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# OPAQUE MINERALS IN TERTIARY BASALTS FROM THE LOWER SILESIA

## INTRODUCTION

The Tertiary volcanic rocks from the Lower Silesia (SW Poland) represent the eastern part of the Central European Volcanic Province (CEVP). Different lithospheric and astenospheric sources were involved in generation of undersaturated alkali magmas of CEVP (Wilson and Downes 1991). Basaltic rocks from Lower Silesia are represented mainly by basanites, basalts, trachybasalts and foidites (according to TAS classification; Le Bas et al. 1986). Data related to the composition of opaque minerals from volcanic rocks from Góra Św. Anny and Ligota Tułowicka were presented earlier by Birkenmajer and Siemiątkowski (1977) and Kruczyk et al. (1977).

## MATERIAL AND METHODS

Samples collected in several active or abandoned quarries in the Lower Silesia area were collected (Rębiszów, Wilcza Góra, Męcinka, Lądek Zdrój, Winna Góra, Góra Św. Anny).

Samples were analysed using optical microscopy (transmitting and reflected light), X-ray diffraction (Philips X'Pert apparatus), SEM-EDS (field emission HITACHI S-4700 microscope with NORAN Vantage analytical system).

## RESULTS

Rocks studied contain olivine and clinopyroxene phenocrysts in matrix composed of clinopyroxene, Ti-magnetite, plagioclase and nepheline. Content of plagioclase and nepheline is variable (from 0 vol.% to ~10vol.%) in rocks from different localities. Mafic phenocrysts in basalt from Męcinka are surrounded by rusty rims. Secondary minerals (calcite and natrolite) are present in low amount. Ti-magnetite is the main opaque mineral. Only in sample from Rębiszów Ni-containing pyrrhotite was noticed.

Ti-magnetite in various samples differs in crystal size (from few μm to about 50 μm; Fig. 1) and crystal shape. In numerous samples wide size series of Ti-magnetite crystals are present (Figs. 1, 2, 3). Ti-magnetite can be disseminated in

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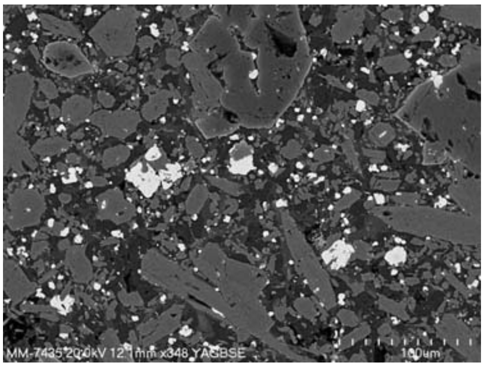


Fig. 1. Various size Ti-magnetite crystals; Lądek Zdrój; SEM; BSE image

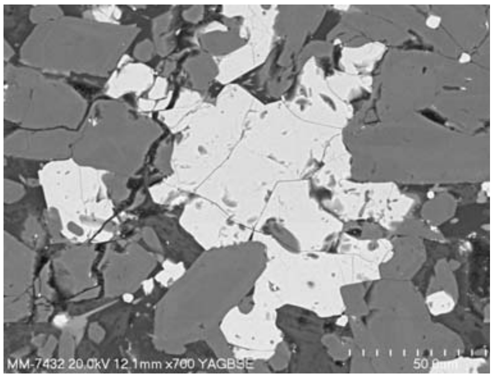


Fig. 2. Ti-magnetite fills spaces between phenocrysts; Rębiszów; SEM; BSE image

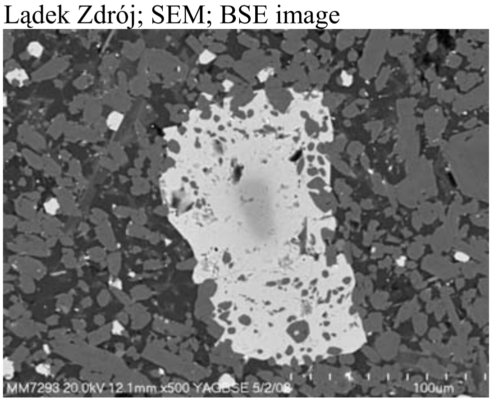


Fig. 3. Ti-magnetite enclosing silicate minerals; Winna Góra; SEM; BSE image

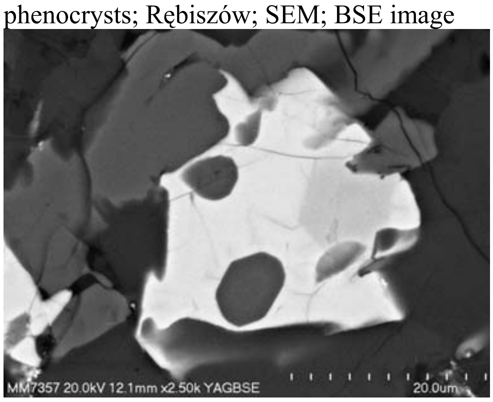


Fig. 4. Ti-magnetite with domains of different chemical composition (dark and bright areas) and clinopyroxene inclusions; Męcinka; SEM; BSE image

rock groundmass (Fig. 1) or fills spaces between phenocrysts (Figs. 2,3). Ti-magnetite is often included in larger phenocrysts (Fig. 2) but also can contain mineral inclusions (mostly clinopyroxene) (Figs. 2, 3, 4). Morphology of Ti-magnetite crystals can be anhedral to subhedral (Fig. 1). In several samples subhedral crystals are relatively common (Figs. 4, 5).

Average chemical composition of Ti-magnetite from different localities varies slightly. The content of Fe atoms (based on three cations in formula) is within the range from 1.6 to 2.2; Ti – from 0.3 to 0.6; Cr – from 0.0 to 0.15; V – from 0.0 to 0.03; Mn – from 0.01 to 0.15; Al – from 0.05 to 0.5; Mg – from 0.05 to 0.35. Positive correlation between Al and Mg content is visible. Fe/Ti and Mg/Mg+Fe ratios for Ti-magnetite from different localities differ only slightly (*e.g*. Góra Świętej Anny - 0.19-0.22 and 0.08-0.17 respectively; Lądek Zdrój - 0.22-0.24 and 0.04-0.05; Rębiszów - 0.24-0.26 and 0.11-0.12; Wilcza Góra - 0.27-0.31 and 0.06-0.14.

Opaque minerals are generally uniform in chemical composition within grains. Only the biggest forms exhibit variations of composition (Fig. 3 and 4). In samples from Męcinka aggregates of domains of different composition are present (Fig. 4) or opaque minerals contain lamellae of Ti-hematite and ilmenite (Fig. 6).

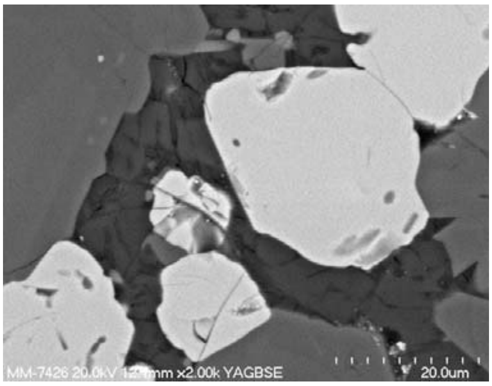


Fig. 5. Subhedral Ti-magnetite grains; Rębiszów; SEM; BSE image

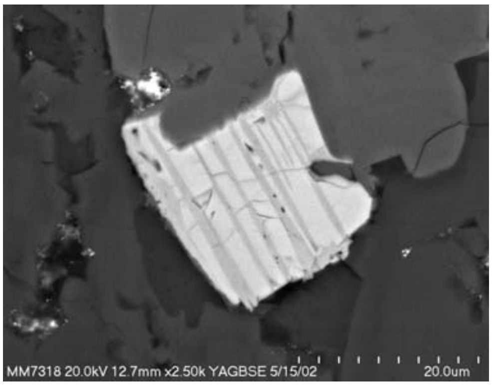


Fig. 6. Ti-hematite (bright) and ilmenite (dark) lamellae; Męcinka; SEM; BSE image

## DISCUSSION OF RESULTS AND CONCLUSIONS

Ti-magnetite is wide-spread in Tertiary basalts and basanites from the Lower Silesia.

Variable size and crystal morphology of Ti-magnetite as well as relationships to olivine or clinopyroxene phenocrysts in basaltic rocks indicate relatively long-lasting history of its crystallization. Relatively broad range of Mg/Mg+Fe ratio value for Ti-magnetite noted in rocks from from several localities (*e.g*. Góra Świętej Anny and Wilcza Góra) supports this conclusion.

The protracted crystallization of Ti-magnetite in rocks studied can be interpreted as indicator of relatively high oxygen fugacity in magma. Two-phase oxide minerals noted in basalts from Męcinka were formed during subsolidus oxyexsolution. Rusty rims mafic phenocrysts indicate also the importance of oxidative conditions in basalt from Męcinka during this stage of evolution of rock.

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