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INVESTIGATION ON THE TEXTURE OF LAPLAND GRANULITE BELT USING X-RAY DIFFRACTION TECHNIQUE

SUMMARY

The research is focused on the garnets from the amphibolite rocks of Lapland Granulite Belt of Kola Peninsula from Kandalaksha region. The minerals from the rocks are rich in almandine and pyrope molecules mostly. As indicate a crystallographic texture, all the samples coming from different parts of the rocks demonstrate similar features from the spatial orientation point of view. Therefore, it seems that the nature of the origin powers in this region was very similar.

INTRODUCTION

Near 10 km on East from Kandalaksha on White Sea there are outcrop of meta-basic rocks are localized. These rocks are component of the Lapland Granulite Belt of Kola. They are mainly various kinds of amphibolites and granulites (Kozlov et al. 1990) in which numerous crystals of garnets (some of them up to 1 cm in diameter) can be found (Krylova 1983; Huber 2001, 2002). The Authors have analyzed the garnets of some selected samples of rocks to find the relations of metamorphic conditions between appearing the garnets and raising the formation that accompanied the blastesting these minerals. The composition of the garnets was identified by means of scanning microscope technique, and confirmed by the X-ray powder analysis as well as the infra-red absorption one.

Then the massive samples of the garnet rocks were taken under texture analysis, by a back-reflection pole figures registered by Schulz method (Schulz 1949). The crystallographic texture is a statistical property of a material with crystalline structure manifested by the ordering of the spatial orientation of the particular crystallites (grains, sub-areas and particles). The highest degree of such ordering is observed in single crystals, the lowest - may be attributed to unformed powder preparation. In practice, it is difficult to find polycrystalline material without

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texture, i.e. characterised by random, chaotic orientation distribution (Cullity 1978; Bonarski 2001).

The X-ray diffraction pattern analysis, and the infra-red spectroscopy were accomplished at the Mineralogy, Petrography and Geochemistry Department of Geology, Geophysics and Environment Protection Faculty of UMM. The microanalysis of the sample was performed by means of SEM technique in the Research Laboratory at the Institute of Geological Sciences of the Jagiellonian University. The X-ray texture investigations were carried-out in the Institute of Metallurgy and Materials Science of the Polish Academy of Sciences in Kraków. The samples were collected during the science expeditions at Kola Peninsula (2001-2002) and the map shows their localization (Fig.1).

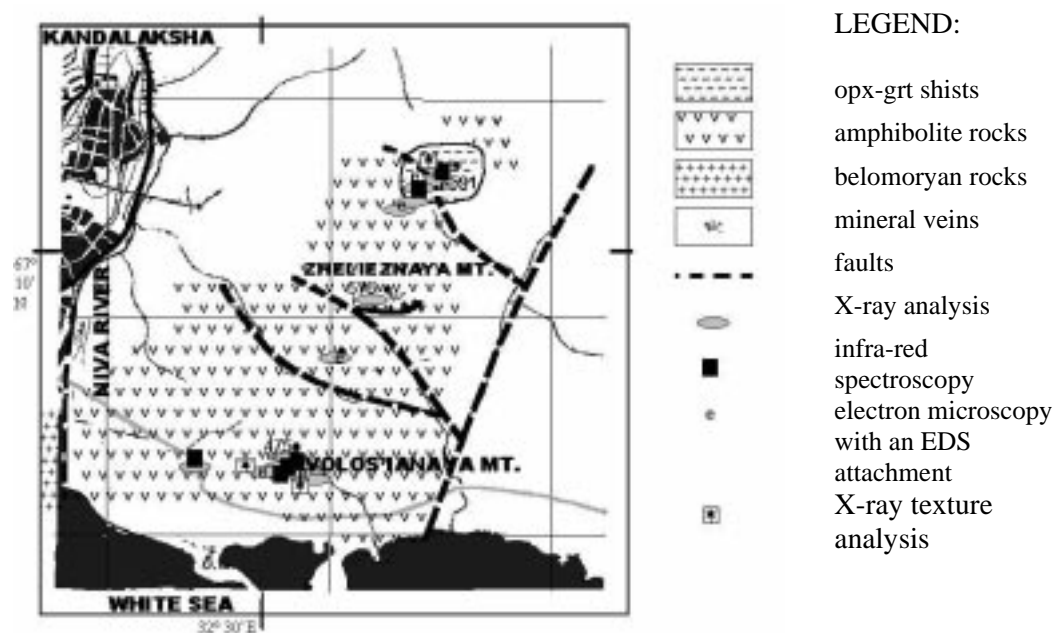


Figure 1. The map of research area with localization of the samples marked (the analysis on samples that have been done)

RESULTS

The composition of garnets is given at the illustration (Tab.1), and changes of this composition is illustrated by a histograme (Fig.2). The minerals contain mainly molecules of almandine with pyrope and grossular. Sometimes andradite is also present. The volume fraction of almandine and mainly pyrope molecules grows to Eastern-North, where the garnet-orthopyroxene schists can be found. The map in Fig. 1 presents the localization of the places that analyzed samples were taken.

Table 1. Presence of the molecules in analyzed samples of garnets.

	Number of rock samples												
	Amphibolites			Garnet-orthopyroxene shists									
	06 1-1	06 1-3	06 1-2	22a 1-1	22a 1-2	22a 1-3	22a 1-4	22a 2-1	22a 2-2	22e 1-1	22e 10-1	23 2-3	23 3-1
Py	13,07	13	11,66	31,55	31,79	27,24	31,21	31,2	19,3	13,4	28,91	17,45	14,91
Alm	52,82	53	52,24	38,31	38,1	42,9	38,23	43,72	47,28	45,72	38,63	63,4	66
Sp	3,66	2,9	4,18	1,15	0,77	1,26	1,22	1	2,89	1,4	0	1,58	1,59
Gro	29,95	27,16	23,49	25,03	25,99	22,8	25,18	19,92	23,29	33,3	13,93	7,87	5,8
Andr	0,5	3,94	8,43	3,96	3,35	5,8	4,16	4,16	7,24	6,18	18,53	9,7	11,7

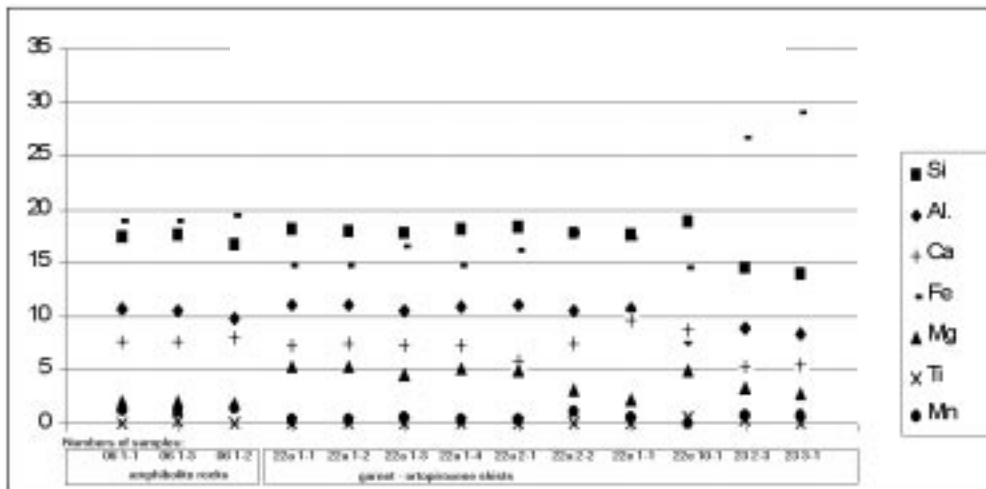


Figure 2. The elements identified in analyzed samples of garnets.

The results of X-ray texture investigations are presented in form of the experimental back-reflection pole figures in Fig.3. As it is visible, the garnets show a preferred orientations in the sample frame which is in known relation to the geographical coordinate system.

The grains of the garnets are relatively large from the statistical point of view, respecting the X-ray texture measurement. Generally all of the garnet samples turn out to be stayed under one-axis powers influences. This influence is correct with the geographical orientation (slightly to North-East). Illustration (see Fig.3) presents the pole figures of these garnets with the indications on direction of the powers influencing. Based on the texture analysis, it seems, the natural power during formation of garnets in described rocks had a one-axis character.

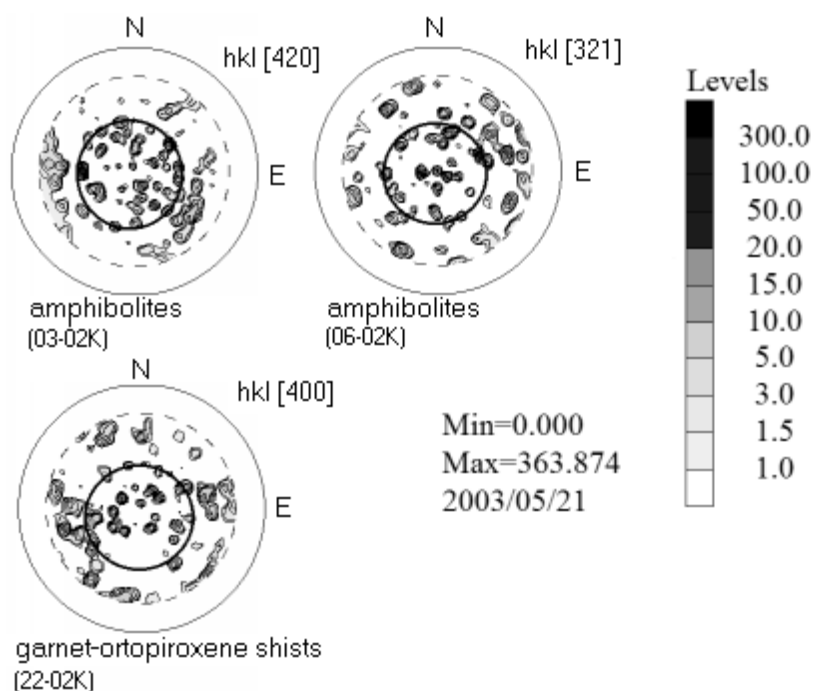


Figure 3. The selected pole figures of garnets registered by means of the X-ray diffraction technique.

CONCLUSIONS

The internal stresses of the investigated rocks existed in the blastesy stage of garnets have a regional character. It seems that the natural powers during formation of garnets were probably an effect of a regional metamorphism. Moreover, power vector in tested samples is the same.

REFERENCES

BONARSKI J. T. 2001: „Rentgenowska Tomografia Teksturowa” , IMM PAN Kraków, pp.119.

- CULLITY, B.D. 1978: "Elements of X-Ray Diffraction". 2nd Ed., Addison Waseley Publ.Comp.Inc., London, Amsterdam, Don Mills, Sydney
- HUBER M., 2001: „Geological and petrographic characterisctic of the Lapland Granulite Belt near Kandalaksha at the White Sea, Kola Peninsula, northern Russia (in Slovak). Mineralia Slovaca, vol.2 17-31.
- HUBER M., 2002: "Mineralogical and Petrographic characterization of eclogites from the Lapland Granulite Belt (Kola Peninsula, northern Russia)" Minerlogical Society of Poland –Special Papers vol. 20, 272-274.
- KOZLOV N.E., IVANOV A.A., NYEROVICH L.I, 1990: "The Lapland Granulite Belt –the primitive nature and development (in Russian), Russian Academy of Science, Apatity, pp.166.
- KRYLOVA M. D. "Geologiczno – geochemiczna ewolucja Laplandzkiego Granulitowego Pasa" (in Russian).
- SCHULZ L. G., 1949: A Direct Method of Determining Preferred Orientation of a Flat Reflection Sample Using a Geiger Counter X-Ray Spectrometer. J. Apply. Phys. 20, 1030-1033.