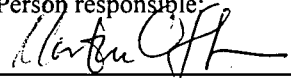


NGU Report 96.148

Mineral Resources of the Kola-Finnmark
region, 1993-1996. Summary of activities.

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**NGU Project 6421.02:
MINERAL RESOURCES OF THE KOLA-FINNMARK REGION, 1993-1996.
SUMMARY OF ACTIVITIES.**

Victor A. Melezhik & Morten Often, Norges geologiske undersøkelse.

Introduction

The Project was designed to serve the main goal: promotion of Russian-Norwegian mining and mineral industrial activity in the north region (Kola Peninsular, East Finnmark). The development of a data base on available mineral deposits in the Kola region has been a major task. The work with the computerised data base has involved the following: (i) systematise the data available; (ii) structure the data in a form acceptable in western countries; (iii) translation to English; (iiii) make the data freely available.

The Project structure has been made in accordance with the main goals and tasks and it is presented in Fig. 1.

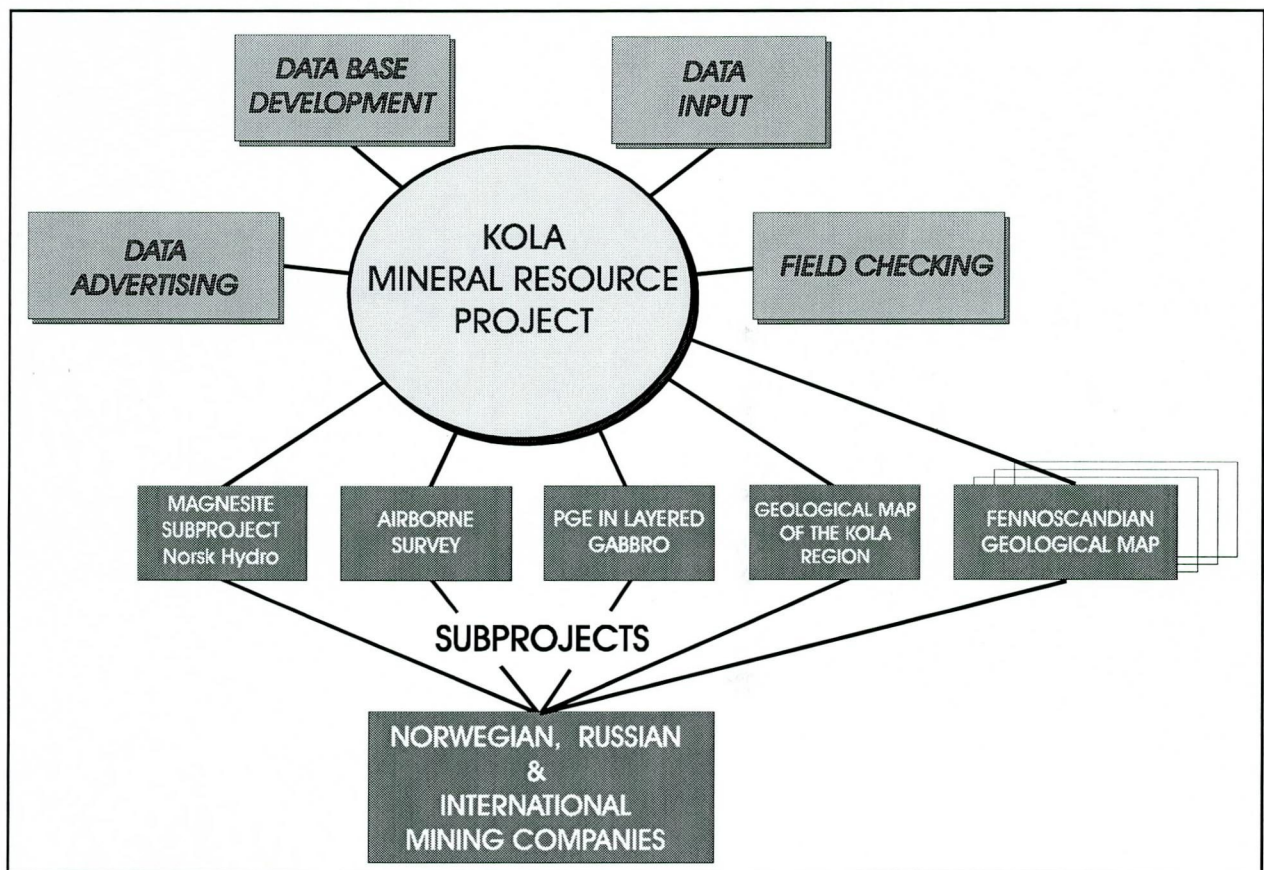


Fig. 1 Project structure.

Results

As we have been reporting regularly on the Project development we will present here only the main results which have been accomplished during the course of the Project.

Data base

Around 135 examples of ore, industrial mineral and dimensional stone deposits have been brought to our present-day knowledge (Table 1). 19 of these deposits are at present being exploited and 84 others have been explored. The main commodities in the Murmansk district are Ni, Co, Fe, apatite, nepheline, Zr, REE, Nb, Ta, baddeleyite, vermiculite, phlogopite, ceramic raw material, clay and flux materials. The Murmansk region is considered to have a high exploration potential for PGE-bearing layered gabbro-norite intrusions (Panskie and Fedorovy Tundry), copper and gold (Late Archaean Kolmozero-Voronja Belt) and diamonds (Tersky coast, White Sea on-shore).

Collection and systematising of available data on mineral resources of the Murmansk region in an easily accessible, computerised form and in English language has been carried out for the most important deposits. The database includes: (1) geographic co-ordinates, (2) general geological & stratigraphical position, (3) radiometric age, (4) short morphological & genetic description, (5) mineralogy of the ore & host rocks, (6) list of exploration works, (7) reserves, (8) average grade, (9) total production. At present data on 80 deposits are available at the Geological Survey of Norway (Table 1), and a number of these have been checked in the field.

This type of data was in Russia formerly regarded as strategic and of importance for national security. It has been a long process for NGU to be able to present this data in an open database.

Although we have been facing a number of obstacles with the Russian co-ordinate system (e.g. secrecy and inaccuracy) the majority of deposits are supplied now with accurate co-ordinates transformed to the UTM system.

Table 1. List of deposits available in the Murmansk district and registered in the data base at the Geological Survey of Norway.

NR.	Deposit	Raw material	Confirmed	Database
1	Rovgora	Amasonite		
2	Ploskaya	Amasonite, Y		
3	Korabl Ridge	Amethyste		
4	Apatity Cirque	Apatite		Registered
5	Eveslogchorr	Apatite		Registered
6	Koashva	Apatite		Registered
7	Kuel'por	Apatite		Registered
8	Kukisvumchorr	Apatite		Registered
9	N'yorpakhhk	Apatite		Registered
10	Oleny Ruchey	Apatite		Registered
11	Partamchorr	Apatite		Registered
12	Rasvumchorr Plateau	Apatite		Registered
13	Yukspor	Apatite		Registered
14	Tukhtavara	Apatite, Baddeleyite		Registered
15	Nyal'm-1	Au	Yes	Registered
16	Nyal'm-2	Au	Yes	Registered
17	Oleninskoe	Au	Yes	Registered
18	Sallanlatva	Barytt, (Apatitt), Nb		Registered
19	Bol'shoi Lapot	Be, Talc		
20	Devitsja	Chromite	Yes	
21	Dunite core	Chromite	Yes	
22	Loipeshnyun	Chromite	Yes	
23	Bolshaya Varaka	Chromite, PGE		Registered
24	Tikozero	Chromite, PGE		Registered
25	Vasin-Myl'k	Cs, (Li, Ta, Be)	Yes	Registered
26	Nittis	Cu, Ni, PGE	Yes	
27	Ermakovskoe-20	Diamond		
28	Ermakovskoe-7	Diamond	Yes	
29	Luppejärvi	Dimensional stone		
30	Sukhoy	Dimensional stone		
31	Val'seyavr	Dimensional stone		
32	Voronje	Dimensional stone		
33	Sormozero	Dimensional stone, black granodiorite		
34	Od'yavr	Dimensional stone, blue granite	Yes	
35	Shongui	Dimensional stone, diorite		
36	Luostari	Dimensional stone, dolomite	Yes	
37	Pirtti-Yarvi	Dimensional stone, dolomite	Yes	
38	Monchetundra	Dimensional stone, gabbro		
39	Chornaya Salma	Dimensional stone, gabbro-norite		
40	Jona (Kulos)	Dimensional stone, gabbro-norite		
41	Kyula-Vaara	Dimensional stone, gabbro-norite	Yes	
42	Rikolatva	Dimensional stone, gabbro-norite		
43	Testchina Gora I	Dimensional stone, gabbro-norite		
44	Testchina Gora II	Dimensional stone, gabbro-norite		
45	Pojakonda	Dimensional stone, garnet amphibolite	Yes	
46	Zelenoborsky	Dimensional stone, granitogneiss		

47	Khibiny	Dimensional stone, khibinite, lovchorrite	Yes	
48	Kusretsjensk	Dimensional stone, pink granite		
49	Vinga	Dimensional stone, pink granite	Yes	
50	Kirikovan	Dimensional stone, pyroksenite		
51	Poriareka	Dimensional stone, pyroksenite	Yes	
52	Tersky Bereg	Dimensional stone, slate/sandstone		
53	15 years of October Revolution	Fe		Registered
54	Aivar	Fe		Registered
55	Anomal'ny	Fe		Registered
56	Kirovogorskoe	Fe		Registered
57	Komsomolskoe	Fe		Registered
58	Kurkenpakhk	Fe		Registered
59	Olenegorskoe	Fe		Registered
60	Pecheguba (Pechegubskoe)	Fe		Registered
61	Pinkeljavr	Fe		Registered
62	Polovinnaya	Fe		Registered
63	Prof. Bauman	Fe		Registered
64	Sholtjavr	Fe		Registered
65	Tukhtavara	Fe		Registered
66	Volch'ya Tundra	Fe		Registered
67	Yuzhno-Kakhozerskoe	Fe		Registered
68	Zapadnoe	Fe		
69	Kovdor	Fe, Apatite, Zr	Yes	Registered
70	Tikozero	Fe, Ti		Registered
71	Kuru-Vaara	Feldspar		Registered
72	Otradnoe	Feldspar		Registered
73	Rikolatva	Feldspar		Registered
74	Skalisty	Flaky graphite		Registered
75	Keivy	Kyanite		
76	Keivy	Kyanite		
77	Keivy	Kyanite		
78	Keivy	Kyanite		
79	Keivy	Kyanite		
80	Keivy	Kyanite		
81	Keivy	Kyanite		
82	Keivy	Kyanite		
83	Keivy	Kyanite		
84	Keivy, Maniuk	Kyanite	Yes	
85	Keivy, Podmaniuk	Kyanite	Yes	
86	Keivy, Shuururta	Kyanite	Yes	Registered
87	Keivy, Tyapshmanyuku	Kyanite	Yes	
88	Kolmozerskoe	Li, Rb, Be, Ta		
89	Polmastundra	Li, Rb, Be, Ta	Yes	
90	Och-Myl'k	Li, Ta, Cs	Yes	
91	Kuolajärvi	Magnesite		
92	Pellapahk	Mo, Cu, Au, Ag	Yes	Registered
93	Yauriyokskoe	Mo, fluor spar	Yes	Registered
94	Neblogorskoe	Muscovite		Registered
95	Rikolatva	Muscovite		Registered
96	Yenskoe	Muscovite		
97	Lastyavr	Ni		Registered
98	Lovno	Ni		Registered

99	Karikyavr	Ni (Cu, PGE)		Registered
100	Nyud	Ni, Cu	Yes	
101	Sopcha	Ni, Cu	Yes	
102	Allarechenskoe	Ni, Cu, Co	Yes	Registered
103	Bystrinskoe	Ni, Cu, Co		Registered
104	Kamikivi	Ni, Cu, Co	Yes	Registered
105	Kaula	Ni, Cu, Co	Yes	
106	Kotsel'vaara	Ni, Cu, Co	Yes	Registered
107	Semiletka	Ni, Cu, Co		Registered
108	Severnye Onki	Ni, Cu, Co		Registered
109	Sputnik	Ni, Cu, Co		Registered
110	Tundrovoe Verkhnee	Ni, Cu, Co		Registered
111	Vostok	Ni, Cu, Co		
112	Zapolyarnoe	Ni, Cu, Co	Yes	Registered
113	Zhdanovskoe	Ni, Cu, Co	Yes	
114	Generalskaya	Ni, Cu, PGE		
115	Fedorovy Tundry	Ni, PGE		Registered
116	Pachkvaraka	Ni, PGE		Registered
117	Panskie Tundry	Ni, PGE		Registered
118	Sr. Ichtegipachk	Ni, PGE		Registered
119	Khabozerskoe	Olivin		Registered
120	Tikozero	PGE		Registered
121	Kovdor	Phlogopite	Yes	Registered
122	Petyain-Vara	Phlogopite		Registered
123	Keivy, Nyussa	Scheelite	Yes	
124	Lovozerskoe	Ta, Nb		
125	Neskevara	Ta, Nb, (Zr, Apatitt)		Registered
126	Pados	Talc, magnesite		
127	Gremyakha-Vyrmes	Ti, Apatite		Registered
128	Kovdor	Ti, Apatite, REE, Zr	Yes	Registered
129	Zapadny	Ti, REE		Registered
130	Kovdor	Vermiculite	Yes	Registered
131	«Apatite» Mine	Waist		Registered
132	Kovdor Mine	Waist		Registered
133	Sallanlatva	Yellow ochre, Limonite		Registered
134	Chinglusuai	Zr, Ta, Nb		
135	Sakharyok	Zr, Y	Yes	Registered

Field work (checking the reliability of data received)

38 deposits have been inspected (Table 1). A sample collection has been obtained from these deposits and the most representative ore types have been analysed in order to provide an independent evaluation. Other samples have also been obtained from various sources, for example we have samples from three main diamond provinces in Russia, e.g. from Yakutsk (Siberia), Archangelsk and Tersky coast (Kola).

Commodity reports

A report, in English, on apatite-bearing alkaline, alkaline-ultramafic and carbonatite intrusions, and 27 related mineral deposits has been produced. This includes the following data: (1) 1:25000 geological maps for each intrusion, (2) 1:10000-1:1000 geological maps for each deposit, (3) geological cross-sections of each deposit on a scale of 1:2000-1:5000 based on drilling material, (4) explanatory notes (reserves, average grades, composition of concentrates etc.). This report can be used both for an independent assessment of deposits in operation and for planning of new prospects in the Kola region. The report is a result of co-operative work between the Geological Survey of Norway and three Russian organisations, namely the Murmansk Geological Committee, the Murmansk Geological Expedition, and the Central Kola Geological Expedition.

Promotion of foreign investment on Kola

The computerised data base on Kola mineral resources and the readily available assistance from the Geological Survey of Norway have been widely advertised at a number of international prospecting and exploration business meetings, e.g. in Toronto (1995, 1996) and London (1995). Various brochures have been printed and world-wide distributed offering our data base and Russian oriented services.

Laboratory work

In order to involve some of the mineral resources available in the Kola region as a possible raw material for Norwegian mining industry, a number of tests have been made at the Geological Survey of Norway, e.g. nepheline concentrate from Khibiny Mine, pure quartz from the Perchatka deposit. A special attempt has been made in order to confirm a reported french diamond find in the Pasvik river in 1882. The original samples with the diamond crystals have now been located at the Mineralogical Museum in Paris and one diamond has been tested. The test confirmed the reliability of the earlier made identifications.

International and domestic assistance

Activity with main orientation towards promotion of Norwegian-Russian or International-Russian industrial cooperation and development is shown in Table 2.

Table 2. Companies served by the Kola Mineral Resource Project and some examples of practical use of the data available at the Geological Survey of Norway.

NOTEBY	Bedrock geological map in the Pechenga Fjord, 'Harbour Project', planning and construction of a harbour in the Pechenga Fjord.
ELKEM	Geological and geochemical data on the Bol'shaya Varaka chromite deposits, consulting work and introduction to Russian contacts.
Falconbridge	Vast geological information on the Pasvik-Pechenga area, consulting and field work, joint prospecting for Ni in Pasvik, introduction to Russian contacts, providing geological excursion to the Russian Ni mining areas.
Kenor A/S	Russian geological information in relation to a gold occurrence found in Pasvik, ground geophysical work, drilling program, prospecting and exploration for Au in Pasvik.
Norsk Hydro	Assessment of magnesite potential in the Fennoscandian Shield, geological data on apatite-bearing carbonatite in the Kola region, field trip to Karelia.
Varanger Steinindustri	Inspection of a blue granite deposit, introduction to Russian contacts.
Outokumpu Oy	Airborne geophysical maps over the Pechenga-Pasvik area.
Ashton Mining	Airborne geophysical maps over the Pechenga-Pasvik area..
Monopros	Airborne geophysical maps over the Pechenga-Pasvik area.
Boliden	Geological, geochemical information and sample collection from the Kolmozero-Voronja area for planning of prospecting for Au, Cu and Mo.

Development of business contacts

Establishment of contacts with Russian authorities, industry and research institutions built up over three years is considered a very valuable knowledge of the Kola Project, which has been extensively utilized by Norwegian and international mineral industry (Table 2). The most important business contacts and their inter-relationships are shown in Figs. 2- 4.

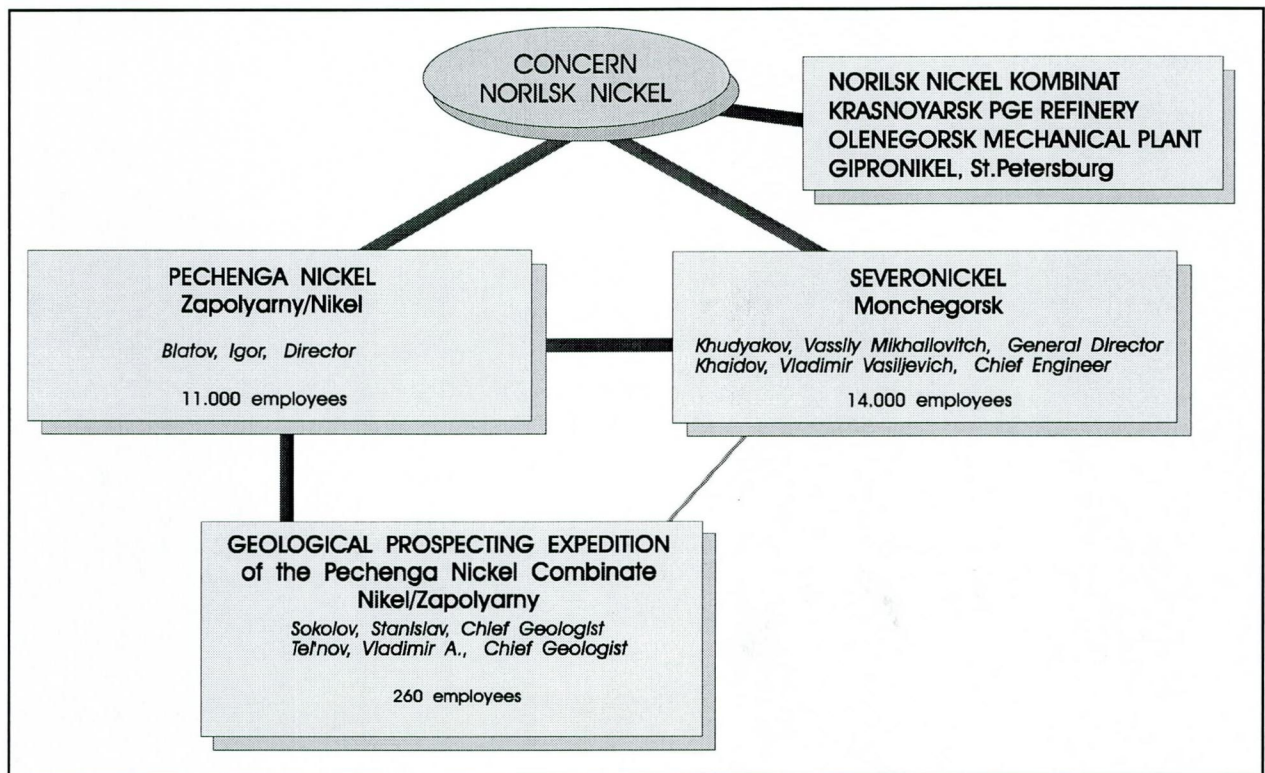


Fig. 2. The Project contacts with institutions from the Russian nickel industry.

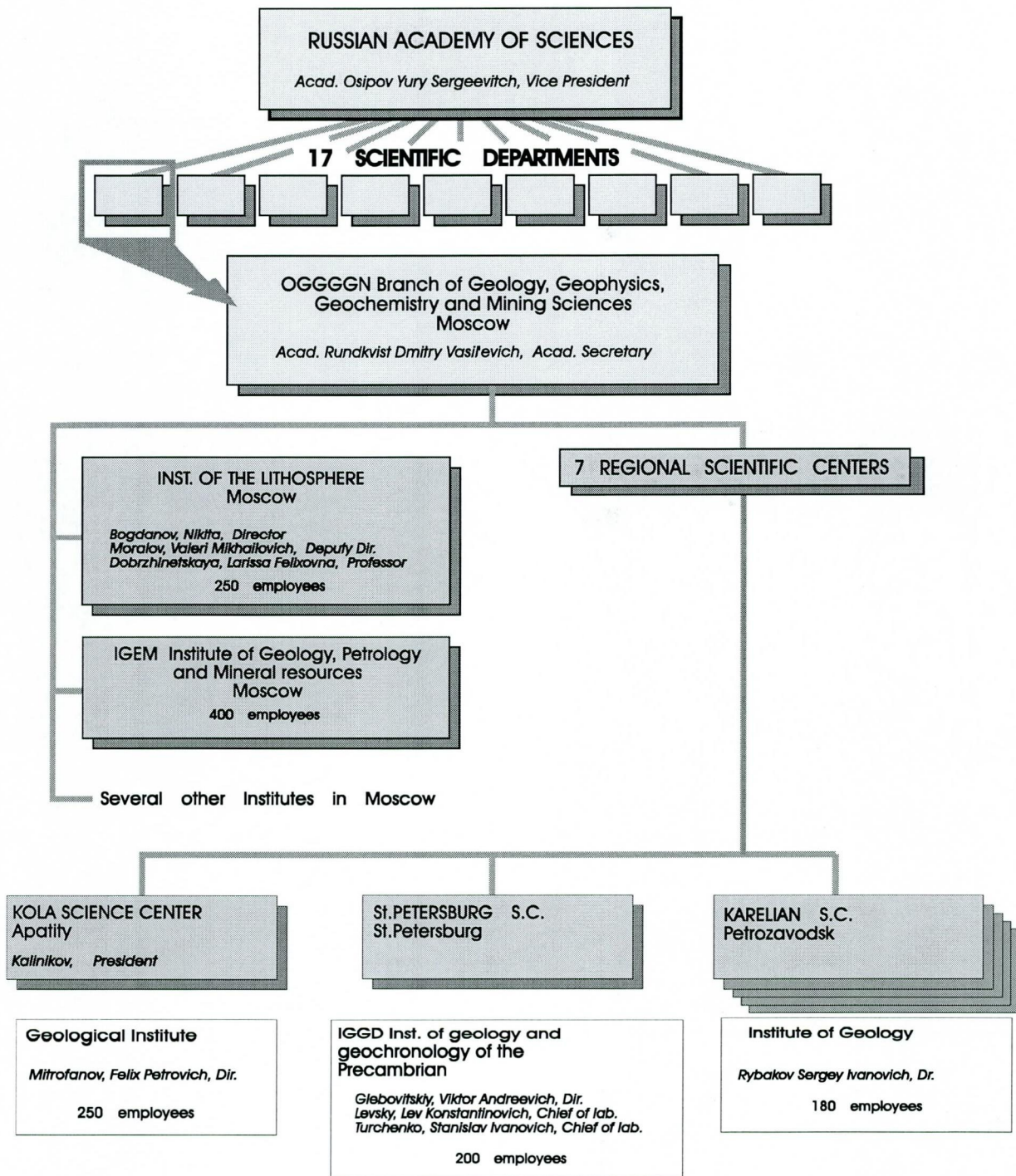


Fig. 3. The Project contacts with institutions from the Russian Academy of Sciences.

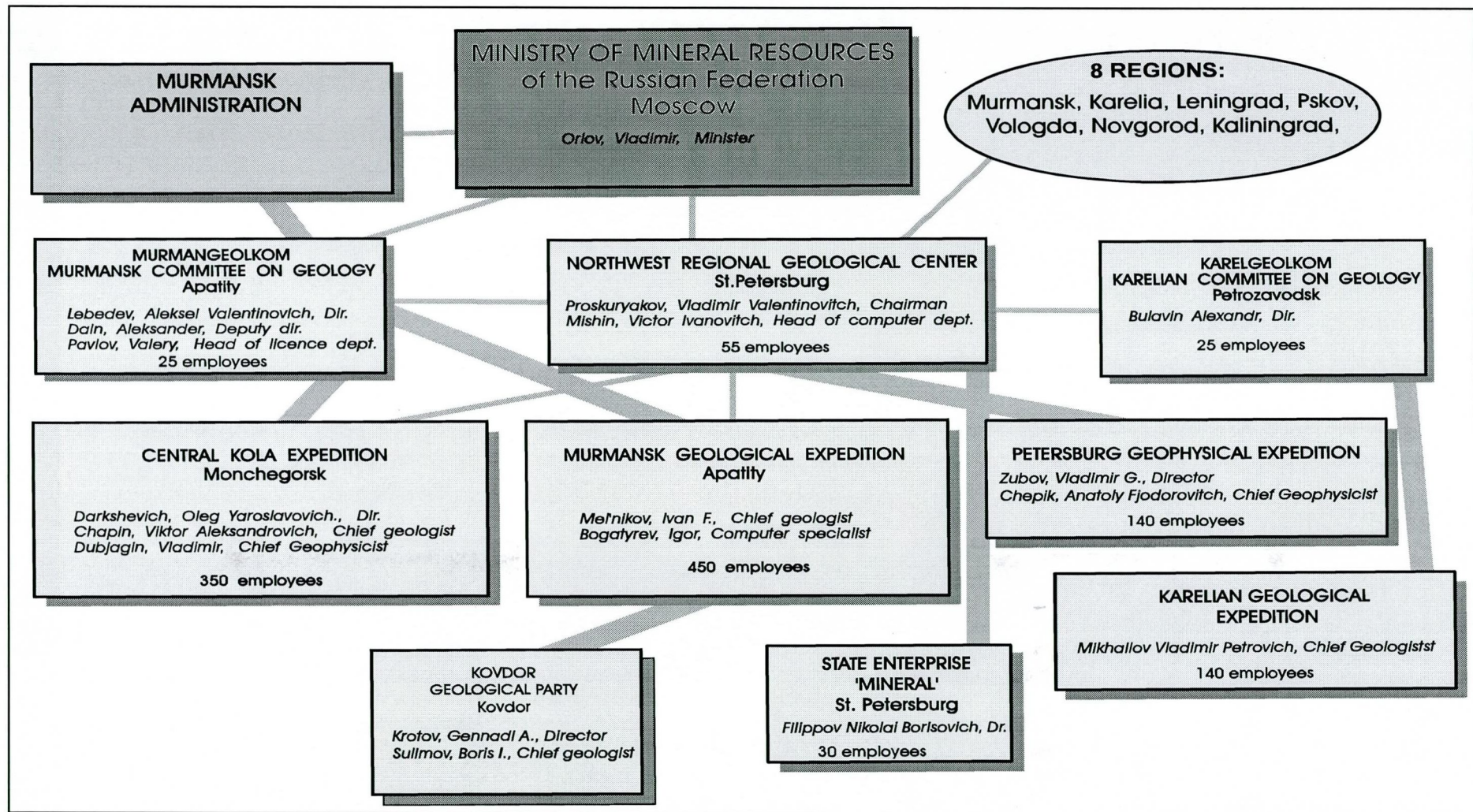


Fig. 4. Project contacts with institutions from the Ministry for Natural Resources of the Russian Federation.

International spin-off projects

Activity within the Kola Project has created many fruitful international contacts which have resulted in development of independent projects shown in Table 3.

Table 3. Spin-off projects developed within the Kola Mineral Resource Project.

Project title	Leading institution	Partner	Duration	Funding organisation	Budget
1 Hydrosphere and atmosphere system evolution in Precambrian.	NGU*	SURRC	Long term	NERSC, CSU	5.000 £ per year
2 World-wide 2 billion-year-old isotopically heavy carbonate carbon: evolutionary significance and driving forces.	NGU	SURRC, GIN, IGGD, IG	2 years	INTAS-RFBR, Brussels-Moscow	54,000 ECU
3 Platinum group element mineralisation in Russian Karelia	UW.	NGU, IG	3 years	UW, NGU	5,000 £
4 Shungite: chemistry, microtexture, origin.	NGU	DTU, IG	3 years	DTU, NGU	50,000 NOK
5 Platinum group element mineralisation in the Pechenga Ore Field.	NGU	UQ, PNC	3 years	NGU, UQ	90,000 NOK

**NGU - Geological Survey of Norway*

CSU - Consortium of Scottish Universities, Scotland

DTU - Danish Technical University, Copenhagen, Denmark

GIN - Geological Institute of the Russian Academy of Sciences, Moscow, Russia

IG - Institute of Geology, Russian Academy of Sciences, Petrozavodsk, Karelia, Russia

IGGD - Institute of Precambrian Geology and Geochronology, Russian Academy of Sciences, St.-Petersburg, Russia

NERSC - Natural Environment Research Council, Scotland

PNC - Pechenga Nickel Combinate

SURRC - Scottish Universities Research and Reactor Centre

UQ - Sciences de la Terre, Université du Québec à Chicoutimi, Canada

UW - Department of Earth Sciences, University of Wales, UK

Reports, articles, maps, guidebooks, brochures and oral presentations (abstracts)

The Kola Mineral Resource Project have resulted in a number of publications listed here below. In addition to these a number of unpublished oral presentations have been delivered at various meetings. The reports are all open file unless otherwise stated.

Boyd, R., Niskavaara, H., Kontas, E., Chekushin, V., Pavlov, V. & Often, M. 1996: Anthropogenic noble-metal enrichment of topsoil in the Monchegorsk area, Kola Peninsula. *Abstract*.

Chepik, A.F. 1995: Report on the results of ground geophysical surveys for verifying airborne local magnetic anomalies in Norway (South Pasvik area). *NGU Report 95.035*, 41pp.

Ebbesen, T.W., Hiura, H., Hedenquist, J.W., de Ronde, C.E.J., Andersen, A., Often, M. & Melezhic, V.A. 1995: Origins of Fullerenes in Rocks. *Technical comment, Science*, 268, 1634-1635.

Ihlen, P.M., Often, M. & Marker, M. 1993: The geology of the Late Archean sequence at Khizovaara, Russian Karelia, and associated metasomatites: Implications for the interpretation of the Raitevarre Cu-Au deposit in the Karasjok Greenstone Belt, North Norway. *Abstract. 1st International Barents Symposium, 21-24 October 1993, Kirkenes, Norway. Nor. geol. unders.*

Ihlen, P.M., Often, M. & Marker, M. 1995: Senarkeiske bergarter i Khisovaara, Russisk Karelen, og assosierte metasomatitter. *Presentation at Norsk Geologisk Forenings Wintermeeting, Trondheim 6.-8.01.1995. Abstract, Geonytt 22/1*, p.37.

Juve, G., Størseth, L.R., Vetrin, V.R. & Nilsson, L.P. 1995: Mineral deposits of the International map sheet Kirkenes 1:250.000. *Presentation at Norsk Geologisk Forenings Vintermøte, Trondheim 6.-8.01.1995. Abstract, Geonytt 22/1*, p.39.

Juve, G., Størseth, L.R., Vetrin, V.R. & Nilsson, L.P. 1993: Mineral deposits of International mapsheet Kirkenes 1:250.000. *Abstract. Barents Symposium, Kirkenes oct. 1993.*

Kihle, O. & Kulmametiev, B.A. 1994: Aeromagnetic Anomaly Map, Pasvik-Pechenga, M 1:50.000, sheet 1-4. Mineral resources Finnmark-Kola, *Petersburg Geophysical Expedition-Nor.geol. unders.*

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Kihle, O. & Chepik, A.F. 1995: Electromagnetic Anomaly Map (3 frequencies), Pasvik-Pechenga-Allarechka area, M 1:50.000, sheet 1-4. Mineral resources Finnmark-Kola, *Petersburg Geophysical Expedition-Nor.geol. unders.*

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Conclusions

The Project has resulted in a clearer understanding of the mineral potential of the region and as such forms an important basis for all future work on the mineral deposits. In a number of cases sufficient data is available to allow Norwegian and other western mining companies to have a better basis for entering into joint-venture agreements for the development and exploitation of such deposits. The results of work done in this project, and in part in a related NGU project (Ecogeochemistry of the North Area), provides a realistic basis for mining

companies to formulate strategies for mineral exploration studies in the region. There is naturally much work to be done to expand on the information regarding mineral resources of this region and it is hoped that this can be achieved via a follow-up project to this initial Pilot Project.