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PRELIMINARY RESULTS OF ANISOTROPY
OF MAGNETIC SUSCEPTIBILITY OF THE PERMIAN VOLCANITES
FROM THE BOLKÓW AREA (NORTH SUDETC BASIN)

Abstract: This study includes the analysis of magnetic fabrics as well as their relation to the structure and texture observed within the Permian volcanites occurring in the Wolbromek Graben (North Sudetic Basin). Magnetic lineations are subparallel to the macroscopically noticed trends for the Popielowa series and the Świny ignimbrites series.

Keywords: anisotropy of magnetic susceptibility, silica-rich volcanic rocks, texture, Permian, Rotliegend, North Sudetic Basin

THE AIMS OF RESEARCH

Measurements of the anisotropy of magnetic susceptibility (AMS) of the volcanic rocks might be the source of information about the paleogeography and paleotopography of the studied area. AMS very often is related to macroscopically observed flow structure and also vesicle foliation (e.g. Cañón-Tapia et al. 1996, Cañón-Tapia, Coe 2002).

Therefore, the main aim of this study is the reconstruction of the probable location of volcanic centers and a possible direction of flows during eruption within the Wolbromek Graben (southeast part of the North Sudetic Basin). In this study the anisotropy of magnetic susceptibility was combined with detail field observations and the petrotextural analysis of silica-rich volcanic rocks: both lavas and pyroclastic deposits.

GEOLOGICAL SETTING AND INVESTIGATED ROCKS

The investigated Rotliegend volcanic succession occurs within the southernmost part of the Świerzawa Graben close to Bolków (North Sudetic Basin). A very detailed textural analysis of the SiO₂-rich volcanic cover leads to distinction of at least five series of volcanic rocks of different genesis (from phreatomagmatic to magmatic eruption; Pańczyk 2002; 2003):

- The tuffs suite, which includes a unit of base surges deposits with accretionary lapilli and two units of non-welded ignimbrites;

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- The Świny ignimbrites suite, extremely welded ignimbrites (high-grade ignimbrites);
- The Świny lavas suite
- The Popielowa ignimbrites suite, welded ignimbrites (moderate-grade ignimbrites);
- The Popielowa lavas suite.

The eruptions spreaded from elongated fissures (Pańczyk 2003). However, the vent area is known only for the lava flows from the Popielowa Hill, where the enechelon aligned vents occur. On the other hand, for the Świny lavas suite only one fissure near Świny village is preserved. Most probably, the hills noticeable in the local topography might be the relicts of volcanic centres. Due to the discontinuous nature of the outcrops, for the ignimbrites and tuffs the location of the vent area is unknown. Nevertheless, according to field observations it is assumed that the volcanic centres for the Świny ignimbrites are presumably situated to the north or north west of the exposures.

The lava flows are characterised by well-defined flow-banded texture emphasized by parallel orientation of ore microliths, and concentration of phenocrysts in layers (Pańczyk 2002, 2003). Also distribution and elongation of vesicles or amygdules correspond with flow foliation. On the contrary, all the types of ignimbrites and base surges deposits have chaotic and irregular groundmass with lenses enriched in ore minerals. However, extremely welded fragments of pumices are found within ignimbrite profiles (*fiamme* 1-2 cm in length) mimicking flow-banded texture.

METHODS

Forty-two orientated hand samples were collected from each of the volcanic series (11 samples of the Świny ignimbrites; 11 samples of the Świny lavas; 6 samples of the Popielowa ignimbrites; 6 samples of the Popielowa lavas; 8 samples of the tuff series) after thorough detail field observations and microscope examination of thin sections perpendicular to flow direction. Next, two to six rocks cylinders, 25 mm in diameter, were drilled from each hand sample. The measurements of anisotropy of magnetic susceptibility (AMS) were performed in the Institute of Geophysics PASC. in Warsaw using the magnetic susceptibility meter Kappabridge KLY 3 (produced by Agico in Brno, Czech Republic).

RESULTS

The anisotropy of magnetic susceptibility was determined for each of cylindrical samples (10 from Popielowa ignimbrites, 8 from Popielowa lavas, 30 from Świny ignimbrites, 31 from Świny lavas and 30 from tuff series). The data include the orientation of the principal axes of AMS ellipsoids: magnetic lineation K_{\max} , and poles to magnetic foliation K_{\min}) as well as the degree of magnetic anisotropy P' and shape ratio T (Jelinek 1978).

The degree of magnetic anisotropy P' for the Permian volcanites from the Bolków area is generally low and ranges from 1.01 to 1.03, rarely up to 1.07 for the

Świny ignimbrites and lavas series. The shape parameter T is very variable – reflecting both prolate and oblate ellipses for a single site.

The Popielowa lavas series (Fig. 1b) as well as the Popielowa ignimbrites are characterized by subhorizontal magnetic lineation (trending WNW-EES). The maximum axes (k_{\max}) are grouped parallel to macroscopically observed direction of flows. In these units a steep magnetic foliation plunge to NNE. The magnetic lineation fabric very similar to that for Popielowa units is observed in the Świny ignimbrite series (Fig. 1a).

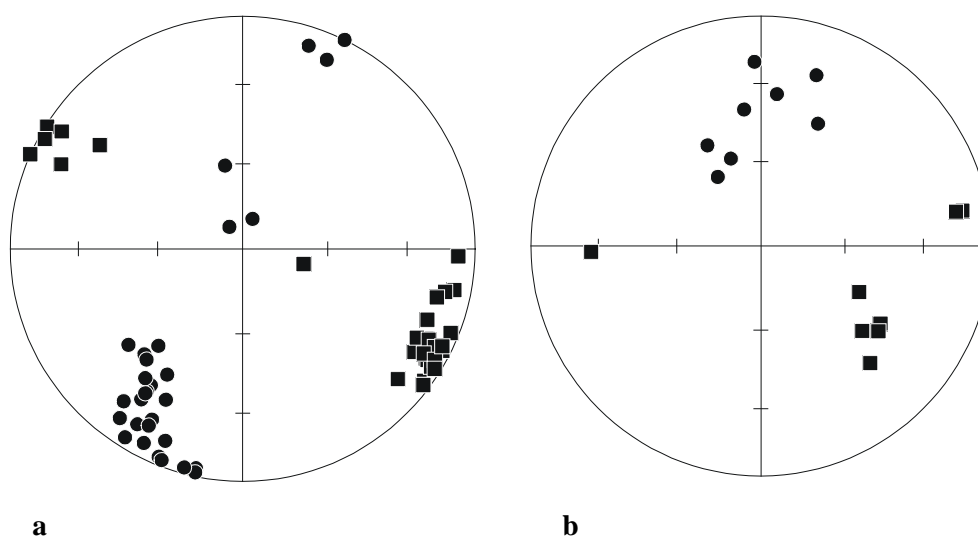


Fig. 1 Examples of the magnetic fabrics in the Świny ignimbrites (a) and in the Popielowa lavas (b). Maximum susceptibility axes K_{\max} -squares, minimum susceptibility axes - k_{\min} - dots). Maximum susceptibility axes are quite well defined and reflect the direction of moving of lava and pyroclastic flow.

On the other hand, the magnetic lineation in the Świny Lavas suite is generally similar to those in the other volcanic series, whereas the magnetic foliation appears to be much more scattered, without any clear direction.

The tuff series do not display any well-defined lineation fabrics, with k_{\max} scattered in the horizontal plane of magnetic foliation.

DISCUSSION AND CONCLUSIONS

The first insights of the measurements of anisotropy of magnetic susceptibility (AMS) of the silica-rich volcanites from the Wolbromek Graben suggested that the magnetic fabrics correspond to the observed in the field directions of moving lavas and pyroclastic flows, and generally show NW-SE trend for the Popielowa lavas and ignimbrites series as well as for the Świny ignimbrites. Additionally, it seems that the vent area for the Świny Ignimbrites might be located to the south or west south of the known Popielowa volcanic centres.

However, the well-defined mostly steep magnetic foliation remains an open question. Probably, it could be connected with paleo-valley system, which might have been followed by lava and pyroclastic flows. On the other hand, the second scenario, perhaps more realistic, could be suggested. The magnetic foliation might reflect the primary magnetic characteristics of the ascending magma within the conduit system.

In the case of the Świny lavas series the magnetic lineation is generally coherent with dominating trends for the volcanites from the Bolków area as well as with macroscopically observed vesicle foliation. The great scatter for the foliation might be the result of post-magmatic alteration phenomena.

The completely dissimilar magnetic fabrics for the Tuff series most probably result from the phreato-magmatic origin and consequently different emplacement mechanism.

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