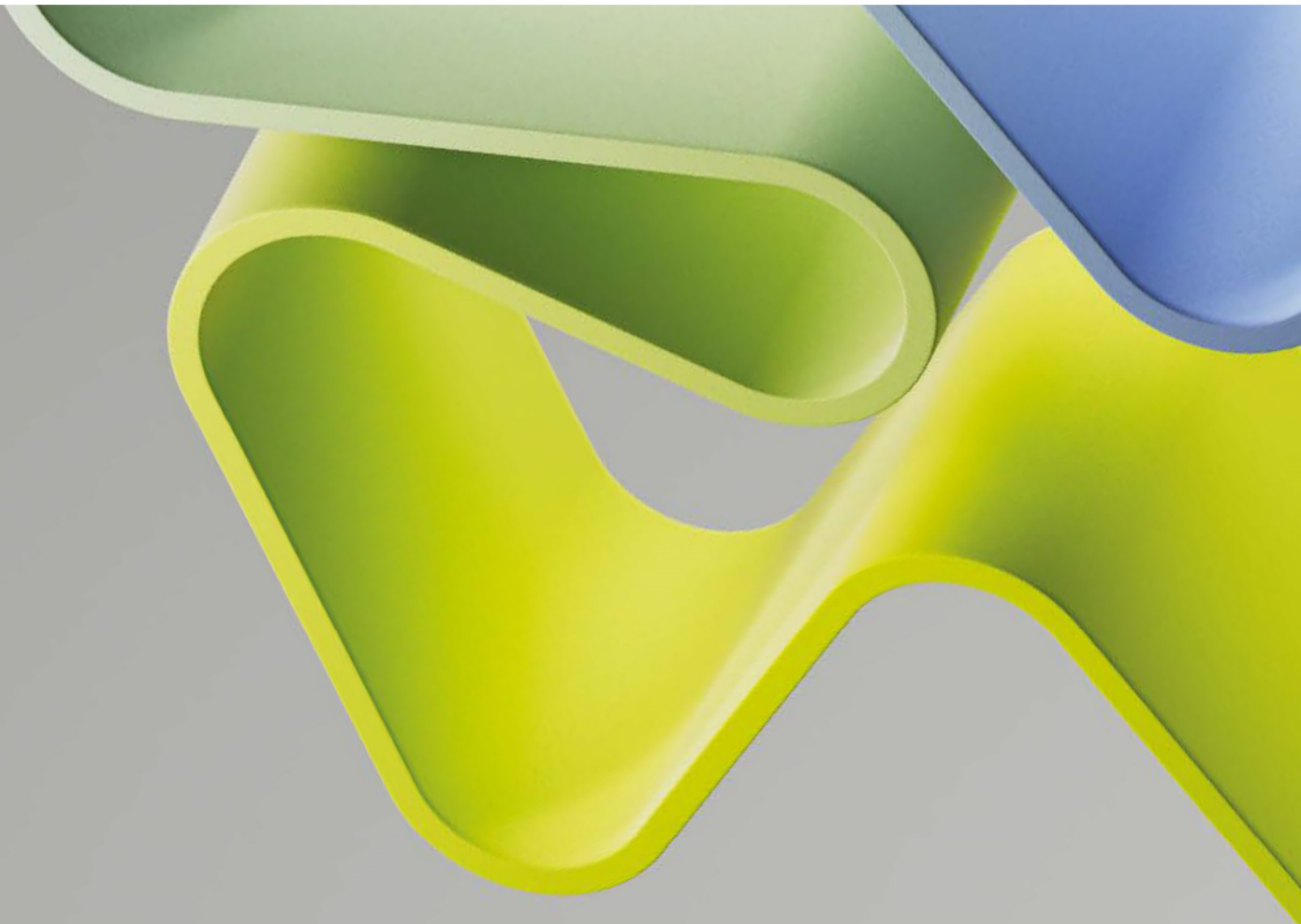


Evaluation of Natural Sciences 2022-2024

Evaluation report Department of Earth Sciences University of Bergen

January 2024



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Statement from Evaluation Committee I

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:

- Geophysical Institute, University of Bergen
- Department of Earth Sciences, University of Bergen
- Department of Physics and Technology, University of Bergen
- Department of Chemistry, University of Bergen
- Department of Theoretical Astrophysics, University of Oslo
- Department of Geosciences, University of Oslo
- Department of Physics, University of Oslo
- Department of Chemistry, University of Oslo

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

The Evaluation Committee has consisted of the following members:

Prof. James Kirchner (chair)
ETH Zurich, Switzerland

Prof. Florencia Canelli
University of Zurich, Switzerland

Prof. Thors Hans Hansson
University of Stockholm, Sweden

Prof. Gideon Henderson
University of Oxford, United Kingdom

Prof. Isobel Hook
University of Lancaster, United Kingdom

Prof. Nicola Hüsing
University of Salzburg, Austria

Prof. Dieter Schinzer
University of Magdeburg, Germany

Description of the administrative unit

The Department of Earth Sciences (GEO) of the University of Bergen (UiB) is organised in four research groups: Quaternary geology and Paleoclimate, Geochemistry and Geobiology, Geodynamics and Basin Studies, and Geophysics. In 2021, GEO UiB had in total 123 academic employees: 29 professors, 19 associate professors, 13 researchers, 18 postdoctoral fellows, and 44 PhD candidates. In addition, GEO employs 24 technical staff and an administration of 9 people.

GEO's strategic plan ran from 2016-2021 and revolves around five key themes: Geohazards, Resources, Environment, Climate, and Energy, with a strong emphasis on marine and polar science. These themes align with the institutional strategies of the UiB, particularly in Marine Science, Climate, Energy Transition, and Global Challenges. GEO's research strategy has four main areas for delivery: 1) Strengthening research in areas where GEO holds a strong international profile, such as climate science and sedimentary basins; 2) Focusing on new priority areas that build upon existing strengths, such as geomatics, hydrology, and offshore wind infrastructure; 3) Supporting Early Career Researchers through systematic career planning and recruitment of exceptional talents, both internally and externally; and 4) Contributing to value creation based on research results, with a shift towards renewable and sustainable research, including geothermal, offshore wind, geohazards, and climate studies.

GEO's self-assessment emphasizes their alignment with the Norwegian higher education sector's goals and UiB development agreement. GEO actively engages in research and education while nurturing innovation and value creation for the benefit of Norwegian society, with a specific focus on areas such as subsurface energy, energy transition, and deep-sea exploration. Notably, GEO is in the midst of a transition towards environmental and transition-related research applications, including renewable resources.

Regarding educational accessibility, GEO offers a comprehensive range of programs, including fundamental geoscience education, sustainability courses, and continuing education opportunities.

Over the evaluation period, GEO has played a key role in hosting and participating in four Centres of Excellence: SFF CIPR (2003-2013), SFF Bjerknes Centre (2003-2013), SFF Centre of Geobiology (2008-2017), and SFF SapienCE (2018-). Additionally, GEO is the home of SFU iEarth, a Centre of Excellence in Education, which is described as highly competitive and successful in securing funding, producing influential publications, and featuring a substantial number of highly esteemed educators.

In GEO self-assessment the administrative unit identifies its key strengths as: expert research staff, top-tier research infrastructure, access to marine vessels, robust and extensive national and international collaborations, global networks, funding success, and high student satisfaction. It also described weaknesses such as understaffing, weakened marine research capacity, gender imbalance, and economic constraints. Opportunities include higher external research income, improved facilities (the "Nygårdshøyden Sør" UiB building project), energy transition's societal shift where geoscientist are needed, establishment of new study programs, and zand research innovation. GEO aims to harness strengths in energy transition and climate change to enhance its position and secure external research funding. But, it faces funding challenges, potential staff reductions, and competitive funding uncertainties.

Overall assessment

This is a strong administrative unit with a rich history of excellent science, a national pedigree for resource geoscience, and an established international reputation for environmental and climate science. The administrative unit is developing additional strength in important new areas, particularly in deep-ocean environments, and actively seeking to navigate the green transition (a challenge of critical importance to all geoscience departments if they are to service the needs of society).

The administrative unit is a critical component of UiB, playing a key role in strategy for the university on climate, environment, and energy. It relies on links to the Department of Geophysics, Biosciences, and to the Bjerknes Centre, and will need to strengthen these links and the ability to collaborate across the university if it is to thrive in the interdisciplinary research required for future challenges.

Despite a well-posed strategy and clear plans for the future, there are indicators that some challenges remain in positioning the administrative unit. The vision statement for the administrative unit presently focuses on traditional geoscience subjects and two of the four research groups focus on subsurface observation and modelling. This reflects a history in hydrocarbon extraction science, but the future of these subject areas is unclear. The administrative unit will need to make important and potentially difficult choices about future directions, with realism about future funding income and opportunities, as it shapes its strategy for the next five years and beyond.

National infrastructure is important to the administrative unit, particularly ships and labs, and their use of this infrastructure provides research capabilities to Norway which are not replicated elsewhere in the country. Recognition of the role of the administrative unit in infrastructure-driven measurement science is important, as is a willingness to invest in the equipment needed for future research opportunities and challenges, including during a planned relocation to a new building.

The administrative unit has some excellent staff, and offers a supportive environment for its research, with strong links nationally to other institutes and infrastructure. It is rather top heavy, however, with a surprisingly small number of early career researchers. And it has some challenges still to solve, particularly related to recognition of diversity and with its own sustainability vision.

The Evaluation Committee considered the points raised by the administrative unit in their Terms-of-Reference document and have commented on many of the issues raised in that document. Where no comments are provided, this generally reflects a lack of relevant information in the Self-Assessment to allow the Evaluation Committee to reach a view.

Recommendations

1. Prepare for a future in which the administrative unit is expected to be leaner and will need to be more strategic by appraising and planning the future of activities focused on traditional resource-extraction geoscience. These are historical strengths of the administrative unit, which makes a move away from the subjects to affect greater focus on environmental research challenging. This will require honesty and strategic self-analysis by faculty members and leadership.
2. Continue to maintain the strong links with the Bjerknes Centre, and with the Geophysics Department at UiB, including periodic consideration of the division of expertise between these unit.
3. The administrative unit should construct a new strategy to replace the expired 2016-2021 document and should identify a small number of specific actions to realise this strategy.

4. Update the administrative unit's vision statement to align with the strategic objectives for the administrative unit, and to those of the wider university.
5. Identify funding opportunities from both public and industry sources, and plan tactically to target these opportunities.
6. A recommendation to UiB, to RCN, and to the administrative unit is to realise the opportunity of the planned new faculty building by investing in analytical equipment and labs during the move. Renewal of analytical resources during the move is an opportunity to maintain the administrative unit's strength nationally and internationally. Failure to invest is a significant risk to the administrative unit's future success and status.
7. Actively seek to increase the number of PhD students and other early-career researchers to engender richer research and learning environment.
8. Seek culture change in the administrative unit regarding diversity, including recognition of gender disparities not only in staff numbers but in other metrics, such as publications.
9. More fully recognise and communicate the dependence of the administrative unit's future success on national infrastructure, including research ships, and the need for investment in new infrastructure for deep-ocean science.
10. Seek additional opportunities to use the infrastructure strengths of the administrative unit to use, lead, and champion international infrastructure programmes in Europe and globally.

1. Strategy, resources and organisation of research

UiB Earth Sciences has had a clearly defined and well-crafted strategy which has enabled it to build on its past successes in research related to the extractive industries, and to achieve international recognition for excellent work in environmental and climate science. The green transition presents challenge for all geoscience departments and, while the administrative unit has done well in navigating this transition so far, it will need to make important strategic choices about future priorities as it shapes its new strategy and vision.

The administrative unit is an integral part of UiB, playing a crucial role in delivery of UiB's strategy, and relying on strong links to other departments in the university, notably the Department of Geophysics, Department of Bioscience, and the Bjerknes Centre.

The administrative unit has had a good level of funding success which has enabled its research. It will need to be strategic about future targets for funding, including building relationships with new industrial partners, if it is to build on this success, and will need to be realistic about the overall level of funding it can expect in the future, shaping its future priorities accordingly.

The administrative unit is home to excellent professors, with international reputations for their work. It has a surprisingly small ratio of early career researchers, including PhD students, relative to the number of professors, which may limit future research and training outcomes.

National and local infrastructure is of critical importance to the administrative unit's research, notably research ships and analytical laboratories. Continued access to such infrastructure, and investment to provide the equipment needed for future research directions, is important for the administrative unit and for Norway as a whole. The administrative unit has an important role, which it appears to only partially recognise, in shaping and championing future infrastructure for Norway's earth and environmental sciences.

1.1 Research Strategy

The administrative unit has had a clear research vision; to understand Earth structure, evolution, and dynamic behaviour.

The strategy (for 2016-2021) is in five themes which reflect key subject areas where society needs geoscience and where there is important research to do. These themes are a consistent focus in the administrative unit's documents and represent a strong strategic direction. The top-level vision statement for the administrative unit does not reflect this strategy well, however, and needs revision as the future strategy is crafted. Agreeing that future strategy across the administrative unit, with broad staff engagement in the process, is now an important task to ensure future success. It will also be important to champion this strategy within UiB and more widely.

At present, the administrative unit's relevance to wider UiB strategy is clear, particularly on marine, climate, and energy, making the administrative unit important for the university as a whole. Having helped to initiate the Bjerknes Centre, the administrative unit's link to this centre remain strong and are important for the success of both.

There is strong match between the work of two of the four research groups (Quaternary geology and Paleoclimate; Geochemistry and Geobiology) and the strategic goals of the administrative unit and the university, but the match is less well-developed for the other two research groups.

Plans for implementation of the strategy were not always convincing. Many of the implementation steps are sub-goals, often good in that context, but not indicating the specific actions that will allow delivery of the strategy. There are also a very large number of these goals, which may dilute the ability to focus and realise change.

1.2 Organisation of research

The administrative unit has positioned itself to contribute to both fundamental research and societally relevant science (e.g., related to resource extraction, renewable energy, environmental science, and the broad climate system).

Research activities are coordinated in four disciplinary research groups which draw together skills and infrastructure needs in a sensible manner. It is less clear how well these groups work together to achieve the strategic outcomes. Mechanisms to work across research groups and to have their work influenced by strategy are clearly important, particularly during a time of strategic transition.

The administrative unit relies heavily on infrastructure, including at national level and in its own laboratories. Research is organised around this infrastructure which supports the expertise required to make optimal use of the equipment for research. A new building is planned at faculty level and will be important for the administrative unit, particularly in respect to its reliance on laboratories and analytical equipment. There is an opportunity for new analytical advances, but also potential for loss of capability with negative implications for the administrative unit and Norway as a whole. The new building may also offer a chance to consider alternative approaches to group structures and departmental organisation.

The division of geophysics between this administrative unit (i.e., in the Geophysics research group) and the Department of Geophysics in UiB is justified by very different foci of research and equipment. The links to bio-science are increasingly important to the administrative unit, making the nature of

collaboration with UiB biological sciences critical for future success. Although not urgent, future consideration of the cross-UiB organisation of geophysics, bioscience, oceanography and the wider relationship between departments and institutes in the university, may be useful.

1.3 Research funding

The administrative unit is reasonably successful at gaining competitive funding with a good number of funded national and EU programmes. There is potential to increase funding, however, and to be more targeted in identifying specific opportunities for future funding from public sources and from industry. Industrial sources of funding have come in the past from the resource extraction industry, but this will be more challenging in the future as the focus of the administrative unit shifts and will create perceived and/or real conflicts of interest with environmental research. Recognition of this issue, and agreement across the staff, of an approach to future funding is important for the administrative unit.

The administrative unit complains of inadequate funding but recognises that it may need to be leaner and more focused in a future where public funding is not increased. The ambition of the research agenda and the size of the department will need to be tailored to a realistic appraisal of future funding opportunities.

1.4 Use of infrastructures

The administrative unit hosts a number of national infrastructure projects (e.g. FarLab, EarthLab, EPOS, Norwegian National Seismic Network, NORMAR) and is a partner, or takes on specific responsibilities, on many others. This infrastructure is a good match for department research and helps position UiB well in the national (and international) landscape.

The administrative unit make less reference to use of international infrastructure. They play an important role in the Norway on the European Plate Observing System (EPOS), and mention involvement in the International Ocean Drilling Programme. Given their considerable national infrastructure use and leadership, there may be greater opportunities for the administrative unit to use, lead, and champion international infrastructures.

The administrative unit takes good advantage of their coastal location and makes extensive use of marine infrastructure, particularly of research ships. There may be a tendency to take this infrastructure for granted, and the administrative unit may benefit from recognising its leadership position to champion national infrastructure, and to argue for investment in new types of infrastructure required for future research (e.g. in the deep sea). Such infrastructure may include that needed to research and develop 'environmentally friendly energy'. UiB and RCN will need to play a role in scoping and supporting adequate marine and energy infrastructure if the administrative unit is to continue to excel nationally and internationally.

The administrative unit also relies extensively on its own analytical equipment and laboratories, with much of its international reputation resting of results derived from this infrastructure. The expertise the department has in development and use of such equipment is a strength, which will need to be nurtured in the future, particularly with adequate investment in equipment during the planned move to a new building.

1.5 National and international collaboration

The administrative unit collaborates well nationally and internationally, with a wide range of leading research institutions, and a well-defined plan for collaboration is also good. There are strong statements about the importance of international exchange and influence which make this focus on collaboration convincing and will position the administrative unit well for the future.

There is good use in the administrative unit of mobility schemes; those locally, nationally, and internationally. These lead to frequent visits of people at all career stages in the administrative unit to other institutes, and to incoming visitors, including from leading international academic organisations. This is strength of the administrative unit and helps to bolster its global standing and ability to conduct state-of-the-art research.

As a result of the international activities, 80% of the unit's publications between 2019 and 2021 were co-authored with international collaborators, which is above the average for Norwegian universities in the natural sciences (71 %).

1.6 Research staff

The administrative unit is home to some excellent established scientists, with global reputations for their research and good links to the international landscape.

The administrative unit's staff profile is unusually top-heavy, with 48 professors and associate professors, compared to 31 researchers/postdocs and only 44 PhD students. This is likely to make it difficult to drive strong research-group dynamics and will limit the learning environment for early-career researchers (though a number of courses and forms of recognition are in place).

There is a need for careful planning of the future size and make-up of the faculty during future recruitment as the department continues to move from a past focused on oil and gas resources (at which it had some significant successes in past decades) to its new focus. A rebalancing of the seniority of staff, and a focus on increasing ratios of more junior scientists, including PhD students, may be sensible. Such directional recruitment policies can be challenging for departments and will need time and discussion involving staff at all career stages.

The unit is proud of training courses for EYRs, and of its recent faculty appointments. It is also important that existing professors are nurtured and supported to develop the administrative unit's internal talent and provide suitable career options and pathways.

2. Research production, quality and integrity

Bibliometric data indicate that the administrative unit's publications are fewer than other administrative units considered by the Evaluation Committee. The impact of these publications is high, however, with the administrative unit enjoying top three performance of administrative units in Natural Science on both '*share of 10% most cited pubs*', and '*mean normalised citation score*'. A focus on quality rather than quantity demonstrates research confidence and international recognition of the administrative unit's research.

Two of the four research groups are producing excellent research (Quaternary geology and Paleoclimate; Geochemistry and Geobiology). Both have good funding success, high-quality publications with good citation rates, and have established a strong international reputation for UiB.

The Quaternary geology and Paleoclimate group have played a leading role in Norwegian climate research for some time and their formation and continued tight linkage to the Bjerknes Centre for Climate Research gives them genuine international traction. This continues to be well merited, based on research output, and is a central plank of UiB's climate focus.

The Geochemistry and Geobiology group has a less well-established reputation but is conducting high-quality work in research fields ripe for important discovery and of increasing societal relevance (e.g. the deep sea). Their links to the biosciences are important and an area to build on in the future (potentially through the planned new building).

The Geodynamics and Basin Studies group has a strong research track record, with good historical funding rates and research output. It has a good balance of ECRs to professors and was positively reviewed by the expert panel. There is concern, however, about lack of recent funding success, and a possible mismatch between the core-skills of this group and the research challenges they are now seeking to address. This group relies on a strong reputation from past successes, but it is unclear whether it is equipped to address future research areas identified as priorities in the developing unit strategy.

The Geophysics research group has a weak research output and appears to act largely as a service group to provide underpinning geophysical measurements to others in Norwegian research and industry, rather than as a vibrant research group. It's focus on sub-surface imaging was developed for past oil and gas work, and the potential of these tools to research sub-surface storage of other future challenges is not yet realised. The administrative unit might consider the future of this research focus in the light of UiB funding positions as the new research strategy is developed.

2.1 Research quality and integrity

Geochemistry and Geobiology research group overall assessment

Strengths

This group is internationally excellent. They have a strong focus on high latitude seas from which arise highly collaborative research programs, working extensively with other groups both nationally and internationally (especially Europe), taking advantage of their interdisciplinary nature.

There is a strong sense of commitment from the institution, not only in standard support, but also in providing funding for several members of staff as the group has grown, for annual cruises, and for equipment and personnel to ensure that the group maintains a high degree of technical capability (SEM, ICPMS, experimental hydrothermal systems etc).

GCGB has a competitive cohort of PhD students, and an excellent record of research income.

Their research is leading to high-quality peer-reviewed publications, some of which are outstanding.

Weaknesses

Despite the group's focus being of major significance to the wider population in Norway and further afield, and acknowledging their past work in international isotopic standardisation, their impact strategies were considered generic and rather passive, relying on others to make the most of the

data they produce. Nonetheless, this is a high-quality interdisciplinary group, with excellent research credentials, some of which are outstanding. It is clearly highly valued, very well supported and integrated with the host institution.

Geodynamics and Basin Studies research group overall assessment

The UiB Geodynamics and Basin Studies group is internationally recognized for advances in understanding the geodynamics of rifts, passive margins, and orogens through structural and depositional evolution of sedimentary basins. They develop and apply numerical, subsurface-, and field-based approaches for the quantification of tectonic and sedimentary basin forming processes and are making fundamental advances with respect to energy and the energy transition, e.g.- subsurface energy exploitation and storage, offshore wind, geothermal energy, mineral exploitation, geohazards and climate-related risks. The group consists of 12 academic staff (professors and associate professors) who coordinate 22 PhD candidates and post-doctoral researchers, and there are a good number of researchers and affiliated adjunct staff. This group produces internationally recognised research and has the intellectual leadership necessary to be classed as excellent to outstanding.

This is an excellent to outstanding group in the national assessment of the subject area.

Geophysics research group overall assessment

This is a well-organised group that has been delivering quality research and development in the marine and terrestrial sectors for some time. They have produced a good number of very well-trained doctoral graduates. The group produces internationally recognized research, but it is not at the level of international excellence, e.g.- more visionary goals and objectives are needed. For example, the integration of seismic and potential field methods is a topic that geophysicists have been working on for 3 decades at least, and the goal to develop geophysical methods – while important – lacks specificity and is not obviously visionary. Societal impact is more significant but needs further improvement to become truly outstanding.

Quaternary geology and Paleoclimate research group overall assessment

This is an outstanding research group which produces leading international research in the fields of paleoclimate, palaeoceanography, marine geology, and ice sheet reconstruction, combining field-based empirical data collection with numerical modelling. It has a clear strategic vision and has the research infrastructure and organisational structures in place to allow this to be achieved. It is well embedded into departmental and university strategic research priorities. The outputs and research grant funding from the group are outstanding and their research has significant national and international impact which extends well beyond academia and has a strong societal contribution. They are clearly committed to knowledge transfer across a range of non-academic audiences.

2.2 Open Science

The administrative unit has open-science policies that follows norms for academic institutes and a goal of achieving 100% Open Access publication. It has some way to go to reach this goal (NIFU statistics indicate 75.4% in 2021) so will require future focus on open access policies to reach this goal. Access to RCN and other funding routes may prove more challenging without improvement in open-access statistics.

3. Diversity and equality

The administrative unit has an EDI committee, and it is welcome that the Head of Department is part of this committee. It is also positive that the department participates in an RCN-funded project that aims to improve gender balance in science subjects.

Despite these sensible approaches the unit does not have defined diversity goals and is not specific about the aspects of EDI that are its focus (gender, ethnicity, disability, income, etc.), nor about policies to realise change.

Female faculty fractions are 21% at both full and associate Professor level suggesting no change in gender representation in recent years, which is a concern given absence of mention of actions taken to address this imbalance.

Poor gender statistics are called out in the Geochemistry and Geobiology research group report in particular. This is disappointing given that marine and bio sciences typically have better gender balance than traditional geological sciences.

On the other hand, the productivity of women and men within the unit, measured as the average number of author shares by FTE, is quite equal. In the period 2019-21, female members of the unit have an average author share of 0.69, whereas their male colleagues have an average of 0.73. The similarity of these statistics is positive and differs from that in some other units evaluated by the Evaluation Committee.

Overall, there appears to be insufficient focus and real action to address diversity issues and a need for attention.

4. Relevance to institutional and sectorial purposes

The unit has had strong past relevance to Norwegian institutes and society through its leading work on resource extraction, particularly related to oil and gas (something it can be proud of). It has recognised the need to move away from these strengths to provide research input to new industries and societal challenges. In written material and in interview the administrative unit has identified a number of particular areas for such sector relevance: On *'Quantification and Dissemination of Climate Risks'* this potential is being realised with substantial demonstrated impact in public and stakeholder awareness of risks. On *'Marine Minerals...'* the impact is at an earlier stage and is less clearly demonstrated but is present and growing. These are well-chosen future-facing research areas with significant sector importance.

Elsewhere in submitted material there continues to be a focus on the science required to support the oil and gas industry (and seabed mining), which perhaps reflects a department in transition, and/or incomplete buy in from faculty to the future strategic direction. There are also some areas that might fit with earlier observational strengths but may not be a top priority for Norway (e.g. work on seismic risk is in a country with such low earthquake risk).

The administrative unit has enjoyed some strong collaboration with industry, particularly those involved in oil and gas. There are ample opportunities for the unit to develop links to other industries as their research focus alters, including in risk/insurance, renewable energy, green-finance, and environmental management. A strategic assessment of potential industries and targeted approaches to relevant businesses would enable a diversification of research income. There is also a need for

administrative unit-wide consideration of the issues raised by working with extractive industries during the green transition as public opinion and economic priorities shift.

The list of successful commercialisation projects provided by the unit demonstrates success, but there was no indication of commercial income, companies started, or other concrete demonstration of commercial success. The organisation 'VIS' appears to be a strong attribute to aid such commercialisation, but no concrete examples of success from this programme were apparent and there was a surprising absence of any mention of Intellectual Property, or a policy on IP during commercialisation.

The administrative unit is proud of its educational programmes and education is integrated throughout the narrative it presents. While the Evaluation Committee was not tasked with assessment of the educational programmes, it noted the good track record and range of good learning programmes for graduate education. Master's students are integrated well in research, and there is an ongoing and successful push to increase such links for bachelor's students which is welcome.

5. Relevance to society

The administrative unit has a strong track record of relevance to society. Its work on hydrocarbon exploration played an important part in Norwegian development and economics. The units present strategy shifts towards future challenges of climate and the green transition which seeks to give the department continued societal relevance.

This relevance is being realised successfully in climate science (including public communication as well as leading primary research). There is growing societal relevance in deep-ocean issues – minerals, and potentially storage and energy extraction.

There is nothing in the units SA about the sustainability of their own institute or their research. What are the units' own policies to address the challenges they are communicating to the rest of Norway? Do they have a policy to reduce emissions and to reverse biodiversity loss related to their own research and educational activities?

Comments on impact case 1: Marine mineral resources and the associated environment

This Impact Case Study represents work at the administrative unit to understand the extent and distribution of metal resources in hydrothermal sulphide deposits and manganese nodules, in both Norwegian waters and in the North Atlantic close to Norway. The work was initially curiosity driven and reported in a number of peer-reviewed publications in good journals. The work was subsequently more applied and has been reported to the Norwegian government through a number of evidenced presentations and publications. This is a good example of timely research providing scientific evidence to government to aid policy making in a controversial and topical subject. Although the environmental impact of exploitation of these resources is mentioned in the Case Study summary, it is not clear whether this aspect has also been communicated to government to provide critical evidence regarding potential negative aspects of such exploitation, to balance the positive economic evidence related to resource potential.

Comments on impact case 2: Quantification and dissemination of climate risk to guide sustainable adaptation

This Study builds on the climate research of the Bjerknes Centre and of scientists at the administrative unit, particularly on high resolution and recent paleoclimate reconstructions at which the administrative unit excels. The Bjerknes Centre was initiated by the administrative unit in 2003 and some relevant examples of its substantial output are provided, supported by influential publications. The climate understanding derived from such studies has enabled an assessment of climate risk such as flood risk, arising from ocean circulation change, and related to changing hydropower potential. Evidence is provided to support impact from this work, derived by working with local authorities, power-general companies, and with the public. The direct link between the specific cited impact and the primary research work is not straightforward, and the impact appears to derive largely from the deep climate expertise of the administrative unit's professors, developed from their fundamental research, rather than from that research itself.

Comments on impact case 3: Arctic geophysics

This Study identifies a wide range of potential impact from the administrative unit's seismic work to assess subsurface geological features below the Arctic Ocean. The primary research provided includes improvement of seismic techniques and papers about the structures underlying the Barents Sea. It is difficult to link impact directly to the papers provided in the paperwork, but some claimed impacts are substantial. In particular, if seismic data from the administrative unit underpinned successful expansion of territorial claims in 2011 this would represent a significant piece of impact for Norway. Impact also comes from positive outcomes related to sea mammal habitats. Claims of impact related to oil-company resource work are not well evidenced, however, nor are those related to use of the research for wind-turbine placement. The involvement of the administrative unit in the CO₂ sequestration project mentioned is unclear; this appears to be a Svalbard project rather than Bergen based on evidence provided. There are some clear positives from the work related to university education and research in other institutes, which are a more general credit to the administrative unit rather than providing impact to policy or industry.

Comments on impact case 4: Earthquake monitoring for a safe society

This Study describes the research and the impact from the administrative unit's work to run the Norwegian National Seismic Network (NNSN). The work is based on careful research to assess risk from earthquakes to Norwegian infrastructure. This research is published in appropriate peer-reviewed journals and is used for routine seismic monitoring and for future risk assessment related to new projects. The administrative unit's work in this area represents a national service, required by all nations (even those with relatively low seismic risk such as Norway).

List of administrative unit's research groups

Institution	Administrative Unit	Research Groups
University of Bergen - Faculty of Mathematics and Natural Sciences	Department of Earth Sciences	Quaternary Geology and Paleoclimate
		Geochemistry and Geobiology
		Geodynamics and Basin Studies
		Geophysics

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 3 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 Evaluation Committee held a meeting and discussed an initial assessment against the assessment criteria and defined questions for the interview with the administrative unit. The Evaluation Committee shared the interview questions with the administrative unit two weeks before the interview.

Following the documentary review, the Evaluation Committee interviewed the administrative unit in an hour-long virtual meeting to fact-check the Evaluation Committee's understanding and refine perceptions. The administrative unit presented answers to the Evaluation Committee's questions and addressed other follow-up questions.

After the online interview, the Evaluation 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 some adjustments. In particular, the unit added some details on their self-assessed strengths and opportunities. The subjective character of these self-assessments remains clearly recognisable, however.

Limitations

- (1) The Evaluation Committee judged the information received through documentary inputs and the interview with the administrative unit sufficient to complete the evaluation.

Appendices

1. Description of the evaluation of EVALNAT
2. Invitation to the evaluation including address list
3. Evaluation protocol
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5. Grading scale for research groups

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

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www.forskningsradet.no

Publikasjonen kan lastes ned fra
www.forskningsradet.no/publikasjoner

Design: [design]

Foto/ill. omslagsside: [fotokreditt]

ISBN 978-82-12-04012-0 (PDF)

