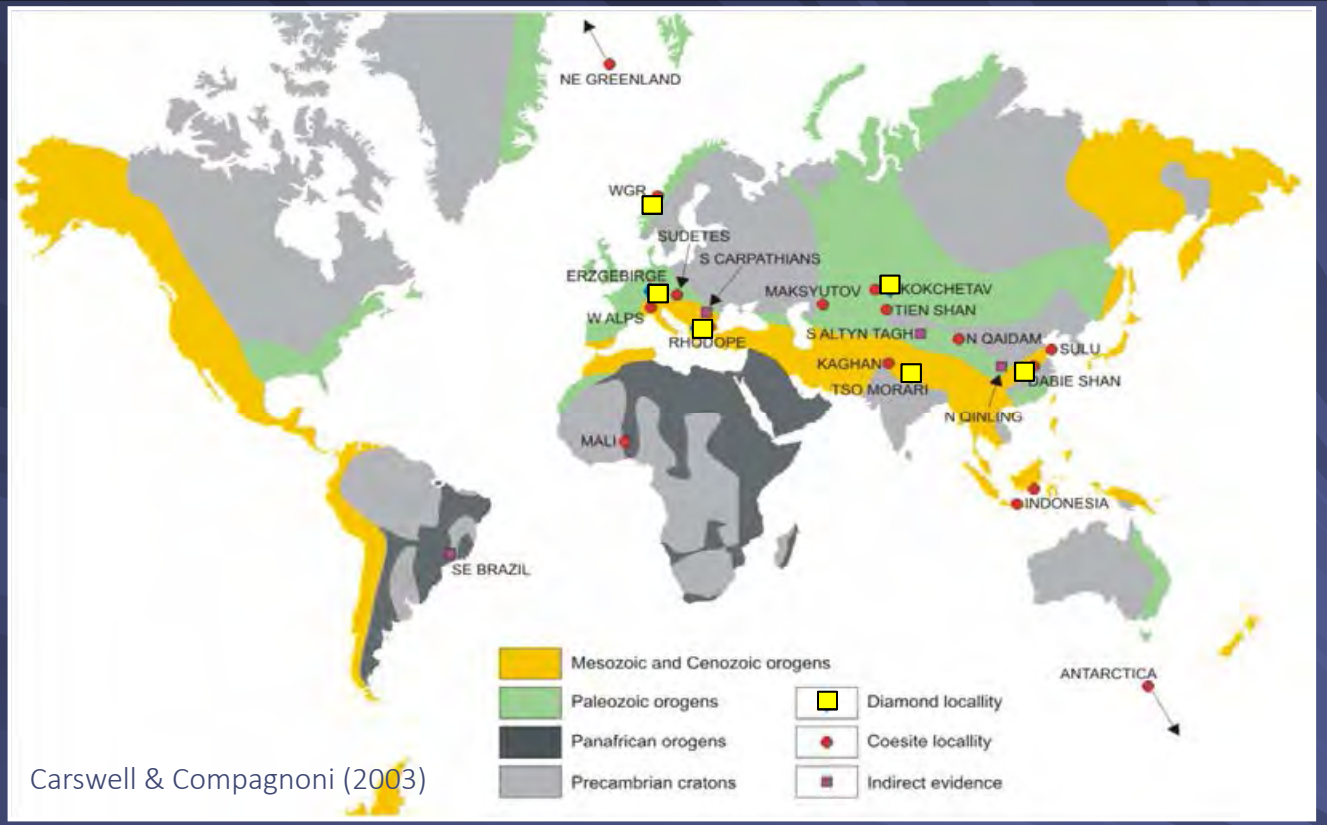
In the Scandinavian Caledonides our research resulted in discovery of diamond in gneisses from the Tromsø Nappe in Norway (Janák et al. 2013, *JMG*) and UHPM of the Seve Nappe in Sweden (Janák et al. 2013, *Gondwana Research*; Majka et al. 2014; *Geology*).

1st quartile

Quality and productivity

UHP metamorphism in Scandinavian Caledonides

Geological Institute
Slovak Academy of Sciences



Carswell & Compagnoni (2003)

In the Scandinavian Caledonides our research resulted in discovery of diamond in gneisses from the Tromsø Nappe in Norway (Janák et al. 2013, *JMG*) and UHPM of the Seve Nappe in Sweden (Janák et al. 2013, *Gondwana Research*; Majka et al. 2014; *Geology*).

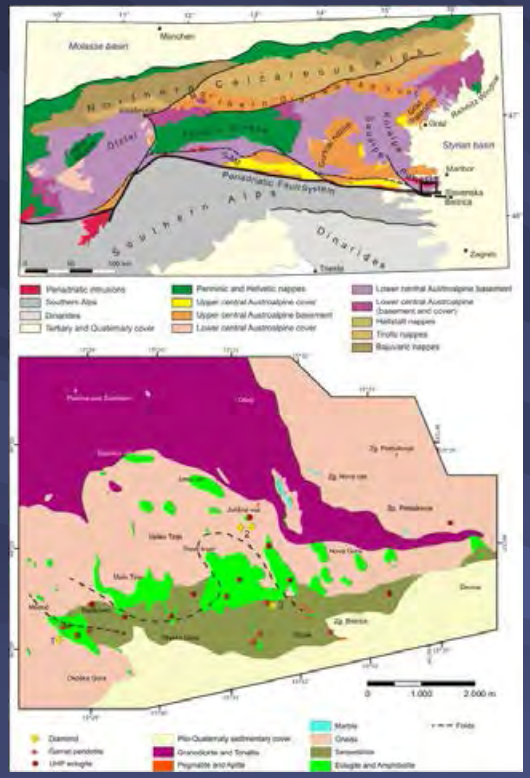
1st quartile

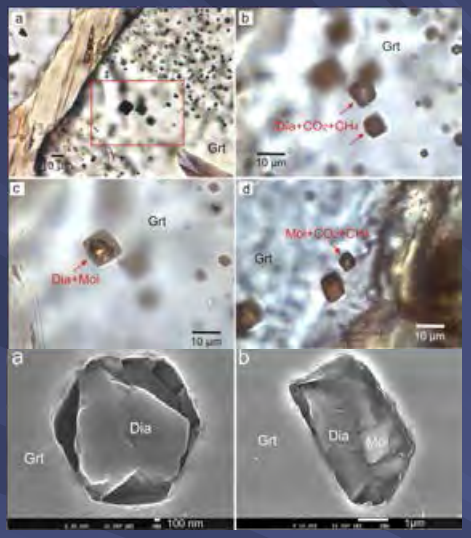
Quality and productivity

UHPM: Eastern Alps (Pohorje)

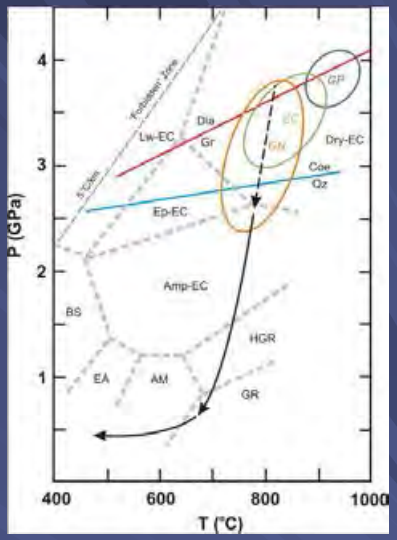
Geological Institute
Slovak Academy of Sciences

1st quartile

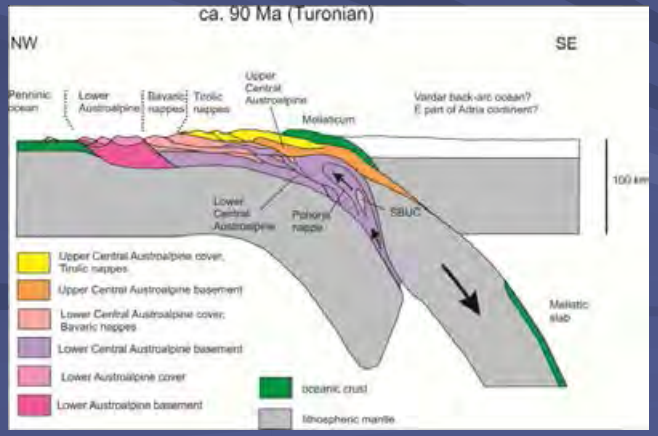




Diamond and moíssanite



UHPM: 3.5-4 GPa; 750-900 °C
P-T path of diamond-bearing rocks



Geodynamic evolution of the SE Alps: Intracontinental subduction in Late Cretaceous

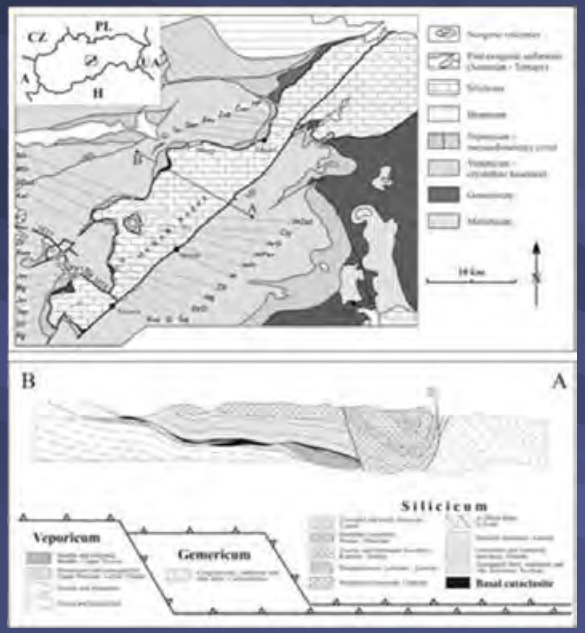
In the Eastern Alps our research resulted in discovery of diamond in gneisses from Pohorje in Slovenia (Janák et al. 2015, *JMG*).

PT conditions on the sole of Alpine nappe in the Western Carpathians

Geological Institute
Slovak Academy of Sciences

- syntectonic thrusting fluids were supralithostatically pressurized
- fluid pressure importance in thrusting mechanics

Cathodoluminescence textures of hydraulic breccia



Outline of research area in tectonic sketch with lithotectonic profile

	Type A	Type B
T_{room}		
Total freezing	~ -100	~ -100
T_e	-77 to -50	-65
T_mCO_2	-58.4	-57.4
T_mI	-27.1	-4.4
T_mClat	-34 to -21.3	+1.9
T_mHh	-1.2 to +13	-1.6 to +5.8
T_mSyl		105 - 118
T_h	129 - 385	
T_mH	187 - 440	354 - 367

Phase transitions in fluid inclusions

1st quartile

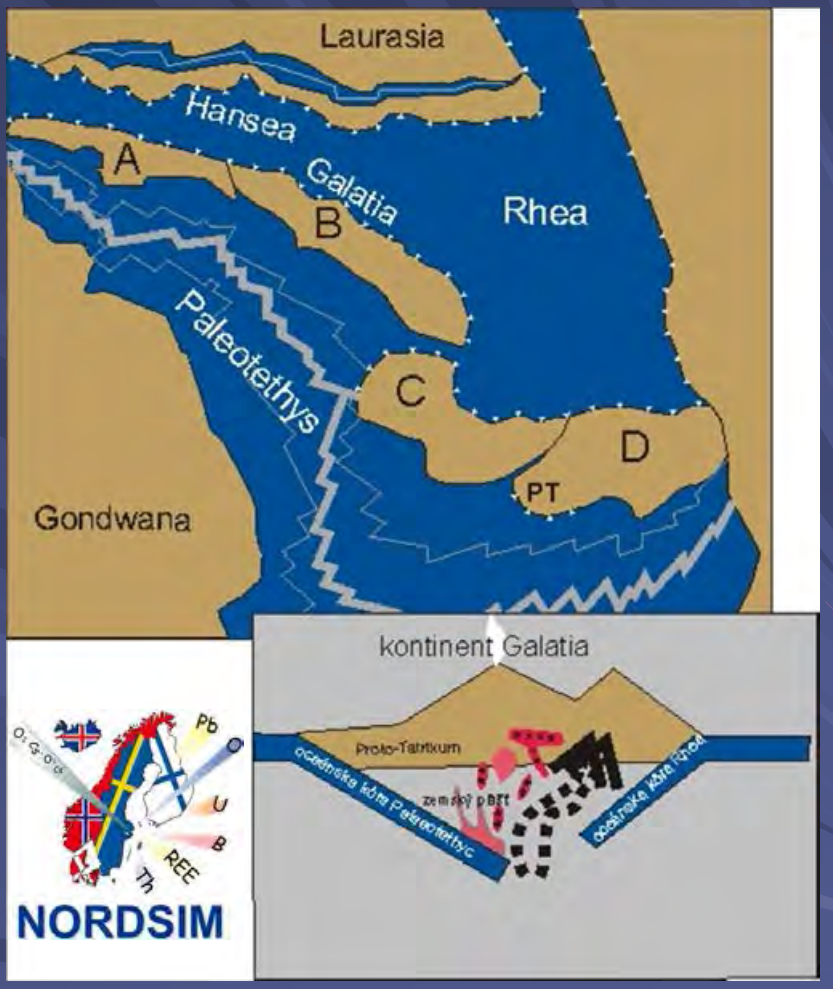
Milovský, Hurai et al. 2012, *International Journal of Earth Sciences*.

Quality and productivity

Origin of the I-type granites

Geological Institute
Slovak Academy of Sciences

I-type granites are subduction-related indicating the onset of Paleotethys subduction. Up to this interpretation the Western Carpathian basement was neglected in Variscan paleoreconstructions.



1st quartile

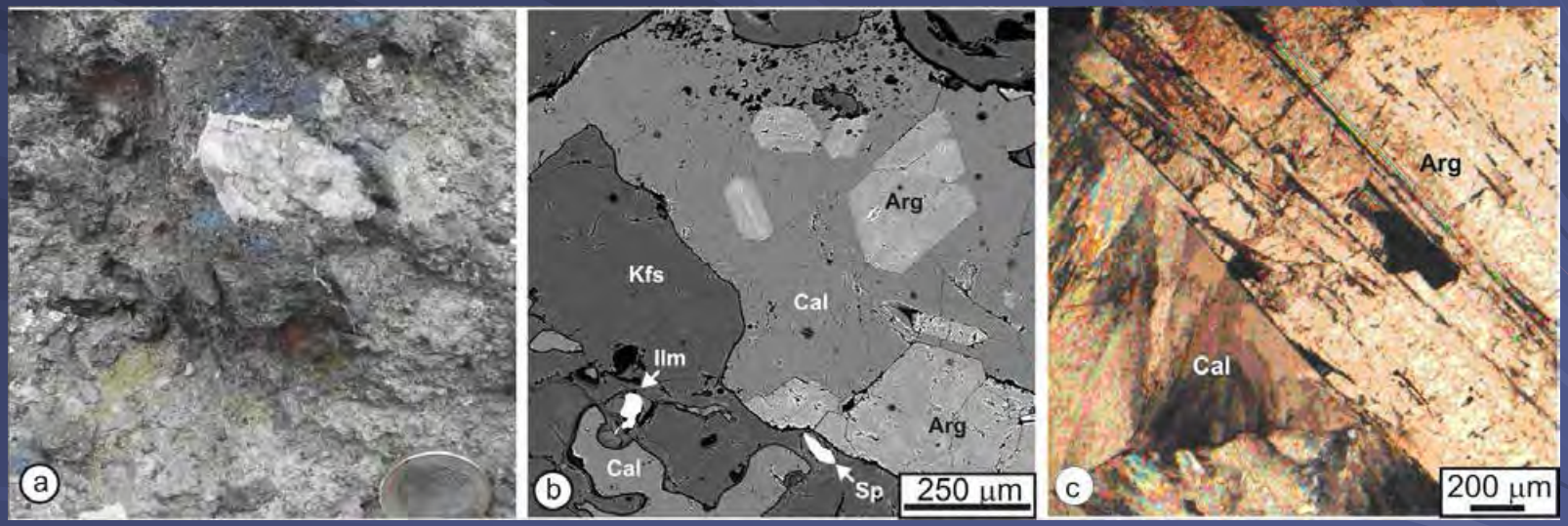
Broska, Petrík et al. 2013, *Lithos*.

Project: e/2010/30

Description of magmatic aragonite

Geological Institute
Slovak Academy of Sciences

- Syenite and carbonatite xenoliths from the Hajnačka diatreme (southern Slovakia) contain aragonite phenocrysts in calcite matrix.
- First finding of carbonatite in Slovakia
- Second description of magmatic aragonite worldwide
- Crystallization of aragonite due to supra-lithostatic pressure in a lower crustal magmatic reservoir
- Calcite matrix with lowered ordering degree due to rapid cooling during decompression coincidental with the volcanic eruption



Carbonatised syenite xenolith with magmatic aragonite ejected in basalt bomb

1st quartile

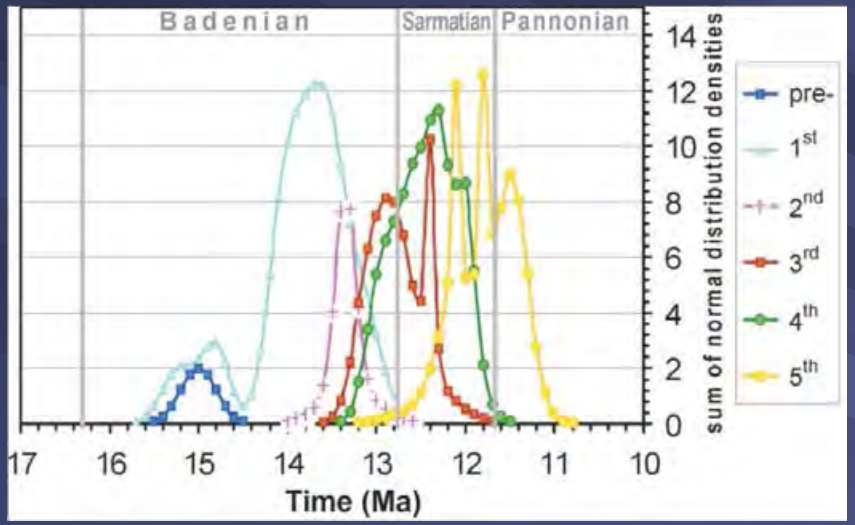
Hurai, ... Milovský, Luptáková et al. 2013, *American Mineralogist*

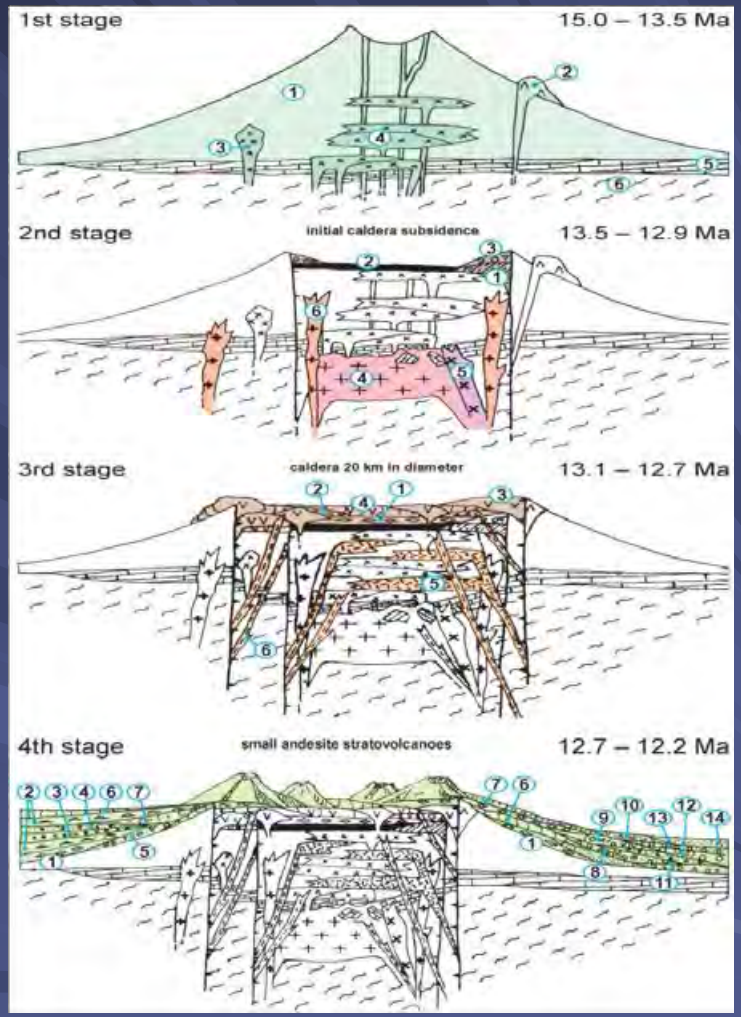
Quality and productivity

Paleovolcanic reconstructions and dating

Geological Institute
Slovak Academy of Sciences

Evolution of the stratovolcano took place in five stages during the interval 15.0 – 11.4 Ma, with emplacement of a subvolcanic intrusive complex and caldera collapse between 13.5 and 12.7 Ma.





2nd quartile

Chernyshev, ...Lexa, Jeleň et al. 2013, *Geologica Carpathica*

Quality and productivity

Paleobiology and sedimentology

Geological Institute
Slovak Academy of Sciences

Taphonomy and conservation biology of fossil assemblage

- Fossil age dated south California programme

Systematics, phylogeny and functional morphology

- Vertebrates
- Insects

Evolutionary paleobiology

- Ostracods
- Moluscs

West – Carpathian Mesozoic and Cenozoic biotic events

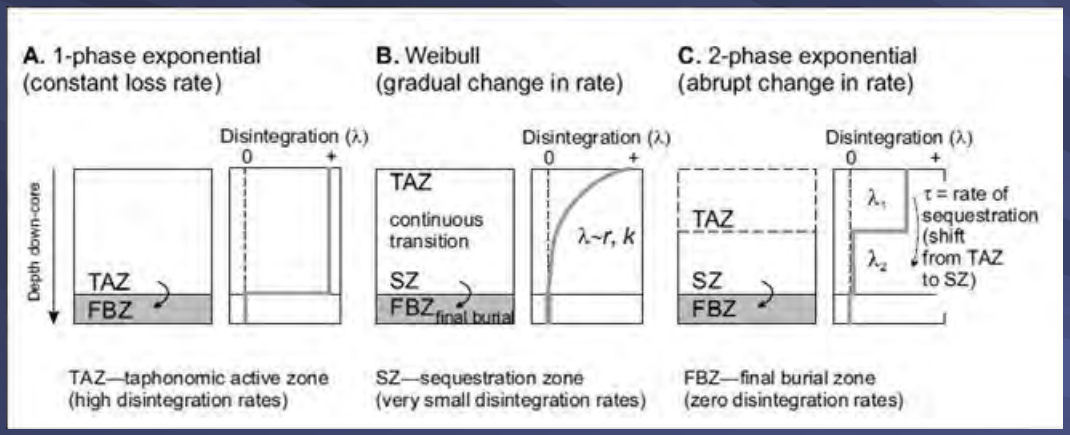
- Triassic Lower Cretaceous
- Upper Cretaceous-Cenozoic

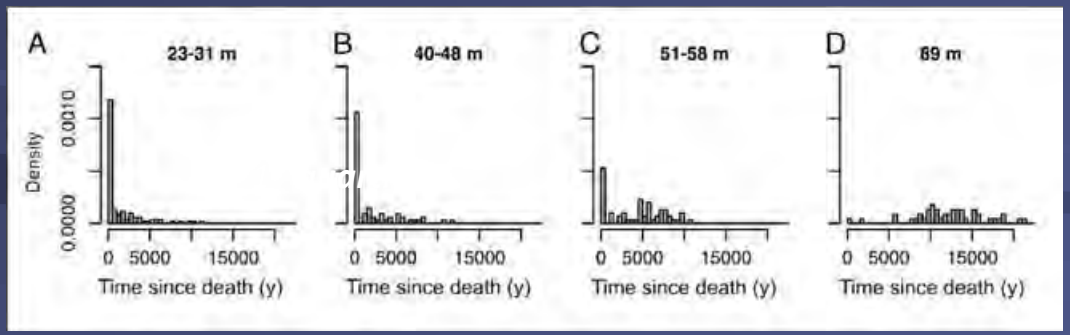
Long-term accumulation of carbonate shells

Geological Institute
Slovak Academy of Sciences

- Rates of aragonite degradation on the open warm-temperate shelf (~100 m depth) are very fast, shells dissolve after few years
- Less than 1% of living shells will make it into the subfossil record
- Molluscan assemblages are significantly time-averaged (~1,000 years)

Research area: California





Tomašových et al. 2014, 2015
1st quartile

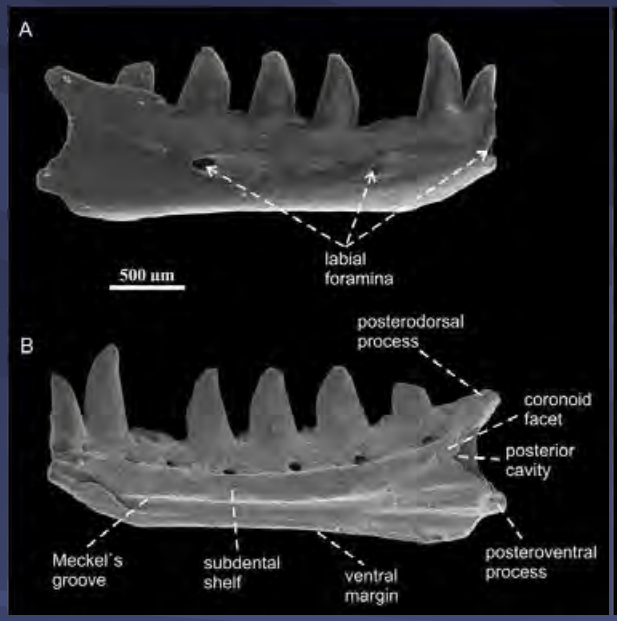
Quality and productivity

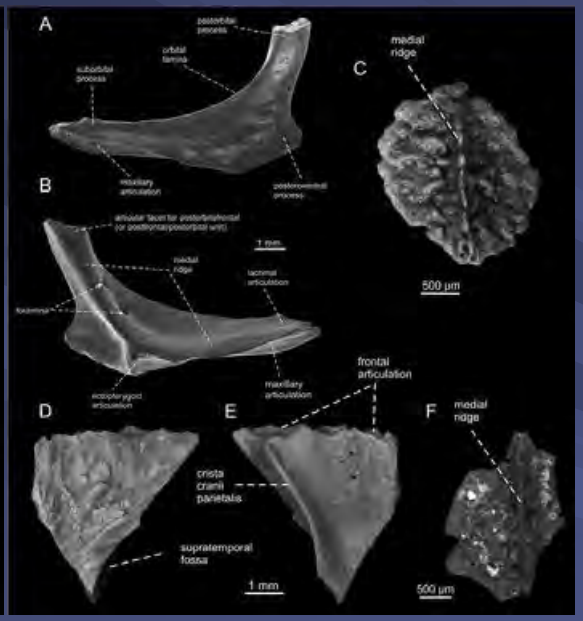
Early Miocene reptiles: the first stages of modern squamates in Europe

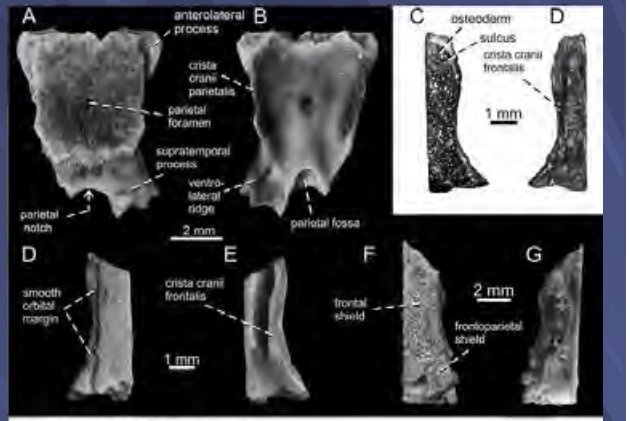
Geological Institute
Slovak Academy of Sciences

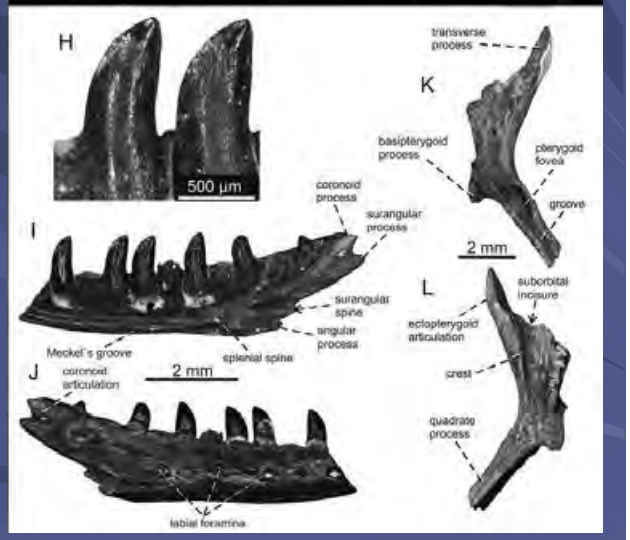
Documenting the opening of migration routes of terrestrial reptiles between Africa and Eurasia at the Oligocene/Miocene boundary, using squamate reptiles

Research area: Amoneburg, Germany









1st quartile

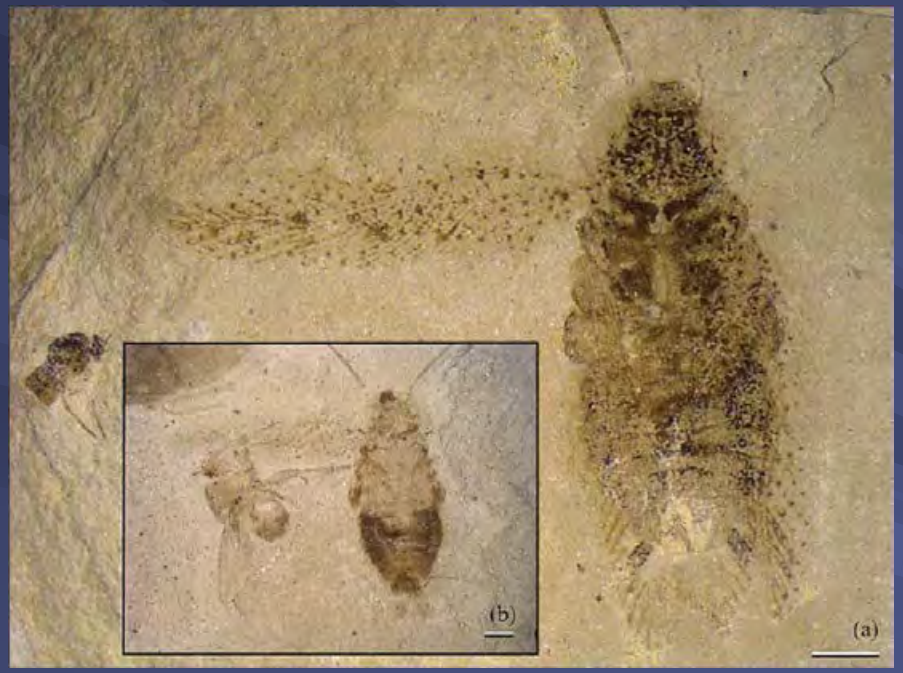
ČERŇANSKÝ et al. 2015 *Journal of Systematic Palaeontology*

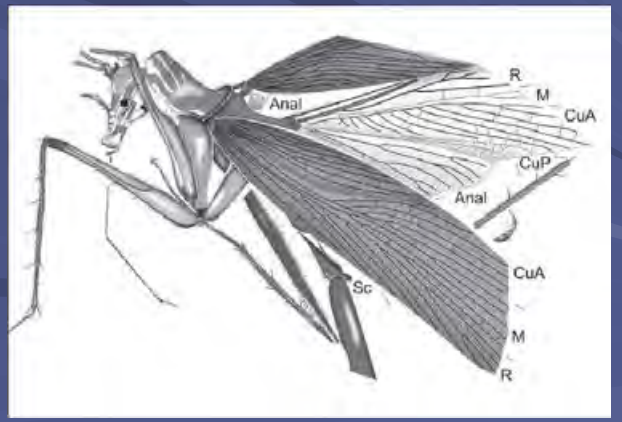
Quality and productivity

Systematics and evolution of cockroaches

Geological Institute
Slovak Academy of Sciences

- Tracing evolution of cockroaches and their viviparity
- New cockroach species that inhabited tropical environments in the North America belong to a lineage who re-invaded Northern America 50 Ma later





1st and 2nd quartiles

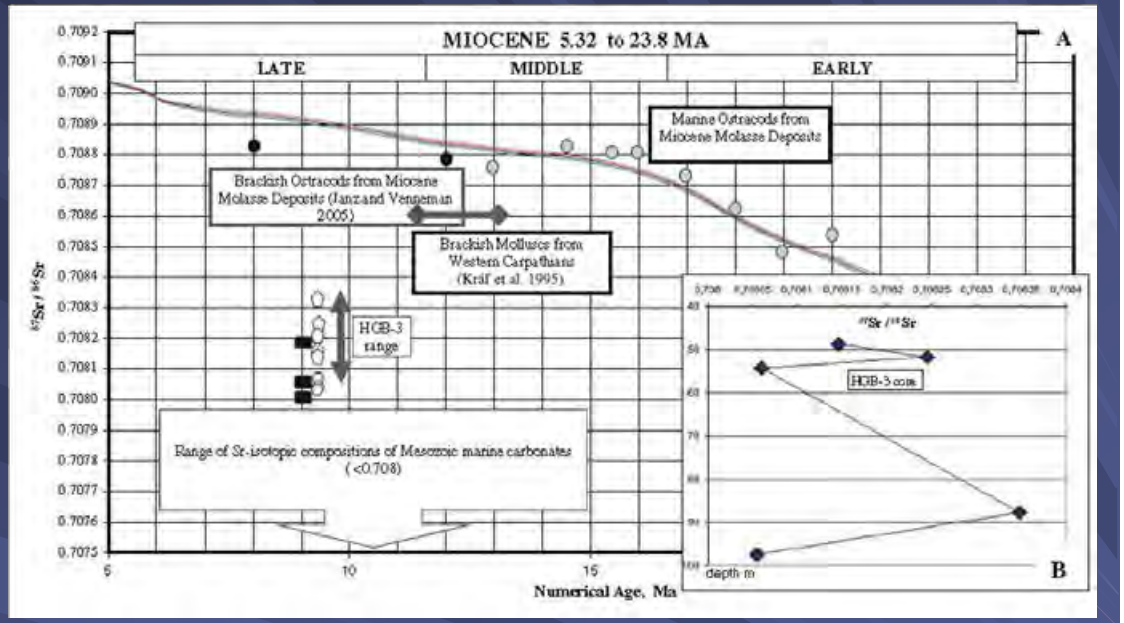
Vršanský et al. 2013, 2014, 2015

Quality and productivity

Evolution of the Pannonian Lake System during the Miocene

Geological Institute
Slovak Academy of Sciences

Research area: Slovakia, Hungary, Bulgaria



1st quartile

Pipík et al. 2012

- $^{87}Sr/^{86}Sr$ demonstrated that during the Late Miocene, the Turiec Basin was isolated from brackish-water basinal system of the Central Paratethys
- Bathymetric differentiation of ostracods during the Late Miocene into shallow- and deep-water communities
- More than 50% of endemic species
- Evolution in an isolated, long-lived lake system, analogous to Lake Baikal, Lake Tanganyika

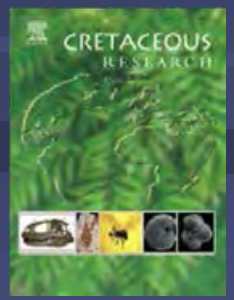
Quality and productivity

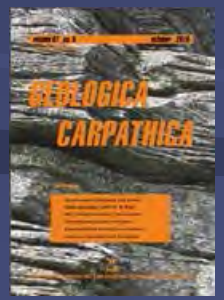
Climatic and biotic changes during the Late Triassic and Early Cretaceous

Geological Institute
Slovak Academy of Sciences



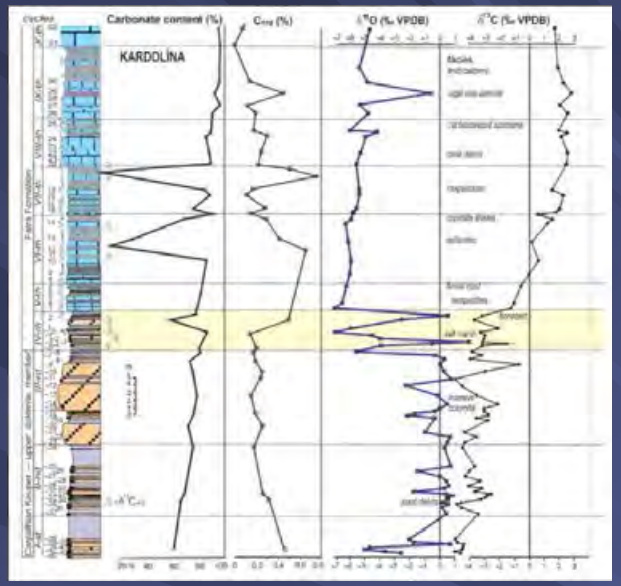
- An increase in precipitation in the uppermost Triassic
- Changes in plankton productivity at the Jurassic/Cretaceous boundary
- Collapse of Lower Cretaceous carbonate platform in the Middle Albian, followed by hardground formation and the deposition of pelagic marls

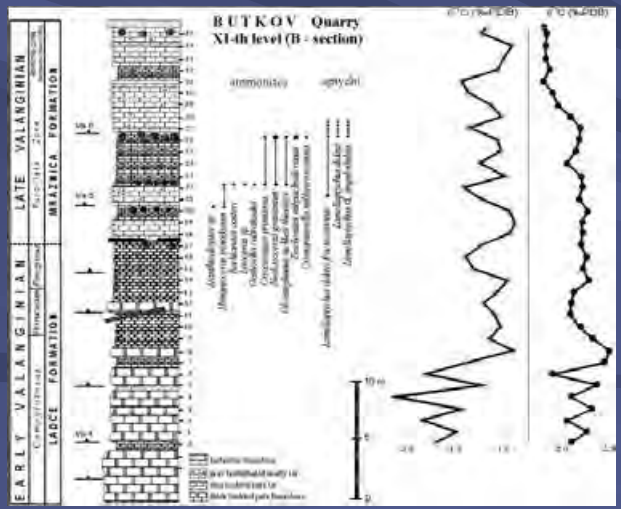


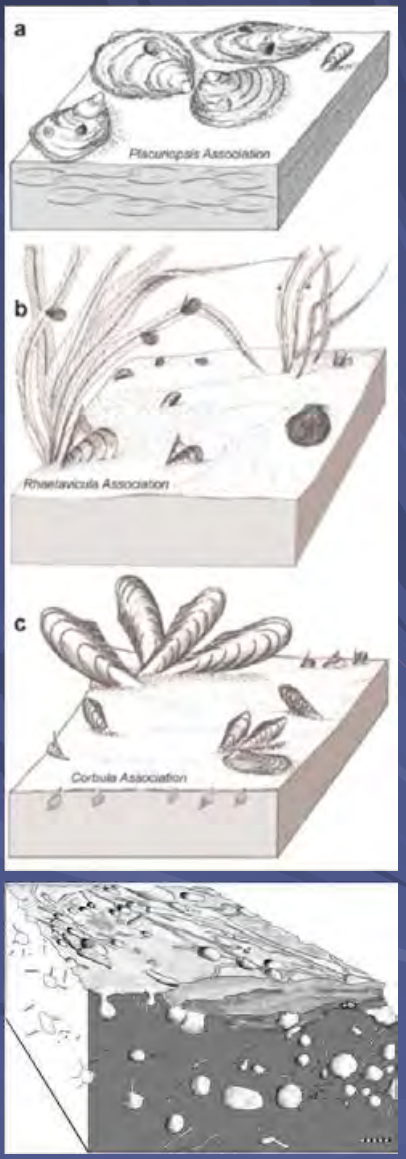


Michalík et al.
2012, 2013, 2016

1st and 2nd quartiles



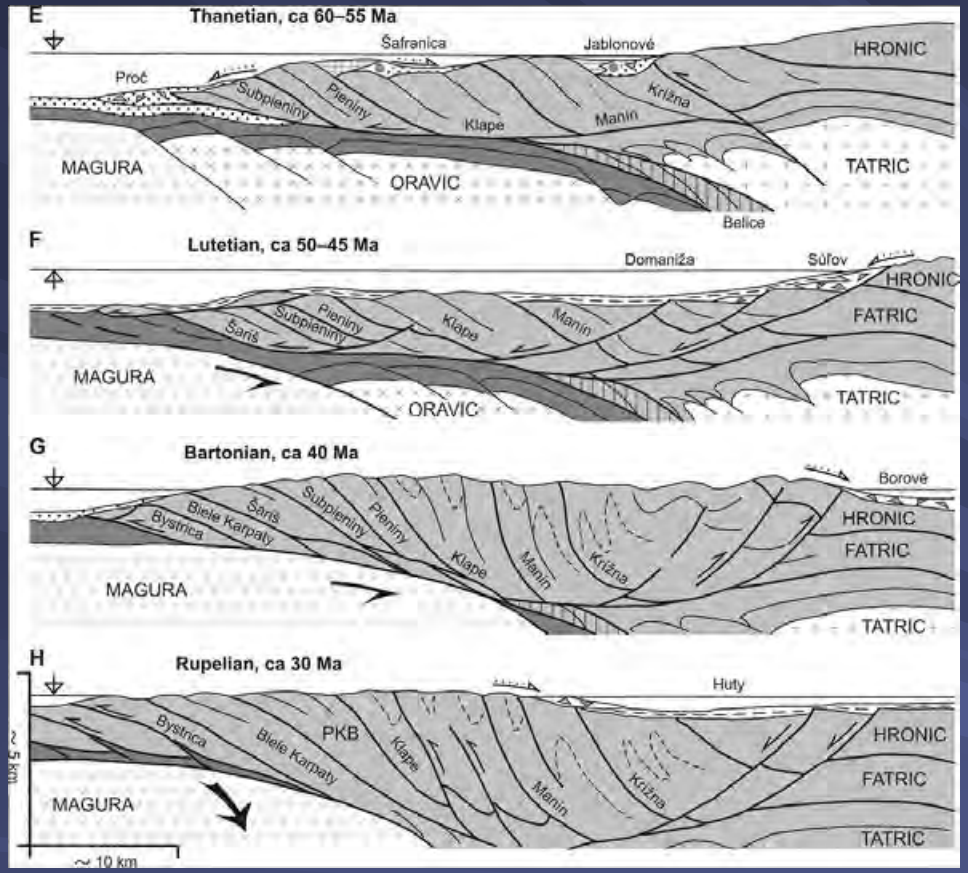


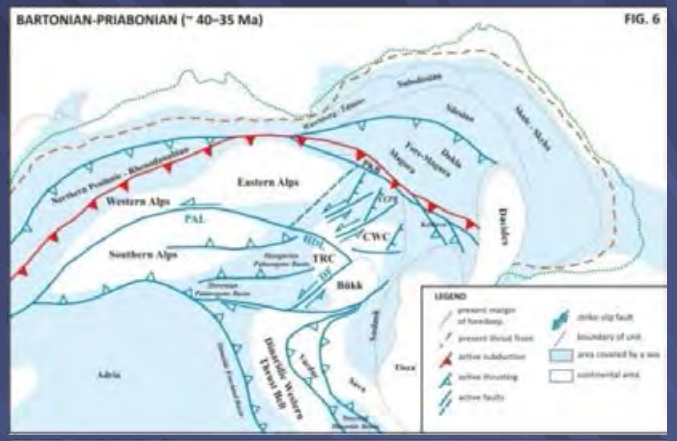


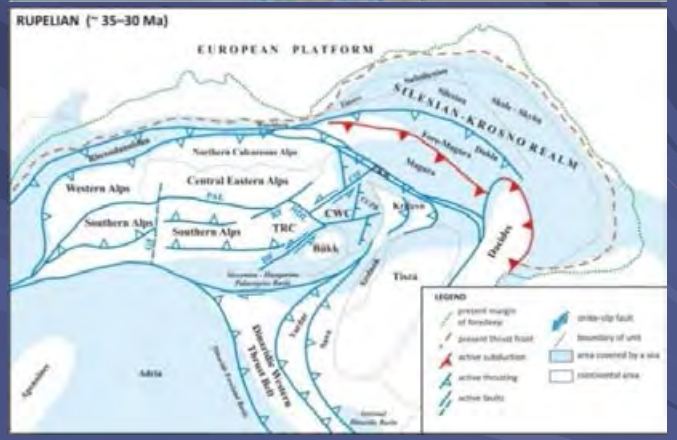
Quality and productivity

A new model of basin tectogenesis and paleogeography of the Western Carpathians during the Paleogene period

Geological Institute
Slovak Academy of Sciences







2nd quartile

Plašienka & Soták 2015

1st quartile

Kováč, ... Soták et al. 2016

Quality and productivity

Metallogeny and environmental geochemistry

Geological Institute
Slovak Academy of Sciences

Heat flow and fluid migration

- Monograph Geofluids, Elsevier, 489 p.

Alpine metallogeny

- Age of siderite veins in the Gemeric unit

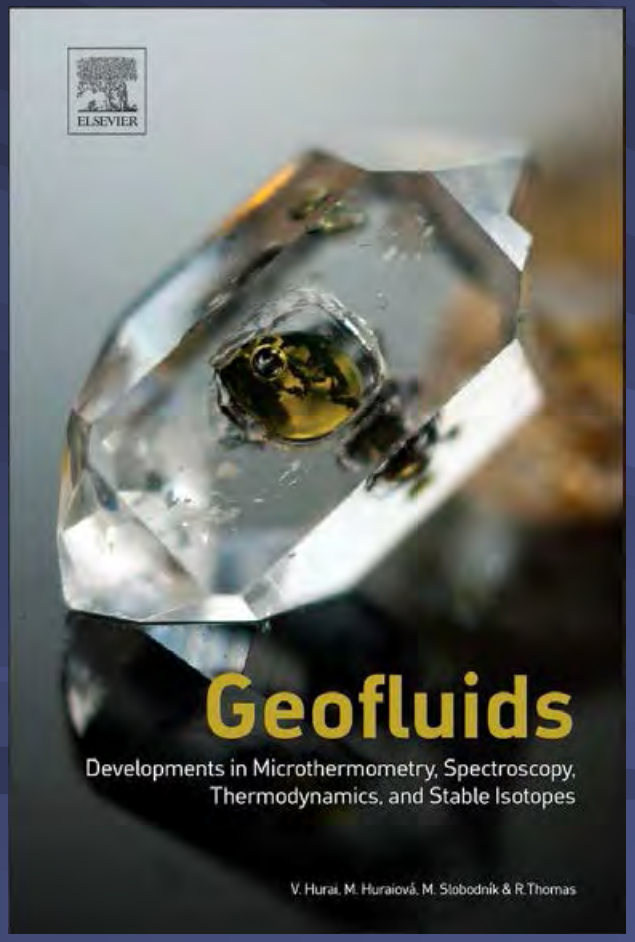
Neogene central volcanic field

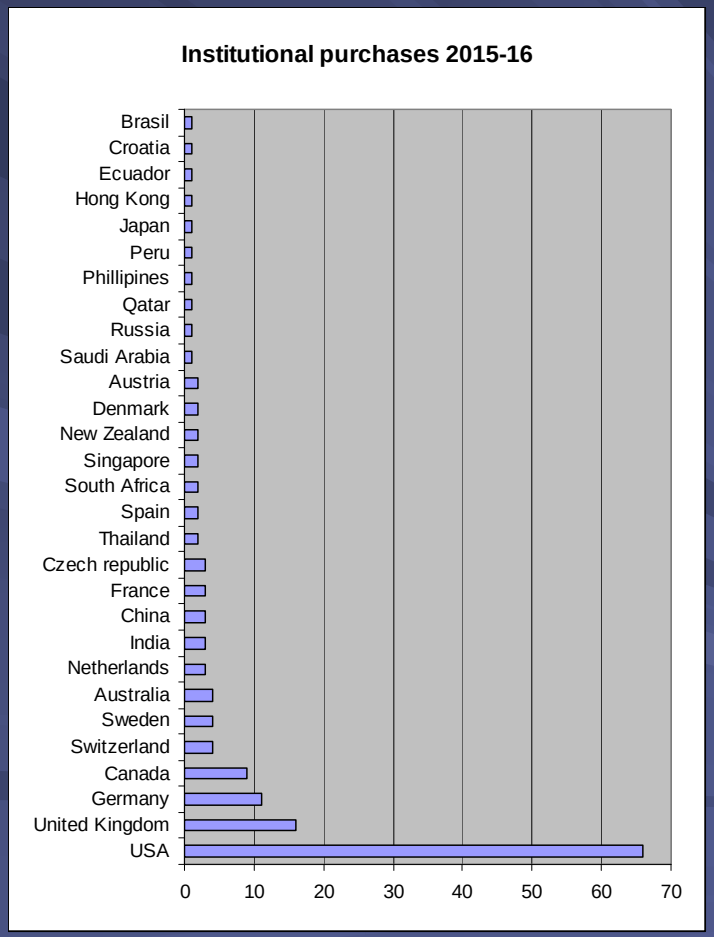
- Evolution
- World-class epithermal mineralisation

Monograph Geofluids in Elsevier

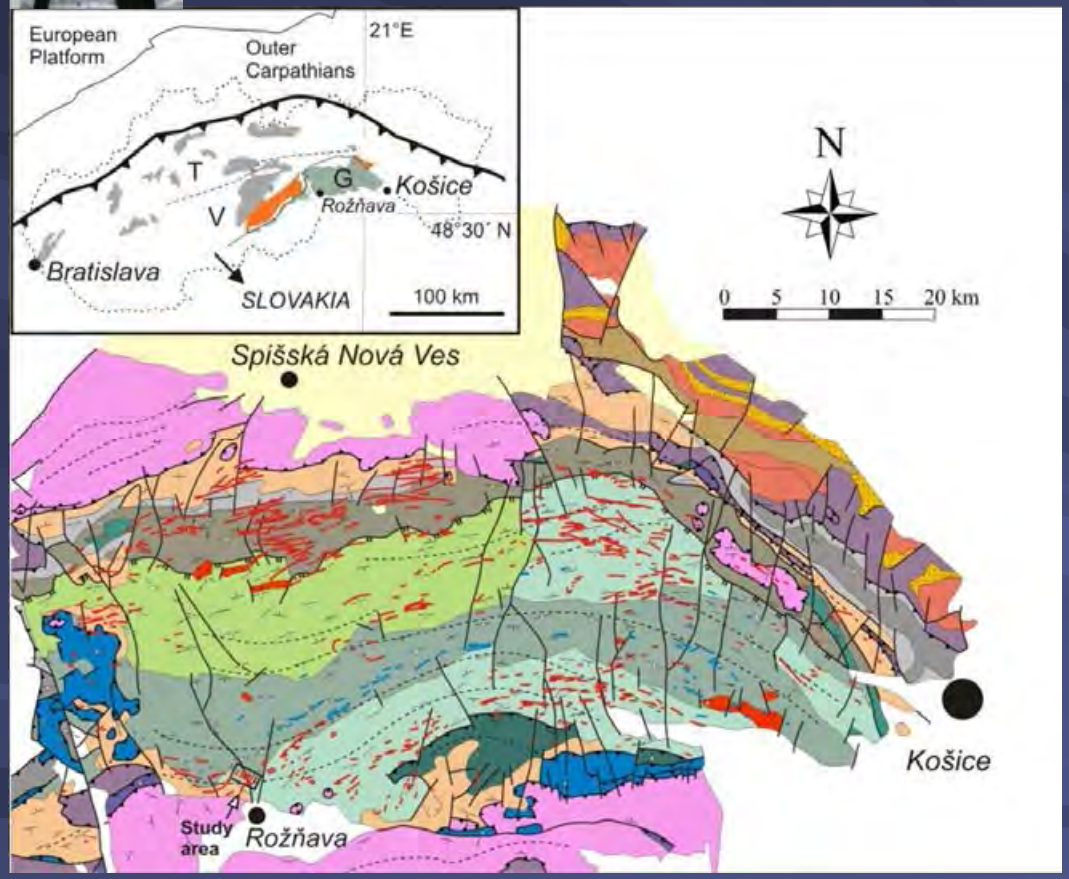
Geological Institute
Slovak Academy of Sciences

HURAI, V – HURAIOVÁ, M – SLOBODNÍK, M – THOMAS, R. Geofluids : Developments in Microthermometry, Spectroscopy, Thermodynamics, and Stable Isotopes. 1. Edition. Amsterdam, Elsevier, 2015, 489 p. ISBN 978-0-12-803241-1.





Age of siderite veins in Gemeric unit



Simplified geological map of the Gemeric unit with orientation of siderite (red) and stibnite (blue) veins

2nd quartile

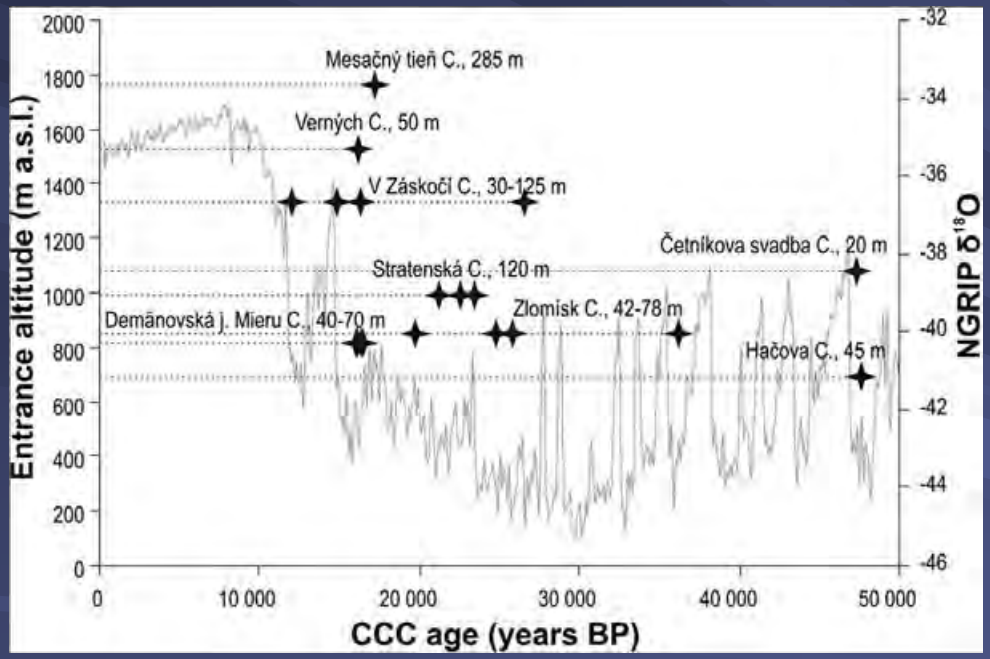
Hurai et al. 2015, *Mineralogy and Petrology*

- Monazite from sodic metasomatites of siderite hydrothermal veins at Rožňava-Nadabula crystallized within a narrow interval of 139±1 Ma, thus corroborating an Alpine age of the mineralization.
- Siderite veins formed inside the deformation front originated within the Variscan basement as a response to Early Cretaceous orogenic compression and folding.
- Neoproterozoic zircon represents the Pan-African magmatic detritus transported from subjacent rocks by hydrothermal fluids.

Dating of last glacial permafrost thaw in cave archives

Geological Institute
Slovak Academy of Sciences

Crystals of cryogenic calcite grow during glacial periods in slowly freezing ice fills in undercooled caves, invaded by meltwater from thawing permafrost. Radiometric dating of the crystals constrains timing and depth of ancient permafrost.



1st quartile

Orvošová et al. 2014, *Boreas*

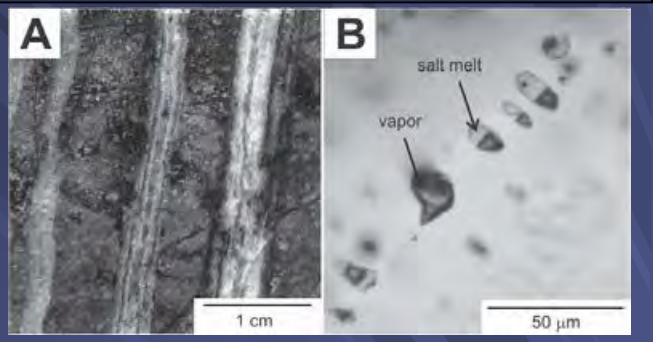
Amazing variety of cryogenic calcite morphologies.

Quality and productivity

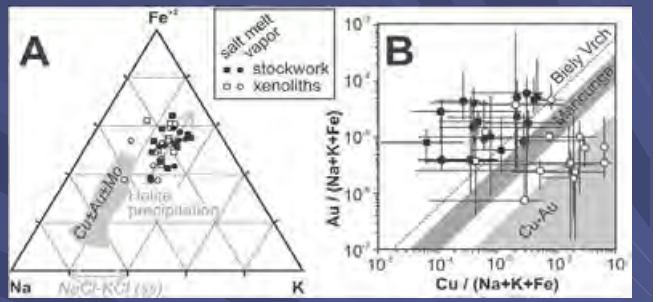
Porphyry gold deposits in shallow subvolcanic setting

Geological Institute
Slovak Academy of Sciences

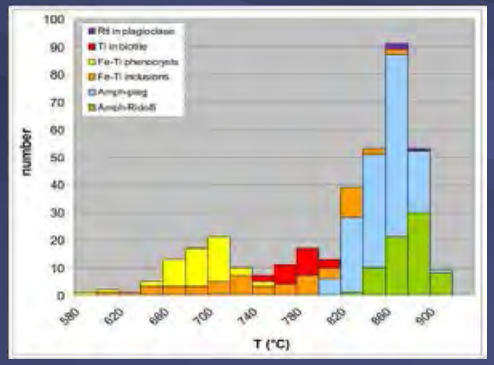
At low P (<3.5 km) parental diorite magma (~850 °C) directly exsolved hypersaline liquid and magmatic vapor. During ascent to the level of the porphyry intrusion (0.5–1 km), fluid expansion at high T / low P led to halite precipitation and further water loss to the vapor, generating an increasingly Fe-K-rich salt melt that transported high concentrations of Au but negligible Cu into the fractured porphyry stock. The low sulfur fugacity resulting from fluid expansion suppressed precipitation of sulfide. These results extend knowledge on porphyry Au deposits world-wide and are directly applicable to their exploration.



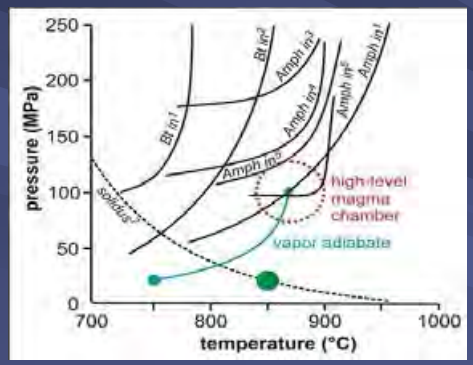
Veinlets and their fluid inclusions



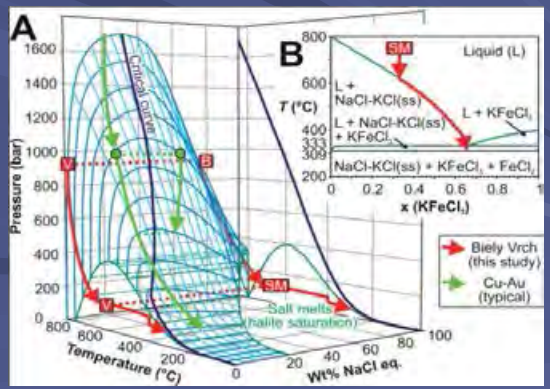
Salt melt comosition, Cu and Au content



Phenocryst assemblage thermometry



PTX fluid path (in blue)



PTX fluid path (in red)

1st quartile

Koděra P., Heinrich CA, Wälle M., Lexa J. 2014, *Geology*; 42

Koděra et al. 2014: *Geological Society, London,*

World-class epithermal mineralisations

Geological Institute
Slovak Academy of Sciences

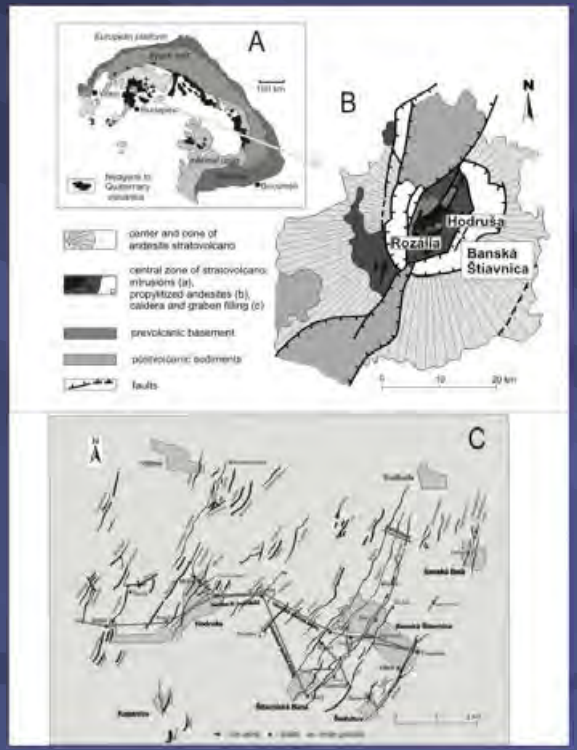
- The Rozália vein in Hodruša is a major base metal ore vein in the copper zone of the world-class epithermal system of the Banská Štiavnica – Hodruša ore district.
- Here, the Cu-Bi sulfosalt Hodrušite has been identified for the first time in the world.
- A careful mineralogical investigation demonstrated also a presence of other Cu-Bi, Cu-Pb-Bi, Ag-Cu-Pb-Bi sulfosalts (kupčíkite, makovickýite, pavonite, dantopaite, benjaminite, mummeite, berryite, etc.). Such the mineral association has been confirmed also in Argentíne, at the deposit in the province Los Manatiales.

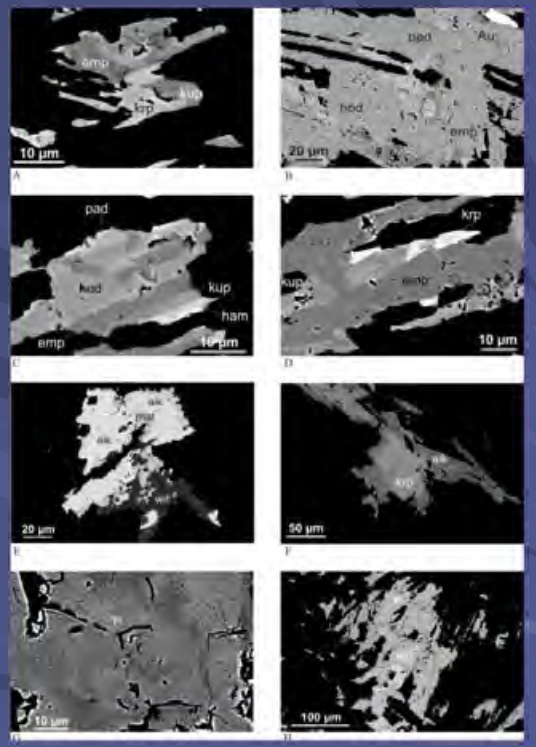
Rozalia mine, Hodruša-Hámre

2nd quartile

Jeleň, S. et al. 2012,
Canadian Mineralogist

Composition of sulphosalts





BSE Images of studied minerals

Geological Institute
Slovak Academy of Sciences

Social significance

Social significance

Geological Institute
Slovak Academy of Sciences

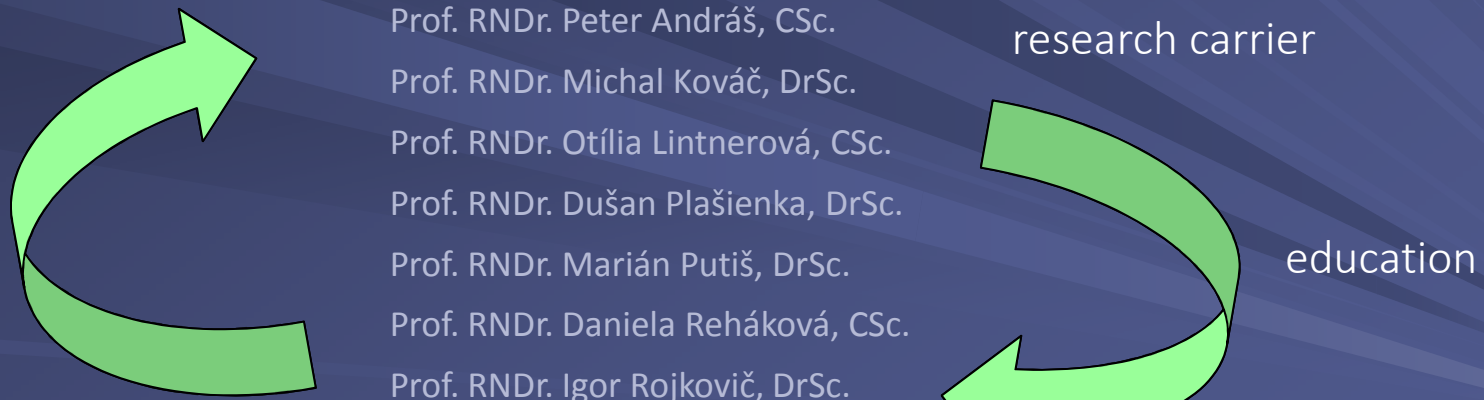
1. Impact on progress of geosciences (geochemistry, mineralogy, petrology, stratigraphy and paleontology)
2. Operation of the top facilities on geochemistry, mineralogy and paleontology
3. Partnership with industry oriented on survey and exploration of raw materials and energetic sources
4. Publishing of top geoscience journal
5. External education
6. Operation of joint laboratories for the Universities
7. Base for the work of Slovak Geological Society and Slovak Mineralogical Society
8. Popularization of geosciences

1. Progress in basic research of geosciences

Geological Institute
Slovak Academy of Sciences

- Immediate publishing of research results mainly in CC journals
- Cooperation with top-ranked scientific centres
- Education
- Organising of scientific conferences

10 university professors began their carriers at our institution:



Prof. RNDr. Peter Andráš, CSc.
Prof. RNDr. Michal Kováč, DrSc.
Prof. RNDr. Otília Lintnerová, CSc.
Prof. RNDr. Dušan Plašienka, DrSc.
Prof. RNDr. Marián Putiš, DrSc.
Prof. RNDr. Daniela Reháková, CSc.
Prof. RNDr. Igor Rojkovič, DrSc.
Prof. RNDr. Ján Spišiak, DrSc.
Prof. RNDr. Vladimír Šucha, DrSc.
Prof. RNDr. Pavel Uher, CSc.

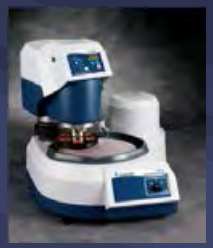
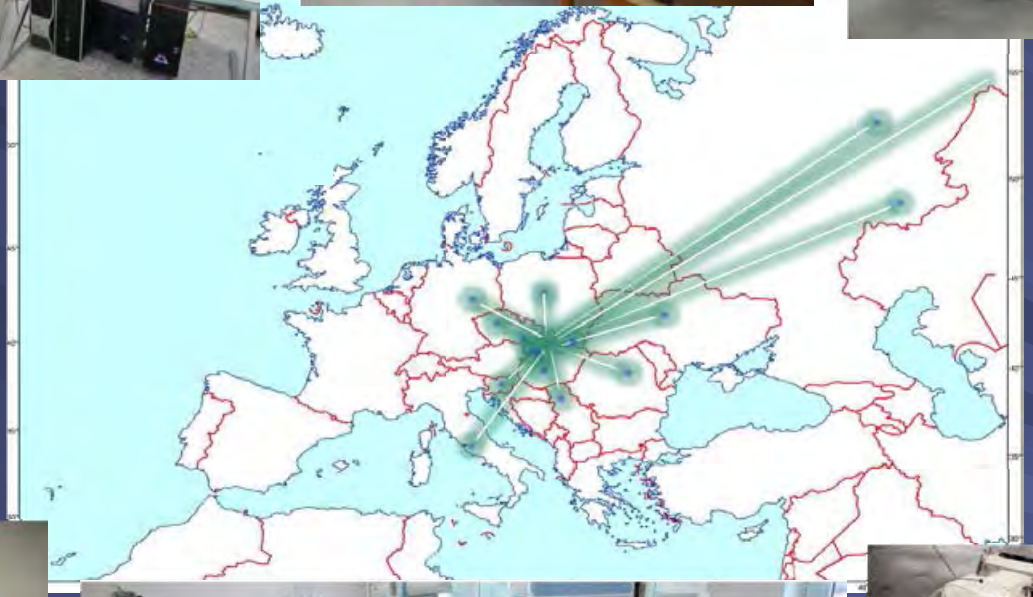
Social significance

2. Operation of state-of-the-art geochemical, paleontological and mineralogical laboratories

Geological Institute
Slovak Academy of Sciences

Accessibility and sustainability







Workplace: Banská Bystrica

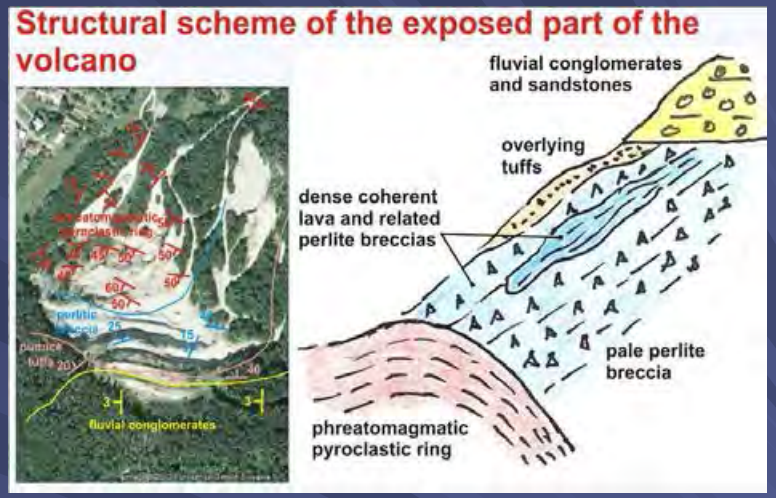
Social significance

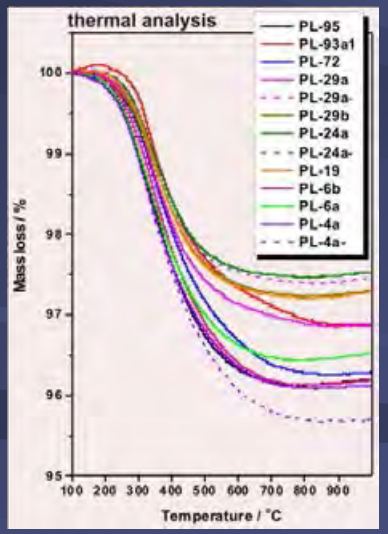
3. Partnership: LB Minerals s.r.o, Košice / LBK Perlit s.r.o, Lehôtka pod Brehmi

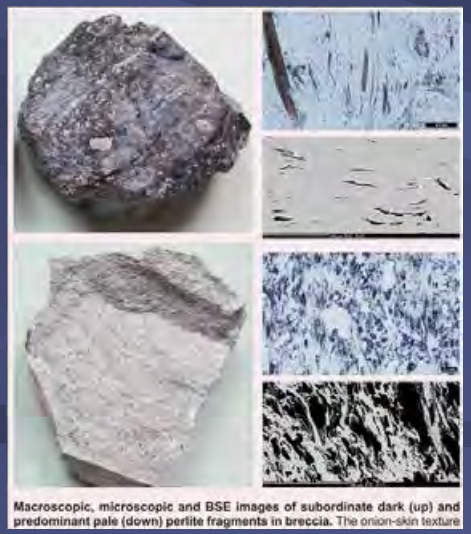
Geological Institute
Slovak Academy of Sciences

Perlite genesis and innovative approaches to its exploitation and processing

Perlite is an important raw material but its utilization keeps behind the potential usage. The main idea of the project is to link the knowledge on geology and genesis of perlite deposits and the hydration of volcanic glass with qualitative and technological parameters of perlite in order to achieve its most effective utilization.







Macroscopic, microscopic and BSE images of subordinate dark (up) and predominant pale (down) perlite fragments in breccia. The onion-skin texture

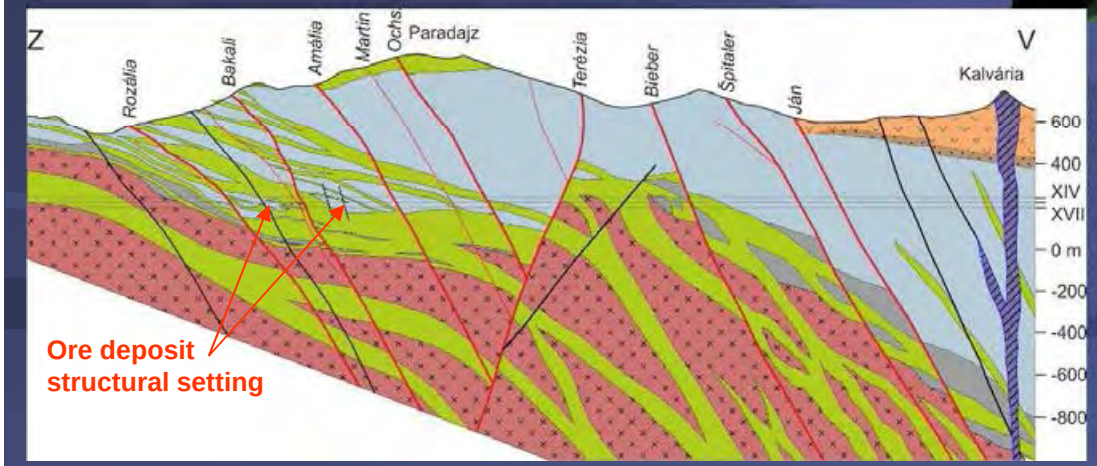
Social significance

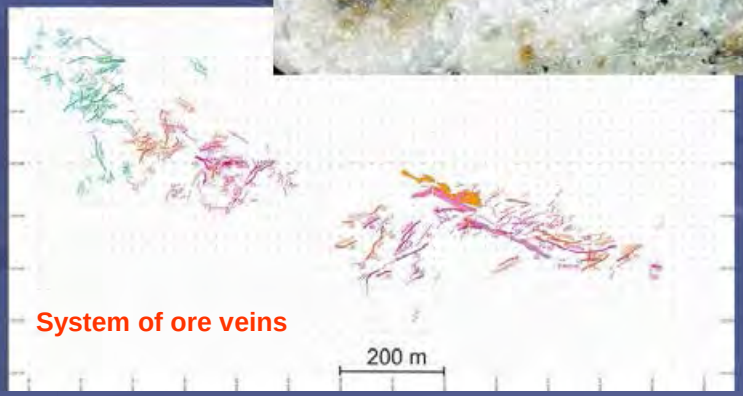
3. Partnership: Slovak mining company, Ltd, Hodruša-Hámre

Geological Institute
Slovak Academy of Sciences

Complex model of base and precious metal mineralisation

The project deals with the only ore deposit actively mined in Slovakia that is exceptional by richness of ore (annual production around 500 kg of gold) and its structural position on subhorizontal veins in center of the Štiavnica stratovolcano caldera. A creation of a complex model of mineralisation, including 3D modelling in GIS, will significantly contribute to formulation of genetic model and resource assessment. Genetic model of this exceptional deposit will contribute to general understanding of epithermal systems.



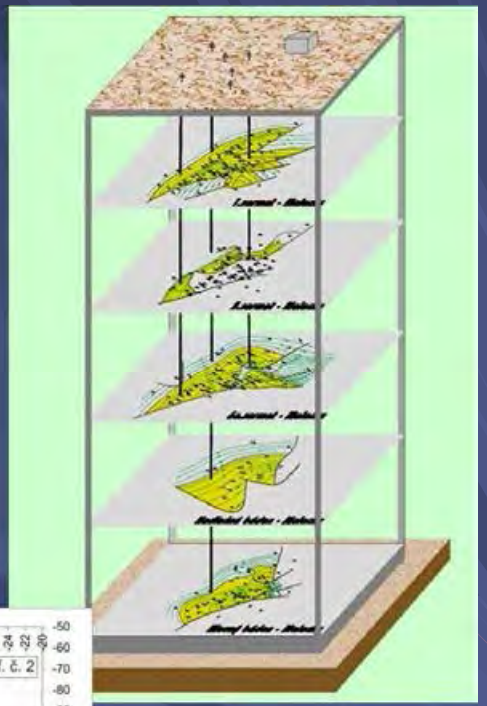


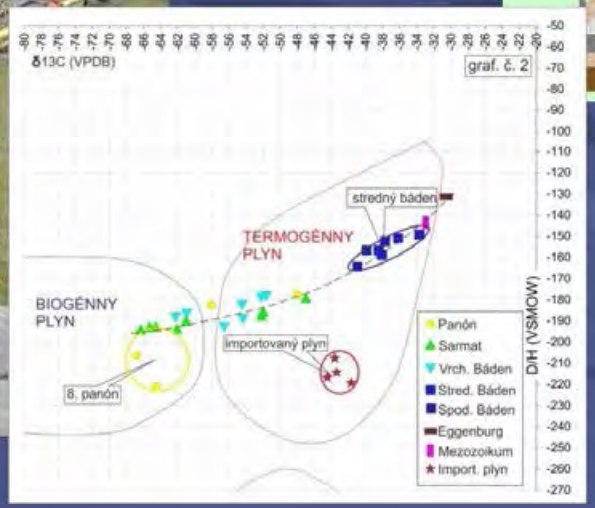
Social significance

3. Partnership: Nafta Ltd.

Geological Institute
Slovak Academy of Sciences

Origin of methane in Vienna Basin





Social significance

4. Geologica Carpathica Editorial office

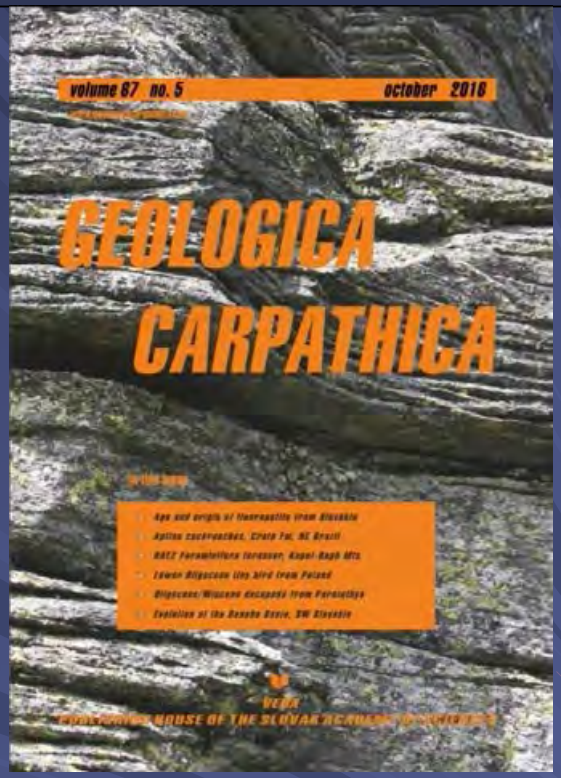
Geological Institute
Slovak Academy of Sciences

Official journal of Carpathian-Balkan Geological Association

- experimental petrology, petrology and mineralogy
- geochemistry and isotope geology
- applied geophysics, stratigraphy and paleontology
- sedimentology, tectonics and structural geology
- metallogeny

Since 1950
6 issues / year

ÚSTAV VIED O ZEMI
SLOVENSKEJ AKADÉMIE VIED



Current Contents®

IF 2015 = 1.523

Social significance

6. Joint workplaces

Geological Institute
Slovak Academy of Sciences

Institute of biology and geology

Joint workplace of Earth science institute SAS, Botany institute SAS and Faculty of Sciences of the Matej Bel University in Banská Bystrica; educational centre

Energy & Geoscience Laboratory

Joint workplace of Earth Science Institute SAS and Energy & Geoscience Institute, University of UTAH; common solution of scientific projects focused on exploration of oil and gas resources mainly in Europe and Asia.

Paleomagnetic observation Modra – Piesok

Joint workplace of Earth Science Institute SAS and FMFI UK; scientific and educational programme

Social significance

7. Scientific societies at Institute

Geological Institute
Slovak Academy of Sciences

Geological Society of Slovakia

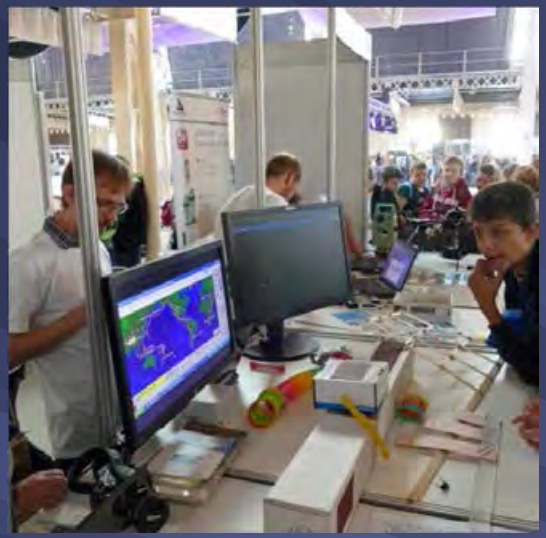
Mineralogical Society of Slovakia

Social significance

8. Popular science activities

Geological Institute
Slovak Academy of Sciences

European night of researchers



Weeks of science and technics

School of panning prospection

Excursions

Social significance

8. Popular science activities

Geological Institute
Slovak Academy of Sciences

Presentation of the book „Planet, where we live on“

Animation of geological events

Exhibition „Planet, where we live on“

49 600 visitors in Bratislava museum, 6000 visitors in Spiš museum

Social significance

Geological Institute
Slovak Academy of Sciences

New building and infrastructure in Banská Bystrica

Geological division
Earth Science Institute SAS

former Geological Institute SAS

director (2010-till now): **RNDr. Igor Broska, DrSc.**

GEOPHYSICAL INSTITUTE

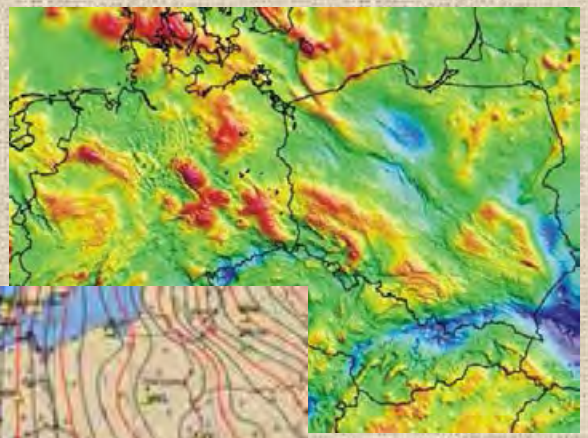
DIVISION OF GEOPHYSICS
EARTH SCIENCE INSTITUTE

2011—2015

GEOPHYSICAL INSTITUTE/DIVISION: KEY RESEARCH THEMES

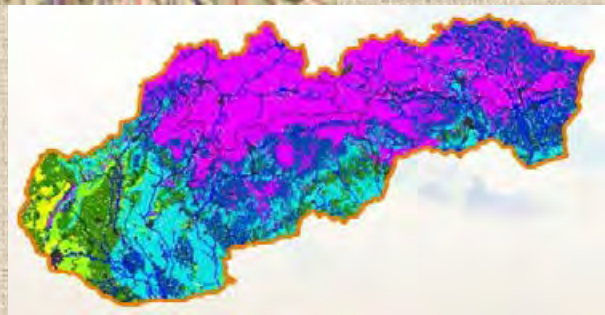
1. Seismology: Monitoring, seismic hazard assessment and seismic waves propagation
(supervisors: Moczo, Kristek, Kristeková)

2. Geophysical modelling of the lithosphere (focus on Carpatho-Pannonian region) evaluation of potential for renewable (geothermal) energy
(supervisors: Bielik, Majcin, Bezák, Vozár, Vajda)



3. Geomagnetic field, its spatio-temporal variations, generation, and space weather
(supervisors: Valach, Revallo, Marsenić)

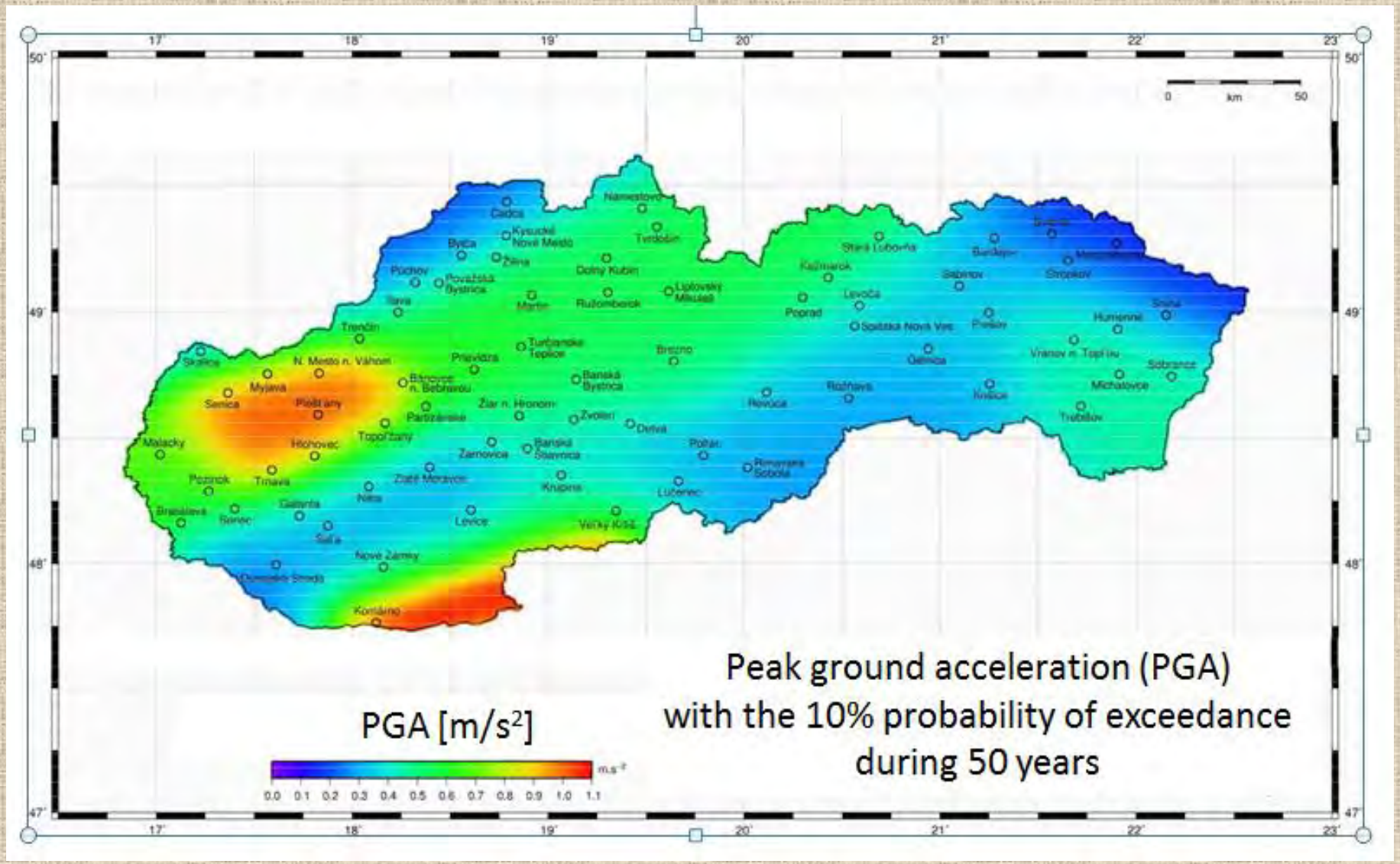
4. Physics of the atmosphere: Climate changes and extreme weather phenomena
(supervisors: Nejedlík, Bičárová)



SEISMIC HAZARD

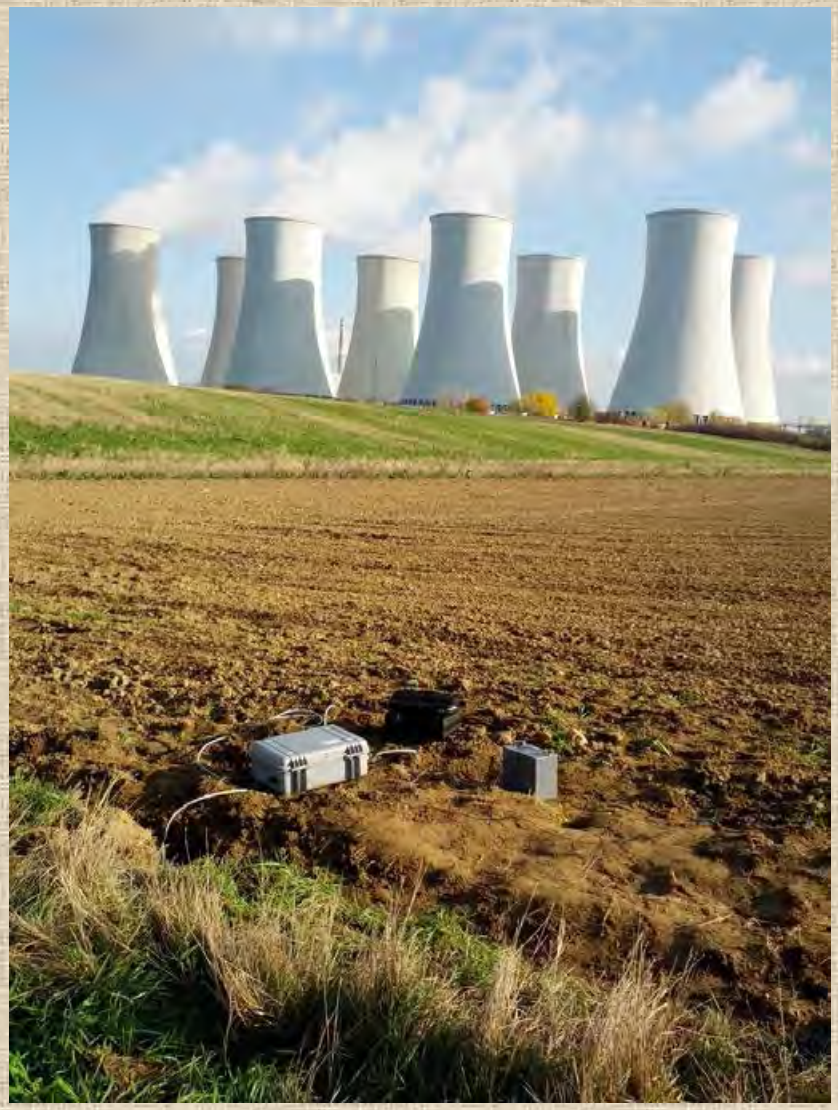
New seismic hazard analysis of the territory of Slovakia

part of a Slovak National Annex to Eurocode 8 (STN EN 1998-1/NA/Z2)



New probabilistic seismic hazard analysis (PSHA) of the Jaslovske Bohunice site

project of the new nuclear power plant



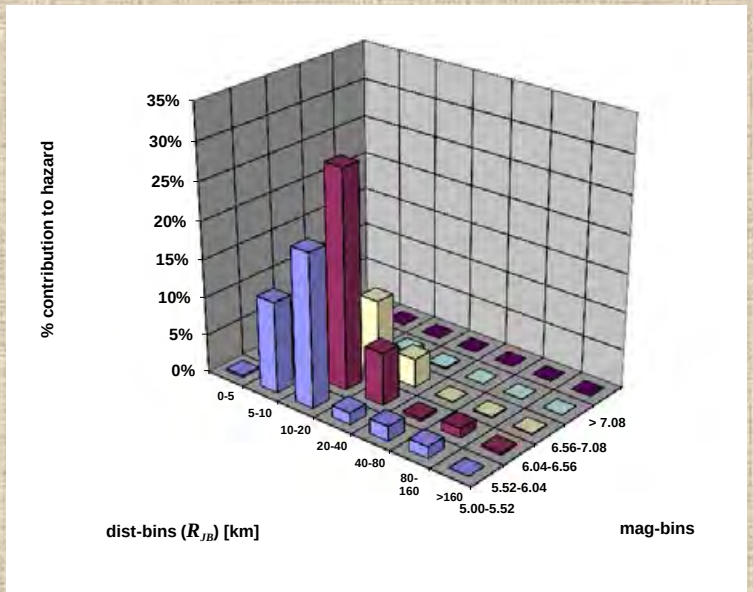
logic-tree based PSHA with deagregation

new homogenized seismological database

new seismotectonic model

in-situ noise measurements

local conditions (site amplification factor)



SEISMIC HAZARD

SCIENTIFIC OUTPUT

Advancement of the methodology
of computing the seismic hazard

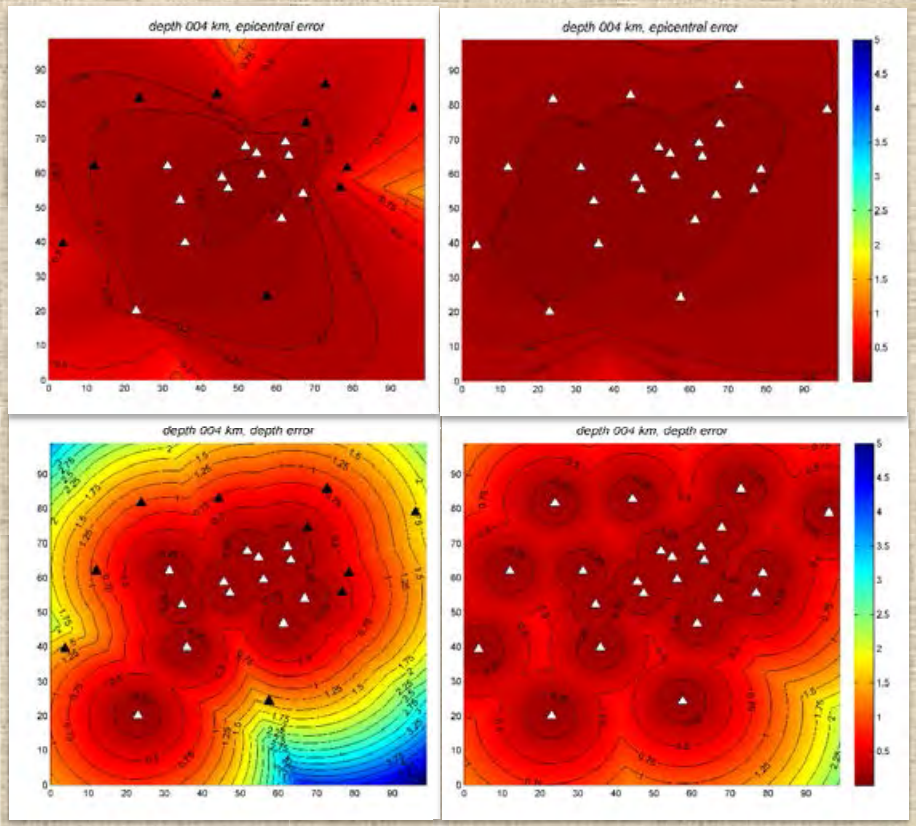
IMPACT ON SOCIETY AND ECONOMY

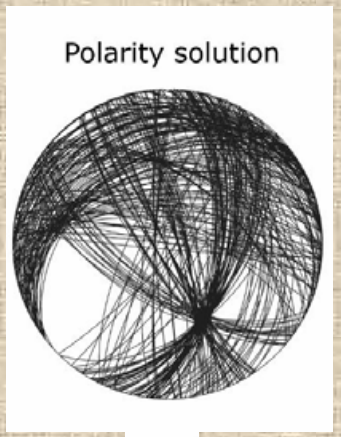
Construction standards and norms
for building powerplants, large engineering projects,
and urban and infrastructure planning

ANALYSIS OF EARTHQUAKES AND EXPLOSIONS

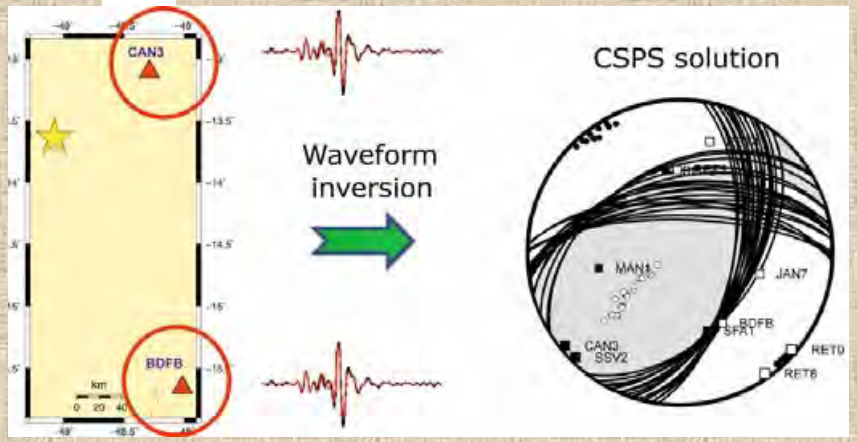
Analysis of earthquakes and explosions

theoretical analysis
of the effect of extension
of a local seismic network





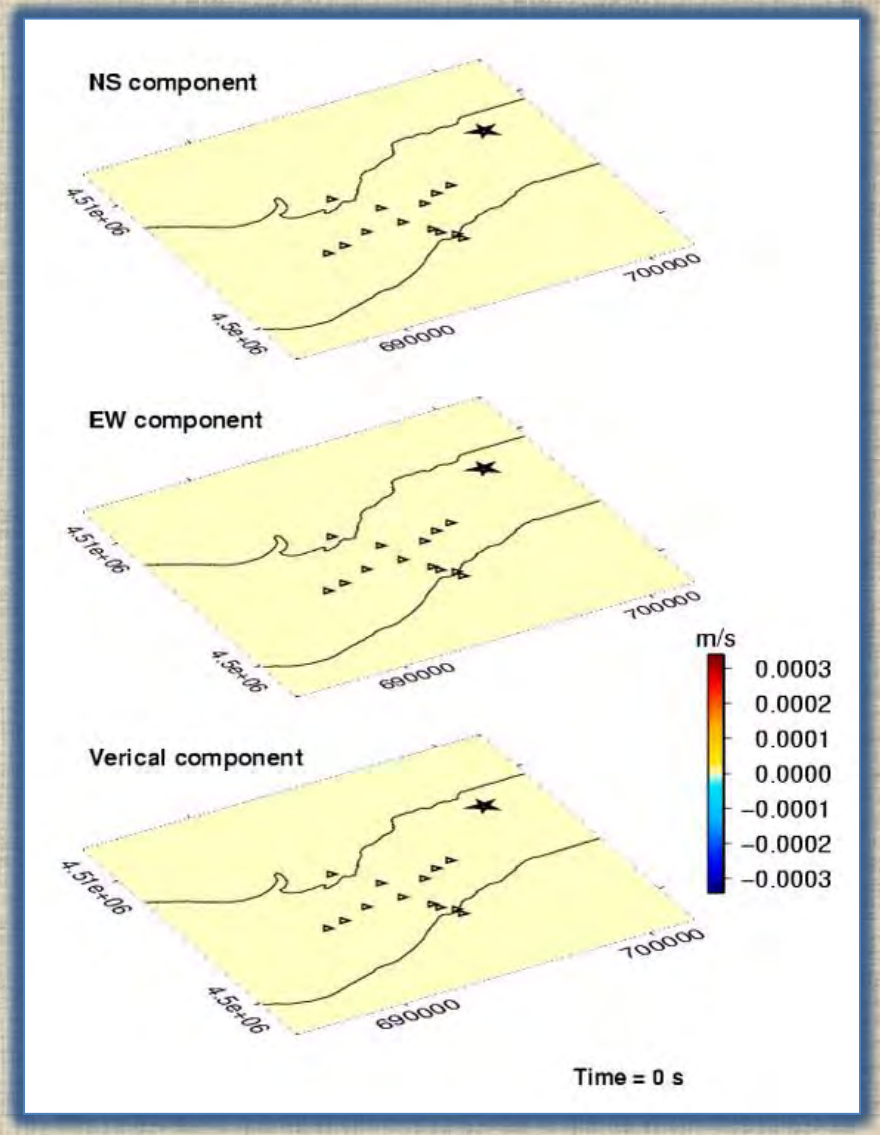
new two-step
method
for waveform
inversion
of weak events
in sparse networks



Seismol. Res. Lett. 2014 (2.268 IF); J. South Am. Eart. Sci. 2015 (1.367 IF)

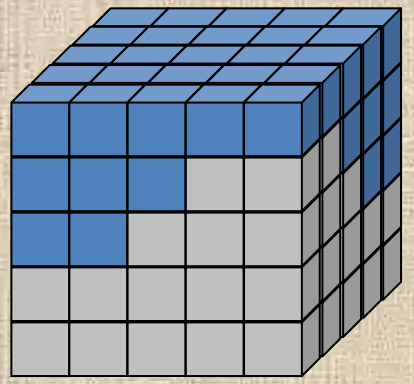
NUMERICAL MODELLING OF SEISMIC MOTION AND SEISMIC WAVE PROPAGATION

Numerical modelling of seismic motion and seismic wave propagation



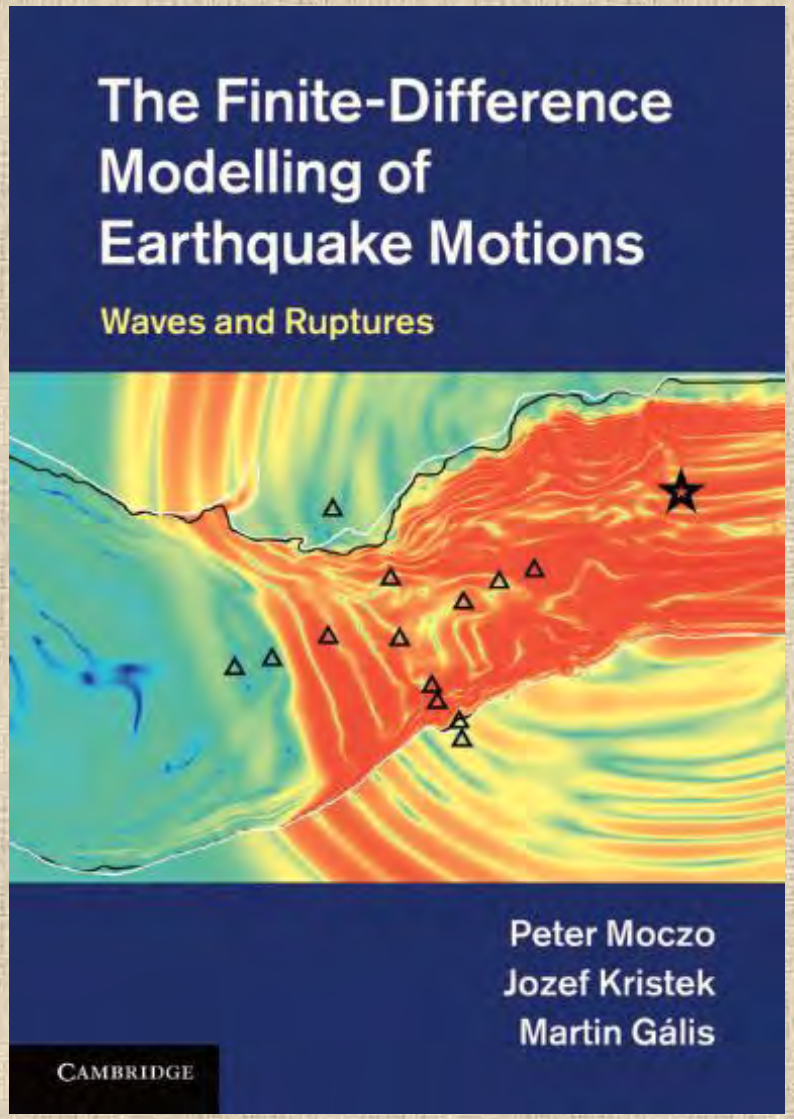
a **new discrete representation**
of a discontinuous
material heterogeneity
based on **orthorhombic medium**
was developed.

the representation is one of
key ingredients
of **accuracy-and-computational-efficiency**
of our finite-difference modelling.



Cambridge Univ. Press 2014; Geophys. J. Int. 2015, (2.484 IF); Bull. Seism. Soc. Am. 2015, (2.322 IF)

Numerical modelling of seismic motion and seismic wave propagation



THE FINITE-DIFFERENCE MODELLING OF EARTHQUAKE MOTIONS

Waves and Ruptures

PETER MOCZO
Comenius University, Bratislava and Slovak Academy of Sciences, Bratislava

JOZEF KRISTEK
Comenius University, Bratislava and Slovak Academy of Sciences, Bratislava

MARTIN GALIS
King Abdullah University of Science and Technology, Saudi Arabia

with contributions by
MIRIAM KRISTEKOVA, EMMANUEL CHALJUB, MARTIN KÄSER, PETER KLIN AND CHRISTIAN PELTIES

the first monograph of its kind

CAMBRIDGE UNIVERSITY PRESS

NUMERICAL MODELLING OF SEISMIC MOTION AND SEISMIC WAVE PROPAGATION

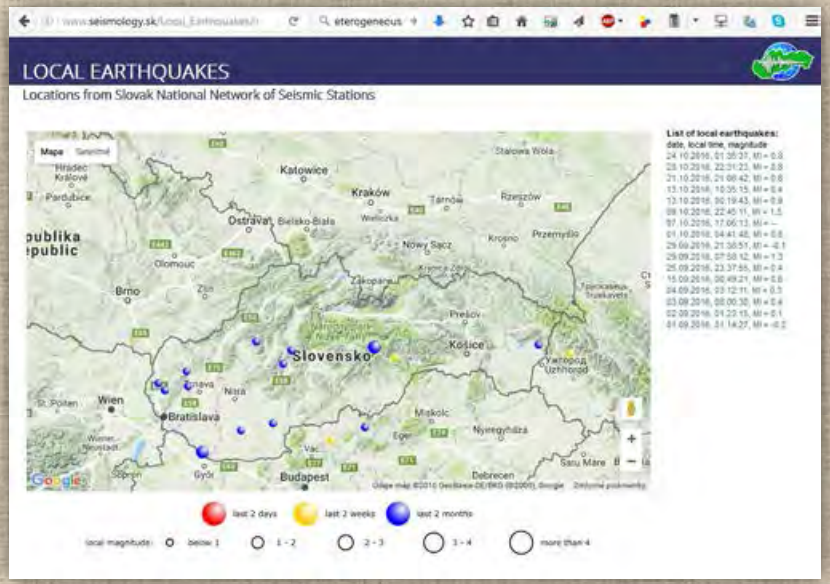
SCIENTIFIC OUTPUT

Advancement of the methodology,
optimization and efficiency of numerical modelling

IMPACT ON SOCIETY AND ECONOMY

Developed open-source software
verified by several international benchmarks
is used worldwide (100+ registered users)

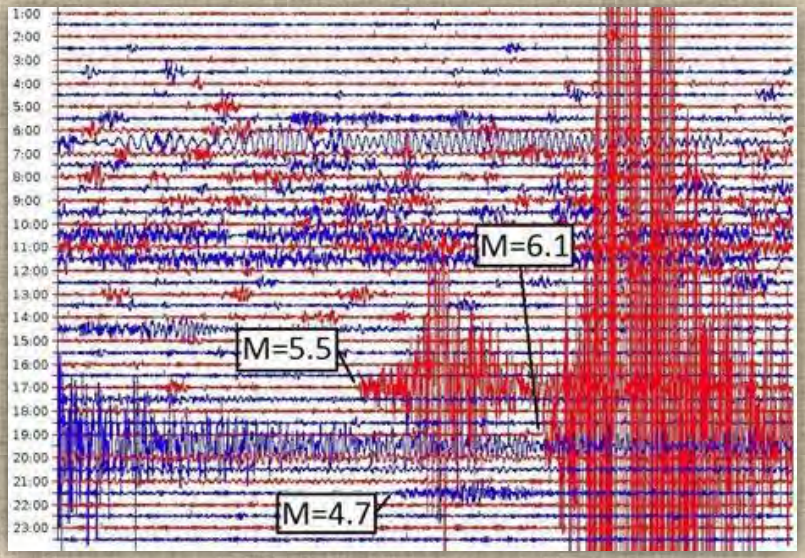
Monitoring of seismic activity by National Network of Seismic Stations (NNSS)

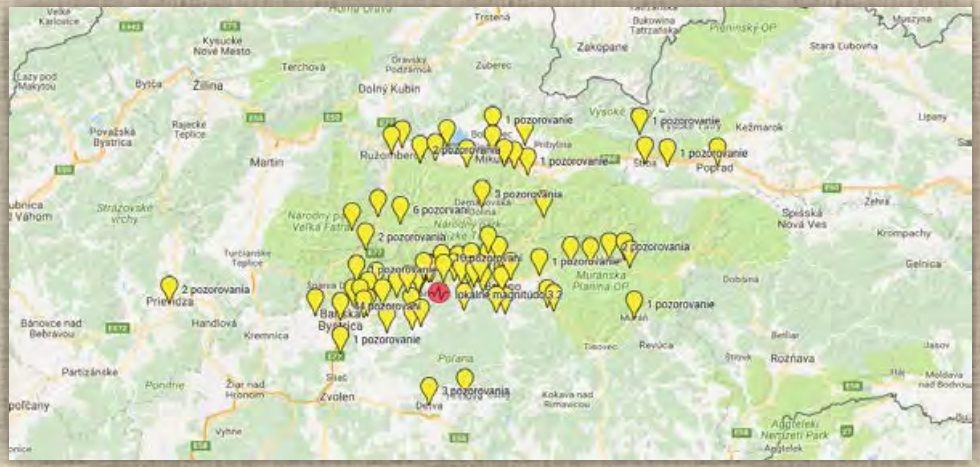


Outputs of the **analyses provided to**:

- public (via web pages and Facebook)
- relevant institutions (civil protection, nuclear power plants)
- international data centres, neighbouring countries

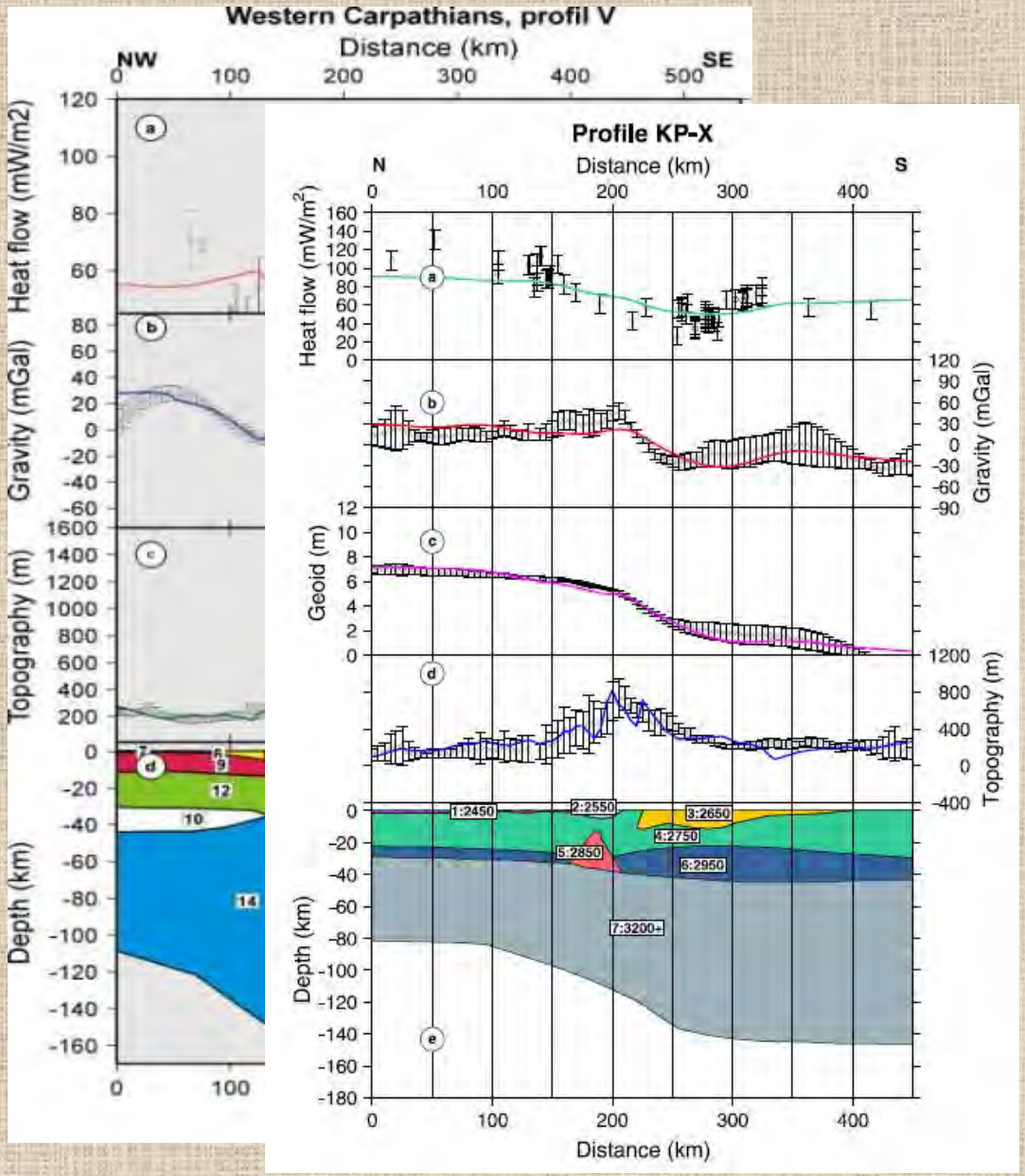
Data and Analysis Centre of NNSS is a **National Data Centre** for Comprehensive Test Ban Treaty Organization (**CTBTO**)





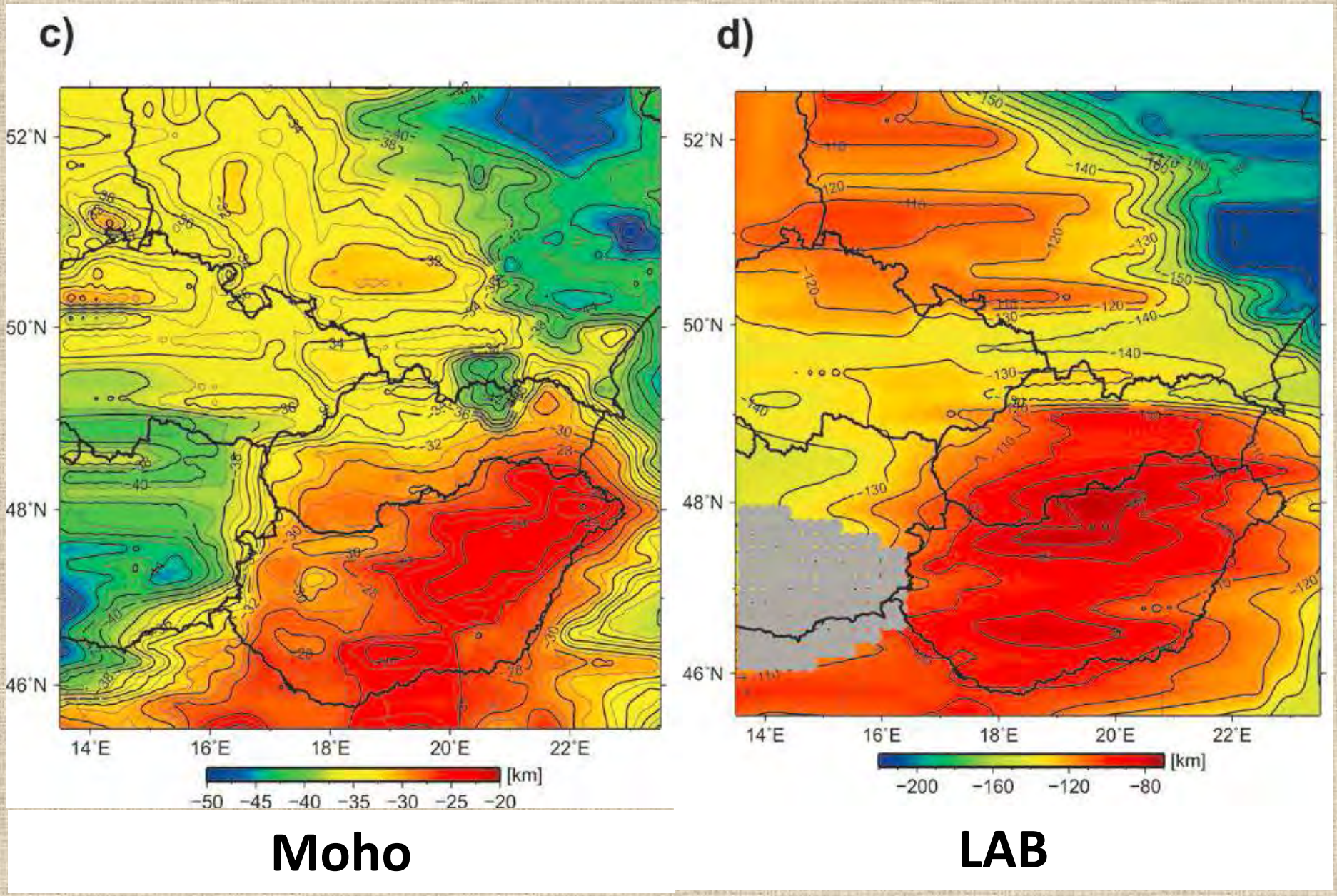
EARTH CRUST AND LITHOSPHERE STRUCTURE INVESTIGATION, GEOTHERMICS

INTEGRATED GEOPHYSICAL MODELLING FOCUSED ON GRAVIMETRY



- Joint modelling of several geophysical fields
- Structure and physical properties of the lithosphere
- Temperature distribution and potential for geothermal energy
- Moho and LAB boundary, rheology, tectonics
- Global and regional studies

INTEGRATED GEOPHYSICAL MODELLING FOCUSED ON GRAVIMETRY



Moho **LAB**

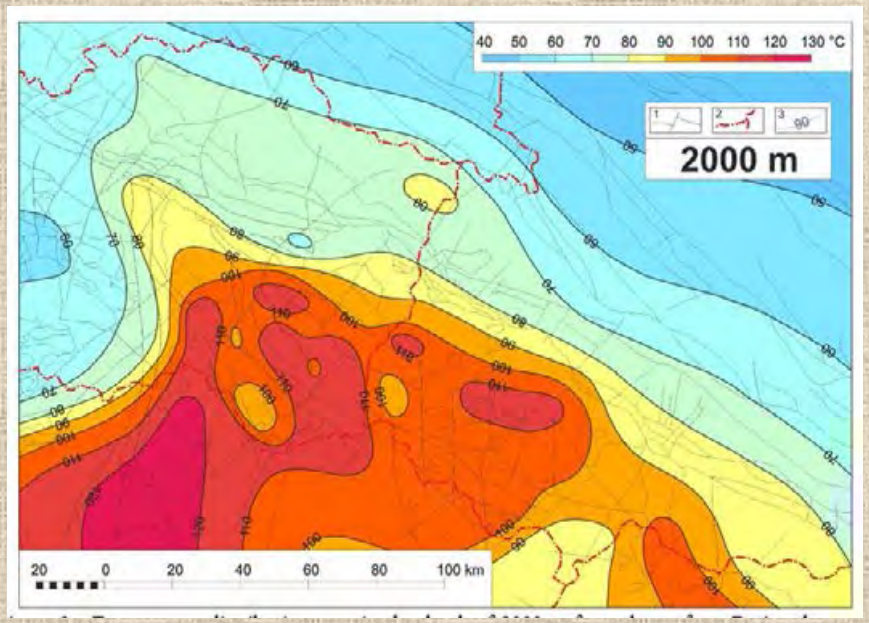
APPLICATIONS FOR ECONOMY AND SOCIETY

Potential for
hydrothermal energy,
dry rock heat, raw materials

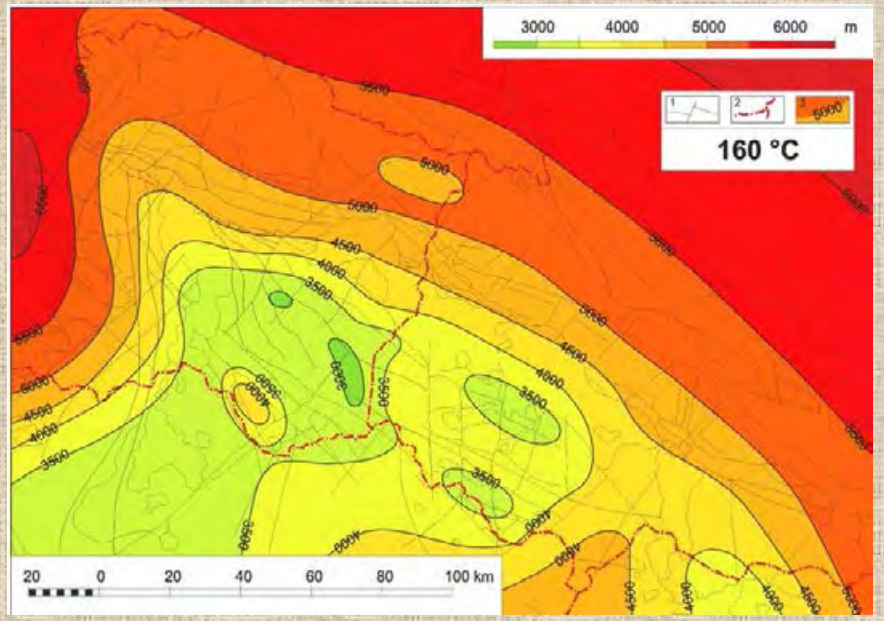
Deliverables upon taking into account local effects and tectonic context

- ❑ Heat flow maps
- ❑ Maps of temperature field for various depth slices
- ❑ Analyses on potential for geothermal energy exploitation

Temperature field at 2 km



Morphology of the 160 Celzius isotherm



EARTH CRUST AND LITHOSPHERE STRUCTURE INVESTIGATION, GEOTHERMICS

SCIENTIFIC OUTPUT

Advancement of the knowledge about the structure, physical properties and tectonic development of the earth crust and upper mantle

IMPACT ON SOCIETY AND ECONOMY

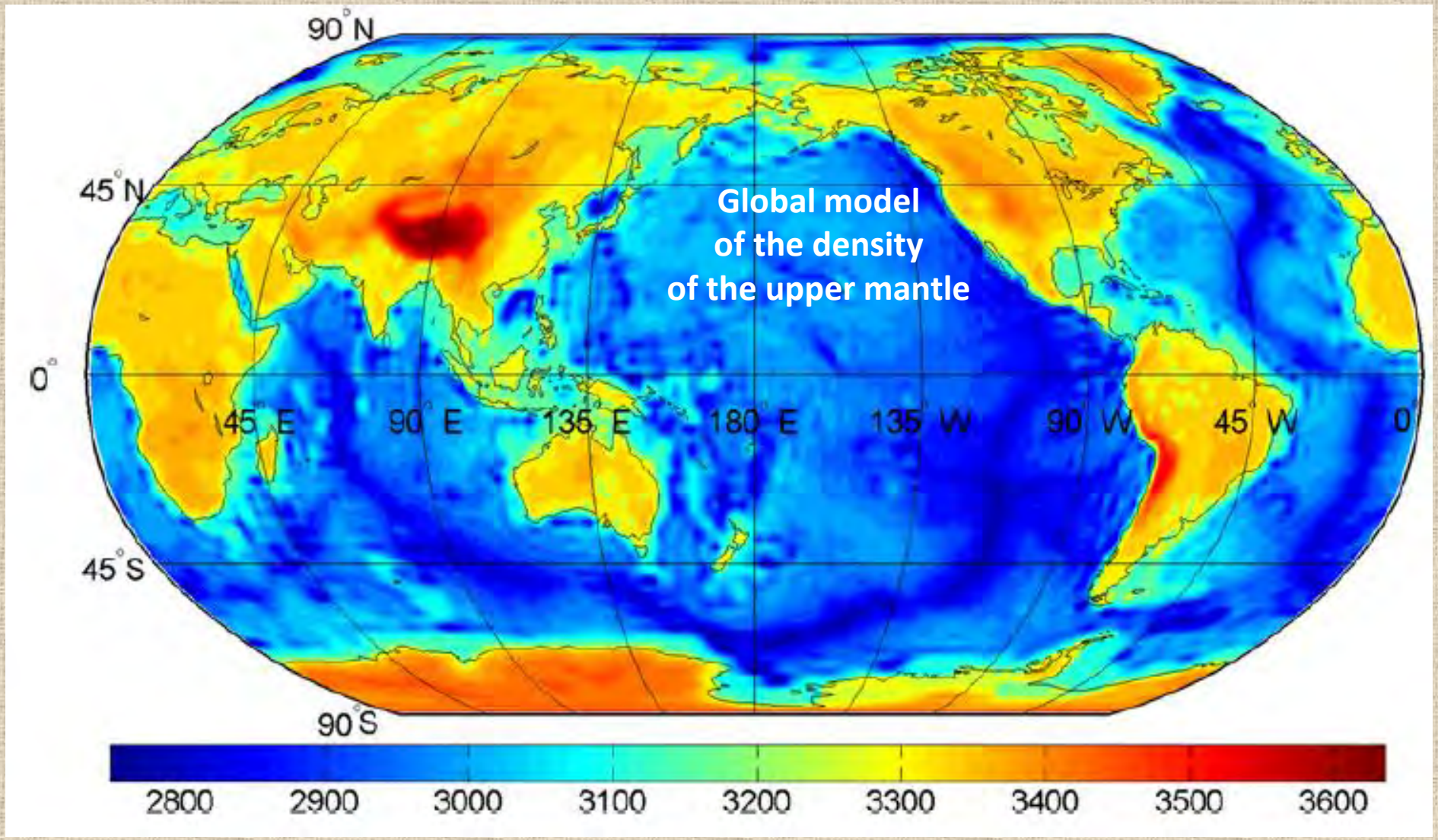
Identification of regions, sites, and depth intervals for renewable energy potential in terms of geothermal (wet and dry) energy, potential for raw materials, as well as underground gas storage and CO_2 sequestration

METHODOLOGY IN GRAVIMETRY

METHODOLOGY

Computation methods for global gravimetric stripping corrections in spectral form

Surveys in Geophysics 2012 (IF 3.1), PAGEOPH 2012 (IF 1.8),
Computational Geosciences 2012 (IF 1.3), SGG 2012, Geosciences Journal 2013



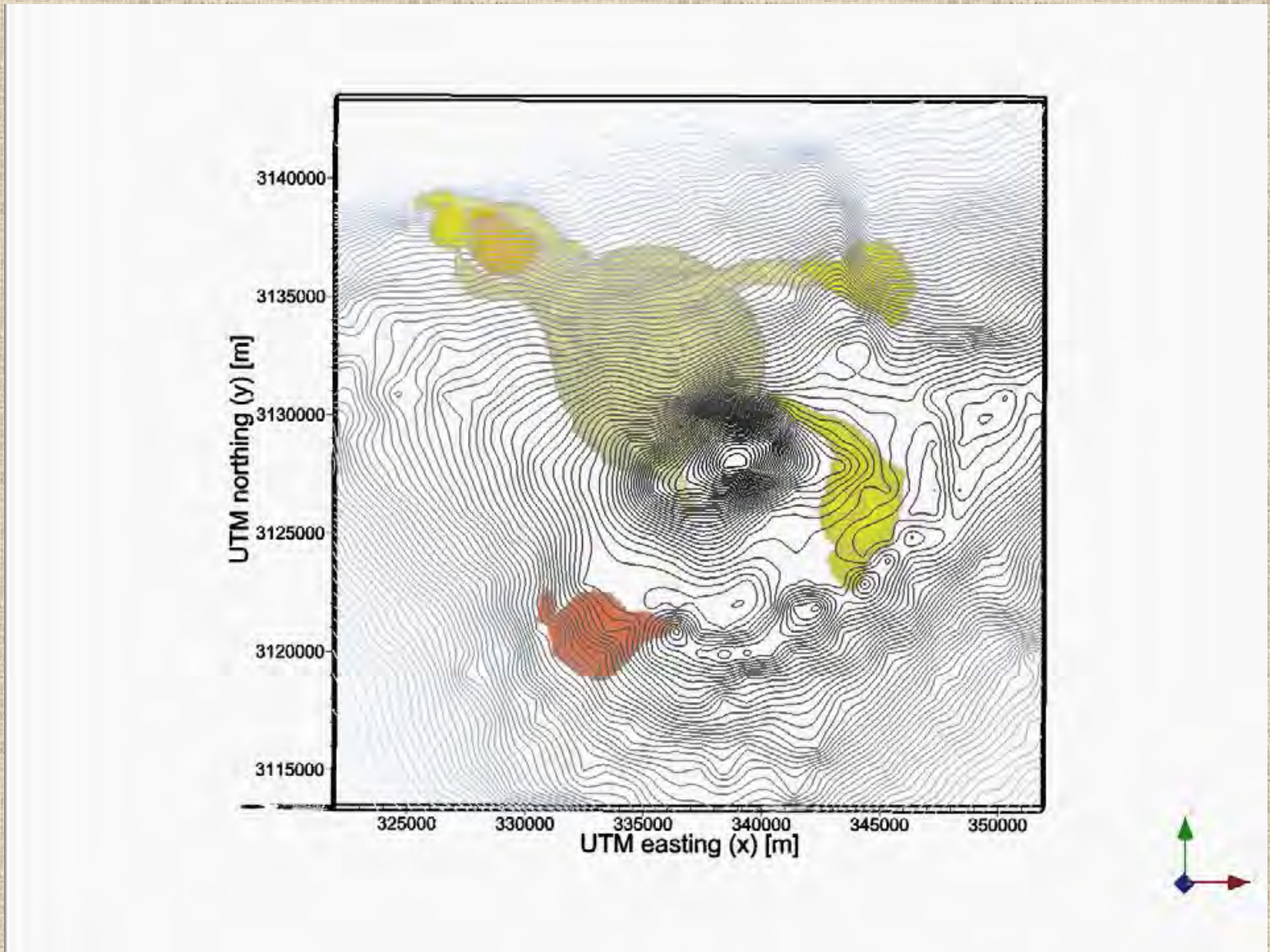
METHODOLOGY

Harmonic Inversion Method

Prutkin Inversion Methodology

Development of new innovative inversion approaches

JAG 2011 (IF 1.3), JVGR 2012 (IF 2.0), JVGR 2014 (IF 2.2)



METHODOLOGY IN GRAVIMETRY

SCIENTIFIC OUTPUT

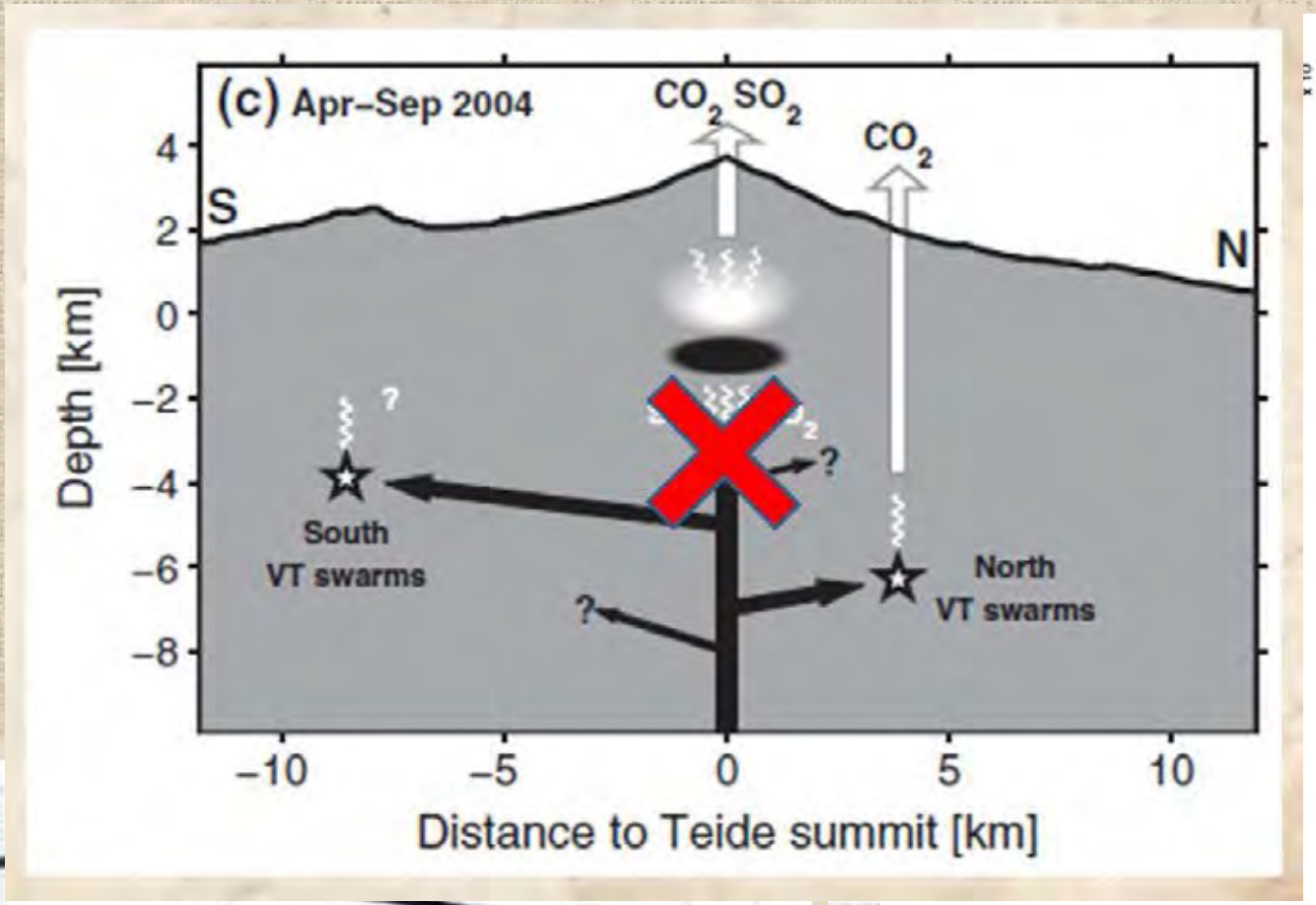
Advancement of data processing numerical methods,
and innovative approaches to solving
inverse problems in potential fields

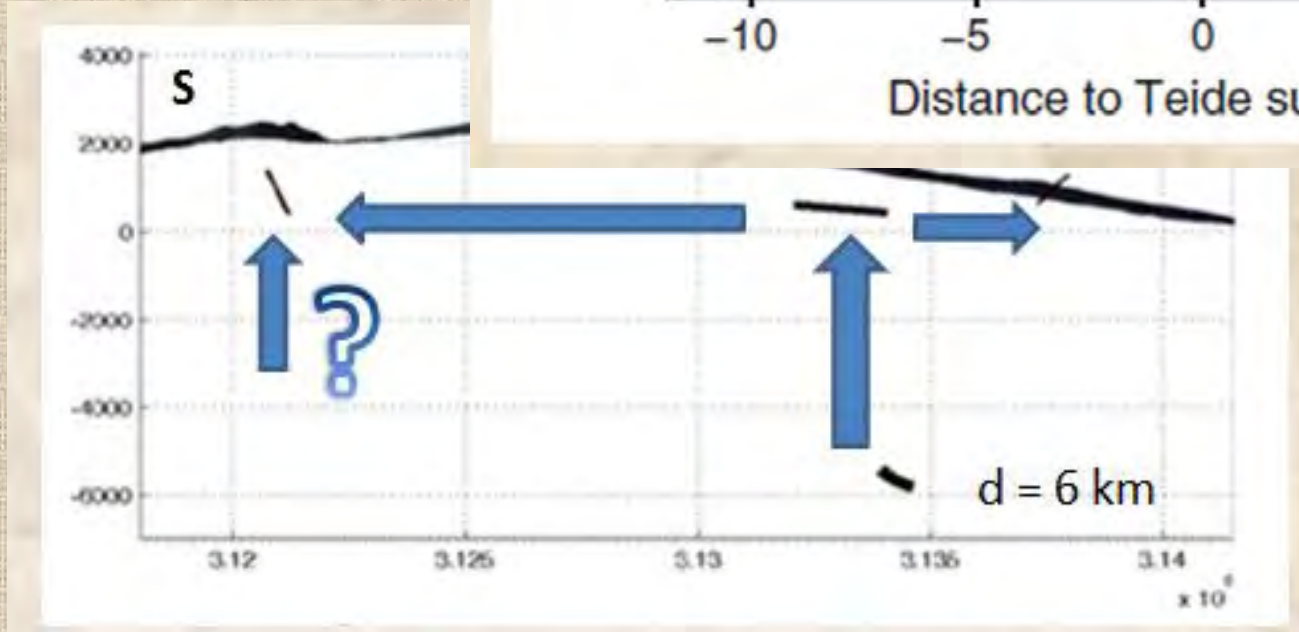
GEODYNAMICS:
VOLCANO GRAVIMETRY

VOLCANO GRAVIMETRY

JVGR 2015 (IF 2.6)

Gravimetric picture of the 2004/5 volcanic unrest on Tenerife, Canary islands





Failed eruption, magma intrusion at 6 km b.s.l.

GEODYNAMICS: VOLCANO GRAVIMETRY

SCIENTIFIC OUTPUT

Advancement of the knowledge about subsurface magmatic processes associated with volcanic unrest and eruptions

IMPACT ON SOCIETY AND ECONOMY

Volcanic hazard estimates and prediction

NEAR SURFACE GEOPHYSICS

Near Surface Geophysics – microgravimetry and GPR for archeological exploration

Pánisová et al., Near Surface Geophysics 2012 (CCC)

a)

b)

[mGal]

Profile 1

Sanctuary

Observed
Calculated

Profile A

Rw: 98.60
Hw: 111.99

Filled cavity

Empty crypt

Height [m]

y [m]

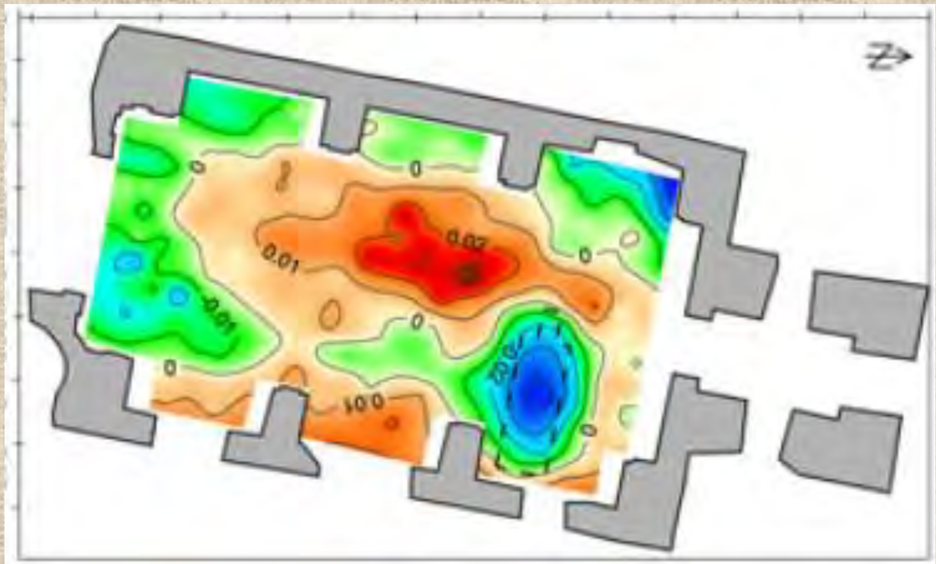
x [m]

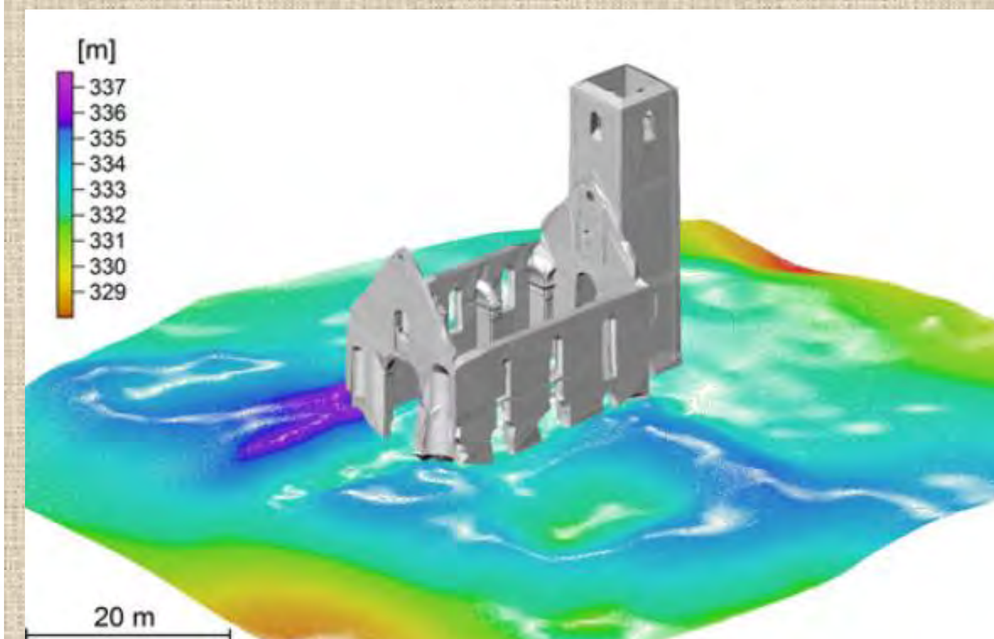
Positions of measured points

Euler deconvolution solutions

Microgravimetry and GPR – cultural heritage

Pánisová et al., Archeological Prospection 2013 (CCC)





Archeological prospection with near surface geophysics – cultural heritage

Drone applications: photogrametry, documentation, popularization

NEAR SURFACE GEOPHYSICS

SCIENTIFIC OUTPUT

Advancement of near surface exploration techniques

IMPACT ON SOCIETY AND ECONOMY

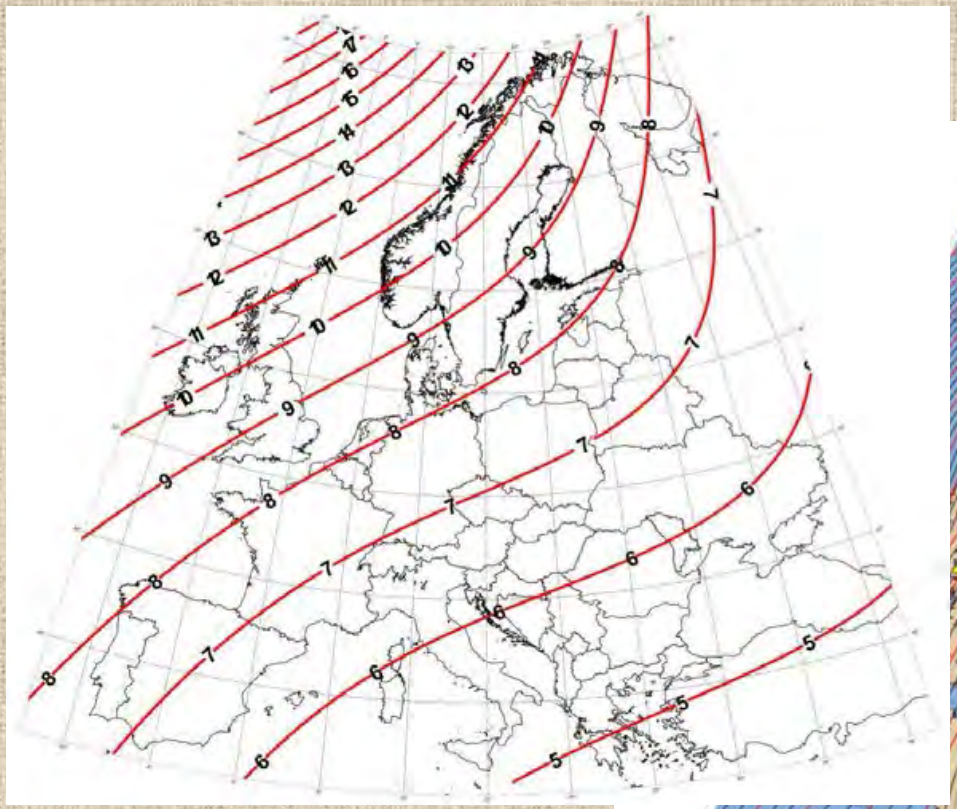
Detection of old historical and abandoned mines
(geohazard for infrastructure, geoheritage)
archeological exploration and cultural heritage:
archeomagnetic dating,
exploration for burried archeological structures

GEOMAGNETIC FIELD MONITORING AND MODELLING, SPACE WEATHER

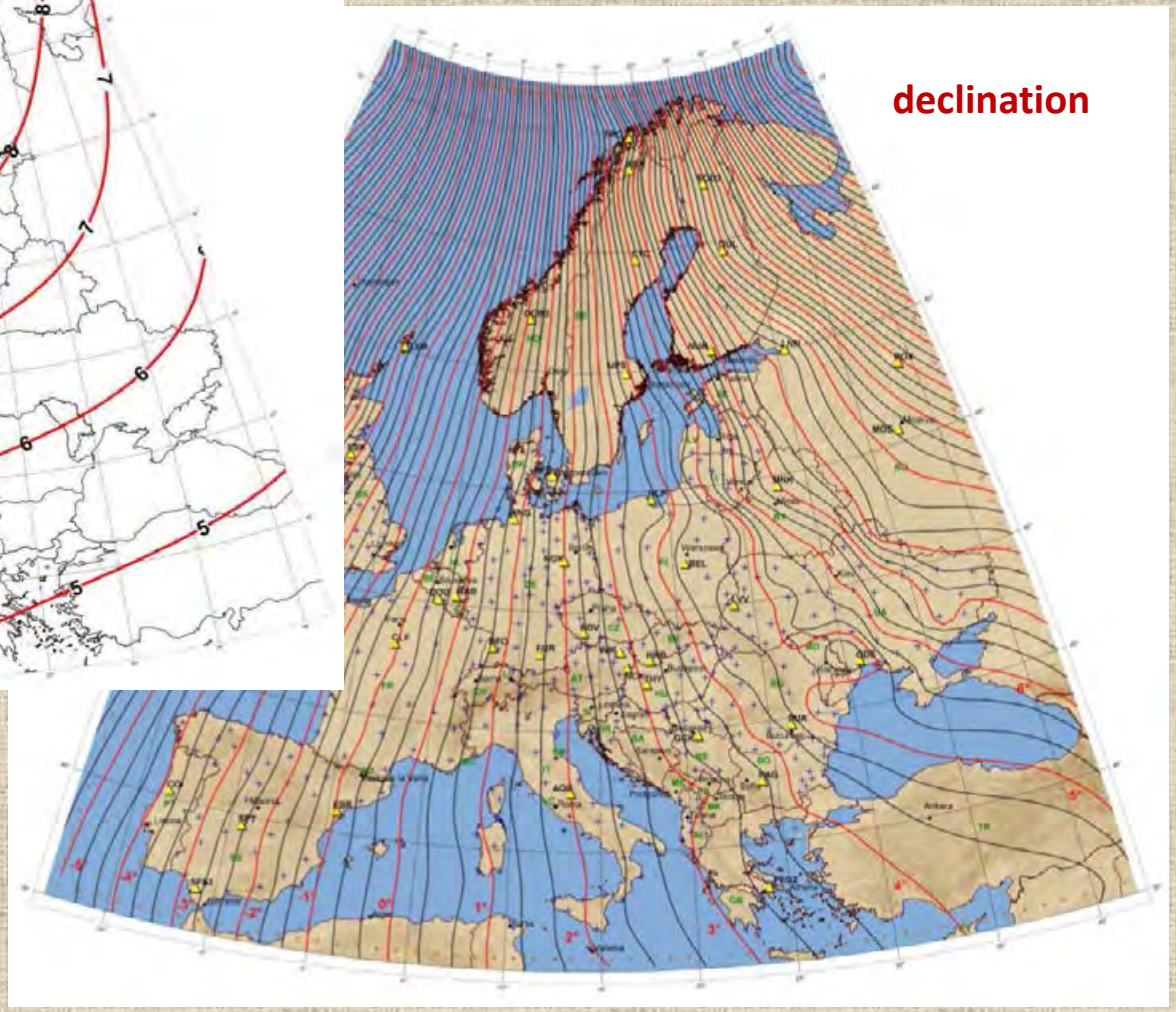
GEOMAGNETIC OBSERVATORY HURBANOVO

Geomagnetic field elements monitoring

Member of:
INTERMAGNET
MagNetE



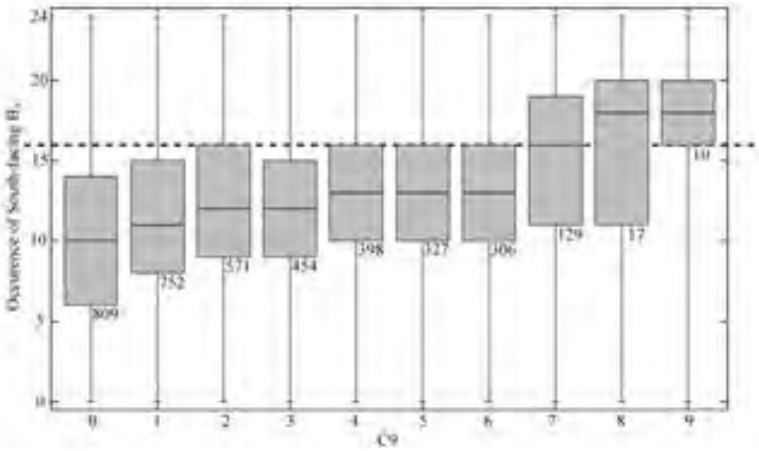
change of declination



declination

ANNALS OF GEOPHYSICS, 2012

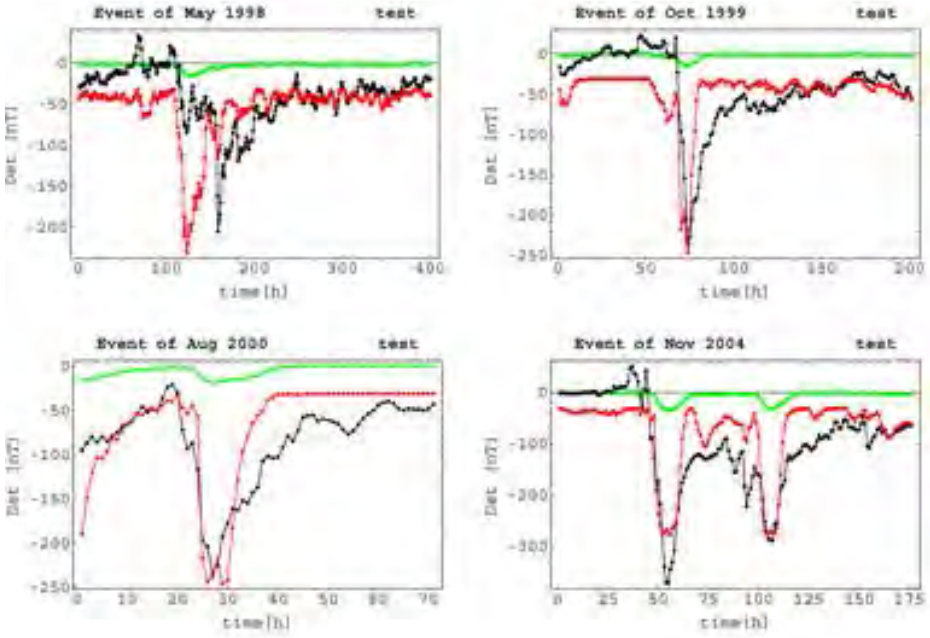
Modelling the geomagnetic activity (GA)



- A revised model to forecast 1-hour lead Dst index was proposed.
- The model was based on artificial neural networks (ANN) combined with an analytical model of the solar wind–magnetosphere interaction (discontinuity in magnetic field)
- We tested the revised model with real data records from solar cycle 23 (**black lines**).
- Our model (**red lines**) provided better results than the primal model (**green lines**).

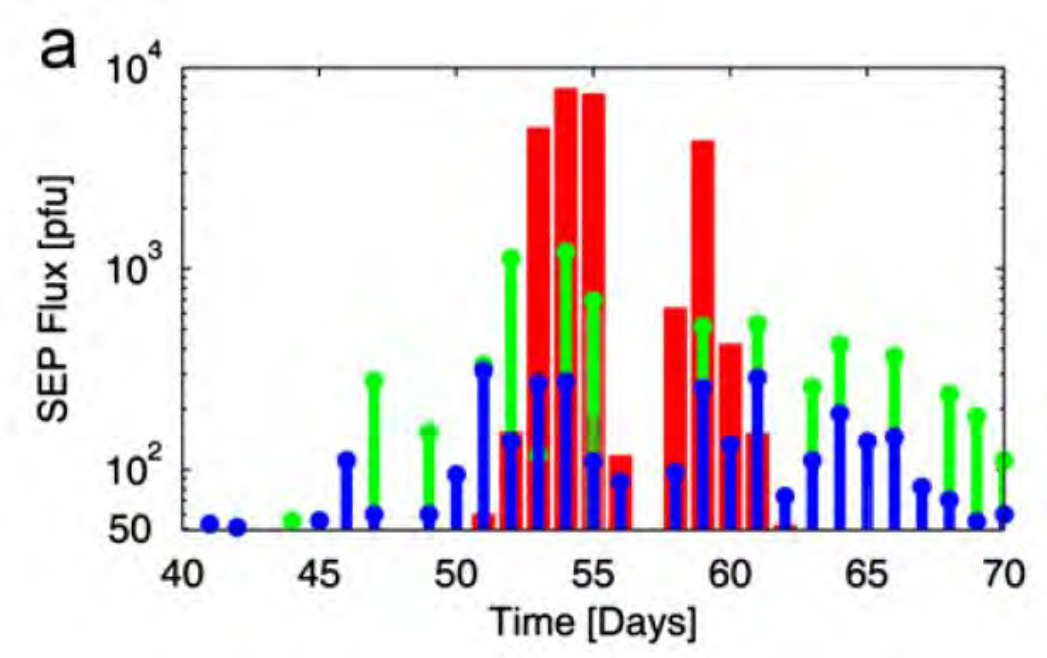
interaction of
solar wind
with magnetosphere:

Forecasting
the Dst index



- *Advances in Space Research (2014)*
- *Journal of Atmospheric and Solar-Terrestrial Physics (2014)*

SPACE WEATHER

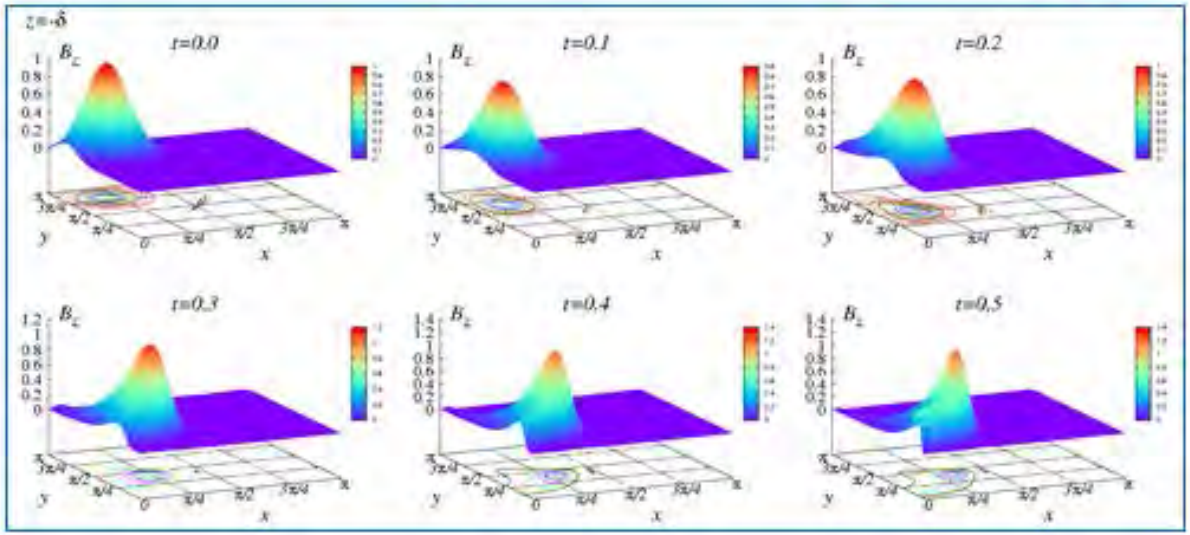


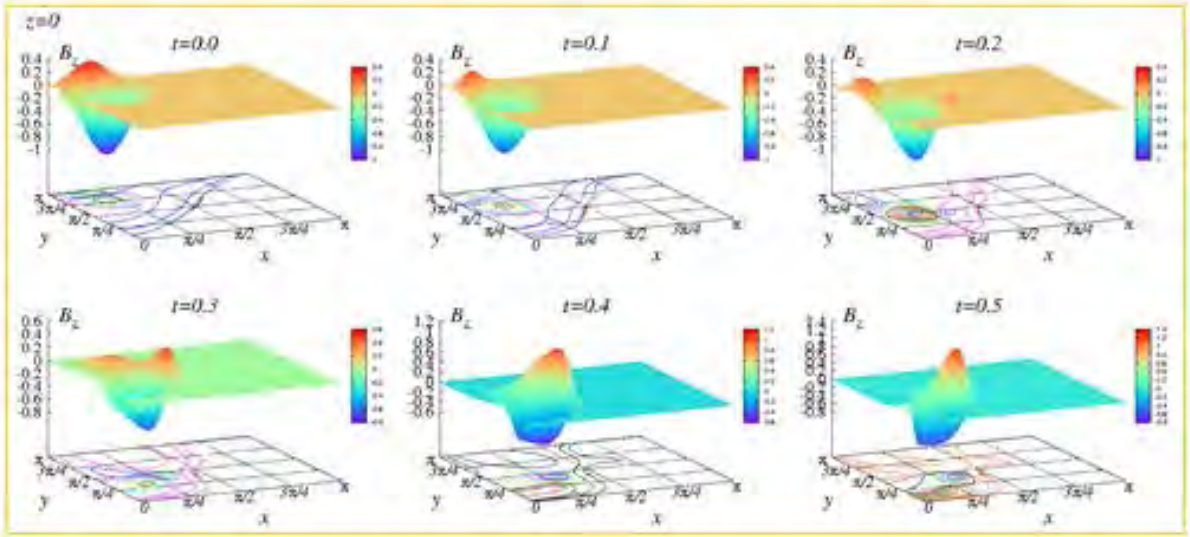
The illustrative figure shows the results of testing the method for forecasting solar energetic particle events
– *Acta Astronautica (2011)*

Geomagnetically induced currents (GICs):
power grid blackouts and damage

High energy particles
– communication equipment and control systems on board planes or spacecraft may be damaged
– enhanced radiation jeopardize passengers and crews of the high latitude flights as well as astronauts on space stations

A kinematic problem for geomagnetic field variations





MHD modelling:

GM field variations from variations in convective flow in the earth core

A kinematic model of vertical geomagnetic field variation resulting from a steady convective flow, Geophysical and Astrophysical Fluid Dynamics, Vol 108, Issue 2, p. 191 – 212, 2014

GEOMAGNETIC FIELD MONITORING AND MODELLING, SPACE WEATHER

SCIENTIFIC OUTPUT

Advancement of the knowledge about the nature and temporal variations of the GM field, deep earth processes, geodynamo, and space weather

IMPACT ON SOCIETY AND ECONOMY

Impact of space weather and extreme rapid changes of GM field on terrestrial and space technologies, infrastructure, as well as humans

AIR QUALITY, CLIMATE

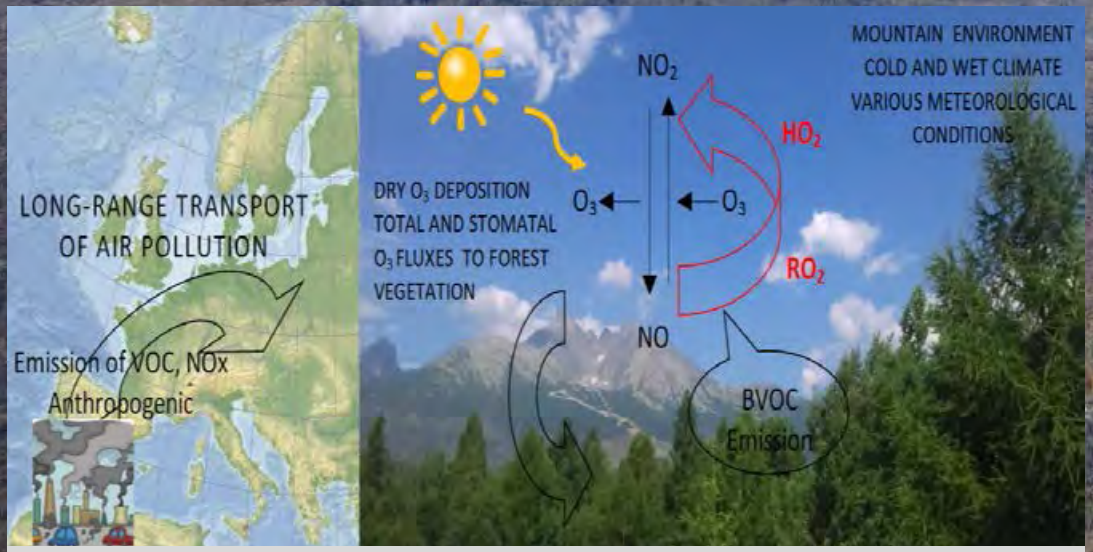
Atmospheric processes and tropospheric ozone in the mountain environment

High Tatra Mts.

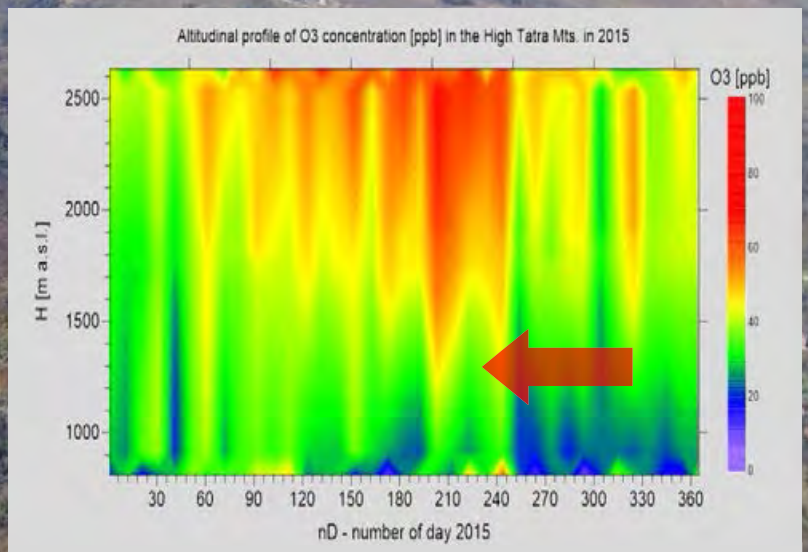
Lomnický štít

2634 m a.s.l.

Polution-related O_3

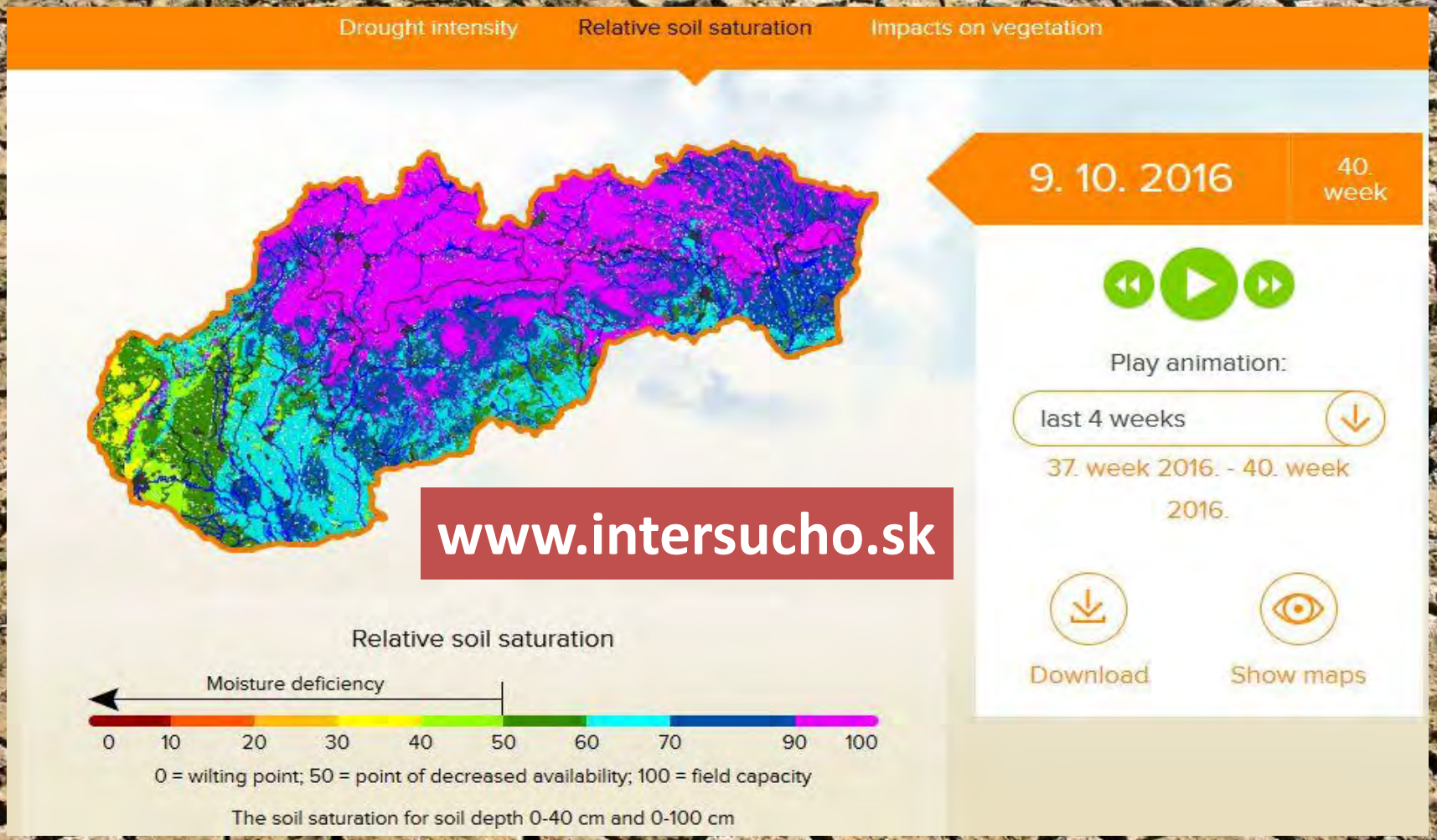


Pollution-related O_3 concentrations tend to be higher in summer, when is more solar energy, and within or downwind of large cities, where more precursors are emitted.



Altitudinal profile of O_3 concentration from the foothill to Lomnický štít, shows summer abundance of O_3 in the High Tatra Mts. in 2015.

Drought monitoring in Slovakia



Developed by

CzechGlobe

EARTH SCIENCE INSTITUTE

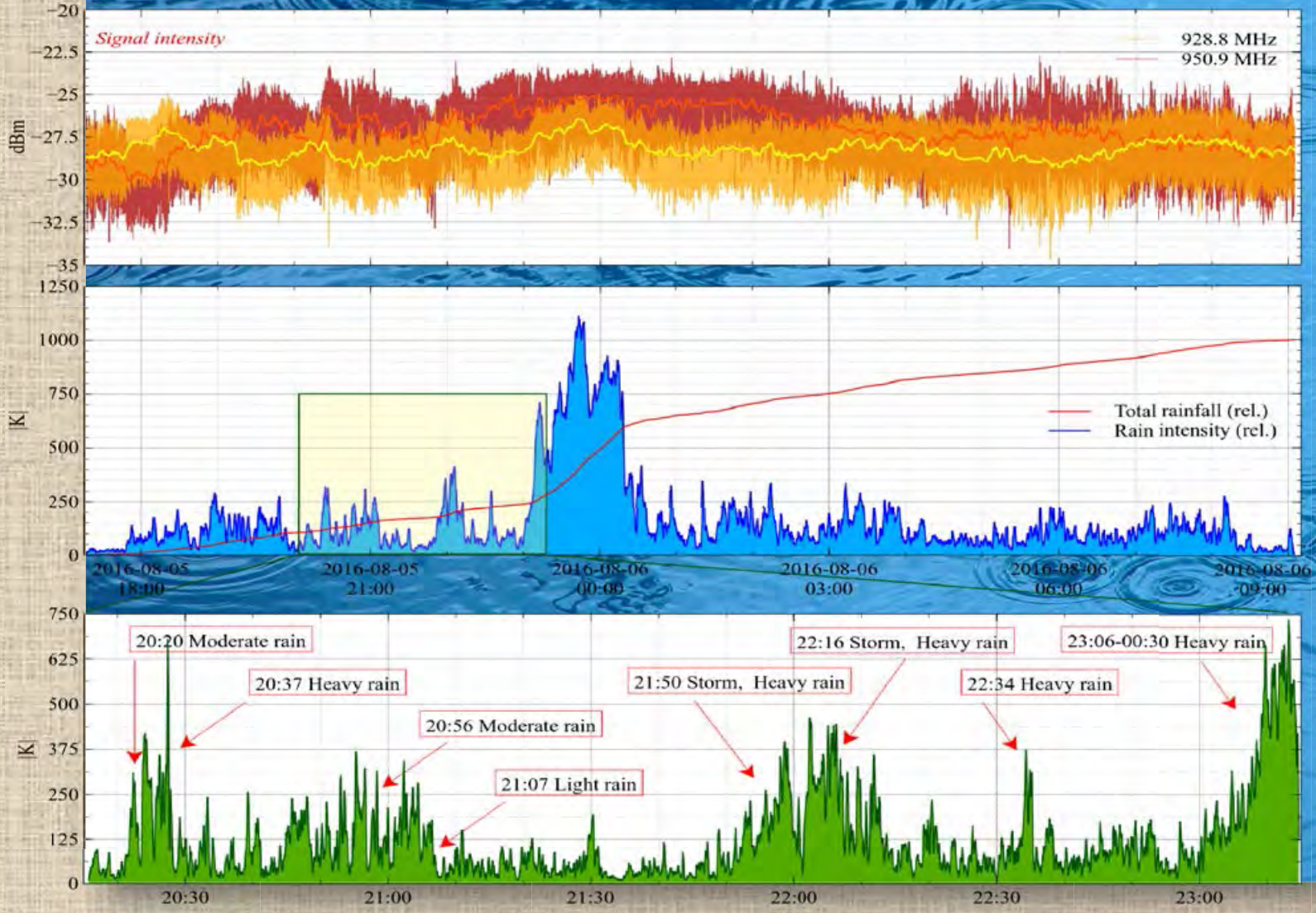
SHMÚ

Mendel University in Brno

Detecting precipitation by BTSs signal intensities

EARTH SCIENCE INSTITUTE
SLOVAK ACADEMY OF SCIENCES

UNIVERSITY OF ŽILINA
Research Centre



AIR QUALITY, CLIMATE

SCIENTIFIC OUTPUT

Advancement of the monitoring and modelling of
complex nonlinear processes
determining weather and climate

IMPACT ON SOCIETY AND ECONOMY

Monitoring and forecasting
extreme (disastrous) weather phenomena and events, climate trends,
evaluation of climate change impacts on various sectors

POPULARISATION OF SCIENCE

Science promotion – abroad

Irish Examiner

Meath Chronicle

IrishTV coverage (RTE)

Newgrange
Zahorec et al. (Oct 2011)

National – radio, TV, web, multimedia

TA3, STV, JOJ

MULTIMED PRODUCTION

DVD

BlueRay

Web