

Estonian Higher Education Accreditation Center

Evaluation of Estonian geological research

Institutes evaluated:

Institute of Geology at Tallinn Technical University

Institute of Geology, University of Tartu

Evaluation dates:

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Expert team:

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Part I

General overview

Introduction

The evaluation team consisted of Prof. Svend Funder (Geological Museum, Copenhagen), Prof. Dr. Patric Jacobs (Ghent University), Prof. Lars Holmer (Institute of Earth Sciences, Historical Geology and Palaeontology, Uppsala)

Organisator of the evaluation was the Estonian Higher Education Accreditation Centre (EHEAC). The evaluation was carried out through an examination of documents and a series of visits, interviews and consultations with research staff and students over the period May 14th - May 19th, 2001. Each evaluator had previously received self-assessment reports from the Institute of Geology, University of Tartu (in the following TU) and Institute of Geology, Tallinn Technical University (in the following TTU). Additional material was provided by the evaluated institutes, laboratories, research groups and individual scientists during the visit.

The visits to institutes started with a general introduction of institute organization, financing, and main research topics given by the directors of each institute. The second stage consisted of leaders of research teams, or alternatively department heads, describing the research activities topic by topic. Finally, the evaluators met the individual researchers and interviewed them. During these meetings the researchers were also asked to give a few representative publications for a closer inspection.

Approach to the evaluation

The evaluators were asked to

- 1) judge the activities of research and development institutions and the research topics implemented by them to ensure the state funding for internationally recognised research and development;
- 2) identify deficiencies in the activities of research and development institutions;
- 3) give recommendations on the development concerning research and development and research areas necessary to the state of Estonia.

The team was given the following materials: a working schedule, principles and criteria for evaluation of research and development institutions, guidelines to experts for the research evaluation, and self-evaluation reports created by the Institute of Geology of Tallinn Technical University and Tartu University

The team arrived on May 14, 2001 in Tallinn, was shortly briefed and transferred to Tartu during the same evening. The team visited the Institute of Geology, University of Tartu on May 15. On May 16 - 17 the team visited the Institute of Geology of the Tallinn Technical University in Tallinn.

Each institute was evaluated using the following criteria on a four-point scale (excellent, good, satisfactory, unsatisfactory):

1. the novelty of the results of research and development;
2. the quality of research and development, including publication record;
3. the strategy and perspective of research;
4. the competence of research groups and their capability for development;
5. success in applying for funds and grants;
6. national and international co-operation;
7. the implementation opportunities for the research results and their importance for the Estonian society;
8. the correspondence of research and development to the international level.

These criteria were divided into two groups: quality of research and capability of a research unit according to the guidelines to experts for research evaluation. In addition to these criteria, written comments were given according to the guidelines. In the following the research institutes and laboratories are briefly discussed, followed by more specific comments and recommendations.

Part II

General remarks on and recommendations for Estonian science organisation and funding

Self-assessment reports

The self-assessment reports testify of the differing nature and background of both Institutes. The TU self-assessment report is not clearly structured. The “General Information” part is informative and clear, but the parts concerning the group activities should have been split in order to provide full but comprehensive information about the “who’s who” in the target funding and ESF grants. Although two TU Groups benefited from the same target funding, preference should have been given to a clear split of information about each group’s role, illustrated by tables about publication and finance records per year. Also, the Expert Team had the impression that the TU Groups had not fully grasped the significance of a self-assessment as details on the Groups’ weaknesses were not provided. As a consequence, only vague ideas about solutions to overcome these obstacles are provided in the self-assessment report. Future developments are thus not fully justified or detailed, which leaves the Expert Team with a strong feeling of not-fulfilled expectations.

The TTU self-assessment report on the other hand was very well structured and informative. It provided the Expert Team with all necessary information in a more or less standardised way, and with the impression of TTU being a well-oiled machine of tradition and managerial competence. All Groups seemed to be well prepared for the Expert Team’s visit and voluntarily provided additional documents of high scientific value.

For the future, the Expert Team suggests that information on publications should be provided by category according to internationally accepted peer-review standards in order to enable easy comparison. This includes categories such as:

books,

chapters in books,

editing of books and proceedings,

papers in SCI and CC listed journals,

papers in international peer-reviewed journals (i.e. international editorial board),

papers in national journals without peer-review,

papers or extended abstracts in proceedings.

(Listed publications should be kept at the disposal of the Expert Team for inspection on site without previous warning, as was the case in both TU and TTU.)

The self-assessment reports should be made up according to clearly defined guidelines and criteria, and possibly structured in a standardised way. This facilitates the peer-review work and enables easy inter-university comparison of scientific results.

Acquisition of equipment

During its visit, the Expert Team was several times confronted with the limited financial resources for the acquisition of equipment. Various groups in both TU and TTU expressed the urgent need for replacement of outdated equipment or for the acquisition of new instruments. In many cases this acquisition showed to be highly justified by the activities of the concerned groups and/or their future development. In some cases (like airborne magnetics or marine seismics) the non-acquisition of the desired necessary equipment could be compensated through tight international co-operation. However, in other cases like for instance the acquisition of a Scanning Electron Microscope eventually with (semi-) quantitative (energy dispersive and/or wavelength dispersive) X-ray micro-analysis tools (EDS and/or WDS), many Groups complained about the virtual impossibility of acquisition of such devices due to lack of funding. Target and ESF grants are sufficient for salaries and consumables, but do not allow extra expenses for such kind of equipment. This insufficient financing seriously limits the growth potential of the concerned Groups and hypothesises their performances on the international scientific scene. The Expert Team strongly suggests that this acquisition problem should be seriously looked into in order not to bring the various Groups concerned in an extremely difficult position in some of the most promising and challenging domains of geological research like isotope geology, geophysics, applied and environmental geology, etc. The Expert Team therefore suggests that the creation of special fund for the acquisition of large research facilities should seriously be considered, e.g. within the framework of the ESF on basis of a nation-wide competition with national/international expert evaluation of applications in the light of multidisciplinary and inter-university co-operation.

Funding structure

To the Estonian scientific community, the structure and organisation of its agencies for funding of research most probably look clear, understandable and justified in the light of the sequence of the rapidly evolving events during the last decade. However, this situation might be assessed in a slightly different way from an outside point-of-view. It took the Expert Team some time to acquaint itself with the different ways of funding, especially with the quite complicated structure of MSc- and PhD-grants intermingled with the target funding and the ESF grants. In the course of the visit, it became clear that the target funding could nowadays be considered as a kind of “structural funding” assuring continuous payment of salaries of researchers and of running costs. This target funding thus more or less replaced the former permanent positions in the Universities and Institutes or Academies, and is allocated without major competition as no groups mentioned failed applications. Nevertheless, continuity is not totally secured as these

target funds for what is commonly considered as “fundamental or basic science” only last five years or so.

The situation widely differs in case of the ESF grants for which competition seems much tougher with a lower success rate. Here the grant allows payment of running costs and salaries both of full-time and part-time researchers, some of the latter being MSc- and PhD-students. Although this might favour transfer of knowledge through the integration of all kinds of researchers into one single group, it can hardly be considered as an example of a clearly defined structure that is properly functioning. This is also exemplified by the fact that the ESF grants could be obtained for fundamental as well as “applied science” topics. All the more, the Expert Team had the impression that the reporting on the target funding was less tedious than on these ESF grants.

In the light of the above findings, the Expert Team advocates that a structure should be put in place that reflects the organic growth of a pure scientific idea (fundamental research) over its application (applied science) towards innovation and industrial realisation. Most European countries have their science funding and structure organised in this way, which is illustrated through the existence of a series of agencies, foundations or institutes with a clearly defined mission such as:

- National Science Foundation with funding for fundamental or basic research through research projects (including equipment) and PhD grants, under the umbrella of the Ministry of Education and/or Science;
- Institute for Technological and Applied Science, providing funding for applied research projects and PhD-grants, mostly under the umbrella of the Ministry of Economy, and
- Institutes for Innovation and Industrial Prototypes with funding for implementation of scientific findings into industrial application and production, also under the umbrella of the Ministry of Economy or of Industry.

This structure (or similar) has the advantage of clarity between funding of projects and of PhD-grants on the one hand, and of funding of fundamental and applied research on the other. This clarity also solves the problem of where to apply for what kind of research. External control quantifies the output of each of these agencies in the light of scientific and economic relevance of projects and grants. We have the impression that through the creation of an Estonian Technology Agency, Estonia is strongly moving in the direction of the above mentioned structure.

Libraries

Books and journals undeniably form an invaluable and continuous source of information. Libraries therefore constitute an integral part of science production and conservation. In this respect, their accessibility should be optimal and their functioning should be constantly updated. The Expert Team is fully aware of the (financial) difficulties that face the Estonian libraries (and museums), especially in the rapidly evolving domain of

scientific publishing. Electronic publishing and information gathering will continuously increase, and Estonian scientists are inventive enough to find ingenious solutions to circumvent the problem of lack of electronic access to scientific publications. But this situation cannot last continuously and demands for urgent solutions. Access to electronic journals or other should be assured on a nation-wide basis for all Estonian libraries through a general membership.

To facilitate library consultation, TU Central Library should consider decentralisation of geology-related topics to the Geological Institute Library.

Geological teaching in Tartu and Tallinn.

It is clear that the rather unique Estonian system with entirely short-term target financed and non-permanent positions to a large extent hampers the further development of the geological teaching and research. Most importantly, it most probably tends to discourage the much needed long-term planning and development of the teaching-research structure as senior staff at all levels naturally will be more concerned with securing their own short-term salaries. Moreover, it is likely that this system even further erodes the possibility of attracting young and competent research and teaching staff in Estonia. We recommend that a system with several permanent positions (with clearly defined teaching and/or research responsibilities) be created both at Tartu University and the Institute of Geology, Tallinn Technical University.

The integration between geological teaching and research in Estonia is also hampered by the fact that the transitional period from the pre-existing institute structure is still not entirely completed. Of the scientific institutes evaluated by us, only the structure in Tartu has more or less been completely integrated, whereas the Institute of Geology, Tallinn Technical University is still going through a transitional period. During our visit, we were not given a very good insight into the present geological teaching at the Tallinn Technical University, and it is not possible to evaluate the planned future teaching and structure due to lack of information. However, we are uncertain if it will be possible to maintain geological teaching both in Tartu and Tallinn, particularly in the long time perspective. In any event, the new teaching and research structure to be developed at Tallinn Technical University should obviously be planned so that there is no duplication in subjects between the two geological centres. All decisions in this matter should indeed be scrupulously screened in the light of their financial and economic relevance for the Estonian society, including future labour market developments and its accommodation potential for geologists. The Expert Team wants to draw the attention on the fact that almost everywhere in Europe (-although France, Germany, The Netherlands, United Kingdom and the like have a much wider geological potential than Estonia-), University Institutes or Departments of Geology have been restructured and integrated or simply closed down to increase efficiency and critical mass in teaching and research, notwithstanding their internationally recognised quality.

The proposed new Museum of Geology

Presently large collections especially of Palaeozoic fossils exist both in Tartu and Tallinn, and serve primarily as a base for palaeontological research. In addition Tartu University has a museum exhibit of all aspects of geology. Although this museum is open to the public it is primarily aimed at students, and its pedagogic value is low. Both institutions expressed a wish to expand their museums, although still mainly as a base for research. In our opinion Estonia should certainly have a geological museum, but with equal weight on research and public exhibits, and the opportunity of establishing a museum in the new building on the Tallinn Campus should be vigorously pursued. A model for such a museum could be the Naturhistoriska Riksmuseet in Stockholm or the Royal Belgian Institute for Natural Sciences in Brussels –both independent institutions under the ministry of culture and covering all aspects of natural science-, or the geological museums in Oslo and Copenhagen, which are independent university-institutes under the faculties of natural science. In all these institutions the scientific staff is obliged to do curation/exhibition and supervise students on all levels, as well as research. We find that a geological museum built along these lines would be a significant asset to the Estonian community and an important instrument for heightening the public awareness of Estonia's natural environments.

The age problem

The geological group at Tartu University is dominated by young researchers whereas the much larger group in Tallinn has a heavy overweight towards seniority. This is clearly stated in the self assessment report from the Tallinn institute, which shows that more than half of the staff is over 55 years of age, and a large part of these are on part time. This unfortunate age structure was frequently brought forward during our interviews in Tallinn as mentioned in the assessment of working groups below. After our meetings we have no doubt that the seniors form an active and very productive part of the environment, but for future success of the institute a rejuvenation of the staff must be given a very high priority. We have the feeling that researchers in Tallinn felt that moving to the Tallinn campus and starting undergraduate education would solve the problem in giving access to young students. Although this certainly may help, we have some reservations. The present intake of students at Tartu is 10-15/yr, and we are not quite sure that Estonia can absorb and provide a livelihood for a larger production of geologists. We also noted that some working groups in Tallinn have been quite successful in attracting young and highly motivated people. We therefore suggest that as a first measure the institute in Tallinn should increase its efforts to attract graduates from Tartu. A first step could be a rejuvenation of the leadership of the working groups in Tallinn.

Part III

Evaluation of institutes and research groups

Institute of Geology at Tallinn Technical University

General overview

The Institute (acting director: Professor Anto Raukas) is divided into the Department of Palaeozoic Geology (head Professor Dimitri Kaljo), the Department of Quaternary Geology (head Professor Anto Raukas) and the Laboratory of Isotope-palaeoclimatology (head PhD Rein Vaikmäe).

The Institute currently has a staff of 85 persons (researchers and technical staff).

Working groups of Stratigraphy and Facies analysis (Dr Heldur Nestor) and Geological and Palaeontological collections (Dr Linda Hints)

The two projects (Main geo-events and evolution of biota in the Early Palaeozoic of Baltoscandia and Comparison of Early Palaeozoic faunas of Estonia and neighbouring areas, high-resolution stratigraphy, creation of palaeontological database) are carried out by a mixture of people from the two working groups. It is difficult to separate these topics and they are treated and evaluated together below.

The research in this general area is motivated by the fact that the Cambrian-Devonian sedimentary rocks of Baltoscandia (which are particularly well exposed in Estonia and also accessible in numerous drilling cores) preserve an outstanding, nearly continuous record of environmental and faunal changes, thus providing us with a key for the understanding of this important interval of time. Moreover, the sedimentary rocks in most of Baltoscandia are only slightly affected by diagenesis.

The two working groups comprise a total of c. 26 persons; 7 are full-time researchers (financed through the Target grants) in addition to 7 part-time researchers (financed through the ESF grants). Like many of the research groups at the Institute of Geology in Tallinn, the age-profile is unfortunately not very satisfactory, and of the 7 full-time researchers, a majority is between 50-72. The research group is clearly aware of the problems and it is also important to note that three young PhD students have been recruited.

The Geological and Palaeontological collections of the Institute are extensive and important but the space for storage is presently inadequate, should be modernised and expanded.

As mentioned above we strongly support the plans to form a Museum of Geology as a part of the re-structured institute (at the Technical University of Tallinn), and as proposed in the self-assessment report it would be the natural place for the palaeontological studies within the two working groups (see also above).

Main geo-events and evolution of biota in the Early Palaeozoic of Baltoscandia (Professor Dimitri Kaljo) and Comparison of Early Palaeozoic faunas of Estonia and

neighbouring areas, high resolution stratigraphy, creation of palaeontological database (Dr Linda Hints)

These two research projects cover a wide range of geological and palaeontological topics related to the Early Palaeozoic sedimentary rocks of Baltoscandia, including Ordovician and Silurian micropalaeontological investigations (conodonts, scolecodonts, and chitinozoans), investigations of Late Ordovician changes in the carbon isotopic composition, the evolution and taxonomy of stromatoporoids and Silurian and Devonian vertebrates. The projects also are aimed at compiling a stratigraphical and palaeontological database based not only on Estonian material, but also incorporating data from the neighbouring areas in order to compare the faunas and their development during the Early Palaeozoic, refine the correlations etc.

The research within the group is extensively carried out in co-operation with a large number of national and international research teams including the Laboratory of Isotope-palaeoclimatology at the Institute of Geology, Tallinn Technical University, as well as Tartu University and numerous groups in Sweden, Poland, Great Britain, France, and USA etc.

In spite of the problems surrounding the rejuvenation the group, it is clear that it represents a highly motivated and active team of internationally renowned scientists. The researchers are mainly not involved in teaching (other than supervision of postgraduate students). The overall publication record of the work within the group is rated as **good** with c. 30+ CC papers out of some 80 peer-reviewed papers both in national and international journals. The level of technical support seems to be adequate for the on-going work. Office workspace is also adequate.

The multidisciplinary research activities within the group can be described as very successful. The work with the Late Ordovician stable isotopes is an important contribution to the understanding of the major environmental and biotic changes during this important time interval. The high-resolution stratigraphy of the Ordovician and Silurian using acid-resistant microfossils (in particularly conodonts and chitinozoans) developed by the team has turned out to be extremely important both in the region and elsewhere. The group also has contributed to numerous sections in the book "Geology and mineral resources of Estonia". The rigorous palaeontological studies carried out by the team are at a high international level. There is a fair strategy for future research, and the group has been successful in applying for grants and funds (a total of 8+4 ESF grants for the two projects). The number of postgraduate and postdoctoral students is not satisfactory and should be increased. The overall capability of the group is rated as **good**, and there should be good implementation opportunities for the research results in a new structure as a museum and university-based unit.

The overall research activities of the group are considered to be **good**, and we recommend further support.

***Lithology–mineralogy and geochemistry of sedimentary bedrock and its rational use
(Leader Prof. Enn Pirrus, DSc)***

This group comprises 2–3 researchers, 1-2 lecturers, and 2-3 PhD and MSc students. The activity is centred on lithology and geochemistry with a special view to the sedimentary environment and facies of the Early Palaeozoic basins. The topics range from lithification and dolomitisation to biomineralisation and its relation to environmental parameters.

The overall competence of the group is a good mix of applied and basic aspects and the group possesses a deep and detailed knowledge of the geochemistry of Estonia's Palaeozoic sediments, and appear as co-workers on several other projects dealing with Estonia's Palaeozoic rocks. However, the publication record shows the group's inclination towards applied science, with only 3 CC-journal articles out of a total of 23, and a large proportion in Estonian journals. The publication record might however be biased by the fact that 2 members of the group (amongst which team leader E. Pirrus) develop the bulk of their activities at the Mining Institute. This is clearly not a fortunate situation that needs clarification in the light of the future restructuring or reorganisation of the Institute of Geology within Tallinn Technical University.

The group has been able to attract target grants and ESF grants, as well as several contracts for applied research. A target project "The main features of authigenic mineral formation in Palaeozoic rocks of Estonia" (PI, E. Pirrus) was running from 1993 to 1996, and continued in the project "Lithological and mineralogical preconditions for rational use of the bowels of the Earth in Estonia" (1997-2001, PI for both projects E. Pirrus with 6 co-workers). This has resulted in a large number of papers, but mostly in Estonian journals, as well as a PhD thesis. In addition the group has obtained 4 ESF grants. Although the group has a clear applied geology profile and an international potential (as illustrated by themes like biomineralisation, natural building stone decay and K-bentonites), no EC funding has been fostered.

Our overall ranking of this group is **satisfactory**. We feel that the results obtained by this group could be of value to the international community, and suggest that while continuing to work together with palaeontologists and sedimentologists the members attempt a higher international involvement. As an example, we found that the detailed knowledge of the geochemistry of Palaeozoic limestone could be of use in research on decay of building stones and other cultural heritage endeavours in Europe. Closer connections in soil science could be developed with the Agricultural Institute.

TTU Basement geology, Tectonics and Geophysics Group (head V. PUURA, PhD, PI)

1. The research activities of this group are assessed as **good** as the majority of the submitted works are at least of a good international level and virtually all others at a fair international level.

The Basement geology, Tectonics and Geophysics Group currently consists of 5 researchers (including 1 PhD student) and 1 engineer-technician, financed through 2

target funds: (1) Tectonic pattern and magmatism in the NE Baltic area (1996-97), and (2) Earth crust of Baltoscandia: diversity and processes (1998-2002). In all, 8 research grants on related but differing topics complemented the financing of the group and allowed the involvement of part-time researchers and MSc- and PhD-students. Nearly all funds obtained were in line with the group's mission or at least closely related to. The group lists 28 publications in peer-reviewed journals (10 of which in CC-journals). There is a surprisingly large amount of abstracts over the referenced 1996-2000 period (83 in total). 1 PhD degree has been obtained by a former group member.

The strength of the group lies in its strong tradition in basement geology and geophysics for new developments to build upon. However its weakness is formed by its age profile which seems to be disproportional as 2 members of the group out of 6 are close to retirement while their replacement has not been secured thus hampering continuity. As a consequence it might need some time to overcome this obstacle. The group might explore new developments in basement geology and geophysics during this transition period that preferably should be kept as short as possible.

The scientific production of the group as a result of its target funding is acceptable at this stage of its lifetime. Nevertheless it should be realised that the transition period might undermine the quality and the quantity of its production (unless this transition period could be kept as short as possible). The group has not fully exploited all international publication possibilities. It should take advantage of the ongoing revival for basement geology (in the framework of plate tectonics) or impact geology, and for the continuous attention paid to geophysics to fully explore and exploit the unique geological setting of the Estonian basement geology.

Adoption of a national perspective would positively influence the evaluation rating as limiting factors like international funding and publication would disappear or largely be reduced. The group has demonstrated to be too modest to present its research results to an international (i.e. non-Nordic/Baltic) audience.

2. The rating of the overall capability of the group is **good**. There is some novelty/originality in its ongoing research activity and a fair strategy and perspective for further research. Some multidisciplinary has been developed and some aspects of the research of the group (like the soil pollution study in the Tallinn area) are of immediate relevance to the Estonian society and thus show a good implementation potential. There is undoubtedly competence in the group but too few postgraduate and postdoctoral students according to its intrinsic potential. Although good or tight national/international co-operation has been developed, it has been too much oriented towards Nordic/Baltic countries in spite of the large truly international significance of the themes studied.

The group complains about bad technical conditions and suffers from lack of adequate equipment, which is temporarily compensated through Nordic/Baltic co-operation. Activities that require geochemical laboratory assistance should be reconsidered in the light of a possible transfer to the corresponding geochemistry/geochronology unit at TTU to avoid future duplication and/or reduce risk of failure due to insufficient critical mass.

The group has been fairly successful in applying for ESF grants and target funds. Funding is thus adequate according to national standards but no EC or other international funding has been attracted nor explored in full although the conducted research in itself bears some potential for outside funding and co-operation. The research outcome and potential of the group would highly benefit from this international integration.

General comments

The Basement geology, Tectonics and Geophysics Group is clearly in a transition period, which is reflected by its age profile and in its slowly changing research domains. The former is illustrated by the presence of 2 members out of 6 that reached the retirement age but still are very active. One of these 2 members (V. PUURA) is an authority in Estonian basement geology, which is reflected in his publication record and in the large experience of the group in the domain of basement geology and geophysics. The group thus will have to explore new developments in these 2 domains of research to compensate for the future loss of knowledge and experience caused by these 2 retirements. But the group has a solid base and large potential to build upon new developments and partly reorient its activities in a modern way. Basement geology and geophysics form an integral part of modern basin analysis that is process-oriented (importance of isotope geology and geochemistry). The new leadership emergent from this group is fully aware of these new orientations and already its activity points in this direction. It should be given large credits and full support to develop and implement this basin analysis approach into the activities of the group.

This approach will also strengthen the international image of the group for the future. This will undeniably generate close international and worldwide co-operation with leading institutes and expert teams, and definitely put Estonian basement geology and geophysics on the international scene. It will also stimulate more truly international publication in peer-reviewed journals instead of abstracts.

In order to attain continuity in critical mass, the group should consider to transfer part of its activities in the environmental geology domain to relevant groups active in this field in order not to duplicate research activities or equipment. This not only is a matter of efficiency, but also enables better definition and future planning of research activities.

The group should seriously envisage acquisition of basic geophysical equipment. Access to large-scale facilities like airborne magnetics or marine seismics should be assured through international co-operation as has already been demonstrated through past and ongoing research. But basic and relatively inexpensive equipment like borehole logging tools could be acquired for joint use with the TU Quaternary and applied geology Group (V. KALM).

Although there exists complementarity with the TU Groups on Quaternary and applied geology (V. KALM) and Crystalline basement and tectonics (V. PUURA), it is not clear whether a teaching load for the TTU Basement geology, Tectonics and Geophysics Group (V. PUURA) would be beneficial. The argument of generating students' interest

for basement geology through teaching is rather weak. Moreover, (heavy) teaching activities and efforts might be counterproductive for research results.

Quaternary Stratigraphy and Geomorphology Research Group (PI Anto Raukas, Prof., acting director, DSc)

This group comprises 10 members and may in some respects be characterised as an erosional remnant from a structure, the Department of Quaternary Geology, which after its creation almost fifty years ago won recognition both in the east and west. At present the group deals with a very wide and not entirely cohesive range of problems related to the Quaternary, such as the Quaternary geology of the northwestern East-European Platform, nature conservation, development of physical dating methods, and effects of extraterrestrial impacts. The topics are a blend of traditional Quaternary mapping of landforms and ice margin retreat with more novel studies of meteor impacts.

The competence of the group cannot be questioned. Among its members can be found some of the most distinguished and most productive Estonian scientists, proven over many years - notably its leader. Also, this group is one of the few we have met with a working field and horizon extending beyond Estonia and far into the former USSR. The publication list, with 12 cc publications in widespread international journals must be considered **good**, in addition there is a large number of publications directed at an Estonian audience, reflecting the group leader's importance in communicating knowledge of the country's geology and landscapes to Estonians. The group has attracted one target grant dealing with correlation of deposits and Late-Quaternary geological events in the transitional zone of the Fennoscandian Shield and East-European Platform (1996–2000, PI A. Raukas). The project has 8 participants with varying work-loads and has resulted in 9 cc publications dealing with a wide variety of topics and with an international outlook. In addition 7 ESF grants have been obtained.

In spite of the many qualities in this group we do feel reason for some concern, especially with the lack of coherence and strategy. Also the age profile in this group is particularly unfortunate, as clearly recognised by its members. The youngest of the scientific staff was born in 1958 and the average age of the scientists is 62 years. This does not in any way show in the productivity of the members, but is to some extent reflected in the choice of research topics. For these reasons our rating of the group's overall capability is **good-satisfactory**.

For the future, we recommend reorganisation under younger leadership with due respect paid to the vast knowledge of Estonian geology accumulated over a lifetime, which exists in the group. The laboratory for ESR (electron spin resonance dating) probably has the world's longest experience with this method. However, it should be recognised that although the dating results have been accepted at face value in the former USSR the method has not gained acceptance in the west because of lack of rigorous testing and convincing results. We suggest that this challenge should be met with, starting with a transfer of the laboratory to the department of isotope-dating with its long experience of co-operation with western scientists.

Holocene palaeogeography and environmental geology research group (PI 1992–2000, Senior Researcher Leili Saarse. Since 2001 Senior Researcher Siim Veski)

The group has evolved during the last decade and has undergone a history of changing combinations of topics, and it is still evolving. The research topics combine a variety of disciplines centered on biostratigraphy of lake basins, but covering also prehistoric human impact, history of the Baltic Sea, ground- and surface water pollution, and natural heritage documentation. As it appeared before us the group comprises c. 10 persons, among which 2-3 PhD stipendiats or newly appointed PhDs.

With its range of topics and methods the group has managed to become a part of a network of similar modern and successful research groups dealing with environmental change on millennial-decadal scale in the Nordic countries, and close ties to these institutions have been established, as seen especially in the supervision of PhD stipendiats. By this co-operation knowledge has been acquired in diatoms, pollen, and the relation between catchment area and lake hydrology. An important asset is the finding and study of laminated sediments, which provide precise but floating chronology in sediments, which cannot be dated by C14. The equipment still lags behind that of the Nordic countries, but better facilities for preparation and cold storage will probably come with the new building on the Tallinn campus. Other modern equipment can to some extent be utilised in Finnish and Swedish laboratories, thereby strengthening the international co-operation, but additional funding for such services as AMS C-14 dates are needed.

The publication record, with 17 CC papers out of 52 published papers during the last five years, is **good**, and we acknowledge that local ground water problems and national heritage sites are relevant mostly to an Estonian audience. A measure of the group's success is that besides the target grants mentioned below it has been able to attract 7 grants from the Estonian Science Foundation, some of which with foreign contributions, and 7 contracts on hydrological and nature conservation jobs. Among the groups from Tallinn that we have met, this one is especially characterised by its healthy age-profile, spanning the whole range from well-merited senior to PhD stipendiats, and we note as a very positive thing the transfer of leadership downwards in age. The group is highly motivated and should be supported in the future because it provides the Estonian community with scientific results necessary for future political decisions, and contributes an Estonian input in the environmental policy for the Baltic region. The group lacks somewhat in instrumentation, and eventually the outlook should be widened beyond the Baltic region. Over the last five years the group has - with somewhat changing personnel - attracted two project- and two personal target grants. Two project target grants deal with Postglacial natural and anthropogenic changes in Estonia (1996-2000. Project leader L. Saarse) and Formation of the groundwater regime in different geological environments (1994–1996, Project leader: H. Kink). The first resulted in 17 papers, most of which in English, and some with non-Estonian co-authors, as well as 2 PhD theses from Lund University, and 3 MSc dissertations from Tartu. The second resulted in three papers for an Estonian audience. This group has a strong potential for further development, and we rate its overall capability as **good**.

TTU Isotope-palaeoclimatology and radiometrical dating Group (head R. VAIKMAE, PhD, PI)

1. The research activities of this group are assessed as **excellent to good** as at least one third of the submitted works are at a high international level and a large majority is at a good international level.

The group currently consists of 8 researchers (1 PhD student included) and 4 engineers-technicians (1 MSc student included). The group's activities are mainly financed through 2 target fundings, which generated 32 relevant publications in peer-reviewed journals and conference proceedings, 2 MSc theses and 1 PhD thesis. Also 4 ESF grants have been successfully conducted that produced 15 additional publications so far. For the moment, 1 MSc thesis and 3 PhD theses are in progress.

The target funding is related to (1) isotopic indicators of palaeoclimate, and (2) Late Quaternary climate and environmental changes and formation of groundwater in the sphere of influence of the Scandinavian glaciation: isotope-geochemical reconstructions. Both topics fully comply with the group's mission and are at the cutting edge of knowledge. They also keep promising perspectives for future developments and international co-operation according to high scientific standards.

The strength of the group lies in its clearly defined vision on its twofold mission: (1) independent production of research in various domains of rapidly evolving isotope geology and geochronology, (2) technical-analytical support for various research groups active in other fields of geology. The group therefore disposes of an impressive and well-integrated series of research facilities that attract young scientists. The success of the group however results from the group leader's authority and competence. This not only forms its strength but also its weakness. In case the group leader's involvement should decrease in one way or another, it might shed a shadow over the group's undeniable growth potential and its external image.

2. The overall capability of the Isotope group is rated as **excellent** as there is a high degree of originality/novelty in its past and ongoing research. Also the group demonstrated a clear strategy and perspective for further research. There is a good multidisciplinary in the team (degrees in geography, biology, geoecology, chemistry, geology and mineralogy, applied geology). The implementation opportunities for the research results are high as the activities of this group focus on various aspects of environmental geology and hydrogeology which are of high relevance for the Estonian society (groundwater research e.g.).

There is a high degree of competence in the group underlined by the presence of postgraduate students. The Isotope group has good and tight national and international co-operation as it is very well integrated into past and ongoing EC funded research like Palaeaux and Baseline. Publication of its research results is therefore largely guaranteed in various ways. All available channels are used, but in order to keep up with high

European and international standards a good balance between national and international publication should be attempted.

Application for grants and funds have been highly successful, even on the EC market. Resources of the group (like funding, personnel, technical support, ...) are therefore adequate. Even the existing (and partly home-made) equipment is considered as adequate, but the group itself recognises its limitations and puts high and justified expectations about the efficiency of the new equipment to be acquired at the occasion of the transfer to the new housing facilities. If uncontrolled, the growth of the analytical and scientific support provided by the Isotope group to other research groups, might limit its own expansion and research production in the future. The group management should carefully and continuously consider this matter.

The adoption of a national perspective would not have influenced the evaluation rating. It would only have widened the gap with other research teams' evaluation.

General comments

The Isotope group pioneered in the 70's (Galina Hütt) with the development of isotope geology in the Baltic area and beyond, and showed its continuous dynamism with the further development or implementation of new analytical techniques like OSL and TL. It should be credited for its visionary ideas outside the classical and traditional mainstream geology domains.

The group has a considerable growth potential not only in its own domains of research, but also as an analytical support unit to other research teams. To provide it with all necessary possibilities and instruments, preference should be given to concentrate all analytical, geochemical and geochronological research activities and facilities into this group in order to avoid unnecessary duplication and to assure sufficient critical mass.

The group demonstrates a stimulating dynamism coupled to a clearly defined vision on its future development and activities. It has largely benefited from its excellent European positioning in the framework of the 5FP, which might serve as a platform for a "Center of Excellence" in isotope geology or the like.

Uncontrolled or too rapid growth might damage the group's organic structure unless strict control on a stepwise development is exerted. The age profile of the group is quite equilibrated and new influx of qualified researchers is guaranteed through sufficient PhD students attracted by the group's high quality profile and technical instrumentation.

The necessary managerial competence to lead the group is present, as are the necessary facilities of working rooms and laboratories. The group's dynamism and sense of initiative should be accredited with new and up-to-date equipment at the occasion of the occupation of the new building on the premises of the Tallinn Technical University.

Institute of Geology, University of Tartu

General overview

The Department (head: Professor Tõnu Meidla) is divided into the Chair of Applied Geology (head: Professor Volli Kalm), the Chair of Palaeontology and Stratigraphy (head: Professor Tõnu Meidla), Chair of Geology and Mineralogy (temporarily unfilled) and the Museum of Geology (chief curator: MSc Mare Isakar).

The Institute currently has a staff of close to 30 persons (lecturers, researchers, and technical staff) and the available office and laboratory space of the Institute is too small and inadequately equipped to meet the need of the growing institute (see further below). The library facilities (a sub-branch of the TU Central Library) housed within the building are also largely inadequate in terms of space and equipment (access to electronic journals and databases).

Evaluation of the specific research teams (target-financed projects) at the Institute of Geology

Sedimentology and palaeontology of Baltoscandian sedimentary cover (theme leader Professor V. Kalm)

This project comprises two sub-projects (“Life and environments in the Palaeozoic record” and “Quaternary and applied geology”), which are evaluated separately below.

Life and environments in the Palaeozoic record (theme leader Professor Tõnu Meidla)

This research group investigates the environmental and faunal record in the Early Palaeozoic (Cambrian-Silurian) sedimentary rocks of Baltoscandia. The wide range of topics covered by the group include Ordovician faunal and environmental changes, changes in Ordovician Carbon isotopic composition, seismic profiling of the Baltic Sea bottom, as well as palaeontological studies (ostracodes, brachiopods, molluscs, and tabulate corals). Most of these research topics are carried out in co-operation with numerous other research groups including the Institute of Geology in Tallinn, the University of Liverpool, Stockholm University, and Uppsala University. The teaching and research staff is young and shows a good balance between postgraduate students and lecturers. Not all of the staff members (some also work part-time at the Institute of Geology, Tallinn) were present at the evaluation visit, but the group includes c. 8 persons of which half are PhDs. The teaching and research activities are well integrated within the group. The unit has had a dynamic and rather rapid growth during the past years and can be expected to develop further in the near future. Presently the level of technical support seems to be adequate for the on-going work, but the laboratory space and equipment is inadequate for the teaching and research, and it should be modernised and expanded. Office workspace is also inadequate and should be increased to suit the need

of the expanding department. It is clear that a Scanning Electron Microscope is much needed both for teaching and research.

The overall publication record of the group is rated as **good** with 13 CC papers out of some 30 peer-reviewed papers both in national and international journals (numbers are somewhat uncertain as a detailed tabulation of publications was not included in the self evaluation report). Unlike most other European universities, there appears to be no clear definition of the teaching and administrative work load (e.g. in percent of a full position) for the individual staff members at Tartu University and the heavy teaching and administrative work load for some of the staff clearly influences their publication record.

The most important aspect of the ongoing research activity is the integration between palaeontological, sedimentological, as well as geochemical studies, which have provided valuable information for understanding of the palaeo-environments of the Baltoscandian Basin. This type of basic research is by its nature descriptive, but also multidisciplinary and there is a good strategy for future research. The success in applying for grants and funds has been quite good (6 ESF funded related projects). The number of young postgraduate and postdoctoral students is satisfactory and there is a good level of national and international co-operation, although the co-ordination with the research activities at the Institute of Geology (Technical University of Tallinn) could be further improved. The overall capability of the group is rated as **good**, and there are good implementation opportunities for the research results through the broad educational activities of the group in Tartu.

The Museum of Geology (head: M. Isakar) includes extensive scientific collections that are important both for the research and teaching activities within the group. Although the curation of the collections is competent, the space for exhibition and storage of these unique scientific collections are presently inadequate, and should be modernised and expanded. We strongly support the plan to integrate the University museums.

The overall research activities of the group are considered to be **good**, and we recommend further support.

TU Quaternary and applied geology Group (head V. KALM, PhD, PI)

1. The research activities of this group are assessed as **good to satisfactory** because at least one third of the submitted works are of a good international level while a clear majority is at a fair international level.

The group is financed by means of a target fund “Sedimentology and palaeontology of Balto-Scandian sedimentary cover” (partim “Quaternary and applied geology”) and consists of 7 researchers (including 1 MSc and 2 PhD students). Various and widely diverging topics are studied in the framework of this target fund (from isotope studies of Lower Cambrium Blue Clay over microstructure studies of quartz grains towards hydrogeological studies of groundwater in bedrock and Quaternary sediments). Some of these were additionally supported by 3 postdoctoral themes and 3 ESF grants (including

one on modelling of thermal history of meteorite impact craters). The group lists some 58 publications in peer-reviewed journals.

The strength of this group lies in the fact that it appears to be a young and enthusiastic team with a growth potential in areas of applied geology and hydrogeology. The group has sufficient international contacts and demonstrates a reasonable scientific output. A too heavy teaching load of staff members and lack of time however could have hindered this scientific production. Better room facilities and acquisition of adequate and up-to-date equipment might considerably improve the research quality and its output. Publication of research results in Nordic/Baltic research journals seems adequate and appropriate as these represent the “natural biotope” for regional geology topics. In the future however, larger attention should be paid to publication of research results in internationally (CC, SCI) cited journals as various treated topics show a large potential for a more international audience.

Perhaps due to historic reasons, the group’s weakness is formed by its investigations derived from a too classical approach of sedimentological-stratigraphical research up to now. In its attempt to overcome this obstacle, a wide range of subjects has been tackled that are not fully integrated with one another and therefore show too wide scatter and lack coherence. New developments might have been overlooked possibly due to overload of teaching and administration, but possibly also due to limited (non-Baltic/Nordic) international contacts.

2. The overall capability of the Quaternary and applied geology Group is rated as **satisfactory**. There exists some novelty/originality in their past and ongoing research but the Group failed to develop a clear strategy or a perspective on further research. The group heralds the extension of its activities in the field of “applied geology and environmental geology”, but fails to provide details on ways to achieve this aim. Moreover, no planning is provided on items like staff management and budget. This lack of vision is further exemplified by the absence of a critical vision on the group’s laboratory facilities and their further development. Basic equipment for applied geology and environmental geology (like coring device with essential geophysical exploration tools, cone penetration testing equipment, ground penetrating radar, resistivity sounding equipment, etc) is missing and existing laboratories (especially sedimentology and XRD) need urgent updating. Poor office facilities seriously hamper future development.

There exists some multidisciplinary with other groups in the Department of Geology in TU (within the target funding of “Sedimentology and palaeontology of the Balto-Scandian cover”, partim “Life and environment in the Palaeozoic record” headed by T. Meidla). Some research topics show relevance for the Estonian society, but implementation opportunities of applied and environmental geology are not fully exploited. Some opportunities have been met (preparatory studies for road connections), but the full panoply of hydrogeology and environmental geology applications (still to be developed!) should be identified and explored. This would strengthen the group’s relevance for Estonian society.

Undoubtedly there is some competence in the group as is demonstrated by the presence of young MSc and PhD students, and postdoctoral students, which demonstrates the existence of good national and international (i.e. Baltic/Nordic) co-operation. Applications for grants and funds has been fairly successful on a national basis, but the group failed to explore the possibilities of EC or other international funding of high scientific standards.

A national perspective in rating the research activity of this Quaternary and applied geology Group would definitely change its evaluation, but is not desirable as it might not stimulate the team to foster promising developments in its various fields of interest. Eventually an unfortunate feeling of “self-overestimation of its own capacities” might result from this, which is not a stimulating nor a sound atmosphere especially for young scientists.

General comments

The general impression dominates that the Quaternary and applied geology Group is a hard working and dynamic group, largely involved in teaching, research and administration. Exploitation of all possible national-funding possibilities like target funding, ESF funding and (partly) contracts has been successfully undertaken. However, the group is rather inexperienced in attracting EC (e.g. 5FP) or other international funding although it is active in the domain of Quaternary and applied geology, which has a large growth potential due to its environmental applications. Both domains are at the forefront of new developments in geology and the group should seriously consider its position with regard to this rapidly evolving domain.

In this respect, the group’s strategy is not fully clear and needs more thorough thinking. The announced extension of its activities in the field of applied and environmental geology urgently needs specification (geotechnics, urban geology, geophysics, survey and planning, ...?). A management plan for staff member and financial resources could be extremely helpful in this respect. This might help to implement the announced and desired new directions and developments in applied and environmental geology on the one hand, and accommodate the (decided but not executed?) extension of the working and laboratory room facilities on the other.

Funding of the group is sufficient for its actual needs (staff salaries), but largely insufficient to almost non-existent for replacement of outdated XRD or sedimentology laboratory instrumentation or for acquisition of new equipment. Today acquisition of large instruments (e.g. SEM, drilling equipment, etc) is highly problematic and should be assured on a nation-wide basis (at ESF level?) through competitive application.

To facilitate library consultation, TU Central Library should consider decentralisation of geology-related topics to the Geological Institute Library. Access to electronic journals or other should be assured on a nation-wide basis for all Estonian libraries through a general membership.

At the moment it is not clear whether the activities of the group leader as a Vice-Rector of TU influences the performance of the group or not, but it should be realised that in the long run teaching, research or administration of the group might suffer from his time-consuming absence.

Systematic composition, taphonomy, synecology and evolution of Palaeozoic biota (theme leader Professor Madis Rubel)

The research work within this finished project investigated the systematics and phylogeny of a wide range of Palaeozoic fossil organisms as well as aspects of their taphonomy and ecology. Important results from this work were published in the “Treatise on Invertebrate Paleontology”. The results from this project and the continuing faunal studies are now carried out as a part of the project “Life and environments in the Palaeozoic record”.

The publication record and overall general level of the scientific work is rated as **satisfactory** with a total of 9 peer-reviewed publications.

Earth crust of Baltoscandia: diversity and processes (1998-2002, PI Prof. V. Puura)

This project concerns offshore and onshore geology in the Baltic, the Baltic states and Sweden, and is a cooperation with co-workers at institutes in Tallinn and Sweden. As this project is mentioned above among the projects of the Geological Institute in Tallinn, only a few specific remarks will be mentioned here. The activities of the group in Tartu concentrate on structural geology and mineral resources, whereas in Tallinn large attention is paid to the study of basement rocks in a structural framework. It should be acknowledged from its scientific record that the group has a long standing tradition and a solid base in the field of basement and structural geology. Nevertheless during the Expert Team’s visit it became clear that a wide range of various sub-subjects are treated that seriously threaten the coherence of the group, although they are related to the basement and structural geology of Estonia in one way or another. Studies on oil shales and phosphorite deposits, carbonate rocks, crustal weathering and impact structures through zircon research, r p kivi granites and the K rdla impact crater, black shales and uranium, stress and strain models of mantle material are indeed very useful and interesting on their own, but lack integration and reduce the potential of the group below the necessary critical mass. This panoply of smaller topics obscures the group’s competence which together with its unfortunate age profile forms a serious drawback for its future development. We therefore rate its activities and capabilities as **satisfactory**.

Final remarks

Our short stay and many interviews have given us the impression that geological research in Estonia is sound and growing in quality and international recognition. For the future we would like to give - in random order - the following suggestions:

- Considering Estonia's size, focussing on a more restricted number of geological topics could be contemplated. A candidate for expansion could be the field of environmental geology.
- Co-operation with nations around the Baltic has been consolidated. The next step should be a widening of the scope to include the rest of Europe.
- We suggest that the Institute of Mining Geology, and Institute of Geology, both of the Tallinn Technical University, should be merged.
- But teaching of geology should still be restricted to the University of Tartu. The demand for geologists in Estonia is and will be limited.
- On the Tallinn campus, on the other hand, we suggest the establishment of a new national museum of geology with equal weight on research and public relations.
- For the staff we recommend a system with some permanent positions with clearly defined teaching and/or research responsibilities.
- There is a strong need for a source for funding of equipment.
- According to European standard the funding of R & D should be increased (see Overview of research and development in Estonia, 1996-1999, structure and trends)

We hope that this evaluation can be of some use to the Estonian geological community and wish to thank all the involved persons for the efforts they have put into preparing the self-assessment reports and for their willingness to cooperate. We will also like to commend the Estonian Higher Education Accreditation Center for the efficient organisation of our brief stay.

Tallinn, May 19th 2001

Svend Funder (chairman) Lars Holmer Patric Jacobs