Mineral Deposits, Papunen (ed.) © 1997 Balkema, Rotterdam, ISBN 90 5410 889 4

Quartz of Karelia (Russia)

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ABSTRACT: This paper describes investigations of the geology and processing of Karelian quartz occurrences, Russia. Different types of quartz were studied, such as quartz from mica and ceramic pegmatites of Saamian formations of Belomorian mobile zone, quartz from veins of Saamian, Lopian, Sariolian and Jatulian formations including placers, quartzites of Lopian and Jatulian formations. The quartz samples were refined and Al, Fe, Na, K, Ca, Mg and Ti were analyzed by a Swedish laboratory Analytica Ab and a Japanese laboratory in Tokio. The tests were done in the processing laboratory of Partek Nordkalk (Virkkala, Finland) and the laboratory of the Institute of Geology (Petrozavodsk, Russia). The outcome was that Karelian quartz could be of interest for high-purity quartz after different purification procedures.

1 GENERAL

Quartz is formed from the two most widespread elements on the Earth's crust: silicon and oxygen. According to the Roskill Information Services Ltd (the Economics of Quartz, 1992) about 10 billion tons of quartz are consumed annually in various forms all over the world. Construction industry accounts about 98 % off all.

In the Karelian territory (Russia), quartz occurs in various geological environments, namely in hydrothermal-metasomatic veins and pegmatites as well as in different types of rocks as an important rock-forming mineral. Its percentage in rocks may be 90-95% (sedimentary and metasomatic quartzites, granites, quartz conglomerates).

Here the first aerial survey on pure quartz was begun in the 1950's. The outcome was, that there are good possibilities to find pure quartz deposits in North Karelia. This study was continued in the 1970's on 15 pegmatitic occurrences with quartz core. Laboratory tests indicated that the quartz could be used as raw material for fused products, for synthesis of artificial crystals and for optical glass manufacture (Shchiptsov 1993).

The qualitative-quantitative circuit developed during the processing of quartz and its concentration made it possible to begin industrial use of by-products mined by Mining & Processing Complex "Karelslyuyda" in Chupa. Nowadays the Chupian "lascas" (the term for crystal chips which form the feedstock for quartz crystal production) is used in the domestic manufacture for multicomponent optical glass, growth of artificial quartz crystals and quartz ceramics. At the moment the mining of mica and quartz is practically finished.

At present the Institute of Geology (Petrozavodsk) and the Northern Geologic Prospecting Expedition are working on a project of "Mineragenic Prognoses" of pure quartz in Karelia. The Industrial Minerals Division of Partek Nordkalk Ltd paticipates in the project. Additional assistance is obtained from the Japanese specialists of quartz, H.Iwasaki and F.Iwasaki.

2 GEOLOGY

Quartz in Karelia is found in a variety of geological environments. Three important types of quartz occurrences are distinguished: pegmatites, quartz veins and quartzites. The contents of impurities measured in powders after purification are shown in Table 1. Analyses 1-6, 8-9 and 12-14 were carried out by a Japanese laboratory (Tokio) and analyses 7 and 10-11 by Analytica Ab (Sweden)

Table 1 Concentrations of impurities (ppm) after refining of quartz of some Karelian deposits.

Deposit	Al	Ca	Mg	K	Na	Li	Fe	Ti
Pegmatites								
1. Pirtostrov	62	2,4	< 1	13	7,7	< 5	1,0	6
2. Nikonova	180	13	2	17	100	< 5	88	6
3. Karelskoe	150	7.8	< 1	6	120	< 5	1,7	4
4. Kyryala	150	6.1	1	< 5	95	< 5	26	5
Veins								
5. Hizovara Y	36	4,1	< 1	< 5	10	< 5	1,1	4
6. Hizovara V	28	7,3	< 1	< 5	12	< 5	1,1	9
7. Pezhostrov	220	-	-	92	330	-	8,4	11
8. Tiroyarvi	25	14	3	13	55	< 5	4,6	< 1
9. Kyvikanda	39	29	2	14	14	< 5	6,2	13
10. Girvas	180	-	-	69	290	-	11,0	1,9
11. Fenkina	36	-	-	24	100	-	4,0	< 0,5
Quartzites								
12. Hizovara	220	12	1	< 5	7,2	< 5	39	13
13. Metchangyarv	5100	8,1	23	300	13	< 5	64	51
14. Òikshozero	50	4,6	< 1	5	4,8	< 5	3,0	4

2.1 Pegmatites

Pegmatites are very common and abundant in the Belomorian mobile belt. They are related to the period of the Svekofennian activity of the Saamian complex. As a rule the quartz cores of pegmatites are most interesting (Table 1, Nos. 1-3). On the other hand the quartz of this type is known rather well and it is already used in industry. Belomorian pegmatites with large quartz cores were formed in closed systems of pegmatitic-hydrothermal processes during the Svecofennian reactivation. Mica-pegmatites are considered favourable for quatrz occurrences. The other types of quartz with a good quality are mica-ceramic and ceramic pegmatites. White quartz, transparent-white, milky-white, rosy and smoky colours of quartz are known. In addition, ceramic pegmatites were surveyed in southern Karelia where quartz is common in pegmatites of the Lopian volcanic-sedimentary formations (No. 4).

2.2 Veins

Samples of vein quartz were taken from various stratigraphic units. In the Belomorian mobile zone special attention was paid to host rocks (ultramafics, gabbro-amphibolite, feldspar amphibolite, hornblende gneisses, biotite gneisses, granite-gneisses). Impurities are practically similar. The most important commercial products are quartz pebbles from local placers at White sea shore (No. 9). Fluid inclusions are as common as in quartz from pegmatites.

Vein quartz of the greenstone belt has also been investigated. Some veins show a minimum content of impurities (Nos. 5-6) and a very small amount of fluid inclusions, unlike the Belomorian quartz veins (No. 7).

Additionally quartz samples were analyzed from veins of the volcanic formation of the Sariolan formations and from veins of the Jatulian formations (volcanic-sedimentary and carbonate rocks). The content of impurities are satisfactory (Nos. 8, 10-11). Vein quartz is white or milky white.

2.3 Quartzites

Quartzites consisting quartz as the main mineral also represent a possible source of pure quartz. Quartzites were formed in various geological environments and periods. The research has shown, that it is possible to obtain a rather low content of impurities by specific processing. An example would be a recrystallized milky-white quartzite occurring in a grey quartzite of Jatulian superhorizon (No. 14). The size of quartz grains is less than 1 mm.

The sedimentary Lopian and the Jatulian quartzites are problematic as for processing (Nos. 12-13). The Lopian sample was taken from greyish, medium-grained, quartzite in the Hizovara area (Late Archean). Main minerals are quartz, feldspar and sericite. Jatulian quarzite - for example Metchangyarvi - is white with a greyish shade and fine-grained. It consists angular quartz grains up to 1 mm in diameter cemented by finer quartz and sericite, with local disseminated dust of ore minerals and rare tourmaline and grains of zircon

The advantage of quartz from quartzite is the almost total absence of fluid inclusions. However mineral inclusions occur in considerable amounts.

3 REFINING TEST PROCEDURES

Quality of quartz can be inproved by benefication. Raw materials for the test production of refined quartz were collected from quartz occurrences lascas from a pegmatite, lascas from quartz veins and samples of quartzites.

The tests were done in Partek processing laboratory at Virkkala (Finland) and in the laboratory of the Institute of Geology of Petrozavodsk. The results between different laboratories were comparable.

The procedure was as follows:

(1) crushing with jaw crusher

(2) grinding in a ball mill, for pegmatite and vein quartz into size 0.4 mm and quartzite into size <0.16 mm.

(3) desliming using triple decant

(4) extraction of iron with dry magnetic separation using high intensity up to 12 000 oersted.

Impurities of quartz from pegmatite consist mainly of aluminium and in vein quartz of aluminium and iron. Acid leaching was used for refining iron contamination from the surfaces of quartz grains. The content of impurities (Na, K, Ca, Fe) decreased after acid leaching. The experience showed that Al cannot be additionally extracted in acid leaching, because Al is combined with SiO_2 in the crystal lattice.

Quartzites might be of interest as for pure quartz after different cleaning procedures including flotation. Mica flotation preceded feldspar flotation. Kyanite, iron and titanium bearing minerals with mica were extracted. Further processing may involve acid leaching and high-intensity magnetic separation removing fine-grained particles. Quartz from quartzites is inferior because of smaller sizes of particles. Examples of major changes of impurities after multi-stage treatment are shown in figures 1 and 2.

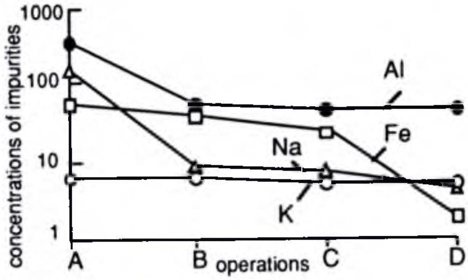

Figure 1. Variation of Tikshozero quartz composition after the phases of refining process. A-Natural Ore; B-Flotation; C-Magnetic Separation; D-Acid Treatment

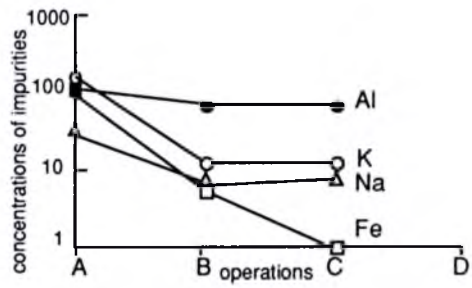

Figure 2 Variation of Pirtostrov quartz composition after the phases of refining process. A-Natural Ore; B-Flotation; C-Magnetic Separation; D-Acid Treatment

4 CONCLUSIONS

Lascas from pegmatites are traditionally extracted in mines in Chuba. However the quality of quartz may be improved by special processing. Vein quartz on the tectonically reactivated Lopian and Sariolian formations has better characteristics than quartz from the Belomorian mobile zone. Some quartzites could have certain interest for extraction of pure quartz by mechanical, physical and chemical methods.

REFERENCES

Shchiptsov, V.V. 1993 Quartz. *In Precambrian Industrial Minerals of Karelia*. Petrozavodsk: 31-32