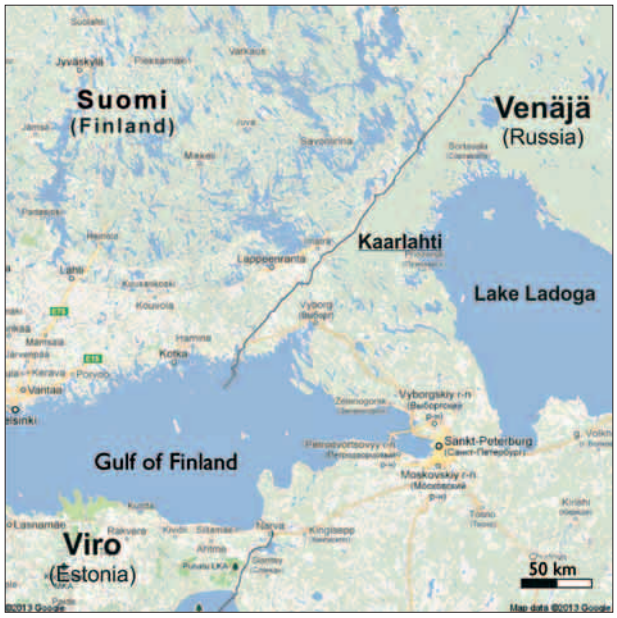

Figure 1. Regional map showing the location of the Kuznechenskiy (Kaarlahti) massif on the Karelian Isthmus.

History of exploration of granites of the Kuznechenskiy (Kaarlahti) massif on the Karelian Isthmus

ANNA TUTAKOVA

This paper studies the main stages of geological exploration and granite extraction in the Kuznechenskiy (Kaarlahti) massif. Short description of facing granite deposits and examples of architectural monuments, where this granite was used, are given.

The Kuznechenskiy (Kaarlahti) massif is located in the north of the Karelian Isthmus in the Priozersk district of the Leningrad region (Fig. 1) near the Kuznechnoe (Kaarlahti up to 1948) railway station. This part of the Karelian Isthmus belongs to the southern edge of the Baltic Shield formed by dislocated metamorphosed Precambrian rocks near the border with the Russian Plate, the cover of which is formed by the younger sedimentary rocks. According to up-to-date radio isotopic determination the age of the Kuznechnoe granite is Palaeoproterozoic. The area of the massif is about 50 km^2. Mineral composition of the granite is microcline 30–40 %, plagioclase 25–35 %, quartz 20–40 %, biotite 5–10 %, garnet 0–5 %. Granite is predominantly coarse-grained with massive, partly gneissoid texture. Some veins of aplite, pegmatite and white quartz are found and xenoliths of gneiss are met. Marginal parts of the massif are formed by gneiss-granite. Granite is of grey-pink, grey-red and grey in color.

Russian geologists have carried out the search and exploration of facing and building stone deposits within the Kuznechenskiy granite massif since 1940. During this period some old Finnish quarries, where granite blocks were extracted for crushed aggregate production, have been found near the Kaarlahti railway station. Geological exploration has been carried out in four perspectives for block extraction areas near the Kaarlahti railway station. Petrographic features, physical-mechanical

and high decorative properties of the Kaarlahti granites were determined, as well as their favorable transportation conditions [near the railway and motorways Leningrad–Kexgolm (from 1940–Priozersk)–Hiitola–Sortavala and the Lake Ladoga] were noted.

Geological exploration continued in 1948. Granite of the Kaarlahti massif was actively studied due to necessary restoration and reconstruction of Leningrad after the war of 1941–1945. Natural facing stone was also used for construction of underground stations in Leningrad and Moscow. In 1948–1965 within the Kuznechenskiy (Kaarlahti) massif exploration work was carried out in 22 areas and 5 of them were distinguished as the most promising for block extraction. Petrographic, decorative, physical–mechanical properties and jointing of granite were properly studied. Areas favorable for block extraction according to jointing degree as well as zones of increased jointing were defined. In 1948–1950 the necessity of test extraction was noted. According to the results of test extraction the output of commercial blocks made as 25–30 %. Minimum block size was determined as 0.28 m^3 and medium size was 0.7 m^3. Large blocks were not extracted, as it was difficult to transport them to railway station. Though it was noted that large blocks could be extracted in the Kaarlahti massif (5 m^3 and more). Slabs made of test extraction blocks were used for facing of high-rise buildings in the Smolenskaya Square in Moscow. Granite deposits of this massif were considered the most promising and first-priority targets for facing stone exploration.

From 1950 to 1994, granite blocks of 0.7 m^3 and more were extracted in the Percon-Lampi deposit located 1 km north-east from the Kuznechnoe railway station. This coarse-grained gray-red granite was used for decoration of the Liteiny, Grenaderskiy and Kamennoostrovskiy bridges in Leningrad in 1960–1970. The Robespier, Arsenalnaya and partly Sverdlovskaya embankments are faced with the same granite. The pedestals of monuments to A.S. Pushkin on the Arts Square (1957), N.A. Dobrolubov (1959) and A.M. Gorky (1968) in Petrogradskiy district were also made of the Percon-Lampi granite. This granite was also used for the Memorial to the Heroic Defenders of Leningrad opened on the Victory Square in 1975. The same granite was used for the pedestal of V.I. Lenin monument which was placed on the Moscow Square in 1970 and the pedestal of M.V. Lomonosov monument (Fig. 2) on the crossing of the University embankment and Mendeleyevskya Line on Vasilyevskiy Island (1986).

In 1960–1980 the Percon-Lampi deposit provided about half of the block production volume from the Karelian Isthmus deposits. In 1995 development of this deposit ended due to essential decrease of block output: up to 8–10 % instead of 30–35 % according to the exploration results.

In 1991–1992 granite blocks within the Kuznechenskiy massif were extracted from the test-production quarry of the Bogatyry deposit located 4 km to south-west from the Kuznechnoe railway station. The volume of the test-production quarry was about 3000 m^3. This gray-red porphyry granite with large phenocrysts of pink potassic feldspar was used for architectural finish of underground

Figure 2. Monument to M.V. Lomonosov on the Vasilyevskiy Island in St. Petersburg.

stations "Vosstaniya Square" and "Ligovskiy prospect" in St.Petersburg.

From 2002 to 2007 the Kuznechenskiy granite blocks of gray-pink color with coarse-grained structure and massive texture were extracted from time to time in the Kuznechnoe-2 deposit. This deposit is located 3 km eastward from the Kuznechnoe railway station and 2.5 km from the Percon-Lampi deposit. The granite from the Kuznechnoe-2 deposit was used for architectural finish of underground stations in St. Petersburg.

At present facing stone of the Kuznechensky massif is extracted only in the Ladozhskoe deposit. This deposit is located 4 km eastward from the Kuznechnoe railway station and 13 km from Priozersk, 100 m from motor road St. Petersburg–Priozersk–Sortavala, 400 m from the Kuznechnoe-2 deposit. In the Ladozhskoe deposit granite blocks are extracted using blast-hole technology (Figs. 3–5). In recent years the production volume make up 8–15 thousand m^3 of rock mass. Granite has gray-pink and gray colors, coarse-grained structure and massive partly gneissoid texture. Such texture creates a beautiful and slightly wavy pattern. The deposit has been exploited since 1998. During the first years the commercial blocks output consisted of 20–25 %, during the last years it has gone down to 10–15 %. Block size is 1–5 m^3, sometimes more. This decrease in block output is explained by the presence of numerous inclined fractures, which were not clearly seen in test production during exploration stage. It seems probable that the closed fractures were opened as a result of blasting work, even though "Granilen Z" an explosive especially developed for block extraction, was used. This causes decrease of natural stone blocks output and

Figure 3. Ladozhskoe deposit on the Karelian Isthmus (Leningrad region). Quarry for granite block extraction.

Figure 4. Ladozhskoe deposit on the Karelian Isthmus (Leningrad region). Splitting up of primary monolith using blast-hole technique.

Figure 5. Ladozhskoe deposit on the Karelian Isthmus (Leningrad region). Splitting of primary monolith for secondary monoliths for commercial blocks production.

their irregular oblique-angled form and leads to losses during commercial block processing.

Here are some examples of using the granite of Ladozhskoe deposit in the architecture of St. Petersburg. One of them is the monument "300 years of the city, port and customs" on Vasilyevskiy Island erected in 2000 (Fig. 6). The others represent inner decoration of the Ladozhskiy railway station (2003), the fountains near the Finland railway station and on the Moscow prospect raised in 2005–2006 (Fig. 7). These beautiful granites were also used for decoration of underground stations and other architectural monuments in St Petersburg and other cities.

The problem of storage of the leftover stone from block production on the Ladozhskoe deposit was successfully solved. Calibrated chips of size 150–500 mm are produced using hydrohammer technique. These chips are used for building of hydrotechnical constructions (e.g. a dam in St. Petersburg), and also in architectural and construction work related to landscape design and road construction. For the producer this means receiving one more type of product and solving an ecological problem. After a deposit is closed there will remain a beautiful lake instead of stone waste.

Granite for crushed aggregate production in the Kuznechenskiy massif has been quarried since 1945. In 1950–1970 two deposits were developed, from 1980 and up to present such granite has been quarried in three deposits located 1–3.5 km eastward and westward from the Kuznechnoe railway station.

Granites of the Kuznechenskiy (Kaarlahti) massif have good decorative and physical-mechanical properties. Low content of natural radionuclides enables using this granite in all types of architectural and building work. Natural jointing of the massif and optimal direction of quarry working face enables quarrying of large blocks (2–5 m^3 and more).

In the recent years natural stone has become fashionable in St. Petersburg. Good combination of color, pattern and polishing of this stable ornamental material could be found in inner and external decoration of residential and public buildings. We would like to hope that in the future the granites of the Kuznechenskiy massif will take their worthy place in the architectural aspect of St. Petersburg.

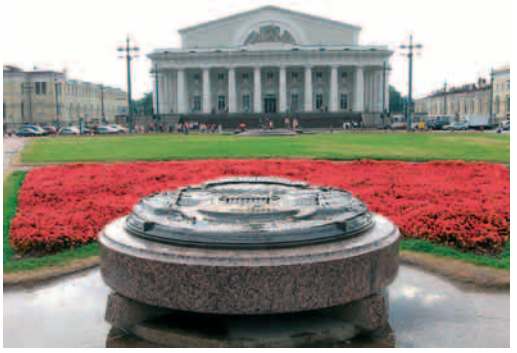

Figure 6. Monument "300 years of city, port and customs" on the Vasilyevskiy Island.

Figure 7. Fragment of a fountain complex on the Moscow prospect in St. Petersburg.

Acknowledgments

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