

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 Rock Structure and Mechanics of the CAS, 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: Filip Hartvich, substitute observer Lubomír Němec

Commission No. 5: Earth and related environmental sciences

Chair: Prof. Dr. Franz Fiedler

Date(s) of the visit of the Institute: October 29, 2015

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

Evaluated research teams:

No. 4 - Department of Geochemistry; No. 5 - Department of Seismotectonics; No. 6 - Department of Engineering Geology

A. Evaluation of the Institute as a whole

Report on Institute of Rock Structure and Mechanics (IRSM) of the CAS

Foreword

The IRSM consist of five Departments (Department of Materials Structure and Properties, Department of Composites and Carbon Materials, Department of Geochemistry, Department of Seism tectonics, and Department of Engineering Geology) three of which (underlined) are evaluated by the Commission 5. The IRSM has experienced major changes in the organizational structure during the evaluation period, including replacement and changing of scientific personal.

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

The IRSM conducts basic and applied research into rocks in their natural location in the earth's crust, their natural and induced phenomena, derived inorganic and organic materials and special composite materials, and into conditions for their practical exploitation. Two joint research laboratories supply modern facilities for the Departments and for collaboration with university institutes. The IRSM is involved in numerous national and international networks. It has an outstanding role in, e.g., research of landslides and slope deformation, rock biomarker analysis, fluid-induced microseismicity, neotectonics and paleoseismicity, coal and organic petrology geochemistry, and application of geochemistry to medicine. Development of new scientific instruments ("rotaphone") has been successful in cooperation with the Faculty of Mathematics and Physics of Charles-University. Recently, the IRSM has started a voluminous investigation program to build up a new "Centre of Thermochronology" and a new "Centre of Texture Analysis" which are highly appreciated by the Commission. Along with the restructuring of the IRSM the age structure has already significantly improved and scientific outputs have increased in quality and quantity. But there are still differences between the departments. Nevertheless, the reorganization of the IRSM after the last evaluation (2010) has been overall successful and is on a promising way. As a result, the IRSM participates in 5 (from 14) research programs of the "Strategy AV21" of the CAS and coordinates the Natural Hazards program.

The IRSM has presented a detailed and rigorous analysis of its strengths, weaknesses and threats (Appendix 3.4 in the documents for the evaluation) which need not be repeated here. Specific comments by the Commission are given in the reports on the three evaluated Departments. The wide range of research fields allowing for flexibility to follow new trends can certainly be categorized as a strength but also includes the danger of dissipating the energies, in particular for small departments such as "Seismotectonics" and "Materials Structure and Properties". Overlapping and perhaps competitive interests with other CAS Institutes (e.g., Geophysical Institute) may become ominous but may also be turned into better synergies.

Altogether, the IRSM has been strongly engaged on higher education by giving courses at several universities in Prague and in the CR and also some abroad. As a result, the considerable number of 15 PhD theses were defended in 2010-2014. Despite this, and efforts to motivate employees, there appears to be lack of promising students at both M.Sc. and Ph.D. levels in some specifications.

The IRSM publishes "Acta Geodynamica et Geomaterialia", an international multidisciplinary peer-reviewed journal. Its IF increased during the evaluation period (IF 0.667 in 2013) on Q3/2 level. Furthermore, and jointly with the Institute of Chemical Technology (University of Chemistry and Technology Prague), the IRSM publishes "Ceramics-Silikaty", an international multidisciplinary peer-reviewed journal (IF 0.4434 in 2013). Both journals are, however, not

ranked very high and researchers of the IRSM should not restrict themselves to publish mainly in these journals.

2. Structure of the institute

The Director is assisted by a Supervisory Board and a Board of the Institute. Five (in future six?) Scientific Departments (all assisted by individual boards) and Other Departments (Service) exist. Among these, the library contains ca 27,000 books. It has access to electronic publication resources of the Elsevier Consortium (Science Direct), but it is not evident if also electronic publications from other consortia are easily available.

3. Role of the Board

The board is elected for 5 years. It consists of 4 external and 7 internal members, and meets 5 times a year. Agenda are: approval of research directions and new research projects proposed by researchers. The Commission questioned how conflicts between the Director and the Board are handled but according the Board members this has not been the case.

4. Role of the director

As apparently conflicts between the Director and the Board have not shown up and decisions have been reached by consensus the distribution of power did not become clearly evident. The Director expressed his wish to increase the quality of the Institute and to rejuvenate the staff. He denied conflicts between the new Director and emeriti and stressed the orientation towards new scientific fields (e.g., the thermochronology laboratory supported with 750,000 €). He envisaged collaboration with other institutes of the CAS, universities, and international partners. He is ambitious and appears to propel the IRSM forward.

5. Recommendations

The IRSM has succeeded towards a prosperous CAS-institute since its reorganization but not all problems are yet solved. In general, the Institute needs great efforts to successfully apply for European funding. Some teams (see reports on the evaluated Departments) are strongly advised to publish more in highly ranked international journals to increase their international visibility. Smaller teams, in particular, need to care about their sustainability by improving their internal bonds and by boosting recruitment of the best students. They also should take care to prevent dissipation of their energies. Maintaining flexibility for new scientific fields is essential for the vitality and will be advantageous to attract motivated students. Although in general research at the IRSM is of environmental and societal relevance this aspect can be more emphasized by some teams. Most of all, however, the IRSM is encouraged to proceed on its promising way of the past few years.

B. Evaluation of the individual teams

Evaluation of the Team No. 4: Department of Geochemistry

Report on Department of Geochemistry, Institute of Rock Structure and Mechanics

1. Introduction.

The Department of Geochemistry has 9 researchers (6.2 FTE), among them 5 women. In 2014, there was a considerable increase by 0.9 FTE. The age structure is relatively well balanced, with a slight tendency towards overageing, and with few researchers younger than 30 years. The department covers an impressive range of topics. The main topics of research are coal and organic geochemistry, “from environment to medicine” (medicinal insights from geochemical methods), sorption and texture properties of materials such as rocks and coal seams, and studies in geochemistry and petrology of granite suites. The department combines basic and applied research, and it covers several urgent environmental and/or health issues. Recently, the institute was equipped with new and up-to-date instrumentation and it founded the Centre for Texture Analysis (CTA) to further develop cooperation with the various research departments within the institute, among institutions, and with businesses.

2. Strengths and Opportunities.

In some research domains (coal and organic petrology and geochemistry, biomarker analysis from sedimentary rocks, high pressure sorption of CO₂) the department poses a unique position within the Czech Republic (CR). It cooperates with a larger number of other CAS and university institutes within the CR, as well as a few institutions abroad. The attention given to environmental (including paleo-environmental) questions and problems and to radioactive waste deposition and the focus on human health aspects (e.g., mineralised aortic valves, carcinogenic organic materials) offer valuable perspectives for the future development of the department.

3. Weaknesses and Threats.

The team is relatively small (6.2 FTE). A few members will probably retire in the coming years and replacement may be difficult because of the very small number of PhD and MSc students. Coal as a main energy source is expected to further decrease in the CR, which may have constraints on the future relevance of this research domain, unless research will be stronger oriented towards environmental issues (e.g., management of post-mining areas). International collaborations are, in contrast to the national ones, not yet well developed.

4. Recommendations.

More efforts are necessary in order to attract students to work in the department. The department should support and improve an offensive and professional communication strategy to emphasize the relevance of the outcome of the scientific work at the department for the society and for decision makers. This communication may be targeted at, e.g., high schools, universities and other popularization actions. Coupling of mass spectrometry (stable isotopes) with biomarker analysis is considered advantageous and therefore expected to foster the internationally outstanding position in this innovative research topic. The department is advised to undertake strong efforts to considerably increase international

collaboration. With respect to the small team, there is a need to put more focus on the core research domains and to establish and support synergies, internally and externally (e.g., with the Institute of Geonics).

5. Detailed evaluations.

- a) Quality of results: The quality is good to very good; 9 out of 11 papers submitted in Phase I are ranked in the 1st quartile of “Outputs by Journal Ranking”.
- b) Involvement of students: This is not satisfying at present (see Recommendations).
- c) Societal relevance: The research is of high to very high societal relevance; however, the outcome must be much better communicated as, e.g., the alternative options for the capture of CO₂ by high pressure sorption, which may perhaps gain global relevance.
- d) International and national context: In the national context, the department enjoys a very good standing based on its outputs, numerous collaborations with related institutes from universities and other CAS Institutes as well as the Geological Survey. Some unique topics of research, and the societal relevance of its outputs, contribute to the very good standing. The international visibility is to be improved, preferentially by an enhancement of international collaborations (e.g., in the case of biomarkers, biochar and black carbon, e.g. cooperation with the Dept. of Soil Biogeochemistry at the University of Halle, Germany, Prof. B. Glaser, may be recommended).
- e) Vitality and sustainability: Most of the scientific topics will remain paramount for science and society in the future. The research on coal may need to be reframed considering the future energy and environmental politics of the CR and the EU. The department needs to turn its attention to recruit young scientists (PhD students and postdocs), preferably from leading institutes nationally and internationally. The recent foundation of the “Centre for Texture Analysis” (CTA) increases the competitiveness of the Institute and will help to maintain and support sustainability.
- f) Plans for the future: The department aims on continuing its focus on topics already dealt within the period 2010-2014, but also aims on establishing a number of other topics. All of the topics mentioned in the Research Plan for 2015-2019 are seminal and promising, and, without doubt, a department of the Academy of Sciences needs to set the benchmark also in fundamental research. It appears arguable, however, if a relatively small team will be able to manage all these ambitious plans. Establishing better synergies with national and international partners and creating additional positions for researchers through international (e.g., European) projects may avoid dissipating and diluting the energies of the team.

Evaluation of the Team No. 5: Department of Seismotectonics

Report on the Research Team of Seismotectonics, Institute of Rock Structure and Mechanics of the CAS

1. Introduction.

The research team of the Department of Seismotectonics deals with investigation of seismic phenomena induced in the Earth's upper crust by both tectonic motions and anthropogenic activities and with developing novel seismic devices for field measurements. The researchers also participate in monitoring of the seismic activity at important industrial sites and, in cooperation with other institutions, provide the assessment of natural hazard.

2. Strengths and Opportunities.

Most of the team members are well qualified seismologists or applied geophysicists skilled in data acquisition and processing. The undoubted strength of the team is the close link to industrial applications which provides the team members with the opportunity to work on the research topics that are highly relevant for society. Promising research is conducted in cooperation with the Charles University in the field of development of Rotaphones, new portable seismic sensors which have already obtained a national patent protection and received some attention from abroad.

3. Weaknesses and Threats.

The research team is rather small (6.2 FTE in 2014) and some of its activities crucially depend on cooperation with partners from other institutions. For example, the investments associated with the development of Rotaphone were in the past partly paid by the Charles University, which is now the only owner of the patent. The research productivity of individual team members is uneven, ranging from substandard to superior. The most productive researcher of the team is involved in business management of a private company providing seismic services. The departure of this internationally recognized expert would have a negative impact on the research productivity of the whole department.

4. Recommendations.

- Priorities of the department should be clearly defined and reduced to a few areas where the team can achieve research excellence. The research plan for 2015-2019 is consistent with the latter recommendation but the research strategy of the department should be more precisely formulated, defining goals and innovations for the future research activities.
- Each young researcher applying for a full-time position at the department should be encouraged to spend a long-term post-doctoral fellowship at a top foreign laboratory. The admission to staff should be contingent on a successful stay abroad.
- The team members should publish their results mainly in journals with a high impact on the scientific community.

- a) The publication record of the team is of variable quality. Fifteen papers were submitted for evaluation; 9 (60%) were judged to be in category 1 and 2, and 6 in categories 3 and 4. The record is somewhat worse than that of the Seismological Department of the Geophysical Institute, where 96% of the papers are in category 1+2, but significantly better than the record of the Department of Geomechanics and Mining Research of the Institute of Geonics (only 14% in category 1+2). The papers included among the bibliometric outputs were typically published in third-quartile journals
- b) The team members are not systematically involved in teaching activities but they are in touch with a number of university institutions where they often serve as consultants of student projects at various levels. At present, three PhD students are involved in the research activities of the department.
- c) Some of the research conducted at the Department of Seismotectonics has a high societal relevance. The natural hazard assessment at the sites of nuclear power plants and monitoring of fluid-induced seismicity are among the main areas where the team members can contribute to societal needs. The team members also participate in research in a seismically active region in Western Bohemia at the border with Germany.
- d) The team plays an important role in the national context and some of the researchers are internationally recognized. The researchers of the department cooperate with all relevant national institutions and they have also established several links to university and industrial institutions abroad. However, publications resulting from international cooperation are not numerous and most of them are related to projects of L. Eisner (fluid-induced seismicity).
- e) The age structure of the scientific team is very good. However, the small size of the team and its dependence on key people (Eisner – flow-induced seismicity, Málek – rotaphone, DalMoro – surface waves) are potential risk factors. Another threat is the lack of cohesion and team bonding.
- f) At present, the researchers at the department deal with too many research topics. In the next few years, the department “will undergo internal rearrangement” and it “will focus more precisely on a fewer, more closely defined, research topics”. This is definitely a step in the right direction. The department is going to deepen the research in two areas which received international recognition in the past years, namely in the field of flow-induced and natural microseismicity and the development of the rotaphone. The third topic (surface wave analysis) is new and it is related to the scientific activities of the team leader (appointed in September 2014). However, the research plans for the former two research areas are written in a too general way, more or less reproducing what is already done, without offering a clear research strategy. The plan of the third, very new research area is described on only six lines, which raises some doubts regarding whether the research strategy in this area is sufficiently elaborated.

Evaluation of the Team No. 6: Department of Engineering Geology

Report on the Research Team of the Department of Engineering Geology in the Institute of Rock Structure and Mechanics of the CAS

1. Introduction.

The Department of Engineering Geology has a valuable niche in the Czech Republic. Specifically, the group provides information about slope stability (especially important in highway and railway construction and maintenance). This is a particularly complex set of problems including the groups stated four research topics: 1) slope deformation and landslide monitoring, hazard and risk assessment; 2) monitoring of micro-movements on tectonic faults; 3) paleoseismology and tectonic geomorphology; 4) weathering of sandstone and carbonate rocks. The four topics are integral in understanding slope dynamics relevant to each unique geologic setting. Measurements are made with seismometers, an optical-mechanical crack gauge, as well as geologic mapping of geomorphological features and bedrock. Also, careful documentation of groundwater levels and forestation must be recorded. Given varying seasonal and annual fluctuations in groundwater, extremes must enter slope stability calculations. The team has noted a particular hazard associated with debris flows - well hydrated, loose materials on a glide surface or shales on solid bedrock. It is noted that the group also deals with karst risks, a significant geologic hazard.

2. Strengths and opportunities.

Staff is generally young and is working to develop international projects. This has been successful, with Polish (coal in Svalbard), Ethiopian, Slovenian and Peruvian work, among others. Direct interaction with foreign nationals is meritorious. Applied work in Czech Republic has been extensive, with risk assessment of landslides, mud flows, and slope failures. The department is fairly well equipped, with a scanning electron microscope (SEM), laser scanner, dilatometer, climatic test chamber, and a portable field drilling apparatus.

3. Weaknesses and threats.

As stated by the director, student motivation is low. This apparently includes recruitment. Considering that there are five scientists and four PhD students in the department, it appears that research productivity (especially in international journals) could be improved. Considering that the Institute of Geonics in Ostrava has some other types of apparatus to study rock fracturing and failure, there could be overlapping goals. However, the Engineering Geology group focuses on slope behaviors and stability, so this aspect of the department is unique. The group might consider dewatering techniques to quell mudslide threats.

4. Recommendations.

Given the international cooperative projects with the group, there should be more published results. It could be argued that the group largely does applied work, and this is to its credit and bodes well for the safe construction of roads, building sites, and other public works and infrastructure.

5. Detailed evaluations.

- a) Publications need improvement in quality and quantity, considering the size of the department. There are some good venues, including Earth Science Reviews, Tectonophysics, and the International Journal of Geophysics. Conference presentations are good, thereby giving the group international exposure, although more higher-impact follow-up publications must appear. Cooperative work with foreign interests should ideally yield published results.
- b) There has been a reasonable number of students at all levels graduated via the department's program. One PhD graduate is listed (2010-2014), while four PhD projects are listed as current. There were seven Master's and five Bachelor's degrees. It is unclear how many of the lower level graduates continued in the department.
- c) Perhaps the most significant impact of this group is its impact on society. First and most importantly, roads, coal mines, karst and other construction needs proper foundation and slope stability assessment. The team has done this service well. Of particular note is the group's interaction with other nationals on the karst issue - a serious global problem, for which remedies are difficult.
- d) The group should continue 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 stable for this group. There is a continuing need for engineers with significant geologic backgrounds. Considering the heterogeneity of Czech geology, a wide range of issues present themselves - all of which need analysis and remediation.

Date: December 28, 2015

Commission Chair: Prof. Dr. Franz Fiedler