**Evaluation of Natural Sciences 2022-2024** 

# **Evaluation report**

# **Department of Geoscience**

# University of Tromsø - Faculty of Science and Technology

January 2024



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# Statement from Evaluation Committee II

The members of this Evaluation Committee have evaluated the following administrative units at the higher education institutions within natural sciences in 2022-2023 and submitted a report for each administrative unit:

- Department of Chemistry, Norwegian University of Science and Technology
- Department of Physics, Norwegian University of Science and Technology
- Department of Chemical Engineering, Norwegian University of Science and Technology
- Department of Materials Science and Engineering, Norwegian University of Science and Technology
- Department of Geoscience, University of Tromsø
- Department of Chemistry, University of Tromsø
- Department of Physics and Technology, University of Tromsø
- Department of Energy Resources, University of Stavanger
- UNIS The University Centre in Svalbard

The members of the Evaluation Committee are in collective agreement with the assessments, conclusions and recommendations presented in this report. None of the Evaluation Committee members has declared any conflict of interest.

The Evaluation Committee has consisted of the following members:

Professor Amelie Hagelauer (chair)

Technical University of Munich, Germany

Dr. Eric Deville

IFP Energies Nouvelles, France

Professor Christian Ruegg

Federal Institutes of Technology ETH Zurich, Switzerland

Professor **Guido Mul** University of Twente, The Netherlands Professor Sigridur Suman

University of Iceland, Iceland

# Description of the administrative unit

### University of Tromsø – UiT Department of Geosciences – IG

#### The administrative unit

The unit employs 76.1 FTE research staff out of which 15.4 are professors, 8.3 associate professors, 13.2 researchers, 6 postdocs, 23 PhD students, 0.2 assistant professors, 8 technical engineers and 2 are administrative support. Research and education at IG focus on the following themes: Ice and ocean climate systems; Natural resources in the Arctic; Dynamics of the lithosphere; Geohazards; Coastal Research; Environmental geology in Arctic regions; Technology development; Modelling. IG hosted the Norwegian Centre of Excellence CAGE (2013-2023), the National Petroleum Centre ARCEx (2013-2021) and participates in the Norwegian Centre for Excellence in Education iEarth (lead: UiB). It hosts currently the Norwegian Centre of Excellence iC3 (2023-2033) and will host an ERC Synergy Grant i2B (2024-2029). Furthermore, IG has multiple projects supported by public and private funding sources.

#### The belonging research groups

IG has three research groups: Solid Earth Science, Mineral Resources and Geohazards; Sedimentary Systems, Paleoclimates and Environments; Geophysics, Glaciology and Oceanography Group.

#### The administrative unit works in relation to the unit's strategies

Based on the favourable location in relation to research and education in marine and terrestrial Arctic geosciences, as well as dynamic processes of the Earth's crust, IG aims to be an outstanding research environment for the Arctic and polar areas, as well as a hub for environmental, energy, natural resources and climate topics. The main tasks for research, education and outreach are addressed by individual scientists, internal and external collaboration of individuals, as well as in centres originated from and hosted at IG. Outreach activities transfer knowledge from research activities to academia, industry and society in general. IG facilitates knowledge-transfer through conferences/workshops, visits, official agreements/contracts, joint participation in research- and/or outreach projects.

#### The unit works in relation to the belonging sector

IG contributes to two of the five long-term priorities in Norway's Long-Term Plan for Research and Higher Education 2019-2028 (LTP): (I) Ocean; (ii) Climate, environment, and environmentally friendly energy. IG also contributes to interim goals in the LTP such as developing excellent, world leading research groups as well as education environments. IG also contributes to improved public service through research on geohazards. Furthermore, to improved understanding of the formation of mineral resources and consequences of mining, IG contributes to improved competitiveness of the industry. IG also contributes to digitalisation addressed in the LTP.

#### Where the unit will be in the future

IG's overall goal is to be a solid environment for research and education in geosciences with a particular focus on Arctic issues and fundamental earth-science processes. The unit aims to:

• Conduct outstanding research and research-based education within the department's areas of expertise.

• Have professional flexibility to be able to handle future changes and the development of new research fields.

• Preserve its character with broad scientific education in marine and terrestrial geosciences.

• Have a good balance between fundamental and applied research, and interdisciplinarity.

• Strengthen its visibility and status, both internationally, nationally and regionally in collaboration with international and national partners.

# **Overall assessment**

The strength of IG-UiT is that it is mostly oriented toward the study of marine geosciences in Artic. This unit is recognized for its excellent competency about this subject and officially recognized as a Centre of Excellence. Research activities at IG-UiT are very well adapted to study Artic geosystems, but also other geosystems as well.

This unit is well structured. A relatively high level of recent staff turnover has provided a positive dynamism after a transition period. This has resulted in a significant increase in research work. Infrastructures and equipment are of very high quality. The development of high-resolution 3D acquisition is excellent to collect up-to-date geophysical data and to maintain high-quality research in offshore and good research visibility at a worldwide scale. An important point of vigilance concerns staff resources to operate and maintain sea operations and laboratory resources. Various national and international collaborations have produced excellent results.

Collaborations with industry are effective but could be more encouraged. Research themes are good and well adapted to the geographical environment of IG-UiT. If Artic systems is the core of the research ongoing in IG-UiT, the continuous support of internationally competitive fundamental research is maintaining high-quality studies about global geosystems, and favour teaching of, up-to-date geosciences principles making this administrative unit very visible at an international scale.

The Evaluation Committee considered the points raised by IKP in their Terms-of-Reference document and have commented on many of the issues raised in that document.

### Recommendations

The Evaluation Committee recommends maintaining and developing the expertise of marine studies of the Artic area, and to maintain the dynamism of the last years of the evaluation period.

The Evaluation Committee recommends promotion of external funding with respect to public funding, and to strive progressively better to become part of the Norwegian industrial and societal fabric through collaborations with industry and technological developments. This will favour the societal impact and the job opportunities for the students.

Collaborations with other universities, such as the University of Svalbard, as well as other Norwegian and international universities notably used to work with industry should be maintained and developed, if possible.

Concerning the problems related to the available scientific staff during marine surveys, the increase of collaborations with other institutions could minimize the problem and optimize the scientific production. Such collaborations could be organized by more or less formal bidding/invitation processes to be defined.

Concerning the management of infrastructures, technical staff stability and recruitment has to be managed carefully. UiT being a leader in marine studies, innovative systems to investigate the sea floor and subsurface could be developed, like sea-floor observatory/monitoring systems to study fluid seepages, marine currents, slope stability, and others. Machine learning and AI should be developed notably for the processing of marine geophysical data.

Access to excellent UiT infrastructure upon request to external researchers and private actors should be encouraged. This could be a way to extend interactions and collaborations with other national and international institutions but also a way to minimize the problems related to available staff. This could be also a way to find additional funding.

Concerning aspects related climate change in Artic, interactions of the different systems sea-landatmosphere could be studied and modelled more globally. UIT is in good position to study such problems.

The Evaluation Committee encourages the development of equal career opportunities for men and women, and in particular a balance between full professors and associate professors.

# 1. Strategy, resources, and organisation of research

Overall, the administrative unit has a good research strategy in place and the unit is organised in a coherent and own necessary infrastructure. The unit has sufficient funding, however, could increase private funding sources.

# 1.1 Research Strategy

With its favourable location for research and teaching in Arctic marine and terrestrial geology, as well as dynamic processes in the Earth's crust, IG offers an outstanding research environment for the Arctic and polar regions, as well as a hub for issues relating to the environment, energy, natural resources and climate. Outreach activities enable the transfer of knowledge from research activities to academia, industry, and society at large. IG facilitates knowledge transfer through meetings, various visits, formal agreements/contracts, joint participation in research and/or awareness-raising projects; awareness-raising activities via the media, social platforms, or institutions.

IG conducts research and teaching in polar marine geology and geophysics, coastal and terrestrial geosciences, as well as bedrock geology. If the focus is on geoscientific processes in arctic regions, research is also carried out in other geographical areas to increase general knowledge of basic geological processes.

UiT-IG has an adequate strategy for its research activity that matches its strategic goals about Artic geosystems, mineral resources and geohazards (ice and ocean climate systems, natural resources in the Artic, Dynamics of the lithosphere, Geohazards, Costal research, Environmental Geology, technology Development, Modelling).

By its research UiT-IG contributes largely to the long-term societal development of Norway and UN Sustainable Development goals.

Moreover, UiT-IG has been successful in maintaining good research in traditional geoscience topics «from mantle to bubble», like crustal/mantle geological processes, ore-forming processes, sedimentary processes.

# 1.2 Organisation of research

Research at UiT is organised in a coherent way with the Head of Department supported by a department Board. The administrative unit supports early-career researchers and PhD students as well as more senior scientists, and there is clear alignment with the strategic goals of the institution.

# 1.3 Research funding

Main national funding of IG comes from RCN (61%) and from the ministries and underlying directorates via the Faculty of Science and Technology of UiT (20%). Additional external funding comes from industry, other governmental and public sources, the EU and private funds.

Industrial funding rate is relatively low (10%). Most of the industry funding is derived from hydrocarbon industry. Funding rates with industry could probably be increased. Note the limited engagement toward commercialisation activities. Important available infrastructures should be used to better support research commercialisation.

Note that this unit contributes to an important part devoted to education (~50%). Also note the high number of PhD students.

# 1.4 Use of infrastructures

The Department of Geosciences has access to exceptional world-class marine infrastructure in form of the research vessels RV Kronprins Haakon (taken in operation in 2018) and RV Helmer Hanssen (in operation for UiT since 1992).

UiT makes a good use of infrastructures for marine and terrestrial geosciences including the 2 boats, Kronprins Haakon icebreaking (UiT share 50%), and Helmer Hanssen (marginal ice zone, UiT owned), with associated equipment and modern laboratory equipment. The Department is also using notably the national infrastructure "P-cable system", a high-resolution 3-D seismic system which is an excellent tool to accomplish good up-to-date research offshore.

Furthermore, the department takes also advantage of an extensive laboratory instrument park. Access to UIT infrastructure is also possible upon request to internal and external researchers, and private actors. Infrastructure use is charged to cover expenses related to maintenance and salary. The amount charged depends on whether the analyses are collaborative scientific projects or for business purposes. IG scientists share material (sediment-core and rock samples, acoustic data sets) with other scientists, primarily within collaborative projects.

# 1.5 National and international collaboration

The IG has a well-known long tradition of cross-sectoral and interdisciplinary collaboration at regional, national, and international levels. The CAGE centre was primarily a centre for national and international interdisciplinary collaboration with leading research environments. The ARCEx petroleum centre was a hub bringing together universities, private companies, and research institutes, as well as public entities in Norway. IG researchers also benefit from institutional MOU with several institutions (notably Alfred Wegener Institute for Polar and Marine Research in Germany). IG researchers have initiated and participated in numerous national and international staff and student exchange programmes with universities and industrial partners funded by multiple sources, ERASMUS+, Diku UTFORSK, RCN INTPART\* HK-dir. Participating countries are Brazil, Croatia, Italy, Japan, South Korea, Russia and Ukraine. The IG has significantly advanced collaboration in the field of education through the GeoIntern project.

Note that the scientific production shows an increase of national authors, and international authors remaining more or less constant.

# 1.6 Research staff

The unit employs 76.1 FTE research staff out of which 15.4 are professors, 8.3 associate professors, 13.2 researchers, 6 postdocs, 23 PhD students, 0.2 assistant professors, 8 technical engineers and 2 are administrative support. There are noticeable efforts to hire younger people.

Mobility funding is covered by external grants or a small allocation from IG that individuals can use flexibly for relevant activity (10.000 NOK/year). Sabbatical opportunities could be more encouraged.

PhD fellows funded by UiT can spend part of their education abroad, with financial support from the faculty which is in decrease (average of 12 months during the early phase of the evaluation period to only 2 to 3 months recently).

# 2. Research production, quality and integrity

UiT-IG is publishing in goods journals, with international and national collaborations. The administrative unit is a dynamic institution with an increase of publications during the past decade (40 in 2012 to 108 in 2021), with an increase of national authors, and international authors remaining more or less constant.

Noticeable challenges occurred during the early phase of the evaluation period (author shares per FTE divided by more than 2 between 2012 and 2015), but this has improved during the recent years for women, whereas it has been variable for men.

This unit has all the competences and the infrastructures to remain being a leader in Artic geosciences studies. Initiatives like the Centre for ice, Cryosphere, Carbon and Climate (iC3), are very promising. The new younger generation should help promote geosciences in Artic.

# 2.1 Research quality and integrity

#### Research group: Geophysics, Glaciology and Oceanography

Strengths are the diversity of disciplines and the methodological skills as well as the numerical background and the connection to Centers of excellence. A weakness is the lack of sufficient academic positions to continue the expertise gained in the last decade and insufficient support to maintain laboratories and equipment. major issue is the cut of Norwegian and European research funding in relevant topics. The group shows a very high portion of external competitive funding (88%) and at the same time has the aim to train the next generation of geoscientists. With about 30 researchers, and 4 professors, the group is amongst the larger ones. The 10 PhD students are well trained and have access to industry collaborations, which is important in the field of geophysics. The strategy includes joining forces with experts in disciplines that complement ours to go further in the understanding of processes, and the related projects cover a wide range of subjects obviously excellent and needed. The group produces highest quality research as proven by publications in Science, Nature and other leading journals. Mobility programs for Early Career Scientists foster exchange. The group uses vessels and geophysical infrastructure and makes very good use of resources. The group contributes to the UiT Arctic research, to the priority areas Ice and Ocean Climate systems, Energy and Arctic Resources. The research is at the highest level and advances the state of the art. With the topics of Energy and Arctic resources, the group is very important not only for Norwegian but also European Economics. This group is outstanding in terms of scientific quality and sets a benchmark for European research of major economic and political importance. The group matches its strategic goals.

#### Research group: Solid Earth, Mineral Resources and Geohazards

The group recognizes this challenging transition requires increased visibility, nationally and internationally, a strong effort to increase their publication activity, and significantly more collaborative research projects, as well as improved focus on the societal relevance of its activities. The group aims to increase its external funding to 30%, its national and international visibility with an increase of publication output, and to develop more collaborative research projects. Given a currently solid performance, these additional measures are critical to achieve parity with comparable international groups presently leading the field.

#### Research group: Sedimentary Systems, Paleoclimates and Environments

Strengths:

- A large group with a broad suite of complementary research expertise and a clear focus on Arctic palaeoceanography and palaeoenvironmental problems
- Outstanding evidence of research organisation, including support for both early-career researchers and PhD students as well as more senior scientists, and clear alignment with the strategic goals of the institution and department
- Excellent track record of national funding, including roles in some large high-profile research projects, centres of excellence, and consortia
- Well-known internationally and at the forefront of Arctic geoscience research, with an excellent national and international collaborative network
- Research outputs are consistently of very high quality, and are noteworthy for including publications led by research students as well as early-career scientists
- Very considerable efforts to develop and apply the group's scientific research to economic, societal, and cultural development, with some genuine evidence of innovation in their approach to impact

#### Weaknesses:

- Reported funding is exclusively from national sources, albeit spanning a range of organisations and funding bodies. Given the stated threats to basic research funding mentioned in the self-evaluation, it would be worth considering how to diversify to draw on international funding sources as well
- The outputs that are provided in the self-evaluation tend to be focused more on case studies, which are important but somewhat incremental. It is difficult to find evidence of outputs that are outstanding or world-leading in terms of originality, significance, and rigor
- Impact work by the group is largely standard, and somewhat lacking in evidence of involvement of stakeholders in the research process

# 2.2. Open Science

IG follows the UiT principles in line with the San Francisco Declaration on Research Assessment. The IG-UiT is increasing progressively open access, respecting the principles of open access to UiT academic publications. From 2020 to 2022, 255 of the 287 articles published by IG scientists were open access. All published articles are also available in the CRISTIN database.

Researchers can archive their data in UiT Open Research Data. Data curators at the university library ensure that datasets comply with FAIR principles. Several courses are also offered in connection with

Open Science. UiT has a professional communications department that helps scientists communicate their results to the general public.

# 3. Diversity and equality

IG has 73 persons employed in scientific positions with a gender balance of 30% females. 23,3 % of the research staff are professors. Associate professors constitute 16,4 % of the research staff. There is a noticeable difference between women and men, with only 29% of full professor being women, whereas 42% of associate professor being women.

Gender is balanced for PhD candidates and postdocs. PhD students are the largest group of the research staff, accounting for 31,5% of which 61% are females. Postdocs account of 8,2 % of the research staff, 50 % females. In addition, IG has 8 engineers (37.5 % females) providing technical support during cruises and laboratory analyses, and data logistics, in addition 4 person years of administrative support (75 % females).

# 4. Relevance to institutional and sectorial purposes

The IG contributes to the achievement of specific sector objectives as defined in the Ministry of Education and Research, as a leader in Arctic education and research and strengthen its position as Norway's Arctic university. The IG is strongly focused on geoscientific research in the Arctic.

IG-UiT develops multiple research environments at a high national and international level and contributes to this objective through several scientific groups.

The CAGE center has developed a ten-year work plan and implementation strategy to establish an expertise and infrastructure to study how natural gas hydrates and methane emissions in the Arctic affect ocean environments and ecosystems. CAGE scientists were recently awarded a new center of excellence, iC3 (2023-2033), aimed at quantifying the future impact of ice sheet evolution on the Earth's carbon cycle.

The National and Transdisciplinary Research Center for Arctic Petroleum Exploration (ARCEx) hosted by the IG (2013-2021) has played an important role as a national coordinator and catalyst for industry-relevant research and development in Norway. ARCEx has given rise to close collaboration between academia, industry and the authorities. The final report shows that ARCEx has contributed to the acquisition of general and sectoral knowledge through specialized studies and presentations that have resulted in sectoral reports and protocols for best practice. Both centers have published a significant number of articles in high-impact journals.

There is limited tradition or culture for innovation and commercialization at IG. No specific inventions or new commercial products were provided during the evaluation period.

# 5. Relevance to society

The long-term plan (LTP) for research and higher education has five long-term priorities, of which the IG has contributed to the following two: (1) Ocean; (2) Climate, environment, and environmentally friendly energy. Ocean research concerns the study of geological processes on and beneath the seafloor, as well as past and present oceanography. The IG also contributes to the intermediate objectives of the long-term plan, such as the development of research groups (CAGE), as well as educational environments, for example the iEarth Center of Excellence in Education. IG contributes to improving public service through research into geohazards (slope failures, sediment and snow avalanches, and tsunamis), in collaboration with the public sector (municipalities, Norwegian Public Roads Administration).

In addition to a better understanding of the formation of mineral resources and the consequences of mining in collaboration with NPD and NGU. IG contributes to improving industry competitiveness, through collaborations within ARCEx. IG also contributes to the digitization addressed in the LTP, for example by including artificial intelligence skills in teaching and new research projects (digital modelling, geohazards and environmental monitoring).

#### Comments to impact case 1

This impact case represents work at IG to increase avalanche knowledge to minimize challenges related to safety and values for people, emergency planning, and crisis management in avalancheprone municipalities. It is highly relevant for society for societies not only on a regional level but also on an international level. Researchers combined basic geological knowledge with new methods and advanced technologies. Integrating geological, geophysical, and engineering work on the behaviour and anisotropy of unstable rock masses and structurally controlled rear ruptures is new and ground-breaking in geohazards research. IG collaborated with several other researches throughout Norway. A dedicated number on how much PhD students and master students who were working on that project is not given. A good number of publications is listed. Worth mentioning is the award for Louise Mary Vick, who has given a significant contribution to research in geosciences. The planned establishment of an internationally competitive research and education hub for geohazards in Tromsø seems very promising.

#### Comments to impact case 2

In this impact case – ARCEx – a national consortium of research and industry partners worked together on reducing risk connected to petroleum activities in the Arctic for over 8 years, where IG served as host institution. The geological research activity aimed to reduce the risk for not locating areas containing prospective petroleum resources, the environmental research activity aimed to reduce the risk for invoking environmentally harmful, inaccurate and incorrect measurements and analysis. The centre has recruited an impressive number of excellent PhD students and postdocs. About 250 peer review publications show the high impact of this case. It had matured to become an important instrument for research, education and national coordination in the field of petroleum research. The success of ARCEx is undeniably very great, but IG's contribution is not clearly stated in the impact case. What has IG contributed as an individual institution?

#### Comments to impact case 3

In this impact case, a technology for detection and monitoring of subsurface fluids for de-risking CO<sub>2</sub> sequestration and geohazard detection is described. This technology has allowed UiT to become a world leader in 3D seismology and helped to establish new research fields, like e.g. the 4D time-lapse seismic studies of natural geological processes. New knowledge provided the scientific basis for two IODP drilling legs and in each case, the high-resolution 3D seismic data offers full, detailed view of the subsurface allowing the planning of drill site with great precision. It's essential to support marine geoscience. Furthermore, it's a key infrastructure for many projects and has already led to several high impact publications.

#### Comments to impact case 4

This impact case represents work at the Center of Excellence CAGE on the carbon-cryosphere-ocean interactions in the Arctic. The development of new models and empirical investigation has enhanced the understanding that has fed into policy, public discourse and national resource management. A numerical ice-sheet model of the growth and deglaciation of the last Eurasian ice sheet represents the culmination of a long history of empirical investigations constraining its development and chronology. Results and datasets gained international recognition in papers and joint collaborations as well as in various international forums for guiding policy decisions. An overview of research staff involved (e.g. PhD or master students) would strengthen the impact case.

#### Comments to impact case 5

In this impact case a recently started project MinExTarget is mentioned, which wants to develop an innovative methodology for more efficient exploration of metals, including metals needed for the green energy transition. It's introducing a new exploration tool, which provides better targeting capacities in the early stages of mineral exploration. So far, the impact is mainly on education and transfer. The project has been contributing to the research-based education of a new generation of experts in the mineral exploration sector through an active involvement of Master and PhD students in the project activities, as well as through organization of short-courses. Additionally, several publications are listed. As this project is not finished yet, the overall impact on society can't be evaluated.

#### List of administrative unit's research groups

Institution	Administrative Unit	Research Groups
University of Tromso Department	Department of Geoscience	Geophysics, Glaciology and
		Oceanography
		Solid Earth, Mineral Resources
		and Geohazards
		Sedimentary Systems,
		Paleoclimates and
		Environments

# Methods and limitations

#### Methods

The evaluation is based on documentary evidence and online interviews with the representatives of Administrative Unit.

The documentary inputs to the evaluation were:

- Evaluation Protocol (see appendix Evaluation Protocol) that guided the process
- Terms of Reference
- Administrative Unit's self-assessment report
- Administrative Unit's impact cases
- Administrative Unit's research groups evaluation reports
- Bibliometric data
- Personnel and funding data
- Data from Norwegian student and teacher surveys

After the documentary review, the Committee held a meeting and discussed an initial assessment against the assessment criteria and defined questions for the interview with the Administrative Unit. The Committee shared the interview questions with the Administrative Unit two weeks before the interview.

Following the documentary review, the Committee interviewed the Administrative Unit in an hourlong virtual meeting to fact-check the Committee's understanding and refine perceptions. The Administrative Unit presented answers to the Committee's questions and addressed other follow-up questions.

After the online interview, the Committee attended the final meeting to review the initial assessment in light of the interview and make any final adjustments.

A one-page summary of the Administrative Unit was developed based on the information from the self-assessment, the research group assessment, and the interview. The Administrative Unit had the opportunity to fact-check this summary. The Administrative Unit approved the summary with minor adjustments.

#### Limitations

The Committee judged the information received through documentary inputs and the interview with the Administrative Unit sufficient to complete the evaluation.

# Appendices (link to website)

- 1. Description of the evaluation of EVALNAT
- 2. Invitation to the evaluation including address list
- 3. Evaluation protocol
- 4. Self-assessment administrative units
- 5. Grading scale for research groups

Website: <u>https://www.forskningsradet.no/tall-analyse/evalueringer/fag-tema/naturvitenskap/</u>

Norges forskningsråd Besøksadresse: Drammensveien 288 Postboks 564 1327 Lysaker

Telefon: 22 03 70 00 Telefaks: 22 03 70 01

post@forskningsradet.no
www.forskningsradet.no

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