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LITHIUM IN ROCK-FORMING QUARTZ IN THE NORTHERN CONTACT ZONE OF THE KARKONOSZE MASSIF, SW POLAND

INTRODUCTION

Karkonosze massif (Mazur 2002) of the Variscan age consists of granites and granodiorites of several morphological varieties (Borkowska 1966, Słaby 2002). It contains numerous pegmatites and mineral veins (Kozłowski 1978, Pieczka, Gołębiowska 2002), the post-magmatic activity is relatively well developed and in pegmatites and quartz-feldspar-mica veins zinnwaldite has been found. The massif is thus considered as rather rich in lithium, especially in its marginal parts. This study is based on the investigation of the lithium content in rock-forming quartz in the granitoids of the massif, and in the rocks of the northern exocontact of the Karkonosze massif. The rocks of the exocontact zone comprise a belt of the metapelites eventually altered in hornfelses, and varieties of the so-called Izera gneisses of the pre-Variscan age. Obliquely to the contact a complex fault zone metasomatically mineralised by quartz (called the Izerskie Garby Zone) occurs at the distance of several kilometres.

SAMPLES

The study has been performed on the rock samples collected in 54 points (18 points in the massif area and 34 points in the metamorphic cover area) arranged in five logs crosscutting the massif contact with its metamorphic cover (Fig. 1). The sample sets from each point comprised three specimens of the rock taken at the vertices of the triangle with the sides ca. 1 m long; the sampling places have been located at the points, where postmagmatic alteration signs or mineral veins have not been visible, except for the quartz metasomatites in the Izerskie Garby Zone. From each specimen two separate analytical portions have been obtained.

LABORATORY PROCEDURES

The rock samples have been cut to prepare the 0.5 mm thick slices of a size of the petrographic preparation. After thorough observations under microscope the quartz grains not containing solid inclusions have been selected and then picked from the preparation by use of a corundum blade. The grains have been washed in

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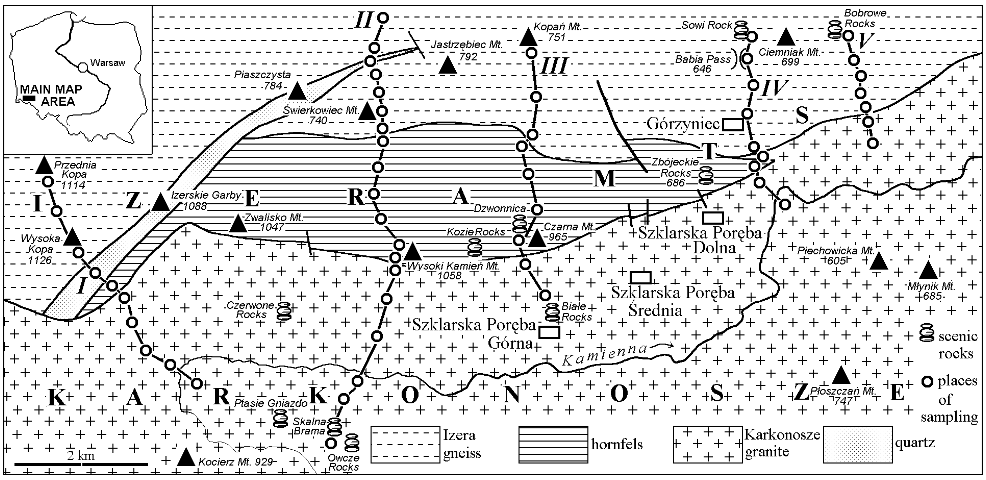

Fig. 1. Map of the investigated contact area with the sampling logs (*I–V*).

acetone, methanol and hot *aqua regia*, and next multiple rinsed in hot water of high purity. The 324 analytical quartz samples of the weight of 1–5 mg have been placed in carbon electrodes and decomposed with HF of special purity in an air-tight plastic box, and then lithium has been determined with use of the spectrographical emission procedure described by Walenczak (1969); the analytical error was ±9%.

LITHIUM IN QUARTZ

Lithium is a common trace element occurring in quartz in the concentrations of tenths to tens ppm. Its contents in quartz from various types of rocks from Lower Silesia have been characterised by Smulikowski and Walenczak (1966), and Walenczak (1969).. This element due to the relatively small size of its ion (0.68 Å) may migrate through the structural channels of quartz, which diameter equals to 1 Å. The typical Li contents in quartz of the Karkonosze granitoids range from 10 to 20 ppm, whereas in quartz from the Izera gneisses – from 0.1 to 1 ppm (*op. cit.*). The high ability of lithium to migrate and its contrasting concentrations in

Table 1. Concentrations of lithium in the quartz samples from the log II
(Each value is an average of the six analytical determinations)

Sample	Li, ppm	Sample	Li, ppm	Sample	Li, ppm	Sample	Li, ppm
II/1	11,7	II/6	22.3	II/11	1.0	II/16	4.5
II/2	10.4	II/7	13.6	II/12	0.3	II/17	6.0
II/3	11.6	II/8	9.0	II/13	0.7	II/18	4.0
II/4	11.3	II/9	2.0	II/14	0.7	II/19	0.4
II/5	18.2	II/10	0.9	II/15	1.8		

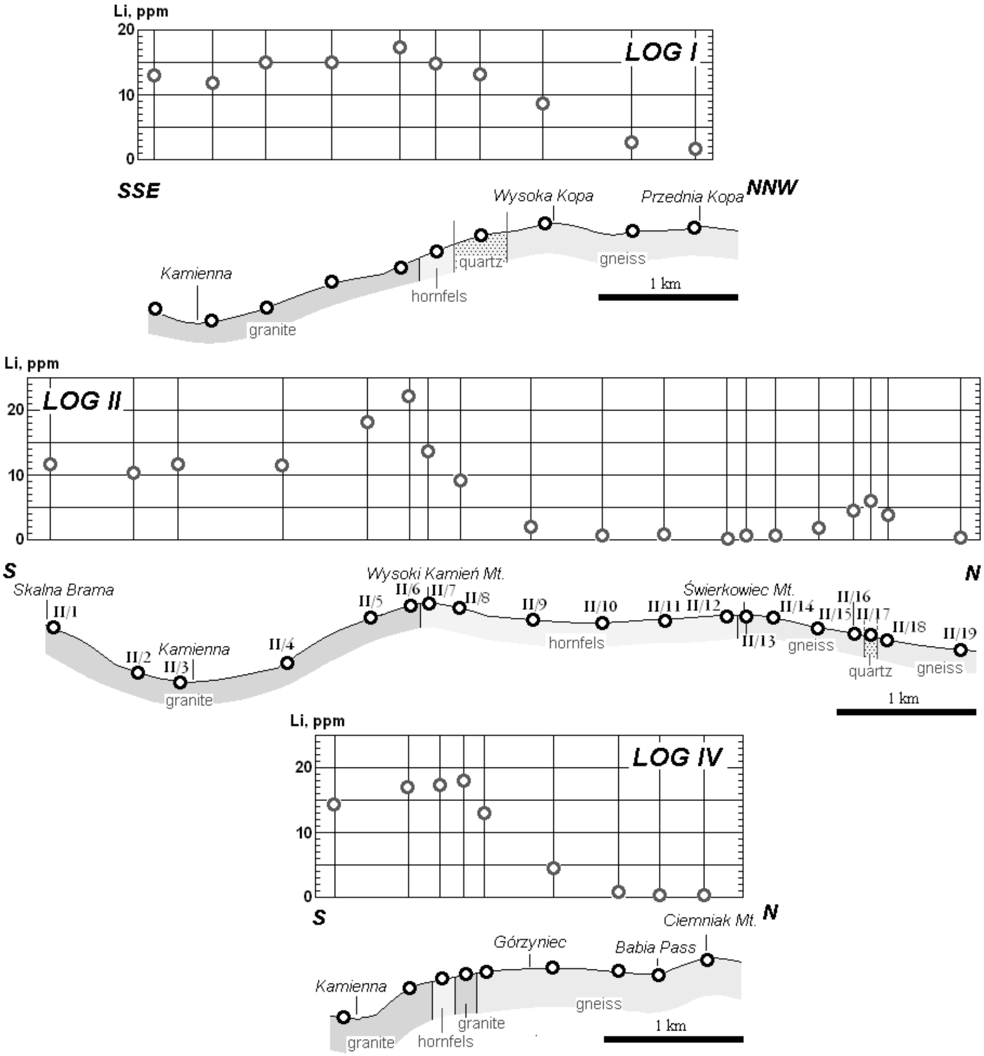

Fig. 2. Three selected logs (*I*, *II* and *IV*, cf. Fig. 1) crosscutting the contact of the Karkonosze massif granite with its metamorphic cover (comprising hornfels, gneiss and metasomatic quartz), with the shown changes of the lithium concentrations in quartz.

the two neighbouring areas suggest its use for genetic considerations.

The typical changes of the lithium contents in rock-forming quartz across the massif-cover contact display high values in the quartz in granite, even increasing at the endocontact side – here the highest contents of lithium have been found (Table 1 and Fig. 2). The overstepping of the contact is connected with gradual decrease of the lithium concentrations in quartz from hornfels and Izera gneiss. Beside the direct exocontact zone the lithium contents are typical for the Izera area, i.e. very low, usually below the value of 1 ppm. Nevertheless, there are zones of elevated Li concentrations within the Izera area, although they are quite distant from the contact of the Karkonosze granite with the metamorphic rocks. These zones are connected with faults with developed metasomatosis (in this case of the siliceous type). Though the concentrations are not so high like they are in the direct exocontact rocks, the increase is very distinct, reaching 6 ppm.

CONCLUSIONS

The data, obtained by the studies of the lithium contents in the rock-forming quartz in the contact zone of the Karkonosze massif indicate a distinct chemical influence of the massif on its metamorphic cover, delineated by the concentrations of Li in quartz from the metamorphic rocks, exceeding the background values, which are not higher than 1 ppm. The transport of lithium probably occurred through the fluids, mobilised by the granitoid massif emplacement, as it is suggested by the elevated lithium concentrations around the metasomatic vein-shaped bodies developed in the dislocation zones. Further migration might have occur through the intergranular spaces. Within the quartz grains the migration of lithium was apparently by the diffusion mode.

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