N O T E S

Department of Geodesy and Photogrammetry
Agricultural University of Wrocław, Poland

Institute of Rock Structure and Mechanics
Academy of Sciences of the Czech Republic

Section of the Geodynamics Commission of Geodesy
Polish Academy of Sciences

4th Czech–Polish Workshop

ON RECENT GEODYNAMICS OF THE SUDETY MTS. AND ADJACENT AREAS

Lubawka, Poland
November 7–9, 2002

Organizing Committee
of the

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ABSTRACTS

Contents

THE SUDETIC MARGINAL FAULT IN THE LIGHT OF MORPHOTECTONIC STUDIES

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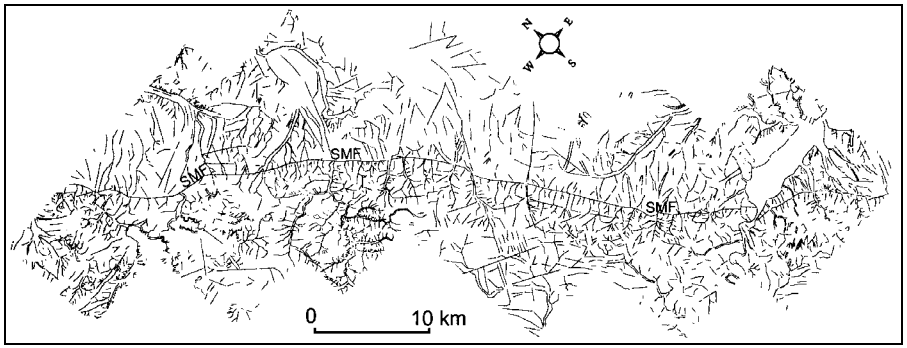
ABSTRACT

The Sudetic Marginal Fault (SMF) is one of the most clearly marked tectonic zones of Europe, more than 300–km–long, the 200 km of which is represented by a well–pronounced morphotectonic scarp. Despite its morphological distinctness, the evolutionary history of this fault has not been fully recognised. Basing on indirect evidence, one can infer that this structure originated during the Variscan orogenesis,



Topolineaments in the Sudetic Marginal Fault zone

and became reactivated during the Alpine cycle. The age of correlative sediments indicates that the fault was already active in Late Oligocene times, although many researchers suggested either Middle Miocene or Pliocene as the onset of faulting. Most of geologists infer that the fault zone became inactive in the Pliocene; and only few suggested a possibility of continuation of its mobility in Quaternary times, principally due to vertical glacioisostatic motions induced by the consecutive

Scandinavian icesheet advances and waning tectonic activity of the fault itself. Detailed analysis of terraces of the main Sudetic rivers that have been formed during the past 200 thousand years points to their divergence. The presence of overhanging valleys and rocky steps at the outlets of some of these valleys appear to confirm the still existing tectonic mobility along the SMF. Indirect pieces of evidence come from morphostructural analyses of the scarp and truncating valleys, as well as from clearly marked breaks of slope, drainage basin asymmetry, and the course of topolineaments which display different properties in each of the six main fault segments of the SMF. Each of these segments shows the different orientation, height of the scarp, fault throw, and dip of the fault plane.

GRAVIMETRIC INVESTIGATIONS IN THE EAST SUDETY MTS. AND FORE–SUDETIC BLOCK

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ABSTRACT

Non–tidal gravity changes with time by the author using repeated gravity measurements were monitored. Precision gravity networks were established for monitoring long–term changes in certain region. It is easy to recognise that local gravity disturbances are caused by variations of atmospheric pressure, groundwater level and soil moisture. They could be caused by man–made mass displacements, also.

In eastern part of Sudety Mountains, in Kłodzki Śnieżnik Massif and in Fore–Sudetic Block, since 1992, during six cycles, the observations of gravity differences between installed geodynamical stations have been performed. There have been monitored temporal variations of the gravity using precise LaCoste&Romberg (Model G and D) and Scintrex CG–3 Autograv gravity meters in reference to some stations located outside geological structures under investigation and by gravity point situated at the building of the Agriculture University in Wrocław. This last one is connected with permanent GPS station established there.

Gravity change measurements carried out in Eastern Sudeten and Fore–Sudetic Block have been carried out within the frame of one from the segments of monitoring and control system implemented on geodynamic polygons: “Śnieżnik Massif”, “Paczków Graben”, “Stołowe Mountains”, “Karkonosze” geodynamical test field.

There was pointed out a clear tendency of gravity arising on points in lower parts of geodynamic test field and decreasing of gravity in upper parts. The most interesting situation in Fore–Sudetic Block, in Paczków Tectonic Graben has been appeared. Our investigations pointed out the gravity decreasing to the East from Nysa and, anti–symmetrically, the gravity increasing on the western part of this complex.

MOBILITY OF LOCAL TECTONIC STRUCTURES IN WESTERN PART OF THE PACZKÓW GRABEN (SUDETIC FORELAND) ON THE GROUNDS OF PRESENT INVESTIGATIONS

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ABSTRACT

In the paper preliminary results of gravimetric observations in 1994–2001 period and comparison of benchmark relative heights in precise levelling lines of the 1st order (1953–2002) are presented. Research performed with the intention of determining vertical movements of earth's crust surface layers is connected with planned construction of an earth dam in the Nysa Kłodzka River valley. The area of investigations is characterised by complicated geological conditions and documented cases of tectonic activity in historical times. Analyses take into consideration tectonic, stratigraphic and hydrogeological settings of the site. Results show residual but continuing tectonic activity in the area. Observed elevation of benchmarks and decrease of gravitational force may suggest relaxation of the ground in western part of Paczków graben.
Attention is drawn for the need to set up additional reference points with the intention of continued geodynamic observations and control measurements of the dam. Plan of their location is proposed.
The paper is a continuation of studies performed as part of doctoral dissertation preparation. Earlier results have been presented at the 24th Winter School of Rock Mechanics in Lądek Zdrój and the 3rd Czech–Polish Workshop in Ramzova (2001).

METEOROLOGICAL DATA AND DETERMINATION OF HEIGHTS IN LOCAL GPS NETWORKS

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ABSTRACT

The processing of Global Positioning System (GPS) observations for establishment high–precision network requires models to reduce a influence of systematic errors. One of the crucial sources of the errors is tropospheric refraction, particularly its changes and influence on height determination in local precise GPS networks, especially located on the mountain area.
Authors present the results of GPS data processing of local precise geodynamic research network ŚNIEŻNIK2001 (Sudetes, S–W Poland) using different input data (standard atmosphere, ground meteorological data) and different methods of tropospheric delay estimation. Bernese GPS Software v. 4.2 was used, as an analytical tool.

GPS DATA PROCESSING AND GEODYNAMIC MOVEMENT ASSESSMENT

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ABSTRACT

The geodynamic network SUDETEN was established to detect and verify geodynamic movements in the north–eastern part of the Bohemian Massif. Six annual GPS campaigns have been realised on the regional network and various approaches of the GPS data processing using the Bernese software have been applied. Naturally, these calculations have brought differences in assessments of the geodynamic movement vectors. A few attempts to connect some of these differences to following methodological steps and/or postulated assumptions, like as:

- geodynamic network and EPN stations — base–line scheme(s),
- a carrier–phase observation processing of independent vectors of triple differences,
- combinations of the carrier–frequencies and cycle slips — Hugentobler et al. 2001,
- ambiguity solution — QIF and wide–lane ambiguity resolution,
- Earth rotation parameters (IGS) and localisation of the Earth's Pole (IERS),
- calibration of antenna phase centres,
- troposphere model (e.g. Saastamoinen 1973) and its mapping function (Niell 1996),
- ionosphere elimination (the ionosphere free linear combination) and CODE, and
- continental platform movements consistent with the ITRF–97

were examined. Examples of the test calculations will be delivered and the influences of selected methodological steps to the coordinate differences will be displayed in millimetres. Thus, the realized analyses present conspicuously ranges of coordinate differences related to individual data processing steps.

„DOBROMIERZ" GEODYNAMIC NETWORK — RESULTS OF 2001 AND 2002 CAMPAIGNS

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ABSATRACT

"Dobromierz" geodynamic research ground has been established on one of profiles of the "GEOSUD II" regional geodynamic network. The profile cuts across Sudety Mts. horst, Roztoka–Mokrzeszów Graben and Strzegom Horst tectonic structures. This region lies in a area of tectonically engaged metamorphic and sedimentary rocks that had been subjected to two orogeny periods older Wariscian and younger Late Alpine. The Sudetic Marginal Fault, with over 250 m amplitude of tectonic movements, originated during Late Alpine Orogeny. "Dobromierz" earth dam on the Strzegomka River has been located in this complex tectonic structure on the edge of Sudety Mts. One must point out that in the neighbouring regions earthquakes have been recorded in historic times i.e. Złotoryja — 1599, Staszowice — 1855. Seismic activity connected with copper mining in nearby Legnica–Głogów Copper Basin (LGOM) is on the rise. Above–mentioned facts indicate possible threat to the dam, that furthermore substantiated organisation of detailed geodynamic investigations in this area.

Geodynamic research network, established in 2001, consists of 5 points located on both sides of the Sudetic Marginal Fault and next to the dam. Periodic observations performed in this network have been correlated with the 4–segment control and measurement system. Satellite GPS and gravimetric measurements, performed once a year, make up the base of this system (segments I and II). Geodetic measurements (Total Station) carried out every six months form the III segment and relative observations (monthly cycle) using TM–71 feeler gauge augment these measurements.

Two–year period of observations (2001–2002) in individual segments confirm mobility of geological structures in this region. Superposition of registered variations of endogenous and exogenous character makes their separation impossible. This particularly concerns gravity measurements and observations with feeler gauges installed in the dam's adit and below its right abutment in the crystalline zone of Sudetic Marginal Fault.

RESULTS OF GEODYNAMIC INVESTIGATIONS IN THE STOŁOWE MTS. RESEARCH AREA

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ABSATRACT

Present day orographic picture of the Stołowe Mts. had been shaped as a result of geological and tectonic processes, climatic and atmospheric changes, as well as seismic events. These processes have been started in Late Cretaceous Period. Repeated geodetic, satellite GPS and gravimetric measurements indicate continuing changes of the lithosphere's upper layer.

Deformation studies of the upper lithosphere layer in Stolowe Mts. began in 1972. Geodetic network was then established in the upper part of Szczeliniec Wielki — in front of PTTK mountain refuge. Periodic observations in this rather small research network combined with relative measurements using TM–71 feeler gauge were aimed at estimation of present–day mass movements of cretaceous sandstone blocks. The following years have brought extension of these observations on to the whole of the Szczeliniec Massif including "Piekiełko" interstice. Periodic geodetic and relative (TM–71) observations confirmed the Massif's instability until the early 90–ties of last century. The greatest changes have been recorded in "Piekiełko" (~0.5 mm/year). In 1989 similar observations were started on the "Ostaš" object in the then Czechoslovakia. Both objects were linked in 1993 by a 8–point geodynamic satellite and gravimetric network. Satellite, gravimetric, geodetic and relative (TM–71) measurements carried out with varying frequency on local objects (Szczeliniec and Ostaš) as well as in the geodynamic network prove present–day mobility of geologic and tectonic structures. Recent measurements, realized in 2002 allow quantitative assessment of changes in relation to tectonic and mass movements.

NATURAL TECTONIC HAZARDS FOR ENGINEERING STRUCTURES IN THE REGION OF LOWER SILESIA

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ABSTRACT

Southern and central parts of Lower Silesia is potentially threatened by present–day movements of the earth crust and resulting earthquakes. This is connected with numerous, regional tectonic zones that had originated in Neogene period and whose activity is being observed today. These zones break up crystalline structures of Sudety Mts. and Fore–Sudetic Block into separate tectonic blocks and accompanying graben and tectonic horst zones.

Sudety Mts. and Fore–Sudetic Block have rich and diversified mineral deposits, good climatic and soil conditions that favour settlement growth. As a result urban, industrial and mining infrastructure has developed. Numerous water dams, often in the area or nearby active tectonic zones, have been constructed (Dobromierz, Słup, Otmuchów, Nysa).

Historical records show numerous events of noticeable tectonic shaking throughout the Lower Silesia region. Seismic stations register present–day seismic activity in Sudety Mts. and their foreland. This is closely connected with intensification of mining activities mainly in the LGOM, Bełchatów brown coal mine and Upper Silesia Coal Basin areas. Diversified, vertical movements of the earth crust can also be observed near constructed water dams (Nysa).

As a result of these, the need for marking out active tectonic zones and development of control and measurement systems capable of indication of threats for important engineering objects and city agglomerations arose. Geodynamic profiles have been set up across the most active tectonic zones covering Sudety Mts. and Fore–Sudetic Block. These base on repeated, every year, satellite GPS and gravimetric, as well as, relative feeler gauge measurements. Feeler gauges have been installed along main fault zones i.e. Sudetic Marginal Fault and Intra–Sudetic Fault. Geodynamic investigations have been started in the beginning of the 90'ies on local geodynamic research grounds: "Snieżnik Massif", "Stołowe Mts." and "Paczków Graben" and carried on after that within the "GEOSUD" project (1996–1998). Presently these are continued in "GEOSUD II" Polish Scientific Committee research project (2000–2002). Since 1997 investigations of the Sudety Mts. geodynamics have been performed on both sides of the Polish–Czech border as a cooperation between Department of Geodesy and Photogrammetry at Agricultural

University of Wrocław and Institute of Rock Mechanics of the Czech Academy of Sciences in Prague.
Geodetic measurements with satellite GPS techniques are performed yearly in campaigns lasting several days on points of combined Polish and Czech "SUDETY" network and geodynamic profiles (GEOSUD network). These are then linked to selected IGS/EPN network stations for permanent observations. The newest results indicate natural (tectonic) movements, in SW Poland, reaching locally 2 to 3 mm per year. The maximum velocities of horizontal movements for the 1997–2001 period have been determined for KLOD (Kłodzko) STRZ (Strzelin) and MECI (Męcinka near Jawor). Significant values of horizontal and vertical movements have been noted for points in Paczków tectonic graben. These data suggests existence of ground stresses in Sudety Mts. that may be furthermore intensified by mining activity or construction of water dam systems in active tectonic zones.

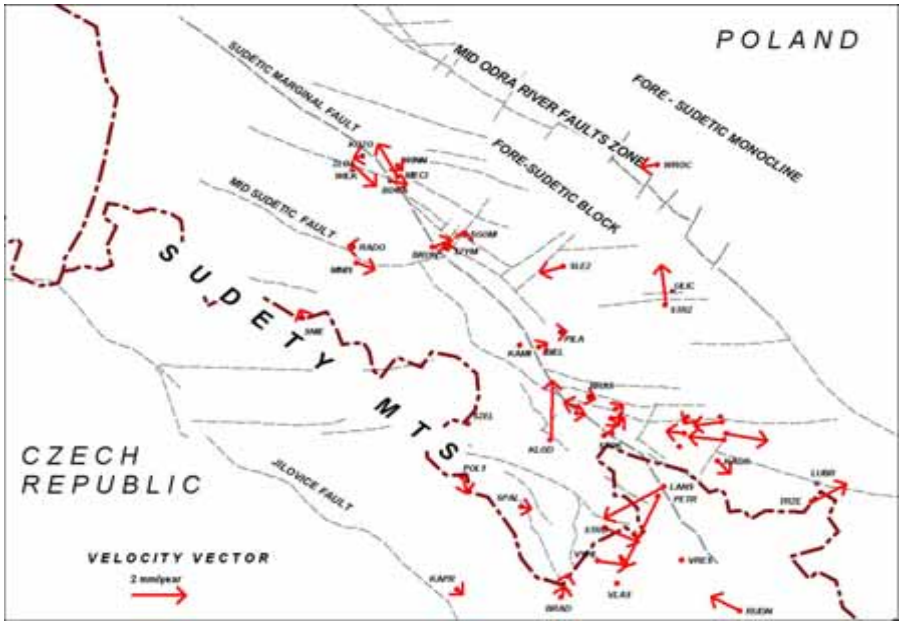

Fig. Horizontal GPS velocities (1997–2001)

Results of up–to–date studies have diversified cognitive value due to different periods of measurements (2 to 8 years), different sessions lengths (4 to 48 hours) and various equipment used. However these confirm existence of ground stresses that may be discharged in local earthquakes and point to the existence of potential threat for urban and industrial infrastructure in the region.

A CONCEPT OF UTILIZING SILESIA ACTIVE GEODETIC NETWORK TO DETERMINE CURRENT PARAMETERS OF LOCAL DIFFERENTIAL REFRACTION

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ABSTRACT

In 2001 Head Office of Geodesy and Cartography decided on establishing the permanent GPS reference stations in Silesia area. Presently active GPS reference system, consisting of six stations distributed throughout Silesia Coal Basin, is under construction. It is hoped that at the beginning of 2003 this system will become fully operational.
At the same time permanent GPS station KRAK in Cracow will be opened. It is being installed at the University of Mining and Metallurgy — Faculty of Mining Surveying and Environmental Engineering. Silesian active GPS stations as well as KRAK will be equipped with the same receivers — Ashtech μ Z — CGRS (Continuously Geodetic Reference Station) and geodetic antennas. It is noteworthy that Silesian GPS network is situated between permanent stations KRAK and WROC giving opportunity of undertaking research on the ranges of high precision positioning applications. We are particularly interested in the improvement of a better modelling of the atmosphere in an improved estimation of the height. A special software is created for this goal. A focus is given to reliable integer ambiguity resolution for the local monitoring receivers. Numerical results using data from a high precision GPS tracking array are presented to demonstrate the result of our approach.

TO GENESIS OF UPPER MORAVA AND KŁODZKO GRABENS*

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ABSTRACT

Pull–apart basins are an integral part of intraplate and interplate strike–slip fault zones (Sylvester 1988). Bends or sidesteps (jogs) in the main strike–slip fault system (principal displacement zones — PDZ; e.g., Christie–Blick and Biddle 1985) generally produce either zones of extension (pull–apart basins) at releasing bends or sidesteps or, alternatively, regions of compression (uplifts or pop–up structures) at restraining bends or restraining sidesteps. Releasing sidesteps or jogs characteristically produce rhombicshaped pull–apart basins in the overlying sedimentary section (e.g., Crowell 1974; Mann et al. 1983; Aydin and Nur 1985; Sylvester 1988). The pull–apart basins evolve progressively from a narrow graben bounded by the oblique–slip link faults to wider rhombic basins flanked by terraced basin sidewall fault systems. The synkinematic strata are generally flat or gently dipping, and deformed only at the basin margins by the terraced sidewall fault systems. The PDZ at each end of the pull–apart basin system are relatively narrow and generally develop in–line horst and graben structures that broaden outward into the pull–apart basin. The analog models are compared with natural examples of pull–apart systems and show many strong similarities in structural geometries and stratal architectures.

Published synoptic models usually depict pull–apart basins as simple rhombohedra bounded by two vertical, laterally offset strike–slip faults linked by two steep, parallel, oblique–slip extensional faults (e.g., Crowell 1974; Aydin and Nur 1985). The experiments made by Dooley and McClay 1997, however, show that pull–apart basins are significantly more structurally complex than these previous synoptic models.

Our morphotectonic analysis of Moravosilesian and adjacent area is based on 3D visualization and interpretation of digital elevation models (DEM). Analyzed digital models have been compiled on basis of detailed digitalization of topographic map of 1: 25000 and 1: 50000 scales. A model was compiled partially using software Surfer 8.0 (surface and shaded relief) and by ArcInfo GIS 8.2 visualization capabilities. The results of this method were compared with structure analysis. Also brittle faults paleodynamic analysis and strain analysis were carrying out. All made DEM of particular areas were integrated in wider GTOPO30 DEM model of recent relief of Bohemian Massif. The GTOPO30 DEM (http://edcdaac.usgs.gov/gtopo30/ gtopo30.html) has been set up on basis satellite radar data.

Special attention we focused on framework of main sudetic faults systems in the area under study. The causal (genetic) relation of Kłodzko and Upper Morava grabens to dextral strike–slip activity of WNW–ESE striking sudetic fault zones, mainly Intra–Sudetic Fault, Temenice fault and Nectava fault is indisputable. Long–term dextral wrenching movements and/or dextral tangential stress field state on above mentioned fault systems from Late–Variscan tectogenesis up to Neotectonic and Recent stages is well know (e.g. Grygar 1987, Aleksandrowski et al. 1997, Uličny 2001 etc.). One of typical feature of all studied fault systems is "en echelon" pattern of fault network. Releasing sidesteps or jogs superimposed individual faults characteristically produce rhombic shaped pull–apart basins — Late Cretaceous (Cenomanian) "Kłodzko pull–apart graben" and Tertiary–Quaternary "Upper Morava pull–apart graben".

The Kłodzko pull–apart graben corresponds to offset of Intra–Sudetic Fault zone with Bušín and Temenice fault system. It represents distinctly asymmetrical hinge–like pull–apart half–graben with main control, steeply dipping fault in east–ward Sněžník flank and hinge point near Štíty town in its most southern Czech part (Králíky graben). Most rapid sedimentary subsided domain is located in northern Polish part (Bystrzyca Kłodzka region).

The Upper Morava pull–apart graben subsidence started in Miocene. This structure was initiated due to interaction both Bušín–Temenice fault and Nectava fault zones. Typical pull–apart basin is growing herein up to recent time. The evidence for Pleistocene–Holocene tectonic activity of the graben could be documented by highest Morava river fluvial terraces lifted up on both NE and SW flanks and also on horst structures (developed in inner part of graben) up to level 415–435 meters altitude in relation to today approximately average 200 m of Morava river altitude.

* This work was supported by the GAČR – Grant Agency of the Czech Republic (Project #205/00/1182 and #205/01/0480)

ANALYSIS AND INTERPRETATION OF VERTICAL GROUND MOVEMENTS IN WROCŁAW

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ABSTRACT

In the paper vertical changes of benchmarks in local networks and precise levelling lines, of the 1 and 2 order, passing across Wrocław for the 1968–1998 period are presented. Wrocław is characterized by diversified geological, groundwater and dwelling density conditions. Ground reactions due to increased loads resulting from development and growth of housing districts and industrial activity are also varied. W and SW parts of the city is subjected to elevation while the remaining areas experience subsidence. Wrocław is located in the old Odra river basin, at a boundary of two large pre–Cenozoic units: Fore–Sudetic Block and Fore–Sudetic Monocline separated by middle Odra fault zone. Tertiary and Quaternary deposits reach combined thickness of 150–170 m. Tertiary sediments are 170 m thick in SW part and decrease in the SE direction to about 85 m. Quaternary deposits are thickest in the centre of the city (57 m) and decrease to the W and SW to around 10 m. Central part of the city lies in a zone of alluvial deposits accumulated by Odra river.

Analysis of Ząbkowice–Wrocław levelling line (1st order) measured in 1956,1975,1990 and 1999 indicates that the most significant changes (70 mm subsidence) occurred between 1975 and 1990 in the period of greatest housing development and increase of road transport. Basing on the analysis of vertical movements of benchmarks a map with isolines of elevation changes has been developed. It shows that the zone of negative to positive change of benchmark movements is consistent with the direction of dense built up of the city (SE–NW) .

Growth of housing developments has probably the greatest effect on vertical variations of benchmarks. However mobility of above–mentioned tectonic units cannot be ruled out as these also extend in the SE–NW direction.

In the article results of a repeated satellite measurement of levelling network in 2002 will also be presented. These will be compared with the results from 1998. The network consists of 12 points in the city limits located closely to fundamental benchmarks and 5 points at a distance up to 30 km outside Wrocław.

In the paper an attempt has been made to interpret the process of vertical motion of the ground and indicate its possible causes.

RECENT CRUSTAL MOBILITY OF THE UPPER NYSA AND PACZKÓW GRABENS, SW POLAND

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ABSTRACT

The paper presents a project of integrated geodynamics studies of the Śnieżnik Massif and Złote (Rychlebske Hory) Mts. These massifs form a separate, trapezoidal in shape, morphotectonic unit within the Eastern Sudetes Mts. The spatial extent of this unit is coincident with the Śnieżnik–Orlickie Mts. dome which is bounded on the west by the Nysa Kłodzka graben along the Waliszów fault, passes into the Ramzova fault in the east, is cut on the north by the Sudetic Marginal Fault, and is bounded on the south by a fault that belongs to the Elbe fault zone. All the marginal faults are of Variscan origin and play an important role in geological structure of the NE Bohemian Massif. These faults became reactivated during post–Alpine tectonic activity. The amounts of throw change from 1500 m to the west to some 600 m to the north and south. The post–Alpine uplift on the east is poorly documented, although it could be approximated at some 400 m. Morphostructural analysis of the contemporary drainage pattern dissecting the above fault zones indicates that slow tectonic uplift still affects the Śnieżnik Massif and Złote Mts. The contact of this area with the Bardzkie Mts., as far as morphotectonic features are concerned, is poorly known. It cannot be excluded, however, that the Laskówka Depression, at the boundary between the Bardzkie and Złote Mts., is also tectonically controlled.

The principal objective of future research included in our project is a detailed morphotectonic analysis based on 1:10 000 topographic maps, alongside with field studies of the relevant river valleys, and reconstruction of tectonic–geomorphological features of the Polish segment of the Bohemian Massif. These studies should enable us to estimate the rates of vertical crustal movements during the past 20–10 thousand years, whereas geophysical soudings will make it possible to trace dislocations in the uppermost crust of that region. Geodetic surveys, in turn, will provide reliable framework of the recent crustal movements.

THE HIGH PRECISION WATER TUBE TILTMETER IN KSIĄŻ GEOPHYSICAL STATION

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ABSTRACT

The preliminary works on a new tiltmeter has been done in laboratory of the Space Research Centre of the Polish Academy of Sciences in 1998 (In this year the project have been accepted by the Committee of Scientific Research).
The long water tube tiltmeter consist of two about hundred meters length tubes partially filled with water. The inclinations of plumb line in relation to the water surface produce gravity component tangential to the water surface. The gravity component in plane parallel to the length of the tube, force the water inside the tube to move to the position, in which water surface will be covered with a new equipotential surface.
The interferometric system for continuous measurement and registration of the ultra small variations of water level was developed. The monitoring of the water level variations at ends of the tube allowed us to determine component of plumb line variations in plane parallel to the length of the tube. Variations of water level thickness caused displacement of Newtonian rings on interference pictures. This system enables permanent measurements of water level variations with the nano–meter level of accuracy. This accuracy corresponds to 0.005 millisecond of plumb line variation.
A new tiltmeter has several advantages over the traditional tiltmeters like horizontal pendulums: high accuracy, hundred times greater then obtained to far, lack of instrumental drift (in practice instrumental drift is very little and can be modelled), extensive base of instrument near to hundred of meters. The exceptional properties of the long water tube tiltmeter open a new field of investigations in geodesy and geodynamics. Examples are investigations of the secular variations of gravity field and present movements of the tectonic plates, researches of Sudeten formation tectonic and erosion processes. Another subjects of new investigations are influence of „global greenhouse effect" on systematic variations of gravity field, and annual modulation of the tidal waves. The list of applications of a new tiltmeter contains also researches on non–periodic plumb line variations as well as comparative analysis of the horizontal pendulums and long water tube tiltmeter.

SEISMICITY OF THE EAST SUDETES AS RECORDED BY SOLITARY TRIGGERED STATIONS OF UGN

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ABSTRACT

Three permanent seismic stations equipped with digital seismic signal recorder PCM3–EPC have recently been installed in the East Sudetes area, Northern Moravia, to monitor seismic activity in this region. This activity was studied in the context of the project of GACR No. 205/01/0480. The area is characterized by a complex structural setting and very low seismic acivity. The installation of these stations allowed to operators to improve the magnitude detection level down to magnitude 0 for hypocentral distance 9 km.
The triggered levels of individual seismic stations (Raduň, Javorník and Slezská Harta) are usually 5.10^{-6} $m.s^{-1}$. The large number of seismic events registered by solitary triggered stations may be divided into following groups: local natural seismic events (very weak intensity), events induced by quarry blasts and/or other human activities in monitored area, events induced by mining activities in the Czech and Polish part of the Upper Silesian Coal Basin (hard coal mines) and in the Lubin area (Polish cooper mines), and unidentified parts of teleseismic events, as well. Location procedure of local events is based on using S–P times and polarization analysis because often only one station recorded these ones.
More than 2000 triggered records were recorded in the period I–IX/2002 and about 300 from these are seismic events. Only one sequence of three shocks of natural earthquakes was recorded in this period. It was in May 5, epicenters are near from Litultovice (W of Opava), local magnitude up to 0.1.

INTERNATIONAL EARTH ROTATION SERVICE AND ITS IMPORTANCE FOR GLOBAL GEODYNAMICS

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ABSTRACT

The International Earth Rotation Service (IERS) was created by the IAU and IUGG in 1988, with the main goals to establish and maintain the International Celestial Reference System (ICRS), the International Terrestrial Reference System (ITRS), and to monitor their mutual orientation via the Earth Orientation Parameters (EOP). To this end, several modern techniques of observation are used, such as VLBI, GPS, SLR, LLR and DORIS. Because the ever changing Earth's orientation is substantionally affected by the motions of the non–solid parts of the Earth (atmosphere, oceans, core…), the IERS established a Global Geophysical Fluids Center (GGFC). Thus the IERS evolved into a rather complicated international structure, consisting of many Technique Centers, Product Centers and Combination Research Centers, all serving to one ultimate goal, global geodynamics.
All aspects of the structure of the service will be addressed in the presentation, and the most important results obtained recently will be discussed (ICRS, ITRS, EOP). Some examples of mutual interactions between the geophysical processes and rotating Earth will be shown.

REMOTE CONTROL OF GPS OBSERVATORY USING GSM MODEM

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ABSTRACT

The observatory works in autonomous regime. GPS receiver Ashtech Z18 is connected to PC, data are continuously stored on local hard disk and downloaded approximately once per two months to 1 GB JAZ disk. All equipment is powered 12 V DC from 230 V AC / 12 V DC converter. This converter serves also as a charger for 12 V / 220 Ah backup accumulator. To be able to remote control and check the station, a GSM modem Siemens TC35 was connected to serial port of PC. Program Microsoft NetMeeting was selected as a tool for remote access. GPS observatory SNEZ located on the top of the highest Czech mount Sněžka was selected as test site. Problems and their solutions connected with GSM remote control are discussed in this contribution.

SPACE GEODESY AND EXPANDING EARTH

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ABSTRACT

The possibility of the application of space geodesy to geotectonics appeared already at the early stage of development of the former. It could be used especially for measurements of the relative movement of the lithospheric plates. The task was undertaken and the following methods were successively involved: from the SLR, through the VLBI, to the GPS. The possibility of the direct verification of the theory of the expanding Earth and the plate tectonics, which assumes the stable Earth's radius, appeared as well. This was very important because the plate tectonics became very popular without proving its basic assumptions. In contrary, the expanding earth theory is well based on geological data (Koziar & Zagożdżon, this conference) although much less popular.

In spite of its importance, the problem of the change of the earth's radius was not taken up by specialists dealing with the space geodesy technology. The popularity of the plate tectonics turned out to be the decisive factor. The specialists assume the constant earth radius up to nowadays, like the gravitational constant and the speed of light. Successive global combinations of plate motions obtained by space methods are being compared with results of calculations based on the assumptions of the plate tectonics. Collisions of plates resulting from the space geodesy are treated as a proof of the plate tectonics. But in both cases there is a risk of using of vicious circle.

The attempt of estimation of the change of the Earth radius was made by an outsider. Carey, a geologist, published (1988) the calculated (together with Parkinson) value of the annual growth of the radius based on the SLR data. It was equal to 2,08 ± 0,8 cm/yr. The value is close to my result – 2,6 cm/yr (Koziar 1980) based on the spreading of the oceanic lithosphere. Afterwards, Carey (1996) referred to the convergence of both the results.

Apart from that, Carey (1988) pointed to the apparent shrinking of Australia and the cratonic part of America obtained by SLR method, that testified by itself to the uncertainty of the method. It will be shown at this conference by the present author, using his own model of lithospheric plates on an expanding Earth (Koziar 1980, 1994), that the apparent shrinking is a result of assuming the stability of the Earth radius, while it is really growing. So, the plate collisions obtained by the space geodesy are apparent ones. Proving by them both, the validity of the plate tectonics and the assumption of the constant Earth radius (the latter, common in fact, for the space geology and the plate tectonics), is really a vicious circle.

Maxlow (2000) stressed the odd situation in the interpretation of the VLBI results. Robaudo and Harrison (1993) reported that medium annual increase in the height of the measured points was over 1.8 cm. However the authors wrote: *„We must expect that most VLBI station will have up–down motions of only a few mm/yr. It therefore seems reasonable to restrict the vertical motion to be zero, because this is closer the true situation than an average motion of 18 mm/yr"*. Maxlow compared their result with his value 2.2 cm/yr obtained by the same method as mine, but using more recent maps.

At the end we must consider the growth of the Earth's mass. This was already postulated by Jarkowski (1888) and Hilgenberg (1933). We can estimate it from geological data (Ciechanowicz, Koziar 1994) as being of the order of 10^{19} g/yr. A similar value can be obtained from the measurement of the product of the gravitational constant and the Earth's mass (GM) performed using the SLR method in the period 1976–1988. However, there are no new results of the measurement of the GM value published after 1992.

EXTENSIONAL DEVELOPMENT OF THE BOHEMIAN MASSIF ON THE BACKGROUND OF BREAKING UP OF THE EUROPEAN VARISCIDES

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ABSTRACT

The majority of sedimentary basins that separate Variscan massifs in Europe or occur on their borders display distinct features of extensional regional tectonics. Consequently, this points to dilatational break up of the European Variscides and implies a useful method of their reconstruction.

Dilatational development of sedimentary basins can be seen and is quite well documented in western part of Europe. It concerns mainly the Aquitaine Basin, the Paris Basin and the North Sea Basin. Clearly marked edges of fragments of older continental crust allow to put and fit them together in a strictly defined way. Such a procedure considerably reduces the areas of the massif–separating depressions.

The so reconstructed area of European Variscides, is a starting point of their later scattering. The shift directions of individual massifs and the age of basin sediments clearly indicate SW–NE stretching in the period from at least early Palaeozoic till the end of Mesozoic. The stretching was greater in the western part of the Variscides where the Central Massif moved far from the Bohemian Massif towards SE. As a result a line of large sinistral shear movement emerged, corresponding to the line of recent Rhone and Rhine troughs.

The Bohemian Massif also moved away from the East European Craton. The main indicator of such a movement is the tensional development of the Polish Basin, which is the structural prolongation of the tensional North Sea Basin. Because Bohemian Massif was shifting relatively more to SW than Małopolska Massif, another regional sinistral shear zone was created. It has also a counter clockwise shift and follows the SE edge of the Bohemian Massif and the NW margin of the Holy Cross Mountains Massif. It roughly corresponds to the Warsaw–Vienna line. As a result, the SE end of the deep section of the Mid–Polish Trough and the Upper Silesian Basin create coupled pull–apart basins.

Variscan massifs also occur in the Alpine Belt of Europe, where their dilatational break up can be seen as well. In the geosynclinal stage, the process is generally recognised and accepted, whereas for the folding phase, it can be proved to have a character of the gravitational slides, also caused by tension. The original tension brought about diapirism and elevations of the crust (primary tectonogenesis) in the regions where recent intramontane depressions are developed. These elevations generated gravitational slides (secondary tecto–nogenesis) of nappes outside from the elevation tops (Koziar, Jamrozik 1985). The develop–ment of the Mediterranean Sea is also a manifestation of tension (Koziar, Muszyński 1980). The tensional break up of meso– and neo–Europe also relates to the documented dilatational break up of North Africa. These phenomena unambiguously indicate the process of gradual movement of Europe and Africa apart from each other at least since the late Precambrian.

The development of the Bohemian Massif itself obviously had to occur in the above–described context of the regional development. The processes observed within the Massif correspond with it. Among the indicators of the tensional evolution are Variscan granitoid batholiths. The result of tension was the separation of the Foresudetic Block from the main body of the Bohemian Massif, which already started in Devonian times, as well as the consequent development of the Intrasudetic and North Sudetic Basins. Tensional in character are the Bohemian Cretaceous Basin and the Sudetic front depressions (Mokrzeszów, Paczków and Kędzierzyn–Koźle troughs) of Tertiary age. Finally, the Cainozoic basaltic volcanism and almost contemporary shifting up of the Sudetic Block also evidence widespread regional extension.

FOUNDATIONS OF THE EXPANDING EARTH THEORY

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ABSTRACT

The first who wrote about the expansion of the Earth was the Pole, Jan Jarkowski (1888, 1889). Then, two German scientists Bruno Lindemann (1927) and Ott Hilgenberg (1933) developed the expanding Earth theory (EET), well supported by geological data. It was just the time, after the discovery of the drawing aside of continents by Alfred Wegener. Consequently, the elimination of the hypothetical lands used by the land–bridges theory (LBT) was possible. The land–bridges were to fulfill the recent oceans according to the well established data coming from paleontology, lithology and sedimentology. The data indicated that the Pacific Ocean, like the Atlantic and the Indian Ocean didn't exist in the pre–Jurassic time. The fault of Wegener was the assumption that the development of the Pacific was different from that of the other oceans. Lindemann and Hilgenberg went consequently further treating the Pacific in the same way as the other oceans according to the LBT, and using the innovative approach of Wegener. It implies unambiguously the expansion of the Earth. To close the oceans, including the Pacific, one must use the Earth radius twice smaller than the present one. Hilgenberg (1933) was the first who made the reconstruction of the continuous continental shell of the Earth of significantly smaller size. EET provides a solution for the two level Wegener's curve. It explains also, in a simple way the mantle–crust mechanism of the continental drawing aside which was fatal for Wegener's theory. The cause of the expansion, i.e. a deeper process in the Earth's core, hasn't been found yet, but we consider it simply as "a process unknown to contemporary physics".
Rejecting of the expansion of the Earth only because of the lack of explanation of its cause is a very often methodical fault. The correct method is verification of the EET in phenomenological sense by confrontation with facts. The confrontation reveals the superiority of EET over the so called plate tectonics theory (PTT). PTT is a modern continuation of the Wegener's theory. Its starting point and main argument is the causative explanation in the form of hypothesis of convective currents. However, the latter cannot be fitted to geotectonic structures by any way.
The essential progress in EET took place in the 50ties when Samuel Warren Carey pointed to the enlargement of oceanic ridges in comparison with corresponding edges of continents. He also noticed that all the continents surrounding the Pacific Ocean are drawing aside as well. It means that the Pacific is growing, and at the same time, the Earth is growing too. In the 70ties Yan Steward pointed out that all the hot spots are mutually moving away. That also means the expansion of the Earth. Afterwards, starting from the 80ties, the seismic tomography showed that all the lithospheric plates have deep cool mantle roots. So, they are staying in the same place relatively to the deep basement. At the same time they are mutually moving away which is documented by spreading of the oceanic lithosphere. The two facts prove again the expansion of the Earth.
PTT, a very commonly accepted theory, can oppose to the proofs of EET only the unproved assumption that the Earth is not expanding. On this assumption several models were built, e. g. the model of subduction and collision of the plates in the zones of active continental margins. This model ignores the fact that island arcs are breaking away from continents and that diapers exist there, like under the midoceanic ridges. The analysis of the processes occurring in these zones (without using any global assumptions) leads to the reconstruction of their tension–gravitational development (Koziar, Jamrozik, 1985). The zones of inland orogens show, by the same method, exactly the same development (Koziar, Jamrozik 1985).

APPLICATION OF THE GPS MEASURE TECHNIQUE FOR INVESTIGATIONS OF THE HORIZONTAL COMPONENTS OF TIDAL STRAIN FIELD, PRODUCING BY THE DIURNAL AND SEMI–DIURNAL TIDAL FORCES

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ABSTRACT

Progress of GPS measuring technique as well as increase of its accuracy opens new applications of GPS in geodynamic science. The relative accuracy of GPS measurements achieved accuracy better then (10^{-8}) for elaborations of net of permanent station (1998 Technical Report) and of measuring campaign (Ineichen, 1999) at the present time.
This accuracy makes possible of investigations of the tidal origin earth's crust deformations as well as direct tidal strain field on several hundred kilometers length baselines.
Hitherto the height precise measurements of the Earth's crust relative deformations were only possible by means of extensometric techniques made in underground tunnels on very few meters baselines. In spite of the high occurace of extensometric measurements (10^{-10}) the GPS technique supplies valuable information about regional deformations of earth's crust. Because of the length of GPS measure baseline (several hundred kilometers) we obtain averaged deformation of the crust on bases in opposite to ekstensometric measurements supplying more local information.
The method apply in project relies on measurement of the variations of the length of two perpendiculars vectors situated in meridian and parallel. The supplied data allowed determining the amplitudes coefficients and phases of diurnal and semi–diurnal strain tidal waves in the Earth's crust. Next, these coefficients will be used for determination of the Love's number h and Schida's number l. Determination of coefficients supply valuable information characterizing mechanical proprieties of the Earth's crust in area of paleozoic platform as well as in are of transition zone of the coast of east European platform (Teisseyre'–Tornquist zone). Tidal analysis of the time series, obtained from GPS observations (Bernese GPS Software ver 4.2) will be helpful to verify expediency of applying global tidal models implemented in this packed for processing GPS observations on Central Europe lowland.

ON THE ORIGIN OF CIRCULAR STRUCTURES IN THE SUDETES AND THEIR FORELAND — STUDY OF THE LANDSAT SATELLITE IMAGE

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ABSTRACT

Correlation of the Landsat satellite images with topographical and geological maps, shows that most of lineaments visible on the image correspond with single faults or deep fault–zones. On the satellite image of the investigated area, there are three long lineaments defined as: (a) deep–fault zones: „Moravian–Silesian" trending NNE–SSW, (b) „Marginal Sudetic" trending NW–SE, and (c) southeastern part of the „Intrasudetic Deep–Fault Zone" trending WNW–ESE. The long dislocation zone of Paczków–Kęzierzyn, trending W–E, which is still active since Tertiary up to now, might have developed on the older deep–fault zone, too. Similarly deep–seatet is probably also the meridional lineament stretching along marginal fault of the Upper Nysa Kłodzka graben to the Kłodzko–Złoty Stok granitoid massif, and continuing further north along the Niemcza dislocation zone. Its southern prolongation run across Czech and Austrian territory.
Circular lines represent the other kind of structures visible in the satellite image. These structures are supposed to result from the meteoritic impact, althoug possibility of their endogenic origin has not been finally excluded. Another interpretation of the same structures suggests that circular structures can be interpreted as the surface expression of underlying magmatic chambers. Such circular structures are also visible in the Landsat satellite image of Sudetes and their foreland. Three of them surround Hercynian granitoid massifs of Strzelin, Kłodzko–Złoty Stok and Žulova, and they run along dislocation zones (in 75% used by the river system). Studying circumferences of these circular structures, one can notice that they overlap close to the Paczków–Kędzierzyn dislocation zone. This observation is significant when considering a supposed origin of the circular structures, in particular alternative possibility of meteoritic impact or endogenic processes.
It seems possible that at least these three circular structures could form above magmatic chambers either during copula uplift or subsidence of the roof–cover of intrusions. It is also possible that circumferences of these structures delineate

approximate extent of the deep–seated intrusions, the pulsation of which caused movements of the roof–cover, resulting in various systems of faults.
Another conclusion concerns the presence of supposedly deep–seated and still active Paczków–Kędzierzyn dislocation zone. This zone, visible in the Landsat image as a long lineament between two circular structures, divides two granitoid massifs of Strzelin and Žulova. Taking into account the earlier suggestions made by several authors, both the massifs should be treated as two independent geological units, what is important in the case of use of unproper name „Strzelin–Žulova granitoid massif".

GEODYNAMIC NETWORK KARKONOSZE — RESULTS OF THE 2001 AND 2002 CAMPAIGNS

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ABSTRACT

KARKONOSZE geodynamic network has been established in the Western Sudetes. Satellite GPS network consists of 19 points located in Karkonosze Mts. area and its foreland. The KARKONOSZE network is connected with GEOSUD and SUDETES geodynamic networks and also makes up their western part. Two measurement campaigns (2001–2002) of local geodynamic network KARKONOSZE were done.
During measurement campaigns permanent observations were carried out on the main point of the network — Śnieżka (SNIE). The meteorological conditions (temperature, pressure, humidity) were also measured in order to determine the field of tropospheric refraction. Data from GPS observations were processed using BERNESE v.4.2 software.
In the paper preliminary result of comparison of GPS data processing from two campaigns KARKONOSZE 2001 and 2002 have been presented.

NEOTECTONIC VERTICAL MOVEMENTS WITHIN THE GRANITIC KARKONOSZE MTS. MASSIF

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ABSTRACT

Within the Karkonosze Mts granitic massif, in SW Poland, symptoms of very young, neotectonic vertical displacements occur. One of the young faults creates an escarpment dissected by the stream. Along an another fault alluvial fan is dissected. In one case the fault was visible high in the mountain, on a meadow. Its morphology was extremaly fresh. The fault's fissure was (during observation undertaken several years ago) still open, and the scarp wasn't destroyed by the rain water. The another fault system is visible in a railway tunnel, on its walls, and especially on its hinge zone. In the eastern part of the massif, an broad Tertiary valley is dislocated.

In every case, the southern parts of the faults are uplifted, the northern show lower position. Nearly all of those phenomena are connected with the lack of isostatic equilibrium within the granitic massif. In Karkonosze Mts. the negative gravimetric anomaly reaches the value of above 40 mgals. From this rule is one exception. Southwards from the Wałbrzych city, a very young fault occur, situated within the Innersudetic Basin, and therefore not connected with the gravimetric low of the Karkonosze Mts. granitic body.

The geometry of same of the faults is also influenced by the recent regional stress field which governs in this part of Central Europe.

SEISMIC ACTIVITY IN WESTERN BOHEMIA 1991–2001

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ABSTRACT

The area Western Bohemia–Vogtland is known by occurrence of the seismic swarms. The contribution collects the measurements executed in area by stations of the Institute of Physics of the Earth Brno in years 1991–2001. It is presented the seismic activity in the main places of the occurence and in the individual years. The special attention is given to the seismic swarms in years 1994, 1997 and 2000.

GEOLOGICAL AND GEODYNAMIC ANALYSIS OF THE KRÁLICKÝ SNĚŽNÍK MTS. AREA

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ABSTRACT

The study area is situated along the border of the Czech Republic and Poland between Králíky and Staré Město towns. Geodynamic analysis is based on a detailed geological mapping and its correlation with geophysical and morphostructural data. The main faults are oriented here in the NNE–SSW and in „Sudetic" NW–SE directions. Many of them are indicated by distinct gradient in the gravity field. Some of them are clear visible in the digital terrain model. The border between West and East–Sudets or Lugicum and Silesicum is located just in the Králický Sněžník Mts., Rychleby Mts. and the Jeseníky Mts. region. The goal of the analysis is to find main geological units, important tectonic lines, the relationship between geological pattern and gravity and relief.

Tectonic earthquakes registered in this area in the past years can have been a manifestation of recent movements. The seismic activity is concentred to the contact of the Králický Sněžník Mts. and Staré Město crystalline complexes. Recently precise GPS measurements of „SUDETEN" network (Schenk et al. 2000) can bring new data about direction of movements. The correlation with geological analysis can help to the geodynamic research of the Králický Sněžník Mts. area.

Reference: Schenk V. et al. (2000): GPS Network „SUDETEN" – Preliminary Results of the Campaigns 1998–1999.

GRAVIMETRY AT THE GEODETIC OBSERVATORY PECNÝ

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ABSTRACT

The absolute gravimeter FG5 No. 215 has been employed for repeated gravity measurements at the absolute point of the Geodetic Observatory Pecný since August 2001. From the results collected up to now it is possible to conclude that the gravity at the observation site is not constant. The results of repeated absolute measurements were used for computing and checking the calibration coefficients of the tidal gravimeters (Askania Gs 15 No. 228 and LCR G No.137) running at the observatory. A correct interpretation of the results of very precise relative gravity measurements needs a good knowledge of external disturbing effects on the gravimeters. For gravimeter LCR G No.137 has been determined extreme sensitivity on the changes of the magnetic field and good temperature properties.

LINKAGE OF THE REGIONAL NETWORK GPS OBSERVATIONS TO THE EPN STATION DATA

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ABSTRACT

One of the fundamental steps applied in every GPS data processing software for a site coordinates determination is a linkage of the GPS data monitored on regional network site with the data recorded on permanent GPS stations. In a case of monitoring of the GPS satellite signals on the network SUDETEN, where the signals are monitored whenever on Saturdays and Sundays together, e.g. in days that belong to two different GPS weeks, it was convicted to introduce mutual corrections of daily or weekly coordinate differences among individual EPN stations applied to data processing. These corrections are derived directly from the coordinate residuals determined for a selected ITRF solution of these EPN stations. The principle how to introduce the corrections above mentioned to data processing will be presented and resulting geodynamic movements obtained both with and without the correction applications will be displayed.

GPS GEODYNAMIC MOVEMENTS OF THE EAST SUDETEN AREA IN CONNECTION TO GEOLOGICAL STRUCTURES AND GEOPHYSICAL FIELDS

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ABSTRACT

In the last decade many of the regional GPS networks were established to detect geodynamic movements existed at given regions. For the same purpose the network SUDETEN was built in the north–eastern part of the Bohemian Massif. To find the optimal site distribution for monitoring the GPS satellite signals the manifestations of recent geodynamic movements were thoroughly studied using all available geological, geophysical and geodetic materials. Now, when six annual GPS campaigns 1997–2002 were realised on the network, the detected geodynamic movements in the Moravo–Silesian part of the Bohemian Massif could be correlated with a local earthquake epicentre distribution and other geophysical fields, with tectonic studies including rejuvenating tectonics and remote sensing images, and other phenomena corroborating an existence of movements among individual geological structural blocks. The detected movements are in a good relation to a geodynamical pattern presumed for Central Europe.

MONITORING OF RECENT TECTONIC MICRO–DEFORMATION IN THE RYCHLEBSKÉ HORY MTS.

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ABSTRACT

In the framework of COST 625 action „3–D monitoring of tectonic structures“ 2 caves in the Rychlebské hory Mts. region were selected for installation of TM–71 gauges.
The cave called „Na Pomezí“ is situated in the left part of the valley bottom of the Vidnávka River. The valley is formed just along the major tectonic structure of this region — Marginal Sudetic Fault, in about NW–SE direction. Both evidence of seismic activity and results of geodetic measurements along the Poland part of the fault as well, reports on recent tectonic activity of this fault zone. Also morphotectonic observation showed several evidence of young formation of the landscape.
The deformometres were placed in two tectonically controlled perpendicular galleries of the cave. Both galleries are situated very close to the valley bottom so it leads to preliminary assumption that gravitational slope processes will be minimalized in the obtained records. Regular monitoring have started in October 2001. Records are scanned in the interval of 2 weeks. First results after 1 year of monitoring show several steps and very slight trends of deformations in order of 0,01 mm.
The cave called „Na Špičáku“ is situated on the foot of Špičák Hill formed by marblear limestone. The hill is very strongly disturbed by tectonic ruptures of directions NW–SE and NE–SW. Along the SE foot of the hill just by the entry to the cave the remarkable tectonic zone runs (NE–SW). The main gallery of the cave was formed along this major tectonic direction. Two instruments were placed in the cave; first one in the gallery in the direction NW–SE, second one on the fissure crossing the main gallery in the direction WNW–ESE and forming narrow galleries in the massif of the hill. The installation of the instruments was finished in October 2002. Regular monitoring started in November 2002.

LAST GEODETIC ACTIVITIES OF BUT IN SUDETY MTS. REGION

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ABSTRACT

Brno University of Technology has been carrying out geodetic measurements in Sudety Mts. region for more than ten years. The activities include in first place the long term monitoring of geometric changes in Czech part of Králický Sněžník massif. Several kinds of measuring techniques are employed here — GPS, EDM, astronomic and gravimetric measurements.
In last three years a new activity at western parts of Krkonoše Mts. has started with aim to monitor the diplacements of boulders on high mountain ridges. In that area the three small geodetic monitoring network were established and subsequently repeatedly measured with GPS, precise levelling and classical distance and angle measuring methods.
The papers presents actual state of these activities and refers about some partial results covering last period.

THE TEST–FIELD OF THE PIENINY KLIPEN BELT REVISITED — PRELIMINARY RESULTS

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ABSTRACT

After seven–years–break the test field of the Pieniny Klipen Belt has been re–measured applying precise leveling, trigonometric leveling, GPS and gravimetric methods. Shallow seismic sounding was also executed.
Preliminary results of the measurements are discussed in the paper.

YOUNG TECTONIC MOBILITY OF THE OUTER WEST CARPATHIANS VERSUS TOPOGRAPHY OF THE MAGURA FLOOR THRUST

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ABSTRACT

The aim of this paper is to discuss mutual relationships between the pattern of uplifted and subsided neotectonic structures in the Polish Outer Carpathians with highly changeable topography of the Magura floor thrust, the most extensive nappe of that region. One of cartometric approaches to the studies morphological manifestations of young tectonic activity is construction of envelope and subenvelope maps. The former portray the highest elevations of a terrain, the latter reconstruct the level to which the streams have eroded by connecting points of equal elevation between the streams. A series of such maps produced for drainage networks classified according to the Horton–Strahler hierarchy, and called base–level surface maps, makes it possible to compute maps of residuals between individual surfaces of different orders and to hypothesize about either uplift or subsidence tendencies, indicated by dense/sparse pattern of isobases and increased/decreased relief portrayed on residual maps. The hitherto–published geomorphological maps of the Polish Carpathians feature a few longitudinal elevated areas. More prominent subsiding structures are located along the Soła river course, in the Orava–Nowy Targ Basin, in the Jasło–Sanok Depression and following the lower course of the San river valley in the eastern portion of the Outer Carpathians.
The floor thrust of the Magura Nappe is highly uneven, its position changing from 500 m a.s.l. to more than 7,000 m b.s.l. The most prominent depression is located in the medial segment of the Polish Outer Carpathians (2–7 km b.s.l.), and its axis trends NW–SE from the eastern margin of the Mszana Dolna tectonic window to the Poprad river valley. Another, much more shallower, Jordanów depression (2 km b.s.l.) is to be found NW of the Mszana Dolna tectonic window, shortly north of the Skawa river valley. Elevated structures, in turn, include the Mszana Dolna tectonic window, Sól–Skomielna (on the west), and Limanowa–Klęczany (on the east) elevations of subparallel orientation. Still farther to the east, a longitudinal elevation extending between the Klęczany–Pisarzowa and Świątkowa tectonic windows is to be seen some 10–15 km south of the Magura frontal thrust. South of this area, the Magura floor thrust slopes steeply down to more than 4 km b.s.l. A comparison between the pattern of elevated and subsided structures of the Magura

floor thrust and subenvelope sufaces of different orders shows that in the western part of the Polish Outer Carpathians the highest–elevated neotectonic structures (in the southern portion of that area) coincide with depressions of the Magura thrust, whereas farther north a reverse pattern becomes dominant: neotectonic elevations coincide either with the Magura frontal thrust or with elevations of its surface. This is particularly true for an area comprised between 20° and 20°30'E meridians. Moreover, the strongly uplifted region in this part of the Outer Carpathians, i.e. the Gorce Mts., is situated shortly south of the main elevation of the Magura floor thrust, represented by the Mszana Dolna tectonic window. Farther to the east, no clear relationship between the discussed surfaces can be seen, except that the highest orogen–parallel neotectonic structures appear to coincide with the greatest thicknesses of the Magura Nappe.

The origin of such relationships is difficult to explain. We infer that one of possible factors could be Pliocene–Quaternary reactivation of faults cutting the Magura floor thrust, and particularly that which appears to separate the western–medial segment of the Outer Carpathians from the more eastern portion. This zone strikes NW–SE between Limanowa and the Poprad river valley, dividing regions showing contrasting pattern of both subenvelope surfaces and the Magura floor thrust.

GEODYNAMIC INVESTIGATIONS IN THE SUDETIC MARGINAL FAULT ZONE *(FIELD SESSION PROGRAMME)*

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Region of Sudety Mts. and Fore–Sudetic Block is subjected to present–day tectonic activity as confirmed by geodynamic investigations of the past decade. Research concentrated in the eastern part of the area (Śnieżnik Massif, Paczków Graben and Stołowe Mts.). Recently area of investigations has been extended by central and western part of the region. Geodynamic research field "Dobromierz" by Sudetic Marginal Fault zone is one of objects under study. Located nearby is Lower Silesian Geophysical Observatory "Książ".

Planned route of the field session (fig. 1) passes through these two objects. It aims at showing Workshop participants organisation of geodynamic research carried out there.

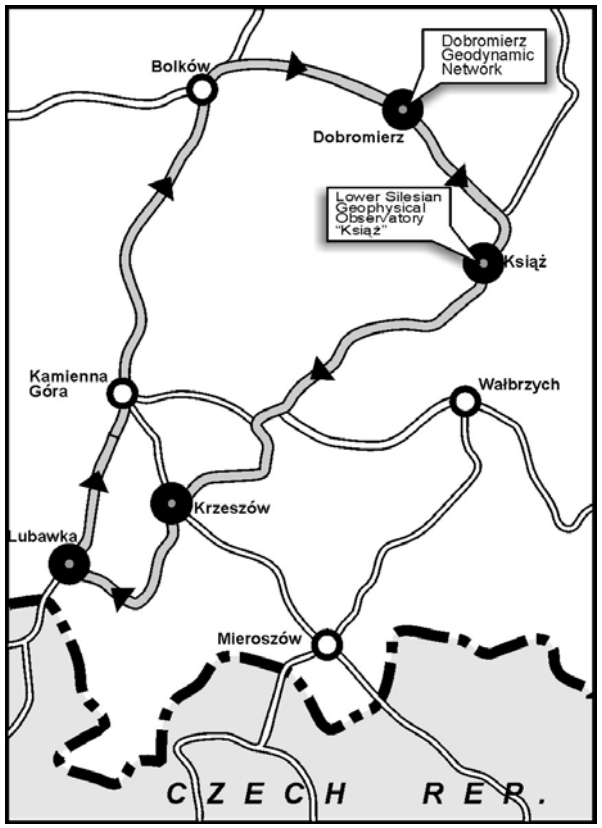

Fig. 1. Planned route of the field session

"DOBROMIERZ" GEODYNAMIC NETWORK

Programme of investigations bases on 4–segment control and measurement system implementing satellite GPS, geodetic (Total Station), gravimetric and relative (TM–71 feeler gauge). Research network (fig. 2) is located in the Sudetic Marginal

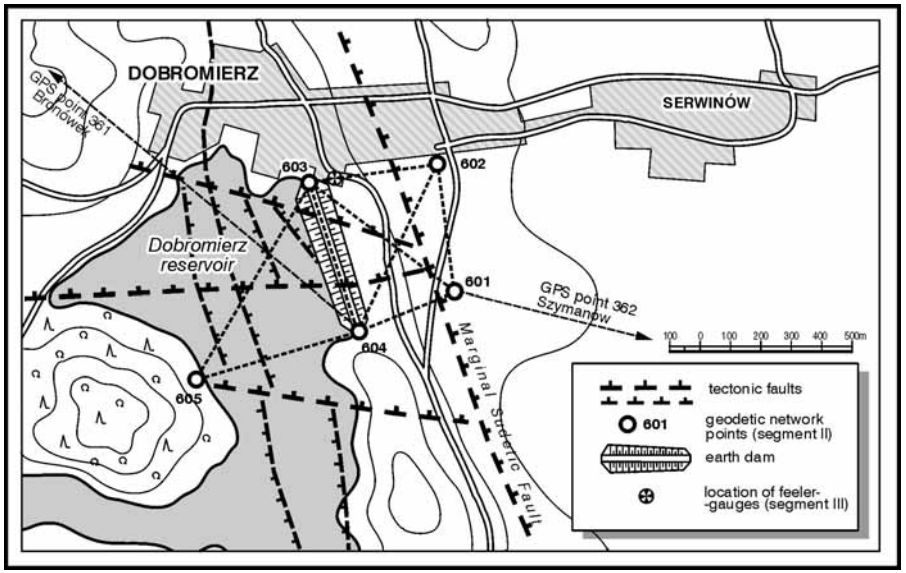

Fig. 2. "Dobromierz" Geodynamic Network

Fault and "Dobromierz" Dam zone. It is connected to the regional "GEOSUD" network via points of geodynamic profile (Bronówek, Szymanów, Strzegom). Geodynamic observations have been started in 2001 and are performed in yearly (satellite, gravimetric), 6–month (geodetic) and monthly (relative — feeler gauge) cycles.

LOWER SILESIAN GEOPHYSICAL OBSERVATORY "KSIĄŻ"

The Lower Silesian Geophysical Observatory (fig. 3) is situated in horizontal galleries build for military purpose during Second World War. The galleries were made in slope of valley of the Pełcznica River. The Pełcznica River formed kind of gorges hundred meters deep with partially rocky walls. Castle hill in which galleries were situated rise 390 meters above sea level and about 100 meters above river level. The entry to underground observatory is outside of the castle walls, 53 meters below castle court.

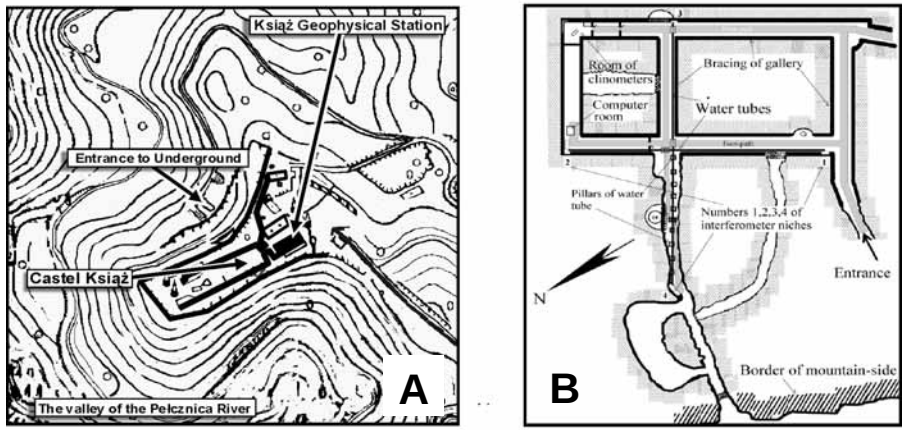

Fig. 3. The Lower Silesian Geophysical Observatory "Książ" (A), Underground of Observatory (B)

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