

# **Evaluation of the Research and Professional Activity of the Institutes of the Czech Academy of Sciences (CAS) for the period 2010–2014**

## **Final Report on the Evaluation of the Institute**

**Name of the Institute: Institute of Geonics of the CAS, v. v. i.**

**Fields, in which the Institute registered its teams:**

Earth and related environmental sciences

Observer representing the Academy Council of the CAS: Josef Lazar

Observer representing the Institute: Josef Foldyna, substitute observer Richard Šňupárek

**Commission No. 5: Earth and related environmental sciences**

Chair: Prof. Dr. Franz Fiedler

Date(s) of the visit of the Institute: November 2, 2015

Programme of the visit of the Institute: see attached Minutes from the visit

Evaluated research teams:

*No. 2 - Physical geography; No. 3 - Department of laboratory research on geomaterials; No. 5 - Department of geomechanics and mining research*

## **A. Evaluation of the Institute as a whole**

### **1. Introduction**

### **2. Strengths and Opportunities**

### **3. Weaknesses and Threats**

### **4. Recommendations**

### **5. Detailed evaluations**

*Declaration on the quality of the results and share in their acquisition*

*Declaration on the involvement of students in research*

*Declaration on societal relevance*

*Declaration on the position in the international and national context*

*Declaration on the vitality and sustainability*

*Declaration on the strategy and plans for the future*

## **Report on the Institute of Geonics of the CAS**

### **Foreword**

The Institute is located in an industrial region near the Polish and Slovakian border, relatively far from the capital, but that is only a disadvantage at first sight. The reason is that the Institute's research activities are largely related to mining, which has historically significantly altered the character of the region and the socio-economic and environmental impacts of which are still highly perceptible. In recent years, the Institute has acquired first-class experimental devices thanks to European support, which should help it in the coming years to carry out cutting-edge applied and basic research.

The Institute of Geonics comprises five departments, three of which (Department of Geomechanics and Mining Research, Department of Laboratory Research on Geomaterials, and Physical Geography team of the Department of Environmental Geography) have been evaluated by Commission 5. The Commission members think it unfortunate that the Department of Environmental Geography was divided into two parts for the evaluation purposes and evaluated independently by two Commissions, as this goes against the modern paradigm of the profession, which is based on interconnecting different perspectives.

### **1. General impression of the institute (Main research activities)**

The Departments evaluated conduct basic and applied research in the areas of Physical Geography, geophysical and geological surveying of shallow areas of the Earth's crust, and laboratory research into geomaterials. The research activities are largely related to the industrial past of the Czech Republic and directly contribute to solutions to some practical issues that are associated with industrial activities and their consequences. The indisputable advantage of the Institute is its combination of various research directions, such as in-situ measurements, laboratory research and mathematical modelling. The Institute is located on the campus of the Technical University of Ostrava and near the new National Supercomputer Centre, built with assistance from European Funds. The Institute of Geonics has close working links with both the institutions, including also teaching and supervision of students at various levels in the former case.

Unlike some other Institutes, the Institute of Geonics does not have difficulty acquiring young qualified people. The age structure of the three departments evaluated is balanced, perhaps with the exception of the Department of Physical Geography, which has a large proportion of staff over 60 years of age. Members of Commission 5 met with a number of enthusiastic young people at the Institute who understand their work well; it was something of a surprise, however, that some of the researchers speak English poorly, which limits their abilities in

international research. As far as members of Commission 5 can judge objectively, the level of English in this Institute was the lowest among all the institutions evaluated. According to officials of the Institute, it is the exception rather the rule for young people to go abroad for fellowships after their doctorate. The Institute attempts to develop international cooperation, but it admits that the process of establishing contacts abroad is slower than would be desirable.

The quality of the scientific output of the three Departments evaluated was found to be significantly lower than in other institutions with a comparable focus. It is beyond doubt that the Institute employees carry out important research that has major social impacts on the one hand, but only a limited impact on the international scientific community on the other hand. The Commission regards this problem as serious, because the quality of scientific research today is largely judged by how internationally competitive the research is. Moreover, international experience shows that even research that is focused on regional problems and application can have a major international impact if it is done well and if its results are published in internationally respected journals having high Impact Factors. Commission 5 attempted to identify the main causes of this situation: (i) The Institute employees lack international experience, which is typically acquired during long-term post-doctoral fellowships at first-class international institutions abroad. (ii) The level of expression in the English language is generally low. The writing of papers for international journals is strenuous and establishment of contacts abroad difficult. (iii) The Institute employees lack self-confidence, which is connected with the aforesaid. They avoid international scientific competition subconsciously and their choice of research focus is often aimed at marginal scientific topics. (iv) The employees lack certain important soft skills, such as presentation of results in English language, preparation of grant applications and papers for international journals, etc. New instruments (e.g., for X-ray computer tomography analysis, as well as microscopes and spectrometers) acquired with money from the European Funds may improve the quality of the research in the international context, but may not be enough by themselves unless the Institute employees overcome the aforesaid shortcomings. Proposals for how to resolve these shortcomings are made in the Recommendations section.

## 2. Structure of the Institute

The current organisational structure of the Institute appears to be efficient and matches the structure of the research done. The Commission sees a main problem in the fact that one of the departments (Environmental Geography) is located in Brno whereas the other departments are in Ostrava. This division is associated with the organisational changes in the Academy of Sciences made in the 1990s, which is difficult to revise today. It is a question of how tenable this division is in the long run, and whether the Department of Environmental Geography should be integrated into one of the academic institutions in Brno (e.g., the Global Change Research Centre) in future.

## 3. Role of the Board

The status and power of the Board are defined by law. The Board evidently performs its basic functions, and its role in deciding on the new instrumentation acquired under the European Structural Funds must be appreciated. The Board and the Director are assisted in their decision-making by experts from abroad, associated in an International Advisory Board. This is clearly a step in the right direction, particularly if this International Advisory Board is capable of meeting periodically (once a year) together with the Institute staff and making specific recommendations.

## 4. Role of the Director

The relationship between the Director of the Institute and the Board appears to be balanced and efficient as concerns the work. The Director deserves recognition for having directed the

Institute to drawing from the European Structural Funds and guiding it through the maze of bureaucracy that goes hand in hand with that.

## 5. Recommendations

The potential of the Institute is considerable, but not fully utilised yet. Specific recommendations relating to the departments evaluated are contained in the reports developed by the Committee for each of the departments. Here, we focus on general recommendations on how to increase the quality of the research, which is one of the principal tasks that the Institute should be dealing with in the coming years. The Commission recommends the following:

- (i) Young researchers should be motivated to strive for long-term fellowships (one year and more) at first-class institutions abroad after their doctorate. The acquisition of new employees in years to come should be conditioned by international experience. This practice should be embraced by the Department Heads, the Board of the Institute and the Director, who decides about the admission of new employees.
- (ii) The Institute should, to the maximum degree possible, develop collaboration with leading institutions domestically and abroad. Collaboration with experts who are used to regular publication in recognised international journals may lead to a rapid increase in the quality of the scientific production. Within the Institutes of the Czech Academy of Sciences, there are several opportunities for collaborations on important (both scientifically and to society) issues such as the sequestration of carbon dioxide produced by burning fossil fuels, the management of nuclear waste, geophysical hazards and the use of geothermal energy.
- (iii) The International Advisory Board should be composed of recognised international experts, who are willing to carry out periodic on-site visits to the Institute. The Board members should communicate with the Institute employees during such visits. Each on-site visit should result in a report containing a critical evaluation of the work and recommendations for the next period.
- (iv) The offices of Heads of Departments should be held by good scientists publishing in international journals who do not have difficulty communicating in English.
- (v) In future, more attention should be paid to the linguistic preparation of the Institution employees and development of additional skills (writing of professional papers in English, development of grant applications). The commission recommends the Institute to consider the creation of a position for international applications and contacts which has already been established at some other institutes of the CAS (Czech Globe, Biology Institute, etc.).
- (vi) The CAS should consider whether the Department of Environmental Geography would be better suited if it were to be allied to some group of researchers in Brno, rather than to the Institute of Geonics.

## **B. Evaluation of the individual teams**

### **Evaluation of the Team No. 2: Physical geography**

- 1. Introduction**
- 2. Strengths and Opportunities**
- 3. Weaknesses and Threats**
- 4. Recommendations**
- 5. Detailed evaluations**

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### **Report on Department of Physical Geography, Institute of Geonics of the CAS**

- 1. Introduction.** The Department of Environmental Geography is hosted in Brno whereas the other departments of the Institute of Geonics are situated on the campus in Ostrava. The name of the department reflects a modern paradigm of geography. The Department of Environmental Geography consists of teams for Physical Geography (PG) and Human Geography (HG) which is essential for a comprehensive understanding of environmental geography. Only for this evaluation was the Environmental Geography Department split between two different commissions; this was not fully comprehensible to members of Commission V (in particular to its member Ludwig Zöller, a geographer).  
The main activities of the PG team (some of whom cooperate closely with the HG team) cover a rather wide thematic field; they are basically orientated towards the modern core research areas of geography. They concern natural (mainly geomorphological) processes, neotectonics (discussed with respect to a planned new nuclear power plant at Dukovany), historical impacts on the landscape, and climatic and hydrological extreme situations. Further main activities deal with the environmental impacts of human activities and climate change, and with the dynamics of the current landscape, especially “post-industrial landscapes” and their natural and societal dynamics. The value and preservation of outstanding elements of the natural landscape, including their educational and cultural benefits, apply the international concept of “geomorphosites”. Research into this topic is embedded in the Working Group of the International Geographical Union (IGU). The Department’s research areas are focussed on the Czech Republic (CR), neighbouring countries (Slovakia, Hungary, Austria) and Romania and Bulgaria. The team has also started an interesting and innovative conjunction of geomorphological and biological geographic approaches as well as GIS analysis of landforms.  
As special instrumentation, the PG team now possesses a Terrestrial Laser Scanning system to detect actual changes of the Earth’s surface at high resolution, in order to study, e.g., soil erosion, gravity driven processes and related risk assessments. Furthermore, ERT (Electrical Resistance Tomography) is used to explore the near surface underground.

2. **Strengths and Opportunities.** The strengths of the PG team can be seen in close collaboration with the HG team in accordance with the modern paradigm of geography (in particular environmental geography) at an international level. The main research aims of the Environmental Geography Department should be of important societal relevance for the Czech Republic.
3. **Weaknesses and Threats.** The major weakness is the low international visibility of the PG team. This is mainly due to relatively few publications in international peer-reviewed journals (possibly related to English language problems) as well as to the rather old age distribution of the team members. Limited international collaboration contributes to this weakness. Another weakness arises from the Department's affiliation to the Institute of Geonics within which it is not well integrated, and which offers less scientific contact points than other CAS institutes may provide (e.g., CzechGlobe in Brno).
4. **Recommendations.** It is recommended that relatively young yet experienced scientists (aged 40 to 50 years) must be recruited to lead the Department if it is to continue. The team should strongly orient itself towards colleagues in Western Europe and the USA, and try to become involved in European cooperation. Collaboration in the "Visegrad Group" is good and seminal but not sufficient to gain higher international visibility. More publications in international journals with high Impact Factors will be essential for improved visibility of the Department. The team should be more ambitious and be better focussed in its objectives. Collaboration with other CAS institutes (e.g., Global Change Research Centre in Brno, Institute of Atmospheric Physics) should be intensified. Affiliation of the Environmental Geography Department to the Global Change Research Centre (CzechGlobe) should be considered thoroughly.
5. **Detailed evaluations.**
  - a) The quality of results published is good in parts, but many publications are insufficiently innovative and not visible enough internationally. Of the only 8 papers evaluated, 2 were of category 2, 3 of category 3, 2 of category 4 and 1 of category 5; this was the poorest performance of all the Departments which this Commission evaluated.
  - b) The involvement of students is good due to teaching and mentoring at several universities; the number of defended doctoral thesis is very good whereas number of MSc theses could be increased.
  - c) The societal relevance of the Department's activities is adequate but should be much improved.
  - d) In the national context many activities and publications (including popular scientific ones) of the PG team play an important role which is not yet mirrored in the international context.
  - e) The age structure needs to be improved in order to increase the vitality of the team.
  - f) Without doubt, the main topics of scientific research remain of great relevance in future. Beyond the close cooperation between PG and HG teams, more collaboration with several other CAS Institutes (including the Institute of Geology) and more international cooperation is essential.

## **Evaluation of the Team No. 3: Department of laboratory research on geomaterials**

### **Report on the Research Team of Laboratory Research on Geomaterials, Institute of Geonics of the CAS**

#### **1. Introduction.**

The team members of the Laboratory Research Department mainly deal with experimental research on a wide range of geomaterials and construction materials. The department has an active programme of applied research with potentially important outputs for industry. A significant part of the research activities, such as the investigation of the effect of rock structure on gas permeability, has an immediate impact on industrial activities in the region.

#### **2. Strengths and Opportunities.**

The team members are well qualified in their field and most of them are skilled experimentalists. The department is located on the campus of the Technical University of Ostrava and has close working and educational ties with this institution. The indisputable advantage is the proximity of the national computer cluster and the cooperation with the Applied Mathematics Department as well as the Department of Geomechanics and Mining Research of the Institute of Geonics, which allows the connection of experimental results with mathematical modelling. The experimental equipment is mainly new (funded by an EU 'structural funds for instruments' programme) and of a good quality (e.g., several microscopes with different capabilities, infrared, ultraviolet and Raman spectrometers, and comprehensive X-ray computer tomography equipment). The research of the team contributes to solving practical problems related to mining in the region and its consequences.

#### **3. Weaknesses and Threats.**

In spite of some progress in recent years, the quality of research outputs is not high and the publication record is only moderate. The team members lack the international experience which may only be obtained during long stays in top laboratories in Europe and the USA. As a result, the members of the team are not very self-confident and insufficiently internationally competitive.

#### **4. Recommendations.**

- For newly recruited team members it should be required that, after obtaining their PhD degrees, they should spend at least one year at a leading laboratory in the USA or Europe.
- The team members should strengthen their current international contacts and possibly develop new ones. Cooperation with top teams abroad can help to enhance the quality of the team's research in an international context.
- More emphasis should be put on the choice of research topics and improving the quality of research outputs.
- Team members should work on improving their English language and other skills, such as writing grant proposals and preparing articles for international journals which have high Impact Factors.

## 5. Detailed evaluations.

a) The quality of the research production is lower than that of most other departments of CAS dealing with solid Earth research. Although a significant fraction (43%) of the bibliographic outputs was published in journals of the first and second quartile, most of the evaluated outputs were judged to be in category 3 and 4. None of the evaluated outputs was classified as “world-leading in terms of originality, significance and rigour” and only one output was considered as “internationally excellent”. This indicates that the team members do not deal with topics that are of high interest for the international community, and/or that they are not able to present their results in an attractive way.

b) The team members are involved in teaching at the Technical University of Ostrava and the University of Ostrava. Unlike some other geo-institutes in the Czech Republic, the department is successful in involving PhD students and young people in its research activities.

c) The department has an active programme of applied research which is relevant to Czech society today. Some of the research conducted by the team members (e.g., the investigation of the thermal state of coal and rocks and their gas permeability, research on properties of building materials, etc.) has a direct social impact and is also important for the regional development. The research in the area of clay minerals and novel composite materials has, potentially, many industrial applications. Research on the effect of air bubbles in reinforced concrete heated to 800 K on the strength of the concrete is especially interesting and important, as is research on urinary stones.

d) The team is well-anchored in the regional environment, and includes links with Poland. The research conducted by the team members is mainly of national importance, with the quality of research outputs being mostly lower than in other geoscience institutes of CAS. Only some of the team’s activities have gained international recognition.

e) The team has an even and basically good age structure. Three employees of the department are older than 70 years; it is not fully clear whether their experience is really needed for the future development of the laboratory. The key person of the department is the team leader, who should support the international orientation of the team and initiate ambitious research which will result in quality publications with a strong impact on the international scientific community; he speaks English well. The team should aim for more collaboration with outside, research active, groups.

f) The plan for 2015-2019 is clear and the main research areas are well defined. However, only little attention is paid to international cooperation and the plan does not specify the ways in which the quality of research can be improved.



## **Evaluation of the Team No. 5: Department of geomechanics and mining research**

### **Report on the Research Team of the Department of Geomechanics and Mining Research (Geonics Institute) of the CAS**

1. **Introduction.** The Geonics Institute as a whole, as well as the Department of Geomechanics and Mining Research exhibits very impressive laboratories of triaxial rock stressing (compression and extension) with X-ray tomographic imaging analyses for rock behaviors in the field. This has the potential to provide impressive applied research on nuclear waste reservoir development, coal mine geological engineering issues, neotectonic seismic risk, as well as strengthening fractured systems with “grout” or geomaterials. Research is on various rock types, from granites and metamorphic rocks of the Bohemian and other massifs, to sedimentary rocks associated with regional coal mines. What impressed the evaluation team most was not only the latest high-technology equipment (funded by European Union monies), but also the energy and enthusiasm of the individual department members responsible for the equipment, its operation, and experimental design of research questions. The Department is well-equipped to study many aspects of rock behaviors in mines, at depth in boreholes, and surface fractures. The laboratories are set up well, with adequate power and ventilation. Safety protocol appeared to be well-established.
2. **Strengths and opportunities.** The Department and the Institute of Geonics have a very impressive diversity of researcher demographics. That is, there are several women scientists in the team, as well as a dedicated younger group that is beginning its analyses and contributions to both applied and pure research. This group has tremendous potential to establish an excellent reputation for the Ostrava region, the Czech Republic and internationally. Given the need to design a proper, secure, stable and long-term repository for radioactive wastes, the group’s rock mechanics studies, as applicable to regional geology are remarkable. The team’s study of failures along mineral alignments and differential rock weathering is particularly interesting. Further, its research in geomaterials design (binding agents or “grout”) for fractured and micro-fractured repository candidates offers an important component to the repository design. It also will stabilize weaker sedimentary rock regimes in the northern Bohemian coal mine regions. The Department is fortunate to have real-time problems to address, while being able to report methods, results and applications at pure research.
3. **Weaknesses and threats.** ... XXX ... The team members lack international experience and exchange of information with other institutes dealing with similar topics abroad. As a result, the team members are not very self-confident to perform internationally competitive research. Given the availability of equipment, as well as the spectrum of geologic systems and rock media in the Ostrava region, there is excellent potential for the team’s success.

4. **Recommendations.** The department appears to be on a path with tremendous momentum. But to achieve the goals, the team needs to strengthen international collaboration and encourage their young members to spend some time in laboratories and institutes of similar focus in Europe or North America. The team members need to improve their English to present the research results on international conference and writing scientific papers and project proposals. Regarding a long tradition of deep mining activities in the region and excellent facilities, the department has great potential for high quality research. It is recommended that communication between institutes be improved. It appears that the Department of Engineering Geology in the Institute of Rock Structure and Mechanics (Prague) is doing some similar research on micro-fractures and their potential for rock failure(s).
5. **Detailed evaluations.**
  - a) Publications have improved in quality and quantity over the past five years. While the department represents that it has high impact publications (this may assume that any publication outside of the country is high impact), it is recommended that efforts be made to reach more international peer-reviewed venues. Conference presentations are good, thereby showcasing the group, although higher-impact follow-up publications must appear.
  - b) There has been a small number of students at all levels graduated via the department's program. Two PhD graduates are listed (2010-2014) with 3 MS and 2 Bachelor's degrees. It is anticipated that with younger researchers and new equipment, these numbers will increase.
  - c) Perhaps the most significant impact of this group is its impact on society. First and most importantly, a safe and permanent repository of nuclear waste must be established. With seismology and fracture studies of the "solid rocks" of the Bohemian Massif, combined with injection of stable geomaterials into fractures, the team is on the path to developing such a repository. Further, remediation of the effects of coal mining is exceedingly important. The soft coals of North Bohemia have long been known to be the source of environmental problems.
  - d) The group needs to expand its visibility in international media and conferences.
  - e) Vitality of the group is refreshingly high. With their new equipment, frontier research appears to be likely.
  - f) The future looks bright for this group. Members should reach their full potential, and highly visible outputs appear probable.

**Date:** December 28, 2015

**Commission Chair:** Prof. Dr. Franz Fiedler