NGU-RAPPORT NR. 92.321
SCIENTIFIC RESEARCH EXCHANGE PROGRAMME ON THE VARANGER PENINSULA, RYBACHI AND SREDNY PENINSULA KILDIN ISLAND, BOLSHOI AYNOV AND MALYI AYNOV ISLAND. REPORT FROM THE JOINT FIELDWORK ON THE NORWEGIAN AND RUSSIAN SIDES OF THE NATIONAL BORDER AUGUST 1-19, 1991

NORGES GEOLOGISKE UNDERSØKELSE

Postboks 3006 - Lade
7002 TRONDHEIM
Tlf. (07) 90 40 11
Telefax (07) 92 16 20

RAPPORT

Rapport nr. 92.321	ISSN 0800-3416	Gradering: Åpen

Tittel:

Scientific Research Exchange Programme on the Upper Proterozoic Geology of the Varanger Peninsula, Rybachi and Sredni Peninsula, Kildin Island, Bolshoi Aynov and Malyi Aynov Islands. Report from the joint fieldwork on the Norwegian and Russian sides of the national border, August 1-19,1991.

Forfatter:
Siedlecka, A., Roberts, D., Torsvik, T.,
Lyubtsov, V., Negrutsa, V., Predovsky, A.

Oppdragsgiver:
NGU

Fylke:

Kommune:

Kartbladnavn (M=1:250.000)

Kartbladnr. og -navn (M=1:50.000)

Forekomstens navn og koordinater:

Sidetall: 17 Pris: 35

Kartbilag:

Feltarbeid utført:	Rapportdato:	Prosjektnr.:	Ansvarlig:
	August 20,1991	61.1886.26	H. Henn-Wolff

Sammendrag:

The 1991 fieldwork in this project was a continuation of investigations commenced in 1990. The Norwegian and Russian workers agreed that: (1) The Trollfjorden-Komagelva Fault Zone continues from the Varanger Peninsula to the isthmus between the Sredni and Rybachi Peninsulas; and (2) there is an overall similarity between the Sredni rocks and those of the Tanafjorden - Varangerfjorden Region, and between the Barents Sea Region and the Rybachi rocks. More detailed interpretations of the Norwegian and Russian authors show differences with regard to the lithostratigraphic correlation and the degree of deformation of the rocks southwest and northeast of the fault zone.

The studied rocks were sampled for geochemistry, micropalaeontology, stromatolites, palaeomagnetism and heavy minerals.

Emneord: Berggrunn		
Prekambrium	Strukturgeologi	
Sedimentær bergart	Stratigrafi	Gangbergart

CONTENTS

THE RUSSIAN-NORWEGIAN PROJECT 'NORTH REGION'

Scientific Research Exchange Programme on the Upper Proterozoic Geology of the Varanger Peninsula, Rybachi and Sredni Peninsula, Kildin Island, Bolshoi Aynov and Malyi Aynov Islands

REPORT

FROM THE JOINT FIELDWORK ON THE NORWEGIAN AND RUSSIAN SIDES OF THE NATIONAL BORDER, AUGUST 1 - 19, 1991.

Murmansk - Mishukovo **August 20, 1991**

PARTICIPANTS

From the Geological Survey of Norway:

Anna Siedlecka
David Roberts
Trond Torsvik

From the Geological Institute of the Kola Science Centre of the Russian Academy of Sciences:

Valeri Lyubtsov
Vladimir Negrutsa
Alexander Predovsky

RESULTS OF FIELDWORK, PRELIMINARY INTERPRETATIONS AND CONCLUSIONS

Introduction

The joint investigations of the Upper Proterozoic sedimentary rocks on the Varanger Peninsula, the Sredni-Rybachi Peninsulas and Kildin Island are aimed at correlation of stratigraphic sections and interpretation of the development of sedimentary basins, and subsequent deformation and metamorphism.

The 1991 fieldwork was a continuation of investigations commenced in August 1990. It was agreed after the 1990 field season that the next stage of fieldwork should be focused on the major fault zone which crosses the Varanger Peninsula and apparently continues towards the isthmus between Rybachi and Sredni, on sedimentary facies analysis, on stratigraphic relationships and on the age of the major stratigraphic units.

The fieldwork on the Varanger Peninsula was carried out during the period 1-10 August by A. Siedlecka and D. Roberts from the Norwegian side and by V. Lyubtsov, V. Negrutsa and A. Predovsky from the Russian side. On the Russian side of the border the group was joined by T. Torsvik from NGU and M. Moczydlowska and G. Vidal from the University of Uppsala, Sweden. The fieldwork was carried out in the period 11-19 August. Working on the Varanger Peninsula, the Russian group collected samples for lithological investigations and comparative geochemical studies, and sampled the stromatolite formations.

Thirteen samples, each weighing c. 15 kg, were also collected by A. Siedlecka from various sandstone formations on Varanger Peninsula for a study of heavy minerals to be carried out by the Russian colleagues in Apatity. The scope of this study is to obtain information on likely provenance areas of the terrigenous material, a method previously used on the Russian side. The samples were crushed and concentrated at NGU and sent to Apatity for further treatment.

1. Upper Proterozoic sedimentary rocks on the Varanger Peninsula

V. Lyubtsov, A. Predovsky

1. Based on several years' field observations and geological mapping performed by Russian and Norwegian geologists, it has been concluded that there is a major tectonic zone extending from Tanafjord (Trollfjord) - Varangerfjord (Komagelv) to the isthmus separating the Sredni and Rybachi Peninsulas, and continuing southeastwards to the north of Kildin Island. This zone appears to be a long-lasting system of faulting and accompanying folding; the movements, at various stages of the zone's development, could have occurred on different scales and in varying direction and rate of displacement.

2. The NW-SE trending tectonic line described above separates two major elongate areas or zones (see Fig. 1), which are different in terms of tectonic regime and consequently the types of tectonic structures (folds, cleavage, fracture, faults, veins) represented. The first zone is that of Tana-Varanger-Sredni-Kildin. As the sediments lie unconformably upon the Archaean crystalline basement, the zone is characterised as relatively stabilised.
   The second zone, Barents Sea Region - Rybachi, is tectonically more active than the first one. The basement lies at a greater depth (and, possibly, it has been tectonically divided to a less extent).
   We may think that the tectonic line separating the two zones could have been synsedimentary for some of the Upper Precambrian sequences and could have controlled thicknesses and sedimentary facies (rock associations).

3. Taking the above (points 1 and 2) as a basis for discussion, it is possible to construct a tentative model of correlation of the Upper Precambrian sequences occurring on the Russian and Norwegian territories. The model includes the following:

3.1. On the Russian territory there are no areas that could provide reliable evidence on stratigraphic relations between the rocks of the Sredni Peninsula and Kildin Island and the rocks of the Rybachi Peninsula. The former (southwestern zone) do not extend into Rybachi, and the latter (northeastern zone) do not occur on Sredni and Kildin. The contact lies along the major tectonic zone on the isthmus between Sredni and Rybachi.

3.2. Geological investigations carried out by A. Siedlecka and colleagues on the Norwegian side reliably show that analogues of the Rybachi rock sequences (Kongsfjord Fm and the lowermost part of the Båsnæring Fm) in the northeastern zone (Barents Sea Region) constitute the cores of major anticlines and they are framed by stratigraphi-

cally younger sequences of the upper Båsnæring Fm and the remainder of the Barents Sea Group. These latter sequences, on the basis of several features, can, in our view, be correlated with the Sredni-Kildin rock complex in the southwestern zone on the Russian side. These features are: the presence of variegated and rather differentiated sediments on the Russian territory only within the Kildinskaya Group, and their complete absence in the section of the Rybachi Peninsula. The occurrence of variegated and differentiated rocks in the upper unit of the Båsnæring Fm may possibly be interpreted as a transition to the level coeval with the rocks in the lower part of the Kildinskaya Group.

In consequence of this, it may now be necessary to revise the conception of several Soviet investigators, who consider the Rybachi rock complex to be younger than the Sredni-Rybachi rocks, and to accept the point of view of our Norwegian colleagues who suggest an older stratigraphic position for the Kongsfjord Fm and the lowermost part of the Båsnæring Fm and regard these as stratigraphic analogues of the Rybachi rock complex (upper part).

3.3. Fieldwork on the Varanger Peninsula and a preliminary comparison of Upper Precambrian sediments on the Norwegian and Soviet sides of the national border suggest the following preliminary conclusion: with respect to the Norwegian side (in contrast to the Russian side), the analogues of the Rybachi rock complex occur only in the northeastern zone (Barents Sea Region), and the analogues of the Sredni and Kildin rock sequences occur in both the northeastern (Barents Sea) and the southwestern (Tana-Varanger) zones. However, the tectonic development is different; in the northeastern zone (Barents Sea Region) the rocks show a more complicated and intense deformation and contain hydrothermal veins of the Alpine type.

Although the tectonic development and degree of deformation are different in the units bearing variegated and rather differentiated red sediments, the sequences of the Vadsø and Tanafjord Groups, on the one hand, and the upper parts of the Båsnæring Group can, in our view, be correlated on the basis of rock types and parageneses. This correlation is supported by the fact that they are overlain, respectively, by the sequences of the Vestertana and Lokvikfjellet Groups that may also be correlated.

3.4. The Upper Precambrian sequences can be correlated on the basis of characteristic rock types and, in particular, of typical parageneses that are of special significance for the correlation due to the specific conditions and long duration of their formation. Such parageneses are related, for example, to sequences that contain products of high sedimentary differentiation: quartzites (fine-grained and feldspar-quartz rocks) and relatively pure carbonate sediments or products of specific climatic environments (evaporite, tillite). Thus, it is possible (roughly, without details) to correlate stratigraphically the quartzite-bearing sequences of the Palvinskaya Fm (Sredni),

Tanafjord Group (Tana-Varanger zone) and Barents Sea Group (Båtsfjord Fm in the Barents Sea Region).

3.5. As a preliminary and totally hypothetical correlation we may assume the following:

Tana zone-Varanger Peninsula	Sredni Pen. zone	Rybachi Pen. zone	Barents Sea Group zone
Vestertana Group	Volokovaya Fm.	-	Løkvikfjellet Group
Tanafjord Group	Kildinskaya Group (upper and middle)	-	Upper part of the Barents Sea Group
Vadsø Group	Lower part of Kildinskaya Group	-	Lower quartzites of the Båsnæring Fm.
-	-	Upper part of the Rybachi Complex	Kongsfjord Fm. and the lower part of the Båsnæring Fm.
-	-	Middle and lower parts of the Rybachi Complex	-

We should emphasize that this table is not a scheme of correlation, but a scheme for speculations on correlation; it came to mind during the joint fieldwork and discussions, 1-9 August, 1991. To support the correlation, it will be necessary to analyze the data from publications and mapping, and to conduct a comparative study of the lithology and geochemistry of rocks occurring in the areas under investigation. This study should be set up after all questions as to the techniques and analytical methods have been agreed upon by both sides.

2. Rybachi-Sredni Peninsula and Kildin Island
A. Siedlecka and D. Roberts

2.1. Sedimentary facies interpretation

2.1.1. Kildinskaya Group on Kildin Island

The lower part of the group, the Korovinskaya to Pestsovozerskaya Formations, were examined and sampled. The lowermost terrigenous-carbonate part of the sequence with several stromatolite horizons, in places rich in glauconite, is overlain by red, green and grey shale with limestone interbeds. Then follows a shale-sandstone unit with three (or more?) coarsening-upward sequences, followed by purely arenaceous deposits which were examined only in their lowermost part. This part of the Kildin Group may, in general terms, be interpreted as a coastal marine to deltaic sequence. In this context the upper part of the group, the Pridorozhnaya and Slancevoozevo Formations, may be tentatively thought as representative of delta-front to delta-plain fluvial sands providing that there is no depositional break.

The examined part of the section was sampled for illite crystallinity (Roberts), paleomagnetism (Torsvik) and biostratigraphy (Moczydlowska and Vidal).

2.1.2. Kildinskaya Group on the Sredni-Rybachi Peninsula

The Kildinskaya Group rests with a sedimentary contact on a high-relief crystalline basement. It starts with immature sands of a probably fluvial origin followed by mature glauconitic coastal sands. The bulk of the formation consists of shales and sandstones arranged in two sequences with a coarsening-upwards motif typical of prodelta-delta front associations. The sandstones of the upper part of the first sequence form large lenticular bodies of sands with a high textural and mineralogical maturity which may be representative of a barrier island system within the delta front. The uppermost formation, consisting of variegated shales and carbonate layers with evidence of subaerial exposure and possible evaporite nodules, might have originated in a restricted embayment within a major deltaic system.
The group was sampled for illite crystallinity and for biostratigraphy.
A dolerite dyke dissecting the Iernovskaya Formation was sampled for radiometric dating, geochemistry and paleomagnetic work.

2.1.3. Volokovaya Group

A section through the lower part of the Volokovaya Group, the Kuyakanskaya Formation, was examined. It consists of thick, light-coloured, trough cross-bedded sandstones, massive granule

conglomerates and small-pebble conglomerates. Locally, at the very bottom, it contains a very coarse breccia-conglomerate. Two c. 1-2 m thick beds of mixtite were observed in the uppermost part of the formation. The overall appearance, cross-bedding orientation, abundant channelling and lenticular bedforms suggest a braided stream environment of deposition with some possible coastal reworking in the middle part of the formation.

Only the lowermost part of the Pumanskaya Formation was briefly examined. It consists of blackish-grey laminated mudstone and shale with subordinate thin sandstones, parallel-laminated and ripple cross-stratified with evidence of slumping. These rocks were deposited in a quiet environment offshore and on, or close to, a slope. The Kuyakanskaya-Pumanskaya stratigraphic relationship is not clear.

2.1.4. Skarbeevskaya Formation

This formation consists mostly of evenly bedded shaly turbidites with parallel- and ripple cross-lamination in shaly intervals. Medium-thick sandstones and small shallow channels filled with small-pebble conglomerate with extrabasinal and intraformational fragments occur in the lower part of the examined section. The part of the section observed in 1990 also comprises debris-flow conglomerates and slump deposits. All these observations suggest deposition on a submarine fan with a fining-upwards retrogressive development.

The formation was sampled for biostratigraphy. Uncleaved dolerite dykes cross-cutting the Skarbeevskaya Formation were sampled for paleomagnetism, radiometric dating and geochemistry.

2.1.5. Einovskaya Group

The Motovskaya and Lonskaya Formations were briefly re-examined and their origin on a faulted basin margin and upper-middle submarine fan was confirmed.

3. Remarks on Stratigraphy and Correlation

I. Nowhere has a stratigraphic contact been observed between the rocks of the Einovskaya and Bargoutnaya Groups underlying the bulk of the Rybachi Peninsula and the rocks of the Kildinskaya Group occurring on the Sredni Peninsula and in the Motka area. The rocks of both regions (Rybachi and Sredni) are deformed close to the contacts and field relationships suggest that the contact is everywhere tectonic.

II. The existing biostratigraphic data indicate a Late Riphean age for the majority of the rocks and are insufficient for a chronostratigraphic correlation across the faulted contact. Work in progress on the biostratigraphy (Moczydlowska & Vidal) may help to resolve this correlation problem.

III. The Late Riphean age of the Kildinskaya and Volokovaya Groups, their overall sedimentary facies development, their deposition on the Lower Precambrian basement and their location southwest of the fault zone provide reasons for a comparison with rocks of the Vadsø Group. The Pumanskaya Formation, however, does not have any sedimentary facies equivalent in the Tanafjord-Varangerfjord Region of the Varanger Peninsula.

IV. The Einovskaya and Bargoutnaya Groups, interpreted as slope and submarine fan deposits with a possible prodelta sequence in the uppermost part may be roughly compared with the Kongsfjord Formation and the lower member of the Båsnæring Formation of the Barents Sea Region of the Varanger Peninsula (cf. 1990 report).

V. The olistostrome of the Cape Vestnik area is indicative of the proximity of a faulted margin of the sedimentary basin in which the slope-to-basin turbidite facies accumulated. It is suggested that this zone was reactivated during the subsequent deformation of the region, resulting in the formation of an extensive fault system running between the Sredni Peninsula and the Motka area, the Sredni Zone, on one side and the remainder of the Rybachi Peninsula, the Rybachi Zone, on the other side. This suggestion is in agreement with the interpretation of the Trollfjord-Komagelv Fault Zone as constituting the northwestward continuation of the Rybachi-Sredni structure.

4. Tectonic Deformation and Metamorphism

The areas visited this year confirm the conclusion reached from last year's field observations that there are clear differences in tectonic deformation and metamorphic grade between the Kildin-Sredni and Rybachi zones. The rocks on Rybachi are characterised by NW-SE trending mesoscopic and larger folds overturned towards the southwest; and the folds carry a penetrative axial plane slaty cleavage in the pelitic units. This refracts into the greywacke beds as a fracture cleavage.

The fold style and degree of deformation varies little from the northwestern parts of Rybachi to the southeastern parts. Although deformation appears to be stronger along the northeastern coast than in the southwest in the Lonskaya Formation, this is possibly a consequence merely of the character of the rocks; mainly distal turbidites in the northeast, as opposed to thick-bedded greywackes in the southwest. Work on illite crystallinity in the cleaved mudstones will help to resolve this question. Samples taken last year have unfortunately not been analysed because of an instrument failure at the department in Heidelburg, Germany, where Dr. Hugh Rice was expected to carry out the analyses. The results from the 1990 samples should be ready early in 1992.

In contrast to Rybachi, mesoscopic fold structures on Sredni and Kildin Island are extremely rare, except in the northernmost part of Sredni close to the expected southeastward continuation of the Trollfjord-Komagelv Fault Zone. In southeastern Sredni, some isolated kink folds were observed; and rare small folds were seen along the western coast of Sredni. The folds in northernmost Sredni will be mentioned below in connection with notes on the fault zone.
The rocks on Sredni and Kildin are devoid of any penetrative cleavage. At most, a bedding-parallel compactional cleavage may be developed, and the metamorphic grade is clearly lower than that on Rybachi. This appears to be in diagenesis grade, except for northern Sredni where it may be in low anchizone. The illite crystallinity work will help to determine this more precisely.

Excursions within part of the main fault zone, along northern Sredni, southernmost Rybachi and in the Cape Vestnik area helped to shed light on the character of the faulting. Approaching the northern coastline of Sredni (SE of Cape Vestnik) from the south, a close fracturing can be seen mainly along NW-SE to NNE-SSW trends. Along the coastal profile in the Poropelonskaya Formation mesoscopic folds are common. These show fairly consistent trends between WSW-ENE and WNW-ESE, and face towards the south. No axial surface cleavage is developed. The axial trend of these folds corresponds to a N-S shortening and associated dextral shear along the main NW-SE fault.

Along the Rastoi stream on southern Rybachi, the Poropelonskaya Formation is strongly deformed in a cataclastic fault zone trending NW-SE to NNW-SSE. There are many anastomosing polished fault surfaces, some carrying thin zeolite veins. More importantly, slickenside lineations plunge at

15-25° towards SE to SSE. The stepped nature of the slickenside surfaces denote a clear dextral movement.

The main NW-SE trending fault zone would thus appear to follow the northern shore of Sredni and extend southeastwards across southern Rybachi. Details of the course of this structure will follow in later reports.

In terms of metamorphic grade the mudstones below the olistostrome on Cape Vestnik are more like the Poropelonskaya than the Lonskaya of Rybachi. This suggests that a parallel NW-SE fault may occur just northeast of Cape Vestnik, although the transitional nature of the boundary between the Motovskaya and the Lonskaya Formations would appear to negate this interpretation.

Finally, it should be noted that the 1:100,000 scale enlargement of the Landsat-TM satellite image provides important information on the structural differences between Rybachi and Sredni, and largely confirms the field observations made both in 1990 and in 1991.

4.1. Dolerite Dykes

Dolerite dykes were sampled on Sredni (1 dyke) and Rybachi (5 dykes) for geochemistry, radiometric age dating and paleomagnetic studies. The Rybachi dykes are clearly younger than the penetrative folding and cleavage in the host metasediments, trending consistently at around 060°. These dykes have not been dated previously — in contradiction to the incorrect information given in the 1990 report. The 620 Ma K-Ar date refers to the Sredni dyke, not to one on Rybachi. The Rybachi dykes have an appearance which is not unlike that of the Devono-Carboniferous dolerites on the Varanger Peninsula, and they could turn out to have approximately the same age. If this is the case, then the penetrative slaty cleavage and fold deformation on Rybachi may well be Caledonian.

Some results obtained from the 1991 joint field observations on the Kildin Island, Sredni and Rybachi Peninsulas, and Malyi Aynov Island

V. Lyubtsov and A. Predovsky

The 1991 joint field trips of the international group made it possible to establish some major details of the geological structure and subdivision of Upper Proterozoic sequences on the Russian side. The most important conclusions are:

1. The participants agreed on the possibility of correlating the sections on Kildin Island and Sredni Peninsula in the following way: Korovinskaya, Bezymyannaya and Chernorechenskaya Fms with the Palvinskaya Fm; Poropelonskaya Fm with Pestsovozerskaya Fm; Zemlepakhtinskaya Fm with Pridorozhnaya and Slantsevozerskaya Fms.

2. The participants examined the exposed uppermost variegated sediments of the Karuyarvinskaya Formation along the shore on the northwestern coast of the Sredni Peninsula, 7 km north of the Cape Matala-Niemi. This fact, in conjunction with the known exposures of the Karuyarvinskaya Fm on the Malyi Aynov Island (Kheynya Sari), suggests that the rocks of the Karuyarvinskaya Fm are widespread on the western Sredni Peninsula, including the localities where the formation is not exposed. This signifies that there is no major angular unconformity at the base of the Volokovaya Group, and rules out the supposition that the Volokovaya Group rests directly on the Zemlepakhtinskaya Fm as reported earlier (Negrutsa 1971).
The participants observed widespread gravelstone lenses and fine pebble conglomerate in the Kuyakanskaya Fm; and in its basal and uppermost parts slump structures are found.

3. In the zone separating the sedimentary sequences of the Sredni and Rybachi Peninsulas, interpreted by the authors as a major tectonic zone located in the strip from Cape Vestnik to Cape Motka, it has been established that the rocks of the Sredni Peninsula are not observed to the northeast of the zone; and the rocks of the Rybachi Peninsula are not observed to the southwest of the zone. No evidence has been obtained in support of the idea that the Motovskaya Fm conglomerate rests upon the rocks of the Sredni Peninsula.
Consequently, there is no evidence testifying to a stratigraphic superimposition of the Rybachi Peninsula sequences above the sediments of the Sredni Peninsula, and, accordingly, to a younger age for the rocks of the Rybachi Peninsula.

4. The observed sequences of the Skarbeevskaya Fm have a peculiar composition and structure that suggest to us a comparison with the Tsypnavoloskaya Fm on the one hand, and with the rocks of the uppermost part of the Kongsfjord Fm and the lowermost part of the Båsnæring Fm, on the other.

On a possible correlation of Upper Proterozoic deposits on the Varanger Peninsula, Sredni Peninsula Kildin Island, Bolshoi and Malyi Aynov Islands and Rybachi Peninsula

V. Negrutsa

In the Upper Precambrian sedimentary sequences on the Varanger Peninsula, Sredni and Rybachi Peninsulas, and Bolshoi and Malyi Aynov Islands there are widespread features which are significant for inter-regional chronostratigraphic correlations. Information on the paleotectonic and paleoclimatic regimes of the rock formations, however, has not yet been properly studied and analysed in terms of correlation. Special attention was given to this information during the fieldwork. It appears to be necessary to carry out an additional specialised study of the literature, paying attention to the character of the stratigraphic units and their succession according to paleoclimatic and geodynamic features. The vertical (chronological) and horizontal (facial) columns obtained in this way form the necessary basis for the interpretation of mineralogical-geochemical characteristics and their application for paleogeographical reconstructions and chronostratigraphic correlations. Provisionally, the following points can be outlined:

1. Sedimentary sequences of the Tanafjord Group and the boundary between this group and the Vestertana Group mark a change in the conditions of sedimentation. This is compatible with the sedimentation development during the second half of 'Kildin time' and at the transition from the Zemlepakhtinskaya Fm to the Karuyarvinskaya Fm of the Kildin Group, and further on to the Kuyakanskaya and Pumanskaya Fms. Taking the above into account, the sedimentary sequences of the Tanafjord Group can be reasonably considered as the chronostratigraphic equivalents of the sediments of the uppermost part of the Kildinskaya Group. It is therefore possible to correlate the Vadsø Group with the lowermost part of the Kildinskaya Group, and to consider the three lower formations of the Vestertana Group to be probable age equivalents of the Kuyakanskaya and Pumanskaya Fms of the Volokovaya Group. Lithological differences in the investigated stratigraphic units can be explained by differences in facial environments, as a consequence of relative position in the land-sea system and in the larger scale geodynamic continent-ocean setting.
2. The succession of sedimentary events in the Lonskaya, Perevalnaya, Maiskaya, Zubovskaya and Tsypnavolokskaya Fms of the Einovskaya and Bargoutnaya Groups on the Rybachi Peninsula is similar to the succession observed in the Barents Sea Group and in the lower units of the Løkvikfjellet Group on the Varanger Peninsula. Thus, it is possible to correlate the Kongsfjord Formation both with the Lonskaya Fm of the Einovskaya Group, and with the Zubovskaya Fm of the Bargoutnaya Group; and, therefore, it is possible to assume that the summary section of the territories under investigation comprise analogues of the Motovskaya Fm which is unknown on the Varanger Peninsula, and, at the top of the section, analogues of a major part of the Løkvikfjellet Group which is absent on Rybachi.
3. The structures of the Barents Sea Region and Tanafjord, separated by a fault zone, and the corresponding territories of Rybachi, Sredni and Kildin show evidence of synsedimentary

deformations (including olistostrome-type units observed in the Motovskaya Fm on Cape Vestnik and in the northwestern part of the Sredni Peninsula in the Kuyakanskaya and Pumanskaya Fms) and multiple tectonic deformations. They suggest the existence of a long-lasting tectonic suture, possibly marking the edge of a continental slope in Late Precambrian time. The initial stratigraphic interrelationships between the sedimentary sequences within this zone have been completely changed by the tectonism. They can be reconstructed only by indirect implications. With this aim in view, it is necessary to conduct a further detailed study of pebbles and boulders of sediments in the conglomerates of the Motovskaya and Maiskaya Formations and the Volokovaya Group, and to compare the compositions of the clasts in these conglomerates with those of the conglomerate on the Varanger Peninsula. In particular, special attention should be given to pebbles and boulders of sedimentary rocks of the Kildin type occurring in the conglomerates on the Rybachi Peninsula, and also to jaspoids (e.g. those that are found in the conglomerate of the Sadfjord Fm).

4. Widespread diagenetic concretions and phosphorite concretions may represent accumulators of synsedimentary properties of sedimentary environments and, therefore, may be the objects for interregional stratigraphic correlations.

GENERAL RESULTS AND PROPOSITIONS

The 1991 joint fieldwork on the Varanger Peninsula, Kildin Island, Sredni Peninsula, Malyi Aynov Island and Rybachi Peninsula provided new information on the geology of the regions and refined fundamental details of the Upper Proterozoic geology on the Russian side. All these data, as described in the present report, make it possible to bring the points of view of Russian and Norwegian scientists essentially closer, mainly on the subject of general correlation, and to modify the conceptions of the relationships between the Upper Proterozoic sedimentary sequences on the Russian side.

Geochemistry, mineralogy, biostratigraphy, radiometric age determinations and paleomagnetism will all provide information necessary for reaching final conclusions on correlation, the geological development of the studied areas and compilation of a geological map covering both the Russian and the Norwegian sides. The results of these studies will also indicate what kind of supplementary work would be necessary in the later, post-1992, stages of the work. We therefore suggest a field programme for 1992 which includes areas not yet visited and which would extend our basis for correlation and preparation of a joint geological map.

1. On the Norwegian side:

1.1. Tanafjord and Vestertana Groups in the Gaissa Nappe Complex.

1.2. Lithostratigraphy of the Laksefjord Nappe Complex, Laksefjord area.

1.3. Stromatolites in the Porsanger Formation, Porsangerfjord.

2. On the Russian side:

2.1. The zone of the Upper Proterozoic sediments on the southern, Belomorian coast of the Kola Peninsula (Tury Cape, Tersky Coast, Chapoma river).

2.2. In order to obtain additional material on interregional correlation, a field excursion should be arranged to the area of metamorphosed Upper Proterozoic sediments on the Kanin Peninsula, in the northwestern part of the Pae mountain ridge.

Trondheim 13.12.1991

Anna Siedlecka

David Roberts

Trond Torsvik

Apatity 13.12.1991

Valeri Lyubtsov

Vladimir Negrutsa

Alexander Predovsky