Geological Survey of Finland
GTK

ANNUAL REPORT 2002
CONTENTS

Director General’s Review 4
Board’s Review 5
Index maps 6
Programme activities
  Bedrock and raw materials 8
  Land use and environment 14
Geoservices 20
Information management 22
International activities 24
Finance and administration 28
GTK publications and reports 35
Staff publications and reports 40
GTK’s cooperation networks 49
Organization and management 50
GTK’s vision

GTK is a leading force in the production and interpretation of geological information and a centre of excellence. Investing in geological information will support sustainable development.

Mission

To create conditions for supporting sustainable raw materials supply and land use.

Objective

To create prosperity and welfare for society at large.

GTK in short

- Geological Survey of Finland (GTK) is a national geological research centre
- GTK was established in 1886
- GTK is a result-oriented expert organization under the Ministry of Trade and Industry
- The personnel is about 800
- The overall costs in 2002 amounted to EUR 48.2 million
- The income from contract services was EUR 6.7 million
- GTK has offices in Espoo, Kuopio and Rovaniemi
- The activities were guided by two strategic programmes:
  - bedrock and raw materials
  - land use and environment
The Geological Survey of Finland (GTK) was given good marks in feedback during its results negotiations with the Ministry of Trade and Industry. We have reached our targets and even exceeded them. However, our operating environment is changing rapidly and we have to be ready and able to take advantage of any new opportunities that come our way.

GTK has always enjoyed good cooperation networks and this trend continued in 2002. The roles of the two new professors, one a fixed-term professorship in stone research and the other a joint professorship in environmental chemistry set up in collaboration with the University of Kuopio, should help to activate links with industry and research institutes.

International projects are again on the increase, happily including EU projects, which support research at the European level. Progress in projects in the neighbouring areas, on the other hand, has again been sticky so we shall be giving them special attention in the future.

GTK and the Mozambique Ministry of Mineral Resources and Energy signed an agreement to carry out a four-year geological survey project in eastern Mozambique. The aim of the project is to develop basic geological information to meet the needs of mineral exploration in the region.

GTK hosted the annual meeting of FOREGS (Forum of the European Geological Surveys Directors) in Espoo on September 3-7, and the Executive Committee of EuroGeoSurveys met at the same time. Three seminars were also organized at the forum, introduced by experts from organizations outside FOREGS such as Metla, the EU Directorate General Environment and the European Soil Bureau. The seminars examined geology and sustainable development, the role of the European geological research institutes in soil formation research and geochemical risks.

In May, before the start of the fieldwork season, we held a Geology Day at various GTK sites. The idea was to aim the Geology Day events at young people in particular, so excursions were organized with groups from different schools in Kuopio, Rovaniemi and Espoo, to give them a chance to learn something about local geology.

GTK has been actively increasing the use of its varied datasets through Internet services. The GEOKARTTA (geomap) geological resources service, available to everyone via the Internet, was published in 2002. Digital Quaternary deposits maps and map sheet explanations can be browsed and ordered over the Internet. Other geological map resources at a general scale are also linked with the service. Internet services are one of GTK’s key development targets.

The GTK vision was updated on the basis of thorough preparatory work carried out in close cooperation with the entire staff. The work was based on feedback from last year’s mapping of working atmosphere. Vision 2011 and GTK’s shared values give us long-term guidelines for GTK operations. We have to learn how to listen to the customer better, as it is he who is the user of our information, expertise and research results. It is effectiveness that guides our operations, whether it is a matter of research, surveying or commercial services.

A survey of GTK staff competence was completed at the end of the year. The aim of the project was to clarify the staff’s current expertise, define critical areas of expertise in the future and determine the need for new expertise guided by GTK’s vision and strategy. A substantial amount of material has immediately become available for guiding GTK staff training and for planning and implementing long-term recruitment of new staff.

I want to extend my warmest thanks to the GTK staff for an excellent year and I also want to thank our associated shareholders and partners. Last year has given us a sound basis for the success of GTK operations in the future.

Raimo Matikainen
Society needs geological information to make the right decisions

For the Geological Survey of Finland (GTK), 2002 was another successful year. We increased the impact of our operations by expanding areas in which we are strong and by aligning our activities with the needs of society.

The year under review brought us new activities and worthwhile experience from many of the activities begun earlier. Field work on deep reflection seismic survey soundings in southern and Central Finland was completed and the first analysis results became available. This has increased our knowledge of Finland's bedrock to a depth of 50-60 kilometres.

One very important investment decision was the agreement signed with the Naval Research Institute for a new research vessel. It is a substantial investment and should be of great benefit to both sides.

There was considerable development in the stone sector. At the end of the year a new fixed term research professor's post for the natural stone sector was established at the GTK Kuopio unit. The Finnish Stone Centre, which is under construction at Juuka and is a joint networking project set up by a number of organizations, will also help to promote development, commercial activity and recognition of the stone sector. GTK is involved in the project as an expert advisor. There are many beautiful varieties of high-quality stone in Finland that are well suited for building and other purposes. It is important that the Finns learn to have a broader understanding of the value of stone.

Environmental issues are challenging ones. In the future, we are going to have to resolve environmental issues to a much greater extent and for that we need information. GTK and the University of Kuopio have come to an agreement about a professor for the environmental sector. GTK has an important part to play as an impartial expert in environmental research and thus makes a contribution to the whole of society. Industry also needs the backing of environmental data. For example, society is going to demand more and more environmental responsibility from the minerals industry and this will require carefully researched information.

GTK has extended its customer base for commercial services and has won an extensive survey project in Mozambique against stiff international competition. This project is an important challenge due to its size and it may well bring further interesting assignments enabling GTK to help promote sustainable development on a global basis.

Adoption of the GTK quality system has continued as planned. A comprehensive quality policy helps to ensure high-quality operations and the ability to provide services. The quality system is of assistance to both GTK and to our customers.

GTK activities have long been important to society, especially to business and the world of economics, not just during the year under review. GTK has had a long-term cooperative relationship with society at large and, as a representative of industry I can vouch for the staunch support that GTK has from the outside. The services provided by GTK enable industry and society to work together for the good of mankind by making the right decisions on raw materials and environmental issues.

We will always need information about the Earth's crust. Society needs metals, industrial minerals, building stone, ground water and a clean environment, so there will always be new fields of work for expert organizations like GTK.

Christer Sundström
Turveinventointi
Torvinventering
Peatland research

Suomalasta inventoitu 75-100 %
Invented peatland area 75-100 %

Suomalasta kartoitettu 50-75 %
Invented peatland area 50-75 %

Suomalasta inventoitu 25-50 %
Invented peatland area 25-50 %

Suomalasta inventoitu < 25 %
Invented peatland area < 25 %

Kartoitettavana 2002
Inventering pågår 2002
Survey in process 2002

Matalalentomittaukset
Aerogeofysiska mätningar på låg höjd
Aerogeophysical low-altitude surveys

Mitattu 2002
Mätningen utförd 2002
Surveys completed 2002

Mitattu 1972-2001
Mätningen utförd 1972-2001
Surveys completed 1972-2001
In 2002, GTK continued to digitize existing mapping data. Work on the Standard Operating Procedures on bedrock and raw materials mapping that form part of the GTK’s quality system was completed. Work on developing a model of the zones of weakness in the bedrock in the Helsinki region and suitability for construction was completed.

GTK submitted five new ore exploration reports to the Ministry of Trade and Industry. Exploration for base metals, gold, platinum metals and ilmenite and calcareous rock were conducted in the year under review. Building stone and rock aggregate studies were also carried out, most studies being commissioned by customers or jointly financed. Under the debt conversion programme between the Finnish and Russian governments, deep seismic reflection sounding and testing of electromagnetic geophysical equipment were continued. In contract services the income generated by the Bedrock and raw materials programme declined somewhat on the previous year.

Regional mapping programmes

The airborne survey programme covered 21 097 km². Airborne geophysical mapping of sea areas was started in southwest Finland. External parties commissioned some 20% of airborne surveys. Regional gravimetric surveys were carried out for customers in the mineral industry, other measurements were performed mainly in the schist area of western Finland.

The Quality Manual on bedrock mapping was adopted. Mapping guidelines are part of the GTK’s digital data collection operations. Under the GTK’s materials project, a total of 65 000 items of mapping data were digitized and almost 7000 new items of mapping information were added to the bedrock database which at year-end comprised about 270 000 digital items of bedrock mapping. Four new maps at a scale of 1:100 000 and three explanatory texts were completed. Map production based on ArcView was improved to meet the needs of external customers and GTK itself more flexibly. In northern and eastern Finland, bedrock was mapped primarily in areas that the minerals industry is interested in. In western Finland, further work in mapping the schist area was carried out at a scale of 1:250 000.

Urban geology

The three-year project to develop a model for the suitability of bedrock for construction in the Helsinki region was completed. The project was planned and conducted in cooperation with the National Technology Agency Tekes, the cities of Espoo, Helsinki and Vantaa and businesses in the sector. The project examined the geological structures, fault zones and planes of weakness and fissures by linking them to geological and tectonic events in order to determine how fragmented the bedrock is in the area. A map of construction suitability was drawn up for the area, based on geological and geophysical information. The map can be used in local and regional planning, transport route planning, rock construction, taking inventories of ground water in the bedrock and inventories of aggregates, assessment of pollution risk and radon investigations.

The study was reported in three parts: Method development and guidelines, Construction feasibility map 1:50 000 of Espoo, Helsinki and Vantaa, and Explanatory text to the construction feasibility map. The project demonstrated that basic geological and geophysical information can be turned into a product that serves society. A follow-up project was launched, named KallioINFO (Rock info). It is financed by Tekes, the Uusimaa Regional Environment Centre, The Finnish Road...
A summary of radiometric dating work carried out in bedrock in Lapland was published in the GTK Special Paper series. The bedrock of the Lapland fells varies considerably in age and composition. Levitunturi fell is formed mainly of quartzite 1.8-1.9 billion years old, as are Ylläs, Aakenus, Kumpu and Pyhätunturi fells. A block field of in situ weathered rock can be seen on the slopes of Levitunturi.

Photo: Jari Väätäinen.
Administration, the Topographic Service, JP Suoraplan, and the municipalities of Hyvinkää, Järvenpää, Kerava, Sipoo and Tuusula.

**Mapping of mineral raw material resources**

A quality manual was adopted for the mapping of and exploration for mineral raw materials. The quality system also encompasses all support services concerning field and laboratory activities. In raw material research, GTK considers it essential to observe the principles of sustainable development. As a producer of basic information in an increasingly international field, it plays an important role in guarding the precious balance between exploration for ores and environmental values.

GTK strategy states that its targets in mineral exploration are based on research and modelling. It has strengthened its knowledge base through international research cooperation. Exploration for minerals met targets and five new exploration reports were submitted to the Ministry of Trade and Industry for marketing for further exploration:

- nickel at Rytky in Leppävirta
- ilmenite at Kairineva in Halsua
- calcite–wollastonite at Kuovila in Pohja
- calcite at Hakala in Sauvo
- soapstone at Heiskasensuo in Juuka.

Work on improving the methods of mineral exploration is based on increasing the depth dimension of electromagnetic methods and making results easier to interpret.

**Metallic ores**

Exploration for nickel and gold continued in eastern and northern Finland, as did exploration for chrome, nickel and platinum metals in layer intrusions. The joint venture with industry on the Koillismaa layer intrusions ended. Studies were initiated in northern Finland to assess the likelihood of ore types containing iron oxide, gold and copper. In central and southern Finland, exploration concentrated on massive sulphide ores and gold.

A geological ore model of Outokumpu was completed under the Geomex project, which is a joint venture with the industry. The model will be tested in a modelling project carried out in collaboration with the Australian Commonwealth Scientific and Industrial Research Organization CSIRO.

In the Vihanti-Pyhäsalmi area, exploration concentrated on the assessment of ore potential in mineral occurrences and identification of ore formation. Field and laboratory studies were conducted in collaboration with the Australian James Cook University. The intention was also to locate new rock units and zinc mineralizations that are likely to yield ore, using rich geophysical, geochemical and bedrock geology material and analyses. The data generated in the study was compiled as a comprehensive data package that was used in both regional and site modelling.

The ore potential of the central Lapland and Kotalahti nickel belts was studied in collaboration with CSIRO. The aim is to see whether possible nickel ore formation that has taken place deep in the Earth’s crust is in evidence in volcanic rock that has made its way to the surface. Major and trace elements were analysed in the aggregate, with special emphasis on platinum metal concentrations, which are low in the volcanic rocks if nickel ore has formed. Sampling in the komatiite area in Sattasvaara and the nickel belt in Kotalahti was completed.
**Industrial minerals**

There is a growing demand from Finnish industry for pigment minerals, which GTK is seeking to answer by exploration for industrial minerals. Exploration for ilmenite took place in western Finland and for carbonaceous rock in southwest Finland. The most promising deposits are the calcite-wollastonite deposit at Kairineva in Halsua and the calcite deposit at Hakala in Sauvo. Companies exploring for diamonds in eastern Finland largely turned to GTK. Indeed, its diamond exploration services have become an important part of GTK service sales. Research and development was carried out in collaboration with customers and the Academy of Finland also supported diamond exploration.

The GTK mineralogical research laboratory improved the processing of exploration results for industrial minerals to ensure that they are comparable. Extensive mineral analyses and process mineralogical studies were carried out for the industry and the analysis of diamond indicators was improved.

**Stone and aggregates**

Imports of natural stone have declined in recent years. In contrast, the use and export of Finnish stone have increased and stone has become more popular especially in environmental construction.

It is GTK’s aim to map Finland’s stone resources in their entirety and ensure that the stone industry will have access to raw material and use it in a sustainable manner. The results of exploration surveys in South Karelia and Kymenlaakso and proposals for further exploration were presented to businesses, while jointly funded stone projects in central Lapland and eastern Uusimaa were completed. A new
Deep structural studies of bedrock were continued as part of the debt conversion programme between the Finnish and Russian governments. The deep seismic reflection sounding project is being performed in collaboration with the Institute of Seismology at the University of Helsinki, the Institute of Geosciences at the University of Oulu and the geophysical observatory at Sodankylä. The sounding work is being carried out by the Russian State-owned company Spetsgeofizika.

The deep seismic measuring signal is generated by five specially built vibration vehicles, shown here on the road to Keuruu.

Photo: Ilmo Kukkonen.

GTK took an active part in planning and building the Finnish Stone Centre in Juuka. The purpose of the Centre is to enhance general awareness of natural stone, expand the Finnish stone industry, conduct research and development and training projects and generate new small-scale business activity in the region.

The inventory of bedrock aggregate was continued in east Uusimaa and Kymenlaakso as part of the POSKI project to integrate groundwater protection measures and aggregate supply. In addition, GTK conducted a geological survey for construction purposes of the bedrock on the planned railway shortcut between Kerava and Lahti. Stone and aggregate studies commissioned by local authorities and businesses were also carried out. Stone and bedrock aggregate studies were conducted on the western and southern coasts of Greenland in collaboration with the Geological Survey of Denmark and Greenland.

Promoting the minerals industry

GTK improved its Internet services and web site which provide the minerals industry with information on Finnish bedrock, ore exploration opportunities, GTK material and Finnish legislation. The Ministry of Trade and Industry transferred the marketing of GTK exploration targets to the Internet, which increased business interest in Finland.

GTK has contributed to the development of the biennial Fennoscandian Exploration and Mining (FEM) conference held in Rovaniemi. A cooperation agreement has been signed by FEM and the PDAC (Prospectors & Developers Association of Canada) held annually in Toronto to promote the recognition of Fennoscandia and Finland in the prospecting and mining sector. GTK also has a visible presence at the annual IMI conferences (Industrial Mineral International Congress) and at the international stone fairs at Carrara and Nuremberg.

The industry-led KIVI (=rock) technology and development programme was completed. One of the key GTK projects was the creation of an environment system for the stone sector. New ideas and products were also developed during the project. GTK stone research and development activities were strengthened substantially with the creation of a new research professorship and new applications are being developed to increase the use of stone and promote sustainable development.

Further studies were conducted on sites found by GTK and additional investments were made in accordance with sales agreements signed between the Ministry of Trade and Industry and the companies concerned. Following international competitive tenders, companies launched follow-up studies at the calcite deposit at...
Hyypiänmäki in Kisko and at the calcite-dolomite deposit at Iso-Sorro in Kisko. A private company continued profitability studies on ilmenite at Koivusaarenneva in Kälviä.

The Northern Finland Environmental Permit Authority has granted a mining permit for the gold deposit located by GTK at Suurikuusikko in Kittilä.

Work started on planning a project to compile a metallogenic map of Fennoscandia in collaboration with the Geological Surveys of Norway and Sweden and organizations that come under the Russian Ministry of Natural Resources. GTK will act as the project coordinator. The map and the related databases will help to assess the ore potential of the entire Fennoscandian shield.

The Peuraneva fold structure has been modelled as part of the zinc research in the Vihanti area. The model is based on geophysical interpretation and deep drilling data. The colours show the magnetism of the models, which increases from white to green via yellow and blue. Model: Aimo Ruotsalainen.

**The Northern Finland Environmental Permit Authority has granted a mining permit for the gold deposit located by GTK at Suurikuusikko in Kittilä.**

**Work started on planning a project to compile a metallogenic map of Fennoscandia in collaboration with the Geological Surveys of Norway and Sweden and organizations that come under the Russian Ministry of Natural Resources. GTK will act as the project coordinator. The map and the related databases will help to assess the ore potential of the entire Fennoscandian shield.**

**The Peuraneva fold structure has been modelled as part of the zinc research in the Vihanti area. The model is based on geophysical interpretation and deep drilling data. The colours show the magnetism of the models, which increases from white to green via yellow and blue. Model: Aimo Ruotsalainen.**

---

**BEDROCK AND RAW MATERIALS 2002**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Planned</th>
<th>Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claims related to mineral exploration, hectares</td>
<td>7 000</td>
<td>12 298</td>
</tr>
<tr>
<td>Economically significant exploration targets</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Aerogeophysical surveys, line km</td>
<td>120 000</td>
<td>133 000</td>
</tr>
<tr>
<td>Gravimetric surveys, km²</td>
<td>2 000</td>
<td>1 200</td>
</tr>
<tr>
<td>Bedrock mapping, km²</td>
<td>800</td>
<td>5 263</td>
</tr>
<tr>
<td>Bedrock maps 1:100 000</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Bedrock observations/KALPEA</td>
<td>7 000</td>
<td>6 857</td>
</tr>
<tr>
<td>Inventory of rock aggregates, km²</td>
<td>1 500</td>
<td>1 500</td>
</tr>
</tbody>
</table>
Active cooperation with stakeholders and customers has helped to ensure the effectiveness of the land use and environment programme and determine its development needs. As a whole the programme was able to meet its targets and produce useful results, while specific performance targets in mapping were all achieved. More scientific articles than ever before were published in international series, especially on the subject of global change and on research into the disposal of nuclear waste. The Barents Ecogeochemistry project, dealing with mapping of environmental geochemistry in northwest Russia, progressed to the reporting stage.

The project on an environmental information system for natural stone production, which is part of the Tekes KIVI Technology Programme, was concluded. Two EU projects were in progress and three new ones were launched. Under the EU Sixth Framework Programme, a number of preliminary applications were drawn up within the Network of Excellence dealing with sustainable use of natural resources and the environmental impacts of climate change. Preparatory work was carried out in conjunction with the Ministry of the Environment on an accounting system for extractable natural resources. An agreement was drawn up with the University of Kuopio on establishing a joint professorship linked with the minerals industry and research on the environmental impact of land use. GTK expertise was used in a number of ways including preparatory work on legislation connected with the sector and international applications of it. Work continued on linking our operations to our quality system and, in practice, all the mapping functions of the programme came under the quality system by the end of the year.

Quaternary deposits and marine geological mapping
In the mapping of Quaternary deposits at 1:20 000 and 1:50 000 scale, the main focus remained on digitizing which is intended to make the material more easily available and user-friendly. Annual targets were clearly exceeded and as a result, the main part of the digitizing operation will be concluded in 2003. A study was carried out on mapping needs and the results will be used to focus mapping on a regional basis. Most of the new mapping took place in the coastal areas of southern Finland and around Oulu, both important regions in terms of land use, and a total of ten base-map areas were mapped altogether.

Geological soundings and surveys of the seabed were carried out mainly off coastal towns on the Gulf of Bothnia and in the vicinity. One third of the survey work was carried out with joint funding from Metsähallitus (Finnish Forest and Park Service). As a result of contract work on fairways and route clearance, sounding targets were exceeded by almost double. The joint research vessel project that is being implemented in conjunction with the Naval Research Institute progressed to the tender and contract stage, and the procurement contract for the vessel was signed with a Finnish shipbuilder in late autumn.

Natural resources mapping
Mapping of soil, rock and aggregate resources continued in a number of areas in southern, eastern and southeastern Finland in the form of POSKI projects intended to harmonize the requirements of ground water protection and the supply of aggregates. In addition to GTK, these projects are being funded jointly by the local Regional Councils, the environmental administration and by some important companies in southern Finland and Kymi.

Projects in the sub-regions of Kymi, eastern Uusimaa, Outokumpu and Joensuu
Soil and soil formation map of Sotkamo. GTK carried out a pilot project in collaboration with Agrifood Research Finland (MTT) and the Finnish Forest Research Institute (Metla) to study the production of digital information at a scale of 1:250 000 on soil types and soil formation using the latest data-processing technology. The results showed that by applying interpretation and carefully targeted fieldwork, high-quality new information can be produced both on unchanged soil or soil types, and on soils with a changed surface layer or soil formation types. As a result it was decided to begin a five-year project to produce datasets on soil types and soil formation types covering the whole country. User needs are being taken into account as carefully as possible. The datasets will be of benefit in land use planning, environmental conservation, agriculture and forestry, and defence strategy and will serve EU needs, as well.

Contributions by research institutes to the joint soils and soil formation project. The results of the project are also being stored in the European Soil Bureau information systems to meet EU needs. Photos: Raimo Nevalainen.
were coming to an end and the survey results were reported to the partners concerned. A new POSKI project was launched in the sub-region of Central Karjala. A follow-up plan was drawn up in conjunction with the environmental administration to extend the POSKI concept to areas where there is an established need to harmonise aggregate supply and water supply. Several detailed inventories were carried out and extraction schemes prepared for companies, in the form of contract work.

In conjunction with work on updating the Land Extraction Decree, GTK discussed the issue of extractable natural resources accounting with the Ministry of the Environment. The aim is to commence work in 2003 on constructing a system that will permit such accounting as a cooperation project between GTK and the Ministry of the Environment.

In the mapping of groundwater areas, the focus was on the most important esker aquifers in the vicinity of built-up areas. The projects were coordinated with the Finnish environmental administration and the water cooperatives, who also provided some of the funding. GTK’s role is to determine the geological and geophysical methods by which the geological structures have been formed and the conditions for storage and flow of groundwater, which form the basis for sustainable use of groundwater and other local land use planning. The results also contribute to the aims of the EU Water Framework Directive. Research was conducted on the Vihanti ridge and several parts of the Salpausselkä ridge in connection with the VIRMA flow modelling project, which is a joint GTK/VTT operation.

GTK continued its development project on the three-dimensional structural survey of aquifers. It also charted the need for structural surveys of groundwater areas in order to draw up a systematic survey programme for them.

In line with the needs of the industry, fieldwork on peat deposit mapping was focused on Central Finland, Ostrobothnia and southern Lapland. To ensure that the selection of areas would satisfy all the parties concerned, the Ministry of Trade and Industry organized a research coordination meeting for representatives of the peat industry and the most important producers. Altogether, an area of over 30 000 hectares was surveyed, 10% of which was contract work for private investment. GTK took part in the study on estimated future use of peat, commissioned by the Ministry of Trade and Industry. The extent of the survey corresponds well with the latest calculations on the survey work required annually to secure the raw material reserves needed by industry.

The results from surveying peat reserves in eight municipalities were published in report form. The reported results comprise 7718 hectares of peatland suitable for peat energy production, which contain a total of 121 million cubic metres of energy peat. In terms of energy content this corresponds to 60 TWh, or almost three times the amount of energy currently generated from peat annually. Some 1722 hectares of the reported area contain 12 million cubic metres suitable for use as garden peat, roughly six times the amount of garden peat used annually.

The project studying the environmental impact of natural stone production, which had been running for many years, was completed. The project was part of the Tekes KIVI technology programme and it studied the impact of stone production on groundwater. The picture above shows drilling for water in the rock and, below, water samples are being taken from the borehole for chemical analysis. Photo above: Miikka Paalijärvi, photo below: Olli Breitin. Natural resources and the environment

Studies of the environmental condition of disused mines in eastern Finland were continued in a number of places in cooperation with industry and the universities, either with joint funding or as contract work. The research focused on the flow of seepage waters from sulphide mines with high metallic and arsenic content. The idea is to develop sustainable and economic remediation measures for managing the problems caused by the harmful environmental impacts of sulphide mines. A report was published on the suitability of solubility tests in determining the
environmental eligibility and fitness for landfill sites of by-products from the mineral industry.

The EU financed MINEO project reached the reporting stage. The project is assessing and monitoring the environmental impact of mining and quarrying using advanced Earth observation techniques and will be completed in 2003. A project on an environmental information system for stone production, which is part of the Tekes KIVI Technology Programme that has been running for several years, was

The Barents Ecogeochemistry project is surveying the state of the geochemical environment in northwestern Russia and northeastern Finland and Norway. The five-year project (1999-2003) is mainly being financed by neighbouring area funding from the Ministry of the Environment and the Ministry of Trade and Industry, GTK and various Russian organizations including the Ministry of Natural Resources. The project is based on the accurate chemical analysis of a variety of natural materials such as soils, mosses and stream water, which can be used to determine the extent to which variation in chemical concentrations is caused by natural geological factors, which in turn are caused by humans. Results from the project will help in regional economic development and environmental care. The project is on schedule and has progressed to the report stage.

The illustrations show variations in the sulphur content of moss and the sulphate content of humus. The high sulphur content in mosses around St Petersburg and in southern Finland reflects the impact of human activity. Variations in the sulphate content of stream water are mainly due to natural causes. In the red areas on the map concentrations are high and in the blue, low.
concluded and the final report prepared for printing. The project had been studying the effects of noise, vibration, dust and water in the stone production industry in cooperation with industry and the universities. A computer registration system for by-products and waste from the mineral industry was drawn up in collaboration with various stakeholders. The idea of registration is to increase the recycling of by-products and waste, and to comply with the obligations contained in the coming EU Mining Waste Directive.

Land use

The first stage of the international, jointly funded PERMAFROST research project was concluded and reported on. The purpose of the project is to investigate the effects of permafrost on the final disposal of spent nuclear fuel. The second stage of the project was begun by determining the level of the underside of the permafrost layer in bedrock and the behaviour of water in mines located in the arctic areas of northern Canada. The project is being jointly funded by Finnish, Swedish and English power companies and universities.

A new project, to be funded under the EU INTERREG programme, was started. The SEAREG project, which will be running for several years, deals with the effects of climate change on surface variation in the Baltic basin and land use planning in the countries around the Baltic rim. GTK has also been chosen to coordinate a pan-European research project to study management of the risks from nature and human activity in spatial planning. The research project is part of the broader ESPON 2006 research programme intended to serve spatial planning and development in an enlarged EU.

The FEMMA project, which is funded by the Academy of Finland, continued. The project is developing a method of modelling the effects of forestry on waterways and the long-term nutrient state in forests based on three-dimensional soil modelling. The project is being coordinated by the Finnish Forest Research Institute (METLA) and involves the Universities of Oulu and Joensuu in addition to GTK. A number of worthwhile geological mapping projects on moraine formations and exposed bedrock continued as planned, mainly funded by the Ministry of the Environment. The extremely popular series of geological excursion maps and guidebooks was added to by publishing a geological excursion map of the Lemmenjoki National Park and preparing the map and guide to the Koli National Park for printing. Preparatory work continued on funding for the GEONAT project linked with the proposal to include the Kvarken area on the UN World Heritage List.

Most of the research on contaminated soil came under contract services. Risk assessment methods were developed in collaboration with industry by studying the effects of soil structure in the migration of chemicals in the subsoil. The EU-financed TOXICAL project, which is being coordinated by GTK, continued according to plan. The project is intended to develop environmental and IT technology for real-time monitoring of contaminated groundwater areas in specific parts of Eastern Europe.

State of the environment and environmental change

The environmental geochemical survey project in northwest Russia progressed to the stages of analysing samples and reporting. The project is being run by GTK and a number of organizations in Russia are also cooperating in it. The FOREGS (Forum of European Geological Surveys Directors) geochemical survey programme continued as a multinational cooperation project coordinated by GTK. The first
preliminary drafts of a series of 400 maps covering the whole of Europe were completed. Negotiations have been conducted with the Elsevier printing house on publishing the maps in the form of a geochemical atlas.

A number of scientific articles on paleoclimatic research, which comes under the heading of global change, were published in international series. Research on greenhouse gases from mires and the growing rate of peat was started in collaboration with the Universities of Joensuu and Helsinki. The research is linked with the Ministry of Trade and Industry research programme entitled Impacts on greenhouse gases from the use of peat and peatlands in Finland. The research aims to produce scientifically valid information needed by the authorities on the significance of the use of peat and peatlands to Finland’s greenhouse-gas emission calculations.
The Geoservice Centre, GTK’s national service unit comprises most of GTK’s laboratory, geophysical and field research services.

Airborne services
The GTK airborne services group made a number of high-resolution surveys for customers with the aim of obtaining detailed geophysical data for raw material studies in specific areas. Precision instruments and accurate real-time positioning give extremely good measurement resolution. Measurements were carried out on 50 and 75 metre line spacing.

Marine geology
GTK and the Naval Research Institute made a decision to acquire a joint research vessel. The vessel will have a catamaran type hull, approx. 20 m long with a width of 7.5 m and will be equipped with twin 520 kW engines and water-jet propulsion. Cruising speed will be 20 knots, whereas normal working speed will be 3-4 knots. A contract for building the vessel was signed at GTK with Mobimar Oy, on November 18, 2002.

The vessel’s research equipment follows the currently used type, consisting of seismic equipment, side scan sonar, research echo sounders and multi-beam echo sounders. The procurement cost of the vessel is EUR 1.3 million and it will be completed in autumn 2003 when tests will be carried out. The research equipment will be installed during the winter of 2003-2004. Full-scale sea trials will be performed during summer 2004 and any necessary alterations will be carried out on the basis of sea-trial experience. The vessel will finally be ready for use during the summer season of 2005.

Geolaboratory
In terms of output, last year was a record year for the Geolaboratory. The laboratory supplied over 50 000 specimens for precious metal analysis to ore prospecting organizations operating in Northern Finland, a figure that is in a class of its own in the EU area.

The Geolaboratory extended its accreditation to cover soil sampling, as well. Now, the whole chain of polluted land investigation, from sampling to analysis, comes under the same accredited quality system. A new-generation portable field analysis unit equipped with an X-ray tube, the first of its kind in Finland, was acquired for preliminary assessment of pollution in the field.
The Geolaboratory successfully took part in an international qualification-testing programme. The Geolaboratory’s expertise was used to audit other laboratories and in preparatory work on national guidelines for the accreditation of sample taking. In a joint project with Medivire the fitness for work of laboratory staff was improved through voluntary efforts and the ergonomics of key actions in laboratory work were improved. As a result of teamwork by the staff, a number of alterations and improvements were carried out which cut down strain and promoted job satisfaction.

Technical services
In technical services, the Standard Operating Procedures that form part of the quality system were adopted. More certified sampling staff were trained to improve GTK’s sampling capability.

Numerous commissions were carried out taking samples from polluted ground. Development work is continually being carried out on sampling for land and rock mapping.

### GEOSERVICES 2002

<table>
<thead>
<tr>
<th>SUPPORT SERVICES</th>
<th>planned</th>
<th>implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samples analysed chemically</td>
<td>75 000</td>
<td>99 405</td>
</tr>
<tr>
<td>Chemical determinations</td>
<td>1 500 000</td>
<td>2 525 596</td>
</tr>
<tr>
<td>Till samples taken</td>
<td>7 000</td>
<td>2 574</td>
</tr>
<tr>
<td>Soil samples (contaminated land)</td>
<td>1 300</td>
<td>610</td>
</tr>
<tr>
<td>Samples of lake and sea sediments</td>
<td>600</td>
<td>991</td>
</tr>
<tr>
<td>Water samples</td>
<td>600</td>
<td>1 036</td>
</tr>
<tr>
<td>Drilling, metres</td>
<td>33 000</td>
<td>32 096</td>
</tr>
<tr>
<td>Ground measurements</td>
<td>420 000</td>
<td>258 667</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOUGHT SERVICES</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep drilling, metres</td>
<td>35 000</td>
<td>31 729</td>
</tr>
<tr>
<td>Ground measurements</td>
<td>40 000</td>
<td>39 369</td>
</tr>
</tbody>
</table>

GTK carried out airborne surveys for a private company in Ireland, for mineral exploration purposes. Photo: Kai Nyman.

Julius Nyakaana, a geophysicist from Uganda, was on a 3-month training course at GTK and HUT funded by UNDESA. He made a thorough study of airborne survey work, data processing, quality control, and tender action and evaluation. He also took part in the survey activities. Eventually, Nyakaana is expected to manage an extensive geophysical survey project in Uganda, financed by the World Bank. He made himself familiar with the technical aspects of airborne survey equipment on the plane, in the workshop and in the field. Photo: Kai Nyman.

The Kuopio Geolaboratory’s ergonomic project developed a weighing station with an adjustable table. Photo: Jouko Könönen.
The Information resources management is intended to ensure long-term availability, accessibility and usability of information. The most important ways of achieving this are by harmonizing working methods and information management solutions, such as databases, software and IT architecture, by improving documentation using widely accepted standards, by ensuring equipment operability and by improving skills.

Projects intended to improve the availability and usability of data made progress. In the Geodata warehouse project, the geologists and research assistants who will be using the systems in the future have been planning the specifications for the system content and its applicability. The project will enable GTK to act in accordance with specified requirements. During the preliminary phase, the project has had to use roughly 7 manpower years of work to maintain the old systems, because the only people familiar with them are the Geodata warehouse project staff. This has slowed the project down, so GTK has elected to keep it running until the end of 2004.

The digitizing of GTK research data was almost completed. By the time it is concluded the digitizing project will have used up a total of almost 150 manpower years.

The speed of the network linking the GTK regional offices was increased to the maximum permitted by existing technology. Speeds from Kuopio and Rovaniemi to Espoo and vice versa have quadrupled so that the digitization work has become far more efficient.

Data security has been stepped up with a new firewall system, which was taken into use in mid-September. The backup system was also overhauled and the new system not only enables sufficiently frequent and comprehensive backups, but also makes it possible to take security backups that are stored outside GTK premises.

Distribution of GTK map products via the Internet was studied in two projects, by testing various web-distribution software applications on the GTK intranet. A Quaternary deposits map site was launched in May.

Information services maintained its 16 GTK databases on the Internet, covering areas such as archives, library, publications, drill core, mineralogical museum and photographs. A total of 28 852 visits and 212 631 search hits, were made to these from outside GTK, an increase of 51% on the previous year. The coverage of the databases was improved by renewing the reference data in the claims report database and updating the drill core archives data in the LOPPI database.

International usage of GTK services was promoted by making available the multilingual MULTHES database, which contains the IUGS COGEINFO geological glossary in Finnish and 7 other languages, by increasing the English language descriptive data content, and by designing thematic literature reference lists for printing out directly from the databases. At the end of the year the databases contained a total of 144 000 records.

The GEOSANASTO database was approved for attachment to the SFS Standard 5895, Dublin Core metadata format as a glossary for the geological sector.

GTK published a total of 18 research studies and 8 maps in its own series and about 230 papers in external Finnish and foreign journals. A total of 2722 publications were sold and GTK had a total of 79 publication exchange partners in Finland and 359 abroad.

The GTK libraries received a total of 1164 periodicals, of which 393 were purchased. In addition, a total of 1309 books and 362 geological maps were acquired. The libraries gave or forwarded a total of 8096 loans. A total of 154 geological maps, reports and other geological items were added to the archives, while some 31 shelf metres of administrative material was acquired and 18 shelf metres destroyed. A total of 9159 photocopies of archive material were supplied.

The seventh storage building was completed for the National Drill Core Depot in Loppi and was taken into use at the beginning of September. Samples from various places including Taporova, Rautuvaara and the Kuopio unit were transferred to the...
Depot, totalling 25 200 boxes. A total of 2435 samples were handed over for research purposes.

A total of 1536 people in groups of various size visited the Mineralogical Museum plus another 1200 individual visitors.

Registry work was switched from Administration to Information Management and a cooperation project was started among the various units to harmonize operations, create a shared diary entry form and to acquire new software for registry use.

Work started on the Library and Information Services Standard Operating Procedures and the Applications Development Manual in connection with the development of a quality system.

GTK opened its GEO-KARTTA service to the public at http://www.gsf.fi/geokartta where you can browse Quaternary deposits maps and explanatory texts. The service was shown to stakeholders for the first time in Kuopio at the Geology Day in May. You can also use the service to study the terrain where you live. Maps can be ordered as printouts or in the original digital vector form.

Photo: Eila Karhu.

<table>
<thead>
<tr>
<th>INFORMATION MANAGEMENT 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publications and reports</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
International cooperation

As part of its research and development activities, GTK develops new applications, products and marketing to support its operations. This meets immediate needs and provides a background for increasing the impact of GTK operations in the future. Process development projects are carried out as joint undertakings by different GTK units working together.

Projects funded by the European Commission constitute the largest group of international cooperative undertakings. These include the MINEO, TOXICAL, NuPulse, ENVIRISK and EUROSEISMIC projects under the Fifth Framework Programme and the ESPON and SEAREG programmes, which come under the Interreg IIIb Programme. Some of these projects form part of the EU EuroGeoSurveys network, an association of EU geological surveys.

Biggest international projects are the Finnish-Russian Deep Seismic Reflection Sounding Survey in Finland, which is being carried out as a debt conversion project between the two countries, and the joint Finnish-Norwegian-Russian project on Barents Ecogeochemistry, which is intended to define the current geochemical state of land in northeast Europe.

GTK also makes use of the expertise of Canadian, American and Australian universities and research institutes.

GTK’s most important collaborative international scientific projects and partners include the following:

**Geological mapping**
- The 1:2 000 000 scale Geological Map of the Fennoscandian Shield was printed in February: Geological Survey of Sweden SGU, Geological Survey of Norway NGU, Ministry of Natural Resources of Russia, Northwest Regional Geological Centre and State Company Mineral

**Applied geophysics**
- **Spetsgeofizika, Russia:**
  Deep Seismic Reflection Sounding in Finland — FIRE

- **Virg-Rudgeofizika, Russia:**
  Four electromagnetic measuring devices received and commissioned.

- **Europrobe Programme, Svekalapko Project:**
  Integration working group, geothermal, paleomagnetic and geoelectric sub-projects

- **Object Oriented P223E EM Modelling — AMIRA**

- **Fennoscandian geophysical maps:**
  The 1:2 000 000 scale magnetic and Bouguer anomaly map of the Fennoscandian shield was prepared for printing and printed in collaboration with Russia, Denmark and the Baltic countries.

- **Finnish-Russian cooperation:**
  Magnetic maps of the Central Finland — Karelia and Northern Finland — Kola areas, at a scale of 1:1 000 000, were printed as Finnish-Russian bilateral cooperation.

Field-work on the TOXICAL project on water supply in Karabash in the south Ural region. The photo shows Jussi Levelinen and Juha Kaija from GTK (second and third from the left) studying the terrain with scientists from Russia and the EU. Pollution from the Karabash copper smelting plant has for all practical purposes destroyed the vegetation to the east of the plant. Photo: Gabor Gaál.
State of the environment and sustainable development

- **Barents Ecogeochiminity:** Regional geochemical sampling in Russia, Finland and Norway in the western part of the project area. S/C Mineral, Arkangelskgeoelrasvedka, Central Kola Expedition and S/C Mireko (formerly Poljarnouralgeologia)

- **FOREGS:** Geochemistry Working Group

- A non-destructive Pulse Neutron Multiple Detector Tool for use in environmental, hydrocarbon and mineral exploration work — **NuPulse**

- The spatial effects and management of natural and technological hazards in general and in relation to climate change — **ESPON**

- European seismic metadata and information centre — **EUROSEISMIC**

- Strategy development for long-term pollution control in regions of extreme environmental risk — **ENVIRISK/INTAS**

*GTK collaborated with the Geological Survey of Denmark and Greenland GEUS on studies of stone and rock aggregates on the south and west coasts of Greenland. Study area in southern Greenland. The research group was based on a research vessel and used it for moving about. Photo: Paavo Härmä.*
• Sea-level change affecting spatial development in the Baltic Sea Region — SEAREG/Interreg IIIB

• Assessing and monitoring the environmental impact of mining activities in Europe using advanced Earth Observation techniques — MINEO

• European Environmental Agency — EEA: European Topic Centre/Terrestrial Environment — ETC/TE

• Permafrost (GTK, SKB, Posiva, Nirex, OPG)

Research on minerals and materials
• University of Cape Town

• Independent Diamond Laboratory, Perth

• NORDSIM, Naturhistoriska Riksmuseet, Stockholm

• All-Russian Geological Research Institute (VSEGEI), St Petersburg

• Russian Academy of Sciences, St Petersburg, Petrozavodsk and Apatity

• Estonian Geological Survey EGK

Promoting the mineral industry
• James Cook University; Economic Geology Research Unit:
The Vihanti-Pyhäsalmi zone, the Central Lapland greenstone belt, and iron oxide-copper-gold deposits in Lapland

• University of Queensland, Department of Earth Sciences:
Structural geological study of southern Finland

• CSIRO (Commonwealth Scientific and Industrial Research Organiza-
tion): Joint research on komatiites and mafic volcanic rocks in Finland; Outokumpu ore-deposit modelling

Water supply
• Toxic Pollution Detection in Ground Water:
From real-time early warning to overall assessment — TOXICAL

• University of Waterloo, Ontario, Canada:
Water-Rock Interaction Project

Project exports
During the year under review, GTK carried out a number of projects outside Finland, which clearly called for a broader range of expertise than before. For the first time experts from all GTK units were involved in foreign projects and we were able to offer young experts more demanding international assignments than ever before. GTK pooled their resources with various partners, which in turn called for
interactive skills and understanding of contracts. These broad-based projects also called for the development of risk management skills in association with project activities.

The biggest project abroad won on a competitive basis is a geological survey project in Mozambique funded by The World Bank, the Nordic Development Fund and the Mozambique government. The aim of the project is to increase investment in the Mozambique mineral sector, boost export income, improve employment and build up an industry based on raw materials production.

The application of GTK expertise to the export project market has continued to develop favourably. Various funding organizations are putting together a number of institutional projects in the minerals sector that demand collected expertise. Rather than narrow in-depth expertise, the new project markets call to a growing extent for collected expertise and the ability to combine environmental, social, economic and legal expertise with geo-scientific expertise. This is something that can best be achieved by networking between experts.

The aim of the GTK business management group that has recently been started is to look after GTK’s competitiveness in commercial projects outside Finland and recognize the need for improvement when it exists.
The GTK organization was restructured at the beginning of 2002. The most important changes compared with the previous arrangements were the merger of the Research and Development Unit, the Regional Office for Southern Finland and the GIS services of the Communications Unit into the Espoo Unit. At the same time, the Regional Office for Mid-Finland in Kuopio became the Kuopio Unit, the Regional Office for Northern Finland became the Rovaniemi Unit and the Communications Unit became the Information Resources Management. In addition, a Director’s Staff was formed under the Director General to help with management and maintain relations with interest groups.

GTK improved its personnel structure in line with its personnel policy and gave some fixed-term staff permanent positions. In order to control the management of staff expertise, current levels of staff competence were carefully charted, different areas of expertise were defined and the expertise requirements for various task groups were specified. The action that needs to be taken was prioritized on the basis of the competence study. As part of the programme for maintaining and improving staff working ability, the human resources project studying the health and working ability of staff in the 42 to 53 years age group was continued and a programme to improve the health of Geolaboratory staff was implemented on an individual basis.

The key issues in financial administration during 2002 were the measures associated with the introduction of the euro that were adopted in financial data systems and elsewhere. The conversion of the financial administration systems to the euro was mainly carried out at the beginning of the year, so that the annual accounts for the previous year were in Finnish marks for the last time. GTK overhauled its financial rules to place particular emphasis on the importance of internal supervision and management responsibility at every level. During the year under review, financial administration also implemented the revised arrangements for State financial transactions in which Nordea became the principal bank for transactions.

Work started on the construction of a set of indicators based on the Balanced Scorecard system to improve operational management. During 2002, the critical success factors and criteria at GTK level were sketched out in preliminary form. The intention is to complete the work during 2003 and adopt the actual criteria in 2004. An external evaluation of GTK’s administrative services was carried out during the year under review.
Personnel
Manpower years totalled 809, two less than the previous year. The number of manpower years in contract services went down by five on the previous year, while the number in other services grew by seven. The number of manpower years based on job-creation schemes showed a distinct reduction on the previous year.
At the end of the year, 43% of GTK staff had completed a university degree and over one third of them had received researcher training. At the same time, GTK staff held 29 lectureships at universities.

Income
GTK income in 2002 came to EUR 8.7 million, of which EUR 6.7 million came from contract services and EUR 2 million from other sources. Income was down 3% on the previous year, but the target for 2002 was exceeded by EUR 0.6 million, while income from contract services was down EUR 151 000. As far as contract services are concerned, GTK’s investment in the big Mozambique project will not begin to generate income until some time in the future. Income from other services went also down by EUR 145 000. Finnish businesses and foreign clients made up the largest customer groups in contract services, while in other services the largest income-generating group was government and public administration.
There was no significant change in the structure of GTK funding. Income and external funding covered 20% of expenditure.

Costs
Overall costs in 2002 amounted to EUR 48.2 million, which was up slightly on the year before. Payroll costs amounted to EUR 28.5 million (59%) and running costs to EUR 17.1 million (36%) of the total. Capital costs were EUR 2.6 million (5%), while capital costs on fixed assets came to EUR 2.5 million, of which EUR 2.2 million were depreciations and EUR 0.3 million interest payments, at an interest rate of 4.9%. Interest payments on current assets totalled EUR 0.1 million at an interest rate of 2.3%.

Premises
At the end of 2002, GTK had about 45 500 m² of State-owned premises at its disposal. The head offices at Otaniemi in Espoo covered 18 948 m², the Kuopio office 9 170 m² and the Rovaniemi office 5 270 m². The total area of the buildings at the National Core Sample Depot at Loppi was 6 954 m².

Review of the financial statements
Income and expenditure statement January 1 to December 31, 2002
Deficit for the financial year was EUR 40.2 million, EUR 0.2 million more than the previous year. Operating expenses were up EUR 4.2 million on 2001. The largest item of expenditure was staff expenses at EUR 28.5 million, which amounted to 53% of operating expenses. Second largest item of expenditure was acquisition of services, which grew EUR 3.0 million to EUR 13.1 million and amounted to 24% of operating expenses. Acquisition of services includes the EUR 6 million expenses of the deep seismic reflection sounding project carried out as Russian debt conversion work. Correspondingly, the income from debt conversion has been entered as extraordinary income. Purchases of materials, supplies and goods remained at the same level as the previous year and amounted to EUR 2.9 million. Travel expenses increased EUR 0.2 million to EUR 2.6 million. Capital
investments in 2002 stood at EUR 2.1 million including investments related to acquisition of the new research vessel (EUR 0.4 million) and debt conversion procurement (EUR 0.5 million). Any differences between the items in the income and expenditure statement and the accumulated income and expenditure for 2002 are mainly due to differences between financial bookkeeping used as a basis for the income and expenditure statement and budget bookkeeping based on net budgeting.

**Balance sheet, December 31, 2002**

The balance sheet total was EUR 13.3 million, an increase of EUR 0.6 million on the previous year.

**Assets**

The value of fixed assets came to EUR 6.4 million, EUR 0.1 million bigger than the previous year. Current assets remained at the previous year’s level of EUR 4.8 million, while accounts receivable grew EUR 0.6 million to EUR 1.9 million.

**Liabilities**

The State’s equity totalled EUR 6.2 million, down EUR 0.2 million on the previous year. Liabilities came to EUR 7.1 million, of which accounts payable came to EUR 1.2 million. Advanced payments received showed a clear increase on the previous year mainly due to the advance payment of EUR 0.5 million received for the Mozambique project. Accrued expenses of EUR 3.9 million consisted entirely of holiday pay liabilities.

### Staff in manpower years

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract services</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>Other operations</td>
<td>687</td>
<td>704</td>
</tr>
<tr>
<td>Total budget funding</td>
<td>777</td>
<td>779</td>
</tr>
<tr>
<td>Employment funds</td>
<td>25</td>
<td>18</td>
</tr>
<tr>
<td>Other external funds</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Total external funds</td>
<td>34</td>
<td>30</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td><strong>811</strong></td>
<td><strong>809</strong></td>
</tr>
</tbody>
</table>

### Staff, costs and income by programmes in 2001 and 2002

<table>
<thead>
<tr>
<th></th>
<th>2001 Mpy/1000 €</th>
<th>2002 Mpy/1000 €</th>
<th>2002/2001 %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MANPOWER YEARS (mpy)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedrock and raw materials</td>
<td>440 54</td>
<td>426 53</td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>Land use and environment</td>
<td>240 30</td>
<td>248 30</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Information management</td>
<td>131 16</td>
<td>135 17</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>811 100</strong></td>
<td><strong>809 100</strong></td>
<td><strong>0</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2001 (1000 €)</th>
<th>2002 (1000 €)</th>
<th>2002/2001 %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COSTS</strong> (1000 €)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedrock and raw materials</td>
<td>26 901 56</td>
<td>26 752 55</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Land use and environment</td>
<td>12 830 27</td>
<td>13 328 28</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Information management</td>
<td>7 897 17</td>
<td>8 117 17</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>48 628 100</strong></td>
<td><strong>48 197 100</strong></td>
<td><strong>1</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2001 (1000 €)</th>
<th>2002 (1000 €)</th>
<th>2002/2001 %</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INCOME</strong> (1000 €)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedrock and raw materials</td>
<td>5 347 60</td>
<td>5 364 62</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Land use and environment</td>
<td>3 138 35</td>
<td>3 038 35</td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>Information management</td>
<td>482 5</td>
<td>269 3</td>
<td>-44</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8 967 100</strong></td>
<td><strong>8 671 100</strong></td>
<td><strong>-3</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Scope of operations by unit in 2002

<table>
<thead>
<tr>
<th>Unit</th>
<th>Income 1 000 €</th>
<th>%</th>
<th>Expenditure 1 000 €</th>
<th>%</th>
<th>Staff Htv</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Espoo Unit</td>
<td>2 986</td>
<td>34</td>
<td>11 416</td>
<td>24</td>
<td>216</td>
<td>27</td>
</tr>
<tr>
<td>Kuopio Unit</td>
<td>899</td>
<td>10</td>
<td>6 322</td>
<td>14</td>
<td>132</td>
<td>16</td>
</tr>
<tr>
<td>Rovaniemi Unit</td>
<td>443</td>
<td>5</td>
<td>4 741</td>
<td>10</td>
<td>96</td>
<td>12</td>
</tr>
<tr>
<td>Geoservice Centre</td>
<td>4 136</td>
<td>48</td>
<td>17 941</td>
<td>38</td>
<td>272</td>
<td>33</td>
</tr>
<tr>
<td>Information Mgmt</td>
<td>58</td>
<td>1</td>
<td>3 423</td>
<td>7</td>
<td>47</td>
<td>6</td>
</tr>
<tr>
<td>Mgmt and Admin.</td>
<td>149</td>
<td>2</td>
<td>3 335</td>
<td>7</td>
<td>46</td>
<td>6</td>
</tr>
<tr>
<td><strong>GTK TOTAL</strong></td>
<td><strong>8 671</strong></td>
<td><strong>100</strong></td>
<td><strong>47 178</strong></td>
<td><strong>100</strong></td>
<td><strong>809</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

## Costs in 2001 and 2002

<table>
<thead>
<tr>
<th>Category</th>
<th>2001 1 000 €</th>
<th>2002 1 000 €</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payroll</td>
<td>27 825</td>
<td>28 485</td>
<td>2.4</td>
</tr>
<tr>
<td>Running costs</td>
<td>17 342</td>
<td>17 139</td>
<td>-1.2</td>
</tr>
<tr>
<td>Capital costs</td>
<td>2 461</td>
<td>2 573</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td><strong>47 628</strong></td>
<td><strong>48 197</strong></td>
<td><strong>1.2</strong></td>
</tr>
</tbody>
</table>

## Costs responsibility calculation of contract services in 2001 and 2002

<table>
<thead>
<tr>
<th>Category</th>
<th>2001 1 000 €</th>
<th>2002 1 000 €</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payroll</td>
<td>27 825</td>
<td>28 485</td>
<td>2.4</td>
</tr>
<tr>
<td>Running costs</td>
<td>17 342</td>
<td>17 139</td>
<td>-1.2</td>
</tr>
<tr>
<td>Capital costs</td>
<td>2 461</td>
<td>2 573</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td><strong>47 628</strong></td>
<td><strong>48 197</strong></td>
<td><strong>1.2</strong></td>
</tr>
</tbody>
</table>
Income and expenditure statement

(1000 €)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income from contract services</td>
<td>6 709</td>
<td>6 860</td>
</tr>
<tr>
<td>Other operating income</td>
<td>2 001</td>
<td>1 921</td>
</tr>
<tr>
<td><strong>Operating expenses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials, supplies and goods:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchases during the financial period</td>
<td>2 853</td>
<td>2 842</td>
</tr>
<tr>
<td>Increase (-) or decrease (+) in stocks</td>
<td>185</td>
<td>-8</td>
</tr>
<tr>
<td>Staff expenses</td>
<td>28 520</td>
<td>27 686</td>
</tr>
<tr>
<td>Rents</td>
<td>3 967</td>
<td>3 888</td>
</tr>
<tr>
<td>Purchased services</td>
<td>13 097</td>
<td>10 063</td>
</tr>
<tr>
<td>Other expenses</td>
<td>3 043</td>
<td>2 868</td>
</tr>
<tr>
<td>Increase (-) or decrease (+) in products stocks</td>
<td>-112</td>
<td>13</td>
</tr>
<tr>
<td>Manufacturing for own use (-)</td>
<td>-97</td>
<td>-45</td>
</tr>
<tr>
<td>Depreciation</td>
<td>2 153</td>
<td>-53 609</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 055</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-49 362</td>
</tr>
<tr>
<td><strong>Deficit I</strong></td>
<td>-44 899</td>
<td>-40 581</td>
</tr>
<tr>
<td><strong>Financial income and expenses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial income</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Financial expenses</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td><strong>Extraordinary income and expenses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraordinary income</td>
<td>6 511</td>
<td>2 510</td>
</tr>
<tr>
<td>Extraordinary expenses</td>
<td>40</td>
<td>6 471</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 504</td>
</tr>
<tr>
<td><strong>Deficit II</strong></td>
<td>-38 427</td>
<td>-38 074</td>
</tr>
<tr>
<td><strong>Income and expenses from payment transfers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenses</td>
<td>31</td>
<td>-31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Deficit III</strong></td>
<td>-38 458</td>
<td>-38 074</td>
</tr>
<tr>
<td><strong>Income from taxes and compulsory charges</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value added tax collected</td>
<td>1 331</td>
<td>1 367</td>
</tr>
<tr>
<td>Value added tax paid</td>
<td>3 116</td>
<td>-1 785</td>
</tr>
<tr>
<td></td>
<td>3 327</td>
<td>-1 960</td>
</tr>
<tr>
<td><strong>Deficit for financial period</strong></td>
<td>-40 243</td>
<td>-40 034</td>
</tr>
</tbody>
</table>
## Balance sheet

(1000 €)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSETS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed assets and other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>long-term investments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intangible assets</td>
<td>904</td>
<td>1 036</td>
</tr>
<tr>
<td>Tangible assets</td>
<td>5 449</td>
<td>5 233</td>
</tr>
<tr>
<td>Shares and other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>long-term investments</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>6 358</strong></td>
<td><strong>6 274</strong></td>
</tr>
<tr>
<td><strong>Current and financial assets</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials, supplies and goods in stock</td>
<td>4 766</td>
<td>4 840</td>
</tr>
<tr>
<td>Short-term receivables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts receivables</td>
<td>1 947</td>
<td>1 383</td>
</tr>
<tr>
<td>Prepaid expenses and accrued income</td>
<td>211</td>
<td>203</td>
</tr>
<tr>
<td>Other short-term receivables</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Advance payments</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>2 175</strong></td>
<td><strong>1 588</strong></td>
</tr>
<tr>
<td>Cash, bank receivables and other financial assets</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>6 944</strong></td>
<td><strong>6 428</strong></td>
</tr>
<tr>
<td><strong>Total assets</strong></td>
<td><strong>13 302</strong></td>
<td><strong>12 702</strong></td>
</tr>
<tr>
<td><strong>LIABILITIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Own capital</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State’s equity</td>
<td>6 171</td>
<td>6 402</td>
</tr>
<tr>
<td><strong>Liabilities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other long-term liabilities</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Short-term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advance payments received</td>
<td>736</td>
<td>66</td>
</tr>
<tr>
<td>Accounts payable</td>
<td>1 212</td>
<td>1 493</td>
</tr>
<tr>
<td>Transactions between accounting offices</td>
<td>656</td>
<td>610</td>
</tr>
<tr>
<td>Items to be forwarded for payment</td>
<td>435</td>
<td>472</td>
</tr>
<tr>
<td>Accrued expenses</td>
<td>3 911</td>
<td>3 633</td>
</tr>
<tr>
<td>Other short-term liabilities</td>
<td>176</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td><strong>7 126</strong></td>
<td><strong>6 296</strong></td>
</tr>
<tr>
<td></td>
<td><strong>7 131</strong></td>
<td><strong>6 300</strong></td>
</tr>
<tr>
<td><strong>Total liabilities</strong></td>
<td><strong>13 302</strong></td>
<td><strong>12 702</strong></td>
</tr>
</tbody>
</table>
Rock formations in the village of Pistohiekka near Puumala. Photo: Jari Väätäinen.
mospheric precipitation in thirty observation stations in the territory of Barents ecogeochemistry project. 13 p., 25 apps.

Ta-series
(Information management)
Ta/2002/1.

RS-sarja
(Remote Sensing)
RS/2002/3.


Helminen, Tiina-Riitta & Rääsänen, Marja-Liisa 2002. Regional atmospheric deposition patterns of dust in the vicinity of the Lahnasalmi tailing mine, Sortkamo, Finland, as revealed by moss and humus samples, for MINEO. 10 p., 33 apps.

RS/2002/1.

Laitinen, Jukka 2002. Study of birch NDVI from AISA spectrometer images in the vicinity of Parainen carbonate rock mine. 7 p., 5 apps.
RS/2002/5.

RS/2002/7.

RS/2001/5.

Ruohomäki, Timo; Törmä, Markus; Rainio, Heikki; Lumme, Juho & Mäkilä, Markku 2002. Soil types, vegetation and AISA-imagery in Lammi test area. 62 p.

UT-series
(International cooperation)
UT/Nicaragua/2002/1.

Sale of publications, maps and reports

GTK, Publications Sales
P.O. Box 96
FIN-02151 ESPOO, FINLAND
Tel. +358 20 550 2450
Fax +358 20 550 12
E-mail julkaisumyynti@gtk.fi
www.gsf.fi

Publications and maps are also sold at the libraries of Kuopio and Rovaniemi Units:
GTK, Kuopio Unit, Library
P.O. Box 1237
FIN-70211 KUOPIO, FINLAND
Tel. +358 20 550 3250
Fax +358 20 550 13
E-mail kuolibrary@gsf.fi

GTK, Rovaniemi Unit, Library
P.O. Box 77
FIN-96101 ROVANIEMI, FINLAND
Tel. +358 20 550 4131
Fax +358 20 550 14
E-mail roilibrary@gsf.fi

Peat reports available from:
GTK, Kuopio Unit, Library
P.O. Box 1237
FIN-70211 KUOPIO, FINLAND
Tel. +358 20 550 3250
Fax +358 20 550 13
E-mail kuolibrary@gsf.fi

The nuclear waste disposal research reports are available from: GTK, Asta Sainio
P.O. Box 96
FIN-02151 ESPOO, FINLAND
Tel. +358 20 550 2400
E-mail asta.sainio@gsf.fi

The prices include VAT (publications 8 %, maps 22 %). Export outside the European Union is tax free. Companies in EU-countries are exempted from Finnish VAT, if they supply their VAT identification number. Our VAT number is FI024464807.

The postage is not included in the price.

‘Kummakivi’ (the Strange stone) at Ruokolahti is an erratic boulder balanced on a glaciated rock and is subject to a preservation order.
Photo: Jari Väätäinen.
Papers by GTK staff in 2002

The following list includes references from the database FINGEO as at 28th February 2003 to papers published in 2002 with at least one author from GTK staff (name in bold), and also to papers published in 2001, if not reported in the previous annual report. The list is in Finnish alphabetical order.


Arvola, Lauri; Kortelainen, Pirko; Bergström, Irina; Kankaala, Paula; Ojala, Anne; Pajunen, Hannu; Käki, Tiina; Mäkelä, Suvi; Rantakari, Jouni. 2002. Pohjavesien suojelun ja kiviaittonen lainnan suojelun ja kiviai- tuksen kokemukset. Tiedonanto YST-110. 45 p.


Isosaari, Pirjo; Pajunen, Hannu; Varinen, Terttu 2002. PCDD/F and PCB history in dated sediments of a rural lake. Chemosphere 47 (6), 575-583.


Mannio, Jaakko; Salminen, Reijo; Leppänen, Sirkka; Väisänen, Ulpia; Räinä, Pekka; Poi- kolainen, Jarmo; Kubin, Eero; Piispanen, Juha; Verta, Matti 2002. Ruokametsälianne. In: Mähiö- nen, O. (ed.) AMAP II - Lapin ympäristön tila ja ihmisen terveys. Suomen ympäristö 581, 29-49.


Saarnisto, Matti; Ojala, Antti; Alenius, Teija; Forsström, Pirjo-Leena; Kauppila, Tommi; Lunkka, Juha Pekka; Käärä, Markku; Pajunen, Hannu; Saarnisto, Timo; Sallassmaa, Olli; Tiljander, Mia 2002. Modelling past global change - forecasting the future. In: Käyhkö, I. & Talve, L. (eds.) Un-


Tiljander, Mia; Ojala, Antti; Saarinen, Timo; Saarnisto, Matti 2002. Suhteellinen röntgentihden perusteella näkyvät ympä-
Tiljander, Mia; Ojala, Antti; Saarinen, Timo; Snowball, Ian 2002. Documentation of the physical properties of annually lamina-
ted (varved) sediments at a sub-annual to decadal resolution for environmental inter-
pretation. In: Brauer, A. & Negendank, J. F. W. (eds.) The value of annually laminated lake sediments in palaeoenvironment re-
construction : dedicated to Björn E. Berg-
lund. Quaternary International 88, 5-12.


Tontti, Mikko 2002. Fennoskanidian mal-
mintesintä- ja kaivannisteollisuus : konfe-
ranssi Rovaniemellä. Vuoritoollisuus 60 (1), 16-17.

Tormä, Markus; Rainio, Heikki; Ruohomä-
ki, Timo 2002. Classification of vegetation and soil using AISA-spectrometer : some results from Lammi test area. The Phot-
ogrammetric Journal of Finland 18 (1), 73-84.

ciety, Nice, France, 21-26 April, 2002. Geophysical Research Abstracts 4, 1 p. Opti-
cal disc (CD-ROM).

Vaasjoki, Matti 2001. Three decades of U-
Pb mineral analyses at the Geological Survey of Finland. In: Vaasjoki, M. (ed.) Radiometric age determinations from Finnish Lapland and their bearing on the timing of Precam-
brian volcano-sedimentary sequences. Geo-

Vaasjoki, Matti (ed.) 2001. Radiometric age determinations from Finnish Lapland and their bearing on the timing of Precambrian volca-
no-sedimentary sequences. Geological Sur-
vey of Finland. Special Paper 33. 279 p.

Vaasjoki, Matti; Sipilä, Pekka 2001. U-Pb isotopic determinations on basal dikes and zircon from the Halti-Ridnitsohkka intrusion in Finland - a further constraint on Caledonide evolution. In: Vaasjoki, M. (ed.) Radiometric age determinations from Fin-
ish Lapland and their bearing on the timing of Precambrian volcano-sedimentary sequen-

Vali, Tuire; Vanhala, Heikki; Huotari, Taija 2002. Airborne magnetic and radiome-
tric study around oil shale mine area in Koht-
la-Järve, Estonia [Electronic resource]. In: Senos Mattias, M. & Grangea, C. (eds.) Meeting EEGS-IES, Environmental and En-
ingineering Geophysics. 8-12 September 2002, Aveiro, Portugal : proceedings. Aveiro: Uni-
versidade de Aveiro, 509-512. Optical disc (CD-ROM).

Vallius, H. 2002. Patchiness of sedimentati-
on in the Gotland Basin, based on the geoche-
de. Kaliningrad: Atlantic Branch of P.P. Shir-
shov Institute of Oceanology, RAS, 133.

Vallius, Henry; Hankainen, Tuori; Suom-
en, Veli 2002. Uuden geologimatrikkelin tilastoja. Summary: Statistics from Geologi-
matrikkelin 2000, the new register of geolo-
gists. Geologi 54 (1), 14-16.

Valpola, Samu; Kauppila, Tommi 2002. Kar-
alohjan Pajuvirren sedimenttittukimius. In: Korrika-Niemi, K. (ed.) Geologian tutki-
päivät 13.-14.3.2002 Helsinki : ohjelma, tii-


Vanhala, Heikki; All, Tarmo; Huotari, Tai-
ja; Kattai, Vello; Lintinen, Petri 2002. Test of airborne geophysics for mapping oil shale mining area in Kohtla-Järve, NE Estonia [Electronic resource]. In: EAGE 64th Confer-

iversity, 31.

Vanhala, Heikki; Lintinen, Petri 2002. Test of geophysics for monitoring frozen ground - a case from the southern limit of discontinuo-
sus permafrost in Finnish Lapland. In: The Second AMAP International Symposium on Environmental Pollution of the Arctic, Rova-

Vanyan, L. L.; Kuznetsov, V. A.; Lyubetska-
ty, T. V.; Palshin, N. A.; Korja, T.; Lahti, I. 2002. Electrical conductivity of the crust be-
neath central Lapland. Izvestiya, Physics of the Solid Earth 38 (10), 798-815.

electric model of Fennoscandia : a challen-
ging database for long-period 3D modeling studies within the Baltic Electromagnetic Array Research (BEAR) project. Izvestiya, Physics of the Solid Earth 38 (10), 855-896.

riteollisuus 60 (1), 47.

Väisänen, Tiisto 2002. Keski-Lapissa etsi-
tään rakennuskiviiä. Suomalainen Kirsi (4), 46-47.

ceedings of the International Peat Symposi-

Väisänen, Markku; Mänttäri, Irmeli 2002. U-Pb ages and tectonic setting of volcanic formations in the Orjarijärvi area, southwestern Finland. In: Korkka-Niemi, K. (ed.) Geologi-
an tutkijapäivät 13.-14.3.2002 Helsinki : oh-
jelma, tivistelmät, osallistujat. Helsinki: Geo-
logian valtakunnallinen tutkijakoulu, 9-10.

Väisänen, Markku; Mänttäri, Irmeli; Hölt-
tä, Pentti 2002. Svecofennian magmatic and metamorphic evolution in southwestern Fin-

Väinänen, Jukka 2002. Pasnajärvi. Suo-
gen geologien kartia 1:100 000 : kallioper-
karta lehti 2642.

Väinänen, Jukka; Lehtonen, Matti I. 2001. U-Pb isotopic age determinations from the Kolari-Muonio area, western Finnish Lap-
land. In: Vaasjoki, M. (ed.) Radiometric age determinations from Finnish Lapland and their bearing on the timing of Precambrian volca-
no-sedimentary sequences. Geological Sur-
vey of Finland. Special Paper 33, 85-93.

Watanabe, Naoki; Manno, Jukka S.; Wata-
nabe, Yumiko; Ohmoto, Hiroshi 2002. Geochemistry of a 2.3 Ga Sub-Jaturian paleo-
laterite in the Hallavaara area, eastern Fin-

Winterhalter, Boris 2002. Ilmastoy ja geolo-
ginen tietämys. Geologi 54 (6), 102-103.

Wold, Richard J.; Valli, Tuire 2002. A re-
view of underwater UXO systems in Europe [Electronic resource]. In: The UXO/Counter-
mine forum : DoD’s preeminent conference on technology, programs & partnerships, Sep-
### GTK’s international cooperation network

<table>
<thead>
<tr>
<th>Organization</th>
<th>Acronym</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commission for the Geological Map of the World</td>
<td>CGMW</td>
</tr>
<tr>
<td>EC/Nuclear Fission/ Natural Analogue Working Group</td>
<td>NAWG</td>
</tr>
<tr>
<td>EuroGeoSurveys</td>
<td>EGS</td>
</tr>
<tr>
<td>Eurolab</td>
<td></td>
</tr>
<tr>
<td>European &amp; International Federation of Natural Stone Industries</td>
<td></td>
</tr>
<tr>
<td>European Association of Remote Sensing Laboratories</td>
<td>EARSeL</td>
</tr>
<tr>
<td>European Environment Agency</td>
<td>EEA / ETC-TE</td>
</tr>
<tr>
<td>European Science Foundation</td>
<td>ESF</td>
</tr>
<tr>
<td>Forum of the European Geological Surveys</td>
<td>FOREGS</td>
</tr>
<tr>
<td>Geoscience Information Consortium</td>
<td>GIC</td>
</tr>
<tr>
<td>International Airborne Geophysics Safety Association</td>
<td>IAGSA</td>
</tr>
<tr>
<td>International Atomic Energy Agency</td>
<td>IAEA</td>
</tr>
<tr>
<td>International Consortium of Geological Surveys</td>
<td>ICGOS</td>
</tr>
<tr>
<td>International Geological Correlation Programme</td>
<td>IGCP</td>
</tr>
<tr>
<td>International Geosphere - Biosphere Programme</td>
<td>IGBP</td>
</tr>
<tr>
<td>International Heat Flow Commission</td>
<td>IHFC</td>
</tr>
<tr>
<td>International Lithosphere Programme</td>
<td>ILP</td>
</tr>
<tr>
<td>International Mineralogical Association</td>
<td>IMA</td>
</tr>
<tr>
<td>International Peat Society</td>
<td>IPS</td>
</tr>
<tr>
<td>International Science Initiative in the Russian Arctic</td>
<td>ISIRA</td>
</tr>
<tr>
<td>International Union for Quaternary Research</td>
<td>INQUA</td>
</tr>
<tr>
<td>International Union of Geodesy and Geophysics</td>
<td>IUGG</td>
</tr>
<tr>
<td>International Union of Geological Sciences</td>
<td>IUGS</td>
</tr>
<tr>
<td>Karelian Research Centre</td>
<td></td>
</tr>
<tr>
<td>NATO / Environmental Issues Associated with Nuclear Disarmament</td>
<td></td>
</tr>
<tr>
<td>Nordic Arctic Research Programme</td>
<td>NARP</td>
</tr>
<tr>
<td>Nordic Laboratory for Luminescence dating</td>
<td>NLL</td>
</tr>
<tr>
<td>NORDSIM, Nordic Secondary Ion Mass Spectrometer</td>
<td></td>
</tr>
<tr>
<td>OECD / Nuclear Energy Agency</td>
<td>NEA</td>
</tr>
<tr>
<td>ProGEO, European Association for the Conservation of the Geological Heritage</td>
<td></td>
</tr>
<tr>
<td>Prospectors &amp; Developers Association of Canada</td>
<td>PDAC</td>
</tr>
<tr>
<td>Scientific Committee on Antarctic Research</td>
<td>SCAR</td>
</tr>
<tr>
<td>UN ECOSOC, Committee on Energy and Natural Resources</td>
<td></td>
</tr>
<tr>
<td>VSEGEI</td>
<td></td>
</tr>
</tbody>
</table>

### GTK’s domestic cooperation network

<table>
<thead>
<tr>
<th>Organization</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Academy of Finland</td>
<td></td>
</tr>
<tr>
<td>Association of Finnish Extractive Resources Industries</td>
<td></td>
</tr>
<tr>
<td>Association of Finnish Peat Industries</td>
<td></td>
</tr>
<tr>
<td>Centre for Underground Physics in Pyhäsalmi</td>
<td>CUPP</td>
</tr>
<tr>
<td>Consultative Committee on Excavation Work</td>
<td></td>
</tr>
<tr>
<td>Consultative Committee on GIS</td>
<td></td>
</tr>
<tr>
<td>Consultative Committee on Quaternary Mapping</td>
<td></td>
</tr>
<tr>
<td>Continental Shelf Working Group</td>
<td></td>
</tr>
<tr>
<td>Coordination Group for Finnish Antarctic Research</td>
<td></td>
</tr>
<tr>
<td>Culminatum (Helsinki Region Centre of Expertise)</td>
<td></td>
</tr>
<tr>
<td>Delegation of the Finnish Academies of Science and Letters</td>
<td></td>
</tr>
<tr>
<td>Federation of Finnish Learned Societies</td>
<td></td>
</tr>
<tr>
<td>Finland’s Stone Centre</td>
<td></td>
</tr>
<tr>
<td>Finnish Academy of Science and Letters</td>
<td></td>
</tr>
<tr>
<td>Finnish Association of Mining and Metallurgical Engineers</td>
<td></td>
</tr>
<tr>
<td>Finnish Environment Institute</td>
<td></td>
</tr>
<tr>
<td>Finnish Forest Research Institute METLA</td>
<td></td>
</tr>
<tr>
<td>Finnish Institute of Marine Research</td>
<td></td>
</tr>
<tr>
<td>Finnish National Committee for Geology</td>
<td></td>
</tr>
<tr>
<td>Finnish National Committee for Polar Research</td>
<td></td>
</tr>
<tr>
<td>Finnish National Committee of Geodesy and Geophysics</td>
<td></td>
</tr>
<tr>
<td>Finnish National Committee of the International Peat Society</td>
<td></td>
</tr>
<tr>
<td>Finnish National Committee</td>
<td></td>
</tr>
<tr>
<td>Finnish National Committee of the Russian Arctic (ISIRA)</td>
<td></td>
</tr>
<tr>
<td>International Union for Antarctic Research (SCAR)</td>
<td></td>
</tr>
<tr>
<td>INQUA National Committee</td>
<td></td>
</tr>
<tr>
<td>Kuopio Food Safety Center</td>
<td></td>
</tr>
<tr>
<td>MTT Agrifood Research Finland</td>
<td></td>
</tr>
<tr>
<td>National IPCCC Group</td>
<td></td>
</tr>
<tr>
<td>National Technology Agency TEKES</td>
<td></td>
</tr>
<tr>
<td>Otaverkkio</td>
<td></td>
</tr>
<tr>
<td>Pro-GIS</td>
<td></td>
</tr>
<tr>
<td>Regional Council of Lapland</td>
<td></td>
</tr>
<tr>
<td>Sodankylä Geophysical Observatory</td>
<td></td>
</tr>
<tr>
<td>University of Helsinki</td>
<td></td>
</tr>
<tr>
<td>University of Joensuu</td>
<td></td>
</tr>
<tr>
<td>University of Kuopio</td>
<td></td>
</tr>
<tr>
<td>University of Oulu</td>
<td></td>
</tr>
<tr>
<td>University of Turku</td>
<td></td>
</tr>
<tr>
<td>VTT</td>
<td></td>
</tr>
<tr>
<td>Åbo Akademi University</td>
<td></td>
</tr>
</tbody>
</table>
Organization and management


GTK's management 31.12.2002

Director General
Raimo Matikainen

Director of Administration
Jorma Järvinen

Director's staff

Bedrock and Raw Materials
Programme Director
Elias Ekdahl

Land Use and Environment
Programme Director
Hannu Ilman

Communications Director
Caj Kortman

Directors of units

Espoo Unit
Gabor Gaál

Kuopio Unit
Kari Pääkkönen

Rovaniemi Unit
Ahti Silvennoinen

Geoservice Centre
Harry Sandström

Information Management
Kalle Taipale

Finance and Administration
Jorma Järvinen

MINISTRY OF TRADE AND INDUSTRY

BOARD

DIRECTOR GENERAL

MANAGEMENT GROUP

DIRECTOR'S STAFF

MINISTRY OF TRADE AND INDUSTRY

BOARD

DIRECTOR GENERAL

MANAGEMENT GROUP

DIRECTOR'S STAFF
Board of directors as at 31 December 2002

Christer Sundström
Managing Director
Chairman
Nordkalk Oyj Abp

Paula Nybergh
Industrial Counsellor
Deputy Chairperson
Ministry of Trade and Industry

Raimo Matikainen
Director General,
Professor, Geological Survey of Finland (GTK)

Markku Isohanni
Chief Geologist
Outokumpu Oyj

Helena Korhonen
Ministerial Counsellor
Ministry of the Environment

Jukka Noponen
Commercial Director
Jaakko Pöyry Infra

Seija Silvennoinen
Project Secretary
GTK

Jorma Järvinen
Director of Administration
Secretary
GTK
The snow lasts until July on the floor of the Hiidenkirkko ravine near Hyrynsalmi.

Photo: Jari Väätäinen