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ХРОНИКА

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FINNISH-RUSSIAN KARELIAN COLLABORATION IN QUATERNARY GEOLOGICAL RESEARCH IN KARELIA

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Geological Survey of Finland

Russian Karelia has been a special target of Finnish Quaternary geologists and geographers for more than a hundred years since J. E. Rosberg published beautiful maps of Late Glacial (Late Valdai) end moraines in North Karelia in 1892 comparable to Salpausselkä end moraines in Finland. Another topic of lasting interest has been the problem of postulated Late Glacial White Sea – Baltic connection. This problem brought Finnish scholars to Russian Karelia during World War II (1941–1944). Most of them were in favour of such a sea connection [Sauramo, 1958]. These classical topics were of major interest also in the 1970s, when favourable conditions for Finnish-Russian co-operation were created.

The geological collaboration was governed by the Committee for Scientific and Technological Co-operation between Finland and the Soviet Union. The General Directors of the Geological Survey of Finland, Herman Stigzelius and Kalevi Kauranne, the Finnish chairmen of the joint Working Group for Geology, actively supported the collaboration. Similarly, Veikko Lappalainen, General Director, and Kauko Korpela, Research Director, of the Geological Survey of Finland, were strongly in favour of geological cooperation between Finland and Russian Karelia when perestroika in the late 1980s opened new opportunities for joint geological projects, for example in geological mapping. The last decade of the second millennium and the first years of the third millennium were remarkable for the most active collaboration in Quaternary geology between Finland and Russian Karelia. The activities of the Finnish-Russian Science and Technology Committee were mostly terminated in the 1990s, and institutes established their international scientific contacts directly. The Finnish Working Group for Mathematics and Natural Sciences (including geology) also terminated its activities. The present author was its last chairman in 1995–1997.

Active exchange visits between Finnish and Karelian Quaternary geologists commenced in the 1970s. Anatoli Lukashov and Ilpo Ekman were guided in 1975 by Kalevi Virkkala and other colleagues at the Geological Survey of Finland throughout Finland to Lapland. In September 1976, the present author, together with Hannu Hyvärinen and Ari Siiriäinen, spent two weeks in Petrozavodsk and surrounding areas, collecting Late Glacial sediment samples and studying deposits of the ancient Lake Ladoga transgression. The comprehensive visit also included a trip to prehistoric dwelling sites in the Lake

Säämäjärvi area guided by G. A. Pankrushev. Active exchange visits to Finland and Karelia continued until 1982, when a large conference of the International Union for Quaternary Research was organized in Moscow. One post-conference field excursion was held in Karelia. The next active period of geological co-operation commenced in the late 1980s.

IGCP Project 253 "Termination of the Pleistocene" of the International Geological Correlation Programme

The magnificent Late Glacial end moraines, first described by Rosberg in 1892, were actively mapped over decades by geologists from Petrozavodsk. These moraines and glacial landscapes of northern Karelia/Republic of Karelia were brought, obviously for the first time, to the attention of a wide international audience, including particapants from Great Britain and the USA, during a field excursion in 1991. The organization of the Russian Karelian part of the excursion was a great effort of Anatoli Lukashov, Head of the Quaternary Geology Laboratory, and colleagues from the Karelian Science Centre in Petrozavodsk. The end moraines in Finland and Russian Karelia were described in a guide book [Rainio & Saarnisto, 1991, editors] including a comprehensive article by Ekman and Iljin entitled "Deglaciation, the Younger Dryas end moraines and their correlation in the Karelian ASSR and adjacent areas" which was also published 1995 in an international volume "Glacial deposits in North-East Europe". The correlation between the Karelian end moraines and the Salpausselkä end moraines was also confirmed [Rainio et al., 1995]. The colour copies of the maps [Rosberg, 1892] of the Russian Karelian end moraines were also reprinted in the appendix of the guide book.

Late-glacial White Sea – Baltic Sea connection

As mentioned in the Introduction the possible Late-glacial marine connection between the White Sea and the Baltic Sea via Lake Ladoga and Lake Onega has been one of the classical controversial topics both in Russia and Finland. An open sea connection has been supported by several Russian scientists and many Finnish colleagues including Sauramo, Hyyppä and Mölder [Sauramo, 1958] were searching for additional evidence for such a connection in 1941–1944. The extensive open connection required an early deglaciation of Karelia which did not fit with the correlation of Salpausselkä's with the Russian Karelian end moraines and they were not even mentioned anymore in Finnish literature in the 1930s. The question of the early, i. e. pre-Salpausselkä, deglaciation of eastern Finland was challenged 1966 by Hyvärinen and the open sea connection was also questioned [Hyvärinen, 1973]. Marine diatoms in Late-glacial sediments were used as evidence of the sea connection

Exchange visits of Finnish and Russian Karelian geologists commenced in the mid-1970s. Hannu Hyvärinen (left), Natasha Davidova, Ari Siiriäinen, Anatoli Lukashov, Ilpo Ekman and the driver in Olonets, September 1976. Photo by Matti Saarnisto

Matti Saarnisto (front) and Juha Pekka Lunkka at the White Sea-Baltic watershed of Maselga south of Lake Segozero, May 2007

between the White Sea and the Baltic Sea, but it was shown by M. Saarnisto [Rainio et al., 1995] in the Maselga water divide area, that they are re-deposited last interglacial, i. e. Mikulino/Eemian, fossils. In harmony with many Russian colleagues they conclude that no Late Glacial sea connection existed. The Maselga watershed area was simply too elevated. In fact also Lake Onega remained above the (Baltic) Sea level. Raised shorelines and deltas within the White Sea sphere in northern Karelia foremost represent extensive ice-dammed lakes of the White Sea basin [Putkinen & Lunkka, 2008].

The open marine connection between the White Sea and the Baltic Sea during the Mikulino interglacial, on the other hand, has been known for some time and the Russian literature is extensive but partly published only in local reports with limited distribution. An extensive summary of the available material relevant to the Mikulino marine and terrestrial environment in north-western Russia was compiled.

Coring sediments of Lake Paanajärvi 1990

A sediment coring trip to Lake Paanajärvi in northern Russian Karelia was organized in April 1990. The Finnish participants represented Geological Survey of Finland, University of Oulu and University of Helsinki whereas the Russian team came from the Geological and Biological Institutes of the Karelian Research Centre in Petrozavodsk. The teams received permission to cross daily the Finnish-Russian border by snowmobiles in an unofficial point close to Lake Paanajärvi. The bottom sediments of Lake Paanajärvi were cored in four localities and the longest cores cover nearly the entire time after the deglacation of the area more than 10 000 years ago. The best cores were used for a study of the secular variations of the earth's magnetic field [Saarinen, 1994] and analysed for pollen in order to work out the Holocene history of forests [Huttunen et al., 1999]. In the following years botanists and geographers from the University of Oulu continued palaeogeographical and palaeobotanical studies in the Nuorunen area south of Lake Paanajärvi together with colleagues from Petrozavodsk. For general references of the Paanajärvi area see Jankovska et al. [1999].

Quaternary geological map 1:1 mln 1993

Intensified co-operation between the Geological Institute of the Karelian Research Centre and the Geological Survey of Finland resulted in a map of "Quaternary Deposits of Finland and northwestern Russian Federation and their resources" 1:1 mln, which was edited by Jouko Niemelä, Ilpo Ekman and Anatoli Lukashov and published 1993. The editors and their Finnish and Russian teams had more than 30 meetings when compiling the map and working out the legend. The public release of the maps in Ilomantsi, Finnish North

Karelia, received much publicity in the Finnish television and newspapers. The map in two sheets is a most valuable source for regional reconnaissance survey of Quaternary deposits and landforms and its publication opened a new chapter in the co-operation of geological research institutes in Finland and northwestern Russia. The map was accompanied by a symposium volume which contains 12 articles of Finnish and Russian colleagues who were actively contributing to the map project [Kujansuu & Saarnisto, editors, 1997].

QUEEN, "Quaternary Environment of the Eurasian North" programme of the European Science Foundation 1996–2004 and "Eurasian Ice Sheets" programme of the European Union 1998–2000

Major European co-operative research programmes QUEEN and "Eurasian Ice Sheets" which are mentioned above fitted well in the active co-operation in Quaternary Geology between Finland and Institute of Geology in Petrozavodsk. The Geological Survey of Finland was the main operating institute in Finland, but the European programmes also incorporated institutes and individuals from Moscow, St. Petersburg and Apatity. In 1998 a QUEEN workshop was hosted by the Institute of Geology in Petrozavodsk, led by Sergey Rybakov. Academician N. P. Laverov, Vice-President of the Russian Academy of Sciences, an eminent supporter of the Finnish-Russian geological co-operation, participated in the workshop.

Igor Demidov from Petrozavodsk was the main Karelian partner in the programmes. He worked together with the present author and Juha Pekka Lunkka in the Vologda area [Gey et al., 2001; Lunkka et al., 2001] and Kola Peninsula, and he was later also a highly respected partner of Norwegian and Danish teams in the Archangelsk area and Kanin Peninsula [Demidov et al., 2004]. Igor Demidov was a co-author in several scientific papers published by the participants of the QUEEN and "Eurasian Ice Sheet" programmes in international journals including the extensive summary paper of QUEEN [Svendsen et al., 2004] entitled "Late Quaternary ice sheet history of northern Eurasia" which was the most cited paper in the world in its field for ten years after its publication. The early death of Igor in 2007 was a big loss to the Quaternary community and especially to the Institute of Geology in Petrozavodsk.

A major sediment coring campaign was organized on Lake Onega 1992 on board research vessel "Poseidon" and the cores were subjected to the study of secular variations of the earth's magnetic field in the geophysical laboratory of the Geological Survey of Finland. The results were essential when the deglaciation chronology of the Scandinavian Ice Sheet from the Lake Onega basin to the Salpausselkä end moraines was worked out [Saarnisto & Saarinen, 2001]. Another aim of the coring

Coring Quaternary sediments of Lake Onega in the Povenets Bay, winter 1993. Left to right: Sergey Vyahirev, Anatoli Lukashov, helicopter pilot, Ilpo Ekman, Arto Kiiskinen, Seppo Putkinen (front), unknown person and Esa Kukkonen. Photo by Matti Saarnisto

Igor Demidov on the shore of Lake Segozero, August 1993. Photo by Matti Saarnisto

of the Onega sediments was to search for disturbances in the sediment structures which could be related to palaeoseismicity after the deglaciation.

The work on the Late-glacial history of northern Russian Karelia and palaeohydrology of the White Sea basin has continued also when the above European programmes had ended. Juha Pekka Lunkka, University of Oulu, has been the leader of the project and Niko Putkinen, Geological Survey of Finland, has been the younger collaborator [Putkinen & Lunkka, 2008]. Igor Demidov participated in the early planning of the project and also in 2004 in the demanding coring campaign of Lake Kuittijärvi and Lake Tuoppajärvi sediments. The coring was performed by a team of the Geological Survey of Finland, similarly as the coring of Lake Onega sediments in 1992. The sediments were dated by varve counts and palaeomagnetic measurements. Inner structures of glacial landforms in North Karelia, especially end moraines, were investigated by ground penetrating radar and the formations were mapped in addition to extensive field observations and computer assisted analysis of aerial photos and satellite images [Putkinen, 2011]. One of the cores from the bottom of Lake Ylä-Kuittijärvi near the village of Vuonninen was selected for pollen analytical study of the land use history and dated by palaeomagnetic analysis [Alenius et al., 2011]. The work for dating the Karelian end moraines using cosmogenic exposure dating also continues and Dimitri Subetto from the Northern Water Problems Institute of the Karelian Research Centre has joined the team lead by Juha Pekka Lunkka.

Palaeoseismicity and neotectonics

Magnificent rock falls are major elements in the landscape of Zaonezhsky Peninsula and to a somewhat lesser extent in the northern Lake Ladoga area, including the Island of Valaam/Valamo. Palaeoseismicity was a special study area of Anatoli Lukashov. He wrote a report on palaeoseismicity in Karelia at the request of the Geological Survey of Finland [Lukashov, 1995]. Geologists Paavo Vuorela and Aimo Kuivamäki of the Nuclear Waste Disposal Study Group visited Zaonezhsky Peninsula at the invitation of Anatoli Lukashov. Later they took a trip to the northern Lake Ladoga area. They agreed that the rock falls in both places were produced by strong seismicity [Kuivamäki et al., 1998].

The sediment cores from the main Lake Onega basin, totalling almost 200 metres in length, displayed no disturbances [Saarnisto & Saarinen, 2001]. The pollen study of cores from the vicinity of Pegrema village shows that the village area was continuously inhabited for more than 5000 years and that there are no signs of a long settlement break due to a violent earthquake 4200 years ago, as suggested by archaeologist Zhuravlev [Vuorela et al., 2001]. The only disturbed sediment sequence in Zaonezhsky Peninsula dates from the time immediately following the deglaciation somewhat more than 13 000 years ago. Thus, later postglacial earthquakes and rock falls should be seriously questioned.

Valaam Island's neotectonics was studied by a Petrozavodsk-Geological Survey of Finland

Prof. M. Saarnisto at a laboratory of the Institute of Geology with colleagues. Left to right: N. Lavrova, L. Gutaeva, O. Demidova, A. Kolkonen, T. Shelekhova (April 3, 2015)

team in February 1996 by coring sediments from all small lake basins on the island. No evidence to support the postulated anomalously rapid uplift of northeastern Lake Ladoga was obtained, but the emergence history of Valaam was explained by a rapid decline of the water level of Lake Ladoga due to the opening of the Neva outlet 3400 years ago [Saarnisto, 2008]. Some of the sediment cores from the small lakes on Valaam were also used to study the history of agriculture and land use on the island [Vuorela et al., 1998].

Concluding remarks; Sight to the future

The co-operation in Quaternary geological research between the Institute of Geology of the Karelian Research Centre of the Academy of Sciences of the Soviet Union and the Finnish institutes commenced by the mid-1970s. The main Finnish participating institute was the Geological Survey of Finland, but representatives of the Universities of Helsinki and Oulu were also involved. The new activity was guided by the Working Group for Geology of the Commission for Scientific and Technical Co-operation between Finland and the Soviet Union. The early activity consisted mostly of study visits in both countries but has declined after 1982.

During the perestroika in the late 1980s the co-operation developed rapidly to extensive research programms, first the Lake Paanajärvi coring campaign 1990 and the beginning of the efforts for a joint map of Quaternary deposits which was published in 1993. The true international collaboration began 1991 by the field excursion to the magnificent Late-glacial Younger Dryas end moraines in Finnish North Karelia and northern Republic of Karelia. These glacial formations, which are most representative in the vicinity of Kuittijärvi/Kuito lakes had been known for a hundred years but hardly ever visited by western geologists. The excursion and related scientific papers contributed to the Project 253 “Termination of the Pleistocene” of the International Geological Correlation Programme of UNESCO. The co-operation in Quaternary geology between the Geological Survey of Finland and the Institute of Geology of the Karelian Research Centre and other northwestern Russian institutes intensified and gained more and more international visibility and reputation because the work was effectively integrated in the European research programmes entitled QUEEN, “Quaternary Environment of the Eurasian North” programme of the European Science Foundation 1996–2004 and “Eurasian Ice Sheets” programme of the European Union 1998–2000 and the scientific results were widely published in international journals.

The work on the Late-glacial behaviour of the receding Fennoscandian ice sheet in Karelia continues and similarly studies on the palaeohydrology of the White Sea basin where huge ice-dammed lakes of several thousand cubic kilometres existed during the Late-glacial Younger Dryas time. The

sudden drainage of several tens of metres of this ice-dammed water body influenced the ocean currents in North Atlantic but the obvious influence on the climate is not yet fully understood. Thus, the study of the Late-Quaternary history of the ice sheet and ice-dammed water bodies in Karelia has a global dimension for understanding the Quaternary palaeoclimate. That's why Russian Karelia interests so much the international science community working on past environmental changes.

The increased knowledge of the ice flow directions of the continental ice sheet and the stratigraphy of glacial deposits, their lithology and geochemistry have great economic potential in ore exploration. The study of the above parameters of glacial deposits in Finland has resulted in discoveries of several economic ore bodies. As the glacial geological environment in Russian Karelia is similar to Finland, the glacial geological indicator tracing methods in prospecting could be utilized more effectively here in order to support the highly qualified bedrock geological and geophysical mapping and ore exploration methods effectively in use in Karelia. Glacial indicator tracing would offer a promising field for the future co-operation.

The bilateral co-operation between Finland and Russian Karelia in the study of palaeoseismicity and neotectonics has increased understanding of the stability of Precambrian bedrock which has applications in the suitability of bedrock in storing the highly active nuclear waste.

The sediment cores from the neotectonics study sites in the Zaonezhsky Peninsula and the Island of Valaam offered excellent material also for the study of the history of land use. The same applies to the Upper Kuittijärvi sediment core raised from the vicinity of the village of Vuonninen. The study of land use and environment changes in the past are of vital importance for separating natural changes from man-made phenomena including the current climate fluctuations. There is a big demand for such studies in Karelia. The palaeoecological expertise, namely pollen and diatom analysis from Late- and Post-glacial sediments and peat sequences, is readily available in the Institutes of Geology and Biology in Petrozavodsk whereas such expertise in the Geological Survey of Finland is greatly reduced but can be found in Finnish universities.

The active period in co-operation lasted approximately 15 years between 1990 and 2005. That was a highly successful period for Quaternary research in Finland and Republic of Karelia. But then suddenly the joint efforts more or less ceased and for a deeply regretful reason. Most Quaternary geologists in Petrozavodsk and many in the Geological Survey of Finland who had been active in co-operation passed away or otherwise left their institutes within a couple of years.

Our late colleagues have paved a clear path for future co-operation. The Quaternary environments of Russian Karelia and Finland offer both stimulating and demanding scientific problems for students of nature. Our task today is to invigorate and maintain scientific co-operation after the recent standstill. It is clear that the Quaternary geologists of the Geological Survey of Finland and universities have a very positive attitude to re-intensify joint scientific work. Russian Karelia is an El Dorado to Finnish geologists!

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