

# **Evaluation of research and professional activity of research-oriented institutes of the Czech Academy of Sciences for the period 2015–2019**

## **Summary Final Report**

**Name of the Institute: Institute of Inorganic Chemistry of the CAS, v. v. i.**

**Evaluated teams and their leaders:**

1. Department of Syntheses (Bohumír Grüner)
2. Department of Materials Chemistry (Kamil Lang)
3. Laboratory of Environmental Geochemical Analysis (Tomáš Matys Grygar)
4. Academic Laboratory of Material Research of Painted Artworks (David Hradil)

## Part A: Evaluation of the institute

### Strengths:

The Institute as a whole has areas of excellence where it is recognized internationally, for example in boron chemistry and novel approaches to nano- as well as photochemistry. The original basic science in most of the groups has spawned some very good applied research, with novel applications. Good participation in EU-funded programs is a strength. The teams are highly qualified.

### Weaknesses:

On account of the rather modest size of the Institute, it cannot cover all areas with sufficient strength to gain or maintain international competitiveness in all areas, which shows up as under-staffing in many areas. Much of the institutional budget comes from project-based funding, which can make longer-term planning difficult.

### Opportunities:

There is an opportunity for increased EU funding, especially for support for more human resources. There are concrete and immediate technology transfer possibilities which would raise the profile of the Institute as well as provide a visible return for public funding.

### Threats:

Lack of critical mass in some areas, competition for talent from the private sector, and a high share of short-term funding are threats.

### Main criterion: 1. Quality of results (H1.1-H1.5)

<b>H1.1</b>	<b>Quality of selected outputs of Phase I</b>
The Institute's outputs come primarily in the form of publications, which are qualitatively and quantitatively very good. The teams have worked on publishing in high impact journals. In the 2015-2019 period, there is a steady increase in the fraction of publications in the higher-rated journals.	
<b>H1.2</b>	<b>Contribution of workers on the outputs reached</b>
Predominant	
<b>H1.3</b>	<b>Quality of all outputs and results</b>
See comments on publications above. See below for comments on knowledge & technology transfer.	
<b>H1.4</b>	<b>The most valuable discoveries and findings in the fields, their importance for the field</b>
The boron group has discovered a new borane-based laser, and has found unexpected medical applications for carboranes, a field in which the leading role of the team in synthesis of the carboranes gives the Institute a decisive advantage. The ALMA team has an excellent position in application of technical methods to art and culture.	
<b>H1.5</b>	<b>Contribution of the participation of the authors in large collaborations</b>
The nature of the work in this Institute does not tend to large collaborations.	

## Main criterion: 2. Societal relevance (H2.1-H2.5)

<b>H2.1</b>	<b>Societal relevance of outputs and results pursuant to CAS and institute mission</b>
<p>As may be seen in the reports on the individual teams, the Institute has pivoted in the last decades strongly to applications of the basic research for which they had received considerable recognition. A good example is the carborane group. Carborane chemistry is rather specialized, and has been considered a mature field, although even in this situation, the group still leads worldwide in the synthesis of carboranes. They have found interesting applications, which we think would not have been obvious at the onset. The most important are in the medical area. Similarly, the contribution of ALMA to the study and preservation of art and other cultural goods, while more difficult to quantify, nevertheless has a high societal relevance.</p>	
<b>H2.2</b>	<b>System functionality for knowledge transfer into practice, its usefulness for society. The impact of the institute's activity on proper practice in society in the area of social sciences and humanities</b>
<p>The applied work has high potential for translation into practice. Knowledge &amp; Technology Transfer (KTT) structures are rudimentary, though. While the Institute has made a number of discoveries which could be commercialized, the work flow for protecting IP, financing IP protections, seeking external partners, negotiating contracts, and bringing practical insights back into the Academy are not well-enough developed. In the documentation, there is mention that CAS has started building a central KTT group. This activity we would encourage, as uncoordinated efforts would be expensive and produce inconsistencies that undermine an effective KTT policy. We recommend that the CAS partner with European public-sector entities that have had good track records of KTT. (US models, for example, may not be the most appropriate.)</p>	
<b>H2.3</b>	<b>Relation to practice</b>
See above	
<b>H2.4</b>	<b>Participation in AV21 strategy</b>
<p>Activities in three of the four departments are specifically mentioned as strategic foci of the Institute in connection with AV21.</p>	
<b>H2.5</b>	<b>Cooperation with regions of the Czech Republic</b>
<p>The Institute of Inorganic Chemistry, with its multiple sites, interacts with the regions, and the local universities.</p>	

## Further criterion: 1. Position in international and national context (D1.1-D1.3)

<b>D1.1</b>	<b>Comparison of the teams and the institute with similar international and national institutes</b>
<p>An overall comparison is difficult, as the Institute is a collection of rather different departments. As indicated in the initial statement, there are areas of excellence, especially in places where the Institute has maintained a specialization which allowed concentration of resources and expertise.</p>	

<b>D1.2</b>	<b>Scope and quality of international and national cooperation and the role of the institute in such cooperation; engagement in broad international cooperation</b>
Most of the groups in the Institute are well embedded nationally and internationally.	
<b>D1.3</b>	<b>Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)</b>
Good performance.	

## Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

<b>D2.1</b>	<b>Direction in line with the perspective of the planned research directions</b>
The strategy of the Institute continues to emphasize focus and specialization, which is, in our opinion, the most fruitful way to achieve excellence with finite resources. Especially the Strategy AV21 identifies four areas, covering three of the four Departments, where the Institute will build strength on strength.	
<b>D2.2</b>	<b>Assessment of the previous research objectives and their achievement</b>
Good.	
<b>D2.3</b>	<b>Assessment of implementation of recommendations from past evaluation</b>
Especially the shift of publications to higher impact journals shows the responsiveness of the Institute to the recommendations of the past evaluation. Some teams are still understaffed, though.	
<b>D2.4</b>	<b>Success in receiving grants</b>
The provided statistics show constant or increasing funding through the evaluation period.	
<b>D2.5</b>	<b>Adequacy of instrumental equipment</b>
For the most part, the instrumental resources are adequate, although there are specific areas where there could be improvements. Specifically, the evaluation commission for the LEAG found situation with regard to instrumentation weaker.	
<b>D2.6</b>	<b>Effectiveness of management</b>
Management appears effective.	
<b>D2.7</b>	<b>Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth</b>
Overall, and in the individual Departments, the age and professional structure has shifted towards younger researchers. We do not see major issues here.	
<b>D2.8</b>	<b>Creating work-life balance conditions, assessment of approach towards possible gender issues</b>
It is difficult for us to judge work-life balance without a site visit. With respect to gender issues, there is only one Department, ALMA, with a high fraction of women. This is not satisfactory. In general this area needs more attention.	

<b>D2.9</b>	<b>Relation of the institute with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.</b>
Parts of the Institute are strongly connected to the Nanomaterials and Nanotechnologies for Environmental Protection and Sustainable Future (NanoEnviCz) roadmap.	

### Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

<b>D3.1</b>	<b>Scope of cooperation with universities on national and international level</b>
For the Institute as a whole, there is ample evidence of cooperation with universities on the national and international level, with regular teaching in J.E. Purkyne University, Charles University, and Palacky University, and joint accreditation programs for doctoral studies with these three universities, plus the University of Chemistry and Technology and the University of Ostrava. Internationally, the connections are less strong for the Institute as a whole.	
<b>D3.2</b>	<b>Effectiveness of joint research centres</b>
The Institute of Inorganic Chemistry has ties in a number of joint research centres. ALMA, for example, has joint activities with the Academy of Fine Arts in Prague, and is well connected in the European Research Infrastructure for Heritage Science.	
<b>D3.3</b>	<b>Success rate in supervision of PhD students</b>
Success rate is fine, but the number of Ph.D. students could be higher.	
<b>D3.4</b>	<b>Participation of PhD students in the outputs</b>
Good.	
<b>D3.5</b>	<b>Participation of the institute in master or bachelor studies</b>
Good, but the number of students could be higher.	
<b>D3.6</b>	<b>Assessment of cooperation intensity with universities in the form of teaching</b>
The level appears appropriate.	

### Further criterion: 4. Outreach activities (D4.1-D4.3)

<b>D4.1</b>	<b>Sufficiency of media strategy and activities in the area of research popularisation</b>
Some parts of the Institute are uncommonly well-situated for media activities and popularization. The effectiveness of the outreach activities is excellent.	
<b>D4.2</b>	<b>Publishing activities and its quality</b>
See above.	
<b>D4.3</b>	<b>Participation in professional organisations in the area of research and development</b>
Good.	

**Other comments of the commission:**

## Part B: Evaluation of teams

### 1. Department of Syntheses

#### Strengths:

International leadership in carborane chemistry.  
Young team members of excellent level  
Very good outreach activities

#### Weaknesses:

Boron chemistry is perceived as a rather mature area of research  
Low number of PhD students

#### Opportunities:

Recruiting talented PhD students  
Application to EU grants

#### Threats:

Low salaries make it difficult to attract young members of the team.

#### Main criterion: 1. Quality of results (H1.1-H1.5)

<b>H1.1</b>	<b>Quality of selected outputs of Phase I</b>
The Syntheses department of the Institute of Inorganic Chemistry works on the chemistry of boron compounds, the traditional area of research of this institute, which is also highly topical in main-group inorganic chemistry. This group is a key member of the World Boron Community. The quality standards are high, in line with the best international institutions.	
<b>H1.2</b>	<b>Contribution of workers on the outputs reached</b>
The members of the Syntheses department provide the main scientific outputs.	
<b>H1.3</b>	<b>Quality of all outputs and results</b>
The scientific productivity of this department is good with a significant part the publications published in high-quality journals.	
<b>H1.4</b>	<b>The most valuable discoveries and findings in the fields, their importance for the field</b>
Besides fundamental work on basic carborane chemistry, an area in which this department is a pioneer and one of the international leaders, new interesting applications have been developed on the application of boron compounds as photoactive materials (laser materials), and compounds for medicinal chemistry and material science.	
<b>H1.5</b>	<b>Contribution of the participation of the authors in large collaborations</b>
This department collaborates internationally with most of the active teams in carborane chemistry in Europe and the USA.	

## Main criterion: 2. Societal relevance (H2.1-H2.5)

<b>H2.1</b>	<b>Societal relevance of outputs and results pursuant to CAS and institute mission</b>
Work in three areas that are relevant to society: drug design, photoactive materials, and nuclear fuel recycling.	
<b>H2.2</b>	<b>System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team's activity on proper practice in society in the area of social sciences and humanities</b>
See point H2.1	
<b>H2.3</b>	<b>Relation to practice</b>
See point H2.1	
<b>H2.4</b>	<b>Participation in AV21 strategy</b>
No comment.	
<b>H2.5</b>	<b>Cooperation with regions of the Czech Republic</b>
No comment.	

## Further criterion: 1. Position in international and national context (D1.1-D1.3)

<b>D1.1</b>	<b>Comparison of the team with similar international and national institutes</b>
This department ranks internationally amongst the best departments in the area of carborane chemistry	
<b>D1.2</b>	<b>Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation</b>
The quality of the international and national cooperation is very good	
<b>D1.3</b>	<b>Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)</b>
The participation in conferences is satisfactory.	

## Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

<b>D2.1</b>	<b>Direction in line with the perspective of the planned research directions</b>
The basic research objectives for 2020-2024 are essentially the same as those of the period under evaluation.	
<b>D2.2</b>	<b>Assessment of the previous research objectives and their achievement</b>
High quality research outputs have increased and shifted slightly towards applications in medicinal research and the synthesis of carboranes with interesting photophysical properties.	

<b>D2.3</b>	<b>Assessment of implementation of recommendations from past evaluation</b>
In general, all the recommendations from past evaluation have been satisfactorily addressed by the team.	
<b>D2.4</b>	<b>Success in receiving grants</b>
The number of national and international grants is satisfactory In the evaluation period.	
<b>D2.5</b>	<b>Adequacy of instrumental equipment</b>
The laboratory equipment is adequate to carry out the experimental tasks of this team.	
<b>D2.6</b>	<b>Effectiveness of management</b>
The structure and management appear to be very good.	
<b>D2.7</b>	<b>Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth</b>
The age structure of the team has improved from the last evaluation period. However, considering its experimental nature, attracting new graduate students will be critical for the continued success of this team.	
<b>D2.8</b>	<b>Creating work-life balance conditions, assessment of approach towards possible gender issues</b>
The gender balance is low.	
<b>D2.9</b>	<b>Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.</b>
No comment .	

### Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

<b>D3.1</b>	<b>Scope of cooperation with universities on national and international level</b>
The has team many national and, in particular, many international collaborations.	
<b>D3.2</b>	<b>Effectiveness of joint research centres</b>
No comment.	
<b>D3.3</b>	<b>Success rate in supervision of PhD students</b>
The numbers of Ph.D. students is satisfactory.	
<b>D3.4</b>	<b>Participation of PhD students in the outputs</b>
Only two Ph.D. Thesis have been completed in the evaluation period, although their productivity in terms of total number of publications has been exceptionally good (9 and 7 papers for each of them).	
<b>D3.5</b>	<b>Participation of the team in master or bachelor studies</b>
Under current evaluation period, 4 Bachelor and 2 Diploma Theses have been completed.	

<b>D3.6</b>	<b>Assessment of cooperation intensity with universities in the form of teaching</b>
The Team members have been involved satisfactorily in teaching at Universities.	

#### **Further criterion: 4. Outreach activities (D4.1-D4.3)**

<b>D4.1</b>	<b>Sufficiency of media strategy and activities in the area of research popularisation</b>
The many public outreach activities, mainly due to team member Michael Londesborough, who is an award-winning science communicator, are of exceptional quality.	
<b>D4.2</b>	<b>Publishing activities and its quality</b>
The team has a very strong publication record. The percentage of publications in the first quartile has increased in the evaluated period.	
<b>D4.3</b>	<b>Participation in professional organisations in the area of research and development</b>
Participation of team members in activities of the scientific community is very good.	

**Other comments of the commission:**

## 2. Department of Materials Chemistry

**Strengths:** Strong outputs and applications. Collaboration with industry.

**Weaknesses:** Funding and laboratories needs investment/reconstruction. Still need instrumentation that is relied upon. Investment needed.

**Opportunities:** To increase collaboration with companies and build IP portfolio.

**Threats:** Materials chemistry is done practically at every University in Europe. The department needs to focus on novel outputs/targets to remain competitive.

### Main criterion: 1. Quality of results (H1.1-H1.5)

<b>H1.1</b>	<b>Quality of selected outputs of Phase I</b>
<p>Outputs were assessed in Phase 1 with only 2 outputs to be “quality 1” with the majority at “quality 3”. 20 outputs were submitted with FTE = 16.63.</p> <p>In the period 2015 to 2019, the team have published 144 papers.</p>	
<b>H1.2</b>	<b>Contribution of workers on the outputs reached</b>
<p>These metrics can be found from the Phase 1 evaluation report.</p>	
<b>H1.3</b>	<b>Quality of all outputs and results</b>
<p>The team publishes in good journals with good impact factors. There are some notable successes in very high impact journals such as Angew. Chem. Int. Ed. Future focus should be to obtain more of very high impact journals.</p>	
<b>H1.4</b>	<b>The most valuable discoveries and findings in the fields, their importance for the field</b>
<p>There are three notable discoveries/ findings that the team has delivered:</p> <ol style="list-style-type: none"> <li>1. <i>Molybdenum cluster complexes as radiosensitizers of singlet oxygen for X Ray Inducible Photodynamic Therapy</i>. This has been disseminated in good journals (RSC J. Mat. Chem and Inorg. Chem).</li> <li>2. <i>Phosphinic acid based metal-organic frameworks</i>, which have an adsorption capacity greater than activated carbon by 30%. This work has been published in outstanding journals and receives excellent citations.</li> <li>3. <i>Efficient degradation of chemical warfare agents</i>. TiO<sub>2</sub> composites combined with 2D materials has results in some exciting applied work.</li> </ol>	
<b>H1.5</b>	<b>Contribution of the participation of the authors in large collaborations</b>
<p>The team publish articles with their close collaborators, not in large author collectives.</p>	

## Main criterion: 2. Societal relevance (H2.1-H2.5)

<b>H2.1</b>	<b>Societal relevance of outputs and results pursuant to CAS and institute mission</b>
All research topics of the team are clearly motivated by the needs of society. This includes their work on light-responsive molecules and materials, photoinactivation of bacteria, novel apical ligands and nanoparticles as radiosensitizers. Materials chemistry/science is application driven and clearly the work that is conducted by the team has clear societal relevance.	
<b>H2.2</b>	<b>System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team's activity on proper practice in society in the area of social sciences and humanities</b>
As mentioned above, the work is application driven and as such the team have patented 3 areas of interest. This is excellent and should be built upon such that the return of the IP when commercialised is directly fed back to their team/reinvestment.	
<b>H2.3</b>	<b>Relation to practice</b>
The focus of the team is on applied research underpinned by material sciences/chemistry. For example, the team are able to design and fabricate nanoparticle radiosensitizers for HeLa cells.	
<b>H2.4</b>	<b>Participation in AV21 strategy</b>
No data was submitted. From our own investigation the work fits the AV21 strategy.	
<b>H2.5</b>	<b>Cooperation with regions of the Czech Republic</b>
Evidence for regular cooperation with Universities for teaching, supervising students in the Czech Republic.	

## Further criterion: 1. Position in international and national context (D1.1-D1.3)

<b>D1.1</b>	<b>Comparison of the team with similar international and national institutes</b>
Material science is a competitive area and the team are as good as others in national institutes. They however fall down in an international comparison.	
<b>D1.2</b>	<b>Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation</b>
<p>Good evidence of national and international cooperations:</p> <p>National: J. E. Purkyně University in Ústí nad Labem, University of Chemistry and Technology Prague, Charles University, Institutes of the CAS (e.g., J. Heyrovský Institute of Physical Chemistry, Institute of Physics, Institute of Macromolecular Chemistry) and Military Research Institute Brno (state enterprise)</p> <p>International:</p> <ul style="list-style-type: none"> <li>• Uppsala University, Sweden</li> </ul>	

	<ul style="list-style-type: none"> <li>• Institut des Sciences Chimiques de Rennes,</li> <li>• Université de Rennes, Rennes, France</li> <li>• Institut Lavoisier de Versailles, Versailles, France</li> <li>• Nikolaev Institute of Inorganic Chemistry SB RAS</li> <li>• Institute of Inorganic Chemistry,</li> <li>• Eberhard Karls Universität Tübingen</li> <li>• University of Perugia, Department of Chemistry, Perugia, Italy</li> <li>• Bern University of Applied Sciences, Bern, Switzerland</li> </ul>
<b>D1.3</b>	<b>Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)</b>
<p>Extensive evidence provided. Evidence of membership of esteemed committees, organised conferences and workshops (5), invited lectures (6) and awards. Very good to see.</p>	

### Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

<b>D2.1</b>	<b>Direction in line with the perspective of the planned research directions</b>
<p>The research activities of the department comprise the design, preparation, and characterization of molecules and (nano)materials of potential environmental and medical application. This fits the planned research directions of the institute.</p>	
<b>D2.2</b>	<b>Assessment of the previous research objectives and their achievement</b>
<p>Past recommendations were:</p> <p>Recommendation #1: It is recommended that the focus of the department continue to be on basic research into the synthesis of new materials. This has been effective in the past, and the future of the department would be well served by this continued focus.</p> <p>The team have continued in basic research of (nano)materials syntheses towards environmental and medical applications.</p>	
<b>D2.3</b>	<b>Assessment of implementation of recommendations from past evaluation</b>
<p>Recommendation: Additional funding from the CAS to support this basic research, in combination with the effective formation of wider collaborations to develop novel applications, will result in a department whose international impact will continue to grow.</p> <p>The team have been successful in receiving funding. They were recipients or co-recipients of 26 grant and programme projects from the Czech Science Foundation, Technology Agency of the Czech Republic, European Commission, NATO, Ministry of Education, Youth and Sports, and Czech Academy of Sciences.</p> <p><i>Recommendation: Finally, as the Team's nanomaterials are becoming commercialized, investigations on their effects and toxicity are highly desirable to prevent any biological/environmental issues. This may be probably performed through appropriate collaborations.</i></p> <p>During the period 2015 – 2019 the team established a collaboration with the team of the Department of Biochemistry and Microbiology, University of Chemistry and Technology Prague, Czech Republic resulting in 10 joint papers. Also the team started a collaboration</p>	

with the team of the Nikolaev Institute of Inorganic Chemistry SB RAS, Novosibirsk, Russia with the access to well-developed biological facilities and published three joint papers.	
Clearly the team have positively reacted to the recommendations.	
<b>D2.4</b>	<b>Success in receiving grants</b>
While we couldn't find an explicit list of grants, in the research activity it is mentioned that the team were recipients or co-recipients of 26 grant and programme projects from the Czech Science Foundation, Technology Agency of the Czech Republic, European Commission, NATO, Ministry of Education, Youth and Sports, and Czech Academy of Sciences.	
<b>D2.5</b>	<b>Adequacy of instrumental equipment</b>
Basic equipment is available. XPS for example, is not. Needs to share equipment from other institutes or the academy needs to invest. Equally, due to COVID we could not visit and thus our review is incomplete.	
<b>D2.6</b>	<b>Effectiveness of management</b>
The management is effective, from the documents submitted and younger members are being developed and the team have created a research team a balanced aged structure.	
<b>D2.7</b>	<b>Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth</b>
The team has managed to have a balanced age structure which will set-them up in many years to come. It would be good to explore diversity of the research team and make up.	
<b>D2.8</b>	<b>Creating work-life balance conditions, assessment of approach towards possible gender issues</b>
Gender issues were not able to be evaluated. Nor the work-life balance. This probably would have been accessed if we had visited. Our assessment is thus incomplete.	
<b>D2.9</b>	<b>Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.</b>
No evidence was submitted.	

### Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

<b>D3.1</b>	<b>Scope of cooperation with universities on national and international level</b>
Very extensive, in our assessment above there is evidence of substantial national and international cooperation's which are the most important.	
<b>D3.2</b>	<b>Effectiveness of joint research centres</b>
At present the team do not have a joint research centre with universities.	
<b>D3.3</b>	<b>Success rate in supervision of PhD students</b>
Supervisions by the team are summarised:	

<b>Supervision of students</b>			
Type of study	No. of supervisors	No. of consultants	Theses defended 2015-2019
Bachelor	9	4	9
Master	4	4	5
Doctoral	11	10	10

10 PHD students have successfully defended their thesis, which is excellent.

<b>D3.4</b>	<b>Participation of PhD students in the outputs</b>
The team note these are critical to outputs, as is expected. This is evidenced from the outputs with their name on.	
<b>D3.5</b>	<b>Participation of the team in master or bachelor studies</b>
The team extensively lecture at Universities from Bachelor, Master and Doctoral. Good evidence was provided and this a huge positive.	
<b>D3.6</b>	<b>Assessment of cooperation intensity with universities in the form of teaching</b>
See comment above.	

#### Further criterion: 4. Outreach activities (D4.1-D4.3)

<b>D4.1</b>	<b>Sufficiency of media strategy and activities in the area of research popularisation</b>
Good evidence base provided, which ranges from short videos, to escape games and secondary school outreach.	
<b>D4.2</b>	<b>Publishing activities and its quality</b>
Very active, 144 papers from 2015 to 2019. Quality is good and further insights are from Phase 1 evaluation.	
<b>D4.3</b>	<b>Participation in professional organisations in the area of research and development</b>
Kamil Lang holds various roles in professional organisations.	

**Other comments of the commission:**

### 3. Laboratory of Environmental Geochemical Analysis

#### Strengths:

Very good publication output per FTE; Excellent paleoclimate studies; High impact contribution with floodplain analyses and contamination hot spots; Good assessment of weathering indices; Impressive cooperation with associated universities.

#### Weaknesses:

Team below critical size. All achievements depend on the team leader.

#### Opportunities:

Research direction and topic provide good potential for CAS Internal, national as well as international cooperation.

#### Threats:

Besides excellent cooperation with universities the team presents a certain „closed shop“ attitude working in splendid isolation.

#### Main criterion: 1. Quality of results (H1.1-H1.5)

<b>H1.1</b>	<b>Quality of selected outputs of Phase I</b>
Average.	
<b>H1.2</b>	<b>Contribution of workers on the outputs reached</b>
Very good, for a series of remarkable papers lead author of interdisciplinary assessments.	
<b>H1.3</b>	<b>Quality of all outputs and results</b>
Good, interesting results and conclusions with truly interdisciplinary character.	
<b>H1.4</b>	<b>The most valuable discoveries and findings in the fields, their importance for the field</b>
Miocene thermal excursion important for the paleoclimate record of E central Europe; Statistic approaches for compatibility and data comparison. Methodology on geochemical floodplain sampling. Localisation of contaminant hotspots.	
<b>H1.5</b>	<b>Contribution of the participation of the authors in large collaborations</b>
High potential for improvement.	

#### Main criterion: 2. Societal relevance (H2.1-H2.5)

<b>H2.1</b>	<b>Societal relevance of outputs and results pursuant to CAS and institute mission</b>
Rather low. However, paleoclimate studies are fundamental for the understanding of natural to anthropogenic factors on climate change.	
<b>H2.2</b>	<b>System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team's activity on proper practice in society in the area of social sciences and humanities</b>

Good. Strong input in understanding the past to forecast the future.	
<b>H2.3</b>	<b>Relation to practice</b>
Not clearly recognizable.	
<b>H2.4</b>	<b>Participation in AV21 strategy</b>
Rather weak; nothing on this mentioned in the report and presentation of the team.	
<b>H2.5</b>	<b>Cooperation with regions of the Czech Republic</b>
Average. Strongly related to the NW Czech lignite occurrences	

### Further criterion: 1. Position in international and national context (D1.1-D1.3)

<b>D1.1</b>	<b>Comparison of the team with similar international and national institutes</b>
Comparable standard at high level.	
<b>D1.2</b>	<b>Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation</b>
Cooperation not clearly demonstrated for international links, on the national base excellent. International collaboration is demonstrated by joint publications.	
<b>D1.3</b>	<b>Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)</b>
Strong within Czech Republic, serving for the Czech National Foundation.	

### Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

<b>D2.1</b>	<b>Direction in line with the perspective of the planned research directions</b>
Excellent science, somehow isolated within the institute, but linked by the analytical methodology.	
<b>D2.2</b>	<b>Assessment of the previous research objectives and their achievement</b>
Full success.	
<b>D2.3</b>	<b>Assessment of implementation of recommendations from past evaluation</b>
Recommendation largely followed, keeping the awkward situation of a too small team.	
<b>D2.4</b>	<b>Success in receiving grants</b>
Moderate but steady.	
<b>D2.5</b>	<b>Adequacy of instrumental equipment</b>
OK.	
<b>D2.6</b>	<b>Effectiveness of management</b>
Good. Question not to be answered clearly because of the size of the team.	

<b>D2.7</b>	<b>Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth</b>
Team, as far as CAS structure is regarded, clearly below critical size, only successful due to most effective cooperation with associated university partners.	
<b>D2.8</b>	<b>Creating work-life balance conditions, assessment of approach towards possible gender issues</b>
N/A	
<b>D2.9</b>	<b>Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.</b>
N/A	

**Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)**

<b>D3.1</b>	<b>Scope of cooperation with universities on national and international level</b>
Excellent cooperation with local universities. International net work not obvious.	
<b>D3.2</b>	<b>Effectiveness of joint research centres</b>
N/A	
<b>D3.3</b>	<b>Success rate in supervision of PhD students</b>
Very good	
<b>D3.4</b>	<b>Participation of PhD students in the outputs</b>
Good	
<b>D3.5</b>	<b>Participation of the team in master or bachelor studies</b>
Very good	
<b>D3.6</b>	<b>Assessment of cooperation intensity with universities in the form of teaching</b>
Very good, but team leader not involved. All teaching by the second person in the team.	

**Further criterion: 4. Outreach activities (D4.1-D4.3)**

<b>D4.1</b>	<b>Sufficiency of media strategy and activities in the area of research popularisation</b>
Strong potential for improvement. High quality of research based on the personal interest of team leader. This situation does not lead to additional involvement in outreach and popularisation.	
<b>D4.2</b>	<b>Publishing activities and its quality</b>
Very good.	

<b>D4.3</b>	<b>Participation in professional organisations in the area of research and development</b>
Not visible, at least outside Czechia. Obvious need for collaboration with international bodies or at least the national survey.	

**Other comments of the commission:**

The team with two researchers is too small. Research and output is obviously fully focussed on the interests of the team leader.

## 4. Academic Laboratory of Material Research of Painted Artworks

### Strengths:

Gender and age balance of the staff. National and international leader in the focus area of the laboratory. Development of non-invasive methods of painting analysis. European interactions promoted.

### Weaknesses:

Impact of publications limited by the diverse publication venues (art history/conservation vs analytical chemistry/geochemistry). Staff spread between two locations. Lack of student programs.

### Opportunities:

Expansion of interactions/collaborations with international partners. Expanding Cultural Heritage emphasis of work.

### Threats:

Broad range of work with a small staff.

### Main criterion: 1. Quality of results (H1.1-H1.5)

<b>H1.1</b>	<b>Quality of selected outputs of Phase I</b>
The quality is increasing since the last review. More publications in higher quality venues (Q1*, Q1, and Q2 increased).	
<b>H1.2</b>	<b>Contribution of workers on the outputs reached</b>
The members of the ALMA team provide the main contribution to the publications.	
<b>H1.3</b>	<b>Quality of all outputs and results</b>
Generally high-quality publications in specialist journals, with an international impact in the field.	
<b>H1.4</b>	<b>The most valuable discoveries and findings in the fields, their importance for the field</b>
The development of understanding of mechanisms of degradation of paintings via lead carboxylate formation. X-ray fluorescence and micro-Raman analysis for non-invasive/non-destructive analysis of artworks.	
<b>H1.5</b>	<b>Contribution of the participation of the authors in large collaborations</b>
Participation in the development of European Research Infrastructure focusing on Cultural Heritage.	

### Main criterion: 2. Societal relevance (H2.1-H2.5)

<b>H2.1</b>	<b>Societal relevance of outputs and results pursuant to CAS and institute mission</b>
Significant contributions to the understanding and preservation of Czech and European cultural heritage.	

<b>H2.2</b>	<b>System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team´s activity on proper practice in society in the area of social sciences and humanities</b>
A clear leader in the impact of the work of the ALMA institute on areas of humanities.	
<b>H2.3</b>	<b>Relation to practice</b>
New methods have been developed and made available to the field.	
<b>H2.4</b>	<b>Participation in AV21 strategy</b>
The work of the laboratory overall is directed to research in the public interest, with its focus on research to enable authentication and protection of artworks, and understanding degradation routes and ways to conserve and restore artworks, cultural artefacts, and public monuments.	
<b>H2.5</b>	<b>Cooperation with regions of the Czech Republic</b>
The leading institute in the Czech Republic for work of this kind. Apparently very outward facing, to the Czech Republic and more broadly internationally.	

### Further criterion: 1. Position in international and national context (D1.1-D1.3)

<b>D1.1</b>	<b>Comparison of the team with similar international and national institutes</b>
The best institute in this research area within the Czech Republic, and have international impact above that which might be expected for the small size of the group.	
<b>D1.2</b>	<b>Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation</b>
As noted above, project participation in European Research Infrastructure for Cultural Heritage. Also leadership and participation in international conferences focused in this area of research.	
<b>D1.3</b>	<b>Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)</b>
Significant participation in organizing and participating in conferences and workshops.	

### Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

<b>D2.1</b>	<b>Direction in line with the perspective of the planned research directions</b>
The institute has a clear plan for moving forward with their research in the area of the interconnection of science and art, as well as taking full advantage of the team´s expertise in the mineralogical approach to the analysis of painting pigments. They will also continue to contribute to the development of new non-invasive methods of analysis of artworks and cultural artefacts, a historical strength of the institute.	
<b>D2.2</b>	<b>Assessment of the previous research objectives and their achievement</b>
Research outputs have increased and shifted towards publication in higher quality venues.	

<b>D2.3</b>	<b>Assessment of implementation of recommendations from past evaluation</b>
No Comment.	
<b>D2.4</b>	<b>Success in receiving grants</b>
The ALMA institute has increased their external grant support, with 2 Czech Science Foundation awards, and one from the Ministry of Culture.	
<b>D2.5</b>	<b>Adequacy of instrumental equipment</b>
The laboratory is well instrumented, and the instrumentation is up to date. Work is continuing on method development and acquisition of new instrumentation necessary.	
<b>D2.6</b>	<b>Effectiveness of management</b>
The structure and management of the institute appears to be very effective. The management agreement between IIC and the AFA in Prague is well designed, and working effectively.	
<b>D2.7</b>	<b>Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth</b>
The current structure is very good in terms of gender and age distribution. The institute needs to continue to attract good graduate students, and should work to include bachelor's and masters students in the research team.	
<b>D2.8</b>	<b>Creating work-life balance conditions, assessment of approach towards possible gender issues</b>
Having two locations for the institute's work may cause some disruption to work-life balance because of extensive commuting for those team members who must carry out work in both locations.	
<b>D2.9</b>	<b>Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.</b>
No comment.	

### Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

<b>D3.1</b>	<b>Scope of cooperation with universities on national and international level</b>
There is a good deal of cooperation with the Charles University in Prague, the University of Chemistry and Technology in Prague, and Masaryk University in Brno. This is primarily through supervision of graduate students, and also involves lectures on topics of interest to the ALMA scientists. There is also international cooperation with international Universities via supervision of PhD students who did their bachelor's studies at Bologna in Italy, and Fribourg in Switzerland.	
<b>D3.2</b>	<b>Effectiveness of joint research centres</b>
The structure of the joint research centre ALMA, combining the support of the Academy of Fine Arts in Prague and the Institute of Inorganic Chemistry of the CAS has led to a very effective research centre, which operates very well in this important area of interaction between science and art.	

<b>D3.3</b>	<b>Success rate in supervision of PhD students</b>
Two PhD dissertations were defended during the period of the review. Another 4 PhD students worked at ALMA, with two of those leaving before degree, and two continuing presently. The ALMA institute would like to attract more PhD students.	
<b>D3.4</b>	<b>Participation of PhD students in the outputs</b>
The PhD students are heavily involved in the research outputs of the institute.	
<b>D3.5</b>	<b>Participation of the team in master or bachelor studies</b>
This is an area that could be improved. One master's student was involved, and several short-term undergraduate researchers participated in the work of the institute. Development of a formal master's program based at the ALMA institute is desirable.	
<b>D3.6</b>	<b>Assessment of cooperation intensity with universities in the form of teaching</b>
Minimal interaction, limited to several master's level lectures at the Charles University.	

#### Further criterion: 4. Outreach activities (D4.1-D4.3)

<b>D4.1</b>	<b>Sufficiency of media strategy and activities in the area of research popularisation</b>
The public outreach and advertising brochures seem to be effective.	
<b>D4.2</b>	<b>Publishing activities and its quality</b>
Publishing activities at a good level, and quality high.	
<b>D4.3</b>	<b>Participation in professional organisations in the area of research and development</b>
Active participants, and leaders in relevant professional organizations (CrysAC).	

**Other comments of the commission:**

**Final report was elaborated by:**

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**Commission 4 - Earth and environmental sciences**

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