

Information System for the ESF/QUEEN Programme

QUEEN/PANGAEA



A proposal related to the European Network for Research in Global Change (ENRICH)
within the R & D Programme 'Environment and Climate'

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QUEEN/PANGAEA

Summary	3
1. Objectives	
1.1 Background - State of the art	4
1.2 Objectives	6
1.3 Progress beyond the state of the art	7
1.4 Originality and innovation	7
2. Work content	
2.1 General approach	8
2.2 Tasks	9
2.3 Data management plan and quality control	10
3. Project milestones and deliverables	
3.1 Milestones	13
3.2 Deliverables	13
4. Benefits	
4.1 Added value	13
4.2 Relevance of carrying out at European level	14
4.3 Transnational participation	14
5. Economic and social impacts	15
6. Project management	16
7. The partnership	
7.1 Participants and task distribution	16
7.2 Competence of partners	18
8. Financial information	19
9. Exploitation plan	
9.1 Dissemination of results	21
9.2 Target user group	21
9.3 Contribution to management for the sustainable use of the ocean	22
10. Ongoing projects and previous proposals	22
11. References	23

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Part I: anonymous part

Summary

It is the aim of the proposed project to support the interdisciplinary research in the Eurasian Arctic by implementing a common information system between institutions participating in QUEEN (Quaternary Environment of the Eurasian North).

Under the auspices of the ESF (European Science Foundation), the programme QUEEN aims to combine information obtained by Russian and Western projects to provide a common picture of present and past environmental changes across the Arctic. Regions of particular importance for understanding the Arctic's role in global climate change are the Eurasian shelves and the land south of these, including Siberian permafrost. Henceforth changes of the Arctic environment will have a major impact on the European climate because a predicted temperature increase will reduce the Arctic sea ice cover, and the Arctic soils are possible sources of further greenhouse gases.

Special effort in QUEEN is devoted to the correlation of records from different sources across the Arctic. The compilation of data, necessary for the large scale assessments, can be provided by the supporting action QUEEN/PANGAEA. It will help to extend the use of the data beyond the scope of individual research with a catalytic effect for the data exploitation. This project will support the QUEEN programme by building up a network to establish a technical and communication infrastructure between the participating institutes. As a central part of the network, the information system PANGAEA (PaleoNetwork for Geological and Environmental Data) will manage, publish, archive and distribute any site related data from (paleo)environmental research. The data will comprise results from the analysis of marine, terrestrial and lacustrine sediments and ice cores. As contractors two Russian, a Norwegian and a Swedish institute will be included. Six other institutes are joined as minor subcontractors.

1. Objectives

This scientific proposal falls under the *Environment and Climate* work programme related to research into the natural environment, environmental quality and Global Change (Theme 1), climate change and anthropogenic impact on natural resources

(Area 1.1), concentrating on the climate system in the past (1.1.2.). It is a supporting action for the QUEEN programme (Quaternary Environment of the Eurasian North) with benefits for natural resource management. QUEEN is a new ESF (European Science Foundation) research programme, established in 1996. It addresses environmental processes in the Arctic with special emphasis on the Eurasian continental margin. An information system within a network of clients will be installed to consistently store and share paleoenvironmental data from different sources in a common data library. This system will provide the indispensable tool to freely exchange data between partners and thus for the interpretation of the comprehensive and diverse data sets. The project aims to integrate the present knowledge of the environmental changes during the Quaternary in the Arctic and thus adds value to ongoing research activities carried out in the area of Global Change.

1.1 Background - State of the art

Global climatic models clearly demonstrate the sensitivity of the Arctic Ocean and surrounding continental areas to an increasing "greenhouse effect" and potential climatic change in the nearer future. A predicted temperature increase will lead to a reduction in the extent of Arctic sea ice cover and the release of further greenhouse gases from Arctic soils and henceforth have a major impact on the European climate. Associated changes in surface albedo and ocean-atmosphere heat and gas exchange will accelerate global warming. Increased temperatures of Arctic surface waters will seriously affect the deep water renewal in the Nordic Seas and the effectiveness of the global "conveyor belt", which regulates the European climate through the extension of the Gulf Stream into the eastern Norwegian-Greenland Sea and finally into the Arctic Ocean. Its potential response to global warming is unknown.

The models predicting future climatic scenarios are intensively tested and validated on paleoclimatic information from global changes of the past. Although the Arctic is accepted to be a key area for climatic change, comparatively little is known about extent and rates of Late Quaternary changes of climatically and oceanographically important parameters in the Arctic.

Particularly important for the understanding of the role of the Arctic in Global Change are the vast areas of shallow Eurasian shelves and the large landmasses to the south, including the permafrost areas of the Siberian tundra. The present morphology of the Barents, Kara and Laptev Seas and the adjacent continental slopes differ considerably from each other. They reflect the complicated and variable history of Quaternary glaciations. While Upper Quaternary Northern Eurasian ice sheets are elements in paleoclimatic models and elements for the reconstruction of deglacial sea level changes, the extent of the individual ice sheets is still in debate and their history of growth and decay is yet poorly understood.

Presently, huge amounts of freshwater and sediments are discharged by the big Siberian river systems across the shelves, contributing to the surface waters and sedimentary processes in the deep Arctic Ocean. Sea ice is formed from the low saline surface water and transported to the Arctic Ocean and via the Fram Strait to the Greenland Sea. Soils of the lowlands along the Siberian Arctic coastline are assumed to contain large, but yet unknown volumes of greenhouse gases, to be released upon thawing.

QUEEN will address the following issues:

a) The *last glacial maximum* is one of the periods most frequently used for testing and validating climatic models of general circulation. Yet it is still not known for certain how thick the ice sheets were across the entire Eurasian margin, and how far they extend. The goal is to reconstruct these ice sheets.

b) *Changes in relative sea level* have to be mapped and dated. It is known that ice sheets were much larger and more extensive than during more recent ice ages, but more needs to be discovered about the precise pattern and the causes. These large glaciations caused a significant drop in global sea levels. However the weight of the ice caused glacial-isostatic depression of the land under it, causing an offsetting gain in relative sea levels along the coast.

c) Identification and dating of *changes to the drainage* of the Eurasian continent caused by the glaciation. Rivers that now flow into the Arctic ocean were dammed by the ice sheets so that the drainage of an enormous part of the Eurasian continent was diverted from the Arctic Ocean towards the Kara, Caspian and Black seas.

d) *Geological and palaeobotanical data* obtained from the field research will be used to model ice sheet dimensions and dynamics through time. When combining these models with basic physical laws of ice flow and mass continuity, it will be possible to simulate how sensitively different ice sheet configurations are affected by variations in paleoenvironmental factors.

e) The variation in *extent and depth of permafrost* both onshore and offshore in Arctic Eurasia have played a vital role in evolution of the whole Arctic environment. However the spreading and degradation of offshore permafrost and the geothermal conditions of sea floor sediments are poorly understood. Therefore, we intend to investigate past permafrost processes, including:

- the history of the Late Pleistocene *regression* (18-22 kyr BP), with the sub-aerial exposure of continental shelves and consequent freezing of bottom sediments, the accumulation of ice complexes and gases and/or gas hydrates, and the formation of a zone of gas hydrate stability and
- the succeeding marine *transgression* and flooding of the shelf, and the formation and degradation of offshore permafrost resulting in the thermo-abrasion of ice-rich scarps and sub-sea thawing of ice-rich sediments.

Political changes in recent years have made it possible to freely exchange information between Russian scientists and their colleagues from Western countries. A new kind of scientific cooperation in the Arctic has been established providing access to the Russian Arctic, which comprises about half of the circum-Arctic landmasses. As a consequence the exploration of the environmental history

of the Arctic has been focused by many projects which aim to explore parts or aspects of Arctic history during recent geological past.

Under the auspices of the European Science Foundation, the QUEEN programme aims to combine information obtained by Russian and western projects. Some bi-lateral projects between Russian and European institutions have already been launched on a national basis. QUEEN will improve data and knowledge exchange, increase cooperation between current programmes, and establish new collaborative projects. The final goal is to develop a comprehensive understanding of the role played by the whole Arctic region in the global climate system.

1.2 Objectives

To merge Russian and Western information into a common picture of present and past environmental changes of the Eurasian Arctic there is the need for a network allowing the participating institutions to share a central data base. It is the aim of the proposed project to support the data exchange and interdisciplinary research by implementing a common information system between institutions participating in QUEEN. The system will include data from research fields on glaciology, marine and lacustrine geology, permafrost research, geography and research on tree rings.

The implementation of the system will address the following objectives:

- to compile data from the paleoenvironmental archives of the Arctic from the various projects, including the harmonization of data into common units, formats and uniform variables,
- to include data from the literature and unpublished data of former projects,
- to support scientists in using the information system as a tool for the extraction and evaluation of comprehensive data sets (e.g. time slices, paleotemperatures or reconstruction of ice coverage),
- to provide common tools, which can easily be used for the visualization of large data sets and which are closely linked to the information system,
- to ensure the overall accessibility and longtime archiving of the data and thus to make the results available to the scientific community and to authorities involved in decisions about the Arctic environment,
- to identify gaps in the distribution of samples in the different investigation areas and to specify advanced data analysis approaches to be addressed by future projects.

1.3 Progress beyond state of the art

The data, which have been produced within a number of different national projects, as well as relevant data from the literature will be made available in an easily accessible form. Since a number of the data sets have not yet been published or variables may have to be converted to common units, this compilation will produce a data base much larger than hitherto available. This is particularly so, if Russian data are incorporated which are mostly published in literature not accessible to the international community.

The compilation of data from different natural sources and projects will allow the evaluation of processes in the Arctic and the adjacent continental margin. Based on this extensive data base, a much more detailed areal description and environmental reconstruction than presently available would be possible. Such a compilation will be a valuable basis for assessments of an increasing greenhouse effect inducing global climatic change in the near future.

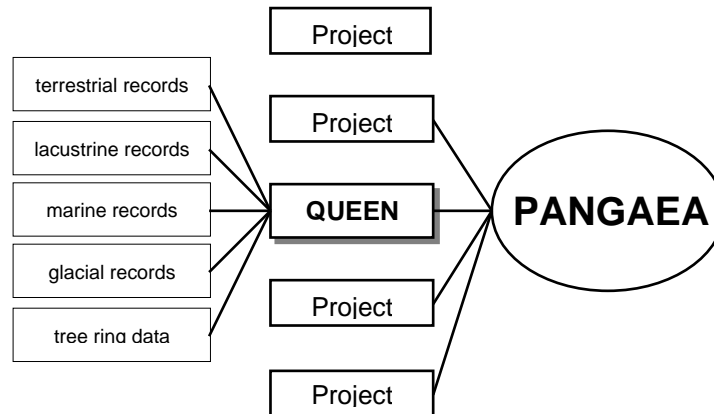
It has to be seen, however, that within this project only the foundations for a common system allowing a more advanced analysis of the data can be laid. But once the data base has been established in the network and the data content is up to date, future data additions can easily be made. It will also be possible to transfer data into Geographic Information Systems (GIS) for advanced or specialized data analysis in future projects.

1.4 Originality and innovation

Data provided by the scientific community of QUEEN can be from very different types of paleoenvironmental archives (Ref. 1). At present no compilation of any type of these records exists for the Arctic. The information system intended to be used for this project is PANGAEA (PaleoNetwork for Geological and Environmental Data). This system does not only allow to store data from one record type, but will also combine data from different paleoclimatic archives in one system. Due to its use by other projects at the same time and in the future, the system will become an increasing library for scientific data, giving scientists the unique opportunity to integrate data from different projects in an easy and quick manner on the same information system level. With a growing data inventory PANGAEA will provide a new and efficient tool to solve questions related to Global Change research.

The PANGAEA information system to be used for the QUEEN data management

- a) allows the compilation of data sets of various parameters from a single archive,
- b) enables the consistent storage of data from different archives/sources,
- c) brings together data from different projects and institutions,
- d) allows flexible data protection in the republishing phase,
- e) and ensures the longtime archiving and accessibility of all data.



Besides allowing the compilation of records from different (paleo)environmental archives for one project (e.g. QUEEN), PANGAEA allows the storage and distribution of further data from other projects at the same time.

2. Work content

2.1. General approach

The tasks outlined below will be achieved by

- a) three workshop meetings (one was already held in November 1997),
- b) the build up of the structures relevant to QUEEN in the information system,
- c) the establishment of the data flow between PANGAEA and the QUEEN group,
- d) the harmonization and conversion of data to be imported,
- e) implementing necessary technical adaptations,
- f) and the analysis of the compiled data according to the scientific requirements as defined during the workshops.

Each partner participates in the compilation of data and undertakes some special tasks related to the conversion and distribution of the data. There are further interested researchers from the scientific community who wish to join in the workshops and contribute to the information system. Their participation in this project will be coordinated by the partners according to nation or field of research. Communication and information exchange between the partners will be organized by the coordinator via e-mail and a QUEEN Web homepage.

The following records from natural archives may be included into the information system subject to the discussions on the first workshop. Included parameter groups are age determinations, sedimentology, mineralogy, micropaleontology, geochemistry, stable isotopes, physical properties, borehole logging, ice rafted debris, grain size, biomarker, structural investigations and descriptions.

QUEEN research includes data of:

- terrestrial origin from till, terminal moraines, melt water channels, permafrost, ground ice bodies, peat, tree rings, treeline, beach ridges, geomorphology, periglacial landscape,
- lacustrine origin from lake gyttja and sediments, glaciolacustrine sediments, fluvial sediments, river sections, estuarine sediments, ice-dammed lakes,
- ice including glacier records, glacier fluctuations, ice extent, iceberg production, mass balance, ice complex, sea ice,
- marine sediments from shelf, continental margin and deep sea

The relational data base behind the information system PANGAEA will not include data from seismic records, remote sensing, aerial photography and numerical modeling, but the data management group will provide sufficient ftp-server capacity to store larger data sets to be exchanged between the groups of QUEEN.

During the workshops the available data will be reviewed, the conversion to common units and variables will be established, the different data types/groups will be structured and the build up of the database will be discussed. The outcome will be a data flow sheet for the second phase which is devoted to the compilation/import of data in the information system and first analysis of data. In the third phase support will be given for the different groups for the analysis of the data and publication/dissemination of results will be prepared.

2.2 Tasks

Task 1 - workshops

Workshop I: Introduce participants to the interactive use, the tools and the possibilities of the information system, identify suitable datasets and variables to be collected in the common data base, draft of data flow plan.

Workshop II: Refine and adjust data flow plan, establish units and, where required, conversion routines/algorithms to harmonize data, discuss procedures for data collection, transfer and import.

Task 2 - Network buildup

Building up the data network structure including communication lines between QUEEN members and other projects relevant to Arctic research, presentation in the annual workshops, traveling for local support and introduction to the software, individual discussions on harmonization, conversion and import of data, introduce World Wide Web site (WWW).

Task 3 - Collection of data from various projects

For the collection and integration of data the information system PANGAEA will be used. At present some of the available data groups are heterogeneous both in respect to the variables determined and sampling strategy/frequency. Thus, the integration requires normalization of data and the conversion of proxy data to

paleoenvironmental data. Preprocessing of analytical data into acceptable formats will be provided by the individual groups with support of the data management group. Originators are requested to deliver their data at latest after publication of results in the scientific literature.

Task 4 - Data import/analysis

In a first step the metadata are imported, secondly the analytical and measured data are imported and will be related to the metadata. During the import data are procedurally checked for errors, consistency and completeness of meta-information. The different variables within the data base will, as a first approach, be analyzed for correlations. This will provide information on relationships which may be utilized to extend the geographical coverage of data obtained at only a few stations. For advanced analysis of data an export to a Geographic Information System (GIS) can be provided. The results of advanced analysis of data, e.g. maps, are not accessible via the relational database of PANGAEA but can be made available to the community on the common ftp-server on request.

Task 5 - Workshop III

Review the data collection and their analysis for areal representation. Identify gaps of sampling and knowledge and make suggestions for advanced analyses in future projects and further data collection.

Task 6 - Publication and dissemination of results

The achieved results will be made available to the scientific public via joint publications in relevant journals by the individual groups of the QUEEN project. A wider user group will be addressed by the QUEEN homepage presenting the most pertinent results and giving access to all data being published.

2.3 Data management plan and quality control

The data management plan includes the following steps:

- data collection by partners,
- quality control by data curators,
- data import with quality checking through validation routines by PANGAEA,
- support and data publication/dissemination

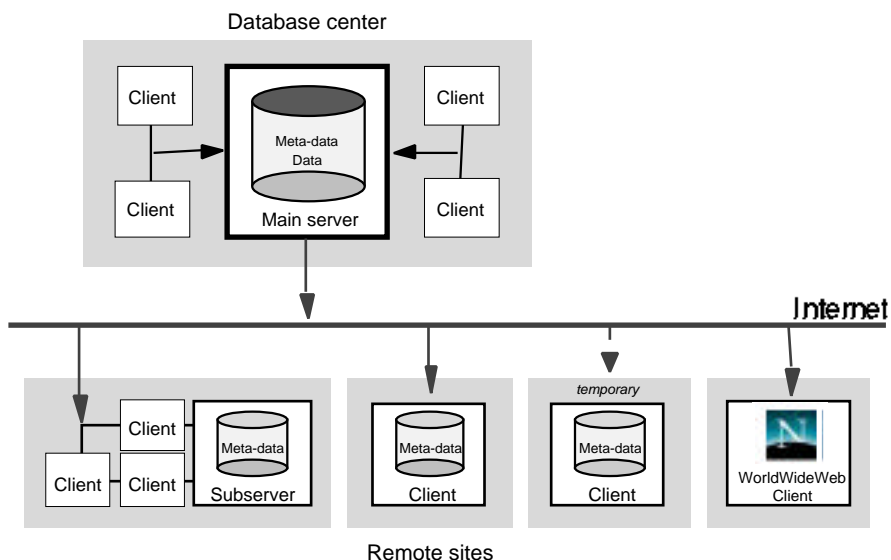
Approach

The working groups in the different partner institutions will provide quality checked data in suitable form to the coordinator. Each partner has to name a 'data curator', being familiar with the scientific background of the data. The data curator is responsible for the general quality of the data (validity and objectivity of measuring and calibration methods, error checking within the data sets), which are quality checked in a second step during the import into the system by the data curator of PANGAEA; validation routines will check e.g. for outliers or complete and valid

metainformation. The coordinator is responsible for supplying these data to the data base and for the processing and dissemination of data sets by providing the information system PANGAEA. In particular this includes:

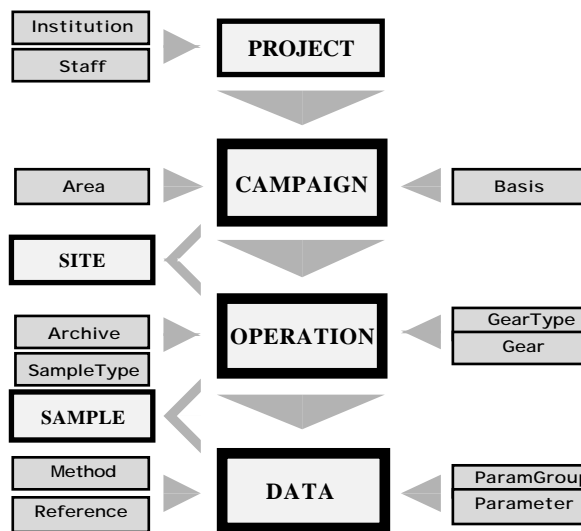
- import of data sets (including transformation of data sets into import formats and procedural quality checking within the system), links to the scientific publications,
- provide a WWW server for project specific information including an entry level for data retrieval, and links to relevant homepages of project members,
- prepare data sets and related metadata for mirroring on other sites on request,
- support working groups by collecting project relevant data from previous works and publications or digitizing maps, in data retrieval, handling and visualization in the phase of interpretation,
- supply software, data products, and interfaces for the visualization of data in mapping tools and Geographical Information Systems (GIS) for the synthesis of results.

The information system PANGAEA (Ref. 2) was developed through a project, financed by the German Ministry of Education, Science, Research and Technology (BMBF) at the Alfred Wegener Institute for Polar and Marine Research (AWI), Bremerhaven. The PANGAEA system uses client/server technology through the Intranet/Internet; the main database server is a DEC Alpha 8200 (4 processor, 2 GB internal memory, 50 GB hard disc capacity, similar to those used by the WWW search engine Altavista) running SYBASE Version 11 under DEC/UNIX as the relational database management software. The user-friendly client software for access to the server was written in 4th Dimension and can be used for MacOS and Windows as well. A web client, allowing read-only access to the system via a Java applet is under construction and will be available in 1998 (<http://www.pangaea.de>).



Network concept of the PANGAEA system. Data are accessible from the main server via the Internet by specific clients which allow the import of data and have a high functionality. General access on published data is provided through WWW clients.

PANGAEA allows the integration and correlation of ice, ocean and terrestrial records, and encourages the interpretation of large data sets by providing efficient retrieval and visualization tools. Problems arising from the great variety of parameters, methods, calibrations, and interpretations, typical for the field of paleoenvironmental reconstruction, are solved through a flexible and simple data model. (The data content of the system in 1997 includes about 80 000 sites of paleoenvironmental investigations/samples/observations with 100 000 related data sets of former or running projects, mainly from polar research.)



The structure of the data model reflects the standard processing steps for environmental data. Different institutes/projects (PROJECT) are working during different expeditions (CAMPAIGN) to take samples (SITE/OPERATION). From each SAMPLE one or more analytical DATA will be produced. Lists including standardized meta-information are connected to the main data fields (e.g. staff, reference). The combination of the DATA, PARAMETER and METHOD fields is the essential part of the model, which allows the definition of new unique parameters (text or numeric) by the user at any time.

- The PANGAEA-system is operable and is able to import any site oriented data of (paleo)environmental research and to store them in a consistent format. From the beginning, the system can be used as the central facility to store metadata as well as analytical data related to QUEEN research.
- Access to the data is realized in two ways. The client software allows a high functionality with comprehensive retrievals to extract data sets for specific requirements in nearly any combination of metadata and analytical data. The system can be installed in any group of the project if necessary. For public access on published data of the project, a web interface is provided.
- The long time archiving and accessibility of the data is ensured since the system is installed at an experienced computer center which is part of a Helmholtz Research Center (former Major Research Center). There is no similar system available at this time.

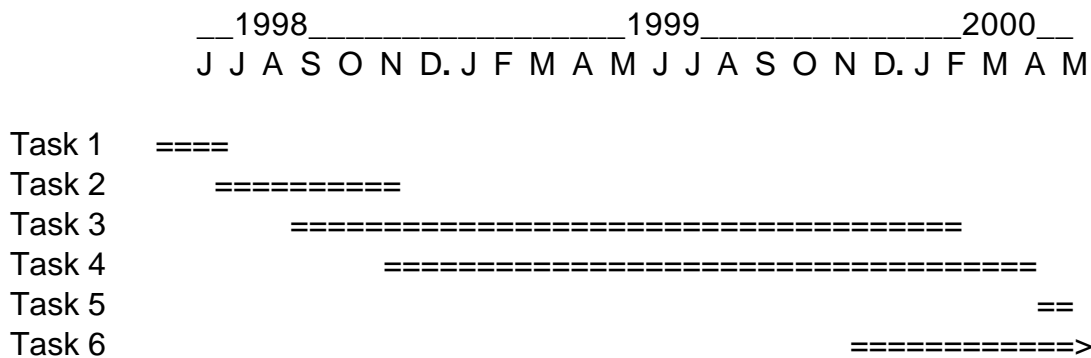
3. Project milestones and deliverables

3.1 Milestones

The project milestones comprise the workshops, the collection and import of data, and the electronic publication of the results in a common information system for exchange and long-term archiving. The time table gives an overview of the temporal distribution of the tasks. Collection and import of data will occupy most of the time section of the project. Data analysis and dissemination of results occupy the last third of the project.

The project is envisaged to start in June 1998 and to run for two years.

Time table:



3.2 Deliverables

- a) Common data base of paleoenvironmental data of the Arctic
- b) Representation of key paleoenvironmental variables versus time and space
- c) Description of paleoenvironmental changes
- d) Publication of data for further use in scientific journals and on the Internet
- e) Report of the project including identification of the gaps of knowledge and suggestions for further contributions to the data base and advanced analysis of data

4. Benefits

4.1 Added value

When science tries to come to large scale assessments, data distributed through a number of individual national projects are of little use. No single project is able to ensure the integration of all data. This particular task can be provided by the supporting action QUEEN/PANGAEA for paleoenvironmental data from the Arctic. Therefore it can help to extend the use of the data beyond the scope of the

individual projects. The data management structure is supposed to have a catalytic effect for the data exploitation. The efficiency of handling, sharing and integrating data should increase significantly. This point might become even more important, when more projects of (paleo)environmental relevance are managed through PANGAEA in the nearer future.

The reconstruction of environments from different natural archives of the past would contribute to the assessment of recent and future Arctic wide environmental changes. In addition to this objective, which helps to support the ESF project QUEEN, it provides also an important data base for the evaluation of any potential use of the Arctic. It would enable the identification of particularly sensitive areas and, thereby, aid political, economical and legal decision finding processes.

4.2 Relevance of carrying out at European level

According to the former points, the relevant data will be collected from a number of different national projects in Europe. Only by compiling all these data with including available Russian data, a sufficient data coverage of the Arctic can be achieved to tackle the objectives of QUEEN. The main target area of this project is the Eurasian continental margin including ocean, rivers and continental areas. It addresses an environmental crisis in Europe and thus has value in terms of general EU policies.

The implementation of an information system for Global Change research contributes to the improvement of the European research infrastructure. As part of the efforts to integrate systems for archiving, processing and exchanging data, PANGAEA will provide industrial and institutional users with processed and quality checked data as required for research and applications. In the future PANGAEA might contribute to the European participation in global research networks (e.g. GOOS (Global Ocean Observing System)).

4.3 Transnational participation

The partners are from five different institutions located in 4 nations (Germany, Sweden, Norway and Russia) acting as contractors. The project includes minor subcontractors of six institutes from three further countries (Denmark, Finland, Switzerland), also intending to contribute data. The inclusion of participants from outside the European Union is vital to this project, since important data particularly from the Siberian shelf seas and Arctic glaciers have been produced by Russian groups and need to be included in the data base. Some of these data are available in printed form only and an attempt will be made to convert those to quality checked electronic data.

The work carried out through QUEEN is relevant and complementary to other international organizations and programmes in the Arctic Ocean and exchange of

data and partial cooperation is an important task of the this project. Due to a close relationship between some of the programmes and QUEEN and the general accessibility of the data, other projects will get use from the data management for QUEEN. The research programmes listed below are in accordance with major Arctic Ocean research initiatives recommended by the Arctic Ocean Science Board (AOSB), the International Arctic Science Committee (IASC), and the International Conference for Arctic Research Planning (ICARP). Appropriate steps are being taken to ensure that the activities of QUEEN are linked closely to these organizations, but that duplication of efforts is avoided.

ACSYS	(Arctic System Science)
AMAP	(Arctic Monitoring and Assessment Programme)
APARD	(Arctic Paleo-River Discharge)
CAPE	(Circum Arctic Paleo Environment)
LOIRA	(Land-Ocean Interactions in the Russian Arctic)
MAGICS	(Mass Balance of Arctic Glaciers and Ice Sheets in Relation to the Climate)
NAD	(Nansen Arctic Drilling)
PALE	(Paleoclimate of Arctic Lakes and Estuaries)
PAGES	(Past Global Changes, core project of International-Geosphere Biosphere Programme)

Most of the programmes are still in its initial stage. The QUEEN/PANGAEA project could be seen as a first step in implementing an information system for a specific field of research in the Arctic. If this is successful, it could be the seed for a much more comprehensive data base in Arctic Global Change research.

5. Economic and social impacts

Reconstruction of environmental changes, understanding the natural processes in the Arctic and identification of potentially sensitive areas to e.g. climatic change is a key requirement for assessments in respect to any anthropogenic use or protection of areas in the Arctic. Thus, the basic information service provided by this project may aid in developing regulations/legislations for the use and protection of the Arctic and may support decisions related to Global Change.

Information System for the ESF/QUEEN Programme

QUEEN/PANGAEA

Part II: participants identified

6. Project management

The project comprises the coordinator with the PANGAEA group, 4 contractors, 5 associated contractors, further groups being involved in QUEEN and the ESF which supports and coordinates all common activities via its secretary in Strasbourg and the QUEEN secretary at GEOMAR.

The coordinator is responsible for the management of the project as well as for the data management itself and the dissemination of the results. The import of data to the data base will be carried out in close cooperation with the partners. The coordinator is supported by the secretary of the QUEEN project at GEOMAR by organizing workshops, maintaining communication between all scientists and providing the web pages. Communication will be maintained via e-mail and the WWW homepage of the project. Each of the partners will participate in the workshops and is responsible for the supply of quality checked data in correct formats for compilation and import. Full metadata documentation has to be provided with the analytical data.

Further scientists within the QUEEN community are interested to join the discussion and compilation of data. These additional experts will be invited to join the workshops and discussions. If they wish to contribute data, this will be coordinated by the partner who is resident in the same country or working in the same field of research. With the involvement of external experts, the extent of the data base, the quality of data analysis and the general discussions will be improved.

7. The partnership

7.1 Participants and task distribution

Contractors

Partner 1: Alfred Wegener Institute for Polar and Marine Research (AWI)

Columbusstrasse, 27568 Bremerhaven, Germany

Prof. Dr. Jörn Thiede (Chairman of the QUEEN Steering Committee)

Dr. Michael Diepenbroek (system manager)

Dr. Hannes Grobe (coordinator),

Dr. Rainer Sieger (data curator)

Dr. Hans Hubberten (AWI Potsdam, lake sediments, permafrost),

Dr. Ruediger Stein (AWI Bremerhaven, marine sediments)

Partner 2: Department of Quaternary Geology, Lund University
Sölvegatan 13, 223 62 Lund, Sweden
Dr. Christian Hjort, Dr. Per Möller (terrestrial, fluvial and raised marine sediment data)

Partner 3: Geological Institute, University of Bergen
Allégt. 41, 5007 Bergen, Norway
Prof. Dr. Jan Mangerud (terrestrial and lake sediment data)

Partner 4: Institute of Geography, Russian Academy of Sciences
Staromonetny pereulok, 29, Moscow 109017, Russia
Prof. Dr. Vladimir M. Kotlyakov, Dr. Serguei Arkhipov (ice core data bank)

Partner 5: Arctic and Antarctic Research Institute
38 Bering Street, St. Petersburg 199397, Russia
Dr. S. Pryamikov (terrestrial, lake and glacier data, paleotemperatures)

Minor subcontractors

GEOMAR Forschungszentrum für Marine Geowissenschaften
Wischhofstrasse 1-3, 24148 Kiel, Germany
Dr. Henning Bauch (QUEEN secretary)
Dr. Heidemarie Kassens (marine sediment data)

VNIKAM
Birzhevoy proyezd 6, 199034 St. Petersburg, Russia
Prof. Dr. Valery Astakhov (terrestrial/periglacial data)

Geological Museum, University of Copenhagen
Ostervoldgade 5-7, 1350 Kobenhavn K, Denmark
Dr. Sven Funder (terrestrial data)

Geological Survey of Finland
Betonimiehenkuja 4, 02150 Espoo 15, Finland
Prof. Dr. Matti Saarnisto (data from peat, lake gyttja and periglacial geology)

Geologisches Institut, Universität Bern
Baltzerstrasse 1, 3012 Bern, Switzerland
Prof. Dr. Christian Schluechter (lake and tree-ring data)

Geological Survey of Norway
Leiv Eirikssons vei 39, 7040 Trondheim, Norway
Dr. Eiliv Larsen (periglacial profiles)

The ESF is involved in being the umbrella organisation of the QUEEN programme.

European Science Foundation
1 quai Lezay-Marnésia, 67080 Srasbourg Cedex, France
Dr. Michele Fratta (ESF Scientific Secretary)

7.2 Competence of partners

The partners are all actively involved in paleoenvironmental research in the Arctic since many years. They are experts in their field of research with numerous publications and have access to the relevant data. Most of the recent major programmes in the Arctic are represented by this group of experts as indicated by the types of data which will be contributed to the PANGAEA system. The partners from Russia have been selected for their experience in environmental research in the Arctic and for their important data sets, which were produced during the last decades.

The project will be coordinated by *Hannes Grobe* (43, geologist), who has been involved in various projects related to paleoenvironmental and paleoclimatic research during the last 15 years (Ref. 7). Besides being a specialist for the analysis of marine sediments, he has experience with the sampling and investigation of lakes and ice. During 10 expeditions to the Antarctic and the Arctic he became familiar with polar research. Grobe is also experienced in data management while being the project leader for the development of the PANGAEA information system during the last 7 years.

Responsible for the development of the PANGAEA system software is *Michael Diepenbroek* (42, geologist/informatician) being involved in implementing the network in Germany during the last 5 years (Ref. 2). His scientific background is terrestrial geology/sedimentology, he is familiar with the sampling and analysis of polar lake sediments and is experienced in using data base management software and developing information systems. Within the QUEEN project, he will be responsible for the management of the data base and the client software and for the technical support of the participants.

The principles of data management through the PANGAEA system/group is based on data curators having scientific expertise on the data. The curator is responsible for the transfer of data between principal investigators and the data base and for the import of the metadata and analytical data. Curator responsible for the import of QUEEN data will be *Rainer Sieger* (36, mathematician/informatician). Sieger is a specialist in modeling environmental data. He writes software since 12 years and was involved in the establishment of the PANGAEA system by contributing the visualization tools.

The scientific data and computing center to be used for this project provides the infrastructure for the information technology at the AWI and for the PANGAEA system. The center employs 17 scientists and engineers. The data center has a 10 year experience in the development of scientific information systems covering the fields of glaciology, geology, meteorology, oceanography, chemistry, and

geophysics. The computing center works in close cooperation with the users/scientists, necessary for a successful management of information systems. The center maintains the National Polar Data Center in cooperation with the Scientific Committee of Antarctic Research (SCAR) and the International Arctic Science Committee (IASC).

The AWI dependency, Potsdam (*Martin Melles*) carries out research on lake sediments and permafrost since 1992. The group will provide analytical data from high resolution studies on cores from Arctic lakes and will support the data management group by its competence on periglacial/permafrost research (Ref. 3).

During the last 10 years GEOMAR, Kiel (*Heidi Kassens*) and the Arctic group at the AWI, Bremerhaven (*Ruediger Stein*) have carried out intense research on marine sediments in the Barents, Kara and Laptev seas as well as in the deep Arctic Ocean, providing data from sedimentological, geochemical and physical investigations/analyses on marine sediment cores (a.o. Ref. 4).

The Department of Quaternary Geology, Lund (*Christian Hjort, Partner 2*) has done QUEEN related field work in Siberia. The related different parameters and age determinations from terrestrial and fluvial records will be included in the system. Other data may result from a Russian/Swedish cooperation on the investigation of marine coastal sediments (Ref. 5)

The Department of Geology, University of Bergen (*Jan Mangerud, Partner 3*) is specialized on the reconstruction of the Weichselian ice sheets and related deposits. The group will provide data on ice dammed lakes and paleodrainage, age models (Ref. 6).

The Institute of Geography, Moscow (*Serguei Arkhipov, Partner 4*) hosts a complete and comprehensive data collection from deep drilling of glaciers from different Soviet-Russian projects in the Arctic between 1975 and 1990. About 20 different parameters from physical and chemical investigations will be converted and included in the common QUEEN system (s. letter of intent, description of data bank).

The Arctic and Antarctic Research Institute, St. Petersburg (*Sergey Pryamikov, Partner 5*) will provide unpublished data about age determinations of terrestrial sequences and ice core data from Severnaya Zemlya. An important contribution will be the paleotemperature reconstructions from periglacial lakes (s. letter of intent).

8. Financial information

The central server of the information system PANGAEA, the related web server and the ftp-server, including hardware, software and connection to the Internet will be

Finally the project will suggest further ways of advanced data compilation to make optimal use of data from different projects. This may form the basis for future research and data management projects. Such analyses may for instance be focused specifically on questions related to exploitation of global paleoclimatic reconstructions and environmental changes.

9.1 Dissemination of results

The results of this project will be made available by publications of the individual groups in scientific journals. This will address the scientific community involved in QUEEN and related fields of research. Further information will be provided by the implementation of the web site. This will show the most pertinent results in a form easy to access and understand and will also give an introduction on the system and the project. The most powerful tool for the dissemination of data and results will be the web client, accessible via the PANGAEA homepage which will allow overall access on published data; limited access will also be possible on unpublished data by using a password. The web pages will be available within the first year of the project (<http://www.pangaea.de>).

Risks to be considered are mostly related to the data flow from the principal investigators to the data management group. Trust in the system and cooperation with the management group will be ensured by giving comprehensive information on the workshops and during local presentations in the related institutes. Support will be given by the members of the steering committee in forcing the groups to publish and deliver their data.

9.2 Target user group

The international scientific steering committee of QUEEN intends to implement a data management with the aim to link the knowledge about the different spheres of the Arctic environment (hydrosphere, cryosphere, biosphere, geosphere) providing geoscientific information in an interdisciplinary framework. This will finally support linkages between QUEEN and other programmes of Arctic research listed in 4.3. Most important is the link to the IGBP core project PAGES (International Geosphere-Biosphere Programme/Past Global Changes). The results of this project contribute necessary information for global paleoclimatic reconstructions within PAGES; due to the Global Change aspects of QUEEN, the data base will be useful for all members of the IGBP community.

The results of this project will also be available for governmental agencies involved in environmental protection and anthropogenic use of the Arctic. The project will provide basic information required for environmental protection measures or exploitation. Up to now, this information is not available in such condensed and easily accessible form.

9.3 Contribution to management for the sustainable use of the ocean

The Arctic Ocean surrounded by industrialized nations will be more subjected to anthropogenic disturbances and climatic change than any other oceanic/coastal regions. In particular, the need to dump different types of waste may increase as storage on land is limited. Such activities require well founded assessments of their impacts on the respective environment in order to protect sensitive areas and to regulate the exploitation of this resource. The data base will contribute the essential information for such assessments.

10. Ongoing projects and previous proposals

Ice Sheets and Climate in the Eurasian Arctic at the Last Glacial Maximum

EU/Environment and Climate, coordinator: John Svendsen, Bergen

This project is a terrestrial branch of QUEEN and needs a large sedimentological data base for the verification of ice sheet modeling. This project will make use of data in PANGAEA more than providing own data.

Geographical information systems for the archiving, exchange and manipulation of climate-related observations of Eurasian Arctic glaciers and ice caps (GISICE)

ENRICH/Environment and Climate, coordinator: Julian Dowdeswell, Aberystwyth

This project deals with ice-surface topography and satellite/aerial photographic images from the Arctic to be exchanged between groups and visualized/interpreted with GIS systems. The data used in this project can not be included in the PANGAEA system (s. 2.1).

In Germany the PANGAEA system is or will be used for the data management of different projects, also contributing with paleoenvironmental data to a common data library. (SFB: Special research project, funded by the Deutsche Forschungsgemeinschaft, DFG; SPP: Schwerpunktprogramm)

- the south Atlantic during the late Quaternary (SFB261, DFG),
- environmental changes: the northern North Atlantic (SFB313, DFG),
- climate related processes in geo-eco-systems (SFB275, DFG),
- changes in the geo-biosphere during the last 15 000 years (DFG-SPP),
- natural climatic variability during the Holocene (BMBF)
- 6 smaller projects within the national paleoclimatic research programme (BMBF)

PANGAEA will also be used for the data management of benthic data produced within JGOFS (Joint Global Ocean Flux Studies) through the EU/ENRICH project ADEPD (Atlantic data base for exchange processes at the deep sea floor).

A previous proposal on QUEEN data management was submitted in January 1997 (PL970093) which was not accepted.

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