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## PALEOMAGNETISM OF THE TESCHENITIC ROCKS IN POLAND

**Abstract:** New results of paleomagnetic investigations of the Early Cretaceous teschenitic rocks in the Outer Western Carpathians of Poland bring evidence for pre-folding remagnetization of these rocks. The age of remagnetization is interpreted as Tertiary, probably Early Miocene. It might be related to maghemitization of primary titanomagnetites. Declination of the secondary component is similar to the Tertiary paleodeclination of the stable Europe in the eastern part of the studied area (Żywiec, Świętoszówka) and rotated ca. 25° counter-clockwise in the western part (Cieszyn area).

**Keywords:** Paleomagnetism, tectonics, petrography, teschenites.

### INTRODUCTION

“Teschenitic rocks”, or teschenite association rocks, comprise variegated basic alkaline rocks of lamprophyre, limburgite, diabase, syenite and teschenite type (Smulikowski 1929; Šmid 1962). Systematic paleomagnetic investigations of teschenitic rocks in Poland has not been performed yet. Preliminary results obtained for the teschenitic sill from the Soła section near Żywiec (Grabowski et al. 1996) brought unexpected results. Stable magnetization of pre-folding origin had to be interpreted as Tertiary component, due to its steep inclination. Moreover, its declination indicated almost no vertical axis rotation of the studied rocks relatively to stable foreland. Recently obtained radiometric datings (Lucińska-Anczkiewicz et al. 2002; Grabowski et al. 2003) supplied new results supporting Neocomian age of the teschenitic intrusions. Therefore magnetization of the Żywiec sill, although pre-folding, must have been considered as secondary. In this paper new results are presented giving constraints on remagnetization of the teschenitic rocks and its tectonic implications.

### SAMPLING AND METHODS

Over 80 samples were collected in 7 localities (Fig. 1). In 6 localities variegated teschenitic rocks were studied, from the area of Cieszyn in the SW up to Żywiec in the ENE. One locality of sedimentary rocks hosting intrusion in Rudów-Haźlach area was investigated. Paleomagnetic experiments were performed mostly

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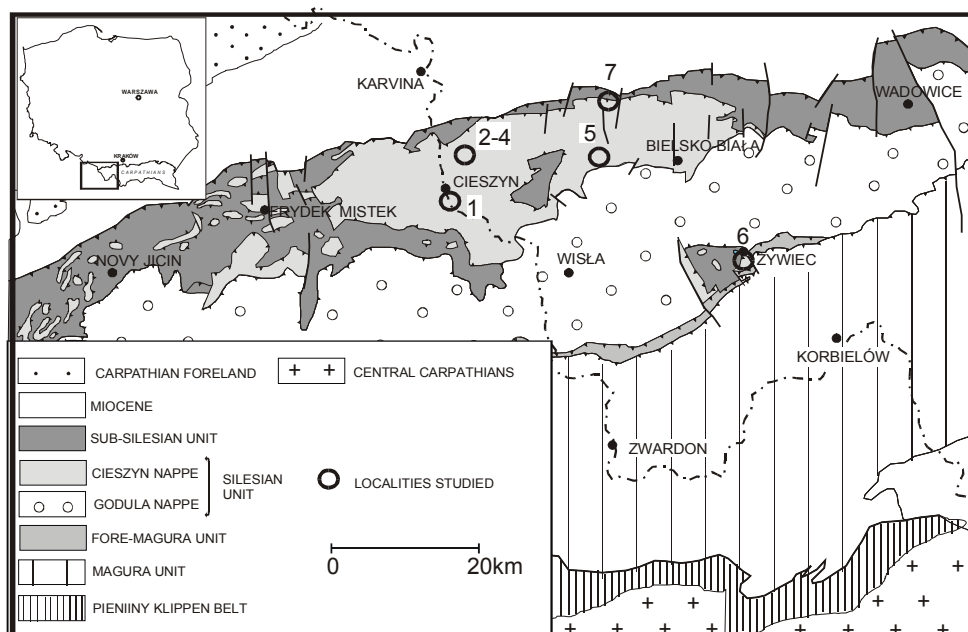


Fig. 1. Tectonic sketch map of the Outer Western Carpathians with sampling localities (after Żytka et al. 1989). Locality numbers correspond to those in Table 1.

in the Polish Geological Institute in Warsaw. They included measurements of the natural remanent magnetization (NRM) and magnetic susceptibility and its anisotropy (AMS), and thermal demagnetization of the NRM. Some investigations (magnetic susceptibility changes vs. temperature) were carried out in the GeoForschungsZentrum in Potsdam by the first author. Additional studies included petrological investigations in reflected and transmitted light and SEM study of iron oxides.

## RESULTS

Except Międzyrzecze picrite, rocks in all other localities were suitable for paleomagnetism and revealed stable ancient magnetization vectors. The magnetic carriers are magnetite and/or maghemite in teschenitic rocks and pyrrhotite in the studied sediments. Pyrrhotite was also present in the Cieszyn limestones at the contact with Żywiec sill. Reliability of interpretation strongly depends on the proper tectonic correction for the intrusions. It is generally assumed that teschenitic rocks form sills in the Cieszyn beds. However a direct contact between intrusion and host sediments, was quite rarely accessible. Performance of the fold tests was possible at Świętoszówka and Żywiec (No. 5 and 6a-d in the Table 1), where teschenitic sills are folded together with sedimentary rocks. Positive result of the fold tests indicates pre-folding origin of the magnetization for these two localities. The magnetization is comparable to the Neogene direction of geomagnetic field for

Table 1. Paleomagnetic directions obtained in the studied localities.

No.	Locality	Sampled rocks	D/I	$\alpha_{95}$	k	Dc/Ic	$\alpha_{95}$	k	N
1	Cieszyn-Boguszowice	Monzonitic teschenites	131/7	5	60	156/-69	5	60	15
2	Hażlach	Monzonitic teschenites	336/47	4.1	83	344/72	4.1	83	16
3	Rudów	Monzonitic teschenites	329/36	8.8	59	323/60	8.8	59	6
4	Rudów - sediments	Dark mudstones (Upper Cieszyn shales)	344/39	10.2	36	350/64	9.9	38	7
5	Świątoszówka	Dolerite	345/57	8.3	22	10/60	4.7	66	15
6a	Żywiec – intrusion 1	Metasomatised rocks and Cieszyn limestones	357/-27	9.6	34	2/70	9.6	34	8
6b	Żywiec – intrusion 2		206/-21	7.8	35	12/66	7.8	35	11
6c	Żywiec – intrusion 3		308/1	9	56	26/71	9	56	6
6d	Żywiec - mean		298/-29	139	1	13/69	7.5	272	3
7	Międzyrzecze	Biotite-pyroxene picrite	Not suitable for paleomagnetic studies						

Explanations: D/I – declination/inclination before tectonic correction, Dc/Ic - declination/inclination after tectonic correction,  $\alpha_{95}$ , k – Fisher statistics parameters, N – number of vectors used for calculations of the mean direction.

the European Platform, thus confirming the results of our pilot studies (Grabowski et al. 1996). In the locality Cieszyn-Boguszowice (No. 1 in the Table 1) tectonic correction supports pre-folding acquisition of characteristic magnetization. Its inclination is very close to those from Żywiec and Świątoszówka, although the polarity is reversed and declination indicates counter-clockwise rotation by ca. 25°. Slightly better clustering of paleomagnetic vectors after bedding correction is observed also in the Upper Cieszyn shales at Rudów (No. 4 in the Table 1) and the inclination again corresponds to “expected” Tertiary inclinations. It is assumed that the same tectonic correction must be applied to the teschenitic intrusions in the area (No. 2 and 3 in the Table 1). Bulk rotation of the Rudów area after acquisition of magnetization did not exceed 25° counter-clockwise.

Arguments for secondary magnetization of teschenitic intrusions come also from the microscopic observations of iron oxides. Primary titanomagnetite grains are strongly altered. Maghemitization of titanomagnetites in teschenitic rocks have been described by Harańczyk et al. (1971), Hubicka-Ptasińska & Jasińska (1971) and Karwowski & Włodyka (1994). Presence of maghemite at Żywiec, Cieszyn-Boguszowice and Hażlach has been proved by the susceptibility vs. temperature curves which indicates Curie temperatures close to 600°C or even slightly higher. It must be concluded that transformations of titanomagnetite to titanomaghemite and subsequently to silicate minerals (titanite, chlorite) led to complete resetting of the

primary, Early Cretaceous magnetization. If our interpretation is correct, it implies, that these transformations continued as late as in the Tertiary, probably even in the Early Miocene, during maximum burial of Cretaceous rocks.

Age of folding and thrusting of the Silesian unit in the Western Carpathians is estimated as 17-15 Ma, between Karpatian and Middle Badenian (Oszczypko, Tomáš 1985). This constrains the age of our magnetization as pre-Badenian. As declinations at Żywiec and Świętoszówka are very close to the reference stable Eurasian data, it must be concluded that before the onset of folding all major rotations in this localities were completed. On the other hand, in more westerly localities (Rudów, Hażlach, Cieszyn-Boguszowice) moderate counter-clockwise rotations occurred in the Early Miocene or later.

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