

**Institute of Geology
at Tallinn University of Technology**

**INSTITUTE OF GEOLOGY
2004-2005**

Tallinn 2006

*Institute of Geology
at Tallinn University of Technology*

Edited by *H. Pärnaste*

Cover: Polished section of Proterozoic granite from the Herbert Viiding's collection

ISSN1406-7285

© Institute of Geology at Tallinn University of Technology 2006

Printed by OÜ Infotrükk

Contents

Foreword.....	5
Institute of Geology in brief.....	7
Funding in 2004 and 2005	8
Structure and staff	10
Laboratories	12
The Earth Processes Modelling Laboratory	12
Micropalaeontology Laboratory.....	12
Laboratory of Physical Investigations.....	13
Laboratory of Isotope-Palaeoclimatology	13
Laboratory of Quaternary Geochronology	14
Laboratory of Holocene Geology.....	15
Collections	16
Research.....	19
Bedrock Geology.....	19
Quaternary Geology	42
Participation in international programmes.....	57
Applied research	58
Training and education.....	63
Degrees defended	63
PhD and MSc projects in progress	69
Courses and lectures given.....	70
Staff training	71
GEOseminars.....	71
Conferences, workshops and exhibitions.....	72
Conferences, workshops and exhibitions organised.....	72
Participation in international conferences and workshops	73
International travels and visits	78
Individual grants and scholarships	81
Co-operation partners.....	83
Membership and other activities.....	86
Publications.....	90
Papers in CC and SCI listed journals	90
Papers in other peer-reviewed journals and books	93
Papers in other journals and books.....	95
Books.....	97
Conference abstracts.....	98
Popular.....	108
Other publications	114
Other events, awards, etc.	115
In memoriam	117
How to find us?	119

Institute of Geology
at Tallinn University of Technology

7 Estonia pst
10143 Tallinn
ESTONIA
(until August 2006)

5 Ehitajate tee
19086 Tallinn
ESTONIA
(from September 2006)

Tel. +372 644 41 89
Fax +372 631 20 74

Homepage: <http://www.gi.ee/>
E-mail: inst@gi.ee

Foreword

This booklet represents a concise report of main achievements and activities of the Institute of Geology at Tallinn University of Technology during 2004–2005. On one hand, these years have been regular in the sense that the institute has continued its research successfully in earlier directions. On the other hand, attempts were made to modernize the institute's work content, laboratory equipment and to increase applied outcome of fundamental studies.

Below these aspects will be illustrated in more detail. Besides, in July 2005 the council of the Tallinn University of Technology accepted the new statute of our institute defining that Institute of Geology (IG) is a research and development institution acting in the field of geology and connected sciences including environmental protection. Among the traditional tasks of the institute (promotion of science, its applications for society etc.) there is a novel statement – IG is eligible to conduct doctoral studies in cooperation with university faculties. This possibility is important for students residing in Northern Estonia and enables the institute to educate a new generation of scientists for itself. As a first step, at the end of 2005 a curriculum of doctoral studies in Earth sciences was compiled together with the Marine Systems Institute. In this work the institute plans to actively cooperate with the Chair of Physical Geology established at the Faculty of Sciences of the Tallinn University of Technology. For future national and international success a rejuvenation of the staff must be given a high priority.

The Institute of Geology maintains its reputation for internationally competitive research across broad fields represented by the existing constituent working groups. This involves intense research activity within the working groups and a constant, competitive reassessment of the balance of activities within and between them. Our mission is also to serve the wider geoscience community by

fostering improved communication between academic science groups, the private sector, and government. The ultimate goals of the development program are to gain a more effective public presence for the geosciences, develop a sufficient stream of well-trained geoscientists to support industry and government projects, and to allow for the dissemination of ideas between the various geoscience sectors.

The Institute's research encompasses a large range of geological subjects under investigation in Estonia. Majority of research topics meet international standards of science and the teams carry out their research in collaboration with the international earth sciences communities, including additional financing from international sources.

In addition to the fundamental studies, our researchers working within six thematic groups are able to (1) solve practical geological problems in Estonia and abroad; (2) consult with both private and government



Alvar Soesoo, director of the Institute of Geology at Tallinn University of Technology since 1 January 2002.

Photo by G. Baranov.

corporations when required; (3) raise and help to solve inter-disciplinary problems both inside and outside their fundamental research topics; (4) use practical knowledge-based research to promote increased commercial activity with the earth sciences.

A great importance is placed on upgrading of existing, and establishment and development of new laboratories in collaboration with other institutions in Estonia and abroad. Within the broad areas of lithology, palaeontology and stratigraphy, geochemistry, petrology, geological modelling and mineral sciences the main focus of coming years will be on further development of all Institute's laboratories and more active participation in applied sciences. Today we very much hope that the next year's move of the institute into new premises in the Mustamäe university campus means also cer-

tain modernization of our laboratories.

Our scientific collections of Palaeozoic rocks and fossils are the largest in the region and open for studies by Estonian and foreign researchers and students. During the last two years situation and maintenance of the collections were considerably improved thanks to the grants from the State programme "Collections of humanities and natural sciences" (Ministry of Education and Science) and from the Environmental Investment Centre at the Ministry of Finance. A great progress has been achieved making a part of the database accessible on-line at the collections' website (<http://sarv.gi.ee>). This network will greatly facilitate usage of biological and palaeontological information by scientists and other people who might need it for their work or for personal interests.

Institute of Geology in brief

The Institute of Geology, presently at Tallinn University of Technology, was founded on 5 April 1946 by the Decree of the Council of Ministers of the Estonian SSR as an institute of the Estonian Academy of Sciences. Professor Artur Luha was appointed the first director of the Institute on 1 January 1947 and the actual work commenced in February. During the first years the staff remained small constituting three departments at the Institute – geology, applied geology and geophysics. As there was no Geological Survey in Estonia at that time, the Institute was engaged with prospecting and study of mineral resources (oil shale, phosphorite and natural building materials) in addition to some hydrogeological investigations. However, at this stage the foundation was laid to fundamental research. The latter was mainly focussed on stratigraphy and lithology of Palaeozoic and Quaternary sediments and palaeontology.

In early 1960s, most of the geological research institutes all over Soviet Union were subordinated to the USSR Ministry of Geology in Moscow. The Institute of Geology in Estonia managed to keep its affiliation to the Academy of Sciences. This was mainly due to the high level of fundamental research conducted by the Institute.

From 1960 to 1990, the staff grew rather rapidly and the structure of the Institute was

changed. The growth of the staff was partly encouraged by increasing role of applied studies on phosphorite and oil shale. From the 29 people in 1947, the staff had grown up to 193 people (about a half of them researchers) in early 1990s. Shortly after regained independence, the Institute underwent great changes. During 1992–1994, the staff was reduced by 54%, mostly on the expense of applied research directions (hydrogeology, geophysics, marine geology). In 1996, with the Decree of the Estonian Government, the Institute was affiliated to the Ministry of Education. Three years later, the Institute of Geology joined the Tallinn University of Technology as an independent research and development institution.

The Institute has had close contacts with all Estonian universities, particularly with University of Tartu, which most of our staff has graduated from. The Institute also has contacts with other environment and education oriented governmental and private organizations. During the last decades, all forms of foreign contacts widened rapidly, including joint projects, organizing scientific meetings, giving lectures etc. The number of scientific publications is quite high as well as international recognition of a number of our research teams.

As of December 2004, there were 76 people employed at the Institute, 43 of them on research position, 37 having doctoral and 6 MSc degrees. For 2005 the same numbers show slightly increasing tendency – 78 employees, among them 45 researchers, 41 of them are doctors and 4 masters. One doctor and two masters work on other positions.



Main entrance of the building at Estonia Ave 7, hosting our institute since 1952. In summer 2006 the Institute will relocate to the campus of the Tallinn University of Technology in Mustamäe.

Photo by G. Baranov.

Funding in 2004 and 2005

The science, research and development programs in Estonia are mainly funded from state budget, only a small part comes from the private sector. The basics of science funding policy are described in a strategy program “Knowledge-based Estonia. Estonian R&D Strategy 2002-2006”, according to which the expenses for science and development were planned to increase from 0.8% (2002) to 1.5% (2006) of GNP. By the end of 2004 the actual level of funding (0.9% GNP) was far behind of that agreed by the Parliament.

According to the Organisation of Research and Development Act the direct funding of science activities via the state budget consists of three main parts: expenditures for maintaining the infrastructure, target financing and research grants. The first two are managed by the Ministry of Education and Science (www.hm.ee) with the Scientific Competence Council as an advisory body to the Minister. Target finances included in 2004 also the expenses for post-doctoral activities. In 2005 a new rather limited instrument was added – the base-line funding for supporting novel research of an institute.

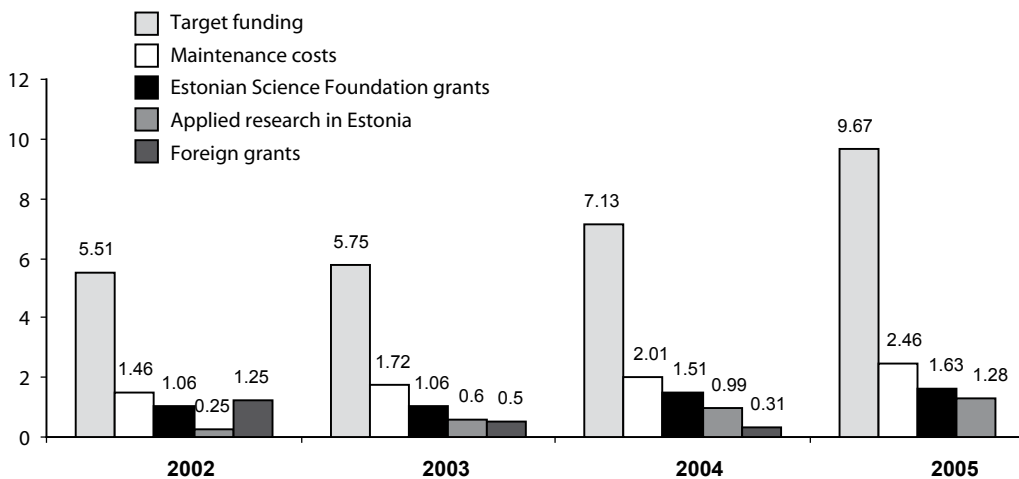
Through the grant finances scheme the Estonian Science Foundation (ETF hereinafter;

www.etf.ee) supports the most promising research initiatives in all fields of basic and applied research. Since 2005 also post-doctoral grants are financed by the ETF. In addition, some applied research and monitoring projects are supported by the Ministry of Environment and the Ministry of Economic Affairs and Communication, in the field of innovation, in particular.

Both, the target funding and grants are awarded on a competitive basis. The target funding and ETF grants are sufficient for salaries and consumables, but do not allow purchasing expensive research equipment. For the latter a special state infrastructure program was initiated, but by the end of 2005 our institute’s perspectives for receiving any support remained obscure.

Main figures describing the annual budget of the Institute of Geology at Tallinn University of Technology in 2002–2004 and its dynamics are shown in the diagram below. In the following a few comments and details illustrating how these sums have been used are added:

(1) Target funding (SF) constitutes ca 60% of the entire budget with slight rising tendency through the years shown. In the same time the actual sums for target financed research were



Funding of the Institute through 2002–2005 by main sources in million kroons (EEK).

increasing last two years 24 and 36% instead of only 4% in 2003. In 2004 there were 9 SF research projects under study, including 2 post-doctoral scholarships, in 2005 these numbers were 8 and 1, respectively.

(2) The number of research grants awarded by the ETF was 17 in 2004 and 15 in 2005. The corresponding funding presented in the diagram has been nearly stable during the earlier years, but began to increase in the last two years. It means that the share of the grant finances has been more or less stable on the background of increasing target finances.

(3) Infrastructural (maintenance) expenses for the Institute in total nearly doubled in 2004 as compared to 2003, and in 2005 the increase continued (22%). Such rapid increase was partly due to the grants from the State programme "Collections of humanities and natural sciences" for covering the expenses for management of Institute's large geological collections (427500 EEK in 2004 and 815700 EEK in 2005) and grants from

the Environmental Investment Centre at the Ministry of Finances.

(4) The number of applied research contracts with partners from Estonia shows clearly increasing trend during the reporting period: 13 in 2004 and 17 in 2005, in terms of money nearly three times. This could be interpreted as a result of directed efforts made by the Institute.

(5) Foreign grants and contracts show, unfortunately, another trend opposite to the previous one can be observed: a long-term EU project was finished, but no new projects were initiated instead.

In total the annual budget of the Institute of Geology at Tallinn University of Technology increased 25% per year through 2004-2005, allowing to carry into effect several new scientific ideas and to improve institute's infrastructure. We expect to make a next step in these directions in 2006 when the institute will move into the new rooms in the campus of the university.



Structure and staff

Data as of 31 December 2005; work load is shown in brackets. Note that since January 1st, 2006 the structure of the institute and the staff list were changed notably; see Institute's homepage at <http://www.gi.ee> for updated information.

Administration

Soesoo, Alvar <i>Ph.D.</i>	director, head of laboratory (0.75)	6454661	Alvar.Soesoo@gi.ee
Viiul, Mati	managing director	6454190	Mati.Viiul@gi.ee
Tubli, Toivo	chief engineer	6444189	Toivo.Tubli@gi.ee
Nõmmisto, Lia	senior inspector (0.50)	6454651	Lia.Nommisto@gi.ee
Tõkke, Eveli	guard	4458193	
Peetermann, Saima	research and development specialist	6444189	Saima.Peetermann@gi.ee
Helle Pohl-Raidla	secretary (maternity leave)		Helle.Pohl@gi.ee

Department of Bedrock Geology

Kaljo, Dimitri <i>D.Sc.</i>	head of department (0.80)	6454653	Dimitri.Kaljo@gi.ee
Baranov, Gennadi	photographer	6454652	genu@gi.ee
Bityukova, Liidia <i>Ph.D.</i>	senior researcher	6454679	lida@gi.ee
Einasto, Rein <i>Cand.Sc.</i>	researcher (0.40)	6454189	einasto@gi.ee
Hints, Linda <i>Cand.Sc.</i>	senior researcher	6454649	Linda.Hints@gi.ee
Hints, Olle <i>Ph.D.</i>	senior researcher	6454649	Olle.Hints@gi.ee
Kestlane, Ülo	senior laboratory assistant	6454189	
Kiipli, Enli <i>Ph.D.</i>	researcher (0.90)	6720077	enli.kiipli@egk.ee
Killing, Mairy	technician (0.60)	6454678	Mairy.Killing@gi.ee
Klaas, Riina	sen. laboratory assistant	6454677	
Kleesment, Anne <i>Cand.Sc.</i>	researcher (0.70)	6454649	kleesmen@gi.ee
Konsa, Mare <i>M.Sc.</i>	researcher	6454119	mare@gi.ee
Linkova, Tatjana	leading engineer	6454660	
Lääts, Jaanika	technician (0.80)	6454677	jaanika@gi.ee
Mark-Kurik, Elga <i>Cand.Sc.</i>	researcher (0.10)	6454189	kurik@gi.ee
Mõtus, Mari-Ann <i>Ph.D.</i>	researcher (0.80)	6454678	motus@gi.ee
Männik, Peep <i>D.Geol.</i>	senior researcher	6454189	mannik@gi.ee
Männik, Riina	senior laboratory assistant	6454677	riinam@gi.ee
Märss, Tiit <i>Cand.Sc.</i>	senior researcher	6454652	marss@gi.ee
Nestor, Viit-Kai <i>Cand.Sc.</i>	researcher (0.70)	6454649	vnestor@gi.ee
Nestor, Heldur <i>D.Sc.</i>	senior researcher (0.80)	6454652	hnestor@gi.ee
Niit, Moonika	technician (0.10)		moonika@gi.ee
Nõlvak, Jaak <i>Ph.D.</i>	senior researcher	6454677	nolvak@gi.ee
Oras, Kersti	lab. assistant (maternity leave)		Kersti.Oras@gi.ee
Pärnaste, Helje <i>Ph.D.</i>	researcher, head of department	6454678	helje@gi.ee
Ronk, Kaie	senior laboratory assistant (0.50)	6454677	Kaie.Ronk@gi.ee
Shogenov, Kazbulat	laboratory assistant (0.50)	6455788	shogenov@gi.ee
Shogenova, Alla <i>Ph.D.</i>	senior researcher	6455788	alla@gi.ee
Teedumäe, Aada <i>Cand.Sc.</i>	researcher (0.50)	6454119	teedumae@gi.ee
Tiirmaa, Reet	engineer (0.20)	6454119	reetmaa@hotmail.ee
Vaher, Rein <i>Cand.Sc.</i>	researcher (0.70)	6454652	vaher@gi.ee
Viira, Viive <i>Cand.Sc.</i>	researcher (0.50)	6454189	viira@gi.ee

The Earth Processes Modelling Laboratory

Soesoo, Alvar <i>Ph.D.</i>	director, head of laboratory	6454661	Alvar.Soesoo@gi.ee
Kalam, Evelyn <i>M.Sc.</i>	engineer (0.50)	6454654	Evelyn.Kalam@gi.ee
Urtson, Kristjan <i>M.Sc.</i>	engineer (0.50)		urtson@gi.ee

Laboratory of Physical Investigations

Nemliher, Jüri <i>Ph.D.</i>	senior researcher, head of laboratory	6454678	nemliher@gi.ee
Kallaste, Ene	senior laboratory assistant (0.50)		
Kallaste, Toivo <i>M.Sc.</i>	researcher (0.80)	6720077	kallaste@egk.ee
Kiipli, Tarmo <i>Ph.D.</i>	senior researcher (0.50)	6720073	tarmo.kiipli@egk.ee

Department of Quaternary Geology

Raukas, Anto <i>D.Sc.</i>	head of department (0.75)	6454659	Anto.Raukas@gi.ee
Alliksaar, Tiiu <i>Ph.D.</i>	senior researcher	6454708	Tiiu.Alliksaar@gi.ee
Heinsalu, Atko <i>Ph.D.</i>	senior researcher	6454708	heinsalu@gi.ee
Karukäpp, Reet <i>Ph.D.</i>	senior researcher (0.50)	6454654	karukapp@gi.ee
Kink, Hella <i>Cand.Sc.</i>	senior researcher (0.20)	6454680	
Kukk, Helle	translator	6454119	hkukk@gi.ee
Maspuran, Urve	laboratory assistant (0.40)	6454680	
Meltsov, Vivika	engineer (0.50)		
Metslang, Toomas <i>M.Sc.</i>	researcher	6454654	metslang@gi.ee
Miidel, Avo <i>Cand.Sc.</i>	senior researcher	6454119	miidel@gi.ee
Niinemets, Eve <i>M.Sc.</i>	leading engineer	6454708	even@ut.ee
Poska, Anneli <i>Ph.D.</i>	senior researcher (0.50)	6454708	poska@gi.ee
Saarse, Leili <i>Cand.Sc.</i>	senior researcher	6454708	saarse@gi.ee
Tavast, Elvi <i>D.Geol.</i>	senior researcher	6454654	tavast@gi.ee
Tiirmaa, Reet	engineer (0.20)	6454119	reetmaa@hotmail.com
Vassiljev, Jüri <i>Ph.D.</i>	senior researcher	6454708	vassilje@gi.ee
Veski, Siim <i>Ph.D.</i>	senior researcher	6454708	veski@gi.ee

Laboratory of Isotope Palaeoclimatology

Vaikmäe, Rein <i>Cand.Sc.</i>	head of laboratory (0.25)	6202005	Rein.Vaikmae@ttu.ee
Ivask, Jüri <i>Ph.D.</i>	senior researcher, (0.90)	6454660	Jyri.Ivask@gi.ee
Kaup, Enn <i>Cand.Sc.</i>	senior researcher	6454679	Enn.Kaup@gi.ee
Martma, Tõnu <i>M.Sc.</i>	researcher	6454122	Tonu.Martma@gi.ee
Raidla, Valle <i>M.Sc.</i>	researcher (0.40)	6454679	Valle.Raidla@gi.ee
Rajamäe, Heivi	senior laboratory assistant	6454660	Heivi.Rajamae@gi.ee
Vallner, Leo <i>Cand.Sc.</i>	researcher (0.40)		Leo.Vallner@gi.ee

Research Laboratory of Quaternary Geochronology

Molodkov, Anatoli <i>D.Geol.</i>	senior researcher, head of laboratory	6454654	molodkov@gi.ee
Balakhnichova, Tatjana	leading engineer	6454540	tatyana@gi.ee
Jaek, Ivar <i>D.Sc.</i>	senior researcher (0.60)	7375528	galinap@physic.ut.ee
Osipova, Marina	engineer	6454540	omarina@hotmail.com
Ploom, Kuldev	engineer (0.20)	6720070	k.ploom@egk.ee
Vasilchenko, Valeri <i>Cand.Sc.</i>	senior researcher (0.60)	7375526	valeriv@physic.ut.ee

Department of Scientific Collections

Pärnaste, Helje <i>Ph.D.</i>	researcher, head of department	6454678	helje@gi.ee
Aaloe, Aasa <i>Cand.Sc.</i>	leading engineer	6454679	Aasa.Aaloe@gi.ee
Noska, Margus	laboratory assistant (0.50)	6454189	noska@gi.ee
Toom, Ursula	chief curator	6454649	Ursula.Toom@gi.ee

Council of the Institute

Soesoo, Alvar <i>Ph.D.</i>	director, head of laboratory	6454661	Alvar.Soesoo@gi.ee
Kaljo, Dimitri <i>D.Sc.</i>	head of department	6454653	Dimitri.Kaljo@gi.ee
Raukas, Anto <i>D.Sc.</i>	head of department	6454659	Anto.Raukas@gi.ee
Kaup, Enn <i>Cand.Sc.</i>	senior researcher	6454679	Enn.Kaup@gi.ee
Vaikmäe, Rein <i>Cand.Sc.</i>	vice-rector for research of TUT	6202005	Rein.Vaikmae@gi.ee
Hints, Olle <i>Ph.D.</i>	senior researcher,	6454649	Olle.Hints@gi.ee
Ivask, Jüri <i>Ph.D.</i>	senior researcher	6454660	Jyri.Ivask@gi.ee
Klein, Vello <i>Cand.Sc.</i>	director of Geological Survey of Estonia	6720094	V.Klein@egk.ee
Kukk, Henn <i>Cand.Sc.</i>	head of Faculty of Mathematics and Natural Sciences, Tallinn University	6409400	henn@tlu.ee
Märss, Tiiu <i>Cand.Sc.</i>	senior researcher	6454652	marss@gi.ee
Pärnaste, Helje <i>Ph.D.</i>	researcher, head of department	6454678	helje@gi.ee
Tammemäe, Olavi <i>M.Sc.</i>	deputy minister of the Ministry of the Environment	6262998	olavi.tammemae@envir.ee
Veski, Siim <i>Ph.D.</i>	senior researcher	6454708	veski@gi.ee

Laboratories

The Earth Processes Modelling Laboratory

Contact: Alvar.Soesoo@gi.ee (+372) 6 454 661

Most geological processes occur on time and length scales and under conditions that are impossible or very expensive to achieve in laboratory. Significant progress in our understanding of geological processes has been achieved by simulating these processes both by numerical and physical experiments with analogue materials. Experimentation is most powerful when both numerical and physical experiments are combined. At the moment the Earth Processes Modelling Laboratory involves both analogue and computer modelling approaches to study:

(1) Igneous processes from partial melting to crystallisation, including mantle and crustal melting, melt accumulation, emplacement and pluton formation.

(2) (a) Interaction. Melt/fluid-rock interaction, with particular attention to the microstructural factors that play a role in such processes. (b) Transport. The way in which fluids (melt, magma, aqueous fluids, oil, gas) moves through a rock and accumulates over up to more than 20 orders of magnitude from source to emplacement. Migmatite and dyke formation.

(3) Chaos and scale-invariant or self-similar phenomena in fluidrock systems, focusing

at the system characteristics that follow from the mechanisms that are subject of (1) and (2). These research directions include international cooperation with scientists from a number of universities.

Numerical modelling. Numerical modelling includes both traditional geochemical modelling and novel numerical modelling techniques. The base for the modelling of transport and accumulation phenomena will be the codes PISTON, MELTPOCKET and ELLE. Although these models originally model the physics of transport and accumulation, they can incorporate chemical processes as well. For this purpose, they will be linked with the geochemical and thermodynamic modelling packages, for instance MELTS (Ghiorso and Sack 1995).

Analogue modelling. Classical chemistry and thermodynamics can usually accurately tell which reactions would occur, but experiments are needed to see how these reactions occur in a rock. "Meso-scale" experiments are aimed at the simulation of larger scale systems, ranging from dm/m-scale partial melt systems (migmatites) to km-scale ascent through crust or mantle. These experiments are done in semi-2D (plexi-) glass tanks in which the system that is to be studied is "rebuilt", with appropriate scaling and analogue materials such as sand or gelatin, and when possible partially molten rock analogues.

Micropalaeontology Laboratory

Contact: Olle.Hints@gi.ee (+372) 6 454 189

Micropalaeontological investigations constitute an important part of the traditional palaeontological research at the Institute. The main groups of microfossils commonly extracted and/or studied include chitinozoans, conodonts, graptolites, micro-vertebrates, and ostracods – groups that play a major role in Lower Palaeozoic biostratigraphy.

The biostratigraphical dating methods are highly rated and frequently utilised to provide the temporal background for sedimentological, geochemical and other studies not directly related to palaeontology. Moreover, even some questions not directly related to geology can be answered on the basis of microfossil content. A good example is dating of limestone pieces in the walls of buildings.

Setup of the micropalaeontology labora-

tory is best suited for extraction of microfossils from carbonate and clayey rocks, which are prevailing in the Lower Palaeozoic strata of the Baltic region. The main methods used in this laboratory include: (1) acid digestion, particularly with acetic- and weak hydrochloric acid, for extracting organic or phosphatic remains; (2) disintegration with hydrogen peroxide and sodium-hyposulphite, for carbonaceous as well as other fossils; (3) separation and concentration, primarily using heavy liquids and sieving.

Laboratory of Physical Investigations

Contact: Tarmo.Kiipli@egk.ee (+372) 6 720 073

The main research fields of the Laboratory are mineralogy and geochemistry. Mineralogical studies are based on X-ray diffraction and carried out using HZG-4 and URD equipment. Chemical studies are conducted using XRF technique and VRA-30 analyzer. All data processing is fully digitised and analysis results are based on original software. The laboratory has joined the international intercalibration programme (EnviPT-2). Starting from 2006, staff of the laboratory participates in the Nordic Mineralogical Network.

Laboratory of Physical Investigations carries out a wide spectrum of activities to provide state and municipal institutions (such as environmental services, custom and police organizations) with analyses, most commonly

of unique character. Also, for several elements (Cr, Mn, Ni, Co, Sr, Ru, Ro, Pd, Os, Ir, Pt, Au, Ag) the test results are precise enough to satisfy the technological demands of private companies.

In past year the main research topics were mineralogy of diagenetically altered volcanoclastic ashes of Palaeozoic age; aragonites, constituting shells of *Macoma* and *Cerastoderma* from the Baltic Sea; and bioapatites of recent and fossil fauna. For studies of such mineralogical constants as lattice parameters, microstrains content and crystallites size, the original software has been developed. Basically, by whole-pattern fitting of XRD patterns by different profile-shape functions (usually, the modified Lorentzian profile is used), specific solutions are constructed for e.g. feldspars, carbonates (hexagonal and rhombic) and apatites of different origin.

Laboratory of Isotope-Palaeoclimatology

Contact: Rein.Vaikmäe@gi.ee (+372) 6 202 005

The history of the Laboratory of Isotope-Palaeoclimatology goes back to the late 1960s, when the laboratory of ^{14}C dating was established in the Department of Quaternary Geology. In the early 1970s, the mass-spectrometry laboratory and the laboratory of Thermally Stimulated Luminescence (TL) dating were started. On the basis of these research groups, the laboratory of isotope geology as a structural unit within the Institute of Geology was established in 1975. To reflect more precisely

the main research trends of this group, the laboratory was renamed in 1996; its present name is the Laboratory of Isotope-Palaeoclimatology. Although since the early 1990s, the Laboratory of Radiometric Dating, has formally been a separate research unit within the Department of Quaternary Geology, since 1997 both laboratories have worked together in the frame of a target-financed project, because for both groups the main research direction has been the development and application of physical and geochemical methods in the study of the Quaternary palaeoclimate and palaeoenvironment.

The main research fields of the laboratory are isotope-palaeoclimatology, palaeocryology and palaeohydrology; application of isotopic methods in Palaeozoic stratigraphy, climatology and oceanology. An important mission of the laboratory is to propagate the possibilities and advantages of the application of modern physical and isotope-geochemical methods in Earth sciences.

The laboratory is based on modern analyti-

cal technique, the most important instruments are:

(1) Finnigan MAT Delta E mass-spectrometer for isotope analyses of light elements (H, C, N, O, S), purchased in 1984 and equipped with relevant sample preparation lines;

(2) ^{14}C analyser based on liquid-scintillation counter and relevant sample preparation laboratory;

(3) ion-liquid chromatograph IVK-21.

Laboratory of Quaternary Geochronology

Contact: Anatoli.Molodkov@gi.ee (+372) 6 454 654

Since the mid-1970s the laboratory has been engaged in research in the field of luminescence, and since the early 1980s – in research in the field of ESR dating of mollusc shells. As a result, in recent years new versions of ESR/OSL techniques have been developed for age determinations of marine, freshwater and terrestrial mollusc shells and enclosing deposits.

Presently, the Laboratory for Quaternary Geochronology is one of the very few in the West- and Central-European countries as well as in the former Soviet Republics, which can provide three up-to-date Radiation Exposure Dating Methods – Electron-Spin-Resonance (ESR), Thermally- and Optically- (infrared-light) Stimulated Luminescence (TL, IR-OSL). A new promising optically stimulated afterglow (OSA) method is currently under development. Together they are applicable over a time range from about hundred years to almost a million years on various naturally occurring minerals: biogenic carbonates, such as terrestrial, freshwater and marine mollusc shells, corals (by ESR), and sedimentary minerals (quartz and feldspar) common in aeolian (e.g., sand dunes, loess) and waterlain (e.g. fluvial, lacustrine, marine) deposits (by TL and IR-OSL). Combined use of the above-mentioned methods is enormously valuable because it can provide an independent age

estimation for Quaternary deposits and cross check often urgently needed to estimate the reliability of the dates obtained.

The research in the field of Mid – Late Pleistocene ESR/OSL-geochronology combined with sedimentology, palynology, diatom analysis, etc. remains to be highly important tool for chronostratigraphic studies on the vast territories of Eurasian north, especially when the age of the sample is greater than the 40000–50000 year limit of radiocarbon dating.

Main facilities are the following:

(1) Electron-spin-resonance (ESR) ERS-221 type spectrometer (X- and Q-band);

(2) computer-controlled Ingrid-type SLM-1, thermally- (TL) and infrared optically stimulated luminescence (IR-OSL) reader equipped with IR laser stimulation;

(3) γ -spectrometer (for measuring of uranium, thorium and potassium content in sediments);

(4) optical high resolution spectrometers for absorption measurements in the near-IR-vis-UV ranges;

(5) X-ray-, β - and γ - sources of irradiation;

(6) specialised chemical equipment for preparation of samples for ESR, OSL and TL analyses;

(7) specialised equipment for luminescence, resonance and radiometric measurements and irradiation;

(8) darkroom equipment for luminescence analysis.

Laboratory of Holocene Geology

Contact: Siim.Veski@gi.ee (+372) 6 454 708

The main aims of the laboratory are palaeoenvironmental, palaeoclimatic and palaeogeographic reconstructions. Changes of vegetation are recorded by means of multidisciplinary methods involving pollen and diatom analysis, geochemistry etc. Methods are developed for quantification of proxy records and modelling vegetation changes related to climate and human impact. Time span covered is mainly the Holocene, involving prehistoric as well as historic and modern time.

The Laboratory of Holocene Geology has extensive experience and is well equipped for coring and subsampling of lake and bog sediment sequences. Over 10-m long sediment cores can be obtained with the coring depth up to 30 m of water using our devices. For unconsolidated topmost sediments freeze crust corer and piston corer are in use. Our laboratory is equipped for preparation and analysis of biostratigraphic sediment samples (pollen, diatoms etc.) with standard microscopes and a complete range of diatom floras of North Europe.

Both fundamental and applied science is included in the research program of the lab.

As the instrumental record of the impact of climate change on the environment is too short to capture the whole range of climatic variability, therefore geological records should be investigated and different proxy data should be produced that reliable reconstruction of the past shifts in the climate outside the historically documented range can be elaborated. Research priority has been given to continuous high resolution natural records with annual to decadal time resolution (annually lake sediments). Our sediment studies are timely with respect to recent initiatives of global change IGBP/PAGES programs HITE (Human Impact on Terrestrial Ecosystems), LIMPACS (Human Impact on Lake Ecosystems), PEP III (Pole-Equator-Pole Europe Africa Transect), and European Science Foundation projects HOLIVAR (Holocene Climate Variability) and European Lake Drilling Project. Our research is also linked to the Nordic scientific programs, e.g. LAMSCAN (Detecting rapid environmental changes through studies of annually laminated lake sediments in northern Scandinavia) set up under the Nordic Council of Ministers Nordic Arctic Research Program, POLLANDCAL (POLlen LANDscape CALibration) and FIGARE (Finnish Global Change Research Program).

Collections

Institute of Geology holds the largest geological collections in Estonia. Particularly well represented are lower and middle Paleozoic fossil invertebrates and vertebrates from the Baltic region and former Soviet Union areas. The total number of individual items reaches several hundreds of thousands palaeontological, mineralogical and petrological specimens complemented with more than 300 drillcores and many rock samples collected for future study.

The collections, drill cores and rock samples are stored at the institute's building in Tallinn and at the Särghaua field-station in

Central Estonia. All of them are being used for everyday research carried out at the institute as well as by many researchers from outside the Institute and from abroad.

Department of Collections was formed at the Institute in 2001. As of 2005, it consists of chief curator Ursula Toom and curator Aasa Aaloe and is headed by Helje Pärnaste (by Linda Hints in 2001–2004). Other people, including several students, have also contributed to curatorial activities during these years.

Years 2004 and 2005 were particularly significant for Institute's collections and their



Collections held in a cellar at the Estonia Ave (left) and in the new core depository at Särghaua field-station (right). *Photos by G. Baranov.*

Removing the drill cores into their new rooms required a lot of manpower (below). *Photo by H. Pärnaste.*



management for several reasons.

First, it became clear that the Institute, together with all collection holdings, will move from the current location in the centre of Tallinn to the university campus in Mustamäe some 7 km apart. This posed several questions especially about the area and conditions for collection storage in new rooms. Finally it was decided that a new building to hold collections on the ground floor and laboratories, library and office rooms on the first floor will be built near the main university building. Indeed, before moving, all collections needed to be carefully packed in for lodging. Following several delays the construction is expected to be finished in July 2006 after which the moving can start.

Second, a special State Program aiming at ensuring preservation and improving accessibility of scientific collections, coordinated by the Ministry of Education and Science was commenced in 2004. Financial support from this program enabled to engage students and other part-time staff for various needs, especially packing, and save research funds that were previously allocated for collections management.

Third, support from the Environmental Investment Centre for several individual projects needs to be acknowledged. The major achievement in 2005 was construction of new core depository at the Särghaua field-station accommodating some 1400 core boxes. This enabled all drill cores that were temporarily held outdoors, or indoors but too tightly packed, to be moved into a modern building, where core boxes can be lifted and transported by pallet truck with minimal time and manpower. Also, building the collections' information system and acquiring appropriate hardware was supported by the Environmental Investment Centre, and a new contract has been launched for building the long-span shelving system for collection-cabinets in the new rooms.

As mentioned above, the main task for the department in 2004–2005 was packing of all specimens one by one into the drawers or boxes to be ready for moving to the new building. Alongside with this, re-labelling, ordering

and electronic registration was carried out (it was not possible to register all specimens to be packed though). In Särghaua, efforts were also put into enhancing the value of drill-cores by marking, photographing, ordering and re-boxing wherever necessary, and box-by-box registration in database.

Putting the databasing into numbers, nearly 50000 new records of individual items were added during 2004 and 2005. This takes the total number of registered items to nearly 130000, which makes up approximately quarter of all collections. Also, more than 800 drill-core boxes were photographed and appropriately registered.

The electronic database utilised for cataloguing, known as SARV, is an in-house developed client-server system that grounds on open source MySQL server as the back-end and MS Access-based user interface for data input and reporting. The underlying data model is currently made up of ca 70 related tables.

Until mid-2004 the system ran on low-end MS Windows workstation. In June 2004, however, support from the Environmental Investment Centre enabled acquisition of appropriate server hardware that currently runs Debian Linux, Apache web-server, MySQL database, MapServer web map server and various other programs.

Using BioCASE provider software the unit-level palaeontological data are made available through BioCASE (<http://www.biocase.org>) and GBIF (<http://www.gbif.org>) international networks. The Institute of Geology was the first to join these networks in Estonia. Indeed, the majority of data are also accessible using a dedicated web-based interface at <http://sarv.gi.ee>.

The same data model and user interface were implemented for geological collections at the Estonian Museum of Natural History. Over 7000 records are now catalogued and made accessible online there. Development of a common interface for querying both collection holders at once is underway.

In May 2005, the database was presented at the international conference "Managing Heritage Collections II: Continuity and Change"

as the only example of natural history collections.

Institute has only a small permanent display in the Särghaua field-station and a few specimens from its collections are shown in other places like a large meteorite in Kaali Museum, Saaremaa. However, in 2004–2005 several temporary exhibitions were organised. A geological exhibition “Mente et Malleo” was prepared and displayed at the Academic Library of Tallinn University in 2004, with opening for the beginning of the WOGOGO Meeting. Similar exhibition was shown at Tallinn University of Technology in 2005. In addition, specimens from Institute’s collections were displayed at the exhibitions “Estonian Oil Shale” (2004), “Ancient fishes” in the Latvian Museum of Natural History, Riga (2004), and in Käsnu Maritime Museum. All these temporary exhibitions were actively visited.

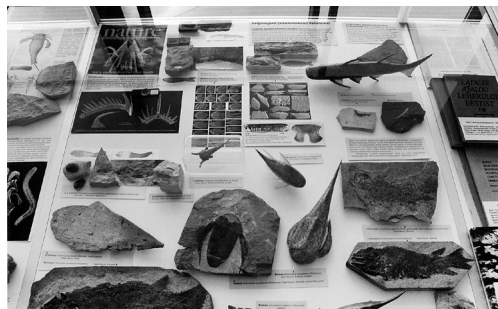
The collections housed at the institute were used beside different research projects in several Ph.D. theses (E. Kiipli, M.-A. Mõtus, H. Pärnaste), in a Postdoctorant project (O. Hints) and M.Sc. projects (M. Killing, J. Lääts, M. Niit and K. Shogenov).



Helje Pärnaste introducing the Estonian trilobites to Danish students at the opening of the exhibition “Mente et Malleo” in the hall of Library of Tallinn University in May 2004. *Photo by G. Baranov.*



Opening of the exhibition “Estonian Oil Shale” in the hall of Library of Tallinn University in January 2004. *Photo by G. Baranov.*



The Vertebrate collection on the same exhibition. *Photo by H. Pärnaste.*



Prof. Lauri J. Pesonen and his students from the Helsinki University together with J. Plado came to analyse some meteorites from our collections in October 2005. *Photo by H. Pärnaste.*

Research

Bedrock Geology

The bedrock of Estonia consists of the Proterozoic crystalline basement and mainly Palaeozoic sedimentary cover (Vendian–Devonian). The latter is very weakly metamorphized and tectonized, but rich in well preserved fossils. Correspondingly, palaeontology-stratigraphy, lithology-mineralogy, petrography, partly geotectonics and geophysics and in recent years isotope geology have been the main research fields in the bedrock geology of Estonia.

In 2004–2005 these trends were accomplished through four target financed projects, twelve Estonian Science Foundation grants (several part time, see below) and one post-

doctoral project (O. Hints). In 2004 institute's research workers engaged in the Ordovician and Silurian geology joined an international working group of the new IGCP project No 503 "Ordovician Palaeogeography and Palaeoclimate" and a special conference of the WOGOGOB was organised together with colleagues from the University of Tartu and Geological Survey of Estonian in Tartu with a scientific excursion through Estonia. In 2005, a large group of palaeontologists and stratigraphers participated in the Sixth Baltic Stratigraphical Conference in St. Petersburg, Russia, where several recent achievements were reported (see below and list of publications).



The Lower and Middle Ordovician dolomitized limestones at Saka section, NE Estonia. *Photo by G. Baranov.*

Late Ordovician and Silurian marine ecosystems in the NW part of the Baltica continent and their role in the progress of geology

Target Financed Research Project No. SF0331760s01

Project leader: D. Kaljo

Team: T. Märss, V. Nestor, H. Nestor, T. Martma, M.-A. Mõtus, E. Mark-Kurik, M. Niit

Duration: 2001–2005

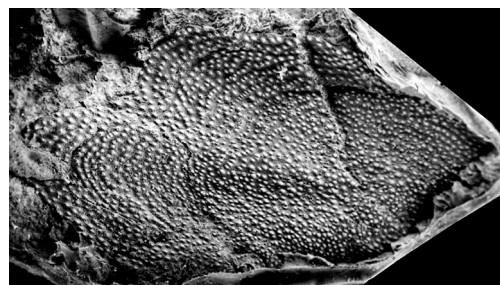


Dimitri Kaljo giving a lecture about his latest results on the isotope geology on the seminar of department. *Photo by H. Pärnaste.*

The main idea of the project is to apply the ecosystem concept in studies of the geological history of the NW part of the Baltica continent, which makes possible to integrate into a whole complex different aspects of the basin evolution, including palaeogeographical and palaeoecological, geological, sedimentological, oceanological and climatological. For such a many-sided research a set of lithofacies-palaeogeographical base maps (16) will be compiled, where also other data are shown. This set of maps allows to study different aspects of the basin evolution both in time and space concurrently. Sedimentary cyclicity, eustatic changes, detailed lithology of certain intervals, carbon and oxygen isotopes will be also investigated. Studies in taxonomy, evolution and distribution of corals, stromatoporoids, vertebrates, chitinozoans should give an understanding of the living component of the palaeoecosystems. The results of the project will be used in applied and theoretical geology, university curriculae in particular.

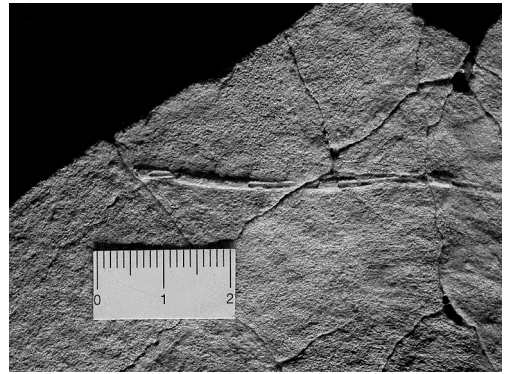
In 2004, the following most essential results

were achieved (see also corresponding grants and publications): (1) In the field of isotope geology serious progress was achieved in detail studies of the mid-Ordovician carbon isotope trend and especially of a large negative excursion confined to the kukersite-bearing rocks at the Darriwilian/Caradoc boundary (D. Kaljo, T. Martma, T. Saadre, *Est. Geol. Surv.*), promising certain hints for facies interpretations. (2) High diversity of the mid-late Ordovician rugose corals of Baltoscandia bases on abundance of lam-belasmatic corals not reported from Laurentia and Australasia (D. Kaljo). Results of a taxonomic revision of the Silurian tabulate corals were presented in a doctoral dissertation (M.-A. Mõtus). (3) A medium-rank sedimentary cyclicity of the Raikküla Stage was described and used for correlation of the formations of the stage. Based also on the data about the lattice parameters it was proved that the intense pervasive dolomitization was associated with the regressive phases of the Palaeobaltic Basin (Teedumäe, Nestor, Kallaste 2004). An integrated chitinozoan and graptolite biozonation was compiled for Telychian of the Baltic area, which will improve the reliability of biostratigraphic correlations (V. Nestor). (4) Ten types of ultrasculpture of scales of the early vertebrates were established and their significance in the taxonomy and evolution of the subclass Thelodonti was demonstrated (T. Märss). The latter was subdivided into two superfamilies, one of them having ultrasculpture similar to that in sharks. A new genus of obruchevid fishes was described from the Upper Devonian of Canadian Arctic, and the lateral line sensory system in psammosteid heterostracans was studied (E. Mark-Kurik with USA colleagues).



Lower Devonian placoderm plate from the Rangkul Lake area, Pamir. Placoderms dominated in this unique Pragian fish fauna (Leleshus et al. 2005). *Photo by G. Baranov.*

In 2005, in the field of isotope geology the Silurian, particularly Wenlock and Ludlow carbon isotope trend was refined (D. Kaljo, T. Martma), promising more exact correlation of the Silurian sequences elsewhere in the world. In palaeontology a highlight of the year was the State Prize in geo- and biosciences received by T. Märss for a cycle of papers on the Mid-Palaeozoic vertebrate evolution and distribution in the seas of Northern Hemisphere and their practical significance in geology. Highly important contribution to the well-known manual “Treatise on Invertebrate Paleontology” part E4 was made by H. Nestor compiling several stromatoporoid chapters of the book.



Tube that enclosed the lateral line on the dorsal plate of the Middle Devonian psammosteid (jawless fish) *Psammosteus bergi* (Obr.) (Elliott and Mark-Kurik 2005). Photo by G. Baranov.

Evolution of communities of Silurian corals and jawed polychaetes of Estonia and its climatic and oceanic agents based on isotope analysis

Estonian Science Foundation Grant No. ETF5042
 Project leader: D. Kaljo
 Team: O. Hints, T. Martma, M-A. Mõtus
 Duration: 2002–2004

The project was aimed at elucidating evolutionary patterns of coral communities (rugosans and tabulates) and jawed polychaetes and finding out the role of biotic and abiotic agents in evolution processes. Very important was the applied aspect of the project, i.e. accumulation of bio- and isotope stratigraphy data for solving different problems of geology. In order to achieve these goals, the following studies were planned:

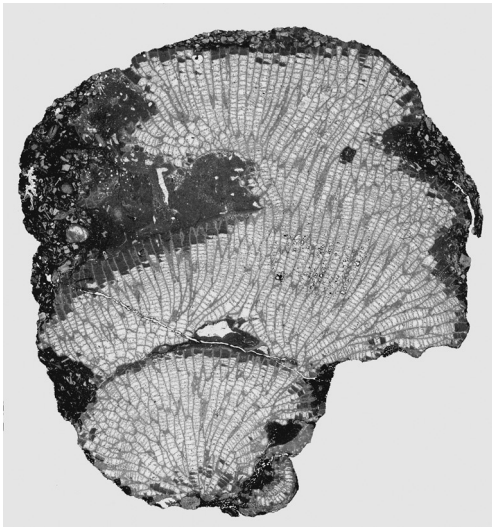
(1) Revision of assemblage content of rugose and tabulate corals, modernization of the taxonomy used earlier, filling of gaps, description of new taxa; compilation of a list of jawed polychaete taxa together with corresponding taxonomical study. Establishment of stratigraphical ranges of all taxa of both groups.

(2) Study of spatial distribution, diversity patterns and development of rugose coral- and jawed polychaete communities; investigation of relationships between the two fossil groups and other fossil organisms.

(3) Study of changes of carbon and oxygen stable isotope content in order to estimate climatic and oceanic parameters, and to use environmental events for chronostratigraphical correlation. The same stratigraphical interval and the same sections as mentioned in items 1 and 2 were studied. In addition, the rocks formed in relatively deep water environments and containing seldom or no corals and polychaetes were studied to correlate coral and polychaete bearing rocks with graptolite biozonation.

(4) Interpretation of integrated palaeontological and geochemical data, which, on the one hand, revealed the trends of biological evolution and development of communities of both fossil groups. On the other hand, the expected results included palaeoclimatic and palaeoceanic conclusions on the evolution of the Baltic Basin.

In 2004, the following most essential results were achieved (see also the list of publications): Three topics as main items were pursued: a) rugose and tabulate coral diversity, variability and reasons of these phenomena; b) taxonomic composition and facies distribution pattern of polychaete jaw assemblages; c) interpretation of environmental conditions based on the carbon isotope analysis. Studies



The tabulate coral *Paleofavosites*, a subject of the PhD study of Mari-Ann Mõtus. Photo by G. Baranov.

showed that increase of the rugose coral diversity is in clear correlation with warming of the climate and vice versa diversity low stands mark the cooling events, but this pattern could be overshadowed by other processes. Changes

Relationships of climate and biotic evolution during the Ordovician and Silurian in Baltic based on palaeontological and isotope geological data

Estonian Science Foundation Grant No. ETF6127

Project leader: D. Kaljo

Team: L. Hints, O. Hints, J. Nõlvak, H. Pärnaste,

T. Martma, M-A. Mõtus

Duration: 2005–2008

Main task of the project is to find through elucidation of interrelationships of evolutionary biotic and climatic processes the agents that cause, first, changes in the biodiversity dynamics both in taxonomic and morphologic sense, and, secondly, changes in the trend of carbon cycling during the time interval under study. This analysis will give reliable data for characterization of climate in the Baltica area but in the global context. Database for that work will be formed by palaeontological and

in abundance and variability of tabulates are mostly caused by dynamic conditions of the environment and by the bottom characteristics. Several Silurian tabulate assemblages of Jämtland and Gotland (Sweden) were described and compared with those of Estonia. Taxonomic composition of the polychaete jaw assemblages in the Wenlock, Ludlow and Pridoli rocks of Saaremaa was studied. Based on data from outcrops and core sections a clear biofacies zonality was revealed. Rich analytical database on the late Ordovician carbon isotope composition allows showing that positive excursions of the trend do not correlate with lithology of the local sedimentary rocks, but are caused by more general reasons as alternating humid and arid climate episodes. New data were obtained about the Middle Ordovician and Wenlock-Ludlow carbon isotope trend. A wide negative excursion at the Darriwilian/Caradoc boundary coinciding with the kukersite-bearing rock sequence rich in organic matter and extremely high level biodiversity may have interesting implications for environmental analysis.

biodiversity studies of corals, brachiopods, jawed polychaetes and trilobites, sedimentological, geochemical and isotope studies of sections in order to compile an as complete as possible trend of carbon isotope changes. For making the time scale and correlation chart in use more exact detailed chitinozoan and conodont biozonations will be employed. Possible practical applications rise from stratigraphical and facies- climatic patterns discovered and can be used in applied geology and university curricula. The reporting year was the first work year of the project, but in fact it continues studies performed under the previous project, several new aspects were added (biodiversity of brachiopods and trilobites, biozonations of chitinozoans) and corresponding new researchers joined the project. Great attention was paid to the collecting of samples (rocks, fossils) in order to study faunas and facies of the early – middle Ordovician and kukersite-

bearing rocks, and for correlation with neighbouring areas (took place expeditions to Podolia, Gotland and St. Petersburg area). Based on the carbon isotope data was suggested a new correlation of the Ordovician rock sequences of Estonia and Nevada (USA). The result was

Boundaries, stratotypes, and integrated stratigraphy of the Wenlock Series in the northern East Baltic, and correlation with adjacent regions

Estonian Science Foundation Grant No. ETF5088

Project leader: H. Nestor

Team: V. Nestor, V. Viira

Duration: 2002–2004

Basing on the correlation of zonal successions of stratigraphically important groups of fossils (conodonts, chitinozoans, graptolites and others), the position of the boundaries of the Wenlock Series are established in key sections of the northern East Baltic. This contributes to the determination of the series boundaries in other regions and to the composition of the global integrated biozonal standard for the Wenlock time interval. Stratigraphical classification and nomenclature of the Wenlock strata is revised on the ground of complex bio- and lithostratigraphical investigations of type sections of regional stages and formations. The investigations contribute to stabilization of the Wenlock regional stratigraphy, which forms a temporal-spatial framework for linkage of results of different geological investigations, and for creation of data bases.

In 2004, (1) H. Nestor as a coauthor (A. Teedumäe, H. Nestor, T. Kallaste) published a paper on sedimentary cyclicity and dolomitization of the middle Llandovery Raikküla Formation in the Nurme drill core in western Estonia, in which a medium-rank sedimentary cyclicity was described. Two shallowing up mesocycles and four submesocycles were distinguished and correlated with sedimentary cycles in other formations of the Raikküla Re-

submitted for publication. At different international meetings were presented 9 reports (abstracts published) and based on these 3 papers are accepted in peer reviewed journals, one of them in a CC journal. One paper was published in a CC and 2 in peer reviewed journals.

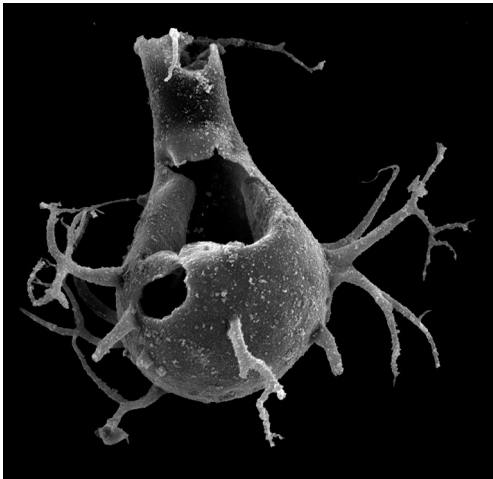
gional Stage. Investigation of lattice parameters of dolomite showed a trend of growing dolomite stoichiometry towards the top of the regressive, shallowing up submesocycles. Extensive diagenetic dolomitization was associated with regressive phases of the evolution of



Viki drill core (111.1 – 116.6 m), interval where the index species *Margachitina margaritana* has been found. Photo by G. Baranov; also exposed in our on-line database at the public web-site <http://sarv.gi.ee>.

the Paleobaltic basin and was related to a zone of shallow, inner shelf facies, migrating in space in accordance with sea level changes.

(2) V. Nestor and D. Loydell (University of Portsmouth) submitted for publication a paper on the integrated graptolite and chitinozoan biostratigraphy of the upper Telychian in the Ventspils drill core, Latvia. The correlation between the graptolite and chitinozoan zonal successions was remarkably improved. It was established, that the base of the *An-*



Ramochitina nestorae Grahn (magnified x265), species which appears at *M. margaritana* chitinozoans Biozone (Nestor, V. 2005). *Microphotograph in SEM.*

gochitina longicollis chitinozoan Biozone is approximately coincident with that of the *spiralis* graptolite Biozone, *Conochitina proboscifera* appears in the upper *spiralis* graptolite Biozone and *Ramochitina ruhnuensis* at a level close to the base of the *lapworthi* graptolite Biozone. The chitinozoan biozonal index species *Margachitina banwyensis* and *M. margaritana* appear in this section in the upper part of the *spiralis* graptolite Biozone, i.e. much lower than recorded elsewhere.

(3) V. Nestor studied succession of chitinozoan taxa in the uppermost Llandovery and lowermost Wenlock of the Viki, Ohesaare, Kaugatuma, and Ruhnu drill cores and correlated it with the succession in the global stratotype section of the basal Wenlock in Welsh Borderland. She found that in the West-Estonian cores the boundary between the Llandovery and Wenlock corresponds to a level in the middle or upper part of the *Margachitina margaritana* chitinozoan Biozone. In the Viki and Ohesaare drill cores this boundary coincides with a bentonite layer, situated a couple of metres higher the traditionally accepted boundary between the Adavere and Jaani regional stages. It corresponds to a level in the middle of the *murchisoni* graptolite Biozone, i.e. much higher in the graptolite succession than commonly expected.

Vertebrates of the Palaeobaltic Sea - taxonomy, phylogeny and distribution in the Silurian and Devonian

Estonian Science Foundation Grant No. ETF5726

Project leader: T. Märss

Team: A. Kleesment, M. Niit, and H. Blom (Uppsala University)

Duration: 2004–2007

In the Silurian and Devonian the Palaeobaltic Sea was inhabited by the agnathans (thelodonts, heterostracans, osteostracans and anaspids) and gnathostome fishes (acanthodians, placoderms, chondrichthyans and osteichthyans (sarcopterygians and actinopterygians)) of the vertebrate phylum. Their diver-

sity and abundance grew from the Silurian to the Devonian. By now, the taxonomy of Silurian thelodonts and anaspids, and of Devonian heterostracans, acanthodians and placoderms is well studied. Silurian heterostracans and osteostracans, and Devonian chondrichthyans and actinopterygians with micromeric dermal skeleton are less investigated. The presence of Silurian and Devonian vertebrate remains in our sections offers a unique opportunity to study the early history of these animals in the Palaeobaltic Sea.

The aim of the project is to elucidate the taxonomic content of agnathans and their phylogenetic relationships within and between

different groups, and with gnathostome fishes, and give their spatio-temporal distribution. For that the morphology, sculpture and microstructure of both articulated and disarticulated exoskeletons of agnathans, and selected fish groups are studied and a large number of characters are used in the cladistic analyses. Phylogenetical investigations help to revise the systematics of early vertebrates, to fix the position of controversial taxa in the vertebrate phylum, and to find out the origin of gnathostomes. Biostratigraphical data help to optimize the topology of the phylogeny tree. Detailed sedimentological analyses of Baltic sections show how the environmental changes influenced the presence or absence of species. Establishing the regularities of the burial conditions of fossils contributes to finding their remains.

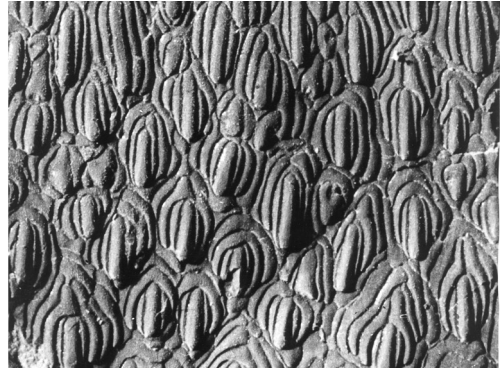
In 2004-2005 eight papers and six abstracts were published presenting the following results:

(1) 16 new early agnathan and gnathostome taxa were established.

(2) The chapter Thelodonti for the Handbook of Paleichthyology: Vol. 1C. Agnatha was completed; it summarizes the results of the thelodont studies carried out so far and deals with the body morphology, scale development and structure, systematics and phylogeny of the thelodonts (co-authors S. Turner, Brisbane, and V. Karatajūtė-Talimaa, Vilnius; ed. H.-P. Schultze, Kansas).

(3) In addition to the body morphology, scale features, such as morphology, sculpture, ultrasculpture and histology of the thelodonts (joint work with M. Wilson, Alberta University), anaspids (with H. Blom, Uppsala University), and gnathostome osteichthyan *Lophosteus* (with H.-P. Schultze, University of Kansas) were used in the phylogeny study of corresponding groups. According to these investigations, thelodonts should be treated as a monophyletic group, and the birkeniid anaspids, with their scale covered body, may be a paraphyletic group; genus *Lophosteus* could be placed between acanthodians and osteichthyans as a basal osteichthyan.

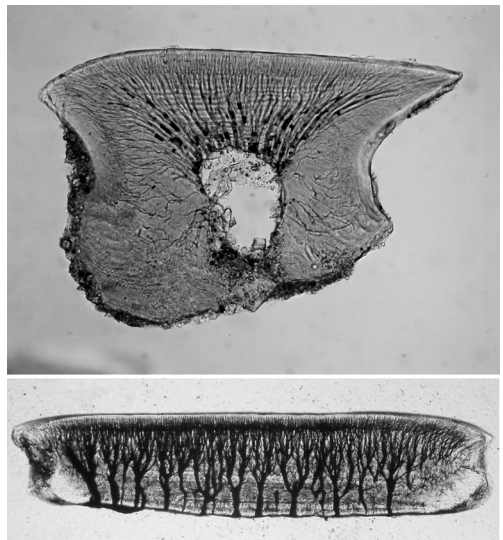
(4) The re-description of the microstructure



Sculpture of the dorsal shield of Silurian agnathan *Tolytel-epis undulata* Pander studied by Tiiu Märss. Photo by G. Baranov.

and sculpture of osteostracans exoskeletons from the Silurian of Estonia was undertaken to enable the identification of their microremains from the insoluble residues (joint work with H. Blom, Uppsala University).

(5) Detailed studies of the East Baltic Middle Devonian sedimentology showed how the changes of the environmental conditions influenced the distribution of vertebrate species; investigations of the distribution of vertebrate microfossils in the Devonian siliciclastic rocks concluded that their small remains accumulated mainly in the coarse-grained and often in the conglomeratic beds. The subdivision of the Devonian sequence in the Mehikoorma-421 drillcore was completed.



Microsculpture of the scales of agnathan thelodonts *Thelodus* and *Katoporodus*. Photo by G. Baranov.

Stratigraphical, sedimentological and palaeobiological significance of frequency patterns of Early Palaeozoic microfossils. Case studies from the Baltic region

Estonian Science Foundation Grant No. ETF5920

Project leader: O. Hints

Team: P. Männik, T. Märss, V. Nestor, M. Killing

Duration: 2004–2007

Quantitative data have extensive use in palaeoecology but may also contribute to a better understanding of environments and deposition regime, palaeobiology and stratigraphy. Frequency patterns of Early Palaeozoic microfossils are nevertheless seldom studied, especially regarding comparison and analysis of several different groups in a detailed temporal and spatial framework. Continuous deposition, low thermal and tectonic alteration, richness and excellent preservation of fossils and long study history make the Baltic region a superb test-field for detailed quantitative palaeontological analysis.

The project is expected to: (1) elaborate and test common and statistically valid sampling and analysis methodology; (2) elucidate frequency dynamics of different taxonomic

groups, relationships between them, and between the biota and the environment; (3) learn to make a distinction between time and facies change; (4) provide a basis for, or reject the stratigraphic usability of recurrent zonules; (5) draw conclusions on the formation and completeness of Baltic sedimentary record and extend these results beyond the study area; (6) interpret possible causes of microfossil frequency changes that have no obvious reflections in the sedimentary record; (7) provide a data set that is open for further tests and analysis by other palaeontologists and geologists.

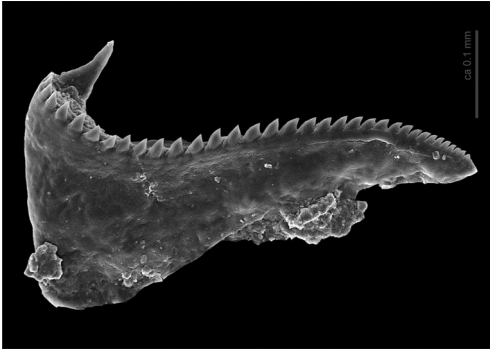
Main results in 2004–2005:

The first two years of the project were devoted to collection of data and preliminary analysis of fossil distributions. For the first time a detailed quantitative data on chitinozoans, scolecodonts and conodonts were obtained from the East Baltic (Paatsalu and Viki cores, western Estonia and Viru Mine, NE Estonia) and a common methodology was elaborated for extracting different fossils from the same samples.

In the Rumba Formation (upper Llandovery) a clear relationship between frequency



Olle Hints showing students how to measure and take samples from a drill core. *Photo by G. Baranov.*



Kadriorgaspis kaisae from the Tremadocian of Kadriorg, Tallinn, represents the early stage of evolution of scolecodont-bearing polychaetes. Magnification see from the scale. *Microphotograph in SEM.*

patterns and rock properties (such as content of clay or clastic material) was revealed and interpreted as an effect of varying compaction or deposition rate. In other intervals studied, however, no significant similar correlation was observed indicating that other factors have likely overprinted this effect.

Jawed polychaetes turned the most diverse but stratigraphically least variable group. This

is best exemplified at the Llandovery-Wenlock boundary interval where chitinozoans and conodonts display major turnover but scolecodonts show only a gradual change.

Some, but certainly not all, observed frequency peaks (acmes) have stratigraphical potential.

Global polychaete diversity and abundance changes in the Ordovician were analysed based on the Estonian material and structure and dynamics of Upper Ordovician assemblages from Baltica and Laurentia were compared. Some of the oldest scolecodonts in the world and an exceptionally rich and diverse chitinozoan assemblage were discovered from the Tremadocian of northern Estonia. The effect of the mid-Caradoc Event on conodont faunas was elaborated in several drill core sections. In the systematic part (chitinozoans, scolecodonts, agnathans), nine new species, two genera and one family were described.

As of the formal results, eight papers were published or accepted for publication and the results were presented in eight international conferences (14 abstracts published).

Ordovician-Silurian stratigraphical schemes: analyse and improvement of global and Baltic regional units based on high-resolution biostratigraphy, isotope geology and sequence stratigraphy

Target Financed Research Project No. SF0332524s03

Project leader: L. Hints

Team: P. Männik, J. Nõlvak, A. Oraspõld, H. Pärnaste, V. Viira

Duration: 2003–2007

The International Subcommittee on Ordovician Stratigraphy (ISOS) initiated elaboration of a standard set of global series and stages for the Ordovician System with the aim of facilitating reliable global correlation and thus reaching a new level in stratigraphic studies. The subcommittee accepted a scheme in which the Ordovician is subdivided into three global series (Lower, Middle and Upper Ordovician) and seven global stages. The global



Linda Hints and Sergei Rozhnov from Paleontological Institute RAS (Moscow) discussing in the 6th BSC, St. Petersburg, August 2005. *Photo by H. Pärnaste.*

stratotype section and point (GSSP) serve as main tool for the identification of global chronostratigraphic unit. A GSSP is defined as the first appearance datum (FAD) of species among graptolites and/or conodonts, which have wide spatial distribution.

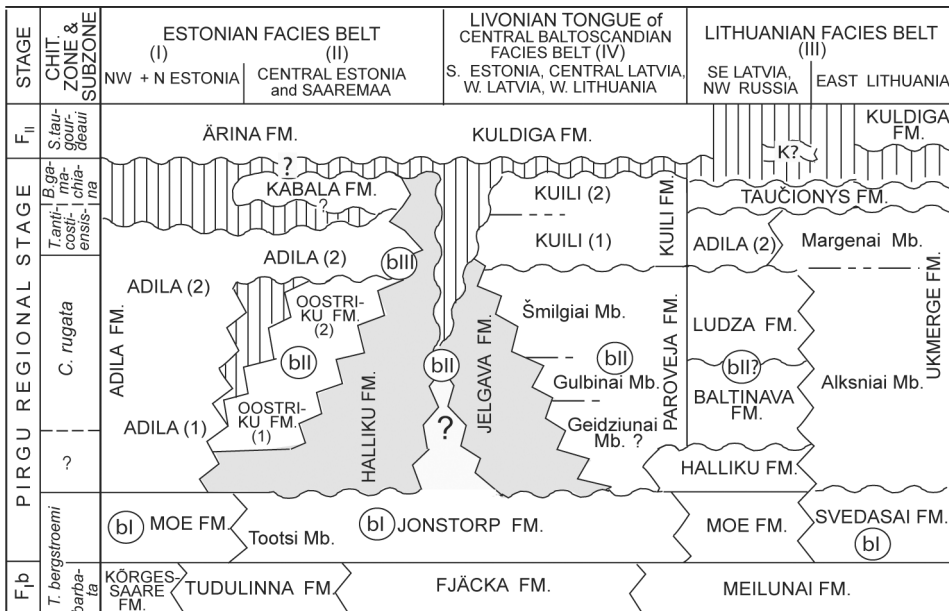


Tatiana Koren from All-Russia Scientific Research Geological Institute (VSEGEI, St. Petersburg) and Viive Viira discuss the problems of Ordovician stratigraphy on the 6th BSC. Photo by H. Pärnaste.

The aim of project 0332524s03 is to update the Ordovician and Silurian stratigraphy in the East Baltic and to correlate regional stratigraphic units with the new global chronostratigraphic standard. One of the main tasks of regional studies is to establish the stratigraphic levels corresponding to the GSSPs, which would facilitate understanding the evolution of sedimentation and faunas in the Baltic Basin in global context.

An updated stratigraphic chart for the East Baltic Ordovician was presented on the conference of the Baltic Stratigraphic Association in St. Petersburg in 2005 (Nõlvak et al. 2005). It includes two new regional subseries (Vinni and Kohila) and revised graptolite, conodont and chitinozoan biozonations. Correlation of regional units with the global standard was proposed as well. The Ordovician and Silurian chronostratigraphy in the East Baltic was improved mainly on the basis of the data on microfossils, mostly conodonts (Männik and Viira 2005), and chitinozoans (Paris et al. 2004).

Data on the distribution of Early Ordovician conodonts, statistical analysis of the



Correlation of the Pirgu Regional Stage in the East Baltic. FIb - Vormsi, FII - Porkuni Stage; K - Kuldiga Formation; bentonite beds, bI, bII and bIII are marked in the chart approximate on their stratigraphic position in the sections; vertical ruling marks the stratigraphic interval of the gaps; grey area marks the Halliku and Jelgava formations for the better observation of different units. The question mark shows the possible occurrence of early Pirgu deposits. (Hints, L. et al. 2005)

taxonomic composition of faunas in different samples and sedimentological study of the glauconitic sandstones of the Leetse Formation showed that the lower boundary of the Upper Lower Ordovician global stage (Stage 2) lies in the lower part of that formation and does not coincide with the boundary between the regional Varangu and Hunneberg stages (Löfgren et al. 2005). Taxonomic revision of the graptolite *Nemagraptus* in the East Baltic sections revealed (Nõlvak and Goldman 2004) that *N. gracilis*, which defines the lower boundary of the Upper Ordovician and of the fifth global stage, occurs here only in the upper half of the Kukruse Stage. However, the occurrence of some conodonts and chitinozoans suggests that the lower boundary of the Upper Ordovician in Estonia most probably lies in the lowermost part of the Kukruse Stage (Hints, O. et al. 2005). For more precise definition of that boundary in Estonian sections additional taxonomic studies of conodont species *Amorphognathus inaequalis* and *A. tverensis* are needed.

Unlike the Ordovician units, all Silurian global stratigraphic units are already ratified. In recent years, the main task has been to test the usefulness of these units and the possibilities of identifying them in sections all over the world. The IUGS Subcommittee on Silurian Stratigraphy initiated restudy of the GSSP for the base of the Wenlock Series. Analysis of data on conodonts indicated that one of the most distinct criteria for recognizing the Llandovery–Wenlock boundary is the level of disappearance of the conodont *Apsidognathus* (Beznosova and Männik 2005).

The Upper Ordovician and Silurian sequences and changes in the isotopic ($\delta^{13}\text{C}$) composition recognised in Estonia can be well correlated with those in Laurentia (North America) (Harris et al. 2004, 2005; Kaljo et al. 2004). The best way to improve biostratigraphy, as well as to constrain models of global biotic and oceanic events, is to collect and interpret the data within the framework of sequence stratigraphy (Barrick and Männik 2005).

The experience of detailed palaeontological and isotopic research in the East Baltic was

applied in the study of the Ordovician–Silurian boundary strata in North America (Copenhagen Canyon section, Nevada) and Russia (sections on the Kozhym River, Subpolar Urals). The Ordovician–Silurian boundary in the latter region was found to lie higher in section than shown in the official stratigraphic scheme and a new unit, the Yaptiknyrd Formation, was proposed for the uppermost Ordovician strata (Beznosova et al. 2005).

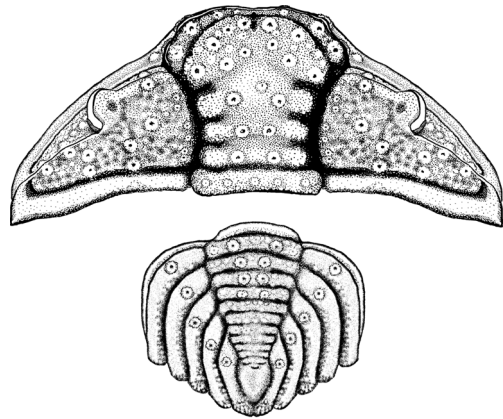
A special study (Hints, L. et al. 2005) of the Pirgu Stage in the East Baltic summarizes data on more than 100 core sections, enabling clarification of the facies differentiation in the basin and explaining some problems connected with the correlation of Baltic and Scandinavian sections. The most distinct stratigraphical level recognised in different facies in the boundary interval of the Vormsi and Pirgu stages is the level of disappearance of chitinozoan *Acanthochitina barbata* (Hints, L. et al. 2005). Detailed biostratigraphical data from the Mehikoorma core section (Hints 2005; Männik and Viira 2005; Nõlvak 2005) serves as a good basis for correlation of sections in easternmost Estonia.

Member of the project team Jaak Nõlvak studied the chitinozoans in the Black Knob Ridge section (USA), which is accepted by the ISOS as a type section for the lower boundary of the Middle Upper Ordovician global stage (Stage 6).



The Black Knob Ridge section, Oklahoma, USA: a Global Stratotype-Section and Point (GSSP) for the base of the Middle Stage of the Upper Ordovician Series. Photo by J. Nõlvak.

The stratigraphy of the upper Lower and lower Middle Ordovician in Baltoscandia is traditionally based on trilobite zones. A revised trilobite zonation of the Billingen and Hunneberg stages in Estonia and NW Russia enabled to improve the correlation with the trilobite zonation in Scandinavia (Pärnaste 2004). The study of the earliest representatives of the subfamilies Encrinurinae and Cybelinae support the monophyly of these subfamilies (Pärnaste 2005).



Reconstruction of the earliest known representative of subfamily Encrinurinae in the world, found from Mäeküla Sandstone. *Drawing by H. Pärnaste.*

Correlation criteria and environmental changes at the boundaries of the global Ordovician stages in the East Baltic

Estonian Science Foundation Grant No. ETF5922

Project leader: J. Nõlvak

Team: D. Kaljo, L. Hints, J. Nemliher, H. Pärnaste

Duration: 2004–2007



Jaak Nõlvak studying chitinozoans - a microscopic planktic faunal group, which gives good results on correlation of global boundaries of the Ordovician stages. *Photo by G. Baranov.*

The goal of the project is the application of the morphological features, chemical composition and preservation history of the different planktic (chitinozoans, graptoloids) and benthic faunal groups (trilobites, brachiopods) as the indicators of the environments in the Ordovician Baltic Basin. The environmen-

tal control on the development of faunas and trends of morphological changes of skeletons and other calcitic or organic walled remains of organisms were analyzed and taxonomical and geochemical methods used. Chitinozoans and graptoloids represent the main biostratigraphical background for the project. At these detailed studies of very rare but valuable specimens of graptoloids from the carbonate facies were found and analysed and the distribution of many chitinozoan species of the wide horizontal but short vertical range analyzed. The distribution of the latter group gave relatively precise geological and stratigraphical background.

Main results in 2004–2005:

(1) The zonal chitinozoan taxa were used in correlations and comparisons of certain stratigraphical levels and boundaries with the different areas of the basin: e.g. Middle and Upper Ordovician global boundary level from Southern Sweden into East Baltic, upper boundary of the global Darrivilian Stage in the Ukraine, Polish, (Nõlvak et al.), Latvian sections (global time slice boundaries 4c/5a), which coincides with the boundary of the Kukruse and Haljala stages in Estonian sections (Hints, O., Nõlvak et al.), etc.

(2) As of January 2006 we are waiting for final ratification of GSSP for the base of the

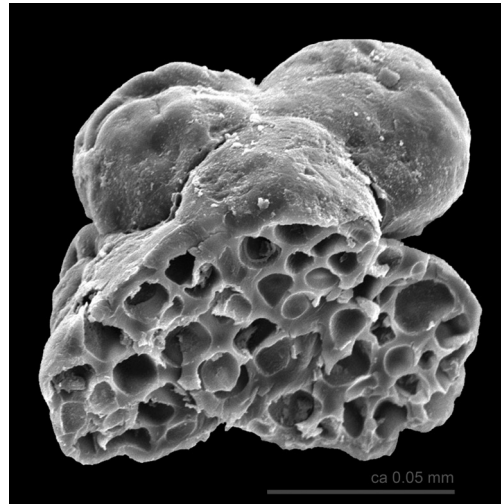
Middle Stage (“Katyan”) of the Upper Ordovician Series at Black Knob Ridge (Oklahoma, USA) by the International Commission on Stratigraphy and the International Union of Geological Sciences, in proposal of which we were actively involved (Nölvak, Goldman et al.). Special attention was paid also to the Ordovician and Silurian boundary beds in order to reveal the changes in distribution of fossils and changes in the biodiversity in the East Baltic and Polish sections caused by the Late Ordovician glaciation (Nölvak, Modlinski, Szymanski). Detailed subdivision and correlation of the Pirgu Stage in the East Baltic sections was described (Hints, L., Oraspöld, Nölvak), also biostratigraphy of some type sections: Mehikoorma, Kerguta, Kandava (Nölvak et al.) were presented. For correlation purposes and environmental interpretations of the geological and palaeontological data the whole rock stable isotopic (C) analyses were used (Kaljo et al.). Results from several East Baltic sections were compared with the beds formed in different environments represented in sections from North America and Poland (Nölvak et al.).

(3) The content of Sr, Mg, and Fe in the initially aragonitic bivalved molluscs was analysed for the establishing of the usefulness of those criteria for reconstruction of sedimentation process (Nemliher). These characteristics have essential role for the distribution of the benthic fauna. Also a new variety among the cardinal processes of rhynchonelliformean brachiopods was described (Hints, L.).

Lower Silurian conodonts - evolution, associations and palaeoecology, and application in high-resolution stratigraphy

Estonian Science Foundation Grant No. ETF5406
Project leader: P. Männik
Duration: 2003–2006

The project is planned as a palaeontological-biostratigraphical research. The studies will mainly be based on collections from Estonia but information from other regions will be essential. The project has two main aims:



Gloeocapsomorpha prisca Zalesky, an uncompressed colony of cells: lowermost Upper Ordovician, Arbuckle Mountains, Oklahoma, USA. The same algae forms the organic component of marine oil shales known as kukersites in North Estonia. Magnification ca. x1000. Collected by J. Nölvak. Microphotograph in SEM.

(4) The studies on trilobites were focused on taxonomy and phylogeny of the Lower Ordovician representatives of suborder Cheirurina and on its younger representative — *Re-raspis* with the implications to their zonation in the Baltoscandia in beds, where often other groups of fossils (e.g. organic-walled microfossils) have restricted distribution caused by poor preservational reasons. The preliminary account on the trilobite zonation of the Billingen and Hunneberg stages (global time slices 1d–2b) in the Estonian and NW Russian sections was given (Pärnaste).

1) taxonomic revision of the Lower Silurian conodonts and monographic description of the faunas from Estonia, and 2) characterization of the evolution of selected evolutionary lineages of taxa as well as faunas in general based on the taxonomic and palaeoecological analysis of the Lower Silurian conodont faunas, and based on these data, the evaluation and updating of the biozonal scheme.

Main results in 2004–2005:

(1) New data from the Middle-Caradoc Event strata allowed to update conodont bio-

stratigraphy in this interval in Estonia (Männik 2004; Männik and Viira 2005).

(2) The early Snipklint Primo Episode was characterised by considerable perturbations in climate which almost stopped the oceanic circulation in the late *Pterospirifer eopennatus* ssp. n. 1 to early *Pt. eopennatus* ssp. n. 2 time (Valgu P-P Event) (Männik 2005).

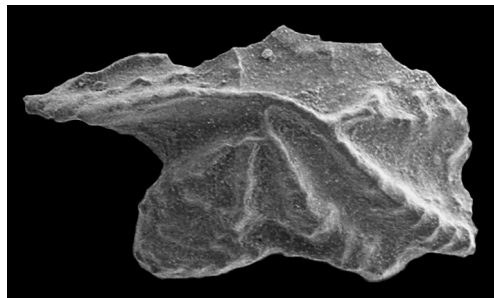
(3) Five years ago the IUGS Subcommission on Silurian Stratigraphy decided to initiate restudy of the GSSP for the base of the Wenlock Series. Analyses of data from all



Fieldwork at Kozhym River, Subpolar Urals. Photo by P.Männik

over the world indicated that one of the most distinct criteria (often the single one) allowing to recognize the Llandovery-Wenlock boundary in the section is the identification of the level of disappearance of the conodont *Apsidognathus* (Beznosova and Männik 2005).

(4) Eight depositional sequences were recognised in the Nabala–Porkuni interval in Estonia (Harris et al. 2004). The Llandovery–Wenlock succession in the region can be divided into seven sequences that comprise two larger-scale “supersequence” packages (Harris et al. 2005).



Apsidognathus ruginosus Mabillard and Aldridge - a Silurian conodont, which disappears in Llandovery-Wenlock boundary. Magnification x75. Microphotograph in SEM.

(5) Species ranges in strata reflect both biological processes and preservation bias imposed by predictable patterns of deposition and erosion in response to eustatic sea-level fluctuations. The best way to improve biostratigraphy, as well as to constrain models of global biotic and oceanic events, is to collect and interpret the data within the framework of sequence stratigraphy (Barrick and Männik 2005).

(6) In the Subpolar Urals (Komi Republic, Russia), the Ordovician–Silurian boundary lies in the lower part of the Dzhagal Formation (Beznosova et al. 2004; Männik et al. 2004). Based on the results of our studies we propose: 1) to redefine the lower boundary of the Dzhagal Formation and consider the massive dolomitised limestones between the upper contact of the Malaya Tavrota Formation below and the contact of massive light-coloured dolostones and dark-grey thin-bedded dolomitised limestones above as one lithological unit; 2) to name this unit as the Yaptiknyrd Formation; 3) to observe the lower part of the Yaptiknyrd Formation corresponding to the strata with the brachiopods *Proconchidium muensteri* (St. Joseph) and *Holorhynchus giganteus* Kiaer as the Yaptikshor Beds (as they were originally defined) (Beznosova, Majdl’ and Männik 2005).

(7) Restudy of conodont collections from the SG-4 core section from Central Urals (Russia) resulted in revision of some earlier datings of strata (Ivanov et al. 2004). Also, it appeared that the early Silurian conodont faunas in this region are quite similar to those known from Estonia.

Evolution of composition and properties of rocks in the Baltic sedimentary cover: geochemical, mineralogical and petrophysical aspects and modelling

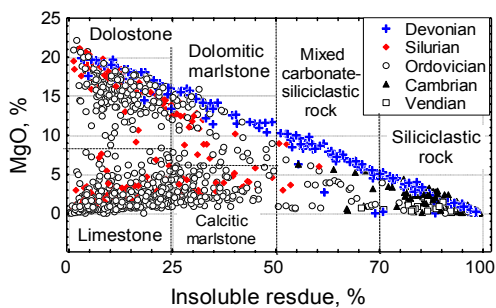
Target Financed Research Project No. SF0332088s02

Project leader: A. Shogenova

Team: L. Bityukova, R. Einasto, A. Kleesment, M. Konsa, T. Linkova, A. Teedumäe, R. Vaher, K. Shogenov

Duration: 2002–2006

Primary sedimentation and diagenetic processes in the Cambrian, Ordovician, Silurian and Devonian basins are studied using chemical and mineralogical composition, physical



MgO content versus insoluble residue content for Estonian sedimentary rocks (Kleesment and Shogeman 2005)

properties and petrography of the rocks and available logging data of boreholes from the Baltic region. Geological processes are interpreted using correlation, regression and multivariate statistical analysis and geostatistic spatial modelling.

The main results achieved in 2004–2005:

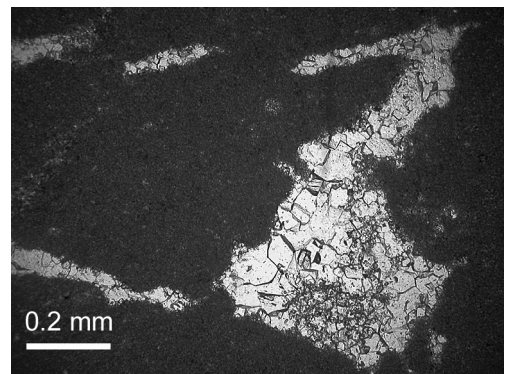
(1) Sedimentary Basin from Vendian up to Devonian. Composition, physical properties and petrography of Palaeozoic rocks in Mehikoorma (421) borehole were analysed and compared with Ruhnu (500) borehole (Kleesment 2005a, Shogenova, Kleesment and Shogenov 2005). Properties of Ordovician and Devonian rocks and geological processes were compared in Mehikoorma (421) and Valga (10) boreholes in the B.Sc. study by K. Shogenov.

Different dolomitization styles of Ordovician, Silurian and Devonian rocks were revealed on the base of their different chemical composition and properties. Devonian time of

dolomitization in the North-Estonian fracture zones is assumed on the base of the similar chemical composition of Ordovician dolomitized rocks from the fracture zones and Devonian dolostones (Shogenova, Kleesment and Teedumäe 2004).

(2) Devonian basin. Fully dolomitized Devonian rocks from Southern Estonia represented by dolostones, dolomitic marlstones, mixed carbonate-siliciclastic and siliciclastic rocks were subdivided using correspondingly 25, 50 and 70% of insoluble residue limits. Dolomite of two generations was determined in thin-sections of dolostones. Early diagenetic dolostones and dolomitic marlstones were deposited in the shallow nearshore tidal flat environment in the sea water saturated with Mg, but changed in the next stages of diagenesis. Siliciclastic rocks were cemented during middle and late diagenesis by Mg- and Mn-enriched fluids. Sometimes cement of siliciclastic and mixed rocks is represented by gypsum and late diagenetic calcite. Mixed rocks of two geneses were determined. Transitional dolomitic siltstones and marlstones were formed during sedimentation and early diagenetic processes, but mixed dolomitic sandstones during the middle and late diagenesis (Kleesment and Shogenova 2005).

Thermal conductivity (T_c) of the carbonate and of the mixed carbonate-siliciclastic rocks may be estimated using its high negative correlation with magnetic susceptibility (Shogenova, Kleesment, Shogenov and Jõelet 2004).

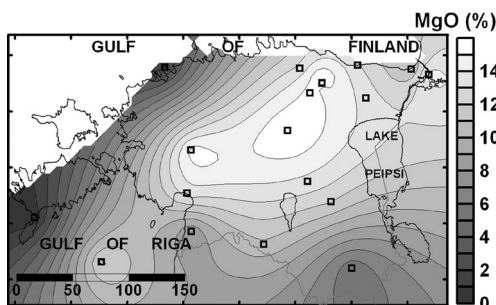


Thin section of dolostone from Valga (10) borehole, 218.3 m, Narva Stage, Devonian. Quadratic vugs and branching fractures in the cloudy aphanocrystalline matrix filled with transparent medium-crystalline authigenic dolomite. (Kleesment and Shogenova 2005). *Plane-polarized light.*

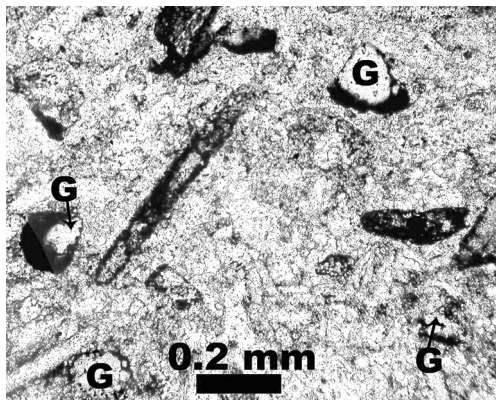
Logging tools permitting precise lithological discrimination of carbonate from siliciclastic rocks and further estimation of Tc could be density, porosity and γ -ray spectrometry logs. The best estimation of Tc of core samples (with 0.92-0.93 correlation) could be made by piecewise linear regression using Quasi-Newton estimation method, applying porosity and potassium content for siliciclastic and mixed rocks, and porosity combined with magnetic susceptibility for carbonate rocks (Shogenova et al. 2005, Šogenova et al. 2005).

The outcrops of stratotype region of Narva Stage were correlated (Kleesment 2004). Devonian outcrops and caves were studied, described and their scientific and cultural value was estimated (Kleesment 2005b, c).

(3) Silurian Basin. Medium-rank sedimentary cyclicity of the Raikküla Formation is described in the Nurme drill core, where totally



Average MgO content in the rocks of Volkhov stage, as indicator of dolomitization. Location of boreholes and outcrops is shown by squares. (Shogenova 2004a, b).



Thin section of dolostone from borehole N 648 (northern facies zone), 126.4 m, Middle Ordovician Volkhov Stage, Toila Formation. Glauconite grains (G) are corroded and partly or fully replaced by dolomite. Porosity is 9.2%. (Shogenova 2004a, b). *Plane-polarized light*.

dolomitized carbonate rocks of Raikküla Fm. are sandwiched between the unaltered Juuru and Adavere limestones. Extensive pervasive dolomitization associated with regressive phases of the evolution of the Baltic Paleobasin in the Silurian and was related to a zone of shallow normal-saline inner shelf facies, migrating in space in accordance with sea level changes (Teedumäe et al. 2004).

During preparation of the PhD work E. Kiipli published articles which show that Aeronian black shales and overlying Telychian greenish-grey and red claystones of the East Baltic Basin indicate different redox conditions of the sea-bottom water, different bio-productivity, but the same sedimentation rate. The difference is explained by change from wind-induced upwelling in the Aeronian to downwelling in the Telychian (Kiipli 2004, Kiipli et al. 2004).

(4) Ordovician Basin. Geological processes in Öland, Viru and Harju Ordovician series were studied and compared. The Volkhov Stage (Öland Series) is distinguished in the Baltic Basin by widespread regional distribution of carbonate-argillaceous rocks with glauconite impurities, regional dolomitization and by thin goethite ooids layer in the NE Estonia. Multivariate R-mode factor analysis helped to interpret the most important processes, such as sedimentation, late diagenetic dolomitization and early diagenetic iron-bearing mineralization, their succession and influence on porosity, density and P-wave velocity. Dolomitization, sedimentation and facies differentiation in Mn content were interpreted as most important factors in the Lasnamägi Stage (Viru Series) and in the Upper Ordovician rocks of the Harju Series. Gridding by Kriging method were applied to construct geostatistic models of the studied parameters, reflecting the geological processes (Shogenova 2004a, b).

(5) Impact mineralogy of sedimentary rocks. Mineralogical and petrographical characteristics of different sedimentary rocks were determined by M. Konsa and A. Kleesment in the sequences connected with Kärđla crater (Puura, Huber et al. 2004) and by M. Konsa in a possible impact structure at the Bothnian Sea coast of central Sweden (Henkel et al. 2005).

(6) Basement. R. Vaher and M. Konsa participated in the basement studies together with colleagues from University of Tartu, Institute of Geology and Geological Survey of Estonia. Zircons from the old member of the post-Svecofennian cover, namely the Subjotnian rapakivi-related porphyries of the northern Baltic Sea were separated and studied by M. Konsa. According to isotope dating the age of those corresponds to the Riga–Åland rapakivi Sub-province around 1580 Mil.years (Puura, Flodén et al. 2004, Puura, Hints et al. 2004). Integrated modelling of the crust using gravity and magnetic data and deep seismic sounding permitted to reveal overthickening of SSW

Estonian and N Latvian crust (50–65 km), while in NNE Estonia it is only moderately overthickened (45–50 km) (All et al. 2004).

(7) International activities. Results of our studies were presented at 7 international conferences. During reported years A. Shogenova participated in several GEO ENeRG research network meetings as the representative of Estonia. As a result we were involved in the preparation of the project together with 25 other partners from 22 countries. The project “Assessing European Capacity for Geological Storage of Carbon Dioxide” was supported by EU commission in the frame of FP 6 programme for the 2006–2008.

Processes of decay of the Ordovician carbonate rocks and assessment of conditions of the historical objects in Tallinn

Estonian Science Foundation Grant No. ETF5017

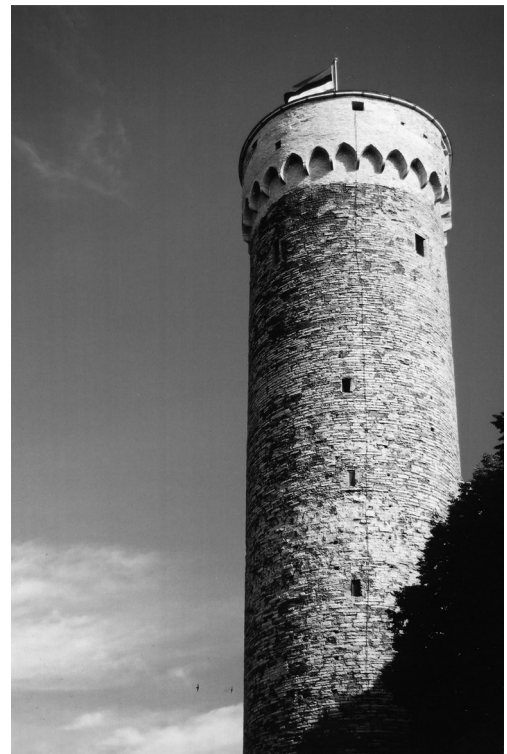
Project leader: L. Bitjukova

Team: J. Nõlvak, A. Teedumäe

Duration: 2002–2004

In the frame of the project the complex study of lithology, chemical and mineralogical composition and physical properties of building stone from historical objects in Old Town of Tallinn was carried out for the first time in Estonia to diagnose quantitatively the deterioration of stone and assess the damage from weathering. The chemical and mineralogical composition of building stone and gypsum black crust from 14 historical objects of Old Town of Tallinn were examined in order to reveal the weathering behaviour of the limestone and estimate the influence of pollution on the decay processes. The X-ray fluorescence, ICP-MS and ACP-ASP analyses and X-ray diffractometry were performed to provide a quantitative analysis of the processes, which are responsible for building stone decay. The data obtained permitted to compile the database for characterising of building stone of main historical objects in Tallinn.

The intensity of weathering and decay was estimated basing on the complex interpretation



Pikk Herman Tower has been built from the Ordovician limestone like most other building in the Old Town. *Photo by H. Pärnaste.*

of obtained data. Detailed analysis of chemical and mineralogical parameters and comparison with the data for local natural limestone permitted to mark the specific geochemical features of damaged limestone, calculate the DGF index and quantify the intensity of decay

taken place under the influence of the chemical attacks and mechanical destruction. The historical objects (St. Nicholas and St. Olaf's churches, Town Wall and Patarei prison) with the most intensive deterioration of the building stones were revealed. For selected samples the physical properties (density and porosity) were measured and thin sections were described.

The significant accumulation of trace elements (As, Ba, Cd, Cu, Pb, Sb, Se, Sn and Zn) in the gypsum crust relative to underlying damaged limestone was estimated.

The enrichment factor and R-mode factor analyses were applied in order to improve understanding the nature and sources of elements and assess the pollution effect. The obtained results confirmed a natural origin for Ca, Mg, Si, Al, Ti, K, Na and Fe. The black crust has elevated concentrations in Cu, Pb, Sb, Sn and Zn as a result of the pollution effect. The highest increase of Cu, Pb and Zn content was determined in the samples from gypsum crust at St. Olaf's church. The enrichment factors calculation and factor analysis confirm the input of these elements from anthropic sources.

Sulphur isotope composition in damaged building stone and black crust was used to discriminate the anthropic and natural sources of sulphur, and reveal its dominant source in the gypsum at the damaged buildings in Tallinn. The measurement of ^{34}S permitted to suggest several sources of sulphur involved in the black crust formation.

The magnetic age of the Estonian sedimentary cover

Estonian Science Foundation Grant No. ETF5500
Project leader: J. Plado (Institute of Geology, UT)
Team: V. Puura (Institute of Geology, UT), M. Konsa
Duration: 2003–2005

The aim of the project was determination of age of sedimentary accumulation and subsequent alteration processes by means of paleomagnetic method. For this purpose the physical properties of (1) Lower Palaeozoic sedimentary rocks and (2) rocks sampled from

The impact of technogenous sulphur in the gypsum formation in the black crust was revealed. The contribution of sulphur dissolved from limestone is reflected in the positive delta values of sulphur. The sulphur includes also in lesser degree the sulphur and aerosols of marine sulphate. Comparison of the obtained data with those for similar objects in European cities was carried out.

The main results were presented and discussed in Vienna University, and with participants of the EU Multi-assess project from Institute of Buildings Materials of Riga Technical University and in Prague SVUOM Institute. Isotope composition (^{34}S) data were discussed during Russian XVII- Symposium of Isotope Geochemistry in Institute of Geochemistry and Analytical Chemistry (GEOHI) in Moscow.



Weathered limestone - seen in the Old Town. Photo by H. Pärnaste.

Kärdla and Neugrund meteorite craters, and, for comparison, from craters in Finland were studied.

(1) In 2005 were completed the measurements of the properties, including intensity and direction of natural remanent magnetization (NRM), on samples of Ordovician and Silurian sedimentary rocks collected from outcrops in 2003–2004. Interpretation of the laboratory findings proved the occurrence of Ordovician primary NRM and secondary NRM originated at the Permian–Triassic boundary in the lime-

and dolostones of Early and Middle Ordovician age. Magnetization of the Silurian rocks is more complicated showing weak contemporaneous NRM and at least two later (Early Carboniferous and Meso- to Cenozoic) NRM components.

Geology of the Baltic Sea depression: evidences from petrological studies and geophysical and structural modelling

Estonian Science Foundation Grant No. ETF5817
 Project leader: V. Puura (Institute of Geology, UT)
 Team: J. Kirs, T. Pani, (Institute of Geology, UT), T. All, K. Suuroja (Geological Survey of Estonia), and M. Konsa
 Duration: 2004–2007

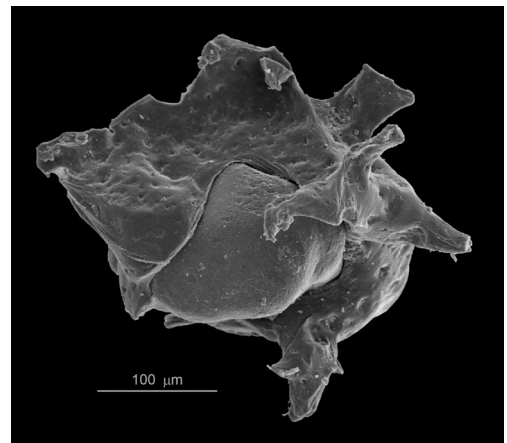
Geologists of the circum-Baltic countries have initiated a design of drilling at the Baltic Sea in frames of the International Ocean Drilling Program. The first target is the oldest supracrustal complexes of Paleoproterozoic to Phanerozoic bedrock. This project is intended to cooperate to the predrilling research and design of the drilling program. Geology of the Baltic-Bothnian Belt (BBB) differs significantly from the surrounding mainland. No specialised complex studies of petrology, age, structure and evolution of oldest suites building the Baltic seabed have been carried out. As very few drill cores are available such studies have to be based on the outcrops and drill cores along the seashores, erratic materials dispersed by Quaternary glaciers, suites trapped in tectonic grabens and as fragments in impact breccias of crater fillings. Using lithological, mineralogical, geochemical, isotopic dating and petrological methods, geophysical studies and structural modelling we studied the formation and subsequent changes of rock and minerals, and as a whole, the history of formation of the oldest post-orogenic and platform suites and of the entire BBB. Boulders and cobbles of red and brown rapakivi-related porphyries were studied and sampled from regolith dispersed in seashore on Gotland (Sweden), Saaremaa (Estonia) and Kuraland (Latvia). They derive from supposed exposures in the

(2) It was found that the magnetic properties of the shock-influenced rock sequence are very different (more variable) from those of the unshocked target rocks. All magnetic properties decrease slightly in the subautochthonous sequence of the crater with depth.

northern part of the Baltic Sea. Zircons were separated and studied from the samples of these volcanic rocks and also from samples of rapakivi-age mafic dikes of Central Sweden. U-Pb isotope of zircons revealed that igneous bodies in the north and central Baltic seabed as well as in Central Sweden (Breven-Hällfors dike swarm), 1573 \pm 14 Ma and 1617 \pm 24 Ma age, respectively, belong to Riga-Aland rapakivi subprovince.

Another collection of samples to detailize the age determinations is under separation and study (red and brown rapakivi-related porphyries from Sweden, Estonia (Saaremaa) and Latvia (Kuraland). The distribution of zircon generations of small potassium granite plutons (Märjamaa, Naissaare, Neeme, Taebala, and Ereda) was identified. Zircons were separated for further studies.

The sand-rich ejecta layer at the Kärđla impact site, containing a considerable amount of mineral grains with impact-influenced fea-



A quartz grain surrounded by intricate C-rich coating first found in the ejecta layer surrounding the Kärđla impact crater (Kleesment et. al. in press). *Microphotograph in SEM.*

tures disseminated among the usual sand material, was studied. As a result of research on impact-induced effects of minerals and diagenetic alteration in the sandy ejecta of Kärddla crater, NW Estonia, a manuscript for printing was composed (Kleesment, Konsa, Puura, V. et al.). The following main conclusions were drawn: the ejecta blanket contains quartz grains with planar deformation features (PDF) and planar fractures (PF), as well as cracked grains showing lowered crystallinity by X-ray diffractometry. Identified orientations of shock-produced deformation suggest the peak pressure about 10–25 GPa.

Physical-chemical processes in Fennoscandian lithosphere: chemical composition of rocks and minerals, geochronology, and numerical and analogue modelling

Target Financed Research Project No. SF0332652s04

Project leader: A. Soesoo

Team: J. Nemliher, T. Kiipli, T. Kallaste, E. Kiipli, K. Urton and E. Kalam

Duration: 2004–2008

The aim of the project is to: (1) continue petrological-geochemical investigation of Precambrian crust in Fennoscandia (incl. Estonia), (2) study the processes of mineral formation and modifications and spatial-temporal correlations of volcanic processes in Baltica palaeocontinent, (3) development of mineralogical-chemical methods. As a synergy point of the problems addressed serves the application and development of modern high resolution precise geochemical methods and consideration of geological processes at a generalizing level using the concepts of self-organisation, critical states, geocomplexity and chaos. Peculiarities of Estonian bedrock formation and geotectonical position are elucidated; the use of fractals in partial melting processes is continued with an aim to develop a method for determining melting processes on the basis of migmatization. Distribution of volcanic strata in the bedrock of Estonia and their geochemical peculiarities are elucidated.

The sandy ejecta deposits contain specific particles, where C-rich material surrounds quartz grains. Examinations by X-ray fluorescence (XRF) indicate an amorphous phase carbon. The ejecta detrital minerals are often coated with pyrite-bearing apatite rims. Neither C-rich coatings and particles nor apatite coatings were previously met by the numerous mineralogical studies of the Estonian bedrock.

Occurrence of PDF-planes in minerals of the impact-breccia of the Åvike crater (Sweden) proved impact-origin of this structure (Henkel, Puura, V., Kirs, Konsa et al. 2005).



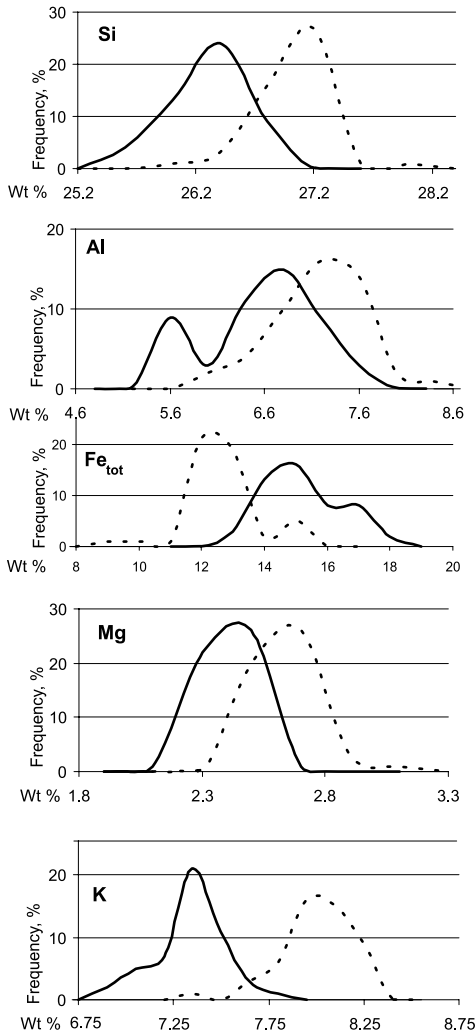
Coastal line in Southern Green land. *Photo by A. Soesoo.*

All parts of the research include development of precision technique and later – generalisation of lithospheric processes.

During 2004–2005, the studies continued in all defined research directions. In order to establish possible correlations and geochemical structure of Palaeozoic volcanic ashes within the sediments, several target areas were studied (Estonia, Bornholm, Northern Finland). It was established that about 200 ash layers may have been derived from 44 volca-

nic eruptions, with possibly six different volcanous (T. Kiipli, E. Kiipli, T. Kallaste). The likely locations of Palaeozoic volcanoes were also established. Within the Silurian quartzites in Northern Finland two types of volcanic layers – one which material was directly transformed into metamorphic rock and others with origin similar to the Estonian metabentonites were found (T.Kiipli).

Chemistry and mineralogy of glauconite from the Leetse Formation and recent bioara-



Frequency distribution of basic constituting elements of glauconite in Pakri Cape (Sample Pa-96-01, solid line) and Saka (Sample Sa-04-04, dotted line) Sections. Curves are constructed on basis of measurements of 50 individual grains from both samples. (Viira, Mens and Nemliher in press)

gonite showed that by their chemical composition, glauconite grains form at least two distinct generations, most probably reflecting the syngenetic conditions (low in K) and speed of diagenetical alteration (rich in K). XRD properties of glauconite reflect rate of sedimentation well in both, siliciclastic as well as in carbonate sedimentation system. However, crystal properties of glauconite of the Leetse Formation were found to be transitional between classical glauconite and Fe-rich illite. Content of Sr in bioaragonite can not be strictly correlated with average salinity changes from ~2 to 20 per mill in the biomineralized matter of species such as *Cerastoderma* and *Macoma*. The function of lattice volume and content of Sr in Recent bioaragonite from bivalvians from all over the world do not match the linear function, found for system aragonite-strontionite (J. Nemliher and T. Kallaste).

In the direction of research of Estonian Proterozoic basement a new phase of partial melting within the granulites was dated at 1.76Ga which was younger than similar granulites in adjacent areas (A. Soesoo). The possible geochronological and geochemical correlation study commenced. Using numerical methods and analogue modelling technique new data on melt segregations and accumulation mechanisms were obtained (K. Urtson). A special issue (guest editor A. Soesoo) on the Precambrian rocks of Estonia was published along the other publications.



Kristjan Urtson, Reedik Kuldkepp and Paul D. Bons from University of Tübingen observing the migmatites of Estonian crystalline basement from the drill cores in the Arbarvere field station. Photo by A. Soesoo

Numerical and analogue modelling of Earth's processes

Estonian Science Foundation Grant No. ETF5301

Project leader: A. Soesoo

Team: K. Urtson, E. Kalam

Duration: 2002–2005

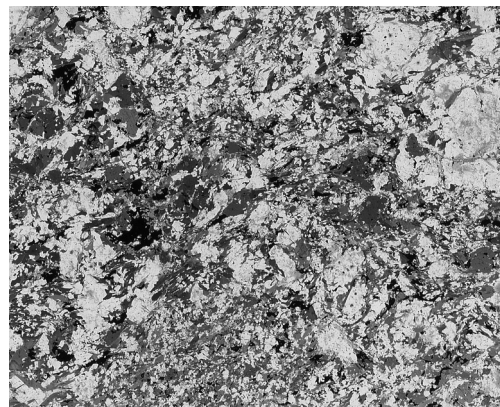
A large proportion of the Earth's crust is composed of igneous and volcanic rocks. Because of the abundance of these rocks and their dominant role in major large-scale geological processes (oceanic spreading, subduction and mountain building) it is important to understand their formation. Much is known about various aspects of their formation, but there is a lack of knowledge on how these aspects are connected across different length scales, from initial melt formation on the microscopic scale to ascent in metre to kilometre scale magmatic bodies and final emplacement in sometimes 100 km scale batholiths. Furthermore, many studies have focussed on either physical-mechanical aspects or geochemical-petrological aspects. A fusion of the results from these different viewpoints is critical to the understanding of the whole process.

This project aims to investigate the formation of igneous rocks, from the initial formation of melts to the ascent and emplacement of magmas and from a combined physical and geochemical perspective. Central to the project is the integration of different methods: geochemical and numerical modelling, analogue modelling and field observations. Experiments with rock analogues were focussed on the microscopic distribution and segregation of melt during progressive melting, while other experiments were investigating the larger-scale processes of transport and accumulation and the non-linear dynamics and system characteristics of the transport and accumulation. Both lines of research are linked by numerical modelling, where chemical and mechanical modelling techniques were combined to systematically investigate the physics and chemistry of magma segregation, accumulation and transport.

The main results obtained showed that fractals can be effectively used in studies of

magma mixing and mingling, mantle convection, lava flows, percolation properties of veins, ore mineralization etc. The width of migmatitic leucosomes in the Estonian basement rocks also follows the power-law distribution and shows fractal properties. Despite the differences in size and number of measured leucosomes and veins, differences in host rock types and formation conditions, the studied leucosome/vein thickness shows good power-law distributions with exponent D usually between 1.0–1.9. The same exponents were obtained from the studies of leucosomes in different outcrops (e.g. Masku area, Southern Finland). The spacing of leucosomes/veins in a rock section is not a random feature, but shows fractal distribution ($D=0.77-0.79$). A combination of the numerical model (MELT-POCKET) and natural observations, it can be mathematically shown that knowing the power-law of the size - number distribution for the melt batches, we are able to estimate the total volume of the melt phase, as well as the relative contributions of the largest batch (dominant for $D<1$), and of the smallest batches (dominant for $D>1$). The relationship between the magmatic leucosome/vein width-distribution exponent, and the melt batch size-distribution has also been derived.

One B.Sc. (K. Urtson) and two M.Sc. (K. Urtson and E. Kalam) theses have been compiled during 2003–2005.



Thin section of shoshonitic rock of Estonia. The magmas forming the shoshonitic series are generated in an enriched lithospheric mantle that had previously been affected by carbonatite metasomatism. (M.Sc. research subject of Evelin Kalam). *Plane-polarized light*.

Traces of Caledonian volcanism in sedimentary rocks of Estonia and Baltoscandia and using for correlation of geological sections, sedimentology and palaeogeography

Estonian Science Foundation Grant No. ETF5921

Project leader: T. Kiipli

Team: T. Kallaste, E. Kiipli,

and Ü. Sõstra (Department of Mining, Tallinn University of Technology)

Duration: 2004–2006

Aims of the investigation are: (1) to establish all volcanic ash layers in Ordovician and Silurian sections in Estonia and to identify their mineralogical and geochemical features; (2) to correlate volcanic ash layers within Estonia (one method for correlation is based on determination of Na-component in effusive sanidine crystals by X-ray diffractometry, the other – on analysing biotite composition by elemental microanalyser, and the third – on the concentrations and ratios of the immobile trace elements determined by X-ray fluorescence analyses); (3) to trace the development of lithofacies using fine-resolution correlations on the base of volcanic ash layers (spatial and temporal changes in lithology give information on ancient seawater redox conditions, diagenetic processes, primary bioproductivity, eustasy, palaeogeography and climate); (4) to correlate the Estonian volcanic ash layers with layers from neighbouring areas using the correlation methods, worked out till now and developed further; (5) to compose thickness maps of correlated volcanic ash layers for reconstructing the directions to the ancient volcanoes; (6) to restore the history of volcanism around the Baltica palaeocontinent on the basis of mineralogical and geochemical data, volcanic ash distributions, grouping of ash layers according to the source volcanoes, revealing the number of different volcanoes and stratigraphical intervals of their activity; (7) to link the history of volcanism with the drift of continents and palaeogeography; (8) to investigate the early diagenesis of volcanic ash (the relationships between volcanic ash, host rock and ancient seawater on the basis of



Tarmo and Enli Kiipli in the field work in Bornholm (Denmark) together with Arne T. Nielsen from the Geological Museum of Copenhagen University. *Photo by M. Kiipli.*

geochemical and mineralogical investigations were elucidated); (9) to compile database of samples from the volcanic ash layers and their analyses, connecting it with the database of the geological collections of the Institute of Geology at TUT.

Main results in 2004–2005

(1) Existing geochemical and mineralogical data of Upper Llandovery bentonites were studied. It was discovered that more than 200 studied volcanic ash samples originated from 44 volcanic eruptions. To these ash beds were assigned stratigraphical ID codes and to the eruptions (found in more than 5 sections) – the stratigraphical names. Considering the above data, hypothesis of six source volcanoes was worked out.

(2) Data about Wenlock volcanic ash beds were studied and a paper was submitted. Twenty seven ash beds can be recognised in Wenlock. More than six source volcanoes can be suggested.

(3) Two reports were presented at the international conference “Silurian Dynamic Earth” in August 2005 (Subcommission of Silurian Stratigraphy).

(4) Enli Kiipli finished successfully PhD study “Modelling Seawater Chemistry of the East Baltic Basin in the Late Ordovician – Early Silurian”.

Quaternary Geology

In 2005, investigations in the Quaternary geology of Estonia and neighbouring countries were accomplished through three target-financed projects and six Estonian Science Foundation grants. On 7–11 September 2005 the Sixth International Conference on Geomorphology was held in Zaragoza, Spain. The conference papers covered the majority of geomorphological and related Quaternary Geology topics of the World, including deglaciation history on the southern slope of the Baltic Shield, presented by A. Raukas. His paper based on the modern dating methods (^{10}Be , OSL, ^{14}C a.o.), unfortunately could not help to improve the existing Late-glacial stratigraphical chart of Estonia and deglaciation chronology in the Baltic area. On August 22–36 2005 in St. Petersburg the Sixth Stratigraphical Conference of the Baltic States was held and no new ideas to the improving of the stratigraphical schemes arose. It means, that in the coming years much more attention should be paid to the improving of dating methods in

the field of Quaternary chronology. Some opportunities to obtain new high-resolution palaeodata for the Holocene stratigraphy present the studies of annually laminated lake sediments (S. Veski a.o.). Different long series of proxi, such as pollen, diatoms, cladocera etc from annually laminated lake sediments of Lake Rõuge Tõugjärv and Kasaritsa Verijärv were connected to historical events in landuse via historical maps and documents (Veski et al. 2005; Alliksaar et al. 2005; Niinemets and Saarse 2006).

Research laboratories of isotope-palaeoclimatology and Quaternary geochronology are the leading research units in the field of isotope-geochemistry and radiometric dating in the eastern Baltic area. As one of the most important results the formation mechanism of glacial groundwater stored in the Cambrian-Vendian aquifer has been elucidated (R. Vaikmäe a.o.). At the same time much more attention should be paid on geochemical explanation of isotope variations in order to find more



Quaternary sediments outcropping in the Voka section, NE Estonia. *Photo by A. Molodkov.*

reliable correlations between palaeoenvironmental changes and corresponding variations in the isotopic composition.

The Quaternary geologists of the Institute have close contacts with researches from neighbouring countries and belong to many international co-ordinative bodies. Collected by A. Molodkov data from Kola Peninsula and neighbouring regions of the European north-east allowed to distinguish within the Late-Pleistocene after Eemian interglacial several interstadials. Some of them were also proposed for Estonia on the the example of detailed study of Voka section in NE Estonia.

Depending on good natural preconditions scientific research was also focused on the study of the deposits and coastal forms of the Baltic Sea. The shorelines of the Baltic Sea were collected into a comprehensive database and isobases of the Baltic Ice Lake, Ancylus Lake and Litorina Sea were modelled (Ojala et al. 2005; Vassiljev et al. 2005; Veski et al. 2005). The results showed different rates of the uplift and irregular gradient. In the Early Holocene the land uplift was uneven and changing. First time in the Baltic states seismogenic structures of Holocene age were identified in

lake sediments (A. Miidel, A. Nikonov). The earthquake took place some 9500–7900 ^{14}C years ago. Complex investigations of lake sediments showed the main changes in the forest history of Estonia 7700 and 3200 cal years BP (L. Saarse a.o.).

An important task was compilation of the “Book of Primeval Nature (H. Kink a.o.) in the frames of which in 2004–2005 five booklets of the series “Natural Heritage of Estonia” were published.

Much attention was paid to the investigation of Kaali craters. The morphology of the main crater was described in detail and the explosion energy of the Kaali meteorite assessed. Institute helped the opening of the Kaali stone and meteorite museum (R. Tiirmaa).

Applied science was conducted in connection with the water quality and restoration problems of Lake Harku (Kink et al. 2004) and assessment of the reference conditions for lakes using paleolimnological methods (Heinsalu and Alliksaar 2005).

Late Quaternary environment dynamics in the northwestern part of the East-European Platform: stratigraphy, geochronology, correlation

Target Financed Research Project No. SF0331759s01

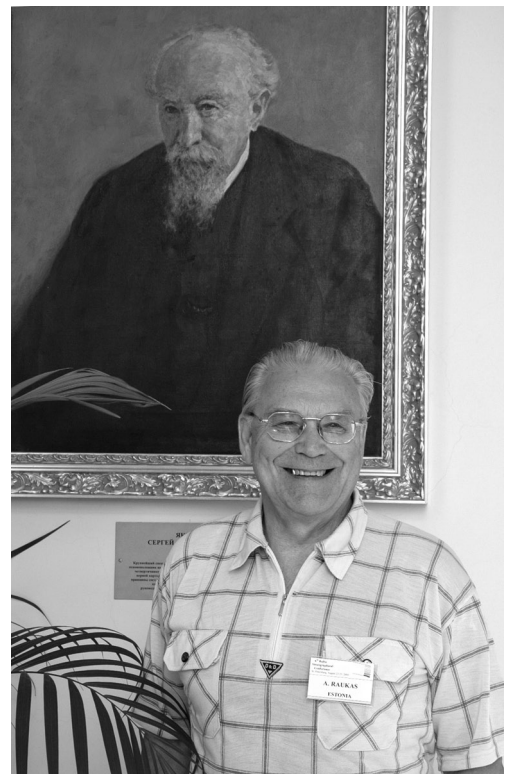
Project leader: A. Raukas

Team: R. Karukäpp, H. Kink, T. Metslang, A. Miidel, A. Molodkov, E. Tavast

Duration: 2001–2005

In cooperation with scientists from USA (P. Clark, W. Rinterknecht) for the first time in the northern Baltic erratic boulders were used for dating ice marginal formations by means of the beryllium method; the ages 11732-16251 were obtained.

The explosive energy of the Kaali meteorite was assessed. It was shown that the resultant emitted three-dimensional turbulent gas



Anto Raukas in the 6th Baltic Stratigraphical Conference, VSEGEI, St. Petersburg. Photo by H. Pärnaste.

flow reached a height of 6.8–7.9 km and was capable of scattering fine meteoritic matter over a large area. In cooperation with French scientists (F. Marini) the composition of the cosmic matter dispersed at Kaali was studied under a high-resolution scanning microscope and by means of an ultra-sond. Its morphogenetic classification was compiled.

At the lower reaches of the Kunda River seismogenic structures of Holocene age were identified in Kunda Lake sediments (together with N. Nikonov from Moscow). The find is the first of this kind in the Baltic States. The lower part of the lake marl of Holocene age and the underlying older lake sediments are seismotectonically disturbed. The earthquake took place in the beginning of the Holocene 9500-7900 ¹⁴C years ago. The direction of sediments deforming lateral pressure was SE-NW.

Together with S. Veski's working group isobases of the Baltic Ice Lake, Ancylus Lake and Litorina Sea were modelled. The results showed that the rate of uplift was higher in NW; this was explained with flexural changes of the Earth's crust uplift. During the Ancylus Lake stage, the direction of the uplift gradient was irregular, its magnitude was greater in NW Estonia and NW Latvia. In the Early Holocene, the uplift of the Earth's crust was uneven and changing.

The study of the last interglacial sediments



Kaali meteorite crater. Photo by G. Baranov.

on the southern coast of the Kola Peninsula showed that some of the stratotype sediments occurring there are erratics. Using two independent dating methods (ESR and IR-OSL) it was proved that the sediments under consideration formed during the Late Pleistocene (Eemian-Boreal) transgression. The results suggest that during isotope stage 5c the level of ocean was rather high. The micro- and macrofauna and plant associations identified in sediments suggest much warmer climatic conditions than those at present. The results obtained on the east coast of the White Sea do not exclude the occurrence of cold-water Weichselian transgression some 46000 years ago. The studies confirm that during isotope stage 5c glacial sediments did not accumulate in the White Sea area.

The last continental glacier in Estonia: its dynamics and chronology

Estonian Science Foundation Grant No. ETF5342
Project leader: A. Raukas
Team: K. Erg, R. Karukäpp, A. Miidel, E. Tavast
Duration: 2003–2006

A survey of the Quaternary sediments in Estonia was compiled and the late-glacial interval was analyzed in particular detail. In Estonia, there were no significant ice margin oscillations in the late-glacial. Thus, the new glacier tongue did not advance from the direction different from the previous one, but the

direction of ice movement within it changed due to the shift of the glacier's feeding area or the increasing effect of the subglacier topography as a result of the thinning of the ice. This resulted in the formation of the so-called palimpsest-structures, where the traces of every following process shaded the previous ones. In terms of the mode and rate of glacier movement as well as the formation of sediments and relief of decisive importance is the circumstance whether the temperature in the glacier's base is below or above the freezing point. As a rule, Estonian glaciers were "warm-bottomed".

Based on all the applied methods (TL, OSL, ^{10}Be , ^{14}C , varvometrical and palynological) and the most recent data on the ice sheet

dynamics in the Baltic Sea region, the chronology of the ice sheet retreat in Estonia was summarised.

Palaeoenvironmental changes in NE Estonia during the Last Ice Age (a pilot project)

Estonian Science Foundation Grant No. ETF5440

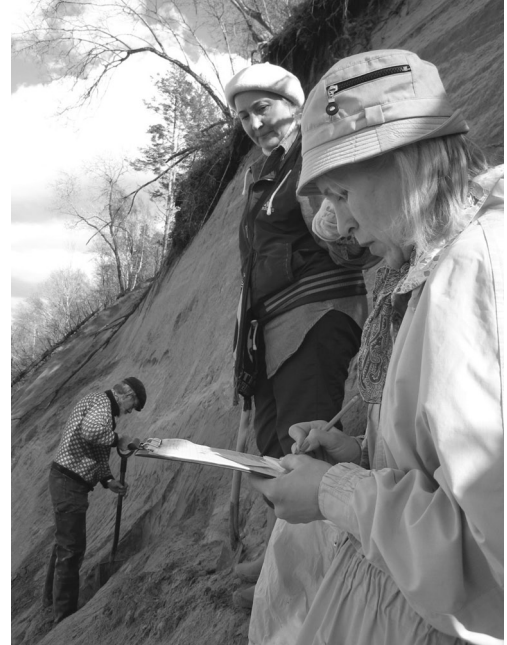
Project leader: A. Molodkov

Team: T. Balakhnichova, I. Jaek, A. Miidel, M. Osipova, E. Tavast, V. Vasilchenko, N. Bolikhovskaya (Moscow State University), A. Nikonov (Institute of Physics of the Earth, Russian Acad. Sci.), K. Ploom and M. Sakson (Geological Survey of Estonia)

Duration: 2003–2004

The first chronostratigraphic and palaeoclimatic data on Late Pleistocene palaeoenvironmental changes in Northern Estonia were received in the course of the pilot study of a new Upper Pleistocene section at the Voka site. It is established that in this section we deal not with the assumed laterglacial and the subsequent Lower Holocene deposits (Miidel 2003), but with the section, which covers most part of the Late Pleistocene period. The upper part of the section consists of deposits spanning the time period from about 40 ka to 30 ka, and the lower part – from about 110 ka to 70 ka (V1) and from about 115 ka to 90 ka (V3). This proves that interglacial (Prangli/Eemian) deposits correlating at least with the oxygen isotope substages 5d to 5a occur here. The presence of older deposits is expected in the deeper part of the section currently not available due to thick talus at the base of the outcrops. On the basis of the pollen data a conclusion is made that the sands of the lower part of the V1 section dated by infra-red optically stimulated luminescence (IR-OSL) at about 110 ka were deposited during the last interglacial.

Sedimentation of the deposits in the middle part of the V3 section occurred in an aqueous environment, probably, in a glaciolacustrine basin under severe climate conditions of the Järva/Weichselian time. In the lower part of these deposits at a depth of 10.7 m and 8.8–9.2 m two interstadial intervals were recognised. The pollen spectra of these intervals are char-



Sampling at the Voka outcrop. Photo by A. Molodkov.

acterised by an increase of the forest component contribution.

The pollen and diatom data have shown that the deposits underlying the Holocene soil accumulated in a fresh-water basin.

The duration, time limits and synchronicity of marine and lake transgressions in the marginal areas of Northern Eurasia (Molodkov and Bolikhovskaya 2004), incl. Kola Peninsula – the eastern periphery of the Fennoscandian Shield (Molodkov and Yevzerov 2004; Korsakova, Molodkov and Kolka 2004) were determined. Chronostratigraphical studies in classical key sections showed that the stratigraphic position of Upper Pleistocene marine sediments in the southern part of Kola Peninsula was determined by at least three marine transgressions, the last of which was preceded by an Early Pleniglacial continental glaciation. To the first transgression (Eemian in age) corresponds the

Boreal transgression in the northern part of the East European Platform (Korsakova, Molodkov and Kolka 2004). The existence of this transgression on the Kola Peninsula is testified by the wide spread of Ponoj sediments in the area under consideration.

It was shown that the second stage of Boreal transgression is of Early Weichselian/Late Eemian (OIS 5b,c) age. In the geological sections of the study area to this correspond the so-called Strelnin marine sediments. Those two uninterrupted stages of transgression developed here in the time span 130 up to 80–70

ka, which is correlatable with the whole OIS 5 (Korsakova, Molodkov and Kolka 2004).

It was established that in the beginning of OIS 4 the marine regime was interrupted by the regression of the Fennoscandian ice sheet. During the time interval 60–40 ka, the third Late Pleistocene transgression followed, which took place in the Middle Weichselian Pleniglacial (OIS 3). In the study area the relevant sediments are everywhere covered with the Late Weichselian Pleniglacial (OIS 2) glacial sediments (Korsakova, Molodkov and Kolka 2004).

Palaeoenvironmental changes dynamics in Northern Estonia during the Last Ice Age

Estonian Science Foundation Grant No. ETF6112

Leader: A. Molodkov

Team: T. Balakhnichova, I. Jaek, A. Miidel, M. Osipova, E. Tavast, N. Bolikhovskaya (Moscow State University), A. Nikonov (Institute of the Earth Physics, Russian Acad. Sci.), K. Ploom and M. Sakson (Geological Survey of Estonia)

Duration: 2005–2008

The results obtained in the course of the previous project from the Kola Peninsula and neighbouring regions of the European northeast allowed to distinguish within the Late Pleistocene period an interglacial and at least 6 interstadials dated at about 145–140 to 70, 65, 56, 44, 32, 26 and 17 ka, respectively (Molodkov and Bolikhovskaya 2005a). Based on this multidisciplinary study an interregional climate-chronostratigraphic correlation of Upper Quaternary sediments (Molodkov and Bolikhovskaya 2005a) and the correlation with the climate-chronostratigraphic data obtained from the Voka section (Molodkov and Bolikhovskaya 2005b) was given. The results obtained were correlated with the information stored in deep sediments, ice cores and loesses (Molodkov and Bolikhovskaya 2005a).

Besides, according to one of the objectives of the present project, a study of waterlain and aeolian deposits was initiated in order to elucidate deglaciation dynamics in the Baltic region, and to obtain new chronostratigraphi-

cal data concerning the palaeoenvironmental changes in this area.

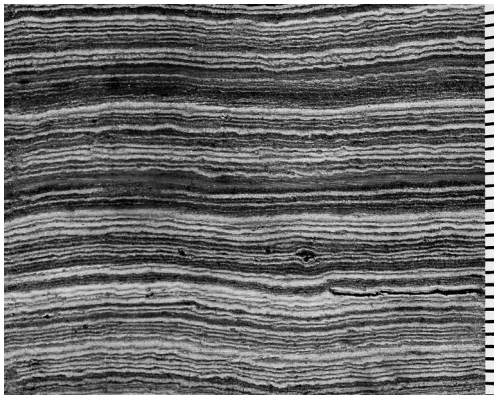
The first results of IR-OSL dating of aeolian deposits from different sites of Southern Baltic showed that the age of these deposits varies from several thousands to a few hundred years. It has been estimated that periods of aeolian activity for massifs of continental dunes and dunes of the Baltic Sea Coast were different. From IR-OSL data set it is clear that sedimentation processes were not linear and usually developed periodically.

The interdisciplinary investigations aimed at elucidating the reasons resulting in the anomalous fading of the absorbed lightsum in various modifications of feldspars were conducted (Satkūnas and Molodkov 2005; Vasilchenko, Molodkov and Jaek 2005). It was shown that tunnel processes are not generally the cause of the fading. During the study the dependence of the tunnelling from various external factors was established.

A hypothesis was proposed suggesting that thermal relaxation processes are the main reason of the fading. In many luminescent materials they lead to the reduction of the luminescent signal without real decrease of population of dosimetric levels.

The method of direct detection of the tunnel transitions from dosimetric traps is proposed utilizing the specific features of the low-temperature dependencies of the IR-OSL intensity stimulated in the infrared region.

work of varved sediments in Europe and Estonia presents an opportunity to provide new high-resolution palaeodata from unique and precise environmental archives. The predicted temporal range of varved sediments in Estonia can extend to 14000 years. Accurate varve counts, verification of their annual nature and documentation of each individual varve thickness from Estonian sediment sequences were made using high-resolution techniques (thin section investigation, image analysis, X-ray densitometry, scanning electron microscopy). Varve thickness variations of the last centuries were compared to meteorological data of the same period to obtain a varve-climate link, which then was extrapolated to the past. These procedures provided quantitative estimates of short- and long-term climate variability. Post-glacial climatic variability and environmental changes were established using diatom-inferred reconstruction. Abrupt transitions between time periods of stable climatic conditions (e.g. the Younger Dryas-Holocene transition, the early Preboreal Oscillation, the cooling events at ca. 8200 years BP and at ca. 2800–2700 years BP, the Little Ice Age) were studied at a high-temporal (an annual and possibly seasonal) resolution. An accurate calendar year chronology provided by sediment sequences enabled to objectively compare variations in palaeoclimatic proxy data with each other and alternative palaeodata sets of similar resolution (e.g. ice-cores and tree-rings). The time-series data sets produced were for the benefit of global change community and could be used to validate predictive climate models.



The annually laminated (varved) sediments. Photo by G. Baranov.

Main results in 2004–2005:

Different long series of proxi, such as pollen, diatoms, cladocera etc from annually laminated lake sediments of Lake Rõuge Tõugjärv and Kasaritsa Verijärv were connected to historical events in land-use via historical maps and documents (Veski et al. 2005; Niinemets and Saarse 2006). Quantitative pollen inferred annual mean temperature reconstruction (Seppä et al. 2004) shows a distinct cold period at 8400–8080 yr BP; the timing is consistent with that seen in the Greenland ice-core data and various high-resolution records from western Europe (Veski et al. 2004). 10000 year long paleoclimate records from 3 lakes show that the Holocene thermal maximum is distinguishable at 8000–4500 yr BP (T_{ann} on average 2.5 °C higher than at present). Detailed diatom studies from Lake Tõugjärv show the response of lake water quality to changes in the catchment land-use during the last 700 years. Diatom-inferred epilimnic total phosphorus reveals periods of high nutrient input into the lake system in the 18-19th century and a recovery in the last decades (Alliksaar et al. 2005). Eutrophication history of the Estonian large lakes – Peipsi and Võrtsjärv – shows changes in the last 150 years (Nõges et al. in print; Stålnacke et al. in print; Heinsalu et al. subm.). Optical properties of sediment pore-water dissolved organic matter are in correspondence with the down-core distribution of sediment composition and changes in diatom assemblage show the feasibility of spectral measurements for tracking changes in lake paleoproductivity (Leeben et al. 2005). The influx of spheroidal fly ash particles from oil-shale-fired power plants in atmospheric precipitations was assessed in order to find out the spacial and temporal distribution (Kaasik and Alliksaar 2004; Kaasik et al. 2005). Earliest traces of cultural plants in Estonia – wheat and hemp – from sediments dating back about 6000 B.C. show contacts with southern neighbours since the end of the Mesolithic (Poska and Saarse, in print). Investigations continued on general prehistoric human impact upon the landscape and vegetation (Poska et al. 2004; Veski and Poska 2004) as well as in co-operation with archaeologists on specific sites,

such as the Pulli Mesolithic settlement (Veski et al. in print). Immigration routes and timing of different tree species into Estonia were modelled by kriging point analysis to reveal vegetation patterns (Saarse 2004). Studies on the Baltic Sea history, alternation of transgressions and regression, changes in water salinity and different coastal formations, palaeoseismic events added important information to the event stratigraphy of the region (Ojala et al. 2005; Vassiljev et al. 2005; Veski et al. 2005; Hutri et al. *subm.*). Traces of volcanic tephra were discovered in western Estonian bog sediments and correlated with the Hekla-4 eruption dated to 4260 years ago (Hang et al. *accepted*). The advances in the field of applied science were connected with the water quality and restoration problems of Lake Harku (Kink et al. 2004) and assessment of the reference conditions for lakes using paleolimnological methods (Heinsalu and Alliksaar 2005).

K. Koppel defended his MSc thesis in 2005 on the topic “The research methods of historical land use as exemplified by the formation of rural landscape on Kasaritsa study area (Rõuge parish) in 17th–19th centuries” which focused on the temporal and spatial dynamics of historical land use and resulted in several papers (e.g. Veski et al 2005). Twelve papers were

published and 8 submitted in CC and peer-reviewed journals and series in 2004–2005.



Siim Veski and Atko Heinsalu coring inside the recently found Vaida (possible) meteorite crater. *Photo by T. Tubli.*

Quantitative reconstruction of climate change and environmental

Estonian Science Foundation Grant No. ETF5923

Project leader: A. Poska

Team: A. Heinsalu, J. Vassiljev, S. Veski

Duration: 2004–2006

The project develops a regional calibration dataset for Estonia consisting of modern lake sediment pollen and diatom samples and associated vegetational, climatic and limnological variables. These data were used to define transfer functions that relate taxon distribution and abundance to contemporary landscape, climatic and limnological conditions. These inference models provided better and more realistic quantitative estimates for re-

constructing Holocene climatic variability and environmental changes from sedimentary pollen and diatom assemblages. Annually laminated sediment sequences from southern Estonia allowed to reconstruct changes in landscape, lake ecosystem and climate at a very high-temporal resolution. Abrupt transitions between time periods of stable climatic conditions, e.g. the early Preboreal Oscillation, the cooling events at ca. 8200 years BP and at ca. 2800–2700 years BP, the Medieval Warming, the Little Ice Age and environmental changes during last 1000 years were of special interest. Also, quantitative rates of environmental change as well as possible time lags between external forcing (climate change) and induced lake ecosystem response were estimated.



Fly ash sources in Kiviõli, NE Estonia. *Photo by H. Pärnaste.*

The interaction of forest and atmospheric fly ash influx

Estonian Science Foundation Grant No. ETF5002
 Project leader: M. Kaasik (Institute of Environmental Physics, University of Tartu)
 Team: J. Ivask, T. Alliksaar
 Duration: 2002–2004

The interaction between forest stands and fly ash pollution is reciprocal: (1) the fly ash affects the condition of trees through the air and soil and (2) the different aerodynamic roughness of the forested and open land induces the non-uniform distribution of ash particles in the landscape. The aim of this project is to clarify the regularities of this interaction.

(1) The systematic differences of deposition of fly ash indicators (cations, anions, heavy metals, insoluble particles) in the landscapes of different surface roughness (flat open, flat forested, hilly) were quantified, paying attention to the variability due to weather conditions. Based on gathered data, the dependence of the fly ash deposition flux on the landscape type was found.

(2) The relation between the oil shale fly ash deposition fluxes and wood increment in the forest stands growing on peaty soils was found (especially during the peak level of alkaline pollution in 1970–1990), using the retrospective studies in NE Estonia as the main method and the air pollution transport modelling as the supporting method. The results are expected to enable the forecasting of the succession of forest condition, using the development scenarios of the oil-shale-based energy production.

The results were applied to upgrade the air pollution dispersion and deposition model AEROPOL in order to enable forecasting of fine territorial distribution of deposition fluxes of particles sized about 10 μm . The project joined two research directions grown up from solving of environmental problems in Estonia: (1) mathematical modelling of air pollution and (2) paleoecological studies. The synergistic effect was achieved as a result.

Main results in 2004:

(1) The atmospheric deposition fluxes of spheroidal particles in the oil-shale processing region are 1-2 decimal orders larger than the background values. Thus, these particles are potentially the best indicators of oil-shale combustion relative to other detected components of fly ash.

(2) The concentration of spheroidal particles in fly ash is highly variable due to different technologies and regimes used for oil shale combustion in power plants. This diminishes their indicative value at our current level of knowledge, but opens new possibilities to refine the tracing methods towards the resolution of “traces” of different energy production units.

(3) Due to lower background loads the wintertime (snowy) campaigns give more reliable results for tracing both the spheroidal particles and chemical components of oil-shale fly ash than those provided during the warm season. On the other hand, campaigns during both cold and warm seasons are needed to get a comprehensive overview of yearly fluxes to the ecosystem.

Holocene event stratigraphy of Estonia

Estonian Science Foundation Grant No. ETF4963

Project leader: L. Saarse

Team: E. Niinemets, A. Poska, S. Veski

Duration: 2002–2005

Detailed litho-, chrono- and biostratigraphical studies on lakes with annually laminated lake sediments in SE Estonia showed two main changes in the forest history, which occurred 7700 and 3200 cal BP. In Verijärv sequence two markers have been identified: catastrophic forest fire at 3450 cal BP, one of the best documented event in Estonia, and a sharp decline in alder pollen ca 2000 years later, registered in several pollen diagrams of SE Estonia (Niinemets and Saarse, 2006).

Additional studies have been carried out to determine more exactly the age of the first appearance of *Cerealia* pollen in Akali. New results confirmed that *Cerealia* turned up into Akali pollen spectra ca 5000 cal. BC, which are the oldest finds so far in Estonia (Poska and Saarse 2006.).

Based on high-resolution pollen analyses, historical documents and maps, changes in landscape openness in the Rõuge area were reconstructed. These results show that landscape opened up between AD 1650–1875 with max-

imum in the second half of the 18th century (Veski et al. 2005 b; Alliksaar et al. 2005).

Together with archaeologists studies on the lower reaches of the Pärnu River were carried out to clarify the settlement history, age and magnitude of the transgression and regression stages of the Baltic Sea in the area.

Post-graduate student K. Koppel, who participated in the grant project, defended in June 2005 his master thesis on the topic “The research methods of historical land use as exemplified by the formation of rural landscape on Kasaritsa study area (Rõuge parish) in 17th – 19th centuries” which focused on the temporal and spatial dynamics of historical land use. Geographical information system (GIS) was used to process, integrate and analyse the data about historical land use.

The studies of the volcanic ash (tephra) were initiated by T. Hang and performed in two western and central Estonian peat bogs. The traces of tephra were discovered in western Estonian bog and correlated with the Hekla-4 eruption dated to 4260 years ago (Hang et al., *subm.*). Tephra of this age have been earlier described in England, Ireland, Germany, Norway and Sweden, but in Estonia it was the first finding, which obviously will be limited to this region. As tephra is an important strati-



Tiiu Alliksaar, Atko Heinsalu and Leili Saarse cleaning the frozen lake sediment cores obtained by freeze-coring. *Photo by S. Veski.*

graphical marker, dispersed rapidly and has a distinct chemical composition it is substantial to continue these studies in Estonia.

Event stratigraphy should also map the hazardous proceedings. In the Holocene one of such events is the formation of Kaali impact craters. The age of the occurrence of this event is up to now under discussion (Veski et al. 2006). Altogether 34 radiocarbon dates are available, among which the oldest comes from the main crater, where the buried peat is dated to 3390 ± 35 , TIn-1359; Saarse et al. 1991) and

macro-remains to 3305 ± 65 , Ua-17964). Still, these dates are about 1000 years older compared with the dates from the peat in Piila bog containing iridium. At the present stage of investigation we can only confirm the formation of Kaali craters before 3600 cal BP.

Studies on the Baltic Sea history, alternation of transgressions and regression, changes in water salinity and different coastal formations also added important information to the event stratigraphy (Vassiljev et al. 2005; Veski et al. 2005a).

Spectrofluorometric characterisation of dissolved organic matter in pore-water of lake sediments

Estonian Science Foundation Grant No. ETF5582

Project leader A. Leeben (Marine Systems Institute, TUT)

Team: T. Alliksaar, K. Künnis (Institute of Ecology, Tallinn University), V. Lepane and M. Kudrjassova (Department of Chemistry, TUT)

Duration: 2003–2005

The proposed research was aimed at analysing dissolved organic matter (DOM) in the pore-water of lake sediments using fluorescence spectra. A set of analyses (including microbiological, size exclusion chromatographic and organic matter analyses) on sediment core samples from small Estonian lakes with different trophic status were carried out in order to:

(1) investigate the relationship between fluorescence of pore-water DOM and lake historical productivity;

(2) study the possibilities of using fluorescence spectra of pore-water DOM for identification of precursors of accumulated organic material.

The obtained data were processed using the principal components analysis.

Application of the fluorescence technique has advantages in comparison with the clas-



Tiiu Alliksaar and Atko Heinsalu on Lake Nohipalu Valgejärv. Photo by S. Veski.

sical methods used in palaeolimnology since it is fast and requires no sample pretreatment. Characterisation of pore-water DOM can be carried out on small volumes of samples. This fluorescence method may be useful for:

(1) sorting large core sample sets to be tested by other characterisation methods or for characterisation of archived samples;

(2) augmenting the interpretation of dissolved organic carbon sources and alterations in sediments for understanding carbon cycling in freshwater ecosystems, determination a carbon budget in aquatic systems or human impact on lake ecosystems.

Late Quaternary and Palaeozoic climatic and environmental changes and their isotope-geochemical records in continental and marine sediments, hydro- and cryosphere of Northern Hemisphere

Target Financed Research Project No. SF0332089s02

Project leader: R. Vaikmäe

Team: T. Balakhnichova, J. Ivask, I. Jaek, E. Kaup, A. Marandi (University of Tartu, PhD student), T. Martma, A. Molodkov, M. Osipova, V. Raidla, H. Rajamäe, L. Vallner, V. Vasilchenko

Duration: 2002–2006

The project is build up on four subtopics: (1) The formation mechanism of glacial groundwater stored in the Cambrian-Vendian aquifer system, it's present distribution limits and formation conditions of the chemical composition of the water are elucidated. (2) Using medium-deep ice core records collected from Svalbard ice fields the present and past millennium of variation of climatic and environmental parameters over the Svalbard sector of the Arctic Ocean will be analysed in order to link climate records from this sector of Arctic ice caps to those from Greenland deep polar ice cores. (3) Isotope methods will be used in the study of Late-Ordovician and Silurian sections in the Baltic basin in order to find connections between the geochemical and isotope composition of deposits, which enables to reconstruct environmental conditions of the Palaeozoic. (4) Development of the physical basis of the luminescent and optical dating techniques.

Essential results in 2004–2005:

(1) In view of the extraordinarily high neg-

ative $\delta^{13}\text{C}$ values detected in the Cambrian-Vendian groundwater during earlier studies, the origin of the carbon was investigated by V. Raidla. In the Cambrian sediments of Estonia, carbonaceous cement is spread in the vicinity of clay deposits. Cement is also found in Vendian rocks, however, its content is much lower. Up to now, the source of the carbon occurring in this cement is not known. E. Pirrus (1977) suggests that organic matter in the form of fine suspension deposited in the sea mud, on its decomposition carbon dioxide was formed which may have served as a source of the carbonaceous cement under consideration. The cement consists prevalingly of siderite, the carbonate isotope composition of which is much more complicated to determine than that of dolomite or calcite. In one sample with a sufficient quantity of dolomite, the $\delta^{13}\text{C}$ value of -11‰ was measured; this supports the above hypothesis. During the course of further studies it is attempted to find out whether such isotope composition in the cement of the Cambrian-Vendian rocks is common or exceptional (this subject is part of V. Raidla's PhD thesis).

(2) The oxygen isotope composition in the ice-cores of Lomonosovfonna and Austfonna, Svalbard, Spitsbergen, were compared as an indicator of changes in climate and sea ice position during the last 400 years. The changes of curves proved quite similar in the 1920s, but the values of oxygen isotope composition for earlier periods in the Austfonna glacier are more negative than in the Lomonosovfonna ice cap. This discrepancy can be explained with the circumstance that due to different heights of ice caps, the precipitation which has



View from the Norwegian Polar Institute Ny-Ålesund station's window to the airship "Norge" tower (built in 1926) and to Kongsfjorden (Spitsbergen). *Photo by T. Martma.*

accumulated on them originates from different layers of the atmosphere and, at the same time, the precipitation formed at different heights of the atmosphere responds differently to the movement of the sea ice boundary. Data on variations in the oxygen isotope and chemical composition of the ice cores drilled from ice domes in different parts of Svalbard were compared. The results showed that despite an obvious meltwater infiltration effect, in case of dense sampling, it is possible using statistical analysis, to establish seasonal variations in the isotope and chemical composition, which at the whole length of the core store information on climate changes. The results were published in Isaksson et al. 2005 a, b.

In co-operation with the Department of Geophysics of University of Helsinki (Mats Granskog) the behaviour of oxygen isotope composition ($\delta^{18}\text{O}$), major ions, organic carbon and microelements during ice formation



T. Martma sampling for $\delta^{18}\text{O}$ analyses from seasonal snow pit in glacier Bogerbreen, Svalbard, Spitsbergen. Photo by T. Martma.

in different parts of the Baltic Sea was studied. Ice growth has potential impact on the chemical budgets and cycling of some elements, especially those which are rejected/retained during sea-ice formation, particularly in the shal-

low parts of the Bothnian Bay covered with a land-fast ice cover. Results were published in Granskog et al. 2004. As a result of these studies, Mats Granskog defended his PhD thesis in University of Helsinki.

(3) (a) The rich analytical material obtained on the carbon isotope composition of Upper Ordovician rocks was studied. Data on changes in the isotope composition of Upper Ordovician rocks sampled from different boreholes were synthesised and a complete curve of isotope variations was obtained. The curve displayed 13 positive $\delta^{13}\text{C}$ blow-outs reflecting seven substantial changes in environmental conditions. Part of these changes in carbon isotope composition are global and observable also in North America. The results obtained were published in Kaljo et al. 2004a, Ainsaar et al. 2004, Martma 2005, Martma and Kaljo 2005.

(b) Based on the samples from the Vidukle borehole in Lithuania, positive carbon peaks at the Silurian Wenlock and Ludlow levels with respect to the graptolite scale were adjusted. It was found out that the Wenlock peak in the Vidukle core is in good agreement with the data published earlier on the Baltic and elsewhere in the world. Ludfordian peak starts earlier and ends later than the conodonts-based "Lau event". The preliminary results were published in Kaljo et al. 2004. (The above results were obtained in cooperation with the Target Financed Programme No. 0331760s01).

(4) In studying the reasons for dosimetric light sum instability (fading) in different feldspar samples it was shown that tunnelling processes, in general, are not an essential cause of fading. The dependence of the probability of tunnelling processes in feldspars on different external influences was elucidated (Vasilchenko et al. 2005).

Fourteen ESR/IR-OSL cross-datings of sediments in key sections in the NW and NE parts of the East-European Platform showed the absence of anomalous fading (loss of information) in the feldspars extracted from these sediments. Based on chronostratigraphical studies the occurrence of ice-free interval in oxygen isotope stage (OIS) 7 in southern Baltic was elucidated. In all likelihood, an

abrupt warming of climate took place in this area at the end of OIS 6 (Saalian-Moscovian glaciation), and transgression of seas in the polar basin in the NE part of the East-Euro-

pean platform during isotope substage 5a. Results were published in Satkūnas and Molodkov 2005, Vasilchenko et al. 2005

Baseline chemical and isotopic composition and age of Estonian groundwater: geochemical foundation for implementation the EU Water Framework Directive in Estonia

Estonian Science Foundation Grant No. ETF5925

Project leader: R. Vaikmäe

Team: J. Ivask, E. Kaup, T. Martma, V. Raidla, L. Vallner

Duration: 2004–2007

The project aims to establish baseline chemical and isotopic composition and age of groundwater in Estonia for to provide scientific foundation for implementation the EU Water Framework Directive and the Daughter Directive on Groundwater. Baseline geochemical parameters are needed as a reference to be able to assess quantitatively whether or not anthropogenic pollution is taking place and if so to what extent. Existing water quality limits may be breached by entirely natural processes for elements as F, Fe, As. Thus, quality changes are not only due human impacts but to changes in the aquifer system hydrodynamics (recharge variations, seawater encroachment, mixing processes etc.). In order to interpret the water quality variations in terms of baseline concentrations, some knowledge of water ages (residence times) within groundwater system is required. For this purpose, both inert and reactive chemical and isotopic natural tracers will be used. Numerical models of flow and geochemical models will be used in combination with the tracer methods. The baseline conditions will be investigated as far as possible by cross-sections along the groundwater flow gradient, where sequential changes in the water-rock interaction as well as mixing, may be readily investigated. By investigating the evolution of water quality along flow lines, it will also be possible to establish relative timescales. The identification (or absence) of marker species related to activities of the



The bay full of ice debris from the Greenland glaciers – a sign of general melting of the glaciers. *Photo by A.Soesoo.*

industrial era, such as total organic carbon (TOC), tritium and dissolved anthropogenic gases (chlorofluorocarbons, SF₆) may provide evidence of a recent component in groundwater. The expected deliverables of the project are: the concept of geochemical baseline and baseline trends applied to Estonian aquifers; scientific basis for water policy documents; recommendations for monitoring; scientific publications and conference presentations.

Essential results in 2004–2005

The hydrochemical data base of aquifer systems stored in the Geological Survey of Estonia was studied and the reliability of the available data in terms of the present project was assessed using statistical analysis methods. The data on maximum and minimum values, medians and standard deviations based on the analysis of ca 250 samples showed that most of the data can be used as background information for the purposes of the present project. The greatest discrepancies were related to the values of total Fe. As a result, a sampling programme was compiled for the years 2004 and 2005. In 2005, the main attention focused on sampling from different aquifer systems and isotope-geochemical analysis of the samples collected. To establish the peculiarities in the concentration and isotope composition of

hydrogen carbonates in the Cambrian–Vendian groundwater the potential effect of organic carbon taken along with meltwaters of Scandinavian glaciers from the pre-klint area was studied. For this purpose, the data obtained by X-ray method on the spread and changes in the mineral and chemical composition of the Cambrian rocks of Estonia both in vertical and horizontal direction in 13 boreholes were gen-

eralised and the distribution and formation of the isotope composition of organic matter in Cambrian rocks were studied. The results obtained were reported in Karro et al. 2004 and at two international conferences: International isotope–hydrology symposium arranged by UNESCO in Paris in 2004 and on the VIII Conference of European Society of Isotope Research in Leipzig, 2005.

Basin-wide groundwater flow and the hydrogeological parameters for implementation of the EC Water Framework Directive in Estonia

Estonian Science Foundation Grant No. ETF6118

Project leader: L. Vallner

Duration: 2005–2007

Goal of the project is to reconstruct the natural geohydrodynamic background and on the basis of the latter to determine the hydrogeological parameters needed for the implementation of EC Water Framework Directive in Estonia (WFD). The main tool of the project is the digital hydrogeological model of Estonia compiled by L. Vallner in 2003. By modelling the vector field of basin-wide groundwater flow will be determined and pathways, velocities and rates of groundwater flow will be calculated. On this basis, the water bearing system will be divided into budget units and the basin-wide groundwater budget will be compiled. The volume of inflow into budget units is considered as their resource. The transversal and lateral conductivities of aquitards will be calculated. The time needed for water exchange in budget units will be determined.

The bodies of groundwater distinguished in accordance with WFD will be delimited in the model. The inflow into groundwater bodies in natural conditions will be calculated. It will be used for determination of the available groundwater resource, which must not be exceeded by abstraction. The pathways and velocity of the movement of contaminated

or naturally poor-quality water under natural and man-made conditions will be identified. The impact of intrusions will be assessed on groundwater quality.

Main scientific outcome of the project will be that for the first time the natural geohydrodynamic background of the water bearing system of Estonia will be reconstructed and profoundly characterised. For the EC water policy is essential the information got on scientific basis for estimation of the groundwater state.

In 2005, the basin-wide natural distribution of the groundwater head was reconstructed by model simulations. The 78-groundwater budget units including all main taxons of the Estonian hydrogeological stratigraphy were distinguished according to directions of the groundwater flow. The transversal and lateral influxes into and from the budget units were calculated. For the first time in Estonia, the natural groundwater resource was determined for all main water bearing layers. The velocities of transversal and lateral groundwater flows and the times needed for water exchange in budget units were calculated.

The WFD groundwater bodies were specified as additional independent budget units in the model. The available groundwater resource was determined for all groundwater bodies of Harju and Viru water management districts. It was found out that the quantitative status of the Cambrian-Vendian groundwater body and Ordovician Ida-Viru oil-shale basin groundwater body is bad correspondingly to WFD criterions in these districts.

Participation in international programmes

- Biological Collection Access Service for Europe (BioCASE) network**, European Union EESD Programme, participants: *O.Hints, H. Pärnaste*;
- Early Agricultural Remnants and Technical Heritage (EARTH)**, European Science Foundation, participants: *S. Veski, A.Poska*;
- Geotourism advancement in Estonia and southern Finland: discovering past geologic history**; Interreg III A programme at the European foundation, participant: *A.Soesoo*;
- Global Biodiversity Information Facility (GBIF) data network**, participants: *O. Hints, H. Pärnaste*;
- Global Stratotype Sections and Points (GSSP) for the Silurian System**, International Subcommission on Silurian Stratigraphy, participant: *V. Nestor*;
- Graptolite Macroevolution: Phylogenetic Analysis and Testing Hypotheses of Directional Change**; EAR 0106844, University of Dayton (Ohio, USA), participant: *J.Nõlvak*;
- Holocene Climate Variability (HOLIVAR)**, European Science Foundation project, participants: *A. Poska, S. Veski*;
- Human Impact on Lake Ecosystems (LIMPACS)**, International Geosphere-Biosphere Programme Network, participants: *S. Veski, A. Poska*;
- Human Impact on Terrestrial Ecosystems (HITE)**, International Geosphere-Biosphere Programme Network, participants: *A. Heinsalu, T. Alliksaar*;
- IGCP Project No 437 “Coastal Environmental Change During Sea-Level Highstands: A Global Synthesis With Implications for Management of Future Coastal Change”**, IUGS, participant: *A.Molodkov*;
- IGCP Project No 490 “The Role of Environmental Catastrophes in Human History”**, IUGS, participant: *S. Veski*;
- IGCP Project No 491 “Middle Palaeozoic Vertebrate Biogeography, Palaeogeography, and Climate”**, IUGS/UNESCO, participants: *E. Mark-Kurik, T. Märss, M.Niit*;
- IGCP Project No 495 “Quaternary Land-Ocean Interactions: Driving Mechanisms and Coastal Responses”**, IUGS, participant: *A. Molodkov*;
- IGCP Project No 499 “Devonian Land-Sea Interaction: Evolution of Ecosystems and Climate”**, IUGS/UNESCO, participant: *E. Mark-Kurik*;
- IGCP Project No 503 “Early Palaeozoic Palaeogeography and Palaeoclimate”**, IUGS, participants: *L. Hints, O. Hints, D. Kaljo, E. Kiipli, T. Kiipli, T. Martma, P.Männik, J. Nõlvak, H. Pärnaste*;
- ISOMAP-UK. A combined data-modelling investigation of water isotopes and their interpretation during rapid climate-change events**, Environmental Change Research Centre, University College London, participant: *T. Martma*;
- Pole-Equator-Pole Europe Africa Transect (PEP III)**, International Geosphere-Biosphere Programme Network, participants: *S. Veski, A. Poska*;
- POLLen LANDscape CALibration (POL-LANDCAL)**, Nordic Council of Ministers Nordic Arctic Research Program, participants: *S. Veski, A. Poska*;
- Stratigraphy of the Ordovician and Silurian boundary beds of northwestern Poland and their correlation with Estonian stratotype sections**; Polish Geological Institute, participant: *J. Nõlvak*;
- The Arctic Paleo-Network**, Uppsala University, participant: *P. Männik*;
- The European Polar Consortium (EUROPOLAR)**, EC FP6 ERA-NET Project, French Polar Institute, participant: *R. Vaimäe*;
- The Sea in Mind**; Interreg III A programme at the European foundation, Helsinki City Environment Centre, participant: *J. Nõlvak*.

Applied research

Risk based environmental site assessment of waste from the oil shale industry

Contract with the Royal Norwegian Ministry of Foreign Affairs

Project leader: L. Bitjukova

Team: J.-E. Sorlie, L. Bitjukova, O.-M. Saether, K. Rudolph-Lund, A. Kahru, L. Vallner, V. Petersell, A. Razgonjajev, L. Pöllumaa

Duration: 2002–2004

In the frame of the project the complex study of the environmental state of North-Eastern Estonia according to the EU landfill and Water Resources Directives was carried out in order to determine the intensity of contamination of surface and groundwater, soil and leaches by organic and inorganic pollutants. The ground-, surface and waste water, sediments, waste and soil around the landfills were examined for trace elements by ICP-MS analysis and organic compounds. The main types of solid wastes were tested by the leaching test. All EU established standards and procedures for field work and laboratory procedures (CEN-tests) were followed.

The obtained data allowed characterization of the level of inorganic and organic compounds in the groundwater from different aquifers and soil, estimation of level of contamination being dependent upon the depth and distance from landfills and other sources of pollution. The main regularities in the distribution of pollutants and local geochemical anomalies were revealed.

This project permitted to enlarge the num-



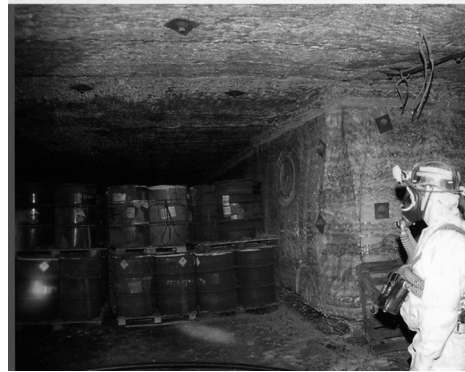
The core from the well drilled through the Kukruse waste landfill, which was examined for trace elements and organic compounds. *Photo by G. Baranov.*

Energy, Waste and the Environment: a Geochemical Perspective

Edited by
R. Gieré and P. Stille



Geological Society
Special Publication 236



Some results of the project were published in the overview of Geological Society.

ber of studied chemical elements, clarify the regularities in the variation of composition of waters, identify the sources of pollution and assess the impact of contamination. The measurement of trace elements and several organic compounds (e.g. PAH, BTX and phenols) gave the possibility to specify inorganic and organic pollutants and to determine the variation of most harmful compounds.

The ecotoxicological testing allowed to estimate negative influence of the contamination by toxic elements and other pollutants on the human health. The hydrological and transport modelling of the main waste heaps (Kiviõli, Kohtla-Järve and Narva) was carried out in co-operation with Norwegian colleagues.

The obtained data were published in the CC article (Saether et al. 2004) and presented during International NATO Advanced Research Workshop “Bioremediation of soils contaminated with aromatic compounds: effects of Rhizosphere, bioavailability, gene regulation and stress adaption” in Tartu (Pöllumaa et al. 2004).

Collections Information System in the Institute of Geology at TUT

Environmental Investment Centre,
Project No. MP2004/19
Project leader: O. Hints
Team: A. Aaloe, G. Baranov, U. Toom
Duration: 2004

Institute of Geology holds large geological and palaeontological collections for which an in-house database system has been developed during the last few years. The current project aimed at opening this information source to anyone interested in, or related with, Estonian geology and Palaeozoic fossils, facilitating curatorial work and assuring long-term preservation of the collections and the data thereof.

Long-span shelving system for collection-cabinets in the new rooms of the Institute of Geology, TUT

Contract with Environmental Investment Centre
Team: H. Pärnaste
Duration: 2005–2006

Long span shelving system allows to save one third of space for holding 300 cabinets of our large geological and palaeontological collections in the new rooms of the University campus.

State monitoring of coasts of Estonian big lakes.

Contract with Estonian Ministry of the Environment
Team: A. Raukas, E. Tavast
Duration: 2004–2005

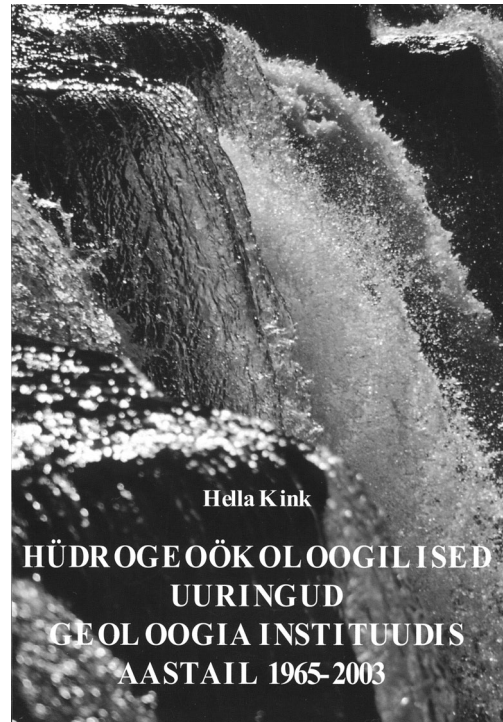
In 2004 and 2005 the state monitoring of coasts of big lakes (Peipsi and Võrtsjärv) was carried out in accordance with the contract with the Ministry of Environment. As during last years the water level was low, therefore the coasts did not suffer any noteworthy wave damage. At the same time in many areas on the coasts of both lakes unlawful human activities were recorded. In spring 2004 in Lake Peipsi and in spring 2005 in Lake Võrtsjärv the coasts were damaged by hummocky ice.

To approach these goals, the infrastructure, including computer hardware, was upgraded and the relational client-server database was improved and provided with a multi-lingual web-based user interface to query and display the data on fossil, mineral and rock specimens as well as on various geological localities and sites. The new set-up enables also storing digital image data that is essential for better visualisation and public interest. The database acts now also as a node of international BioBASE/GBIF networks and can be queried using the corresponding tools.

The data provided on the web-site at <http://sarv.gi.ee/>, including full resolution images, are freely available for non-commercial use (under Creative Commons license).

Hydrogeological monitoring of the Kunda and Ubja mining and industrial area

Contract with Kunda Nordic Cement No. L04-01
Project leader: H. Kink
Team: T. Tubli, T. Metslang
Duration: 2004–2005



Front cover of the book "Hydrogeological monitorings at the Institute of Geology during 1965–2003". Photo by G. Baranov.

Nomination documentation for inclusion of the Baltic Klint on the UNESCO World Heritage List

Contract with Estonian Ministry of the Environment
No. L270

Team: H. Kink, A. Miiel, U. Sinijärv, H. Kukkk, O. Hints,
G. Baranov, T. Tubli

Duration: 2004–2005

The Baltic Klint is a large and complex geological structure featuring one of the best Cambrian-Ordovician successions in the world. It represents the best preserved and accessible example of Cambrian-Ordovician epicontinental basin with developing paleogeography and climate and evolving biota. The time span of the klint covers the “Cambrian Explosion” and the major episode of the “Great Ordovician Biodiversification Event”. For several invertebrate groups the Baltic Klint is where the earliest discoveries were made or the oldest or most diverse faunas recovered.

Moreover, the Baltic Klint is one of the longest and still actively developing coastal escarpments in the world constituting a well developed structural boundary between the shield and an old platform. It also features one of the five submarine meteorite craters, obviously the best preserved old crater in the world. The Baltic Klint has a prominent study history and many scenery landscapes. Modern biotopes with rich flora and fauna add further value for the property. Individual sites of the Baltic Klint are easily accessible, and contain many examples of different geological and ecological processes which strongly support its educational as well as scientific value.

On these grounds Estonian National Commission for UNESCO and Estonian Ministry

Radiocarbon datings by contracts with various institutions in Estonia and abroad

Various contracts

Project leader: E. Kaup

Team: V. Raidla, H. Rajamäe

Duration: 2004–2005

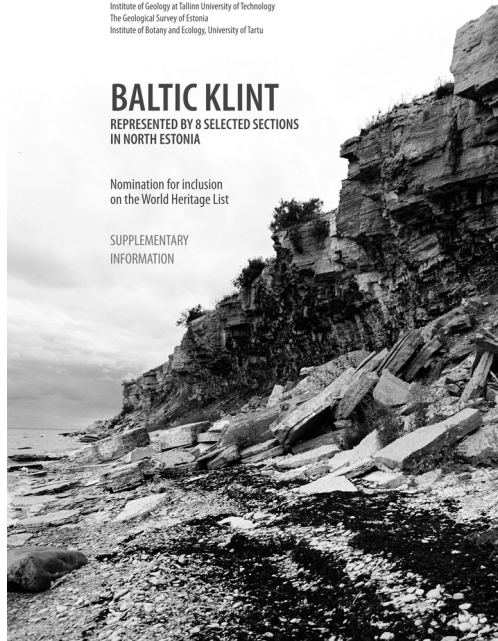
Altogether ca 100 datings, 22 datings to foreign companies.

Estonian Ministry of the Environment
Institute of Geology at Tallinn University of Technology
The Geological Survey of Estonia
Institute of Botany and Ecology, University of Tartu

BALTIC KLINT REPRESENTED BY 8 SELECTED SECTIONS IN NORTH ESTONIA

Nomination for inclusion
on the World Heritage List

SUPPLEMENTARY
INFORMATION



Front cover of the report for UNESCO. *Photo by G. Baranov.*

of the Environment decided to submit the Baltic Klint in North Estonia for inscription in the World Heritage List, where currently 160 natural and 24 mixed natural and cultural properties have been described.

Institute of Geology at TUT, together with the Geological Survey of Estonia and Ministry of the Environment, prepared nomination documentation in 2004 and early 2005, and hosted IUCN expert mission and composed additional documentation on the scientific value of the Baltic Klint in the late 2005. The final decision will be made by World Heritage Committee in July 2006.

Compilation of book Natural Heritage of Estonia 11. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lügánuse, Aseri, Viru-Nigula.

Contract with Environmental Investment Centre
Team: H. Kink, A. Miidel, A. Raukas
Duration: 2004–2005

This and the following booklets present inanimate nature monuments, including outcrops, erratic boulders and interesting landforms, but also provide information on mineral resources, water, greenery objects, historical and cultural monuments.

Compilation of book Natural Heritage of Estonia 12. Harjumaa, Raplamaa— around the Mahtra mire system. Kose, Kõue, Kohila, Kaiu, Juuru

Contract with Environmental Investment Centre
Team: H. Kink, A. Miidel, A. Raukas
Duration: 2004–2005

Compilation of book Natural Heritage of Estonia 13. Ida-Virumaa. Illuka, Mäetaguse, Iisaku, Alajõe

Contract with Environmental Investment Centre
Team: H. Kink, A. Miidel, A. Raukas
Duration: 2004–2005

Assessing reference conditions for lakes using paleolimnological methods

Contract with Estonian Ministry of the Environment
Team: A. Heinsalu, T. Alliksaar
Duration 2005

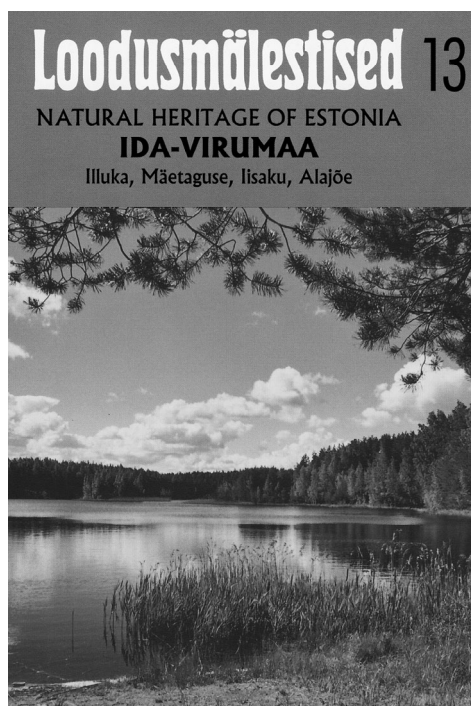
According to the EU Water Framework Directive (WFD) the ecological quality of lakes will be assessed by the degree to which the present day conditions deviate from those expected to be in the absence of significant anthropogenic impact, termed as reference conditions. In the frame of the current project paleolimnological methods were applied to study environmental changes in four small lakes during the last centuries in order to determine their onset of the man-made eutrophication

Compilation of book Natural Heritage of Estonia 14. Ida-Virumaa Sonda, Maidla, Tudulinna, Avinurme, Lohusuu

Contract with Environmental Investment Centre
Team: H. Kink, A. Miidel, A. Raukas
Duration: 2004–2005

Compilation of book Natural Heritage of Estonia 15. Lääne-Virumaa. Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu

Contract with Environmental Investment Centre
Team: H. Kink, A. Miidel, A. Raukas
Duration: 2004–2005



Front cover of the book: “Natural Heritage of Estonia. 13”. Photo by G. Baranov.

and to establish reference conditions in these water bodies. Three of the lakes studied (Pappjärvi, Harku and Verevi) are severely polluted or eutrophied due to human impact in the course of last 100 years, in the case of Lake Kooraste Kõverjärvi its suitability as a reference lake for hard-water stratified water bodies was tested.

The sediment cores of four lakes were analyzed in detail for their physical-chemi-

cal properties and diatom community, the age of the sediments was determined by different methods. Additionally in Lake Harku other algal communities and cladocerans were analyzed, and also the sediment phosphorus content was determined. In lakes Harku and Pappjärv the origin of sediment organic matter and its changes were found out by applying the analysis of the optical properties of sediment pore-water dissolved organic mat-



Atko Heinsalu measuring water quality and sampling sediments at Lake Kooraste Kõverjärv. *Photo by S. Veski.*

Geotourism advancement in Estonia and southern Finland: discovering past geologic history, Interreg III A programme

The Steering Committee:

O. Eklund (University of Turku),
A. Soesoo (Institute of Geology at TUT),
H. Bauert (NGO GEOGuide Baltoscandia)
R. Raudsep (Ministry of Environment).
project commenced in 2005

The project is coordinated by Estonian non-governmental organization GEOGuide Baltoscandia, the Institute of Geology is participating as a partner and financial supporter, financial support is also given by the Ministry of the Interior. The Finnish partner is the Department of Geology at Turku University and from the Finnish side the project is supported by local communities and a private foundation.

The project is targeted at establishing a common network among nature-oriented people (particularly for school teachers teaching

ter. Past changes in water chemistry variables (e.g. total phosphorus) were quantitatively reconstructed using lake sediment diatom-based transfer functions. Applying Bray-Curtis index the changes in diatom community were evaluated, the classification of the ecological status of the lake was developed and the present day conditions were compared with the reference conditions of the lake.



Atko Heinsalu giving an overview about the paleolimnological research and lake sediments for the ETV programme "Tasakaal [Balance]" on ice-covered Lake Vagu-la. *Photo by S. Veski.*

natural sciences and similar university staff, nature museum guides, environmentalists and tourism entrepreneurs) that enables a better understanding and proper information dissemination about our common geologic history as well as regional development peculiarities over the past 2000 million years and a thorough introduction of most pronounced nature monuments as tourist destination sites in both countries. For this purpose, 16 thematical travel guides will be compiled and published, 13 educational documentary videofilms on DVD will be released, a dedicated web-forum will be set up and instructional seminars arranged. The conclusive events for the project will be openings of two (one in Estonian and the other in Finnish language) comprehensive travelling poster and nature photo exhibitions with educational videos: "Geologic history and nature monuments of Estonia and Southern Finland". Both exhibitions will be shown in major larger towns of Southern Finland and Estonia during 2008 a year after completion of the project.

Training and education

Degrees defended

Early Ordovician trilobites of suborder Cheirurina in Estonia and NW Russia: systematics, evolution and distribution

Helje Pärnaste
Ph.D. project at University of Tartu
supervised by Prof. Tõnu Meidla
defended on 17 December 2004

The PhD project was focussed on taxonomy, ontogeny and phylogeny of the Lower Ordovician trilobites of suborder Cheirurina, with the implications to the trilobite distribution and zonation in Baltoscandia. As the studied trilobites included the earliest representatives of several phylogenetic lineages, one of the aims of this study was to contribute to the better understanding of systematics and phylogeny of different cheirurina families.

The first representatives of the family Cheiruridae were studied, clearing up the concept of genus *Krattaspis*, whose holotype appeared to have been affected by some distortions, consequently carrying several characters misleading earlier researchers. Some trends in ontogeny and phylogeny of *Krattaspis* were first described. Another cyrtometopine genus - *Reraspis* was revised and its first representative described. Phylogenetic relationship of both genera with the other cyrtometopine genera was discussed and the concept of subfamily Cyrtometopinae established by Öpik was restricted to include more homologous group.

The earliest representative of subfamily Encrinurinae (family Encrinuridae) was described and taxonomy of the other Ordovician encrinurids, and especially that of the *Encrinuroides sensu lato* was discussed. In addition, two new characters distinguishing Encrinurinae and Cybelinae from each other were introduced to support the monophyly



Helje Pärnaste together with her opponent Prof. Per Ahlberg from Lund University, Sweden after successful defending her PhD project. Photo by G. Baranov.

of these subfamilies. Study on pliomeric and pilekiid trilobites and their distribution in the Baltoscandian palaeobasin revealed several characters specific to the near-shore facies (in the northern East Baltic). Preliminary account on the trilobite zonation of the Billingen and Hunneberg stages in Estonia and northwestern Russia and correlation with trilobite, conodont and graptolite zonation in Sweden was also included to show more precise relative age of these very interesting taxa.

Silurian (Llandovery-Wenlock) tabulate corals of Baltoscandia: taxonomy, palaeoecology, distribution.

Mari-Ann Mõtus
Ph.D. project at University of Tartu
supervised by Prof. Tõnu Meidla
defended on 18 February 2005

Taxonomic revision of Baltoscandian tabulate corals was the main task of the thesis. The taxonomy of tabulate corals in Baltoscandia was largely based on the tyopological species concept. The intraspecific variability was not considered in tyopological species descriptions and therefore the diagnostic characters based on the intervals of metric parameters overlap between many species. The ecophenotypic response of paleofavositids and halysitids from Gotland was studied in aid to analyse their intraspecific variability. The upward growth of columnar and branching tabulates is characteristic of environments of moderate to high sedimentation rates, whereas tabular coralla are indicative of high-energy environments. Taxonomic changes resulted from biometric description of the diagnostic characters of tabulates and several species have been synonymised.

The changes in diversity and abundance of tabulate corals were possibly related to global events occurring at the Rhuddanian-Aeronian



Mari-Ann Mõtus holding a fossil-coral between her opponent Dr. Bernhard Hubmann from Graz Karl-Franzens-University, Austria (left) and her supervisor Prof. Tõnu Meidla (right) after defending the PhD Thesis. *Photo by G. Baranov.*

boundary and the Llandovery-Wenlock boundary. The appearance of peculiar biostromes in Gotland follows the middle Homeric event.

The biostratigraphy of tabulate corals is quite regional due to the strong facies control over the distribution of taxa. However, tabulates are valuable in regional biostratigraphy in cases if stratigraphically important taxa are poorly represented. This study demonstrates close affinities between the tabulate faunas from Estonia and Jämtland, suggesting the Aeronian age of the Berge Formation.

Modelling seawater chemistry of the East Baltic Basin in the Late Ordovician - Early Silurian

Enli Kiipli
Ph.D. project at Tallinn University of Technology
supervised by Prof. Alvar Soesoo and Dr. Tarmo Kiipli
defended on 19 December 2005

The models describing seawater chemistry base on lithology, mineralogy and chemical composition of the rock. Two aspects of seawater chemistry were considered, 1) the oxygenation of deep shelf waters, yielding the Eh-model, and 2) the carbonate system responsible for calcite - dolomite formation - dissolution, giving the pH-model.



Prof. Karl Loide, Prof. Dimitri Kaljo, Dr. Andrei Dronov (Geological Institute of the Russian Academy of Sciences, Moscow), Enli Kiipli, Prof. emeritus Enn Pirrus (starting from the left) after Enli's defending of the PhD Thesis. *Photo by G. Baranov.*

The Eh-model was worked out on the basis of the Raikküla Regional Stage, the Aeronian, and Adavere Regional Stage, the Telychian, the Llandovery Series of Early Silurian. The pH-model deals with times from the late Ordovician Pirgu Regional Stage, the Ashgill Series, to the Early Silurian Adavere Regional Stage.

The Aeronian and Telychian of the East Baltic basin differed from each other by the oxygen regime of deep shelf bottom waters, primary bioproductivity of surface waters, organic carbon preservation in deep shelf sediments, carbonate accumulation, and eustasy-related water depth. Wind-driven coastal up- and downwellings regulated the nutrient and oxygen supply in the East Baltic shelf and were responsible for most of the redox changes at the Aeronian/Telychian boundary.

Carbonate distribution varied between stages from the Late Ordovician to Early Si-

lurian. Ca-carbonate distribution was widest in the late Ashgill, its production was most prominent in the mid-Llandovery. In the Telychian, the late Llandovery, the carbonate production diminished. This can be explained by the rise in atmospheric CO₂ culminating in the late Llandovery.

Dissolution of the carbonates in the deep shelf was due to relatively low pH coming from high atmospheric CO₂. Primary bioproductivity modified the influence of atmospheric CO₂ on the seawater pH. The Aeronian great primary bioproductivity created favourable conditions for carbonate formation in the surface waters of the shallow shelf, but great organic carbon flux enhanced the dissolution of calcite in deep waters. Up- and downwelling increased and decreased, correspondingly, the concentration of carbonate and calcium ions in the shallow shelf, additionally regulating the carbonate saturation state.

Groundwater Sulphate Content Changes in Estonian Underground Oil Shale Mines

Katrin Erg

Ph.D. project at Tallinn University of Technology
supervised by Prof. Anto Raukas
defended on 10 June 2005

Shoshonitic magmatism in the southern part of the Fennoscandian Shield

Evelyn Kalam

M.Sc. project at Tallinn University of Technology
supervised by Prof. Alvar Soesoo
defended on June 2005

The shoshonitic affinity of the Abja, Virtsu and Muhu intrusions in Estonia were investigated using conventional geochemical whole rock and mineral analyses. About 400 microprobe- and 10 new whole rock chemical analyses were made. In order to give a more comprehensive overview of the geochemical material, whole rock major element analyses from the Geological Survey of Estonian were also used.

The results of this study show that the rocks from the three studied intrusions range from gabbro to granite and form a unique shoshonitic series with K₂O+Na₂O>5%, K₂O/Na₂O>0,5, Al₂O₃>9% over a wide spectrum of SiO₂ (45-74%). All the rocks are strongly enriched in LREE, Ba and Sr, depletion is noted for HFSE Ti, Nb, Hf, Zr and Ta. The enrichment pattern does not change during fractionation from mafic parental magma to HiBaSr granites. The magmas that form the shoshonitic series are generated in an enriched lithospheric mantle that had previously been affected by carbonate metasomatism, as shown by high Sr/Sm, La/Nb, Zr/Hf and Nb/Ta ratios.

Melt segregation and accumulation: analogue and numerical modelling approach

Kristjan Urtson
 M.Sc. project at University of Tartu
 supervised by Prof. Kalle Kirsimäe and Prof. Alvar Soesoo
 defended on 16 June 2005

Partial melting process and its dynamics were studied on the ground of the observed fractality in migmatite structures and possible self-organised critical nature of magma generation. In the two investigated migmatite outcrops and six drill cores the leucosome thicknesses follow the power law with exponents $D=0.83-1.41$. In the experiment with sand and carbon dioxide as analogues of the host rock and melt phase, the stepwise transport and accumulation of gas led to the power law distribution of gas batch sizes with an exponent $D=0.5$. The recalculation of leucosome width and gas batch area distributions to respective volume distributions suggests that melt accumulation into larger leucosomes is not favoured in migmatites, whereas the accumulation of the gas is effective in the analogue experiment. Better accumulation in the experiment is evidently the result of relatively higher mobility of gas compared to the melt in migmatites, as the mobility is the main factor,



Kristjan Urtson (in front, and Valle Raidla - back) in the field-station in Särghaua in summer 2005. *Photo by H.Pärnaste.*

which enhances the accumulation. Poor accumulation can reflect also poor melt extraction from the migmatite. Little melt is probably extracted from measured migmatites or alternatively, the observed structures result from the last stage melting processes with low melt mobility prior to freezing of migmatite.

Historical rural landscape development from 17th to 19th century in Estonia

Kalev Koppel
 M.Sc. project at University of Tartu
 supervised by Prof. Aadu Must and Dr. Siim Veski
 defended on 22 June 2005

Human impact and vegetation development around Keava hillfort(s) and Linnaaluste Viking age settlement

Holger Koot
 B.Sc. project at Tallinn University
 supervised by Dr. Siim Veski
 defended on 15 May 2004

The ecosystems of water bodies in the Bunger Hills, East Antarctica

Inga Rugal
 M.Sc. project at EuroUniversity, Tallinn
 supervised by Dr. Enn Kaup
 defended on 14 June 2005

Historical land use reconstruction in the research area around Lake Rõuge Tõugjärv

Edgar Sepp
 B.Sc. project at University of Tartu, Institute of Geography
 supervised by Prof. Jüri Roosaare and Dr. Anneli Poska
 defended on 2004

On the facies distribution of microfossils in the Lower-Silurian stages of Estonia

Mairy Killing

B.Sc. project at Tallinn University of Technology supervised by Prof. emeritus Enn Pirrus and Dr. Viiu Nestor defended on 7 June 2004

The purpose of this bachelor's thesis was to study the effect of facies influence on distribution of acid-resistant microfossils and frequency dynamics of different taxonomic groups in the Lower-Silurian sequence of Estonia.

Within the frame of the present project

On the grain size composition of the Upper Ordovician Blidene member in the Central East-Baltic

Jaanika Lääts

B.Sc. project at Tallinn University of Technology supervised by Prof. emeritus Enn Pirrus and Dr. Linda Hints defended on 7 June 2004

The aim of the present bachelor project was the study of grain size composition of the Upper Ordovician Blidene Formation in the stratotype area in West Latvia, and comparison with the data from lithologically similar sequences in South Estonia, including the Variku Formation.

The facies and temporal relationships of silty marls in West Latvia and South Estonia were analysed. Samples from two sections in West Latvia, Blidene No 5 and Aizpute-41, were studied for grain size composition using the pipete analysis. The data obtained were compared with the published data on the Blidene and Variku formations.

The results of analyses of samples and their comparison showed that the Blidene Formation is differentiated from other Upper Ordovician sequences by high content of terrigenous material (insoluble component) indicating increased influx of terrigenous material or reduction in carbonate sedimentation. The change of grain size composition in the west-

quantitative data on chitinozoans and other microfossils were obtained from the Lower-Silurian sequence of Estonia (Adavere, Jaani, Jaagarahu and Rootsiküla stages) using ordinary sampling and counting techniques. The data were analysed statistically and compared with the rock properties reflecting characteristics of palaeoenvironment.

In consequence of the study it was established that the frequency and diversity of chitinozoans vary considerably in different facies belts. The maximum abundance and diversity of chitinozoans were observed in the mudstones and marlstones of the transitional facies belt. Smaller abundances occurred in the nodular limestones of the outer shelf.

east direction with the increase of clay component indicates that the source area of the terrigenous material was located to the west of the East Baltic. The grain size composition of the Blidene Formation is very similar to that of the lower part of the Variku formation, which some authors consider as the unit overlaying the Blidene Formation. According to the data obtained within the present study the Blidene Formation can be contemporaneous with the lower part of the Variku Formation. The last statement is important from the standpoint of correlation of sections and is worth of attention when analysing faunal and other data.



Happy Mairy Killing and Jaanika Lääts after successfully defending their B.Sc. projects. *Photo by H. Pärnaste.*

Properties of Ordovician and Devonian rocks in Valga and Mehikoorma drill cores

Kazbulat Shogenov

B.Sc. project at Department of Mining, Tallinn University of Technology

Supervised by Prof. Mait Mets and Dr. Alla Shogenova
Defended on 7 December 2005

Composition and properties of 180 rock samples were studied and analyzed in two drill cores from southern Estonia. Bulk and grain density, porosity, dielectric constant and magnetic properties were studied together with chemical composition and interpreted using correlation and factor analysis. Differences in composition and properties in two boreholes were explained by facies and secondary changes. Primary sedimentation and subsequent dolomitization are the major factors which have influenced rock composition

and properties. Clay fraction content determined by primary sedimentation is a first factor for Ordovician rocks represented mainly by limestones, calcitic marlstones, dolostones and dolomitic marlstones. Dolomitization and carbonate cementation is a first factor for Devonian rocks represented by dolostones, dolomitic marlstones, mixed carbonate-siliciclastic rocks and siliciclastic rocks. Increase in clay fraction content caused increase in porosity, total iron content and magnetic susceptibility; increase in mineral dolomite content caused increase in total and grain density in both Ordovician and Devonian successions. Using bulk density and porosity it was possible to discriminate limestones and calcitic marlstones from dolostones and dolomitic marlstones in Ordovician and dolostones and dolomitic marlstones from siliciclastic rocks in Devonian.

Microfossils of the Burtneiki Stage of Middle Devonian and their stratigraphical significance

Moonika Niit

B.Sc. project at Tallinn University of Technology

supervised by Prof. emeritus Enn Pirrus, Dr. Tiiu Märss, and Dr. Anne Kleesment
defended on 7 June 2004

The aim of this bachelor's project was to study microfossils of the Burtneiki Stage and to explain their importance in stratigraphical subdivision and correlation. Total 21 samples from the outcrops of Karksi, Härma, Arstle, Essi, Suur- and Väike Ütsealutse were studied.

Results of the study: two new fossil taxa were found in the Karksi outcrop; microfossils were found and described from the Suur- and Väike Ütsealutse, where till now only a few bone plates had been found; the list of microfossils of the Burtneiki Stage was supplemented by three new taxa; the difference between Härma and Abava beds, which have very similar lithology and mineralogy was described on the grounds of microfossils; it was identified



Moonika Niit with her poster in the 6th Baltic Stratigraphical Conference, VSEGEI, St. Petersburg. *Photo by H.Pärnaste.*

that microfossils commonly accumulate in coarse-grained beds. The above results prove that microfossils have good potential to supplement the biostratigraphical subdivision of the Burtneiki Stage.

PhD and MSc projects in progress

- Evelyn Kalam** PhD project “Physical-chemical and geochronological aspects of 1.8-1.5 Ga magmatism in the southern Fennoscandian Shield and adjacent area”, Institute of Geology, Tallinn University of Technology, supervisor **Prof. Alvar Soesoo**;
- Reedik Kuldkepp** PhD project “Geochemistry, partial melting and geochronology of Svecofennian crystalline rocks”, Institute of Geology, Tallinn University of Technology, supervisor **Prof. Alvar Soesoo**;
- Helen Luup** PhD project “Paleoenvironmental reconstruction of Estonian large lakes”, Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Tartu, supervisors Prof. Peeter Nõges and **Dr. Atko Heinsalu**;
- Andres Marandi** PhD project “Formation of the chemical composition of the Cambrian-Vendian groundwater in Estonia”, Institute of Geology, University of Tartu, supervisor **Prof. Rein Vaikmäe**;
- Tõnu Martma** PhD project “Application of carbon and oxygen isotopes in the study of Baltic Ordovician and Silurian”, Institute of Geology, Tallinn University of Technology, supervisors **Prof. Dimitri Kaljo** and **Prof. Rein Vaikmäe**;
- Eve Niinemets** PhD project “Abrupt climatic changes in Holocene and Late-Pleistocene”, Institute of Geology, University of Tartu, supervisors Prof. Tõnu Meidla (University of Tartu), **Prof. Rein Vaikmäe** and **Dr. Siim Veski**;
- Kuldev Ploom** PhD project “Palaeoenvironmental changes dynamics in northern Estonia during the Järva pleniglacial”, Tallinn University of Technology, supervisor **Dr. Anatoli Molodkov**;
- Valle Raidla** PhD project “The formation of carbon content in Estonian Cambrian-Vendian groundwater”, Institute of Geology, University of Tartu, supervisors Prof. Kalle Kirsimäe and **Prof. Rein Vaikmäe**;
- Kristjan Urtson** PhD project “Analogue and numerical methods in studies of partial melting processes”, Institute of Geology, University of Tartu, supervisors Prof. Kalle Kirsimäe and **Prof. Alvar Soesoo**;
- Mairy Killing** MSc project “Frequency patterns of Lower Paleozoic chitinozoans: scientific and applied aspects”, Department of Mining, Tallinn University of Technology, supervisors **Dr. Olle Hints** and Prof. emeritus Enn Pirrus;
- Jaanika Lääts** MSc project “Chemical and grain-size composition of Upper Ordovician Blidene Formation”, Department of Mining, Tallinn University of Technology, supervisors **Dr. Linda Hints** and Prof. emeritus Enn Pirrus;
- Moonika Niit** MSc project “Utilization of vertebrate microfossils in the stratigraphy of Burtneki and Aruküla stages, Devonian of Estonia”, Tallinn University of Technology, supervisors **Dr. T. Märss** and Prof. emeritus Enn Pirrus;

Courses and lectures given

- Can modelling contribute to EBGA (Archean) studies?**, Natural Museum, University of Helsinki, lecture by *A. Soesoo*;
- Earth sciences and geological processes**, Võru County Education Board, lectures by *A. Soesoo*;
- Earth sciences and natural disasters**, Pelgulinna High School, lecture by *A. Soesoo*;
- Earth's processes**, Kristiine Lions Club, lecture by *A. Soesoo*;
- Ecology of wetlands**, Eurouniversity, course by *E. Kaup*;
- Environmental technique**, Estonian Maritime Academy, course by *A. Raukas*;
- Estonian landforms and Quaternary cover**, Tallinn University, course by *A. Raukas*;
- Evolution of Earth biosphere and global climate and environmental changes**, University of Tartu, course by *R. Vaikmäe*;
- Geological evolution and volcanism in the area of Ross Sea, Antarctica**, Project Meeting - Antarctica, lecture by *A. Soesoo*;
- Geological excursions in North Estonia (4)**, NGO Loodusajakiri, guided by *J. Nõlvak*;
- Geological processes and physical-chemical methods**, Tallinn University of Technology, course by *A. Soesoo*;
- Geology and geophysics**, Estonian Maritime Academy, course by *A. Raukas*;
- Geophysical methods in impact studies**, University of Tartu, course by *S. Veski*;
- Geophysics and marine geology**, Estonian Maritime Academy, course by *A. Raukas*;
- Geotourism in Estonia and Finland: discovering past and present environments**, University of Turku, lecture by *A. Soesoo*;
- Hydrology and hydrogeology**, Eurouniversity, course by *E. Kaup*;
- Introduction to physical geology**, Tallinn University of Technology, course by *A. Soesoo*;
- Isotope geology and hydrology**, University of Tartu, course by *R. Vaikmäe*;
- Managing of education and research**, Tallinn University of Technology, course by *R. Vaikmäe*;
- Melt segregation, accumulation and transport: some physical and chemical constraints**, University of Toulouse, lecture by *A. Soesoo*;
- Mineral resources of Estonia and their protection**, Eurouniversity, course by *A. Raukas*;
- Modelling of melt segregation, accumulation and transport**, University of Helsinki, lecture by *A. Soesoo*;
- Monitoring of surface waters**, Eurouniversity, course by *E. Kaup*;
- Nature and environmental protection in the Antarctic**, Gymnasium of Kiili, lectures by *E. Kaup*;
- Nature and environmental protection in the Antarctic**, Tallinn Secondary School of Science, lecture by *E. Kaup*;
- Numerical and analogue modelling and observations of partial melting processes**, University of Turku, lecture by *A. Soesoo*;
- Overview on the Palaeozoic rocks and fossils in Estonia with demonstration of rocks and fossils**, Journal Horisont, excursion to the Institute of Geology at TUT, by *L. Hints and E. Mark-Kurik*;
- Palaeoclimatology**, Estonian Maritime Academy, course by *A. Raukas*;
- Physical geology**, Tallinn University of Technology, courses by *J. Nemliher*;
- Postglacial interaction of man and nature in Estonia**, Estonian Youth Work Centre, lecture by *S. Veski*;
- Seminar on physical geology**, Tallinn University of Technology, course by *A. Soesoo*.

Staff training

6th Framework co-operative research (CRAFT) projects at Enterprise Estonia: *L. Bityukova*;

Composing financial project in science- and development area, at Open University TUT, SPINNO *L. Bityukova, H. Pärnaste, L. Hints*;

English at TUT, IT Further Education Centre: *M-A. Mõtus, J. Nemliher, M. Killing, J.Lääts, U. Toom*;

How to apply for the support from the Enterprise Estonia at Enterprise Estonia: *S.Peetermann*;

How to use CorelDRAW at TUT, IT Further Education Centre: *L. Hints*;

How to use PowerPoint at TUT, IT Further Education Centre: *L. Saarse, L. Hints, E.Kiipli, S. Peetermann*;

Linux network server administration at Baltic Computer Systems: *O. Hints*;

Linux system administration at Baltic Com-

puter System: *O. Hints*;

MS Excel for beginners at TUT, IT Further Education Centre: *L. Hints, L. Saarse, M.Killing, J. Lääts, S. Peetermann*;

Practical Intellectual Property Issues in Estonia (Business Strategy for SMEs) at World Intellectual Property Organisation, Estonian and Estonian Patent Office: *S.Peetermann*;

Project management and MS Project at Open University TUT, SPINNO: *L. Bityukova*;

Projects supported by the European Union, at Business Estonia, Focus IT: *S. Peetermann*;

Some aspects of the Copyright Law in universities, at TUT (lecturer Prof. H. Pisuke, Institute of Law, University of Tartu): *S.Peetermann*;

The experience of the University of Turku at carrying out Interreg projects, at Tartu Folk High School: *S. Peetermann*.

GEOseminars

In late 2005, a new type of seminar - GEO-Seminars - was introduced at the institute. The main aim of this activity is to present the hot topics of Earth sciences and main advancement to wider audience, including scientists working in different fields related to Earth sciences, teachers, government officials, students and others. A number of lectures were organised during 2005

ISOMAP-UK. A combined data - modelling investigation of water isotopes and their interpretation during rapid climate-change events, Prof. Jim Marshall,

Department of Earth and Ocean Sciences, University of Liverpool, 11 May 2005;

Thelodonts — the 90 million years existed Palaeozoic agnathan vertebrates, Dr. Tiiu Märss (who was awarded the State Prize in geo- and biosciences for 2004), Institute of Geology, TUT, 18 May 2005;

What is wrong with plate tectonics?, Prof. Donald Tarling, Plymouth University, UK, 21 September 2005;

News in research on metabentonites here and elsewhere. Erika Jürgenson — 80, Dr. Tarmo Kiipli, Prof. Dmitri Kaljo, Institute of Geology, TUT, 14 December 2005.

Conferences, workshops and exhibitions

Conferences, workshops and exhibitions organised

2004

8th Marine Geological Conference “The Baltic”, September 23 – 28, Institute of Geology, University of Tartu, Tartu, Estonia; organiser from IG TUT: *A. Shogenova*;

8th Meeting of the Working Group on Ordovician Geology of Baltoscandia (WOGOGO-2004), May 13 – 18, Institute of Geology at Tallinn University of Technology and Institute of Geology, University of Tartu; organisers from IG TUT: *R. Einasto, L. Hints, O. Hints, P. Männik, J. Nõlvak*;

Environmental Day at the Paldiski Russian Gymnasium, May 21, Paldiski, Estonia; organiser from IG TUT: *H. Kink*;

Exhibition “Ancient Fishes”, January 2 – May 2, Latvian Museum of Natural History, Riga, Latvia; organiser from IG TUT: *E. Mark-Kurik*;



Field-excursion of the WOGOGO Meeting. Stop in the Kunda quarry. Photo by *L. Hints*

Exhibition “Estonian Oil Shale. Science and Industry Through Ages”, January 20 – March 1, Academic Library of Tallinn University, Tallinn, Estonia; organisers from IG TUT: *A. Aaloe, L. Hints, U.Toom*;

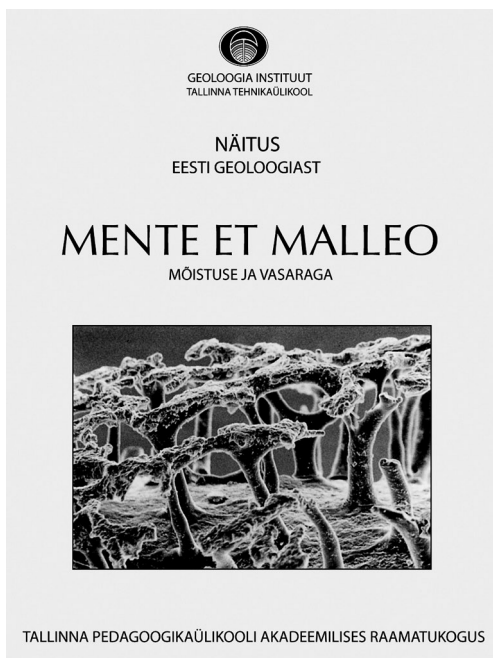
Exhibition “Mente et Malleo.”, May 13 – August 15, Academic Library of Tallinn Pedagogical University, Tallinn, Estonia; organisers: *A. Aaloe, A. Heinsalu, L. Hints, O. Hints, E. Kaup, E. Kelam, A. Kleesment, E. Mark-Kurik, T. Märss, K. Mens, M.-A. Mõtus, H. Nestor, J. Nõlvak, H. Pärnaste, S. Peetermann, A. Soesoo, R. Tiirmaa, U. Toom, S. Veski*;

Exhibition of geological photos, May 13 – August 3, Café “Strix” of the House of Scientist, Tallinn, Estonia; organisers: *J.Nõlvak, H. Pärnaste, G. Baranov*;

New exhibition at the Lahemaa National Park, September 29, 2004 – May 31, 2005, Estonian Institute, Tallinn, Estonia; organiser from IG TUT: *S. Veski*;

Photo exhibition “A City with Trees / The Handicapped City”, November 18 – December 13, Photomuseum, Cellar “Lee”, Tallinn, Estonia; organiser: *H. Pärnaste*;

Photo exhibition “What is on and what is in the rock”, January 6 – March 5, Café “Strix” of the House of Scientist, Tallinn, Estonia; organiser: *J. Nõlvak*.



Poster of the exhibition “Mente et Malleo” made by *G. Baranov*.

2005

Estonica (www.estonica.org) web-encyclopedia, October 6 – May 31, Estonian Institute, Estonia; organiser from IG TUT: *S. Veski*;

Exhibition “Mente et Malleo”, February 15 – March 14, Hall of Tallinn University of Technology, Estonia; organisers: *L. Hints, H. Pärnaste, U. Toom, A. Aaloe*;

Maritime day, July 9, Käsnu Maritime Museum, Estonia; organiser: *E. Mark-Kurik*;

Nature festival, August 2, Environmental Survey, Tõrva, Estonia; organiser from IG TUT: *E. Mark-Kurik*;

Polar Research Workshop, October 25–26, Estonian Polar Foundation, Institute of Geology at TUT, Särgghaua Field Station, Pärnu County, Estonia; organisers: *J. Ivask, E. Kaup*;

POLLANDCAL field seminar, August 13–17, Otepää, Estonia; organiser from IG TUT: *A. Poska*.



Elga Mark-Kurik and her masterpieces the fish-models in the exhibition at the Käsnu Maritime Museum. *Photo by A. Vaik.*

Participation in international conferences and workshops

2004

10th International Symposium on Early Vertebrates, May 24 – June 2, Federal University of Rio Grande do Sul, Gramado, Brazil; participant: *T. Märss*;

32nd International Geological Congress, August 20–28, IUGS, Florence, Italy; participants: *D. Kaljo, A. Shogenova*;

66th EAGE Conference & Exhibition, June 7–10, European Association of Geoscientists & Engineers, Paris, France; participant: *A. Shogenova*;

8th International Conference “Methods of Absolute Chronology”, May 17–19, Ustroń, Poland; participant: *A. Molodkov*;

8th Meeting of the Working Group on Ordovician Geology of Baltoscandia (WOGOGOB-2004), May 13–18, Institute of Geology at Tallinn University of Technology; Institute of Geology, University of Tartu, Tallinn, Tartu, ESTONIA; participants: *A. Heinsalu, L. Hints, O. Hints, D. Kaljo, E. Kiipli, T. Kiipli,*

T. Martma, P. Männik, J. Nõlvak, H. Pärnaste, A. Shogenova, S. Veski;

Academia Europaea 16th Annual Conference, September 2–4, Helsinki, Finland; participant: *R. Vaikmäe*;

Bioremediation of soils contaminated with aromatic compounds: effects of Rhizosphere, bioavailability, gene regulation and stress adaption, July 1–3, NATO and the Centre of Excellence for Gene and Environmental Technologies, University of Tartu, Estonia; participant: *L. Bityukova*;

Earth’s Fields (and Psychophysics of Environment) and their Influence on Organisms, June 3–6, Institute of Geology of Lithuania, Tomosava, Lithuania; participant: *A. Raukas*;

ENeRG meeting, June 24–26, European Network for Research in Geo-Energy, Prague, Czech Republic; participant: *A. Shogenova*;

EU Global Change Research: international partnership, May 5–6, European Commission, Brussels, Belgium; participant: *R. Vaikmäe*;

European Society for Isotope Research, VII Workshop, June 27 – July 1, Graz, Austria; participant: *T. Martma*;

Euroscience Open Forum, August 25–29, Euroscience, Stockholm, Sweden; participant: *R. Vaikmäe*;

Experience of biosphere reserves in Estonia and Europe, January 21–22, Board of European Reserves, Käina, Estonia; participant: *A. Raukas*;

First International Symposium of IGCP 503 on Early Palaeozoic Palaeogeography and Palaeoclimate, September 1–12, University of Erlangen, Germany; participants: *O. Hints, D. Kaljo, T. Kiipli, T. Martma, J. Nõlvak*;

Groundwater aspects of the Cambrian-Vendian reservoir rocks in the Baltic states, December 9–11, Institute of Geography and Geology, University of Greifswald, Greifswald, Germany; participant: *A. Shogenova*;

ICSU Workshop on Comet/Asteroid Impacts and Human Society, November 27 – December 2, International Council of Sciences, Santa Cruz de Tenerife, Spain; participant: *S. Veski*;



Layers of multi-colored volcanic ash from the eruptions of Pico del Teide volcano on Tenerife, Spain. Photo by *S. Veski*.

Institute of Seismology, University of Helsinki Field-excursion to Saaremaa, May 29, Institute of Seismology, University of Helsinki, Saaremaa, Estonia; participant: *Ü. Kestlane*;

INTAS-NEMLOR Workshop, October 31 – November 3, VSEGEI, St. Petersburg, Russia, participant: *P. Männik*;

Interdisciplinary methods in research of past events, December 15, Institute of History, University of Tartu, Tartu, Estonia; participants: *A. Heinsalu, S. Veski*;

International Field Symposium on Quaternary Geology and Modern Terrestrial Processes, September 12–17, University of Latvia, Rojupe and Riga, Latvia; participants: *A. Raukas, S. Veski*;

International NATO Advanced Research Workshop “Bioremediation of soils contaminated with aromatic compounds: effects of Rhizosphere, bioavailability, gene regulation and stress adaptation”, July 1-3, Tartu, Estonia; participant: *L. Bityukova*.

International Symposium on Arctic Glaciology, August 23–27, International Glaciological Society, Geilo, Norway; participant: *T. Martma*;

International Symposium on Earth System Sciences, September 8–10, Istanbul University, Istanbul, Turkey; participant: *L. Saarse*;

Isotopes in Hydrological Cycle and Environment, September 6–10, UNESCO, Paris, France; participant: *R. Vaikmäe*;

Kotkajärve Forest University, July 9, Forest University, Canada, Heimtali, Estonia; participant: *A. Raukas*;

Meeting of the Directors of Nordic and Baltic Geological Surveys, May 12–14, Geological Survey of Estonia, Pärnu, Estonia; participant: *S. Peetermann*;

Near Surface 2004, 10th European Meeting of Environmental and Engineering Geophysics, September 6–9, European Association of Geoscientists & Engineers, Utrecht, The Netherlands; participant: *E. Tavast*;

Paleo, Rock and Environmental Magnetism, 9th Castle Meeting, June 27 – July 3, Geophysical Institute, Slovak Academy of Sciences, Tatranska Javorina, Slovak Republic; participant: *A. Shogenova*;

POLLANDCAL, May 21–25, NorFA and Aarhus University, Aarhus, Denmark; par-

participants: *A. Poska, S. Veski*;

Risks caused by the geodynamic phenomena in Europe, May 20–22, Gogeoenvironment, Wysowa, Poland; participant: *A. Raukas*;

SCAR Open Science Conference, July 25–31, SCAR, Bremen, Germany; participants: *J. Ivask, E. Kaup*;

Societas Internationalis Limnologiae (SIL) XXIX Congress, August 8–14, University of Helsinki, Lahti, Finland; participants: *T. Alliksaar, E. Kaup*;

The Baltic: The Eighth Marine Geological Conference, September 23–28, Institute of Geology, University of Tartu, Tartu, Estonia; participants: *D. Kaljo, M. Konsa, A. Shogenova*;

The EEA Financial Mechanisms: New opportunities for cooperation between Norway and Estonia, November 17, Royal Norwegian Embassy, Tallinn, Tallinn, Estonia; participant: *L. Bityukova*;

2005

10th Baltic Conference on Intellectual Cooperation, June 8–10, Finnish Academy of Science and Letters, Helsinki, Finland; participant: *R. Vaikmäe*;

11th International Conference on Luminescence and Electron Spin Resonance Dating, July 24–29, University of Cologne, Köln, Germany; participant: *A. Molodkov*;

22nd International Polar Meeting, September 18–24, German Society of Polar Research, Jena, Federal Republic of Germany; participant: *E. Kaup*;

5th International Brachiopod Congress, July 4–7, Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark; participants: *L. Hints, J. Nemliher*;

5th International Dyke Conference, July 30 – August 3, Geological Survey of Finland, Rovaniemi, Finland; participant: *A. Soesoo*;

6⁷th EAGE Conference and Technical Exhibition, June 13–16, European Association of Geoscientists & Engineers, Madrid, Spain; participant: *A. Shogenova*;

The XI International Palynological Conference, July 4–9, , Granada, Spain; participant: *S. Veski*;

Towards the integrated Baltic Sea drilling programme (IODP-Baltic initiative), February 28 – March 1, Institute of Geology, University of Tartu, Tartu, Estonia; participant: *M. Konsa*;

World Summit on Leadership and Governance, January 25–29, International and Interregional Federation for World Peace, Soul, Korea; participant: *A. Raukas*;

XXIX Antarctic Treaty Consultative Meeting, May 24 – June 4, Department of Environmental Affairs and Tourism of the Republic of South Africa, Cape Town, Republic of South Africa; participant: *E. Kaup*.



Tour to the laboratory of VSEGEI during the 6th Baltic Stratigraphical Conference. Photo by *H. Pärnaste*.

6th Baltic Stratigraphical Conference, August 23–25, VSEGEI, St. Petersburg, Russia; participants: *L. Hints, O. Hints, D. Kaljo, M. Killing, J. Lääts, A. Molodkov, M. Niit, H. Pärnaste, A. Raukas, L. Saarse, V. Viira*;

9th European Seminar on the Geography of Water “Integrated Water Management of Small River Basins”, August 10–28, Tallinn–Tartu ; participant: *A. Raukas*;

Academia Europaea 17th Annual Meeting, September 22–24, Academia Europaea, Potsdam, Germany; participant: *R. Vaikmäe*;



Closing of the 6th Baltic Stratigraphical Conference. *Photo by O. Hints.*

Dynamic Silurian Earth, August 15–22, Lund University, BioGeoCenter, Gotland, Visby, Sweden; participants: *D. Kaljo, E. Kiipli, T. Kiipli, T. Martma*;

Ecological Response to Climate Change: Scales of Change, Scales of Observation, November 3–4, Helsinki University, Helsinki, Finland; participant: *S. Veski*;

ECORD-IODP Workshop, December 12–13, Swedish Research Council, Stockholm, Sweden; participant: *S. Veski*;

European Polar Consortium Science Advisory Board meeting, September 19–20, European Science Foundation, Brussels, Belgium; participant: *R. Vaikmäe*;

European Polar Consortium Strategic Management Board meeting, May 2–3, European Science Foundation, Brussels, Belgium; participant: *R. Vaikmäe*;

European Society of Isotope Research (ESIR) 8th Conference, June 26–30, Environmental Research Centre Leipzig-Halle, Leipzig, Germany; participants: *T. Martma, R. Vaikmäe*;

First joint HITE-POLLANDCAL Conference: Human impact on terrestrial

ecosystems on long to short term scales with an emphasis on pollen calibration and quantitative reconstruction of past land-cover changes, November 11–14, University of Umeå, Sweden; participants: *A. Poska, S. Veski*;

Funding Systems for Research in the EU, December 2, Foundation for Science and Liberal Arts Domus Dorpatensis, Tartu, Estonia; participant: *L. Bityukova, S. Peetermann*;

GEO ENeRG meeting, January 20–21, TNO-NITG, Utrecht, Holland; participant: *A. Shogenova*;

INQUA PMP V, May 12–17, University of Varna, Bulgaria; participant: *A. Poska*;

International Arctic Science Summit Week and European Polar Board meeting, April 16–20, International Arctic Science Council, Kunming, China; participant: *R. Vaikmäe*;

International Conference “Living for the Sake of Others”, March 23–28, IIF-WP, Praha, Czechoslovakia; participant: *A. Raukas*;

International Conference of Encyclopaedia-publishing Institutions, March 2–6, Zagreb, Croatia; participant: *A. Raukas*;

International Field Symposium on Quaternary Geology and Landforming Processes, September 4–9, Geological Institute of Kola Science Centre RAS, Apatity, Russia; participant: *A. Molodkov, L. Saarse*;

International seminar of the project about the nature of the Gulf of Finland, March 3–5, Environmental Center of Helsinki, Finland; participant: *J. Nõlvak*;

International seminar of the project on the nature of the Gulf of Finland, May 2–4, Environmental Center of Helsinki, Finland; participant: *J. Nõlvak*;

IV All-Russian Conference on Quaternary Research, August 23–26, Syktyvkar, Komi Republic, Russia; participant: *A. Molodkov*;

IX International Antarctic Biology Symposium, July 25–29, Scientific Committee on Antarctic Research, Curitiba, Brazil; participant: *E. Kaup*;

Managing Heritage Collections II: Continuity and Change, May 5–6, National Library, Estonian Ministry of Culture, Tallinn, Estonia; participants: *O. Hints, H. Pärnaste, U. Toom*;



Olle Hints, Helje Pärnaste and Ursula Toom presenting a poster at the meeting: Managing Heritage Collections II: Continuity and Change. *Photo by G. Baranov.*

Meeting of the COST experts on environmental technologies, January 26–28, European Science Foundation and British

Geological Survey, Wallingford, UK; participant: *R. Vaikmäe*;

Middle Palaeozoic vertebrates of Laurussia: relationships with Siberia, Kazakhstan, Asia and Gondwana, August 22–25, St. Petersburg; participant: *M. Niit*;

Nordic Diatomists' Meeting, May 20–23, Centre for Limnology, Institute of Agricultural and Environmental Sciences, Estonian Agricultural University, Muhu Island, Estonia; participant: *A. Heinsalu*;

Palaeontological Institute, Russian Academy of Sciences, 75th anniversary conference, October 31 – November 3, Palaeontological Institute, Russian Academy of Sciences, Moscow, Russia; participant: *D. Kaljo*;

POLLANDCAL, May 20–24, University of Besançon, France; participants: *A. Poska, S. Veski*;

Seminar of the project about the nature of Finnish Gulf, September 26–28, Environmental Center of Helsinki, Finland; participant: *J. Nõlvak*;

Shallow Lakes 2005, June 5–9, NecoV (Netherlands-Flemish Ecological Society), Dalfsen, The Netherlands; participant: *T. Alliksaar*;

The Second International Symposium of IGCP 503 on Ordovician Palaeogeography and Palaeoclimate, June 11–18, Milwaukee Public Museum, Milwaukee, USA; participants: *O. Hints, J. Nõlvak*;

VI International Conference on Geomorphology, September 6–13, Zaragoza, Spain; participant: *A. Raukas*;

Workshop “Scientific work in the museum”, April 14–15, Natural History Museum of Latvia, Riga, Latvia; participant: *E. Mark-Kurik*;

Workshop “Isotope methods in environmental studies”, May 1 – June 1, Gliwice Absolute Dating Methods Centre (GAD-AM Centre), Uston, Poland; participant: *V. Raidla*;

XI All-Russian Palynological Conference, September 27 – October 1, Moscow, Russia; participant: *A. Molodkov*.

International travels and visits



T. Martma in the fieldwork in Svalbard, Spitsbergen. View to the Bøgerbreen glacier. *Photo by T. Martma.*

2004

Bitjukova, L., May 15–19, Institute of Geology, University of Latvia, Riga; discussion on the results of the mechanical properties of the Ordovician carbonate rocks and study of publication;

Bitjukova, L., August 6–9, Vienna University of Technology, Institute of Engineering Geology, Vienna, Austria, studying the methods of research and conservation of building stones and lithological mapping of the historical buildings in Vienna;

Bitjukova, L., August 10–16, Department of the Earth Science, University of Florence, Italy; studying the methods of research of historical buildings; presentation and discussion of the results of ESF project; and meeting with the co-ordinator of EU NORISC environmental project and discussion of collaborative projects results;

Bitjukova, L., August 17–19, SVUOM Institute, Prague, Czech Republic, visit to SVUOM Institute and meeting with the co-ordinator of the EU project in Czech Republic; presentation and discussion of ESF and EU Multi-assess projects' results;

Bitjukova, L., November 30– December 1, Riga Technical University, Institute of Silicate Materials, Riga, Latvia, meeting with Latvian coordinator and participants of EU Multi-assess project; discussion of ESF and Multi-assess projects' results, and study on technique of composition and properties measurements of building stone;

Hints, L., August 23 – September 1, Latvian Museum of Natural History, Riga, Latvia, study on Ordovician brachiopods from the drillcore sections in Latvia;

Kaup, E., February 6, University of Helsinki, Finland, consultations in ¹⁴C Dating Laboratory;

Kiipli, T and Kiipli, E., July–August, 1 week fieldwork in Denmark, Bornholm, study and sampling of bentonites from Silurian and Ordovician sections in cooperation with A. T. Nielsen;

Mark-Kurik, E., April 22–29, Humboldt Universität, Museum of Natural History, Berlin, Germany, study of placoderm and heterostracan collections, particularly representatives of the genera *Heterostius*, *Holonema* and *Lunaspis (Wijdeaspis)* from the Devonian of Rhineland, also collections of W. Gross from the Baltic area;

Martma, T., April 11 – May 4, Norwegian Polar Institute, Svalbard, Norway, fieldwork;

Martma, T., March 4–7, University of Helsinki, Helsinki, Finland, visit to the Dating Laboratory and Geophysical Department of the University of Helsinki;

Mõtus, M.-A., June 2–21, Geological Museum of Natural History, Kiev, Dniestr River Basin, Ukraine, work on the tabulate coral collections of Dr. Gritsenko and in the fieldwork;

Männik, P., July 5 – September 9, Institute of Geology, Komi Science Centre, Uralian

Division of RAS, Komi Republic, Russian Federation, fieldwork in the Subpolar Urals;

Männik, P., September 27 – October 1, Uppsala University, Sweden, discussion on cooperative studies;

Männik, P., November 21–27, Uppsala University, Sweden, discussion of the geological evolution of the Severnaya Zemlya region;

Nölvak, J., August 17–21, Gullhögen quarry in Sweden, Geological Museum in Copenhagen, Västergötland; Copenhagen, Sweden, Denmark, fieldwork and research of collections in the museum;

Nölvak, J., June 23–25, Helsinki City Environment Centre, Finland, participated in the meeting of the Finnish–Estonian project “Meri minussa” (The Sea in Mind);

Raukas, A., July 27 – August 10, Nancy University, Nancy, France, visit in connection with joint (with Prof. F. Marini) meteorite studies in the frame of Parrot project;

Raukas, A., September 30 – October 3, University of Latvia, Riga, Latvia, participation in the 85th anniversary celebration of the University of Latvia and discussion on collaborative research;

Raukas, A., June 16–20, TUL, Oulu, Finland, participation in the 85th anniversary celebration of TUL;

Soesoo, A., March 23, Institute of Seismology, University of Helsinki, Finland, research;

Soesoo, A., April 16–18, University of Helsinki, Geological Museum, Finland, NORFA network project meeting;

Soesoo, A., April 25–30, University of Turku, Åland islands, Finland, geological excursion and fieldwork;

Soesoo, A., August 23 – September 5, Greenland, Denmark-Greenland, geological excursion and fieldwork;

Soesoo, A., October 17–21, Charles University, Prague, Czech Republic, scientific meeting and use of geochemical laboratory;

Soesoo, A., November 23–28, University of Turku, Finland, meeting on joint research project;

Teedumäe, A., April 22 – May 2, Institute of Geology University of Latvia, Institute of Geology and Geography Vilnius, Riga, Vilnius, Latvia, Lithuania, collecting of samples;

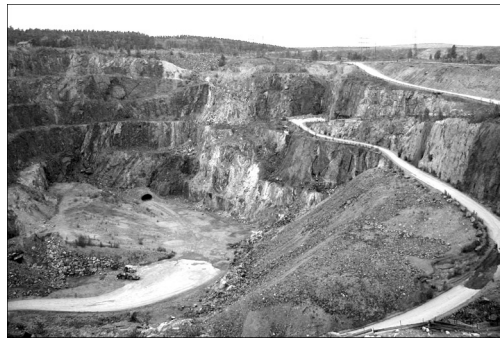
Vaher, R., April 22 – May 2, Institute of Geology, Riga, Latvia, fieldwork and collecting samples of sedimentary rocks.



Geological excursion and fieldwork in Greenland. *Photo by A. Soesoo.*

2005

- Heinsalu, A.**, October 26–28, University of Helsinki, Finland, defence of Academic Dissertation, co-operation;
- Kaljo, D.**, March 18–21, International Union of Geological Sciences, Lithuanian Academy of Sciences, Vilnius, Lithuania, participation as an observer in the Executive committee meeting ;
- Kaljo, D.**, October 27, Latvian University, Riga, Latvia, organizing committee meeting of a conference on history of geology;
- Karukäpp, R.**, May 25–30, Geological Survey of Lithuanian, Vilnius, Lithuania, common works in the field of glacial topography;
- Mark-Kurik, E.**, June 11–19, Geology Department, Faculty of Biological Sciences of the University of Valencia, Valencia (Burjasot), Spain, co-ordinating of the joint work with Dr. Hector Botella on morphology and biomechanics of pteraspids (Hererostraci);
- Martma, T.**, February 1–2, University of Helsinki, Dating Laboratory, Finland, preparation papers for publication;
- Martma, T.**, April 9–29, Svalbard, Norway, fieldwork, collecting samples for isotope analyses;
- Martma, T.**, August 26 – September 5, Norwegian Polar Institute, Tromsø, Norway, collecting samples from Holtedahlfonna ice core;
- Mõtus, M.-A.**, August 5–22, Geological Museum of National Natural History Museum, Kiev, Dniestr River Basin, Ukraine; sampling tabulate corals and isotope samples in cooperation with museum;
- Männik, P.**, March 17–25, Institute of Geology, Komi Science Centre, Uralian Division of RAS, Komi Republic, Russian Federation, preparation of papers;
- Männik, P.**, June 27 – August 30, Institute of Geology, Komi Science Centre, Uralian Division of RAS, Komi Republic, Russian Federation, participated in field work in the Subpolar Urals;
- Männik, P.**, May 23–31, Arkhangelskgeoldobycha, Arkhangelsk, Russian Federation, study of collections;
- Männik, P.**, November 20–24, Uppsala University, Sweden, preparation of a project;
- Raukas, A.**, September 28 – October 5, Poznan University, Poland;
- Shogenova, A.**, April 17 – May 1, Paleomagnetic and Rock Magnetic laboratory, Institute of Geophysics, ETH, Zurich, Switzerland; measuring of Devonian rocks magnetic properties;
- Shogenova, A.**, February 23–24, BRGM, Paris, France, as a member of CO2 Geonet-work of Excellence Scientific Advisory Board;
- Shogenova, A.**, October 3, OGS, Rome, Italy, CO2 Geonetwork of Excellence Scientific Advisory Board;
- Soesoo, A.**, February 16–17, Turku University, Finland, Interreg III A project planning;
- Soesoo, A.**, April 14–16, University of Helsinki, Finland, EBGA (Archaic) project planning meeting;
- Soesoo, A.**, May 23 – June 1, Turku and Stockholm Universities, Bergslagen, Sweden, geological excursion for ore geology;



Open pit mining in Bergslagen area, Sweden – the foundation of Swedish wealth. *Photo by A. Soesoo.*

- Soesoo, A.**, August 18, University of Turku, Finland, Interreg III A project commencement;
- Soesoo, A.**, September 11–17, Eastern Finland, Eurogranites 2005 meeting and excursion;
- Vaikmäe, R.**, June 8, Dating Laboratory, University of Helsinki, Finland, to learn about experiences of running the new mass-spectrometry;
- Veski, S.**, March 28–30, Latgale, Latvia, field-work on Latvian lakes.

Individual grants and scholarships

2004

Academy of Sciences of Russia grant for research visit for *P. Männik* to the Institute of Geology of the Komi Science Center (Academy of Sciences of Russia, Ural Division);

Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brazil, processo 451789/03-2 travel support for *T. Märss* to participation in the 10th International Symposium on Early Vertebrates in Gramado, Brazil, and the following geological excursion;



Leaders of IGCP projects nos 491 and 406: Zhu Min, Mark Wilson and Tiiu Märss at the 10th International Symposium on Early vertebrates in Brazil. Photo by Wenjin Zhao.

Cultural Endowment of Estonia, for *H. Pärnaste* to the photo-project “**A City with Trees/ The Handicapped City**” with first opening in the Photomuseum, Cellar “Lee”, Tallinn, Estonia;

EAGE-PACE grant for registration and lodging for *A. Shogenova* to participation in the 66th EAGE Conference and Exhibition;

ENeRG travel grant from European Network for Research in Geo-Energy for *A. Shogenova* to visit the ENeRG meeting in Prague;

European Commission grant for registration and lodging for *A. Shogenova* to participation in the 32nd International Geological Congress;

IGCP Project 491 travel support for *T. Märss* to participation in the 10th International Symposium on Early Vertebrates in Gramado, Brazil, and the following geological excursion;

Institute of Geology of the Komi Science Centre (Academy of Sciences of Russia, Ural Division) grant for *P. Männik* to fieldwork in the Subpolar Urals;

INTAS-NEMLOR grant for *P. Männik* for participation in the workshop of INTAS-NEMLOR;

Latvian Academy of Sciences research grant for *L. Hints* to study of the Ordovician brachiopods in the Latvian Museum of Natural History,

NSERC research grant A9180 to M.H.V. Wilson, Edmonton University for *T. Märss* to participation in the 10th International Symposium on Early Vertebrates in Gramado, Brazil, and the following geological excursion;

U.S. Department of State Federal Assistance Award (travel grant) for *P. Männik* to visit the Institute of Geology of the Komi Science Center, (Academy of Sciences of Russia, Ural Division).



Subpolar Urals – the destination of the repeated fieldwork of Peep Männik. Photo by *P. Männik*.

2005



Mari-Ann Mõtus together with her Ukrainian colleagues needed a boat to reach to some localities at Dniestr River, Ukraine.

Russian Academy of Sciences (RAS) grant for research visit for *P. Männik* to the Institute of Geology of the Komi Science Center;

Russian Academy of Sciences grant for research visit for *P. Männik* to the Institute of Geology of the Komi Science Center;

Academy of Sciences of Switzerland exchange programme grant for *A. Shogenova* to scientific work;

Arctic Paleo-Network travel grant for *P. Männik* to visit the Uppsala University for preparation of a project;

CO2 Network of Excellence travel grant for *A. Shogenova* for participation in the Scientific Advisory Board (BRGM, Paris) as a member;

EAGE-PACE foundation conference grant for *A. Shogenova* to Madrid, 67th EAGE Conference & Exhibition;

ENeRG travel grant from GEOeNERG for *A. Shogenova* for participation in the GEOeNERG steering meeting in Bratislava;

Estonian Academy of Sciences international exchange grant for *M.-A. Mõtus* to fieldwork in Ukraine;

Estonian Academy of Sciences international exchange grant for *T. Martma* to fieldwork in Svalbard;

GEOeNERG grant for *A. Shogenova* for participation in the GEOeNERG steering meeting in Utrecht as representative from Estonia;

IGCP Project 503 support to attend a conference in St. Petersburg for *M. Killing* to participate in conference;

IGCP Project 503 support to attend a conference in St. Petersburg for *J. Lääts* to participate in conference;

NordForsk POLLANDCAL funding for *A. Poska* to field seminar.



Mairy Killing (left) and Jaanika Lääts (right) studied a lot during their first scientific meeting, St. Petersburg. The golden words of famous scientist I. P. Pavlov on a new statue at the University of St. Petersburg: "Science obtains the primary power in the life of human". *Photo by H. Pärnaste.*

Co-operation partners

- Academy of Natural Sciences**, Philadelphia, USA;
All-Russian Geological Institute (VSEGEI), St. Petersburg, Russia;
Arctic and Antarctic Research Institute, Russian Academy of Sciences, St. Petersburg, Russia;
Arctic Center, Rovaniemi, Finland;
British Geological Survey, Nottingham, UK;
British Geological Survey, Wallingford, UK;
Bundesanstalt für Geologie und Rohstoffen (BGR), Hannover, Germany;
Centre of Isotope Research, Grønningen, Netherlands;
Climate and Environmental Physics Institute, Bern University, Switzerland;
CSIRO Marine Research, Hobart, Australia;
Dating Laboratory, University of Helsinki, Finland;
Department of Chemistry, Tallinn University of Technology, Estonia;
Department of Earth Science, University of Bergen, Norway;
Department of Earth Sciences, University of Uppsala, Sweden;
Department of Ecology and Environmental Science, Umeå University, Sweden;
Department of Environment & Resources, Technical University of Denmark, Lyngby, Denmark;
Department of Geography and Oceanography, Australian Defence Force Academy, Australian Capital Territory, Australia;
Department of Geophysics, University of Helsinki, Finland;
Department of Mining, Tallinn University of Technology, Estonia;
Department of Natural Sciences, Tallinn University, Estonia;
Division of Earth Sciences, University of Glasgow, Glasgow, Scotland, UK;
Eberhard Karls Universität Tübingen, Germany;
Ecofys, Utrecht, Netherlands;
Endesa Generacion (Industry Partner), Madrid, Spain;
EniTecnologie, Milan, Italy;
Environmental Change Research Centre, University College London, UK;
Eötvös Loránd Geophysical Institute (ELGI), Budapest, Hungary;
Estonian, Latvian & Lithuanian Environment Ltd, Tallinn, Estonia;
Estonian Museum of Natural History, Tallinn, Estonia;
Federal Institute of Geosciences and Natural Resources, Berlin, Germany;
Freie Universität Berlin, Institut für Geologische Wissenschaften, Berlin, Germany;
GeoForschungsZentrum/ Germany's National Research Centre for Geosciences, Potsdam, Germany;
Geoinzeniring Ltd., Ljubljana, Slovenia;
Geological and Mining Institute of Spain (IGME), Madrid, Spain;
Geological Museum, University of Copenhagen, Denmark;
Geological Museum, University of Helsinki, Finland;
Geological Survey of Denmark and Greenland, Copenhagen, Denmark;
Geological Survey of Estonia, Tallinn, Est.;
Geological Survey of Finland, Espoo, Finland;
Geological Survey of Lithuania, Vilnius, Lithuania;
Geological Survey of Norway, Trondheim, Norway;
Geological Survey of the Netherlands (TNO-NITG), Utrecht, Netherlands;
Geophysical Exploration Company (PBG), Poland;
Grontmij Nederland bv, Amsterdam, Netherlands;
Hungarian Geological Institute, Budapest, Hungary;
Hydroisotop Laboratory, Schweitenkirchen, Germany;
Indiana University, Bloomington, USA;
Institute for Geology and Mining Engineering (BRGM), Paris, France;
Institute for Geology and Mining Engineering (IGME), Athens, Greece;
Institute Francaise du Petrole (IFP), Paris,

- France;
- Institute of Archaeology and Ethnography of the Siberian Branch, Russian Academy of Science**, Novosibirsk, Russia;
- Institute of Ecology, Tallinn University**, Estonia;
- Institute of Environmental Physics, University of Tartu**, Estonia;
- Institute of Experimental Physics and Technology, University of Tartu**, Estonia;
- Institute of Geography and Geology, University of Greifswald**, Germany;
- Institute of Geological Sciences, Belarus National Academy**, Minsk, Belarus;
- Institute of Geology and Geochemistry**, Ekaterinburg, Russia;
- Institute of Geology and Geography**, Vilnius, Lithuania;
- Institute of Geology, Komi Science Centre, Ural Branch of Russian Academy of Sciences**, Syktyvkar, Komi Republic, Russia;
- Institute of Geology, University of Tartu**, Estonia;
- Institute of Geophysics**, Zürich, Switzerland;
- Institute of Palaeontology, Russian Academy of Sciences**, Moscow, Russia;
- Institute of Petroleum and Gas Geology, Siberian Branch of Russian Academy of Sciences**, Novosibirsk, Russia;
- Institute of Petroleum Engineering**, Edinburgh, UK;
- Institute of Physics of the Earth, Russian Academy of Sciences**, Moscow, Russia;
- Institute of Zoology and Botany, Estonian Agricultural University**, Tartu, Estonia;
- Kola Science Centre, Russian Academy of Sciences**, Apatity, Russia;
- Krakow University of Mining and Metallurgy**, Krakow, Poland;
- Latvian Museum of Natural History**, Riga, Latvia;
- Laurentian University**, Sudbury, Canada;
- Lithuanian Institute of Geology**, Vilnius, Lithuania;
- Lund University**, Sweden;
- MacQuarie University**, N.S.W., Australia;
- Mainz University**, Germany;
- Marine Systems Institute at Tallinn University of Technology**, Estonia;
- Milwaukee Public Museum**, Milwaukee, USA;
- Mineral and Energy Economy Research Institute, Polish Academy of Sciences**, Cracow, Poland;
- Mining Institute**, St. Petersburg, Russia;
- Ministry of the Environment, Tallinn**, Estonia;
- Ministry of Science and Technology (MOST)**, Beijing, CHINA;
- Montanuniversität Leoben Institut für Geophysik**, Leoben, Austria;
- Moscow State University**, Russia;
- Museum Victoria, Geology Section**, Carlton, Victoria, Australia;
- Nancy University**, France;
- National Environmental Research Institute**, Silkeborg, Denmark;
- National Institute of Chemical Physics and Biophysics**, Tallinn, Estonia;
- National Institute of Marine Geology and Geoecology**, Bucharest, Romania;
- National Institute of Oceanography and Applied Geophysics (OGS)**, Trieste, Italy;
- National Institute of Polar Research**, Tokyo, Japan;
- National Museums and Galleries of Wales**, Cardiff, UK;
- National Natural History Museum**, Kiev, Ukraine;
- Natural History Museum**, London, UK;
- Nordic Mineralogical Network**, Geological Institute, Copenhagen University, Denmark;
- Northern Arizona University**, Flagstaff, USA;
- Norwegian Geotechnical Institute**, Oslo, Norway;
- Norwegian Polar Institute**, Tromsø, Norway;
- Polish Geological Institute**, Warsaw, Poland;
- Pskov Pedagogical University**, Russia;
- Queensland Museum**, Hendra, Queensland, Australia;
- Radiometric Laboratory, Ukrainian Hydrometeorological Research Inst**, Kiev, Ukraine;
- Research Institute of Earth Crust, St. Petersburg State University**, Russia;
- RF-Rogaland Research**, Stavanger, Norway;

State Geological Institute of Dionyz Stur, Bratislava, Slovakia;
State Geological Survey of Latvia, Riga, Latvia;
Stockholm University, Sweden;
Tartu Observatory, Tõravere, Estonia;
Technische Universität Braunschweig, Institut für Umweltgeologie, Braunschweig, Germany;
Texas Technical University, Lubbock, USA;
University of Alabama, Tuscaloosa, Alabama, USA;
University of Alberta, Edmonton, Canada;
University of Bergen, Norway;
University of Dayton, Ohio, USA;
University of Exeter, UK;
University of Helsinki, Finland;
University of Kansas, Lawrence, Kansas, USA;
University of Latvia, Riga, Latvia;
University of Leicester, UK;
University of Liverpool, UK;
University of Münster, Germany;
University of Oulu, Finland;
University of Portsmouth, UK;
University of Poznan, Poland;
University of Rennes, France;
University of Rio de Janeiro, Brasil;
University of Sofia, Bulgaria;
University of Tartu, Estonia;
University of Turku, Finland;
University of Vilnius, Lithuania;
University of Wisconsin-Milwaukee, Milwaukee, USA;
University of Zagreb, Croatia;
Vattenfall AB, Sweden/Poland;
Växjö University, Sweden;
Vienna University of Technology, Vienna, Austria;
Vrije Universiteit Amsterdam, Netherlands.

Membership and other activities

- Academia Europaea**, *R. Vaikmäe* (member);
- Academic Library of the Tallinn University**, *D. Kaljo* (member of council), *O. Hints*; *H. Pärnaste* (members of advisory board of compiling of the collections);
- Academy of Sciences of New York**, *A. Raukas* (acting member);
- American Geochemical Society**, *A. Lepland* (member);
- American Geographical Society**, *A. Raukas* (member);
- American Geophysical Society**, *A. Lepland* (member);
- American Geophysical Union**, *R. Vaikmäe* (member);
- Archimedes Foundation**, *R. Vaikmäe* (member of the board);
- Australian National Antarctic Research Expeditions (ANARE) Club**, *E. Kaup* (member);
- Baltic Stratigraphical Association**, *D. Kaljo*, *A. Raukas* (members);
- Baltica (Vilnius)**, *A. Raukas* (member of the scientific programme committee of the journal);
- Biographic Lexicon of Estonian Science**, *H. Nestor* (editor of speciality);
- Bulletin of the Geological Society of Finland**, *A. Heinsalu* (member of editorial board);
- Bulletin of the Geological Survey of Estonia**, *A. Miidel* (member of editorial board);
- Centre of Archaeology, NGO**, *Ü. Kestlane* (member);
- CIMP Subcommittee on Chitinozoa**, *V. Nestor*, *J. Nõlvak* (member);
- Commission of Estonian Mineral Resources**, *D. Kaljo* (chairman); *A. Teedumäe* (expert); *A. Soesoo* (member);
- COST Technical Committee on Environment**, *R. Vaikmäe* (member);
- Encyclopaedia of Estonia**, *A. Raukas* (scientific chief editor);
- Encyclopaedia of Tallinn**, *A. Raukas* (member of the editorial board);
- Enterprise Estonia, assessment commission of projects in technology area**, *R. Vaikmäe* (member);
- Estonian Academy of Sciences**, *D. Kaljo*, *A. Raukas* (members);
- Commission of Meteoritics**, *A. Raukas* (chairman); *Ü. Kestlane* (member); *R. Tiirmaa* (secretary);
- Commission of Nature Conservation**, *A. Miidel* (member);
- Commission on Science Stipends**, *A. Raukas* (member);
- Council of the Biology, Chemistry and Geology Division**, *D. Kaljo* (member);
- Council of Energetics**, *A. Raukas* (member);
- Polar Research Committee**, *R. Vaikmäe* (chair), *E. Kaup* (scientific secretary);
- Estonian Astronomical Society**, *J. Ivask*, *Ü. Kestlane* (members);
- Estonian Commission on Stratigraphy**, *D. Kaljo* (chairman); *A. Raukas* (member); *O. Hints* (secretary);
- Ordovician-Silurian-Devonian Working Group**, *J. Nõlvak*, *O. Hints*, *L. Hints*, *D. Kaljo*, *A. Kleesment*, *E. Mark-Kurik*, *P. Männik*, *T. Märss*, *H. Nestor* (members);
- Precambrian Working Group**, *A. Soesoo* (member);
- Quaternary Working Group**, *A. Raukas* (chairman); *E. Kaup*, *A. Miidel*, *A. Molodkov*, *L. Saarse*, *S. Veski* (members);
- Vendian-Cambrian Working Group**, *K. Mens* (member);
- Estonian Encyclopedia Publishers**, *A. Raukas* (chairman of the board);
- Estonian Geographical Society**, *A. Raukas* (deputy chairman and member of the presidium); *A. Raukas* (honorary member); *R. Karukäpp*, *E. Kaup*, *A. Miidel*, *J. Nõlvak*, *L. Saarse*, *E. Tavast*, *R. Vaher*, *R. Vaikmäe* (member); *H. Kink* (member of the board);
- Estonian Geological Society**, *L. Bityukova*, *R. Karukäpp*, *E. Mark-Kurik*, *A. Marandi*, *K. Mens*, *A. Miidel*, *A. Shogenova*, *E. Tavast*, *R. Vaher*, *R. Vaikmäe* (members); *O. Hints* (member of the board); *D. Kaljo*, *A. Raukas* (member of the council);
- Estonian Malacological Society**, *E. Tavast*

- (member);
- Estonian Maritime Academy**, *A. Raukas* (member of council of Marine Department; member of board of councils, member of scientific commission);
- Estonian Ministry of Education and Research; Board of Scientific Competence**, *R. Vaikmäe* (member), *A. Raukas*, *O. Hints* (members of geoscience expert group);
- Estonian Ministry of Environment**, *A. Raukas* (member of board and Environmental Monitoring Board);
- Estonian National Committee of Geologists**, *D. Kaljo* (chairman), *A. Raukas* (vice-chairman), *A. Soesoo* (member);
- Estonian National Culture Foundation, Tiina Tamman's Subfoundation**, *A. Raukas* (member of board);
- Estonian Naturalists' Society**, *H. Nestor* (chairman of division of palaeontology); *R. Einasto*, *L. Hints*, *D. Kaljo*, *H. Kink*, *A. Kleesment*, *M. Konsa*, *E. Mark-Kurik*, *K. Mens*, *A. Müidel*, *V. Nestor*, *J. Nõlvak*, *A. Raukas*, *L. Saarse*, *E. Tavast*, *R. Tiirmaa*, *R. Vaher*, *V. Viira* (members);
- Estonian Polar Club**, *E. Kaup*, *T. Martma*, *R. Vaikmäe* (members);
- Estonian Polar Foundation**, *E. Kaup* (member of the board);
- Estonian Rome Club**, *A. Raukas* (member);
- Estonian Science Foundation**, *R. Vaikmäe* (member of the board); *S. Veski* (bio-geoscience expert commission, expert);
- Estonian Society for Research of Native Place**, *A. Raukas* (member);
- Estonian Society of Prehistoric Art**, *Ü. Kestlane* (member of the board);
- Estonian Union of History and Philosophy of Science**, *H. Nestor* (member);
- Estonian Union of Science Historians**, *A. Raukas* (member);
- Estonian Union of Scientists**, *A. Raukas* (co-chairman member of board); *R. Vaikmäe* (member of the board); *R. Einasto*, *D. Kaljo*, *R. Karukäpp*, *H. Kink*, *H. Nestor*, *A. Soesoo*, *E. Tavast*, *R. Vaher* (members) *A. Kleesment* (member of the council);
- Euro-Asian Geophysical Society**, *A. Shogenova* (member);
- European Association of Geoscientists and Engineers (EAGE)**, *A. Shogenova* (member);
- European CO2 GeoNet Network of Excellence**, *A. Shogenova* (member of scientific advisory board);
- European Geophysical Society**, *L. Bityukova* (member);
- European Geosciences Union**, *R. Vaikmäe* (member);
- European Polar Consortium, Science Advisory Council**, *R. Vaikmäe* (member);
- European Pollen Monitoring Program**, *A. Poska* (member);
- European Society for Isotopic Research**, *R. Vaikmäe* (member of advisory board); *T. Martma* (member);
- Finnish Society of Earth Physics**, *A. Raukas* (member);
- GEO ENeRG**, *A. Shogenova* (representative of Estonia);
- Geological Curators Group**, *O. Hints* (member);
- Geological Society of Finland**, *A. Raukas* (corresponding member);
- Geological Society of London**, *D. Kaljo* (honorary member);
- Geotechnical Society of Estonia**, *S. Peetermann* (member);
- INTAS**, *L. Bityukova*, *E. Kaup* (evaluator);
- International Association For Mathematical Geology (IAMG)**, *A. Shogenova* (member);
- International Association for the Study of Fossil Cnidaria and Porifera**, *H. Nestor* (member of the council);
- International Association of Exploration Geochemistry**, *L. Bityukova* (member);
- International Association of Geoanalysts**, *T. Kiipli* (member);
- International Association of Geochemistry and Cosmochemistry**, *L. Bityukova* (member);
- International Association of Geomorphologists**, *A. Raukas* (Estonian national representative, chairman of Estonian National Committee); *R. Karukäpp* (secretary of Estonian National Committee);
- International Association of Hydrogeologists (IAH)**, *R. Vaikmäe* (member);
- International Association of Sedimentology**,

- L. Bityukova* (member);
- International Association of Theoretical and Applied Limnology (SIL)**, *E. Kaup* (member);
- International EPR (ESR) Society**, *A. Molodkov* (member);
- International Federation of Scientists**, *A. Raukas* (member);
- International Glaciological Society, IGS**, *R. Vaikmäe* (member);
- International Palaeontological Association**, *T. Märss*, *V. Viira* (members); *D. Kaljo* (member of graptolite working group);
- International Permafrost Association, IPA**, *R. Vaikmäe* (individual member);
- International Union for Quaternary Research (INQUA)**, *A. Raukas* (honorary member);
- Estonian National Committee**, *A. Raukas*, *L. Saarse* (member); *R. Vaikmäe* (vice-chairman);
- Comission on Continental Palaeohydrology**, *L. Saarse* (corresponding member);
- Commission on Glaciations, Peribaltic Group**, *R. Karukäpp* (member);
- International Union of Geological Sciences (IUGS)**,
Commission on Geological Sciences and Environmental Planning, *A. Raukas* (Estonian national representative);
- Subcommission on Devonian Stratigraphy**, *E. Mark-Kurik* (corresponding member);
- Subcommission on Ordovician Stratigraphy**, *L. Hints*, *O. Hints*, *D. Kaljo*, *J. Nõlvak* (corresponding members);
- Subcommission on Silurian Stratigraphy**, *T. Märss*, *H. Nestor* (corresponding members), *D. Kaljo* (member), *P. Männik* (titular member);
- IPA Task Force for Isotope Geochemistry of Permafrost**, *R. Vaikmäe* (member);
- International Society of Vertebrate Morphology**, *T. Märss* (member);
- Joint Committee on Antarctic Data Management (JCADM)**, *J. Ivask* (member);
- National Committee of Estonian Geologists**, *A. Soesoo* (member); *A. Raukas* (vice-chairman);
- Natural History Museum of Latvia**, *E. Mark-Kurik* (consultant);
- Nature Conservation Working Group of Social Agreement**, *A. Raukas* (member);
- Newsletter on Stratigraphy**, *D. Kaljo* (member of editorial board, corresponding editor);
- Nordic Association for Hydrology**, *R. Vaikmäe* (member);
- Oceanological and Hydrobiological Studies (Gdansk)**, *A. Raukas* (member of editorial advisory board);
- Oil Shale**, *A. Raukas* (chairman of editorial board and editor-in-chief);
- Pakri Nature Centre, NGO**, *A. Raukas* (chairman of board), *H. Kink* (members of board);
- Paleontologicheskij Zhurnal**, *D. Kaljo* (member of editorial board);
- Pander Society**, *P. Männik*, *V. Viira* (members);
- Past Global Changes (PAGES)**, *L. Saarse*, *S. Veski* (corresponding members)
- Proceedings of the Estonian Academy of Sciences. Geology, editorial board**, *A. Raukas* (chairman); *D. Kaljo* (deputy chairman); *A. Miidel* (member);
- Quaternary International (Canada)**, *R. Vaikmäe* (member of the editorial board);
- Research Centre Free Europe, Scientific Board** *A. Raukas* (member);
- Royal Geographical Society of London**, *A. Raukas* (honorary member);
- Scientific Society of Gdansk**, *A. Raukas* (foreign member);
- Society for Nature Conservation of Tallinn**, *H. Kink* (member of the board);
- Society of Geopathy**, *A. Raukas* (member);
- Stratigrafiya. Geologicheskaya Korrelyatsiya**, *D. Kaljo* (member of editorial board);
- Tallinn College of Engineering**, *A. Raukas* (chairman of board of councils);
- Tallinn House of Scientists**, *R. Vaikmäe* (member of council), *D. Kaljo*, *E. Kaup*, *A. Raukas*, *H. Pohl-Raidla*, *A. Soesoo*, *M. Viilul* (members);
- Tallinn University of Technology, Council**, *A. Soesoo*, *R. Vaikmäe* (members);
- Commission of Development and Finances**, *A. Soesoo* (member);

- Research Commission of the Council,**
R. Vaikmäe (member);
- Earth System Science Centre of Excellence,** *R. Vaikmäe* (head);
- Tallinn University,**
- Council on Defending of Doctor's Degree in Ecology,** *A. Raukas, L. Saarse* (members);
- Curatorium,** *A. Raukas* (chairman);
- The Geochemical Society,** *T. Alliksaar, R. Vaikmäe* (members);
- The World Innovation Foundation,** *A. Raukas* (honorary member);
- UNESCO International Hydrological Programme, Estonian National Committee,** *R. Vaikmäe* (member);
- Year Book "Research into Ancient Times",** *A. Raukas* (member of editorial board).

Publications

Papers in CC and SCl listed journals

- Ainsaar, L., Meidla, T., Martma, T. 2004. The Middle Caradoc Facies and Faunal Turn-over in the Late Ordovician Baltoscandian Palaeobasin. *Palaeogeography, Palaeoclimatology, Palaeoecology* **210**, 119-133.
- Alliksaar, T., Heinsalu, A., Saarse, L., Salujõe, J., Veski, S. 2005. A 700-year decadal scale record of lake response to catchment land use from annually laminated lake sediments in southern Estonia. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* **29**(1), 457-460.
- Barrick, J.E., Männik, P. 2005. Silurian conodont biostratigraphy and palaeobiology in stratigraphic sequences. In: Purnell, M. A. and Donoghue, P. C. J. (eds.). Conodont biology and phylogeny – interpreting the fossil record. *Special Papers in Palaeontology* **73**, 1-14.
- Beznosova, T.M., Männik, P. 2005. The Llandovery–Wenlock Boundary in the Northern Part of the Baltica Palecontinent. *Transactions (Doklady) of the Russian Academy of Sciences* **401A**, 374-377.
- Bons, P. D., Arnold, J., Elburg, M. A., Kalda, J., Soesoo, A., van Milligen, B. P. 2004. Melt extraction and accumulation from partially molten rocks. *Lithos* **78**, 25-42.
- Granskog, M., Virkkunen, K., Thomas, D., Ehn, J., Kola, H., Martma, T. 2004. Chemical properties of brackish water ice in the Bothnian Bay, the Baltic Sea. *Journal of Glaciology* **50**(169), 292-302.
- Harris, M. T., Sheehan, P. M., Ainsaar, L., Hints, L., Männik, P., Nõlvak, J., Rubel, M. 2004. Upper Ordovician sequences of western Estonia. Elsevier. *Palaeogeography, Palaeoclimatology, Palaeoecology* **210**, 135-148.
- Hints, L. 2004. Maximizing diductor adhesion: An unusual cardinal process in Late Ordovician brachiopod from Estonia. *Acta Palaeontologica Polonica* **49**(4), 635-638.
- Isaksson, E., Divine, D., Kohler, J., Martma, T., Pohjola, V., Motoyama, H., Watanabe, O. 2005. Climate oscillations as recorded in Svalbard ice core $\delta^{18}O$ records between 1200-1997 AD. *Geografiska Annaler* **87A**(1), 203-214.
- Isaksson, E., Kohler, J., Pohjola, V., Moore, J., Igarashi, M., Karlöf, L., Martma, T., Meijer, H., Motoyama, H., Vaikmäe, R., van de Wal, R.S.W. 2005. Two ice-cored $\delta^{18}O$ records from Svalbard illustrating climate and sea-ice variability over the last 400 years. *The Holocene* **15**(4), 501-509.
- Kaasik, M., Alliksaar, T. 2004. Dry deposition of coarse solid particles in patchy sub-boreal landscape. In: Borrego, C., Incecik, S. (eds.) Air Pollution Modeling and Its Application XVI, NATO “Challenges of modern society”. Kluwer Academic/Plenum Publishers, New-York. 491-499.
- Kaasik, M., Alliksaar, T., Ivask, J., Loosaar, J. 2005. Spheroidal fly ash particles from oil-shale-fired power plants in atmospheric precipitations. Possibilities of quantitative tracing. *Oil Shale* **22**(4), 547-562.
- Kaljo, D., Hints, L., Martma, T., Nõlvak, J., Oraspõld, A. 2004. Late Ordovician carbon isotope trend in Estonia, its significance in stratigraphy and environmental analysis. Elsevier. *Palaeogeography, Palaeoclimatology, Palaeoecology* **210**, 165-185.
- Kallaste, T., Nemliher, J. 2005. Apatite varieties in extant and fossil vertebrate mineralized tissues. *Journal of Applied Crystallography*, **38**, 587-594.
- Karro, E., Marandi, A., Vaikmäe, R. 2004. The origin of increased salinity in the Cambrian-Vendian aquifer system on the Kopli Peninsula, northern Estonia. *Hydrogeology Journal* **12**, 424-435.
- Kaup, E. 2005. Development of anthropogenic eutrophication in Antarctic lakes of the Schirmacher Oasis. E. Schweizerbartsche Verlagsbuchhandlung, Stuttgart. *Verhand-*

- lungen Internationale Vereinigung der Limnologie* **29**(2), 678-682.
- Kekonen, T., Moore, J., Perämäki, P., Martma, T. 2005. The Icelandic Laki volcanic tephra layer in the Lomonosovfonna ice core, Svalbard. *Polar Research* **24**(1-2), 33-40.
- Kiipli, E., Kiipli, T., Kallaste, T. 2004. Bioproductivity rise in the East Baltic epicontinental sea in the Aeronian (Early Silurian). *Palaeogeography, Palaeoclimatology, Palaeoecology* **205**(3-4), 255-272.
- Koff, T., Punning, J.-M., Sarmaja-Korjonen, K., Martma, T. 2005. Ecosystem response to early and late Holocene lake-level changes in Lake Juusa, Southern Estonia. *Polish Journal of Ecology* **53**(4), 553-570.
- Korsakova, O. P., Molodkov, A. N., Kolka, V. V. 2004. Geological-Stratigraphic Position of Upper Pleistocene Marine Sediments in the Southern Kola Peninsula: Evidence from Geochronological and Geological Data. *Doklady Earth Sciences* **398**(7), 908-912.
- Kärkäs, E., Martma, T., Sonninen, E. 2005. Physical properties and stratigraphy of surface snow in western Dronning Maud Land, Antarctica. *Polar Research* **24**(1-2), 55-67.
- Leeben, A., Heinsalu, A., Alliksaar, T., Saarse, L. 2005. A high-resolution spectroscopic study of pore-water dissolved organic matter in annually laminated lake sediments: a new tool for reconstructing lake eutrophication history. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* **29**(1), 465-468.
- Loydell, D.K., Nestor, V. 2005. Integrated graptolite and chitinozoan biostratigraphy of the upper Telychian (Llandovery, Silurian) of the Ventspils D-3 core, Latvia. *Geol. Magazine* **142**(4), 369-376.
- Löfgren, A., Viira, V., Mens, K. 2005. Conodont biostratigraphy and sedimentary history in the upper Tremadoc at Uuga, Cape Pakri, NW Estonia. *GFF* **127**, 283-293.
- Marini, F., Raukas, A., Tiirmaa, R. 2004. Magnetic fines from the Kaali impact-site (Holocene, Estonia): Preliminary SEM investigation. *Geochemical Journal* **38**, 107-120.
- Martma, T., Brazauskas, A., Kaljo, D., Kaminskas, D., Musteikis, P. 2005. The Wenlock - Ludlow carbon isotope trend in the Vidukle core, Lithuania, and its relations with oceanic events. *Geological Quarterly* **49**(2), 223-234.
- Molodkov, A., Yevzerov, V. 2004. ESR/OSL ages of long-debated sub-till fossil-bearing marine deposits from the southern Kola Peninsula: stratigraphic implications. *Boreas* **33**, 123-131.
- Mõtus, M.-A. 2004. Tabulate corals from the Lower Silurian of Jämtland (Sweden). *GFF* **126**, 339-352.
- Mõtus, M.-A., Sandström, O. 2005. Cystihalysites sp. and its significance in biostratigraphy and event stratigraphy in the Ludlow of Gotland, Sweden. *GFF* **127**, 269-272.
- Märss, T., Miller, C. G. 2004. Thelodonts and distribution of associated conodonts from the Llandovery - lowermost Lochkovian of the Welsh Borderland. *Palaeontology* **47**(5), 1211-1266.
- Nemliher, J. G., Baturin, G. N., Kallaste, T. E., Murdmaa, I. O. 2004. Transformation of hydroxyapatite of bone phosphate from the ocean bottom during fossilization. *Lithology and Mineral Resources* **39**(5), 468-479.
- Ojala, A.E.K., Heinsalu, A., Saarnisto, M., Tiljander, M. 2005. Annually laminated sediments date the drainage of the Ancylus Lake and early Holocene shoreline displacement in central Finland. *Quaternary International* **130**(1), 63-73.
- Poska, A., Saarse, L., Veski, S. 2004. Reflections of pre- and early-agrarian human impact in the pollen diagrams of Estonia. *Palaeogeography Palaeoclimatology Palaeoecology* **209**, 37-50.
- Punning, J.-M., Alliksaar, T., Terasmaa, J., Jevrejeva, S. 2004. Recent patterns of sediment accumulation in a small closed eutrophic lake revealed by the sediment records. *Hydrobiologia* **529**, 71-81.
- Puura, V., Huber, H., Kirs, J., Kärki, A., Suuroja, K., Kirsimäe, K., Kivisilla, J., Kleesment, A., Konsa, M., Preeden, U., Suuroja, S., Koeberl, C. 2004. Geology, petrography, and geochemistry of impactites and target rocks from the Kärddla crater, Es-

- tonia. *Meteoritics & Planetary Science* **39**(3), 425-451.
- Raukas, A. 2004. Distribution and composition of impact and extraterrestrial spherules in the Kaali area (Island of Saaremaa, Estonia). *Geochemical Journal* **38**, 101-106.
- Raukas, A. 2005. Klint. Encyclopedia of Coastal Science. Springer, The Netherlands. 586-587.
- Raukas, A. 2005. Oil-shale industry and sustainability – governance through dialogue. *Oil Shale* **22**(1), 3-4.
- Raukas, A., Punning, J.-M., Moora, T., Kestlane, Ü., Kraut, A. 2005. The Structure and Age of the Kaali Main Crater, Island of Saaremaa, Estonia. Impact Tectonics. Berlin-Heidelberg: Springer-Verlag. 341-355.
- Raukas, A., Stankowski, W. 2005. Influence of Sedimentological Differences on the OSL Datings of Glaciofluvial Deposits on the Example of Estonia. *Geological Quarterly*, **49**(4), 463-470.
- Rosentau, A., Hang, T., Miidel, A. 2004. Simulation of the shorelines of glacial Lake Peipsi in Eastern Estonia during the Late Weichselian. *Geological Quarterly* **48**(4), 290-307.
- Saadre, T., Einasto, R., Nõlvak, J., Stouge, S. 2004. Ordovician stratigraphy of the Kovel-1 well (Volkhov-Haljälä) in the Volynia region, northwestern Ukraine. Copenhagen. *Bulletin of the Geological Society of Denmark* **51**, 47-69.
- Saether, O. M., Banks, D., Kirso, U., Bitjukova, L., Sorlie, J.-E. 2004. The chemistry and mineralogy of waste from retorting and combustion of oil shale. In: Giere, R., Stille, P. (eds). Energy, Waste, and the Environment: A Geochemical Perspective. The Geological Society, London. *Special Publication* **236**, 262-284.
- Seppä, H., Birks, H. J. B., Odland, A., Poska, A., Veski, S. 2004. Modern pollen-climate training set from northern Europe: developing and testing a tool for palaeoclimatological reconstructions. *Journal of Biogeography* **31**, 251-267.
- Seppä, H., Poska, A. 2004. Holocene annual mean temperature changes in Estonia and their relationship to solar insolation and atmospheric circulation patterns. *Quaternary Research* **61**(1), 22-31.
- Vasilchenko, V., Molodkov, A., Jaek, I. 2005. Tunnel processes and anomalous fading in natural feldspars extracted from Quaternary deposits. *Journal of Applied Spectroscopy* **72**(2), 218-223.
- Vassiljev, J., Saarse, L., Miidel, A. 2005. Simulation of proglacial lake shore displacement in Estonia. *Geological Quarterly* **49**(3), 253-262.
- Veski, S., Heinsalu, A., Klassen, V., Kriiska, A., Lõugas, L., Poska, A., Saluäär, U. 2005. Early Holocene coastal settlement and palaeoenvironment on the shore of the Baltic Sea at Pärnu, southwestern Estonia. *Quaternary International* **130**(1), 75-85.
- Veski, S., Heinsalu, A., Lang, V., Kestlane, Ü., Possnert, G. 2004. The age of the Kaali meteorite craters and the effect of the impact on the environment and man: evidence from inside the Kaali craters, island of Saaremaa, Estonia. *Vegetation History and Archaeobotany* **13**(3), 197-206.
- Veski, S., Koppel, K., Poska, A. 2005. Integrated palaeoecological and historical data in the service of fine-resolution land use and ecological change assessment during the last 1000 years in Rõuge, S Estonia. *Journal of Biogeography* **32**(8), 1473-1488.
- Veski, S., Seppä, H., Ojala, A. E. K. 2004. The cold event 8200 years ago recorded in annually laminated lake sediments in Eastern Europe. *Geology* **32**(8), 681-684.

Papers in other peer-reviewed journals and books

- All, T., Puura, V., Vaher, R. 2004. Orogenic structures of the Precambrian basement of Estonia as revealed from the integrated modelling of the crust. *Proceedings of the Estonian Academy of Sciences. Geology* **53**(3), 165-189.
- Bolikhovskaya, N. S., Molodkov, A. N. 2005. Correlation of the climatic fluctuations over the last 200 ka reconstructed on palynological materials of loess-palaeosol sections and on the data of ESR-chronostratigraphy of Northern Eurasia marine deposits. In: Gozhik P. F. (ed.), *Biostratigraphic criteria for dissection and correlation of the Ukraine's Phanerozoic sediments*. IGS UAS, Kiev. 264-270.
- Henkel, H., Puura, V., Floden, T., Kirs, J., Konsa, M., Preenen, U., Lilljequist, R., Fernlund, J. 2005. Avike Bay - a 10 km diameter possible impact structure at the Bothnian Sea coast of central Sweden. In: *Impact Tectonics*. Springer-Verlag, Berlin. 323-340.
- Hints, L., Oraspõld, A., Nõlvak, J. 2005. The Pirgu Regional Stage (Upper Ordovician) in the East Baltic: lithostratigraphy, biozonation and correlation. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(4), 225-259.
- Hints, O., Eriksson, M., Högström, A. E. S., Kraft, P., Lehnert, O. 2004. Chapter 23. Worms, Worm-like and Sclerite-Bearing Taxa. In: Webby, B. D., Paris, F., Droser, M. L., Percival, I. G. (eds). *The Great Ordovician Biodiversification Event*. Columbia University Press, New-York. 223-230.
- Kaasik, M., Sofiev, M., Alliksaar, T., Ivask, J. 2004. Dry deposition of fly ash depending on boundary-layer stratification and underlying surface roughness: a model validation study. In: Suppan, P. (ed.). *Ninth International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes*. Proceedings, Forschungszentrum Karlsruhe GmbH, Karlsruhe. 74-78.
- Kaljo, D. 2004. Diversity of late Ordovician rugose corals in Baltoscandia: role of environmental changes and comparison with other areas. *Proceedings of the Estonian Academy of Sciences. Geology* **53**(4), 233-245.
- Kaljo, D., Miidel, A., Saarse, L., Soesoo, A. 2005. Anto Raukas - an encyclopedist in Estonian Quaternary geology. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(1), 3-4.
- Karukäpp, R. 2005. Eskers in the periphery of their distribution in North Estonia. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(1), 26-39.
- Kiipli, E. 2004. Redox changes in the deep shelf of the East Baltic Basin in the Aeronian and early Telychian (early Silurian). *Proceedings of the Estonian Academy of Sciences. Geology* **53**(2), 94-124.
- Kleesment, A., Shogenova, A. 2005. Lithology and evolution of Devonian carbonate and carbonate-cemented rocks in Estonia. Tallinn. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(3), 153-180.
- Miidel, A., Raukas, A. 2005. Slope processes at the North Estonian Klint. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(4), 209-224.
- Miller, C. G., Märss, T., Blom H. 2004. New anaspid material from the late Silurian of Britain and Estonia. In: *The Gross Symposium 2: Advances in Palaeoichthyology*. Riga. *Acta Universitatis Latviensis* **679**, 46-56.
- Märss, T. 2005. *Thelodont Oeselia mosaica* gen. et sp. nov. from the Wenlock and Ludlow of the East Baltic. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(3), 181-190.
- Nemliher, J., Kallaste, T. 2005. Thermal behaviour of bone apatite of Recent pike (*Esox lucius* L.). Tallinn. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(2), 112-118.
- Nemliher, J., Kurvits, T., Kallaste, T., Puura, I. 2004. Apatite varieties in the shell of a

- Cambrian lingulate brachiopod *Obolus apillinis* Eichwald. *Proceedings of the Estonian Academy of Sciences. Geology* **53**(4), 246-256.
- Nestor, V. 2005. Chitinozoans of the Margachitina margaritana Biozone and the Llandovery-Wenlock boundary in West Estonian drill cores.. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(2), 87-111.
- Paris, F., Achab, A., Asselin, E., Chen X-H., Grahn, Y., Nölvak, J., Obut, O., Samuelsen, J., Sennikov, N., Vecoli, M., Verniers, J., Wang X-F., Winchester-Seeto, T. 2004. Chitinozoans. In: Webby, B. D., Paris, F., Droser, M. L. and Percival I. G. (eds). The Great Ordovician Biodiversification Event. Columbia University Press, New-York. 294-311.
- Puura, V., Hints, R., Huhma, H., Klein, V., Konsa, M., Kuldkepp, R., Mäntari, I., Soesoo, A. 2004. Svecofennian metamorphic zones in the basement of Estonia. *Proceedings of the Estonian Academy of Sciences. Geology* **53**(3), 190-209.
- Pärnaste, H. 2004. Revision of the Ordovician cheirurid trilobite genus *Reraspis* with the description of the earliest representative. *Proceedings of the Estonian Academy of Sciences. Geology* **53**(2), 125-138.
- Raukas, A. 2004. Application of OSL and ¹⁰Be techniques for the establishment of deglaciation chronology in Estonia. *Proceedings of the Estonian Academy of Sciences. Geology* **53**(4), 267-287.
- Raukas, A. 2004. Klint. In: Schwartz, M. (ed.). Encyclopedia of Coastal Science. Chapman & Hall, London.
- Raukas, A. 2005. Sixth International Conference on Geomorphology in Zaragoza.. *Proceedings of the Estonian Academy of Sciences. Geology* **54**(4), 266.
- Raukas, A., Kalm, V., Karukäpp, R., Rattas, M. 2004. Pleistocene glaciations in Estonia. In: Ehlers, J., Gibbard, P.L. (eds). Quaternary glaciations - Extent and chronology. Elsevier B.V., Amsterdam. 83-91.
- Raukas, A., Laigna, K. 2005. Height of the turbulent gas flow and transport distance of glassy spherules on the example of the Kaali impact, Estonia. *Proceedings of the Estonian Academy of Sciences* **54**(4), 145-152.
- Raukas, A., Tavast, E. 2004. Sustainable management of mineral resources, soil cover and geosites in Estonia. In: Polish Geological Institute. Special Papers. Remigraf Ltd., Warszawa. **13**, 191-197.
- Satkunas, J., Molodkov, A. 2005. Middle Pleistocene stratigraphy in the light of data from the Vilkiškes site, Eastern Lithuania. In: Polish Geological Institute Special Papers, **16**. 94-102.
- Schultze, H.-P., Märss, T. 2004. Revisiting *Lophosteus* Pander 1856, a primitive osteichthyan. In: The Gross Symposium 2: Advances in Palaeoichthyology. Riga. *Acta Universitatis Latviensis* **679**, 57-78.
- Shogenova, A. 2004. Geostatistic modeling of geological processes in the northern part of the Baltic Palaeozoic basin: case study from Ordovician. Extended abstracts, Paris 2004, 66th EAGE Conference & Exhibition. EAGE, Amsterdam. P044, 1-4.
- Shogenova, A., Kleesment, A., Joeleht, A., Shogenov, V. 2005. Prediction of thermal conductivity from magnetic susceptibility, porosity and gamma-ray data. In: Extended abstracts, Madrid, 67th EAGE Conference & Exhibition. EAGE, Amsterdam. 1-4.
- Soesoo, A. 2004. Precambrian basement of Estonia. *Proceedings of the Estonian Academy of Sciences, Geology*, **53**, 147-148.
- Soesoo, A., Kalda, J., Bons, P.D., Urtson, K., Kalm, V. 2004. Fractality in geology: a possible use of fractals in the studies of partial melting processes. *Proceedings of the Estonian Academy of Sciences, Geology* **53**, 13-27
- Soesoo, A., Puura, V., Kirs, J., Petersell, V., Niin, M., All, T. 2004. Outlines of the Precambrian basement of Estonia.. *Proceedings of the Estonian Academy of Sciences, Geology* **53**, 149-164.
- Teedumäe, A., Nestor, H., Kallaste, T. 2004. Sedimentary cyclicity and dolomitization of the Raikküla Formation in the Nurme drill core (Silurian, Estonia). *Proceedings of the Estonian Academy of Sciences. Geology* **53**(1), 42-62.

- Webby, B. D., Elias, R. J., Young, G. A., Neuman, B. E. E., Kaljo, D. 2004. Corals. In: Webby, B. D., Paris, F., Droser, M. L., Percival, I. G. (eds). *The Great Ordovician Biodiversification Event*. Columbia University Press, New-York. 124-146.
- Wilson, M.V.H., Märss, T. 2004. Toward a phylogeny of the thelodonts. In: *Recent Advances in the Origin and Early Radiation of the Vertebrates [Honoring Hans-Peter Schultze]*. Verlag Dr. Friedrich Pfeil, München. 95-108.

Papers in other journals and books

- Daeschler, E. B., Elliott, D. K., Shubin, N. H., Mark-Kurik, E., Jenkins F. A. 2005. Biostratigraphy of the Middle and Late Devonian (Late Givetian – Frasnian) ichthyofauna from the Okse Bay Group, Nunavut territory, Canada. *Journal of Vertebrate Paleontology* 35(Supply to 3), 49A.
- Elliott, D. K., Mark-Kurik, E. 2005. A review of the lateral line sensory system in psammosteid heterostracans. *Revista Brasileira de Paleontologia* 8(2), 99-108.
- Haberman, J., Pihu, E., Raukas, A. 2004. Preface. In: *Lake Võrtsjärv*. Estonian Encyclopaedia Publishers, Tallinn. 9.
- Hints, L. 2005. Distribution of Ordovician macrofossils. In: Põldvere, A. (ed.). *Estonian Geological Sections. Bulletin 6. Mehikoorma (421) drill core*. Tallinn. 22-25.
- Hints, L., Männik, P., Pärnaste, H. 2004. Stop 3. Vasalemma quarry. In: Hints, O., Ainsaar, L. (eds). *WOGOGO-2004: Conference Materials. Abstracts and Field Guide Book*. Tartu University Press, Tartu. 121-124.
- Hints, O. 2004. Stop 1. Pääsküla hillock. In: Hints, O., Ainsaar, L. (eds). *WOGOGO-2004: Conference Materials. Abstracts and Field Guide Book*. Tartu University Press, Tartu. 115-116.
- Hints, O. 2005. Scolecodonts. In: Dronov, A., Tolmacheva, T., Raevskaya, E., Nestell, M. (eds). *The Sixth Baltic Stratigraphical Conference. Cambrian and Ordovician of St. Petersburg Region. Guidebook of the pre-conference field trip*. VSEGEI, St. Petersburg. 31-32.
- Kaasik, M., Alliksaar, T. 2004. Spheroidal particles as passive tracers of spreading and deposition of fly ash from high-temperature combustion. *EURASAP Newsletter* 53, www.meteo.bg/EURASAP.
- Kaljo, D., Brazauskas, A., Kaminskas, D., Martma, T., Musteikis, P. 2004. The Ludfordian carbon isotope excursion in the Vidukle core, Lithuania, its relations with the Lau Oceanic Event and environmental background in NW Baltica. *Berichte des Institutes für Erdwissenschaften Karl-Franzens-Universität Graz* 8, 60-62.
- Kiipli, T., Kallaste, T. 2005. Characteristics of Ordovician volcanic ash beds. In: Põldvere, A. (ed.). *Estonian Geological Sections. Bulletin 6. Mehikoorma (421) drill core [Põldvere, A. (Ed) Mehikoorma (421) drill core. Estonian Geological Sections]*. Geological Survey of Estonia, Tallinn. 6, 27-30.
- Kleesment, A. 2005. Devonian. In: Põldvere, A. (ed.). *Estonian Geological Sections. Bulletin 6. Mehikoorma (421) drill core*. Geological Survey of Estonia, Tallinn. 10-13.
- Leleshus, V., Mark-Kurik, E., Karatajute-Talimaa, V. 2005. Devonian fishes from Tajikistan. *Ichthyolith Issues, Special Publication. Middle Palaeozoic Vertebrates of Laurasia: Relationships with Siberia, Kazakhstan, Asia and Gondwana* 9, 22-26.
- Mark-Kurik, E. 2004. Buchanosteids (Placodermi, Arthrodira) from Central Asia. In: Arratia, G., Wilson, M.V.H., Cloutier, R. (eds.). *Recent Advances in the Origin and Early Radiation of Vertebrates. Honoring Hans-Peter Schultze*. Verlag F. Pfeil, München. 431-438.

- Mark-Kurik, E., Carls, P. 2004. Tityosteus, a marine fish (Arthrodira, Homostiidae) from the Emsian of Aragón, Spain, and its distribution. *Revista Española de Paleontología* 19(2), 139-144.
- Mark-Kurik, E., Karatajute-Talimaa, V. 2004. Chondrichthyan remains from the Middle and Late Devonian of the Baltic Area. *Archiv für Geschiebekunde* 3(8/12), 767-772.
- Mark-Kurik, E., Valiukevicius, J. 2005. Distribution of Devonian fossils. In: Põldvere, A. (ed.). Estonian Geological Sections. Bulletin 6. Mehikoorma (421) drill core. Geological Survey of Estonia, Tallinn. 6, 13-16.
- Martma, T. 2005. Ordovician carbon isotopes. In: Põldvere, A. (ed.). Estonian Geological Sections. Bulletin 6. Mehikoorma (421) drill core. 6, 25-27.
- Miidel, A., Raukas, A., Vaher, R. 2004. Geology of the lake basin. In: Haberman, J., Pihu, E., Raukas, A. (eds). Lake Võrtsjärv. Estonian Encyclopaedia Publishers, Tallinn. 33-47.
- Miller, C.G., Märss, T. 2004. Thelodonts and distribution of associated conodonts from the Llandovery - lowermost Lochkovian of the Welsh Borderland. Data associated with the paper by T. Märss and C.G. Miller published in the journal *Palaeontology*, Volume 47, Part 5. In Supplementary Publication of the British Lending Library. London. 90496, 7 pp.
- Moor, T., Raukas, A. 2004. Evolution of the lake. In: Haberman, J., Pihu, E., Raukas, A. (eds.). Lake Võrtsjärv. Estonian Encyclopaedia Publishers, Tallinn. 49-59.
- Männik, P., Viira, V. 2005. Distribution of conodonts. In: Põldvere, A. (ed). Estonian Geological Sections. Bulletin 6. Mehikoorma (421) drill core. 6, 16-20.
- Nemliher, J. 2005. Apatite as biosignature. In: Hoover, R. B., Rozanov A.Yu., Paepe, R. (eds). *Perspectives in Astrobiology*. IOS Press, Amsterdam, Berlin, Oxford, Tokyo, Washington. 81-85.
- Nõlvak, J. 2004. A glance at the history and geology of Tallinn. In: Hints, O., Ainsaar, L. (eds). WOGOGO-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 112-114.
- Nõlvak, J. 2004. A glimpse of the history and geology of Tallinn. In: Puura, I., Tuuling, I., Hang, T. (eds). The Baltic. The Eighth Marine Geological Conference. Abstracts. Excursion Guide. Institute of Geology, University of Tartu, Tartu. 71-74.
- Nõlvak, J. 2005. Distribution of Ordovician chitinozoans. In: Põldvere, A. (ed.). Estonian Geological Sections. Bulletin 6. Mehikoorma (421) drill core. Geological Survey of Estonia, Tallinn. 20-22, App. 26,27.
- Nõlvak, J., Hints, O., Pärnaste, H. 2004. Is the name 'Volkhovian' appropriate for the third global stage of the Ordovician System?. *Cordoba. Ordovician News* 21, 12-13.
- Punning, J.-M., Miidel, A. 2004. Postglacial uplift in western Estonia during the last four millennia. In: Punning, J.-M. (comp.). Estonia. Geographical Studies. Estonian Academy Publishers, Tallinn. 9, 7-16.
- Põldvere, A., Kleesment, A., Mens, K., Niin, M., Lääts, J. 2005. General geological setting and stratigraphy. In: Põldvere, A. (eds), Estonian Geological Sections, Bulletin 6, Mehikoorma (421) drill core, Geological Survey of Estonia. Eesti Geoloogiakeskus, Tallinn. 6-10
- Raukas, A. 2004. Bottom sediments. In: Haberman, J., Pihu, E., Raukas, A. (eds.). Lake Võrtsjärv. Estonian Encyclopaedia Publishers, Tallinn. 79-87.
- Raukas, A. 2004. Past pollution and its remediation in Estonia [Minevikus toimunud reostusest ja selle likvideerimisest eestis]. *Baltica* 17(2), 71-78.
- Raukas, A. 2004. Säätvast arengust ja geograafide panusest säästva arengu edendamisse [Sustainable development and contribution of geographers to its development]. In: Mander, Ü., Kurss, O (eds). Geograafilisi uurimusi aastatuhande vahetusel [Geographical studies at the turn of the millennium]. Tartu. 32-43.
- Raukas, A. 2004. Water Diving in the Past and Present. In: Petrosius, R. (ed.). Earth's Fields and their Influence on Organisms.

- Proceedings of the international seminar in Tomosava June 3-6. 3-6.
- Raukas, A., Tavast, E. 2005. Peipsi rannad, nende muutused ja kasutamisperspektiivid [The Coasts of Lake Peipsi, their Changes, and Preconditions of Development]. In: Eesti Mereakadeemia Toimetised [Proceedings of Estonian Maritime Academy]. Estonian Maritime Academy, Tallinn. 2, 82-95.
- Shogenova, A., Kleesment, A., Shogenov, V. 2005. Chemical composition and physical properties of the rock. In: Pöldvere, A. (ed.). Estonian Geological Sections. Bulletin 6. Mehikoorma (421) drill core. Geological Survey of Estonia, Tallinn. Bulletin 6, 31-38.
- Tavast, E. 2004. Shores. In: Haberman, J., Pihu, E., Raukas, A. (eds.). Lake Võrtsjärv. Estonian Encyclopaedia Publishers, Tallinn. 69-77.
- Tavast, E., Raukas, A. 2004. Shore changes of Estonian large lakes during the last two decades. In: Kaare, T., Punning, J.-M. (eds). Estonia. Geographical Studies 9. Estonian Academy Publishers, Tallinn. 17-29.
- Wilson, M.V.H., Märss, T. 2005. Anatomy of the Silurian thelodont *Phlebolepis elegans* Pander. *Journal of Vertebrate Paleontology (Supplement to No.3)* 27, 130A-131A.
- Karatajute-Talimaa, V., Märss, T. 2004. Thelodonti. In: Novitskaya, L. I., Afanassieva, O. B. (eds). [Fossil vertebrates of Russia and adjacent countries. Agnathans and early fishes] (In Russian). GEOS, Moscow. 12-68.
- Miidel, A. 2004. Main features of the geology of rivers. Haberman, J., Pihu, E., Raukas, A. (eds). Lake Võrtsjärv. Estonian Encyclopaedia Publishers, Tallinn. 61-66.
- Soesoo, A. 2005. Teaduslik pilk katastroofile [Scientific background of the disaster]. In: [Tsunami. Life after the disaster]. Tallinn. 243-262.
- Uutela, A., Nölvak, J. 2005. Suomenlahden geologinen historia [Geological history of the Gulf of Finland]. In: Pajanen, K., Soulanto, M., Sikk, E. (eds) Suomenlahti - alkumeresta nykymereksi [Finnish Gulf - from ancient to nowadays]. Sarmala OY, Helsinki. 12-17.

Books

- Hints, O. (ed.) 2004. *Institute of Geology 2003*. Institute of Geology at Tallinn University of Technology, Tallinn. 80 pp.
- Hints, O., Ainsaar, L. (eds) 2004. *WOGOGOB-2004 Conference Materials*. Tartu University Press, Tartu. 140 pp.
- Kaup, E. (scient. ed.) 2005. *Vorobjoff S. Po tu storonu zemnogo shara... [Vorobjoff S. To the other side of globe...]*. Imago, Riga. 1-289.
- Kiipli, E. 2005. *Modelling seawater chemistry of the East Baltic Basin in the Late Ordovician - Early Silurian* Thesis on Natural and Exact Sciences B42. Tallinn University of Technology Press, Tallinn. 1-158.
- Kink, H. 2004. *Hüdrogeoloogilised uuringud Geoloogia Instituudis aastail 1965-2003 [Hydrogeological studies at the Institute of Geology in years 1965-2003]*. Estonian Academy Publishers, Tallinn. 166.
- Kink, H. (comp.), Miidel, A., Raukas, A. (eds) 2004. *Loodusmälestised 11. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lügánuse, Aseri, Viru-Nigula [Natural Heritage of Estonia 11. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lügánuse, Aseri, Viru-Nigula]*. Estonian Academy Publishers, Tallinn. 1-47.
- Kink, H. (comp.), Miidel, A., Raukas, A. (eds) 2004. *Loodusmälestised 12. Harjumaa, Raplamaa - ümber Mahtra soostiku. Kose, Kõue, Kohila, Kaiu, Juuru [Natural Heritage of Estonia 12. Harjumaa, Raplamaa - around the Mahtra mire system. Kose, Kõue, Kohila, Kaiu, Juuru]*. Estonian Academy Publishers, Tallinn. 1-46.

- Kink, H. (comp.), Miidel, A., Raukas, A. (eds) 2004. *Loodusmälestised 13. Ida-Virumaa. Illuka, Mäetaguse, Iisaku, Alajõe [Natural Heritage of Estonia 13. Ida-Virumaa. Illuka, Mäetaguse, Iisaku, Alajõe]*. Estonian Academy Publishers, Tallinn. 1-47.
- Kink, H. (comp.), Miidel, A., Raukas, A. (eds) 2004. *Loodusmälestised 14. Ida-Virumaa Sonda, Maidla, Tudulinna, Avinurme, Lohusuu [Natural Heritage of Estonia 14 Ida-Virumaa Sonda, Maidla, Tudulinna, Avinurme, Lohusuu]*. Estonian Academy Publishers, Tallinn. 1-32.
- Kink, H. (comp.), Miidel, A., Raukas, A. (eds) 2004. *Loodusmälestised 15. Lääne-Virumaa. Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu [Natural Heritage of Estonia 15. Lääne-Virumaa. Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu]*. Estonian Academy Publishers, Tallinn. 1-39.
- Mõtus, M.-A. 2005. *Silurian (Llandovery-Wenlock) tabulate corals of Balto-scandia: taxonomy, palaeoecology, distribution*. Dissertationes Geologicae Universitatis Tartuensis. Tartu University Press, Tartu. 1-167.
- Nestor, H., Raukas, A., Veskimäe, R. (eds). 2004. *Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]*. Tallinn. 328 pp.
- Pärnaste, H. 2004. *Early Ordovician trilobites of suborder Cheirurina in Estonia and NW Russia: systematics, evolution and distribution*. Tartu University Press, Tartu. 1-138.
- Soesoo, A. (ed.) 2004. *Proceedings of the Estonian Academy of Sciences, Geology. Special issue on the Precambrian basement of Estonia*. Estonian Academy Publishers, Tallinn. 53(3), 83 pp.

Conference abstracts

- Achab, A., Paris, F., Nölvak, J., Asselin, A. 2004. Patterns on Ordovician chitinozoan biodiversity. In: XI International Palynological Congress. Granada. *Polen* 14, 139.
- Achab, A., Paris, F., Nölvak, J., Asselin, E. 2004. Patterns and driving factors of the chitinozoan diversification during the Ordovician. In: Munnecke, A., Servais, T., Schulbert, C. (eds). International Symposium on Early Palaeozoic Palaeogeography and Palaeoclimate. September 1-3, 2004, Erlangen, Germany. Institut für Geologie der Universität Erlangen-Nürnberg, Erlangen. *Erlangen Geologische Abhandlungen* 5, 17.
- Alliksaar, T., Heinsalu, A. 2005. A switch from a clear macrophyte dominated state to a turbid phytoplankton-prevailing aquatic ecosystem as shown by sedimentary evidence from a shallow hard-water lake. In: Book of Abstracts. Shallow Lakes 2005, 5-9 June Dalfsen, The Netherlands. 68-69.
- Alliksaar, T., Heinsalu, A., Saarse, L., Salujõe, J., Veski, S. 2004. A 600-year decadal scale record of lake response to catchment land use from annually laminated lake sediments in southern Estonia. In: Societas Internationalis Limnologiae (SIL) XXIX Congress, Lahti Finland, 8-14 August 2004. Book of Abstracts. 163.
- Beznosova, T., Majdl', T., Männik, P. 2005. Yaptiknyrd Formation – a new stratigraphical unit proposed for the uppermost Ordovician strata in the Subpolar Urals. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg. 14-16.
- Beznosova, T.M., Majdl', T.V., Männik, P., Martma, T., Lukin, Yu.V., Pashnin, A.I. 2004. Granica ordovika i silura na Pripoljarnom Urale: novye rezul'taty i problemy [The Ordovician-Silurian boundary in the Subpolar Urals: new results and problems]. In: Yuðkin, N. P. (otv. red.). Geologija i mineral'nye resursy evropejskogo severo-vostoka Rossii: Materialy XIV Geologicheskogo s'ezda Respubliki

- Komi, T. IV [Yushkin, N. P. (ed.) Geology and mineral resources of the European NE of Russia: Materials of the XIV Geological Congress of Komi Republic. Vol. IV]. Geoprint, Syktyvkar. 224-227.
- Bitjukova, L., Limberg, M. 2005. Complex study of composition of building stones of the historical objects in Tallinn (Estonia) and assessment of stone deterioration on the base of geochemical data. In: General Assembly of the EGU. Geophysical Research Abstracts. 7(01170), 4.
- Blom, H., Märss, T. 2005. The dermal skeleton and distribution of osteostracans from the Silurian of the Baltic Region. In: Middle Palaeozoic vertebrates of Laurussia: relationships with Siberia, Kazakhstan, Asia and Gondwana. St. Petersburg, Russia, August 22-25, 2005. *Ichthyolith Issues Special Publications 9*, 7-8.
- Bolikhovskaya, N.S., Molodkov, A.N. 2004. Correlation of the climate changes over the last 200 ka recorded in long loess-palaeosol pollen profiles and ESR-dated marine deposits of Northern Eurasia. In: Proceedings of XI International Palynological Congress. Spain, University of Granada. 14, 258.
- Bolikhovskaya, N.S., Molodkov, A.N. 2005. New results of palyno-chronostratigraphical analyses of Late Pleistocene deposits from North-Eastern Estonia, the Voka section. In: Proceedings of the XI All-Russian Palynological Conference. 2, 3-4.
- Dronov, A., Kaljo, D., Meidla, T., Ainsaar, L., Einasto, R., Hints, L., Hints, O., Nestor, H., Nõlvak, J., Rubel, M., Saadre, T., Tinn, O., Tolmacheva, T. 2005. Sea-level curve for the Ordovician of Baltoscandia: contradictions, problems and approaches. In: Koren, T., Evdokimova, I., Tolmacheva T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg State University, St. Petersburg. 24-26.
- Elliott, D.K., Mark-Kurik, E. 2004. The sensory line system in psammosteid heterostracans: a review. In: 10th International Symposium on Early Vertebrates/Lower Vertebrates, Gramado, Brazil, 2004. Abstracts for talks and posters. Universidade Federal do Rio Grande do Sul, Gramado. 18-19.
- Elliott, D.K., Mark-Kurik, E., Daeschler, E.B. 2005. A preliminary vertebrate correlation of the Devonian of the Baltic Region and Canadian Arctic. *Ichthyolith Issues. Special Publication. Middle Palaeozoic Vertebrates of Laurasia: Relationships with Siberia, Kazakhstan, Asia and Gondwana 9*, 9-12.
- Eriksson, M., Hints, O. 2004. Diversity trends of Ordovician jawed polychaetes. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 29-30.
- Eriksson, M., Hints, O. 2004. Ordovician jawed polychaetes and their diversification. In: Eighth International Polychaete Conference. 5-9 July 2004. Program & Abstracts. University of Madrid, Madrid. 66.
- Hang, T., Wastegård, S., Veski, S., Heinsalu, A. 2004. First discovery of Icelandic tephra in Holocene peat deposits of Estonia. In: Zelcs, V., Seglins, V. (eds). International Field Symposium on Quaternary Geology, Modern terrestrial processes in Western Latvia, September 12-17, 2004 Abstract volume. 17-18.
- Harris, M., Sheehan, P., Ainsaar, L., Hints, L., Männik, P., Nõlvak, J., Rubel, M. 2005. The Lower Silurian of Estonia: facies, sequences and basin filling. In: Koren, T., Evdokimova, I., Tolmacheva T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg State University, St. Petersburg. 30-33.
- Harris, M.T., Schultz, T., Sheehan, P.M., Ainsaar, L., Nõlvak, J., Hints, L., Männik, P., Rubel, M. 2004. The Upper Ordovician of Estonia: Facies, Sequences and Basin Evolution. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 37-38.
- Harris, M.T., Schultz, T., Sheehan, P.M., Ainsaar, L., Nõlvak, J., Hints, L., Männik,

- P., Rubel, M. 2005. The Upper Ordovician Of Estonia: Facies, Sequences, And Basin Evolution. In: Insight, A Milwaukee Public Museum Series in Natural History. Milwaukee Public Museum, Milwaukee. 2, 11-12.
- Heinsalu, A. 2004. The Yoldia Sea stage in the Gulf of Finland. In: Puura, I., Tuuling, I., Hang, T. (eds). The Baltic. The Eighth Marine Geological Conference Abstracts. Excursion Guide. Institute of Geology, University of Tartu, Tartu. 79.
- Heinsalu, A., Alliksaar, T., Leeben, A., Nöges, T. 2005. Sediment diatom assemblages and composition of pore-water dissolved organic matter as indicators of eutrophication history of large shallow Lake Peipsi. In: Book of Abstracts. Shallow Lakes 2005, 5-9 June Dalfsen, The Netherlands. 80.
- Heinsalu, A., Leeben, A., Salujõe, J., Veski, S. 2005. Reconstruction of past water quality for shallow hypereutrophic Lake Harku, Tallinn, Estonia using paleolimnological analysis. In: Book of Abstracts. Shallow Lakes 2005, 5-9 June Dalfsen, The Netherlands. 79-80.
- Heinsalu, A., Veski, S. 2005. A 1000-year bidecadal scale record of lake response to catchment land use from annually laminated lake sediments in southern Estonia. In: Nordic Diatomists Meeting 20-23 May 2005 Muhu Island, Estonia Programme & Abstract. p. 7.
- Hints, L., Harper, D.A.T. 2005. Hirnantia brachiopodifaunad Baltoskandias [Hirnantian Brachiopod Faunas in Baltoscandia.]. In: Fifth International Brachiopod Congress. Abstracts. Compiled and edited by Hatper, D.A.T., Long, S. L. and McCorry M. [In Fifth International Brachiopod Congress. Abstracts. Compiled and edited by Hatper, D.A.T., Long, S. L. and McCorry M.]. Copenhagen. 5(1), 16.
- Hints, L., Miidel, A. 2004. Late Ordovician ripple marks in Vasalemma quarry, NW Estonia. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 39-40.
- Hints, L., Nölvak, J., Männik, P., Oraspöld, A. 2005. Proposal for the boundary stratotype of the Pirgu Regional Stage (upper Ordovician) in the East Baltic. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg State University, St. Petersburg. 34-37.
- Hints, L., Oraspöld, A., Nölvak, J. 2004. Pirgu Stage in the East Baltic: lithotypes, biozonation and problems of correlation. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 41-42.
- Hints, O. 2004. Discovery of Lower Ordovician scolecodonts from Baltica. In: Abstracts XI International Palynological Congress. *Polen* 14, 420-421.
- Hints, O., Eriksson, M. 2004. Early diversification of jaw-bearing polychaetes. In: Munnecke, A., Servais, T., Schulbert, C. (eds). International Symposium on Early Palaeozoic Palaeogeography and Palaeoclimate. September 1-3, 2004, Erlangen, Germany. Institut für Geologie der Universität Erlangen-Nürnberg, Erlangen. *Erlanger geologische Abhandlungen* 5, 41.
- Hints, O., Eriksson, M. 2004. Preliminary report on Silurian scolecodonts from Saaremaa Island, Estonia. In: Abstracts XI International Palynological Congress. *Polen* 14, 421-422.
- Hints, O., Killing, M., Männik, P., Nestor, V. 2005. Frequency patterns of chitinozoans and scolecodonts across the Llandovery-Wenlock boundary interval in the Paatsalu drill core, western Estonia. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg State University, St. Petersburg. 37-40.
- Hints, O., Killing, M., Männik, P., Nestor, V. 2005. Microfossil Frequency Patterns in the Llandovery–Wenlock Boundary Interval of Western Estonia. In: Sheehan, P.M., Servais, T. (eds). Abstracts for the Second International Symposium of IGCP503 on

- Ordovician Palaeogeography and Palaeoclimate [Insight, A Milwaukee Public Museum Series in Natural History]. Milwaukee Public Museum, Milwaukee. 2, 14-15.
- Hints, O., Nõlvak, J., Mens, K., Viira, V. 2004. New palaeontological finds from the Tremadocian of Kadriorg, Tallinn, North Estonia. In: Hints, O., Ainsaar, L. (eds). WOGOGO-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 43-44.
- Hints, O., Nõlvak, J., Viira, V. 2005. Microfossil dynamics and biostratigraphy in the Uhaku-Kukruse boundary interval (Ordovician) of NE Estonia. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg State University, St. Petersburg. 40-42.
- Isaksson, E., Igarashi, M., Kekonen, T., Kohler, J., Martma, T., Meijer, H., Moore, J., Motoyama, H., Mulvaney, R., Pohjola, V., Vaikmäe, R., van de Wal, R.S.W., Watanabe, O. 2004. Using Svalbard ice cores to investigate climate and sea ice variability during the last 800 years. *GFF, The 26th Nordic Geological Winter Meeting* 126, 129.
- Isaksson, E., Kohler, J., Pohjola, V., Moore, J., Igarashi, M., Karlöf, L., Martma, T., Meijer, H., Motoyama, H., Vaikmäe, R., van de Wal, R. 2004. Using two ice core delta-O-18 records from Svalbard to illustrate climate and sea ice variability over the last 400 years. In: International Symposium on Arctic Glaciology, Geilo, Norway, Abstracts.
- Ivask, J. 2004. Estonian National Antarctic Data Centre report. In: Terra Nostra. Selbstverlag der Alfred-Wegener-Stiftung, Berlin. 4, 355.
- Ivask, J., Vaikmäe, R. 2004. Dome B ice core major ions concentration profiles and their relation to climate change during last deglaciation period. In: Terra Nostra. Selbstverlag der Alfred-Wegener-Stiftung, Berlin. 4, 225.
- Kaljo, D. 2004. Role of rugose corals and some environmental factors in late Ordovician biodiversity changes in Baltoscandia. In: 32nd International Geological Congress - Florence, 2004. Program and Abstracts. Session G17.03. CD-ROM.
- Kaljo, D. 2005. A sea-way through central Baltica in the Ordovician and Silurian (ideas and evidences)?: In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg State University, St. Petersburg. 47.
- Kaljo, D., Martma, T. 2005. Dating of Silurian rocks: views about bio- and/or carbon isotope stratigraphy. In: Eriksson M. E., Calner, M. (Eds). The Dynamic Silurian Earth. Subcommission on Silurian Stratigraphy Field Meeting 2005, Field Guide and abstracts. 72.
- Kaljo, D., Martma, T. 2005. Ordovician and Silurian carbon isotope stratigraphy of western Baltica: a state of art report. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. 48-49.
- Kaljo, D., Martma, T., Neuman, B.E.E., Rønning, K. 2004. Carbon isotope dating of several uppermost Ordovician and lower Silurian sections in the Oslo Region, Norway. In: Hints, O., Ainsaar, L. (eds). WOGOGO-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 51-52.
- Kaljo, D., Martma, T., Saadre, T. 2004. Ordovician carbon isotope trend based on Baltoscandian data: some aspects of composition and environmental interpretation. In: Munnecke, A., Servais, T., Schulbert, C. (eds).. Institut für Geologie der Universität Erlangen-Nürnberg, Erlangen. *Erlangen Geologische Abhandlungen* 5, 44.
- Karukäpp, R., Raukas, A. 2004. Late glacial ice streams in southern Estonia and northern Latvia. In: Zelcs, V., Seglins, V. (eds). International Field Symposium on Quaternary Geology and Modern Terrestrial Processes, Western Latvia, Sept. 12-17, 2004: Abstracts of Papers and Posters. University of Latvia, Riga. 28-30.

- Kaup, E. 2004. Development of anthropogenic eutrophication in Antarctic lakes. In: *Societas Internationalis Limnologiae (SIL) XXIX Congress, Lahti Finland, 8-14 August 2004. Book of Abstracts.* 262.
- Kaup, E. 2004. Spring through autumn changes of photosynthetically active radiation in the water columns of the freshwater lakes of Bungar and Thala Hills. In: *SCAR Open Science Conference, 25-31 July 2004, Bremen, Germany. Abstract volume. Alfred-Wegener-Stiftung, Berlin.* 115.
- Kaup, E. 2005. Human impacts in catchments and lakes of Schirmacher, Thala and Larsemann oases. In: *Terra Nostra, Schriften der Alfred-Wegener-Stiftung [Terra Nostra, Proceedings of the Alfred Wegener Stiftung]. Selbstverlag der GeoUnion Alfred-Wegener-Stiftung, Berlin.* 3, 78.
- Kaup, E. 2005. Variations of trophic status in the water bodies of the Bungar Hills. In: *Abstracts of the IX SCAR International Biology Symposium: Evolution and Biodiversity in Antarctica, Curitiba (Brazil), 25-29 July 2005.* 190.
- Kiipli, E., Kallaste, T., Kiipli, T. 2004. Metabentonites of the Pirgu Stage (Ashgill, Upper Ordovician) of the East Baltic. In: *Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu.* 53-54.
- Kiipli, E., Kiipli, T. 2005. Ca-carbonate dissolution in the East Baltic deep shelf in the Ashgill and Llandovery (Ordovician-Silurian). In: *Eriksson M. E., Calner, M. (Eds). The Dynamic Silurian Earth. Subcommission on Silurian Stratigraphy Field Meeting 2005, Field Guide and abstracts. Geological Survey of Sweden, Rapport och meddelanden 121, 73 - 74.*
- Kiipli, T., Kallaste, T. 2005. Correlation of Silurian bentonites based on the composition of sanidine phenocrysts. In: *Eriksson M. E., Calner, M. (Eds). The Dynamic Silurian Earth. Subcommission on Silurian Stratigraphy Field Meeting 2005, Field Guide and abstracts. Geological Survey of Sweden, Rapport och meddelanden 121, 74 - 75.*
- Kiipli, T., Kallaste, T., Kiipli, E. 2004. Areal variations in the composition of the Kinnekulle altered volcanic ash bed (Caradoc) - relations to sedimentary facies. In: *Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu.* 55-56.
- Kiipli, T., Kiipli, E., Kallaste, T. 2004. Record of Ordovician and Silurian volcanism in Estonian sections - prospect of research. In: *Buggisch, W. (ed). Early Palaeozoic Palaeogeography and Palaeoclimate, Conference Abstracts, Erlanger Geologische Abhandlungen, Sb 5. University of Erlangen-Nürnberg.* 45-46.
- Kink, H. 2004. Balti klint - UNESCO kultuuri- ja looduspärandi nimekirja kandidaat [Baltic Klint - national candidate for UNESCO World Heritage list]. In: *Eesti Geoloogiakeskuse infoleht [Newsletter of the Geological Survey of Estonia].* 10, 13-14.
- Kirsimäe, K., Hints, R., Kallaste, T., Kiipli, E., Kiipli, T. 2004. Chloritization of Upper Ordovician Pirgu bentonites - source material or diagenetic environment?. In: *Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu.* 57-58.
- Kohler, J., Nordli, Ø., Isaksson, E., Pohjola, V., Martma, T. 2004. Multi-proxy extension of the winter temperature record from Svalbard Airport. In: *American Geophysical Union, Fall Meeting 2004, abstract GC44A-02.*
- Kohler, J., Nordli, Ø., Isaksson, E., Pohjola, V., Martma, T. 2005. Multi-proxy extension of the Svalbard Airport winter temperature record. In: *Ahlström, A.P. and Bøggild, C.E. (eds). Nordic Glaciology - Extended abstracts of the International Glaciological Society Nordic Branch Meeting 3-5 November 2005. Geological Survey of Denmark and Greenland. 2005(67), 25.*
- Korhonen, J.V., Aaro, S., All, T., Elo, S., Kulnich, A., Skilbrei, J.R., Säavuori, H., Vaher, R., Zhdanova, L., Koistinen, T. 2004. Bouguer anomaly map of the Fennoscandian

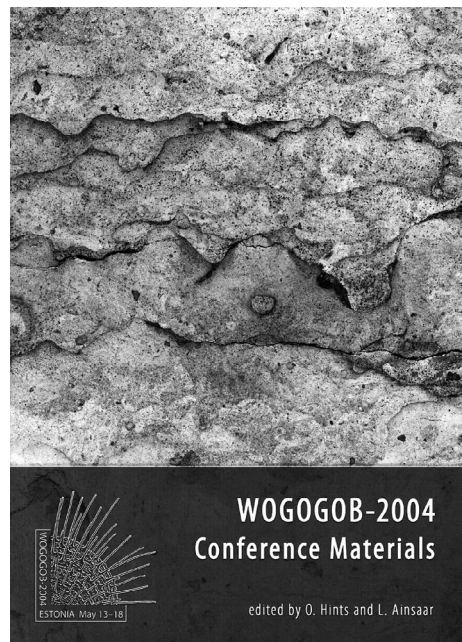
- dian Shield 1:2 000 000. In: 32nd International Geological Congress. Abstract Volume. Florence. 565.
- Korsakova, O.P., Molodkov, A.N., Kolka, V.V. 2004. Late Pleistocene interglacial marine sequences in White Sea depression (Kola Peninsula, NW Russia): timing, stratigraphic position and conditions of formation. In: Zelas, V., Seglins, V (eds). International Field Symposium on Quaternary Geology and Modern Terrestrial Processes, Western Latvia, September 12-17, 2004. Abstracts of Papers and Posters. Riga, University of Latvia. 34-35.
- Leeben, A., Heinsalu, A., Alliksaar, T., Saarse, L. 2004. A high-resolution spectroscopic study of porewater dissolved organic matter in annually laminated lake sediments: A new tool for reconstructing lake eutrophication. In: Societas Internationalis Limnologiae (SIL) XXIX Congress, Lahti Finland, 8-14 August 2004. Book of Abstracts. 163.
- Leslie, S.A., Goldman, D., Young, S.A., Saltzman, M.R., Nölvak, J. 2004. The Black Knob Ridge section, Southeastern Oklahoma, USA: A possible global stratotype section and point (GSSP) for the base of the *Diplacanthograptus caudatus* biozone and the Middle Stage of the Upper Ordovician. In: GSA Abstracts with Programs. Geological Society of America, Denver. 36(5), 75.
- Loydell, D.K., Nestor, V. 2005. Isolated Llandovery graptolites from Baltica. In: Eriksson M. E., Calner, M. (Eds). The Dynamic Silurian Earth. Subcommission on Silurian Stratigraphy Field Meeting 2005, Field Guide and abstracts. Geological Survey of Sweden. 78,
- Luup, H., Alliksaar, T., Heinsalu, A., Nöges, P., Nöges, T. 2005. Linking sediment diatoms, water-level changes and climate: a comparison of historic and sediment core records within Lake Võrtsjärv, Estonia. In: Book of Abstracts. Shallow Lakes 2005, 5-9 June Dalfsen, The Netherlands. 41-42.
- Luup, H., Alliksaar, T., Heinsalu, A., Nöges, P., Nöges, T. 2005. Linking sediment diatoms, water-level changes and climate: a comparison of historic and sediment core records within Lake Võrtsjärv, Estonia. In: Nordic Diatomists Meeting 20-23 May 2005 Muhu Island, Estonia Programme & Abstract. p. 10.
- Lääts, J 2005. New Data on the Blidene Formation (Upper Ordovician) in the Central East Baltic. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg State University, St. Petersburg. 65-67.
- Marini, F., Raukas, A. 2004. Lechatelierite-bearing microspherules from burning oil shales (Kiviõli, Estonia): contribution to the contamination problem of natural microtektites. In: Zelas, V., Seglins, V (eds.). International Field Symposium on Quaternary Geology and Modern Terrestrial Processes, Western Latvia, Sept. 12-17,2004: Abstracts of Papers and Posters. University of Latvia, Riga. 39-41.
- Martma, T., Kaljo, D. 2005. Ordovician and Silurian carbon isotope trend: a state of art report based on the East Baltic data. In: ESIR VIII Workshop, Extended Abstract Volume. Leipzig-Halle. *UFZ-Report* 02/2005, 133-135.
- Martma, T., Pohjola, V., Isaksson, E., Kohler, J., Moore, J., Sjögren, B. 2004. Spatial and temporal variability of $\delta^{18}\text{O}$ over the ice field Lomonosovfonna, Svalbard. In: International Symposium on Arctic Glaciology, Geilo, Norway. Abstract No 122.
- Martma, T., Punning, J.-M., Vaikmäe, R. 2004. Isotope-glaciological studies on Svalbard. In: XIII Glaciological Symposium, St.-Petersburg, May 24-28, 2004. 28.
- Miidel, A., Raukas, A. 2004. Mass movements related to the Baltic Klint, Estonia. In: Mrozek, T., Nescieruk, P. (eds). Risks caused by the geodynamic phenomena in Europe, 20-22 May 2004, Wysowa, Poland. Abstracts and Field-trip Guide-book. Polish Geological Institute, Warsaw. 29-31.
- Molodkov, A. 2005. IRSL dating of uranium-rich deposits from the new Late Pleistocene section at the Voka site, NE Estonia.

- In: 11th International Conference on Luminescence and Electron Spin Resonance Dating, University of Cologne, Germany, 24 – 29th of July 2005. Book of Abstracts. 131.
- Molodkov, A., Bolikhovskaya, N. 2005. The first results of palyno-chronostratigraphical studies of Late Pleistocene deposits from Voka section, North-Eastern Estonia. In: IV All-Russian Conference on Quaternary Research, Syktyvkar, Komi Republic, 23-26 August 2005. Proceedings of the Conference. 285-287.
- Molodkov, A., Bolikhovskaya, N. 2004. A new Weichselian site in Northeast Estonia: expectations induced by pollen and ESR palaeoenvironmental records from Northern Eurasia. In: Zelcs, V., Seglins, V (eds). International Field Symposium on Quaternary Geology and Modern Terrestrial Processes, Western Latvia, September 12-17, 2004, Abstracts of Papers and Posters.
- Molodkov, A., Bolikhovskaya, N. 2004. Late Quaternary palaeoenvironmental changes as derived from long loess-palaeosol pollen profiles and ESR-dated marine deposits of Northern Eurasia. In: Reconstruction of Quaternary palaeoclimate and palaeoenvironments and their abrupt changes. Białowieża, Poland, September 29th – October 2nd, 2004. Book of Abstracts.
- Molodkov, A., Bolikhovskaya, N. 2005. A 200,000 year palyno-chronostratigraphical record of vegetation, sea-level and climatic changes in Northern Eurasia. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. 77-80.
- Molodkov, A., Bolikhovskaya, N. 2005. A new Late Pleistocene site in North-Eastern Estonia: preliminary palyno- and chronostratigraphical results from the Voka section. In: International Field Symposium on Quaternary Geology and Landforming Processes, Kola Peninsula, NW Russia September 4-9, 2005, Proceedings of the Symposium. 39-41.
- Molodkov, A., Bolikhovskaya, N. 2005. Periodization, correlation and absolute age of palaeoclimatic events over the last 200 ka based on palynological and electron spin resonance data.. In: Proceedings of the XI All-Russian Palynological Conference II, Moscow 27 Sept. – 01 Oct. 2005. 171-172.
- Molodkov, A., Jaek, I., Vasilchenko, V. 2004. Anomalous fading of IR-stimulated luminescence from feldspars: preliminary results of the search. In: Book of abstracts of 8th International Conference “Methods of absolute chronology” Ustron, Poland. Gliwice, Poland. 110-111.
- Männik, P. 2004. Recognition of the Mid-Caradoc Event in the conodont sequence of Estonia. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 63-64.
- Männik, P. 2005. Early Telychian Valgu Event – some preliminary data from Estonia. In: Podobina, V. M. (ed.). Evolution of life on the Earth: Proceedings of the III International Symposium, November 1-3, 2005, Tomsk. Tomsk State University, Tomsk. 134-137.
- Männik, P., Beznosova, T., Martma, T. 2004. Ordovician–Silurian boundary in the Subpolar Urals, some new developments. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 65-66.
- Märss, T. 2004. Early Agnathans and Fishes of the Palaeobaltic and Surrounding Seas. In: XI European Congress of Ichthyology (ECI XI). September 6-10, 2004, Tallinn, Estonia. Abstract Volume. 187-188.
- Märss, T. 2004. Ultrasculpture pattern on the exoskeleton of lower vertebrates. In: 10th International Symposium on Early Vertebrates/Lower Vertebrates. Gramado, 24-28th May 2004. Programme and abstracts volume. Universidade Federal do Rio Grande do Sul. 25-26.
- Nemliher, H., Viira, V., Mens, K. 2005. Lower Ordovician Letsee Formation in the North Estonian Clint Area. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St.

- Peterburg State University, St. Peterburg.
- Nemliher, J., Puura, I. 2005. Shell mineralogy of Cambrian linguloids from the Obolus sandstone of Estonia and NW Russia. In: Harper, D., A., Long, S. L., McCorry M. (eds). Fifth International Brachiopod Congress. Abstracts. Geological Survey of Denmark and Greenland, Copenhagen. 24.
- Nielsen A.B., Poska A., Veski S., Kangur M., Sepp E., Koppel K., Odgaard, B. 2005. The use of historical maps in pollen-vegetation calibration and landscape reconstruction. In: First joint HITE-POLLANDCAL Conference: Human impact on terrestrial ecosystems on long to short term scales with an emphasis on pollen calibration and quantitative reconstruction of past land-cover changes. SLU, Umea. 28.
- Niit, M., Kleesment, A., Märss, T. 2005. Vertebrate microremains in the sections of the Aruküla Regional Stage of Estonia and comparison with the Burtnieki Regional Stage. In: Middle Palaeozoic vertebrates of Laurussia: Relationships with Siberia, Kazakhstan, Asia and Gondwana. St. Petersburg, Russia, August 22-25, 2005. *Ichthyolith Issues Special Publication* 9, 27-29.
- Nõges, T., Alliksaar, T., Heinsalu, A., Järvet, A., Kisand, A., Laugaste, R., Loigu, E., Luup, H., Nõges, P. 2005. Consequences of changed nutrient loading and climate changes on the ecological status of large, shallow, temperate lakes Võrtsjärv and Peipsi, Estonia. In: Book of Abstracts. Shallow Lakes 2005, 5-9 June Dalfsen, The Netherlands. 46-47.
- Nõges, T., Alliksaar, T., Heinsalu, A., Nõges, P. 2004. A paleolimnological assessment of recent eutrophication history on large inland water body, Lake Peipsi, Estonia. In: Societas Internationalis Limnologiae (SIL) XXIX Congress, Lahti Finland, 8-14 August 2004. Book of Abstracts. 231.
- Nõlvak, J. 2004. Ordovician chitinozoan distribution in the different areas of Baltoscandia. In: Munnecke, A., Servais, T., Schulbert, C. (eds). International Symposium on Early Palaeozoic Palaeogeography and Palaeoclimate. September 1-3, 2004, Erlangen, Germany. Institut für Geologie der Universität Erlangen-Nürnberg, Erlangen. *Erlangen Geologische Abhandlungen* 5, 56.
- Nõlvak, J. 2005. Some Improvements To The Ordovician Chitinozoan Biozonation Scheme Of Baltoscandia. In: Abstracts for the Second International Symposium of IGCP503 on Ordovician Palaeogeography and Palaeoclimate. Insight, A Milwaukee Public Museum Series in Natural History. Milwaukee. 2, 23-24.
- Nõlvak, J., Goldman, D. 2004. Distribution of *Nemagraptus* in the East Baltic Ordovician. In: Hints, O., Ainsaar, L. (eds). WOGOGO-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 75-76.
- Nõlvak, J., Hints, O. 2005. Ordovician chronostratigraphy in Estonia: current state and future prospects. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. VSEGEI, St. Petersburg State University, St. Petersburg. 84-85.
- Nõlvak, J., Männik, P., Martma, T. 2004. New biostratigraphic and isotopic data from the Ordovician–Silurian boundary beds in the Copenhagen Canyon section, Nevada. In: Hints, O., Ainsaar, L. (eds). WOGOGO-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 77-78.
- Pohjola, V., Sjögren, B., Martma, T., Isaksson, E., Kohler, J., Moore, J. 2005. Water isotopes, ice cores and climate. In: Ahlström, A.P. and Bøggild, C.E. (eds). Nordic Glaciology - Extended abstracts of the International Glaciological Society Nordic Branch Meeting 3-5 November 2005. Geological Survey of Denmark and Greenland. 2005(67), 43.
- Poska, A., Meltsov, V., Vassiljev, J. 2005. Estimating pollen productivity of major wind-pollinating taxa in boreo-nemoral forest zone. Preliminary results. In: INQUA PMP V Conference. Abstracts. University of Varna, Varna. 23.

- Puura, I., Viira, V. 2004. Tracing the base of the Ordovician System in Baltoscandia. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 85-86.
- Puura, V., Floden, T., Mokrik, R., All, T., Kirs, J., Konsa, M., Soesoo, A., Urtson, K. 2004. Geological structure of the Baltic seabed. In: Puura, I., Tuuling, I., Hang, T. (eds). The Baltic. The Eighth Marine Geological Conference Abstracts. Excursion Guide. Tartu. 44.
- Põllumaa, L., Bityukova, L., Petersell, V., Sorlie, J.-E., Kahru, A. 2004. How hazardous is the oil-shale industry waste: Estonian experience. International NATO Advanced Research Workshop "Bioremediation of soils contaminated with aromatic compounds: effects of Rhizosphere, bioavailability, gene regulation and stress adaptation". 1-3 July, Tartu, Estonia. Abstracts.
- Pärnaste, H. 2004. The trilobite zonation of the Billingen Stage in the East Baltic. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 81-82.
- Pärnaste, H. 2005. Trilobites described by W. Lamansky. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. St. Petersburg. 94-95.
- Raukas, A., Zelcs, V. 2004. Aleksis Dreimanis - a living legend of the Quaternary. In: Zelcs, V., Seglins, V. (eds). International Field Symposium on Quaternary Geology and Modern Terrestrial Processes, Western Latvia, Sept. 12-17, 2004: Abstracts of Papers and Posters. University of Latvia, Riga. 7-8.
- Rosentau, A., Vassiljev, J., Saarse, L., Miidel, A. 2005. Shoreline reconstruction of the proglacial lakes in Estonia. In: Uscinowicz, S., Zachowicz, J. (eds.). Related sea-level changes - from subsiding to uplift coasts. 19-20 June 2005, Gdansk, Poland. Abstracts. Polish Geological Institute, Gdansk. 43-44.
- Saarse, L. 2004. Holocene isochrone maps and patterns of tree spreading in Estonia. Proceedings of International Symposium on Earth System Sciences 2004, Istanbul - Turkey. Kelebek & Grafika Grup, Istanbul. 115-129.
- Saarse, L. 2005. Tree arrival and spread in Estonia and adjoining areas. In: Koren, T., Evdokimova, I., Tolmachova T. (eds). The Sixth Baltic Stratigraphical Conference, August 23-25 St. Petersburg, Russia. St. Petersburg. 110-113.
- Saarse, L., Niinemets, E. 2005. Lake sediment composition changes during the last 700 years. In: Kolka, V., Korsakova, O. (eds.). Quaternary Geology and landforming processes. Proceedings of the International Field Symposium. Apatity. 54-56.
- Seppä, H., Veski, S. 2004. The cold event 8200 years ago in Estonia. In: Geologian 3. tutkijapäivät 10.-11.3. 2004 Helsinki, Book of Abstracts. 18.
- Shogenova, A. 2004. Geostatistic modelling of primary and diagenetic processes in the Ordovician sedimentary basin of Estonia. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. 92-93.
- Shogenova, A., Kleesment, A., Jõelett A., Shogenov, V. 2004. Influence of diagenetic changes on the composition and properties of the Vendian and Palaeozoic rocks of Estonia. In: Puura, I., Tuuling, I., Hang, T. (eds). The Baltic. The Eighth Marine Geological Conference. Abstracts. Excursion Guide. Institute of Geology, University of Tartu, Tartu. 50.
- Shogenova, A., Kleesment, A., Jõelett, A. 2004. Carbonate and siliciclastic lithologies analysis by rock physics data from Estonian part of Baltic Palaeozoic sedimentary basin. In: 32nd International Geological Congress, Florence, Italy, August 20-28, 2004, Scientific Sessions: abstracts (part2). IUGS, Italy. 2(202-8), 951.
- Shogenova, A., Kleesment, A., Shogenov, V., Jõelett, A. 2004. Magnetic properties of Devonian carbonate-siliciclastic rocks from Estonia. Geophysical Institute,

- Slovak Academy of Sciences, Bratislava. *Contributions to Geophysics & Geodesy, Paleo, Rock and Environmental Magnetism, 9th Castle Meeting, Special Issue 34*, 132-133.
- Shogenova, A., Kleesment, A., Teedumäe, A. 2004. Variability of dolomitization styles in the Northern part of the Baltic Palaeozoic sedimentary basin. In: 32nd International Geological Congress, Florence, Italy, August 20-28, 2004, Scientific Sessions: abstracts (part 1). IUGS, Italy. 1(179-6), 830.
- Soesoo, A. 2005. Mesozoic mafic dykes in eastern Victoria, Australia - a possible markers of the early stages of Gondwana break-up [of the early stages of Gondwana break-up]. In: Vuollo, J. and Mertanen, S. (eds). Fifth International Dyke Conference 31.7 – 3.8.2005 – Rovaniemi, Finland: Abstracts and Programme. 46.
- Soesoo, A., Kaljo, D. 2005. Geoloogiaõppet TTÜ Geoloogia Instituudis ja edasistest arenguplaanidest . In: Verš, E., Puura, I., Isakar, M. (eds). Geoloogia õpetamine Eestis läbi kolme sajandi.. UT Institute of Geology, Tartu. 71-72.
- Šogenova, A., Kleesment, A., Šogenov, V. 2005. Loodusliku radioaktiivsuse ja magnetilise vastuvõtlikkuse omavaheline sõltuvus lõuna-eesti Devoni karbonaatsetes ja terrigeensetes kivimites [Relationship between natural radioactivity and magnetic susceptibility of Devonian carbonate and siliciclastic rocks from southern Estonia]. In: Eesti Geoloogiakeskuse infoleht [In: Newsletter of the Geological Survey of Estonia]. Geological Survey of Estonia, Tallinn. 11, 16-17.
- Talviste, P., Veski, S., Hang, T. 2004. Formation of the landscape in the surroundings of the lower reaches of the Pärnu River. Heinsalu, A. 2004. Lake Maardu. The Eighth Marine Geological Conference, 23-28 September 2004, Tartu, Estonia Abstracts and Excursion guide.. Institute of Geology, University of Tartu, Tartu. 105-108.
- Vaikmäe, R., Kaup, E., Loosli, H.H., Marandi, A., Martma, T., Raidla, V., Vallner, L. 2004. Isotopically light meltwater from Scandinavian Ice Sheet in the Cambrian-Vendian aquifer system of north Estonia.. In: International Workshop on the Application of Isotope Techniques in Hydrological and Environmental Studies. UNESCO, Paris, France, September 6-8, 2004, Abstracts. 249-250.
- Vasilchenko, V., Molodkov, A., Jaek, I. 2005. On the possible reasons of anomalous fading in alkaline feldspars. In: 11th International Conference on Luminescence and Electron Spin Resonance Dating, University of Cologne, Germany, 24 – 29th of July 2005. Book of Abstracts. 197.
- Vassiljev, J., Saarse, L., Miidel, A. 2004. Shore displacement of local ice-dammed lakes in Estonia. In: Puura, I., Tuuling, I., Hang, T. (eds). The Baltic. The Eighth Marine Geological Conference Abstracts. Excursion Guide. University of Tartu, Tartu. 58.
- Viira, V., Löfgren, A., Mens, K. 2004. Sedimentation, erosion and redeposition of sediment and conodont elements in the upper Tremadoc boundary beds of Pakri Cape, NW Estonia. In: Hints, O., Ainsaar, L. (eds). WOGOGOB-2004: Conference Materials. Abstracts and Field Guide Book. Tartu University Press, Tartu. p. 100.



Popular

- Enmäe, T., Ivask, J., Jänes, J., Kama, M. 2004. Veenus varjas end pilvede taga [Venus was covered up by clouds]. *Horisont* 4, 7.
- Einasto, R. 2005. Kodu otsimas. Mõtteid raamatuisse raiutut lehitsedes. Vissak, P. (comp., ed.). Harmoonia võimalikkus süsteemis inimene – keskkond – ühiskond“. II AS Ülo Siinmaa Grupp, Tallinn. II, 31-50.
- Einasto, R. 2005. Loodusest linna elukeskkonnas [Nature in urban environment]. Tallinn College of Engineering, Tallinn. *Tallinna Tehnikakõrgkooli Toimetised; erinumber "Linn kui elukeskkond"* 7, 42-51.
- Einasto, R. 2005. Tallinna ehituspaestiku läbilõige Paldiskis. [Cross section of Tallinn Building Limestone in Paldiski]. Tallinn College of Engineering, Tallinn. *Tallinna Tehnikakõrgkooli Toimetised* 6, 30-36.
- Einasto, R., Nestor, H., Pirrus, E. 2004. Muistsed mered Baltika pinnal [Ancient seas on the Baltica craton]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe, Past, Present, Future]. Tallinn. 219-231.
- Hints, L., Pärnaste, H. 2004. Aluspõhja paljandid [Outcrops]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 11. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lügänuuse, Aseri, Viru-Nigula [Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Natural Heritage of Estonia 11. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lügänuuse, Aseri, Viru-Nigula]. Estonian Academy Publishers, Tallinn. 11-15.
- Hladik, V., Shogenova, A., Christensen, N. 2005. How much CO₂ can be stored in the geology?. In: GEO ENERGI. Czech Geological Survey, Prague. *The Newsletter of the ENERGI Network* 12, 1.
- Isakar, M., Nestor, H. 2004. Keskaegkonna draakonid [Mesozoic dragons]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Tallinn. 257-268.
- Isakar, M., Nestor, H. 2004. Maa kuldne keskiga [Golden middle age of the Earth]. *Horisont* 2, 10-16.
- Isakar, M., Nestor, H. 2004. Mäed tõusid taevalkõrgusse [Mountains rose up to sky-high]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 269-282.
- Ivask, J. 2005. Marss jälle lähedal. [Mars close again]. *Horisont* 6, 7.
- Järvet, A., Kaup, E. 2005. August Loopmann - hüdroloog ja sooteadlane ning Antarktika uurija [August Loopmann as hydrologist, telmatologist and Antarctic researcher]. In: Eesti Geograafia Seltsi Aastaraamat 35 [Year-book of the Estonian Geographical Society 35]. Eesti Entsüklopeediakirjastus, Tallinn. 34, 196-208.
- Kalm, V., Raukas, A. 2004. Liustikud pinnamoe ja kliima kujundajana [Glaciers as shapers of topography and climate]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. OÜ Reves Grupp, Tallinn. 110-117.
- Karukäpp, R. 2005. Anto Raukas 70 [Anto Raukas 70]. In: Eesti Geograafia Seltsi aastaraamat [Year-book of the Estonian Geographical Society 35]. Estonian Encyclopaedia Publishers, Tallinn. 35, 296-299.
- Karukäpp, R., Miidel, A. 2005. Pinnamood [Topography]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu [Natural Heritage of Estonia 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu]. Estonian Academy Publishers, Tallinn. 15, 10-12.
- Kaup, E. 2004. Kired Antarktika ümber püsivad [Continuing passions about Antarctica]. Eesti Ekspress Publishers, Tallinn. *Eesti*

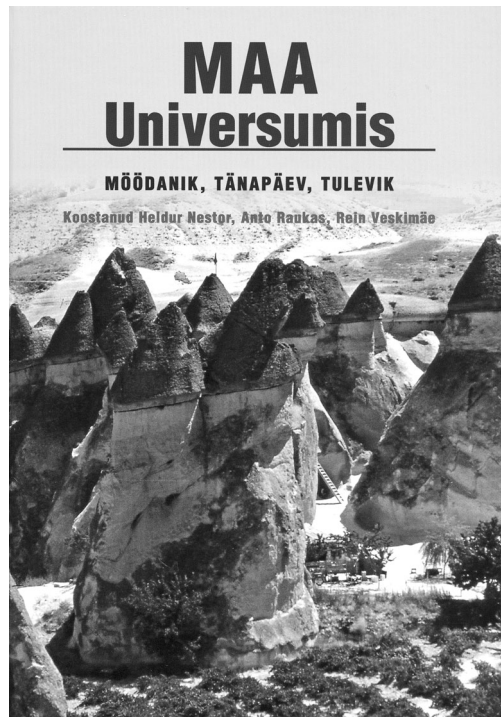
- Ekspress* 45, 30-31.
- Kaup, E. 2005. Antarktise jää võib uputada suurlinnad, Pärnu laheääre ka. [Cities and also the coast of the Pärnu Bay may be flooded by the melt of Antarctic ice]. *Eesti Päevaleht* 42, 22-23.
- Kaup, E. 2005. Miks on Eestile tarvis Antarktika uurimisjaama? [Why should Estonia have an Antarctic research station?]. *Eesti Loodus* 1, 15.
- Kaup, E. 2005. Predislovije [Foreword]. In: Vorobjoff S. Po tu storonu zemnogo shara... [Vorobjoff S. To the other side of globe...]. Imago, Riga. 4-7.
- Kaup, E., Saarso, M. 2004. Miks Eesti peaks saatma iseseisva teadusekspeditsiooni ja rajama uurimisjaama Antarktikas [Why should Estonia send an independent scientific expedition and build a research station in Antarctica]. *Horisont* 2, 8-9.
- Kiipli, T. 2005. Biogeokeemiline uuring Viljandi ja Tartu piirkonnas [Biogeochemical study in Viljandi and Tartu region]. In: Kukk, M. (ed.). Eesti Geoloogiakeskuse aastaraamat 2004 [Annual of the Geological Survey of Estonia 2004]. Geological Survey of Estonia, Tallinn. 30-33.
- Kiipli, T. 2005. Maavarade keemilise kvaliteedi andmekogu [Database of chemical quality of mineral resources]. In: Kukk, M. (ed.). Eesti Geoloogiakeskuse aastaraamat 2004 [Annual of the Geological Survey of Estonia 2004]. Geological Survey of Estonia, Tallinn. 34 - 37.
- Kink, H. (koost.), Miidel, A., Raukas, A. (toim.) 2005. Loodusmälestised 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu [Natural Heritage of Estonia 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu]. Estonian Academy Publishers, Tallinn. 15, 39 lk.
- Kink, H. (koost.), Miidel, A., Raukas, A. (toim.) 2005. Loodusmälestised 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu [Natural Heritage of Estonia 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu]. Estonian Academy Publishers, Tallinn. 14, 32.
- Kink, H. 2004. Eurolätted. Natura 2000 loodushoiualad Eestis [Natura 2000 nature reserves in Estonia]. *Eesti Loodus* 5, 30-34.
- Kink, H. 2004. Sood kaitsealadena [Mires as nature reserves]. In: Kalender 2004 [Calendar 2004]. Olion, Tallinn. 36-41.
- Kink, H. 2005. Kaitsealad [Reserves]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu [Natural Heritage of Estonia 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu]. Estonian Academy Publishers, Tallinn. 19.
- Kink, H. 2005. Kaitsealad [Reserves]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu [Natural Heritage of Estonia 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu]. Estonian Academy Publishers, Tallinn. 23-24.
- Kink, H. 2005. Karst ja allikad [Karst and springs]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu [Natural Heritage of Estonia 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu]. Estonian Academy Publishers, Tallinn. 16-18.
- Kink, H. 2005. Läbi aastatuhandete [Through millennia]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu [Natural Heritage of Estonia 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu]. Estonian Academy Publishers, Tallinn. 7-8.
- Kink, H. 2005. Paekivi ehitistes [Limestone in buildings]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu [Natural Heritage of Estonia 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu]. Estonian Academy Publishers, Tallinn. 22.
- Kink, H. 2005. Pandivere läbi aastatuhandete [Pandivere through millennia]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds).

- Loodusmälestised 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu [Natural Heritage of Estonia 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu]. Estonian Academy Publishers, Tallinn. 7-9.
- Kink, H., Erg, K. 2004. Eestimaa sood [Estonian mires]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present Future]. Reves Grupp, Tallinn. 143-148.
- Kink, H., Hints, O., Miidel, A. 2004. Balti klint on UNESCO kultuuri- ja looduspärandi nimekirja kandidaat [Baltic Klint is national candidate for UNESCO World Heritage list]. *Keskkonnatehnika* 1, 60-62.
- Kink, H., Kaljumäe, H. 2005. Jões, järved, sood [Rivers, lakes and mires]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu [Natural Heritage of Estonia 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu]. Estonian Academy Publishers, Tallinn. 14-16.
- Kink, H., Metslang, T., Miidel, A., Raukas, A. 2004. Pakri poolsaare vesi [Waters on the Pakri Peninsula]. *Keskkonnatehnika* 4, 16-18.
- Kink, H., Miidel, A. 2004. Karst ja allikad [Karst and springs]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 11. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lüganduse, Aseri, Viru-Nigula [Natural Heritage of Estonia 11. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lüganduse, Aseri, Viru-Nigula]. Estonian Academy Publishers, Tallinn. 26-27.
- Kink, H., Miidel, A., Talioja, A. 2004. Karst ja allikad [Karst and springs]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 12. Harjumaa, Raplamaa - ümber Mahtra soostiku. Kose, Kõue, Kohila, Kaiu, Juuru [Natural Heritage of Estonia 12. Harjumaa, Raplamaa - around the Mahtra mire systems. Kose, Kõue, Kohila, Kaiu, Juuru]. Estonian Academy Publishers, Tallinn. 17-23.
- Kink, H., Raukas, A. 2005. Kuidas kaitsta allikaid. *Keskkonnatehnika* 4, 62-63.
- Kleesment, A. 2004. Paljandid [Outcrops]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 13. Ida-Virumaa: Illuka, Mäetaguse, Iisaku, Alajõe [Natural Heritage of Estonia 13. Ida-Virumaa: Illuka, Mäetaguse, Iisaku, Alajõe]. Estonian Academy Publishers, Tallinn. 13, 16-19.
- Kleesment, A. 2005. Devoni koopad ja nendega seotud muistendid [Devonian caves and with them connected national heritage]. In: Verš, E., Nemliher, R. (eds). Teadus geoloogias. Schola Geologica I [Science in Geology. Schola Geologica I]. Estonian Naturalists Society, Tartu. 64-69.
- Kleesment, A. 2005. Huvitavad Devoni liivakiviseinad Võhandu jõe kallastel [Interesting Devonian sandstone walls on the banks of the Võhandu River]. In: Eesti Geograafia Seltsi Aastaraamat 35 [Year-Book of the Estonian Geographical Society 35]. Estonian Encyclopaedia Publishers, Tallinn. 35, 96-110.
- Martin, J., Lember, J., Raukas, A., Kõuts, T., Engelbrecht, J., Jostov, M., Keevallik, A., Kaup, E., Aaviksoo, J., Einasto, J., Punning, J.-M., Vaikmäe, R. 2004. Läkitus peaminister Partsile [A letter to prime minister Parts]. *Eesti Päevaleht* 04.10.04 229, 8.
- Miidel, A. 2004. Geoloogia ja pinnavormid [Geology and landforms]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 12. Harjumaa, Raplamaa -- ümber Mahtra soostiku. Kose, Kõue, Kohila, Kaiu, Juuru [Natural Heritage of Estonia. Harjumaa, Raplamaa -- around Mahtra mire systems. Kose, Kõue, Kohila, Kaiu, Juuru]. Estonian Academy Publishers, Tallinn. 12, 12-15.
- Miidel, A. 2004. Jõgede tegevus. [River activity]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn., 123-128..
- Miidel, A. 2004. Pinnavormid [Landforms]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 11. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lüganduse,

- Aseri, Viru-Nigula [Natural Heritage of Estonia. Ida-Virumaa, Lääne-Virumaa. Kohtla, Lügänu, Aseri, Viru-Nigula]. Estonian Academy Publishers, Tallinn. 11, 15-22.
- Miidel, A. 2004. Saladuslikud aastamiljonid [Mysterious millennia]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 283-287.
- Miidel, A. 2005. Geoloogia [Geology. Landforms]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu [Natural Heritage of Estonia 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu]. Estonian Academy Publishers, Tallinn. 14, 9-10.
- Miidel, A. 2005. Pinnavormid [Landforms]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu [Natural Heritage of Estonia 14. Ida-Virumaa: Sonda, Maidla, Tudulinna, Avinurme, Lohusuu]. Estonian Academy Publishers, Tallinn. 10-12.
- Miidel, A., Raukas, A. 2004. Pakri pank pole ohutu [Pakri Cliff is dangerous]. *Lääne-Harju Ekspress* 24.01.04 4(572), 2.
- Nestor, H. 2004. Kasvuhoone- ja külmhooneperioodid Maa ajaloos [Greenhouse and icehouse periods in history of the Earth]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 118-122.
- Nestor, H. 2004. Kivine kroonika [Geological record]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 177-184.
- Nestor, H. 2004. Korallrahud - merepõhja suurehitised [Coral reefs - large sea-floor buildings]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 103-109.
- Nestor, H. 2004. Maksureformi pahupoolest [The seamy side of tax reform]. *Postimees* 222(4193), 14.
- Nestor, H. 2004. Mäslev maapõu [Raging bowels of the Earth]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 39-48.
- Nestor, H. 2004. Rändav ja uuenev maakoore [Wandering and renewing earth crust]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 33-38.
- Nestor, H. 2004. Tulemäed justkui põrgu korstnad [Volcanoes just like chimneys of the hell]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 64-73.
- Nestor, H. 2005. Paljandid [Outcrops]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu [Natural Heritage of Estonia 15. Lääne-Virumaa: Laekvere, Avanduse, Rakke, Väike-Maarja, Tamsalu]. Estonian Academy Publishers, Tallinn. 12-15.
- Nõlvak, J. 2005. Tallinn Mustkivi ja Mustakivi vahel [Tallinn between Mustkivi and Mustakivi]. Tallinn. *Eesti Loodus* 6, 14(294)-18(298).
- Puura, V., Vaher, R. 2004. Praguline Eestimaa [The cracked Estonia]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 49-56.
- Raukas, A. 2004. Eelmine suurim Osmussaare maavärin lõi majja suure praod [The previous biggest Osmussaare earthquake generated a crack in the wall]. *Eesti Päevaleht* 15.09.04 219, 4.
- Raukas, A. 2004. Eesti energeetilistest ressurs-

- sidest ja nende mõistlikust kasutamisest [Energetical resources of Estonia and their purposeful use]. *Eesti Põlevloodusvarad ja -jäätmed 2004* 27-28.
- Raukas, A. 2004. Eestimaa jääkilbi all ja pärast seda [Estonia under the ice sheet and after that]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 294-305.
- Raukas, A. 2004. Inimajastu radadel [On the roads of mankind]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 288-293.
- Raukas, A. 2004. Inimene Maa ümberkuundajana [Man as a transformer of the Earth]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 129-136.
- Raukas, A. 2004. Looduskaitseprojekti Natura 2000 mured [Concerns of the nature protection project Natura 2000]. *Äripäev 19.03.04* 53(2593), 22.
- Raukas, A. 2004. Maailma ainukesest põlevkivijakirjast ja põlevkivist endast [About oil shale and the world's first oil-shale journal]. *Eesti põlevloodusvarad ja -jäätmed 2004* 11-12.
- Raukas, A. 2004. Mis saab edasi? [What is going to happen?]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 306-310.
- Raukas, A. 2004. Mõtteid haridusest - eestikeelset produktsiooni alahinnatakse [Thinking about education - Estonian production is underestimated]. *Eesti Päevaleht 01.04.04* 13(6465), 5.
- Raukas, A. 2004. Pinnavormid [Landforms]. In: Kink, H. (comp.), Miidel, A., Raukas, A. (eds). Loodusmälestised 13. Ida-Virumaa: Illuka, Mäetaguse, Iisaku, Alajõe [Natural Heritage of Estonia 13. Ida-Virumaa: Illuka, Mäetaguse, Iisaku, Alajõe]. Estonian Academy Publishers, Tallinn. 10-15.
- Raukas, A. 2004. Põlevkivist ja maailma ainsast põlevkivijakirjast [About oil shale and the world's first oil-shale journal]. *Õpetajate Leht 30.01.04, Lisaleht Loodusained* 4,
- Raukas, A. 2004. Quo vadis, Eesti energetika? Realistlik energetika jääb siiski põlevkivi juurde [Quo vadis, Estonian energetics? Reasonable power engineering would prefer oil shale]. *Äripäev 20.01.04* 12(2552), 22.
- Raukas, A. 2004. Tuule toimetused [Actions of wind]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 129-136.
- Raukas, A. 2005. Herbert Viidingu mõtteid teadusest ja teadlastest [Mediation of Herbert Viiding about science and colleagues]. In: Eesti Geograafia Seltsi aastaraamat 35 [Year-Book of the Estonian Geographical Society]. Estonian Encyclopaedia Publishers, Tallinn. 43-60.
- Raukas, A. 2005. Kas Tartu ülikool ja Eesti teaduste akadeemia või saab ka paremini? Arvamusi akadeemikutelt.. In: Eesti Teaduste Akadeemia aastaraamat X (37) 2004 [Year-book of the Estonian Academy of Sciences X (37) 2004]. Estonian Encyclopaedia Publishers, Tallinn.
- Raukas, A. 2005. Okupatsiooniar mee põhjustatud hiiglaslikud keskkonnakahjud [Enormous Environmental Damage Caused by Occupation Army.]. In: Valge Raamat eesti rahva kaotustest okupatsioonide läbi 1940–1991. [The White Book losses inflicted on the Estonian nation by occupation regimes 1940–1991.]. Estonian Encyclopaedia Publishers, Tallinn. 118-124.
- Raukas, A. 2005. Vee sõnumid annavad meile põhjust endasse vaadata. In: Vee sõnumid. OÜ Tuul & Nool, Tallinn.
- Raukas, A., Kink, H. 2004. Riskist meie elus ja Pakri saartel eriti [About risk in our life and especially on the Pakri Islands]. *Lääne-Harju Ekspress 10.01.04* 5(570), 8.
- Raukas, A., Moora, T., Tiirmaa, R. 2005. Kaali

- peakraatri morfoloogia [Morphology of the Kaali main crater]. In: Eesti Geograafia Seltsi aastaraamat 35 [Year-Book of the Estonian Geographical Society 35]. Estonian Encyclopaedia Publishers, Tallinn. 76–88.
- Ritsberg, K., Hang, T., Miidel, A. 2005. Andmeid Emajõe oru geoloogia ja geomorfoloogia kohta [On the geology and geomorphology of the Emajõgi River valley]. In: Eesti Geograafia Seltsi Aastaraamat 35 [Year-Book of the Estonian Geographical Society 35]. Estonian Encyclopaedia Publishers, Tallinn. 130-145.
- Saarse, L. 2004. Järved ja nende elukäik [Lakes and their development]. In: Nestor, H., Raukas, A., Veskimäe, R. (comps-eds). Maa Universumis. Möödanik, tänapäev, tulevik [The Earth in the Universe. Past, Present, Future]. Reves Grupp, Tallinn. 137-142.
- Shogenova, A. 2004. Estonian Oil Shales. In: The Newsletter of the ENeRG Network - GEO ENeRGY. Czech Geological Survey, Prague. 10, December 2004, 3.
- Tavast, E. 2005. Läänemere vanad rannamoodustised geotoobina [Ancient coastal formations of the Baltic Sea as Geosites]. In: Eesti Geograafia Seltsi Aastaraamat 35 [Year-Book of the Estonian Geographical Society 35]. Estonian Encyclopaedia Publishers, Tallinn. 35, 146-159.
- Tiirmaa, R. 2005. Kuidas leida meteoriiite? *Eesti Loodus* 56(11), 38-41.
- Tiirmaa, R. 2005. Kuidas tund ära meteoriidikraatreid? *Eesti Loodus* 56(12), 38-41.
- Tiirmaa, R. 2005. Tähten arvet Saarenmaalla. Tallinn: TTÜ Geoloogia Instituut, 1-24.
- Tiirmaa, R. 2005. Tähearmid Kaalis. Tallinn: TTÜ Geoloogia Instituut, 1-24.
- Tiirmaa, R. Popova, L. 2005. Võõrmineraalidest turbas [Extraneous minerals in the peat]. In: Eesti Geograafia Seltsi aastaraamat 35 [Year-Book of the Estonian Geographical Society 35]. Estonian Encyclopaedia Publishers, Tallinn. 89–95.
- Uudeväli, T., Raukas, A. 2004. Pääsküla sõjaväeobjekti jääkreostus ja piirkonna edasise kasutamise perspektiivid [The Environmental Damages Caused by the Pääsküla Military Object and Perspectives for the Further Use of the Area]. *Eesti Mereakadeemia Toimetised* 1, 33-45.
- Veski, S. 2005. Soojenev kliima võib põhjustada kliimajahenemist [Global warming may chill climate]. *Eesti Loodus* 56(1, Jaanuar), 20-24.
- Veski, S., Poska, P. 2004. Eelajalooline inimene ja pool-looduslikud taimekooslused Eestis - pilk minevikku õietolmu meetodil [Prehistoric man and semi-natural landscapes in Estonia – a palynological approach]. Eesti Looduseuurijate Seltsi aastaraamat [LUS year-book]. Estonian Naturalists Society, Tartu. 82, 24-49.



Front cover of the book: "Maa Universumis. Möödanik, tänapäev, tulevik" [The Earth in the Universe. Past, Present, Future] - a nominant of the Book of the Year 2004.

Other publications

- Alliksaar, T., Heinsalu, A., Luup, H. 2004. Paleolimnology of Lake Võrtsjärv for the last 200 years: chrono- and lithostratigraphy. *Institute of Geology at Tallinn University of Technology Report Series 2004-17*, 1-17.
- Goldman, D., Leslie, S.A., Nõlvak, J., Young, S. 2005. The Black Knob Ridge Section, Southeastern Oklahoma, USA: A Possible Global Stratotype-Section and Point (GSSP) for the Base of the Diplacanthopterus caudatus Biozone and the Middle Stage of the Upper Ordovician Series. <http://www.ordovician.cn/down/bkr/BKRProposal.pdf>. ISOS. 1-41.
- Heinsalu, A., Alliksaar, T. 2003. Paleolimnological studies of Lake Peipsi. In: Nõges, T. (ed.). Final report on the relevant system of indicators and criteria for evaluating the ecological status of a very large nonstratified lake and its river basin in WFD context [MANTRA-East, Integrated Strategies for the Management of Transboundary Waters on the Eastern European fringe - The pilot study of Lake Peipsi and its drainage basin]. 14-17.
- Heinsalu, A., Alliksaar, T. 2005. Järvetüüptide interkalibreerimiseks vajalike foonitingimuste väljaselgitamine paleolimnoloogiliste uuringute abil [Assessing reference conditions for lakes using paleolimnological methods]. *TTÜ Geoloogia Instituudi Aruanne* 29, 98 + lisad 51 lk.
- Heinsalu, A., Alliksaar, T., Veski, S. 2003. Reconstruction of past lake-water quality from sediment diatom assemblages: a pilot study. Viru-Peipsi Catchment Area Management Plan (LIFE00ENV/000925; Viru-Peipsi CAMP). *Institute of Geology at Tallinn Technical University Report Series 2003-16*, 1-59.
- Kink, H. 2004. 40 märksõna [40 entries]. In: Tamm, J. (ed.). Entsüklopeedia. Tallinn [Encyclopedia. Tallinn Vol 1-2]. Estonian Encyclopaedia Publishers, Tallinn. 1, 2.
- Kink, H. 2004. Natura 2000 ja allikad [Natura 2000 and springs]. In: Rohelise Maakonna veekonverentsi "Vesi Ühendab" materjalid [Materials of the conference "The Waters Unite"]. 4.
- Kink, H., Heinsalu, A., Vassiljev, J., Veski, S. 2004. Harku järve seisund ja selle parandamise võimalused [Water quality and restoration problems of Lake Harku]. Tallinn. *Institute of Geology at Tallinn University of Technology Report Series 21*, 1-56.
- Kink, H., Miidel, A., Sinijärv, U., Kukk, H., Hints, O., Baranov, G. 2004. Baltic Klint - nomination for inclusion on the World Heritage List. Estonian Ministry of the Environment, Institute of Geology at TUT, Tallinn. 70 pp.
- Miidel, A. 2004. 41 märksõna [41 entries]. In: Tamm, J. (ed.). Entsüklopeedia. Tallinn 1-2 [Encyclopedia. Tallinn Vol 1-2]. Estonian Encyclopaedia Publishers, Tallinn. 1-2.
- Nõlvak, J. 2004. 35 märksõna [35 entries]. In: Tamm, J. (ed.). Entsüklopeedia. Tallinn 1-2 [Encyclopedia. Tallinn Vol 1-2]. Estonian Encyclopaedia Publishers, Tallinn. 1, 2.
- Raukas, A. 2004. 8 märksõna [8 entries]. In: Tamm, J. (ed.). Entsüklopeedia. Tallinn [Encyclopedia. Tallinn Vol 1-2]. Estonian Encyclopaedia Publishers, Tallinn. 20.

Other events, awards, etc.

State Science Prize in geo- and biosciences for 2004

Dr. Tiiu Märss

Main field of research of T. Märss is palaeontology and biostratigraphy of the Silurian and Lower Devonian vertebrates.

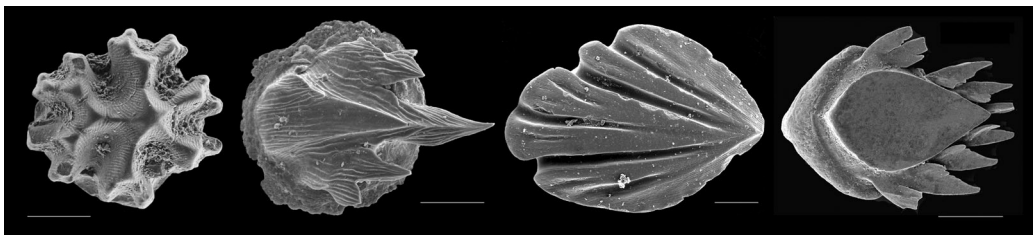
Since 1970 she has published her study results in over 80 scientific papers and in a monograph. Studies during last years have resulted in a series of papers in which the taxonomy, development and distribution of the Silurian and Lower Devonian vertebrates, agnathans and fishes, in the present days northern hemisphere has been dealt with. Her study area embraces Baltic countries, Russia (the Urals and arctic islands), British Isles, and northern Canada (Boothia Peninsula, Mackenzie Mountains, and arctic islands) where she with colleagues has collected fossils during several expeditions.

For the scientific results between 2001–2004, T. Märss was presented as a candidate, and she was granted the State Science Prize in geo- and biosciences for 2004 for the cycle of papers “Evolution and distribution of the Middle Palaeozoic vertebrates in the modern northern hemisphere, and their practical significance in geology”. The set contains 19 papers, majority of which have been published in peer reviewed journals, five papers in CC journals, two extensive papers represent mono-



Dr. Tiiu Märss. Photo by G. Baranov.

graphic treatment of agnathan thelodonts and anaspids, and one – chapter in the reference book for palaeontologists, biologists and geologists.



First Prize in State Competition of Students' Scientific Works in 2005 in category of PhD students in the field of Biology, Environment and Medicine

Dr. Helje Pärnaste

See for PhD project above (p. 63).

Second Prize in Competition of Students' Studies awarded by Estonian Mining Society, Geotechnical Society of Estonia, and Estonian Geological Society

Mairy Killing

See for B.Sc. project above (p. 67).



Dr. Helje Pärnaste. Photo by G. Baranov.

Prizes from documentary film festivals

Mati Viil (author)

“Great earthquake of the small country”
[Väikeses Eesti suur maavärin]

Diploma at World Festival of Amateur Films
in Germany, 2004

Bronze Medal at Festival of Amateur Films
“Euro-Filmforum Scandinavia”, 2004

Diploma at the International Festival of Amateur
Films in Czech Republic, 2005

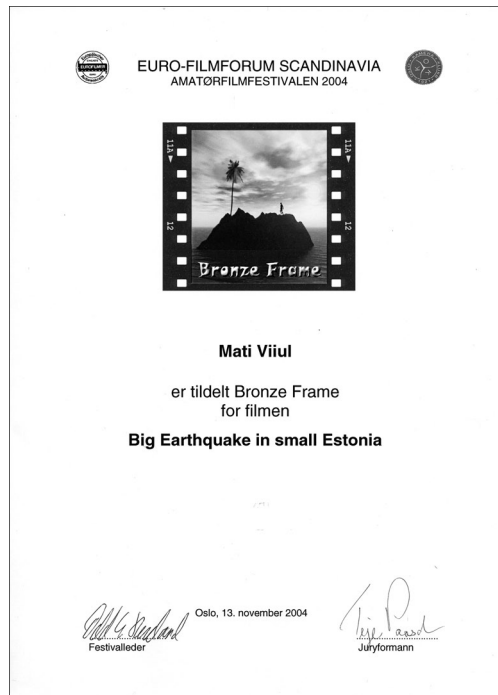
“Reading the book of mud” [Järvemuda
raamat]

Diploma at the International Festival of Amateur
Films in Austria, 2004

Siim Veski (one of the scientific consultants)

“Home of the Sun” (director U. E. Liiv;
Vesilind Ltd - Vides Filmu Studija)

Prize Paolo Orsi at the 16th Rassegna Inter-
nazionale del Cinema Arceologico (the
Archaeological Film Festival), 2005



In memoriam

Reet Männil

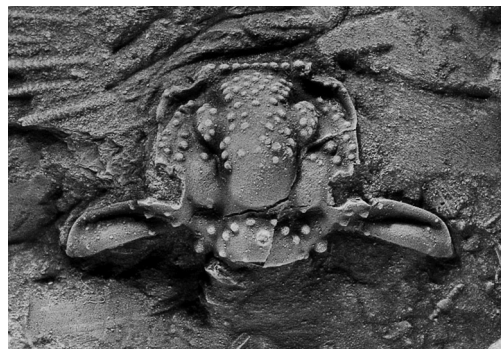
25 August 1931 – 23 April 2005

Reet Männil, a well-known Silurian trilobite researcher and a longtime member of the Institute of Geology, Estonian Academy of Sciences, passed away after a tragic fire accident on 23 April 2005. She graduated from the University of Tartu in 1955 with a diploma work on the geological structure of the Lake Suur-Võrtsjärv area and lacustrine subfossil molluscs. Followed a couple of years in Russia (Chita Geological Survey), but on 3 February 1958 Reet became a research worker at our institute. She continued her studies on the lake marls and subfossils and published in 1961–1967 ten corresponding papers, including her Cand. of Sciences (=PhD) dissertation (1964).

Her first trilobite paper was published in 1968 with a description of *Encrinurus schmidti* sp.n. from the Llandovery of Estonia. In 1970 she published several more new taxa and wrote a summary about trilobite diversity and distribution in the Estonian Silurian. And so on she continued through the entire East Baltic Silurian. Reet Männil was a productive scientist (see the list of publications below) up to the very beginning of the 1990s. She left the institute on 30 June 1992, when the institute's staff was reduced more than 50% in the result of a science reform in Estonia. Just at that time Reet reached the retirement age and was among the first ones leaving the institute.

Reet was a kind lady and talented palaeontologist, who made a significant contribution to the knowledge of Holocene subfossil molluscs, and especially Silurian trilobites.

Kettneraspis reetae Ramsköld and Chatterton, 1991 – an odontopleurid trilobite “named after Dr. Reet Männil, in recognition of her outstanding work on Estonian Silurian trilobites”. Photo by G. Baranov.



cranium = medial part of the head
pygidium = tale



Selected publications by Reet Männil

- Männil, R. **1977**. Some new Llandoveryan encrinurid trilobites of the East Baltic area. *Proceedings of the Estonian Academy of Sciences. Geology* **26**(1), 46-56. [In Russian, English summary].
- **1977**. East Baltic Lower Silurian *Calymenidae* (Trilobita). 240–258. In Kaljo, D. (ed). *Facies and Fauna of the Baltic Silurian*. Akademia Nauk Estonoskoi SSR Institut Geologii, Tallinn, 134 pp. [In Russian, English summary].
- **1978**. Wenlockian trilobites of the *Encrinurus punctatus* species-group of the East Baltic. *Proceedings of the Estonian Academy of Sciences. Geology* **27**(3), 108-115. [In Russian, English summary].
- **1979**. Silurian trilobites of the subfamily Warburgellinae of the East Baltic area. *Proceedings of the Estonian Academy of Sciences. Geology* **28**(3), 100-107. [In Russian, English summary].
- **1981**. Late Silurian Proetidae (Trilobita) of Estonia. *Proceedings of the Estonian Academy of Sciences. Geology* **30**(3), 98-105. [In Russian, English summary].
- **1982**. [Trilobite communities (Wenlock of the East Baltic)]. 51–62, 123–135. In Kaljo, D. and Klaamann, E. (eds). *Communities and biozones in the Baltic Silurian*. Valgus, Tallinn. [In Russian, English summary].
- **1982**. Wenlock and Late Silurian trilobite association of the Distribution of East Baltic area and their stratigraphical value. 63–69. In Kaljo, D. and Klaamann, E. (eds). *Ecostratigraphy of the East Baltic Silurian*. Valgus, Tallinn, 109 pp. [In Russian, English summary].
- **1983**. Upper Silurian *Calymenidae* (Trilobita) of the East Baltic. 72-100. In Klaamann, E. (ed). *Palaeontology of the ancient Palaeozoic of the Prebaltic and Podolia*. Akad. Nauk. Eston. SSR Inst. Geol. Tallinn, 109 pp. [In Russian, English summary].
- **1986**. Distribution of trilobites in different facies of the east Baltic Silurian. 99–109, 271. In Kaljo, D. and Klaamann, E. (eds). *Theory and practice of ecostratigraphy*. Valgus, Tallinn, 295 pp. [In Russian, English summary].
- **1987**. New phacopid trilobites from the Upper Silurian of the East Baltic. *Proceedings of the Estonian Academy of Sciences. Geology* **36**(3), 113-120.
- **1992**. Trilobite faunal changes in the East Baltic Silurian. *Proceedings of the Estonian Academy of Sciences. Geology* **41**(4), 198-204.
- Alberti, H., Alberti, L., Männil, R. and Tomczykowa, E. **1982**. Correlation of the *Proetus signatus* level (Upper Silurian) in Gotland, Poland and the East Baltic area. *Proceedings of the Estonian Academy of Sciences. Geology* **31**(1), 29-32.

How to find us?

Visiting address

Institute of Geology
at Tallinn University of Technology

7 Estonia pst
10143 Tallinn
ESTONIA
(until August 2006)

5 Ehitajate tee
19086 Tallinn
ESTONIA
(from September 2006)

Tel. +372 644 41 89
Fax +372 631 20 74

Internet

Institutes homepage: <http://www.gi.ee/>
General e-mail: inst@gi.ee

Online catalogue of Institute's collections is accessible at
<http://sarv.gi.ee/>

For staff e-mail and web addresses see page 10–11.

