CRUST DEFORMATION MONITORING IN THE POLISH PART OF ŚNIEŻNIK MASSIF-CONTINUING RESEARCHES

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ABSTRACT
Śnieżnik Massif is characterized by complicated geological and tectonic structure. Geodynamical network ŚNIEŻNIK was founded in 1992 as a local network for monitoring of Śnieżnik Kłodzki Massif crust deformation (27 points on Polish and Czech part). Neotectonic activity of this area is confirmed both by results of repeated satellite (GPS), gravimetric and some other field measurements. Results of researches from the period of 2003–2004 in the Polish part of network in the comparison of changes that had been determined previously are presented in this paper. Statistical analysis of the received data allowed four major tectonic blocks in the investigated region to be determined. Authors try to confirm trends of this area mobility.

KEYWORDS: geodynamics, Śnieżnik Massif, deformation analysis, GPS

1. INTRODUCTION

Eastern Sudety and Sudetic Foreland are neotectonical active regions of Poland. Complicated tectonics and geological structure and recent tectonic movements in this area were a background of continuation and enlargement the Bear Cave activity monitoring. This one has been leading since 80-ties. Geodynamical research network ŚNIEŻNIK was founded in 1992. Particular locations of each from 27 points (16 in Polish and 11 in Czech part of massif) depended on geological factors as well as forestation and topography. Satellite GPS technique, gravimetric, as well as geodetic and clinometric observations were used in the investigations. All epoch observations were provided according to the 4-segment control and measurement system (Cacoń, Kontny, 1994). Results of satellite GPS measurements from the period of 2003-2004 are presented.

2. DESCRIPTION OF THE OBJECT

Metamorphic of the Śnieżnik is drawn as heterogeneous geological composition with SN elongated outcrops of Strońska series mica schists accompanied by Śnieżnickie gneisses (Don, Opletal, 1996). The boundary of these formations runs from the Kleśnica river valley through the Stroma and Śnieżnik mountaintops towards the Morava valley in the Czech Republik. Crystalline limestone pockets can be found in the schists. A dense network of varied age faults running both longitudinally and latitudinal divide the structures being discussed here into smaller blocks shifting in different directions and with various intensities (Fig. 1). The control points have been fixed with concrete pillars with mounts for forced centring of measurement instruments. The pillars have been built directly on crystalline rock outcrops or below ground freezing level (Cacoń et al., 1996).

3. SATELLITE GPS MEASUREMENTS

The GPS measurements of the Polish part of ŚNIEŻNIK network were performed in 2003 and 2004. Each of the point was observed in the two 10 hours sessions.

Table 1 GPS measurement instruments used in the 2003 and 2004 campaigns

Receiver	Antenna
ASHTECH Z-XII P3	ASH700718B
ASHTECH UZ-12	ASH701975.01Agp
ASHTECH Z-XII3	ASH700936D_M
ASHTECH UZ-12	ASH701945B_M
TRIMBLE 4700	TRM33429.00+GP

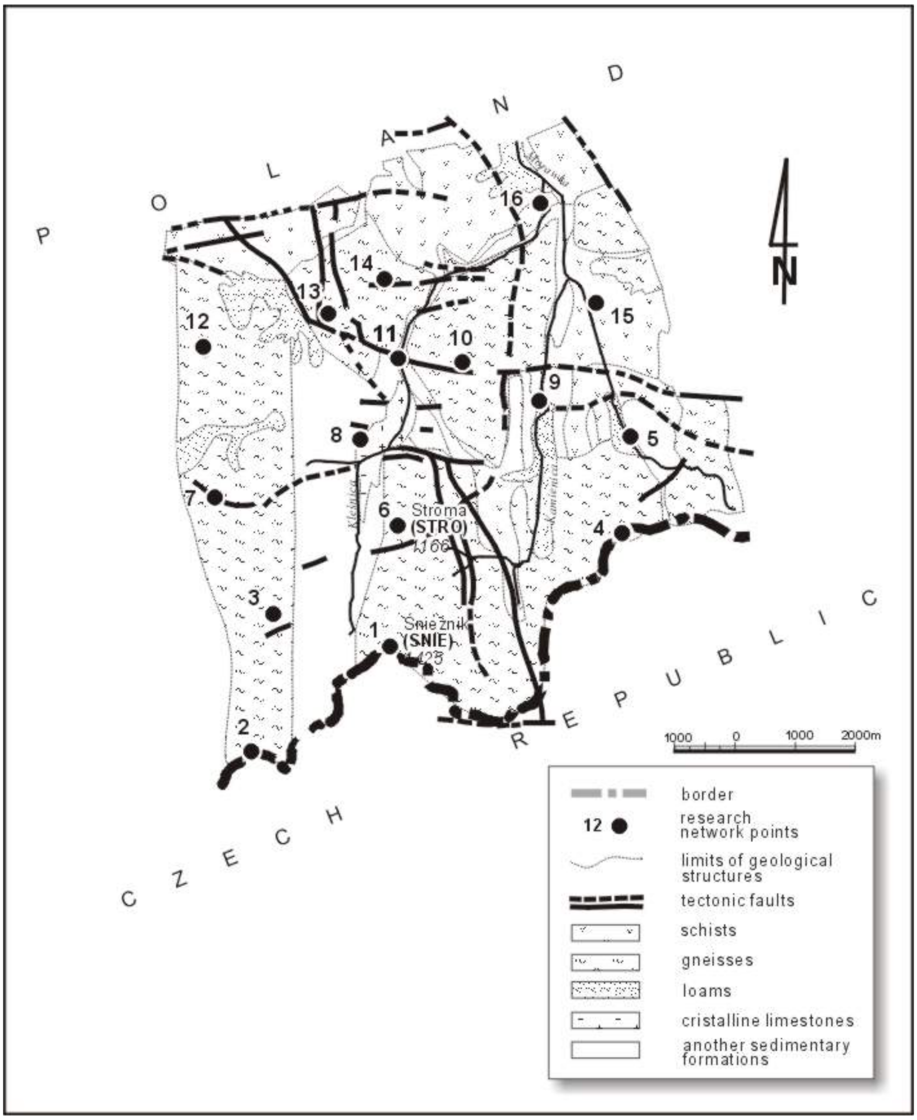

Fig. 1 Geodynamical network ŚNIEŻNIK points on the background of the geological structures (based on Cacoń et al., 1996)

Measurements were realized by static method simultaneously on all of the points at 16th and 17th of May 2003 and 15th and 16th of May 2004. Ashtech and Trimble GPS receivers were used (Table 1).

4. RESULTS OF CALCULATIONS

Results of the satellite GPS measurements have been processed with Ashtech Office Suite for Survey v. 2.11 software. Antenna phase center models from NGS were used. The networks have been adjusted as quasi free. Coordinates of STRO point were adopted from solution of the SUDETY network (Schenk et al., 2002) in the ITRF 2000 system. Horizontal displacements of the points were determined in a local topocentric system using SNET software (Kontny, 1999). Two of the points (6 and 8) were adopted as reference stations-bold marked (Table 2). Horizontal displacement vectors (lengths and azimuths of them) calculated for the ŚNIEŻNIK network points in the period of 2003-2004 are given in the Table 2. Construction of the observation pillar 13 has been damage mechanically. This point was excluded from further analyses.

5. ANALYSIS AND INTERPRETATION OF POINT DISPLACEMENTS

Horizontal displacements of the ŚNIEŻNIK network points in the period of 2003-2004 are presented on Fig. 2. These values were adopted for cluster analysis (Jamroz, 2000, Dąbrowski, Jamroz, 2000). Statistical method of hierarchical classification (cluster analysis) showed four groups of points (Fig. 3). Points from the cluster D (4, 5, 9, 11) are characterized by similar character of movements, corresponding with tectonic structures. Groups selected in blocks A and B present different tendency of movements. It is N and NNE direction (7, 8, 12). It is possible and necessary to verify the tectonic faults that have been identified before.

Table 2 Length and azimuth of horizontal displacements of the ŚNIEŻNIK network points

POINT	Displacement D [mm]	Azimuth [g]	RMS of D [mm]	RATIO
1	3.4	190.3	0.8	4.4
2	3.8	109.2	0.9	4.1
3	2.8	53.8	1.0	2.7
4	5.2	146.7	1.1	4.6
5	8.2	183.9	1.2	6.8
6	**1.2**	**306.0**	**0.5**	**2.4**
7	8.0	21.3	1.3	6.3
8	**1.5**	**60.0**	**1.2**	**1.3**
9	3.3	168.1	1.1	2.9
10	2.4	63.9	0.7	3.2
11	2.3	115.3	1.2	1.9
12	4.1	385.7	1.1	3.6
13	3.0	35.9	0.8	3.7
14	7.5	310.8	0.9	8.1
15	3.5	352.0	0.9	3.8
16	2.4	257.7	0.7	3.3

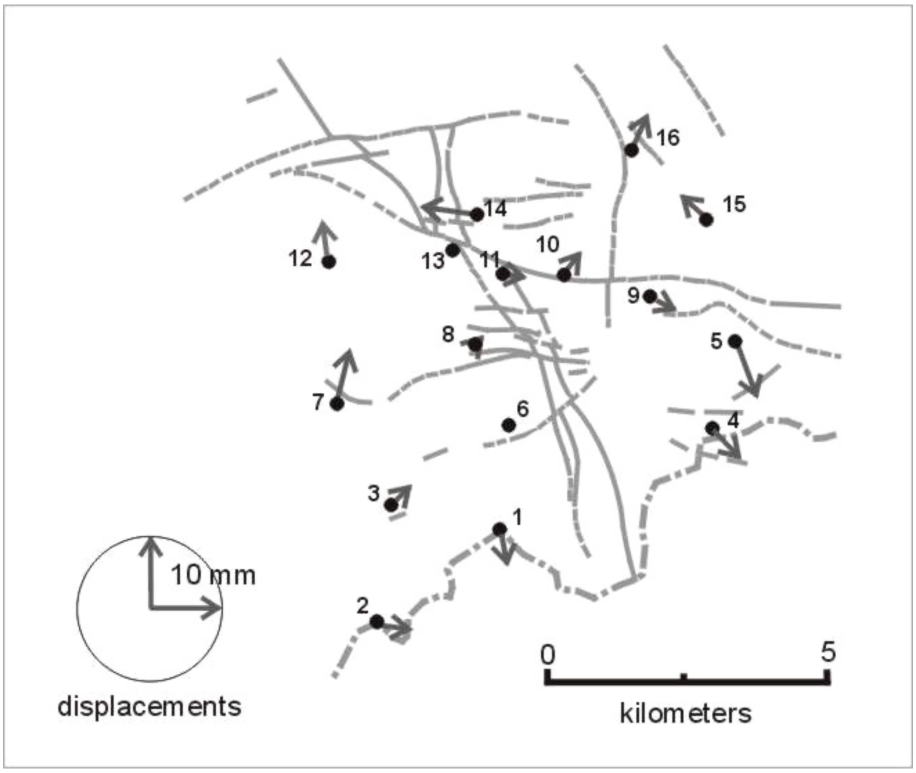

Fig. 2 Horizontal displacements of the ŚNIEŻNIK network points (2003-2004)

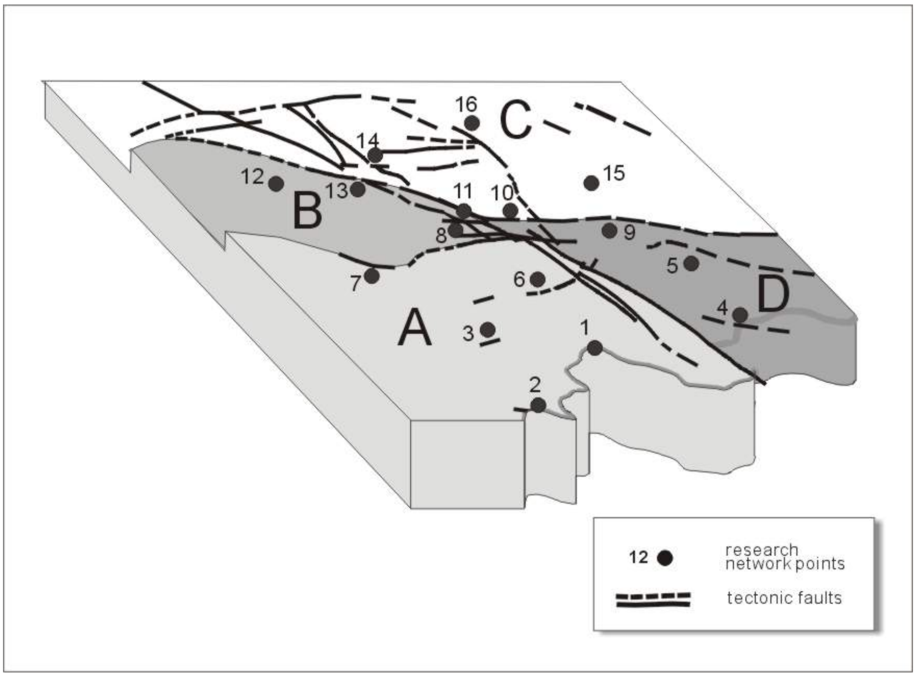

Fig. 3 Crustal blocks determined in the Śnieżnik Massif (Polish part)

SUMMARY

Analysis of determined displacements in the period of 2003-2004 indicated short-periodic character of changes (1.2-8 mm). It is worthy to note that the displacement values in 10-years term were in the range of 1 to 27.4 mm but vectors directions were divergent (Cacoń et al., 2004).

Changes observed in the period of 2003-2004 often have quite different values and azimuths. It is necessary to point that probably this is an episodic oscillation of the point positions. Specific atmospheric conditions could also influenced on results of the measurements in 2004. In the night from May 15th to 16th an intensive snow fall was observed and the temperature felt down of approx. 15 °C.

These changes are visible during analysis of the one-year observation cycle. Analysis of the results from the last two campaigns on the Czech and Polish side of the massif will make possible more reliable explanation.

It is recommended that these investigations should be continued with supplementary geophysical and other methods.

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