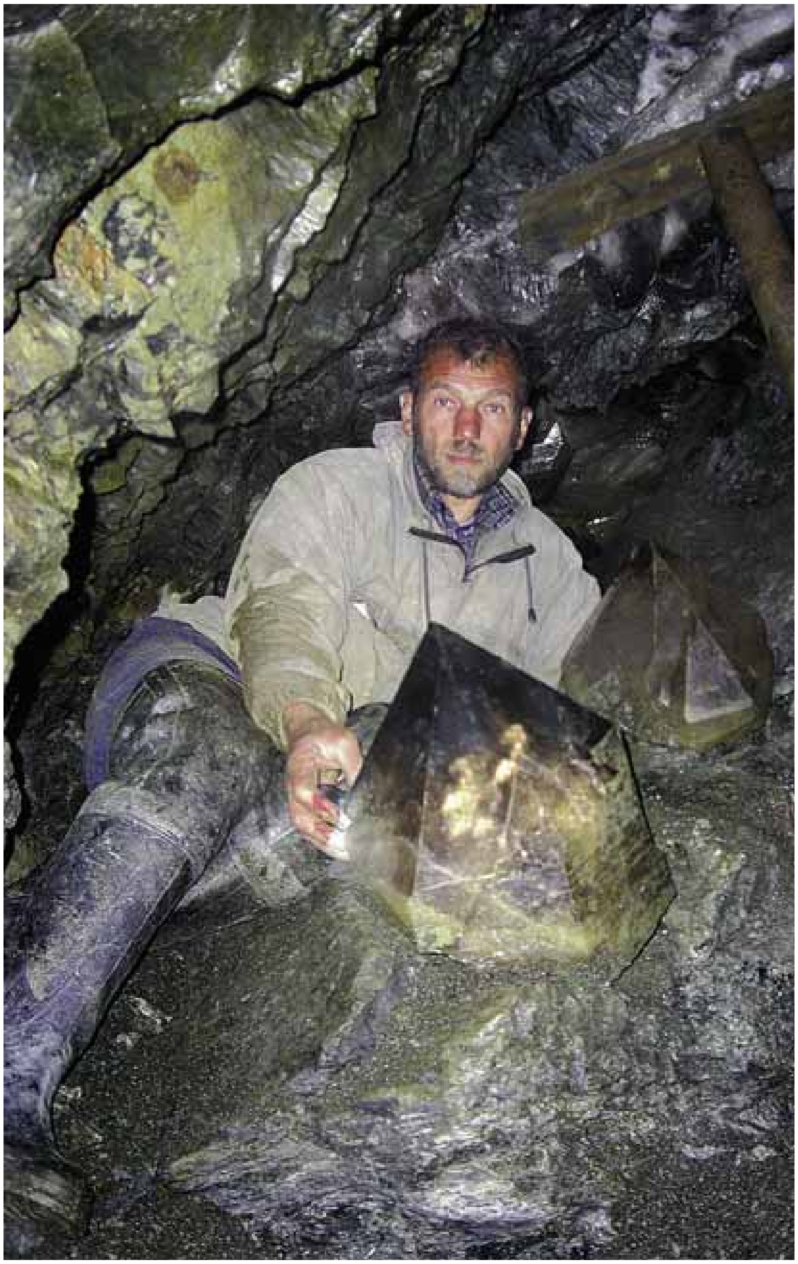
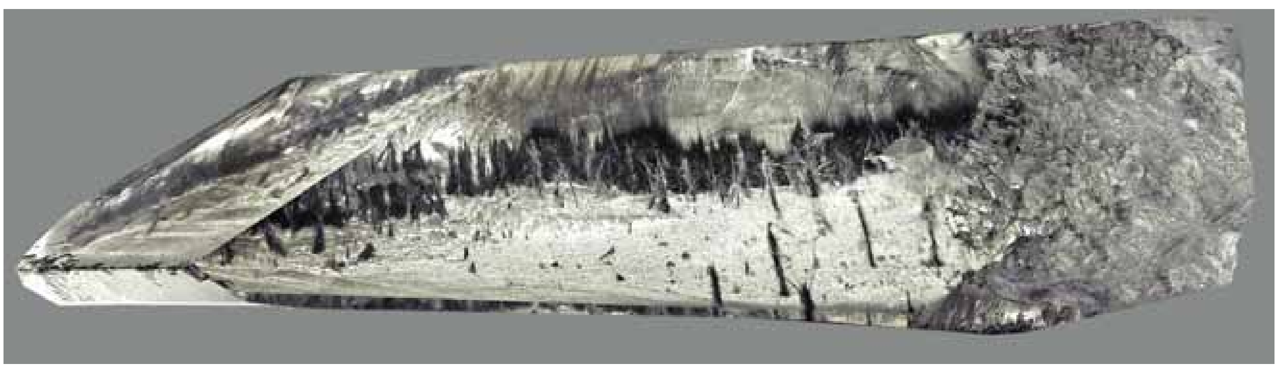


Fig. 20. **Quartz** with inclusions.
7 x 5 cm. Nikolai-Shor. Fersman Mineralogical Museum, RAS, no. K2221, 1946.
Photo: M.B. Leybov.

← *Fig. 19.* N.I. Khokhanov in rock crystal pocket at Puiva. Photo: E.V. Burlakov.

Fig. 21. **Quartz** with inclusions ("Winter Landscape").
38 x 6 cm. Piramida. Geoscience Museum, Lomonosov Moscow State University, no. K2221.
Photo: M.A. Bogomolov.



GEOLOGY OF THE SUBPOLAR URALS AND MAIN DEPOSITS OF QUARTZ

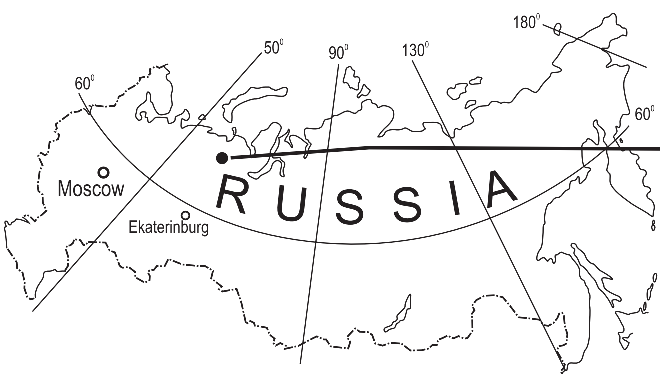
The Subpolar Urals including Mountain Narodnaya (1895 m) is the highest part of the Urals. It is separated from the Northern and Polar Urals by the Schugor River and Kozhim River, respectively (*Fig.* 22).

Geology of the Subpolar Urals

The Subpolar Urals is a part of the Central Ural uplift of the Uralian folded system, which extends as a narrow strip all along the Urals. At the east, it is bounded by the Main fault of the Urals and at the west by the Uralian foredeep. The rock crystal-bearing province of the Subpolar Urals is spatially related to the Kozhim transverse uplift that is a fragment of the basement of the East European platform outcropping in the Subpolar Urals. The poorly eroded Khobeiz granite gneiss dome is the base of the Kozim uplift and is divided into three structural stages: 1) Lower Proterozoic (Nyarta) stage, 2) Riphean-Vendian stage, and 3) Paleozoic stage (*Fig.* 23).

The geological structure of the territory comprises a set of tectonic elements and complexes. The Upper Kozhim ring structure, a northeastern activated part of the Khobeiz granite gneiss dome, is clearly distinguishable among them. The second element is the Malyi Patok volcano-plutonic structure located in the southwest Subpolar Urals.

A crucial structure of the Subpolar Urals is the Central zone of tectono-magmatic activation (Bukanov, Shevchenko, 1982). The zones of northwestern and near-latitudinal trending transverse faults are important ele-



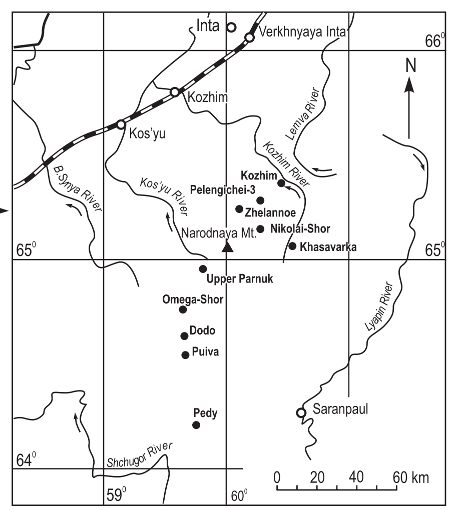


Fig. 22. Geographical location of Subpolar Urals.

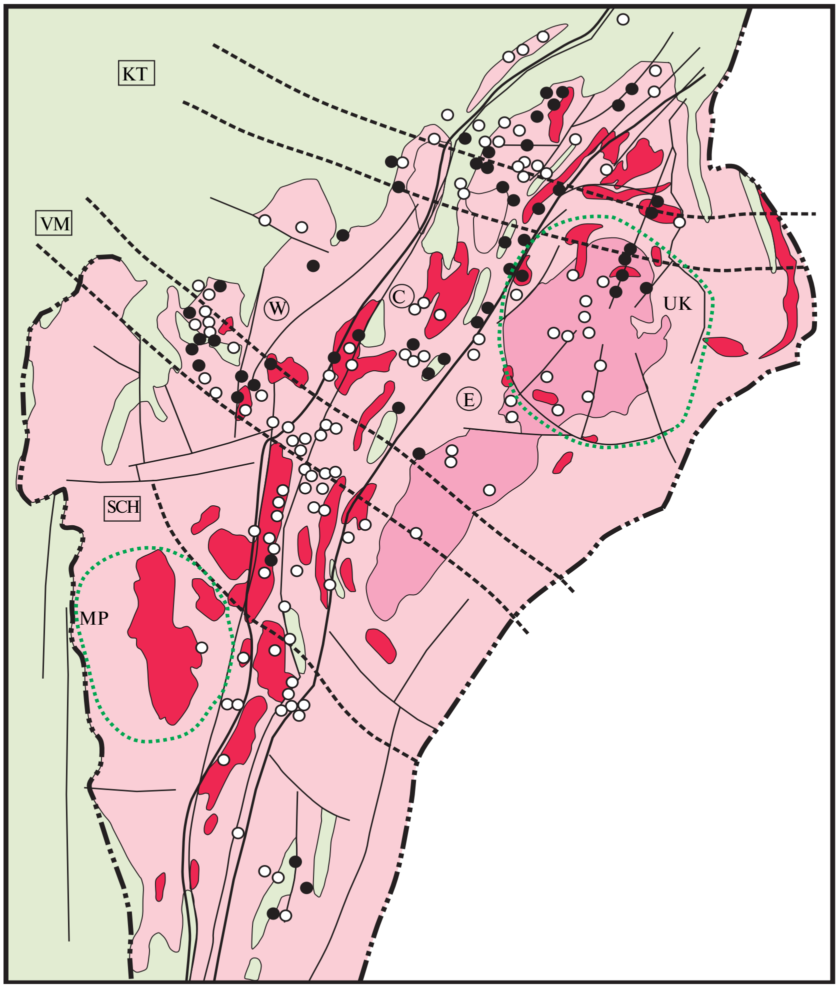


Fig. 23. Geological map of rock crystal province (after A.V. Kozlov).

– Paleozoic structural stage (Telpos, Khydei, and Schugor Formations);

– Riphean-Vendian structural stage(Man'khobeyu, Schokur'yu, Puiva, Khobeyu, Moroin, Sablya, and Laptopai Formations);

– Low Proterozoic structural stage (Nyarta Formation);

– Plutons;

– Faults;

– Thrusts;

VM – Transcurrent faults: (VM) Vangyr-Man'ya, (KT) Kos'yu-Tynagot, (SCH) Schokur'ya (after I.A. Shevchenko);

– Boundaries of central zone of tectonic activation;

W – Tectonic blocks of the first order and rock crystal districts of the same names: (W) Western, (C) Central, (E) Eastern;

UK – Ring structures: (UK) Upper Kozhim, (MP) Malyi Patok.

a b – Rock crystal locations: (a) with smoky crystals, (b) with citrine smoky crystals.

ments of its geological structure (Lennykh, 1984). Most granitic plutons with ages estimated as Riphean-Vendian (Pystin, 1993) or Vendian-Cambrian (Makhlaev, 1996) in the Central zone were activated by the faults related to the Upper Kozhim ring structure.

Three metamorphic events were identified in the Subpolar Urals (Timonina, 1980; Pystin, 1991, 1994). The first Early Proterozoic event of moderate pressure high temperature amphibolite to granulite facies metamorphism is observable only as relict mineral assemblages the Nyarta complex. The second event is seen as a zoned moderate pressure epidote-amphibolite and amphibolite facies metamorphism; the grade of metamorphism reduces from the Nyarta complex toward margins of the Khobeiz granite gneiss dome. The third moderate pressure greenschist facies event with the greatest intensity near the tectonic boundaries of the Nyarta complex (Pystin, 1991) acted on Ordovician and younger rocks. In addition to the described metamorphic events, a poorly documented regional near-fault alteration occurs in the Subpolar Urals. Only local metasomatic halos around rock crystal-bearing quartz veins and pockets (Karyakin, Smirnova, 1967; Bukanova, Bukanov, 1969; Bukanova, 1975; Kozlov *et al.*, 1994) and

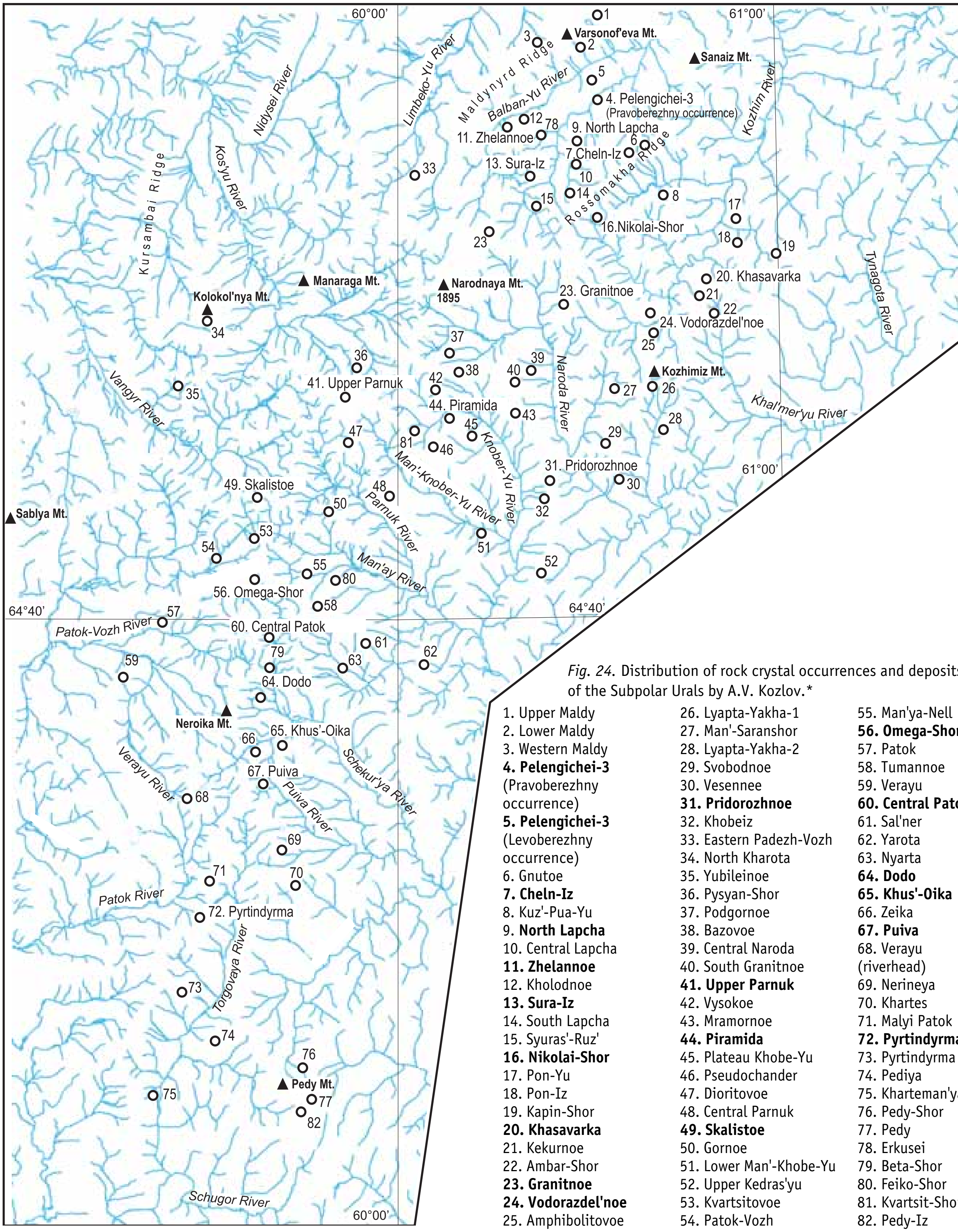


Fig. 24. Distribution of rock crystal occurrences and deposits of the Subpolar Urals by A.V. Kozlov.*

1. Upper Maldy
2. Lower Maldy
3. Western Maldy
4. **Pelengichei-3** (Pravoberezhny occurrence)
5. **Pelengichei-3** (Levoberezhny occurrence)
6. Gnutoe
7. **Cheln-Iz**
8. Kuz'-Pua-Yu
9. **North Lapcha**
10. Central Lapcha
11. **Zhelannoe**
12. Kholodnoe
13. **Sura-Iz**
14. South Lapcha
15. Syuras'-Ruz'
16. **Nikolai-Shor**
17. Pon-Yu
18. Pon-Iz
19. Kapin-Shor
20. **Khasavarka**
21. Kekurnoe
22. Ambar-Shor
23. **Granitnoe**
24. **Vodorazdel'noe**
25. Amphibolitovoe
26. Lyapta-Yakha-1
27. Man'-Saranshor
28. Lyapta-Yakha-2
29. Svobodnoe
30. Vesennee
31. **Pridorozhnoe**
32. Khobeiz
33. Eastern Padezh-Vozh
34. North Kharota
35. Yubileinoe
36. Pysyan-Shor
37. Podgornoe
38. Bazovoe
39. Central Naroda
40. South Granitnoe
41. **Upper Parnuk**
42. Vysokoe
43. Mramornoe
44. **Piramida**
45. Plateau Khobe-Yu
46. Pseudochander
47. Dioritovoe
48. Central Parnuk
49. **Skalistoe**
50. Gornoe
51. Lower Man'-Khobe-Yu
52. Upper Kedras'yu
53. Kvartsitovoe
54. Patok-Vozh
55. Man'ya-Nell
56. **Omega-Shor**
57. Patok
58. Tumannoe
59. Verayu
60. **Central Patok**
61. Sal'ner
62. Yarota
63. Nyarta
64. **Dodo**
65. **Khus'-Oika**
66. Zeika
67. **Puiva**
68. Verayu (riverhead)
69. Nerineya
70. Khartes
71. Malyi Patok
72. **Pyrtindyrma**
73. Pyrtindyrma Mt.
74. Pediya
75. Kharteman'ya
76. Pedy-Shor
77. Pedy
78. Erkusei
79. Beta-Shor
80. Feiko-Shor
81. Kvartsit-Shor
82. Pedy-Iz

* Occurrences and deposits mentioned in Table 1 (pp. 44–45) are **given by bold**.

Fig. 51. **Ferroaxinite.** 19 x 11 x 11 cm. Puiva (Adit #32 m). Natural History Museum of Los Angeles County, no 55691, Hyman and Beverly Savinar Collection.

Fig. 52. Cluster of rhombohedral **calcite** crystals. 36 x 18 cm. Puiva. Chernov Geological Museum, Institute of Geology, Komi Scientific Center, Ural Branch, RAS, Syktyvkar, no. 530/63. Photo: M.B. Leybov.

In some large pockets, the weight of crystal can reach 50–150 kg, and in the 31–36 pocket the weight was more than 150 kg. The largest cluster produced in 1985 was about 1000 kg and 120 x 210 cm in size. Quartz crystals at the deposit are short-columnar and columnar, less frequently long-columnar, with the length/diameter ratio ranging from 3:1 to 6:1. The crystals are hexagonal-prismatic. Their natural color is pale smoky and nice deep tea-colored varieties were also observed.

Mining at Puiva proceeded for more than 80 years, including production of mineral specimens for museums and collectors. The most spectacular mineral of the deposit is axinite (ferroaxinite), for which Puiva is famous. Apophyllite is abundant in the Alpine-type veins. Ilmenite and titanite are the predominant titanium minerals, while rutile and anatase are occasionally found. Pyrrhotite is widespread in the rock crystal-bearing quartz veins in contrast to other deposits where pyrite is predominant. Different areas of the deposit and the rock crystal zones have significantly different mineralogical features. For example, in the Western zone a lateral and vertical change in paragenetic assemblage and crystallomorphology of certain minerals is observed. At its northwestern flank are unique pockets with axinite enclosed in a zone of up to 50 m of altered quartzite-schist sequence. In metasomatic rock, axinite occurs as separate veinlets and phenocrysts together with quartz, feldspar, and zoisite. Superposition of rock crystal-bearing veins and mineralized fractures on the metasomatic provided the formation of axinite in cavities as perfectly formed transparent and semitransparent crystals and clusters together with other minerals of the rock crystal-bearing assemblage (Burlakov, 1986; Burlakov, Yakovleva, 1988).

Fig. 52a. **Quartz**.
21 x 12 x 13 cm. Puiva.
Fersman Mineralogical
Museum, RAS, no. 86024,
1988. Photo: M.B. Leybov.