Institute of Geodesy and Geoinformatics, Wrocław University of Environmental and Life Sciences

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

Center for Earth Dynamic Research, Academy of Sciences of the Czech Republic

Section of the Geodynamics, Committee of Geodesy, Polish Academy of Sciences

Polish Geological Institute – National Research Institute

12th CZECH–POLISH WORKSHOP

ON RECENT GEODYNAMICS OF THE SUDETY MTS. AND ADJACENT AREAS

ABSTRACTS

Jugowice, Sowie Mts. Area, Poland
October 20-22, 2011

Organizing Committee
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ABSTRACTS

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POLISH PART OF THE OHŘE (EGER) GRABEN

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ABSTRACT

The Ohře (Eger) Graben is one of the most important neotectonic structures of the Bohemian Massif, the northern termination of which is still not clearly defined. Most of geologists maintain that it terminates in the tectono-volcanic Łaba (Elbe) zone, while others extend the graben into the Zittau Trough. However, the graben-bounding faults have not been defined yet. Increasing interest in the Palaeogene-Neogene volcanism within the Ohře Graben and the entire Cenozoic Central European Volcanic Province (CEVP) led some authors to conclude about farther northern continuation of the graben.

In the last two decades, two different views have been presented as to possible continuation of the Ohře Graben north of the Lusatian Fault. Geologists dealing with either sedimentological or neotectonic analyses were inclined to extend the graben towards the north or NNE, while volcanologists usually maintan that the graben turns to the NW, into Jawro and Złotoryja volcanic centres.

Difficulties in distinguishing morphotectonic boundaries of the Ohře Graben stem from the lack of visible graben-bounding scarps as well as from political causes. The northern part of the graben is located in the area belonging to three countries, and the presence of large mining and energetic centres made publication of scientific materials difficult.

Delimitation of graben boundaries was enabled by location of exposures of the pre-Cenozoic bedrock and geometry of basaltic bodies, both at the ground surface and those identified due to geophysical sounding or drilling. Morphology of the sub-Quaternary and sub-Cenozoic surfaces was analysed as well based on data provided by a few thousand boreholes and geoelectric soundings, conducted mainly in the Polish segment of the graben.

It became clear from these data that the northern part of the graben is poorly visible due to much more smaller uplift of the graben shoulders. The latter are also obscured by glaciofluvial sediments, 20-40 m thick. In the west, exposures of Palaeozoic rocks extend as far as faults representing continuation of the Ohře Mts. and Dečin faults (Fig. 1). In the east, in turn, the Izera-Karkonosze Block is dissected by a broad valley of probably tectonic origin. This valley forms a continuation of the Straža Fault. Farther to the north, the eastern graben margin is marked by the Leśna Block, clearly uplifted in respect to the Platerówka Block. To the west of the Kwisa Fault, exposures of basaltoid rocks form distinct belts of hills oriented NNE-SSW. In the North-Sudetic Synclinorium, the Ohře Graben is built up of downthrown Permo-Mesozoic rocks.

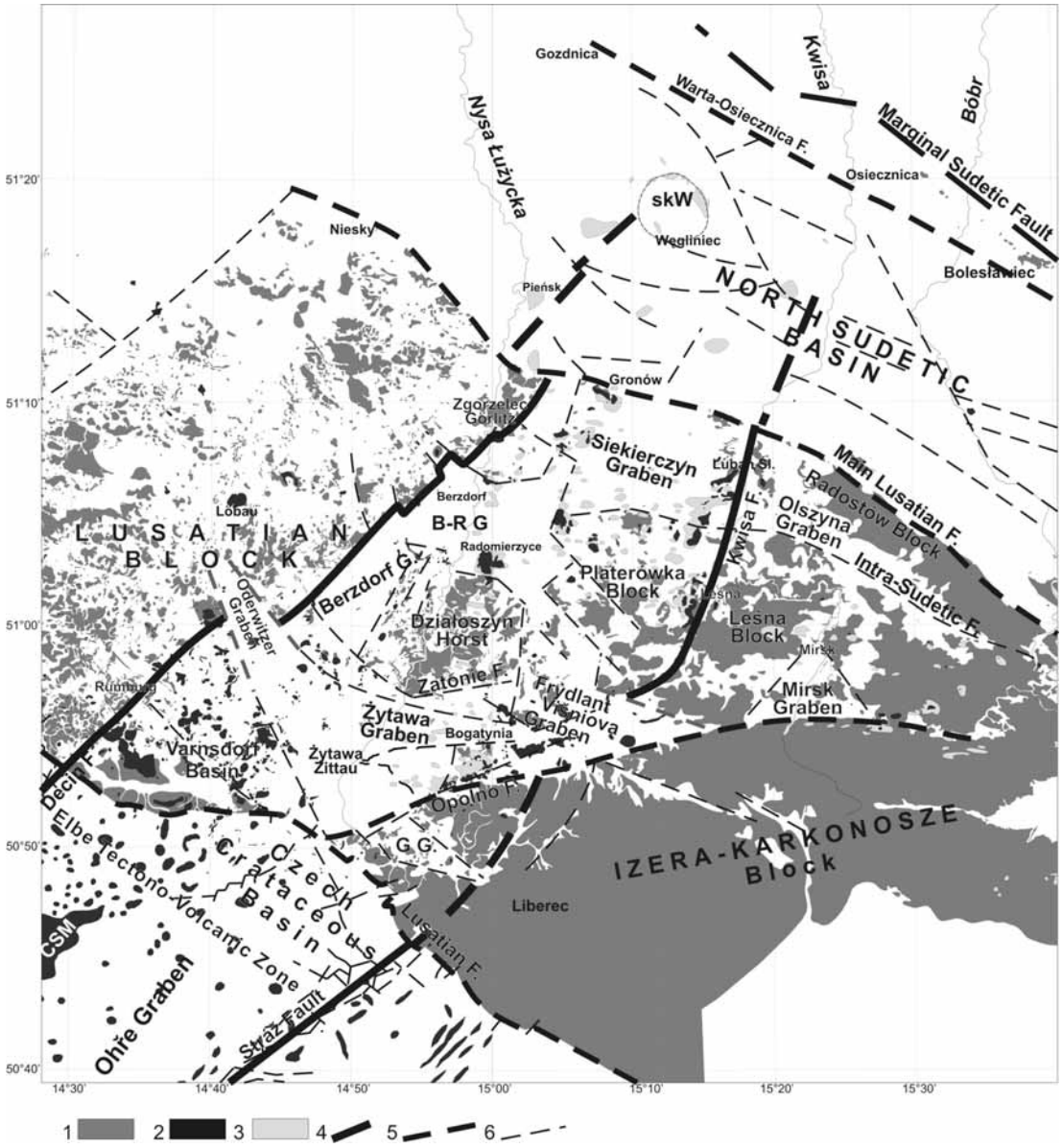

Fig. 1. Northern part of the Ohře (Eger) Graben without Permian, Mesozoic and Neogene strata, 1. Palaeozoic rocks, 2. Palaeogene-Neogene volcanic rocks, 3. volcanic rocks under younger covers, 4. marginal faults of the Ohře Graben, 5. faults of the Elbe Zone, 6. other faults

Based on the above analyses it is possible to show that the Ohře Graben cuts not only the Lusatian Fault, but also the Main Lusatian Fault and that it extends as far as the Warta-Osiecznica Fault Zone and the Sudetic Marginal Fault. Two distinct volcanic centres are located within the graben: Varnsdorf and Opolno-Frydland. Like in the middle and southern parts, the northern part of the graben comprises the second-order tectonic troughs of Zittau, Bersdorf, Radomierzyce, Siekierczyno and Węgliniec, which are separated by horsts or tectonic steps.

The northern part of the Ohře Graben originated in the same time as the remaining part. The oldest traces of volcanism date back to the Eocene. In the Late Eocene, the kaolinized bedrock became covered by lacustrine sediments. The main phase of volcanic activity took place between the Oligocene and Middle Miocene. In the Early and Middle Miocene, the thickest brown coal measures were formed. In the Late

Miocene, in turn, the graben and its shoulders became uplifted in relation to the European Lowland area. The uplifted Działoszyn Horst separated the Zittau-Bersdorf-Radomierzyce Trough into minor basins. The Izera-Karkonosze Block underwent intensive uplift in the Pliocene, while in the Middle Pliocene the Działoszyn Horst continued to be uplifted. Fluvial sediments in the southern part of this horst became uplifted by at least 8 m, whereas terrace alluvium originated in the Weichselian glacial stage were faulted.

Based on the above analysis one can conclude that the Ohře Graben cuts the Lusatian-Izera-Karkonosze Block and dies out in the North-Sudetic Synclinorium. The width of the graben amounts to 30 km and its length measured from the SSW termination up to Węgliniec is ca. 220 km.

ABSOLUTE AND TIDAL OBSERVATIONS AT KSIĄŻ GEODYNAMICAL OBSERVATORY

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ABSTRACT

Absolute gravity measurements is another techniques applied in geodynamical studies at Geodynamical Observatory in Książ. In the frame gravimetric laboratory tidal station and point for absolute gravimeter was prepared. Tidal observations, with LCR spring gravimeter, has started since 2008; apart from that absolute gravity measurements with different FG-5's was done. Gravimetric observatory offers very stable microseismic conditions and low local gravitational effect arises from local ground water or soil moisture changes.

Paper presents results from all absolute g measurements and some aspects of utilization absolute measurements in tidal observations. Analysis of gravity changes show very stable gravity, connected mainly with global effects changing of gravity as a results global hydrology changes. Authors presents potential sources of gravity changes in context of geodynamical effects. Analysis of tidal observation gives a possibility to make local tidal model and compare it with combinations different global models of direct and indirect effects. An application of local tidal model to absolute gravity processing is also presented.

WHAT AND HOW INFLUENCE THE GRACE AMPLITUDE?

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ABSTRACT

Gravity is one of the most interesting problem for scientist nowadays. A way of obtaining such data is GRACE mission, which is an accurate and quick solution. During postprocessing many problems occur. Authors idea was to analyse three of them: to which degree expand spherical harmonics to save high amplitude and eliminate biases as much as possible, which filter should be used for optimal filtering and what is the best radius of filtering. Amplitude is calculated on a basis of comparing filtered model to a raw model using different combinations. Result of analysis is shown on many plots.

MONITORING OF THE ROCK MASS SURFACE DEFORMATIONS IN THE RANA GRUBER MINE (NORWAY)

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Keywords: deformation, monitoring, FEM, Sub-level caving, mining

ABSTRACT

The sub-level caving (SLC) mining system used for exploitation of steep orebodies requires the rock mass to cave into the excavated space in a controlled way. In the paper characteristics of rock mass and iron ore deposit, as well as plans of mining operation, with the SLC system, at the Rana Gruber mine in Norway are described. With the aim of assessing quantitatively and qualitatively the magnitude and extent of the deformations and monitoring behavior of the rock mass, numerical calculations have been realized with the use of finite element method (FEM) and surface geodetic network and extensometer sensors underground have been established. In the paper characteristics of the geodetic network and results of preliminary results of numerical modeling with FEM have been given.

THE SPATIAL GEOLOGICAL AND MINING MODEL OF THE FORMER WALBRZYCH COAL BASIN. DEVELOPMENT AND APPLICATIONS

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Keywords: 3D geological modeling, geoinformation system, abandoned underground coal mines

ABSTRACT

In the paper spatial geological and mining model of the part of the former Walbrzych Coal Basin is presented. The methodology of developing spatial model of geology with division into local geological formations and tectonic faults has been characterized. The geological part of the model has been constructed basing on selected geological profiles and digital terrain model using the potential function. The mining part of the model has been taken from the geoinformation system of the former mines developed by (Blachowski, 2008) basing on old mining maps showing underground workings in the past 200 years.

Applications of the combined model have been demonstrated on the examples of numerical analyses of old mining activities on the ground surface and examples of analyses of former mining operations in the spatial and temporal domain used to aid studies of mining and post-mining ground deformations in the Walbrzych area.

ON THE RELIABILITY OF HORIZONTAL VELOCITY FIELD DERIVED FROM ASG-EUPOS SATELLITE DATA

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ABSTRACT

Presently the determination of the velocity field in the global reference frame is possible by using different space techniques and dense terrestrial networks from global to local and regional scales. But the reliability of such determinations is strongly limited by the by the restricted number of unmodelled effects. Some of them are periodic (atmospheric or hydrological effects), some instantaneous (natural or man-made seismicity) or seasons-related (snow coverage, freezing). This presentation deals with the unmodelled effects observed in the ASG-EUPOS (Polish Active Geodetic Network) time series. The network consists of over 130 permanent GNSS sites with the different level of stability. The presentation deals with the analysis on 3-year times-series of geocentric coordinates in order to obtain best-possible local velocity field.

EXPLORATION OF DIFFERENT DATA SOURCES TO DETERMINE THE KLODNE LANDSLIDE ACTIVITY

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ABSTRACT

On June 1st 2010 after heavy and long-lasting rainfalls the Klodne landslide was triggered affecting the area that was considered as stable. Most of the landslide movement occurred within few days and destroyed 17 houses and two farm buildings. After this catastrophic event two important questions have been raised:

1. Whether any evidence of potential landslide hazard could be found on remote sensing data acquired prior to the landslide?
2. Whether the affected area remains unstable? What is the recent rate of deformation?

With the aim to approach these questions, archival, pre-event data including ERS-1/2 Synthettic Aperture Radar, aerial stereophotograps and topographic and geological maps were collected and analyzed. The post-event dataset was build with newly acquired airborne and terrestrial laser scanning data and TerraSAR-X SAR acquisitions.

In order to estimate the volume of landslide colluvium and calculate the displacement rate of the main landslide event the authors compare the airborne data acquired prior to the landsliding (aerial sterophotograps and photogrammetric DEM) with newly acquired data (aerial photographs and LiDAR DEM) of July 2010. The pre-event area stability have been evaluated based on ERS-1/2 SAR data processed with the Persistent Scatteters Interferometry (PSI) technique.

High Resolution satellite SAR (Synthetic Aperture Radar) data were acquired by TerraSAR-X/TanDEM-X constellation in 2010 and 2011. All scenes were used for interferometric analysis (differential interferometry) to measure the small scale displacements that occurred in different parts of the landslide. The further monitoring of Klodne landslide activity is continued in 2011 using new SAR data acquisitions and repeated terrestrial laser scanning campaigns.

According to the airborne data analysis of Klodne landslide the horizontal displacements in upper part of the landslide between June and July 2010 reached 85 m. During the same period the vertical displacements varies from -20m to +8m in various parts of the landslide. In autumn 2010 the displacement velocities measured

with SAR interferometry show -0.76 mm/day to +0.57 mm/day. The observations are to be continued in the spring 2011 right after snowmelt season to get a better insight into the landslide dynamics.

The research presented in this work was funded by Polish Ministry of Science and Higher Education from founds on science in 2009–2012 as a research project number N N526 146037. ERS-1 and ERS-2 SAR data used in this work are the courtesy of ESA project C1P.3915. TerraSAR-X data are the courtesy of DLR project GEO0772.

PROJECT INVESTIGATION OF EUROPE TRAVERSED BY 15°E PARALLEL

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ABSTRACT

This project is a continuation of interdisciplinary geodynamic studies realized within the framework of an international project COST 625 „3D Monitoring of Active Tectonic Structures" (2001–2006), during which epoch GPS measurements were conducted in two geodynamic test areas located in the Apennines as well as in the Sudetes and Fore-Sudetic Block. Interpretation of the obtained results suggests that such measurements should be continued. It also deems reasonable to extend these studies to the area of the Hornsund Bay, Svalbard, where in 2009 three feeler gauges were planted on tectonic faults together with a Czech partner.

The aim of our research is to collect quantitative data pertaining to recent activity of fault zones in the mentioned areas basing on GPS epoch observations and relative measurements of the activity of crustal structures with the use of extensometers. The results will provide a basis for further analysis of registered changes related to, i.a., seismic activity.

MODERN ACTIVITY OF THE BARDO-JANOWIEC LANDSLIDE BASED ON MEASUREMENTS OF TERRESTRIAL LASER SCANNER

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ABSTRACT

To determine the deformation of the surface objects, not monolithic, it requires a dense network of establishment controlled points, which increases investment costs and do not fully reflect the changes occurring in nature. This is due to the nature of the measurement point by the geodetic methods which are not always in optimal distribution on object.

The article will be described a method using terrestrial laser scanning as a tool to study deformation of slopes. Results obtained from terrestrial laser scanning can greatly assist in the process of determination and deformation analysis of slopes.
Test measurements were made by terrestrial laser scanner from Leica HDS Scan-Station II. The study was conducted on test landslide Bardo-Janowiec located in Lower Silesia. Based on research, author will attempt to identify modern landslide activity.

MEASURING AND CONTROL SYSTEM BASED ON MEMS TECHNOLOGY IN STUDIES OF MASS MOVEMENTS

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ABSTRACT

The paper presents the concept of using MEMS technology (called Micro-Electro-Mechanical Systems), to determine the initial masses movements.

Accelerometers used to detect two types of acceleration: dynamic and static. In a study of masses movements the attention focuses mainly on the static acceleration, accelerometers which was used was the branches of "low-g", which have high resolution for small accelerations of the order 1 to 2 g. The use of such systems will take advantage of Earth's gravity, and precisely the components in each axis, the designation of displacement and indirectly can show the initial mass movements.

In the first part of this work describes a laboratory test procedure designed sensors. The purpose of testing was to determine the parameters of the measurement sensors: repeatability, resolution and accuracy in use. Then in the paper is presented the concept of integrated motion measurement system and the results of laboratory tests on a test frame elements, which will simulate the movements of masses of earth.

THE USE OF OPTOELECTRONIC TECHNIQUES IN STUDIES OF RELATIVE DISPLACEMENTS OF ROCK MASS

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Keywords: optoelectronic techniques, studies of relative displacements

ABSTRACT

This paper describes a prototype of his own design used to measure the relative inclinations of engineering objects and inanimate nature phenomena. Constructed a set of measurement can be used in the determine of ground surface deformation caused by mining activities or due to influences of hydro-geological, geotechnical or construction. The instrument was built with elements of optoelectronic technique. Fiber optic, CCD camera and semiconductor laser are the basic building blocks of the device. Elaborated device runs on CRPD System . The deflection of freely suspended fiber are recorded by a CCD camera and next are transmitted to an external recorder (eg, notebook). Natural light or laser light was introduced into the fiber. The length of the fiber and the optical construction affects on measuring range of device. The accuracy of instruments depends on: method the suspension fiber, method of fiber attenuation fluctuations, resolution CCD camera and identification method of the image laser spot recorded. The experiments have shown for the built prototype device able to obtain a submillimetre accuracy.

ANALYSIS OF TIME-DEPENDENCE OF SURFACE SUBSIDENCE CAUSED BY UNDERGROUND MINING NEAR KARVINÁ

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ABSTRACT

Using GNSS method, fixed points of an observation network were repeatedly surveyed on the surface of the undermined area. Below the surface, at the depth of c. 1 km, there were four mining panels exploited subsequently. The initial reaction of the surface points to the changes in the rock massif and the movement of the points were different, according to their surface position, local geo-mechanical conditions etc. This paper analyses the time-dependence of the surface points mining subsidence on the progress of the exploitation.

TIME AND FREQUENCY ANALYSIS OF DAILY TIME SERIES AFTER THE RE-PROCESSING

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ABSTRACT

The re-processing was done between 2009 and 2011 at MUT. In our presentation we want to show the results of daily time series in the context of linear and oscillation movement on the EPN stations.

The results are the outcome of the ended re-processing. For the time and frequency analysis we used the wavelet tool.

BRITTLE TECTONICS IN THE SOUTHERN CONTACT ZONE OF THE KARKONOSZE MASSIF IN THE VICINITY OF KARPACZ (SW POLAND)

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ABSTRACT

Brittle mesofaults and shears within the southern contact zone of the Karkonosze granitoid massif in the vicinity of Karpacz were studied. They are of different generations and ranges, and present multi-stages evolution. Mainly are of strike-slip nature, both dextral as well as sinistral. Dip-slip faults are much less common structures. Fault surfaces dip usually very steeply with angles between 70 and 90°. Whereas subhorizontal mesofaults constitute only less than 5% of the observed fault population.

Predominant mesofaults oriented NE–SW (50–60°) within the Karkonosze intrusion and NNE–SSW (10–30°) within the Izera–Kowary unit, with steeply dipping towards the NW, WNW fault surfaces. Probably at first they acted as normal faults, and then were transformed into strike-slip faults of dextral sense of displacements, with tectonic striation plunging gently towards the SW. The most commonly observed joints, as well as lineaments (recorded on the basis of DEM and satellite images), are of the same orientation (see Gaidzik & Żaba, 2009 & 2011). Generally, they are diagonal – and locally almost perpendicular – according to the intersection line of the contact, from Karpacz to Kowary, between the Karkonosze intrusion and its southern metamorphic cover.

Subordinate, very steep sublatitudinal, sinistral strike-slip faults inclined mainly towards the SSW, were observed. They seems to form conjugate sets with the main faults, developed under the subhorizontal maximum principal stress axis σ_1 oriented NE–SW, ENE–WSW. They are especially common within the granitoids of the Karkonosze intrusion. Lineaments of this orientation (WNW–ESE) are very noticeable since they are parallel to the main Karkonosze Mountains ridges. According to Cloos (1925) classification of joints within plutons, these two sets might be recognized, in order, as Q (transverse) and S (parallel) according to the orientation of feldspar megacrysts.

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INTEGRATED METHOD OF CALCULATION POSITION AND VELOCITY OF THE SATELLITES GLONASS AND GPS ON THE BASE OF THE GENERALIZED THEORY OF TWO FIXED CENTERS

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ABSTRACT

In this paper we present the mathematical model and algorithms for calculating position and velocity of GNSS satellites, using broadcast ephemeris of GLONASS and GPS satellites. Presented algorithms are based on the problem of two fixed centers. One of the advantages of the analytical solution obtained of the basis of generalized problem of two fixed centers is the fact that it embraces perturbations of all orders, from the second and in part from the third zonal harmonics. Processing of GLONASS observations differs in several aspects from that GPS. GLONASS broadcast ephemeris – provided every 30 minutes – contains satellite positions, and velocities in coordinate system PZ-90.02 (ICD, 2008), and acceleration due to luni-solar attraction. GLONASS ICD (2008) recommends that a fourth order Runge-Kutta integration be used. The fundamental information in the GPS broadcast ephemeris is given in terms of the Kepler elements. In Department of Geomatics (AGH UST) has been elaborated the program for the fitting position and velocity GLONASS and GPS satellites, using broadcast ephemeris. Intermediate GLONASS satellite orbits, derived with the allowance for the second and third zonal harmonics in the gravitational potential of the Earth, are considered. Comparative results of the numerical and analytical integration of the equation of the motion GLONASS satellite are presented.

INTEGRATION DATA SYSTEM TO INTERPRETATION OF THE GEODYNAMIC RESEARCH RESULTS IN A LOCAL AND REGIONAL NETWORK

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ABSTRACT

In the paper main objectives of a prototype system for interpretation of geodynamic research results carried out in the Middle Odra Faults Zone have been presented. The developed and planned modules of information exchange between data acquisition systems and modelling and interpretation systems have been discussed. The scope of the integrated data includes the results of geodetic measurements (GPS, precise leveling), geological and the data processed by outside expert systems. These data are collected and presented in the ArcGIS system. External programs that deliver the processed data are: Bernese (development of GPS observations), Stuttgart Neural Network Simulator (interpretation using artificial neural networks) and ABAQUS (physical interpretation). Exchange of data between programs and calculation control are performed by an application created in Visual Studio.

PRINCIPAL STRESS AXES ORIENTATIONS IN THE NE PART OF THE BOHEMIAN MASSIF DURING CAINOZOIC – PRESENT KNOWLEDGE, DIFFICULTIES AND LIMITS

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ABSTRACT

A set of 72 results of paleostress analyses based on fault-striae data, which were carried out by several authors in the NE part of the Bohemian Massif, was investigated. The examples demonstrating some difficulties and limits of the paleostress analysis in the studied region, especially if the study is focused on the Cainozoic tectonics, are presented.

The serious problem is determination of age of computed stress fields. In the NE part of the Bohemian Massif, the sites, where fault-striae data are collected, are usually situated in the Palaeozoic rocks. Thus, in the most cases (68 results), the faults used for principal stress axes computation propagate only in the Palaeozoic rocks. Some of them (17 results) are surely Variscan, because the fault geometry is affected by the Variscan folding. In the case of other results, very wide range of possible ages has to be taken into account. Even there are 11 results based on faults, which are clearly post-tectonic in respect of Late Variscan folding or in respect of emplacement of Late Variscan plutons, their age theoretically can vary from end of Variscan age up to recent.

Only in the case of four results (from 72 investigated results), the Cainozoic age of computed stress field is proved by superposition of age of faulted rocks and their brittle deformation. However, the Cainozoic age of great part of other computed stress fields could be supposed on the basis of comparison with other results of stress analyses carried out in the Bohemian Massif. But it is necessary to be very carefully, considering the wide age range, which should be taken into account. In the NE part of the Bohemian Massif, the NW–SE compression occurred not less than four times from the Carboniferous to recent. Similarly, the NE–SW compression occurred not less than three times during this period in the studied region.

Other difficulties can be connected with spatial variability of principal stress axes orientation. Some results represent the local stress configuration, which can significantly differ from regional stress orientation. Several results connected with the Variscan folding show the illustrative example of such local stress fields. In the case of Cainozoic stresses, similar local spatial variability (for instance connected with gravity forces) cannot be excluded.

POTENTIAL OF MONITORING SEISMIC PHENOMENA BY ANALYSIS OF HIGH-RATE GPS RECORDINGS

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ABSTRACT

The GPS technology applied for geokinematic and geodynamic research is aimed usually to monitor long-term site displacements accompanied with periodic variations, predominantly of seasonal nature. For such applications the GPS observations are sampled in 30 s or longer intervals and the site coordinates are evaluated on daily or weekly basis. The high-rate recordings, e.g. with 1 s sampling (or even with sampling rate up to 100 Hz) which are feasible for majority of recent GPS receivers, are used predominantly in navigation or surveying applications. We will demonstrate the potential of GPS kinematic mode for monitoring the site movements related to the seismic phenomena. Firstly, the methodology of reducing the short-term noise from 1Hz position estimates focusing on the multipath effect will be discussed. The method of sidereal filtering supplemented with Kalman filtering and resulting to estimation approach for identification of sudden changes is introduced. Next, the filtering method will be applied for analysis of high-rate recordings of several earthquakes, with magnitudes from M 9.0 to M 4.3. The method of Precise Point Positioning is exhibiting as the most suitable for monitoring the large earthquakes, however the possibilities of relative GPS positioning for medium seismic events will be demonstrated too. We will point at problems related to correct identification of sudden, short-term site displacements and their possible geokinematical interpretation.

MORPHOTECTONICS OF THE ŚNIEŻNIK MASSIF WESTERN EDGE

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ABSTRACT

The Upper Nysa Kłodzka Graben is separated from the Śnieżnik Massif by the East Marginal Nysa Graben Fault. This fault consists of two branches: the northern one, called Wilkanów Fault, and the southern one - Bušin Fault. The E-W trending Branna-Potoczek and Heřmanice faults displace the margin of the Śnieżnik Massif by ca. 1600 m, separating it into the above mentioned segments.

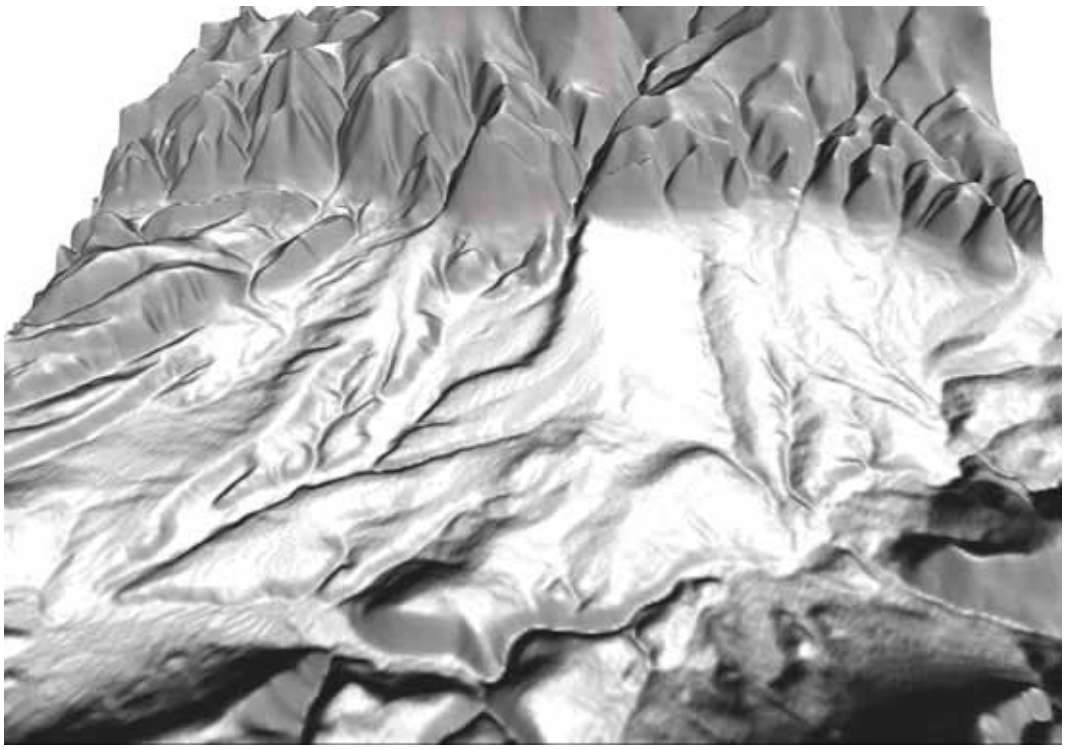

Fig. 1. Triangular facets in the middle part of the Wilkanów Fault

Tectonic activity of this zone is testified to by the presence of trapezoidal and triangular facets (Fig. 1). In the medial portion of the fault scarp, three to five generations of such facets can be distinguished. Such a number of facet tiers is comparable with that of the Sudetic Marginal Fault. The heights of individual facets are between 120 and 550 m.

The Wilkanów Fault is bordered to the north by the Krosnowice Fault and to the south by the Branna-Potoczek Fault. The length of the mountain front measured along the base of the massif attains 21.2 km, while the straight-line length is 19.1 km. The *mountain front sinuosity index* (Smf) is calculated as a ratio of Lmf to Ls, where Lmf is the length of the mountain front measured along the foot of the mountain at the pronounced break of slope, and Ls is the straight-line length of the mountain front. Hence, the Smf ratio calculated for the Wilkanów Fault amounts to 1.1. Figures comprised between 1.0 and 1.4 are considered to indicate weak tectonic activity. The morphotectonic escarpment of the Śnieżnik Massif coinciding with the Wilkanów Fault zone is subdivided into 6 segments that are mutually displaced one versus another by 100 to 400 m.

ABSOLUTE AND RELATIVE GRAVIMETRIC OBSERVATIONS ON BOLESŁAWÓW STATION (SUDETY MTS., SW POLAND) – PRELIMINARY RESULTS

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ABSTRACT

Geodetic researches of a crust activity of the Śnieżnik Massif, Krowiarki and northern part of the Upper Nysa Kłodzka graben (Sudety Mts., SW Poland) started in 1992 as a Śnieżnik network. The project consisted of two nets in Polish and Czech part of the massif. Krowiarki and northern part of the UNKG (Waliszów network) area were added in 2008. All points were fixed into the rock by concrete observation pillars.

Since 1992 several gravimetric measurement cycles have taken place on the terrain of the Śnieżnik polygon. From 1992 to 2011 all measurements have been carried out using a relative static gravimeters: LaCoste & Romberg and Scintrex Autograv CG-3M. Determination of the gravity values on the observed points was carried out using the profiles method together with the repeating on selected stations. All gravimeters were calibrated on spans between national base stations network (POGK). All gravimetric traverses in the Śnieżnik network were connected with Bolesławów relative station with constant g value. Thus every seasonal/yearly gravity changes at reference Bolesławów stations were disregarded. In the paper a brief summary of gravimetric works showing an interesting tendencies on selected stations will be presented.

In 2011 the absolute Bolesławów station was founded and measured using FG-5 ballistic gravimeter No 230. Established of absolute gravity station gives a possibility of monitoring g changes and allow to define reference g value at epochal measurements with single microGals precision.

During absolute g measurement in June 2011 thirty-hours session has been done. Additionally a gravity gradient and span with previous reference stations were measured. All elements permit to change old reference station to the newer with possibility of define the absolute g. The Bolesławów ABS station can be include to calibration spans with existing Kłodzko station.

Results of first absolute measurements show very good conditions for ballistic measurements. Stabilisation of the ABS station gives a possibility to obtain gravity with 2 microGals precision. Detailed summary of absolute g measurements will be presented.

Sources of potential gravity changes for Bolesławów point will be also presented in the paper. Changes are connected with local and global environmental effect and other geodynamical phenomena.

GEOLOGY, TECTONICS, MORPHOSTRUCTURES AND INDICATORS OF THE RELIEF EVOLUTION IN THE WEST BOHEMIA SEISMOACTIVE AREA, SAXOTHURINGIAN, CZECH REPUBLIC

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ABSTRACT

The western part of Bohemian Massif is known for recurring earthquake swarms. Our study focused on geology and geomorphology of crystalline units in the region around the Nový Kostel epicentral zone. The investigated area is located close to the village Nový Kostel 16 km to the NE from Cheb (Eger). The area represents border between the Cheb Basin and Krušné Hory Mts. (Erzgebirge). The Cenozoic Cheb Basin is on the east margin faulted by the Mariánské Lázně Fault Zone (MLFZ). The upland (Krušné Hory Mts.) east of the MLFZ is formed by metamorphic rocks of Saxothuringian.

The metamorphic grade increases southwards from phyllites in the north through mica schists and gneiss in the middle to gneiss and deformed granite in the south. Foliation in metamorphosed rocks mostly strikes E–W. The foliation creates a large antiform with gently dipping northern limb and steep southern limb, axis of the antiform is subhorizontal, dipping to the west. Orientations of stretching lineation and crenulation lineation are preferentially striking E–W.

Three groups of faults orientation were observed: (1) group striking almost N–S with steep dip, some filled by clay-rich gouge; (2) group with strike range between NW–SE to NNW–SSE dipping steeply towards NE; (3) the less common group striking NE–SW (azimuth 40°) with variable dips to NW. Main joint set has variable strike between NNW–SSE to NNE–SSW, secondary joint set is striking WNW–ESE, dipping SSW.

Important results were obtained by measuring of small folds axes. The orientations of the axes are forming girdle from the SW to NE dipping 30° to NW. The strike of the axes is variable from outcrop to outcrop, documenting that there is younger overprint by ductile deformation, probably represented by developing sheath folds with large wavelength.

The morphostructural research was mainly focused on mapping of the valley relief forms and drainage patterns. The recent manifestations of the relief evolution can be seen on: slope and soil deformations (landslides, downslope bending with frost wedges, solifluction or soil piping). The morphostructural analysis was employed with the aim to find structural factors controlling the relief. This analysis enables a correlation of the directions of the structural dislocations (faults, joints) with the linear relief elements – morpholineaments (direct lines/sections of the valleys, slopes

or ridges etc.). In our case, faults and joints were correlated with straight valley sections.

Direct evidence of structures and landforms provided new results. The tectonic analysis confirmed existence of faults striking NNW–SSE, parallel with the Mariánské Lázně Fault Zone and the existence of the N–S striking faults parallel with clustering of earthquake epicentres and the Počátky–Plesná zone. However the expected NE–SW striking faults (Krušné Hory fault system) parallel with Ohře/Eger Rift Zone were found only seldom. Comparison with the valley sections orientation is confusing: the NE–SW (60°) orientation is the most present, however this orientation is represented by only few joints and faults; the second distinct orientation well fits within the NNW–SSE striking faults. The valley relief was found strongly influenced by geology and by the position on the border between morphologically different units. However the orientation of valleys cannot be directly linked to the dislocations (faults, joints).

POSSIBLE FAULT ACTIVITY REGISTERED BY LONG WATER-TUBE TILTMETER AT THE SRC GEODYNAMIC LABORATORY IN KSIĄŻ (CENTRAL SUDETES, SW POLAND)

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ABSTRACT

A water-tube tiltmeter system composed of two perpendicular tubes was installed in the underground galleries of the Geodynamic Laboratory in the Książ Castle, Central Sudetes, in 2003. Tiltmeter has recorded several events of water level variations, with a magnitude of a few hundreds of micrometers and a duration of a few tens of days. The strongest water level variations were one order greater than variations caused by tidal phenomena and occurred in different months of a year hence are expected to have no seasonal origin. Because of extremely large magnitude of phenomenon, no seasonal characteristics of signals as well as time of duration, all the external sources, outside the bedrock space occupied by the instrument, can also readily be precluded. Each of the recorded strong signals of water level variations consists of a symmetrical and an asymmetrical component. Because of proportion between dimensions of water system and dimensions of large scale geodynamic sources, producing water level changes, all the external geodynamic sources can generate in the tubes only symmetrical signals. The evidence indicates episodic tilting of the instrument itself or vertical displacements of any parts of the tubes, which supports the notion of active bedrock deformation. The combination of symmetrical and asymmetrical signals implies that their source is within the bedrock space in which the instrument is embedded.

The Książ Massif is located in the central part of a structural geological unit known as the Świebodzice Depression/Basin, which belongs to the regional mosaic of evolving Sudetic Palaeozoic sedimentary basins. The structural unit, as seen today, is a fault-bounded, tectonically cut-out fragment of an originally larger Famennian–Tournaisian sedimentary basin. The rhomboidal Świebodzice unit is separated by the Marginal Sudetic Fault from the Fore-Sudetic Block to the northeast, by the Szczawienko Fault from the Sowie Góry Gneissic Block to the south, and by the Struga Fault from the Intrasudetic Basin to the southwest. The unit's northeastern boundary with the metamorphic rock complex of the Kaczawa Mountains is less well defined, marked by a system of minor faults. The Książ Massif is cut by numerous faults and several of them intersect the Książ Geodynamic Laboratory underground tunnels and run obliquely to the orientation of the tiltmeter tubes. The angle between the faults and tubes 03−04 and 01−02 is about 75º and 25º, respectively. At least three of the active extensional faults, striking NE−SW, show clayey gouge and a young, possibly Recent, mineralization. Moreover, they are accompanied by a number of

complementary structures, such as the Riedel fractures or slickensides and silicolithes, which are good kinematic indicators. The Książ Massif forms a structural-morphological spur, curved out in the rocks by a large bend of the Pełcznica River that flows here in a 100 m deep canyon. The spur extends towards the WSW between two main mapped faults, with its longitudinal foot-slopes and flanking river segments almost perfectly matching the fault lines. The spectacular bend and deep incision of the Pełcznica River and the resulting bedrock spur of the Książ Massif are apparently related to the faults and may indicate their recent activity. Therefore, it is likely that the strong signal of water level variations recorded by the WT tiltmeter embedded in the Książ Massif derives from the geodynamics of local bedrock structure and reflects active regional tectonics.

EXTENT AND DELIMITATION OF THE MINING INDUCED SUBSIDENCE IN THE LOCALITY NEAR KARVINÁ, CZECH REPUBLIC

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ABSTRACT

Coal mining is carried out in the Czech part of the Upper Silesian Coal Basin between Ostrava and Karviná on the area of 80 square kilometres. Mining causes changes in landscape, especially the ground subsidence. The subsidence is located on the surface above the mined coalface reaching its maximum within the first year after start of exploitation. Generally the subsidence was measured by levelling in this area. Good results were also achieved by the DInSAR processing (IRSM ASCR) and the measurement of stabilized points by GPS (IG ASCR). The comparison of both methods (GPS vs. DInSAR) helped us to improve values of subsidence and the delimitation of the area affected by subsidence in the locality near Karviná.

The geomorphological analysis has been carried out since the summer 2011 in the active mining area. One of the aims is to determinate and describe the subsiding areas belonging to particular exploited coalfaces and to describe how the boundaries of subsiding areas are manifested in the relief. The next presentation will consist of the results: (1) the geomorphological analysis; (2) DInSAR processing; and (3) GPS measurement from the Mining area Louky (located south from Karviná immediately near the borders with Poland). From the preliminary results it can be seen the important role of tectonics in the delimitation of the subsiding areas.

GABRIELA LOCALITY: STARTING GEODETIC OBSERVATIONS TO DETECT THE FIRST SURFACE MANIFESTATIONS OF UNDERMINING

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Keywords: hard coal exploitation, undermining, GNSS

ABSTRACT

A new observation network has been built to observe the surface manifestations of undermining at Gabriela locality. This locality lies in the Czech part of the Upper Silesian Coal Basin and the history of the hard coal underground exploitation is more than 150 years long here. Recently, the last coal mining panel was started to be exploited here. Its location and mining parameters are very suitable for the analysis of the actual and future surface changes caused by undermining. The fixed points of the observation network are surveyed by geodetic GNSS method. This method enables the evaluation of both vertical subsidence and horizontal shifts. Such complex evaluation of processes on the surface of the undermined territory makes it possible to understand the progress of the subsidence depression and to capture the final phase of the surface undermining changes, i.e. the phase of the subsidence decline.

ATMOSPHERE MODEL ON THE AREA OF GBAS SYSTEM FOR REAL-TIME GNSS AND METEOROLOGICAL APPLICATIONS

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ABSTRACT

Global Navigation Satellite System (GNSS) has been designed for positioning, navigation, amongst other possible applications. A number of GNSS applications require precise positioning with centimetre accuracy in real time. Precise positioning in this mode is currently being implemented by two methods: differential RTK and autonomous PPP. These methods also allow determination of points coordinates changes (movements) and are therefore used in studies of crustal deformation, such as GNSS seismology or landslides monitoring. The positioning using RTK or PPP method can be supported by Ground Base Augmentation System (GBAS), which provide better results stability in the area of GBAS network. One of the elements supporting precise positioning, especially for height component is a model of the atmosphere, carried out for the GBAS network area.

Since 2008 in the territory of Poland a Ground Base Augmentation System GBAS) called ASG-EUPOS is working. This system gathers permanently the GNSS data from 130 stations and meteorological (temperature, pressure and relative humidity) data from 17 stations. The average distance between GNSS stations is 70 km. The GNSS and meteorological data from the ASG-EUPOS network are the basis for building a model of the atmosphere in near real-time. The spatial structure and temporal behavior of the atmosphere (mainly water vapour in the atmosphere) is modelled using the GNSS tomography method.

Principal purpose of this paper is the presentation of the methodology of the integrated investigations for near real time (NRT) atmosphere model construction based on the GNSS and meteorological observations from ASG-EUPOS stations. Second aim covers the discussion of procedure and results of GNSS data processing and Numerical Weather Prediction models (NWP) derived products. The last aim covers the results of atmosphere monitoring system based on the GNSS tomography method.

COMPARISON OF THE MODELS OF VERTICAL MOVEMENTS OF THE EARTH CRUST SURFACE ON THE AREA OF POLAND DERIVED FROM LEVELLING AND SATELLITE DATA

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ABSTRACT

Known models of recent vertical movements of the Earth crust surface of the area of Poland were processed on base of data of geometric state leveling network first and second classes, in the form of contour line map. Second map done by Wyrzykowski (1985) was based on results of measurements from years: 1871–1882, 1926–1937, 1952-1956 and 1975–1977. The newest results of assignment of recent vertical movements of the Earth surface for Polish territory were published by Kowalczyk in 2006 year. The map of speed of modern vertical movements has been processed using least squares collocation method on base of repeated measurements of state precise leveling, executed in years 1974–1982 and 1997–2003. Presently, after about 3 years of satellite observations on about one hundred of permanent stations belong to the ASG-EUPOS network, verification of mentioned models is possible on the base of independent (satellite) measurements. As resolution of stations for area of polish country is sufficient, model processed from satellite data was determined for whole area of Poland and it was confronted with earlier (leveling) models. There are some disagreements of the analyzed models. Comparison of leveling and satellite models indicates defect of reference distinctly resulting from sea level variability.

RESULTS OF GEODETIC MEASUREMENTS DURING THE JANUARY 2010 EFPALION EARTHQUAKES AT THE WESTERN TIP OF THE GULF OF CORINTH, CENTRAL GREECE

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ABSTRACT

On 18 January 2010, 15:56 UTC a Mw=5.1 (NOA) earthquake occurred near the town of Efpalion (western Gulf of Corinth, Greece), about 10 km to the east of Nafpaktos, along the north coast of the Gulf. The epicentre of this earthquake was near of GPS station EYPA. We processed the EYPA geodetic data from the Efpalio earthquake sequence to identify fault plane geometry and earthquake interactions at the western tip of the Corinth rift. Our results were compared with seismological model derived by Department of Geophysics of Faculty of Mathematics and Physics, Charles University in Prague.

THE DYNAMICS OF BENCHMARKS ELEVATION CHANGES OF STATE LEVELING NETWORK IN THE AREA OF THE WESTERN SUDETES (JELENIA GÓRA VALLEY AREA AND ITS SURROUNDINGS)

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ABSTRACT

To determine the vertical dislocation of the crust areas there is necessary to perform periodic measurements of leveling points located on the areas examined. Such measurements are very time consuming and expensive. Determine the vertical movement of the rock mass can be made based on periodic measurements of precise geometric leveling in I and II class lines of the state leveling network. Such solution is obviously not fully effective, because the location of the measurement points (benchmarks) of the state leveling networks has to be adapted to the terrain conditions (topography). The course of leveling lines mostly coincide with the course transportation routes (roads), and the individual benchmarks of assumptions are rarely locate in areas of significant vertical displacements. The results of this analysis are not so complete and final solution can only be used to identify areas where detailed studies should be necessary carried out. The study was conducted using archival data from the measurements in state leveling networks in the Western Sudetes region with special consideration to Jelenia Góra valley and its surroundings.

POST-MINING GROUND SURFACE DISPLACEMENT IN THE VICINITY OF TECTONIC FAULTS

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Keywords: post-mining ground deformation, FEM modelling, Walbrzych Coal Basin

ABSTRACT

In the article the results of post-mining activity of the ground surface in the region of tectonic faults on the area of the former Walbrzych Coal Basin have been presented. The work associated with modeling of heterogeneous rock mass has been characterized. It included calculations of test and real models. The numerical analyses have been based on the Finite Element Method using the Dassault Systèmes ABAQUS software. The orthotropic rock mass model has been assumed in the numerical calculations, which included spatial extent of the mining operation and reconstruction of underground water levels after the end of mining activity.

The results indicate significant influence of the Carboniferous groundwater level on the terrain surface in the post-mining period.

PRELIMINARY GEODYNAMIC ANALYSES OF THE WEIZENDORF FAULT AND ITS SURROUNDING ON THE BASE OF THE GEOPHYSICAL, GEOMORPHOLOGICAL AND GPS DATA

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ABSTRACT

In the contribution the results of GNSS measurements at the southern part of the Diendorf–Čebín tectonic zone (DCTZ) are presented. In surrounding of the area of interest – the Znojmo polygon has been built between Znojmo town and Valtrovice village, with network of GPS points.

Preliminary GPS positioning results within Weizendorf and Diendorf faults confirmed expected movement tendencies along this tectonic zone. The results achieved have been confronted with geomorphologic and geophysical data and suggest new possible variants for location and role of this exceptional tectonic element.

THE INFLUENCE OF CONTINENTAL WATER STORAGE ON GRAVITY RATES ESTIMATES: CASE STUDY USING ABSOLUTE GRAVITY MEASUREMENTS FROM LOWER SILESIA AREA

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ABSTRACT

There is no doubt that changes in continental water storage has non negligible impact on geodetic measurements. In case of gravity measurements the surface water mass loading changes causes two effects, namely direct "newtonian" attraction and the indirect effect due to deformation of the loaded surface. The effect of the continental hydrosphere mass transfer can be modelled using hydrology models or low satellite gravity data. Using the WGHM hydrology output we found the peak to peak amplitude of continental water storage can reach as much as 5–6 microgal (10E-8 m s-2) in south west Poland which is climate driven. This effect has the annual period predominantly and only small intra-annual variation are observed.

In this study we used the gravity measurements taken in previous project with FG5 gravimeter. The repeated measurements in Wrocław and Książ are under main investigation while the results for other sites in the Lower Silesia (Janowiec and Kłodzko) are also discussed. Moreover, we refer to Józefosław site (central Poland) as the long series of measurements (more than 50) allows for more reliable conclusion.

The FG5 no. 230 instrument, operated by Warsaw University of Technology, is the state of the art gravimeter with uncertainty of a few (2–3) microgal. During the processing the gravity changes due to tides, ocean tidal loading, pole tide and atmospheric effect are routinely removed. Currently the effect of hydrology loading is not removed from the measurements. The remainder is usually interpreted in terms of geophysics effect. The repeated measurements of absolute gravity measurements are valuable source when one seek for tectonic or mantle flow phenomena. While such study need a reasonably long period of measurements the present accuracy of gravimeters encourage to using only short period of a few years. Therefore, we investigated the importance of continental water storage on gravity rates estimates from short (few years) measurements period.

Our work give also the discussion of differences of hydrology loading modelling for sites beneath or on the Earth surface and importance of local hydrology effects which are insufficiently treated when global hydrology models are used.

SOLAR EXCITATIONS OF BICENTENNIAL CYCLES IN THE EARTH ROTATION

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ABSTRACT

The bicentennial variations of the Earth rotation consist of several oscillations with most known periods 178.7a (Jose cycle), 210a and 230a (de Vries cycle); they are driven by the solar cycles which affect climatic variations, followed by global environmental changes. These periods are close to the higher harmonics of millennial Hallstatt cycle (2300a), so the proper separation between the individual centennial cycles needs time series longer than 2300a. The centennial variations of the Universal Time (UT1) and Length of Day (LOD) are investigated using reconstructed time series of the Total Solar Irradiance (TSI) for the last 9300 years. A linear regression model of TSI influence on the UT1 and the Mean Sea Level (MSL) centennial variations are created. The parameters and time series of the centennial UT1 and LOD oscillations for the last 9.3Ka are determined.

GPS SITE MOVEMENTS, DISPLACEMENTS AND STRESS FIELDS IN THE EARTH'S CRUST CASE EXAMPLE: SEISMOACTIVE WEST BOHEMIA REGION

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Keywords: GPS, displacement, stress field, West Bohemia

ABSTRACT

Since Miocene the West Bohemia region has distinguished by magmatic intra-plate activity which has been manifested by volcanic activity accompanied by earthquake occurrences. To understand better the ongoing geodynamic processes in this area, particularly in the Cheb Basin and surrounding area of seismoactive Nový Kostel zone, the regional geodynamic WEST BOHEMIA network was built in 2007. The GPS campaigns started just the same year and were repeated annually always in equivalent year season, toward every the end of August. When in October 2008 intensive earthquake swarm occurred, immediately in November an additional campaign was realized. Having the GPS data that allowed us to define the network site position changes for the inter-campaign periods, we were able to determine surface crustal deformations related to pre-, co- and post-seismic phases of the 2008 swarm. If regional tectonics, recently observed stress field and the site displacements are taken into account and numerically modelled, the most probable crustal deformations and stress field changes in the individual seismic phases can be calculated. Fault movements with respect to stress field should pass a balancing to find an optimal solution for crustal displacement and shear and normal stress fields. Results will be delivered and discussed from a viewpoint of the West Bohemia geodynamics.

GPS AND PRECISE LEVELING MONITORING IN AREA OF NOVÝ KOSTEL IN WEST BOHEMIA

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ABSTRACT

This paper aggregates recent results of monitoring of seismic active area in the West Bohemia near the village Nový Kostel by means of geodetic methods. This kind of monitoring has more than 15 years history at the Institute of Geophysics AS CR. The original reason of this monitoring was to confirm suggested long term trends in horizontal and vertical position. Currently the monitoring is mostly performed as standard method of supervision of such a unique area not only for scientific purposes. GPS observation and precise leveling methods are used. Data from these measurements are used as another source of information in parallel to other geophysical methods such as seismology and monitoring of ground water level, gravimetry, CO2 and other gas emission etc. It should be mentioned that another geodetic measurements are taken by the Institute of Geophysics AS CR in this area but this paper is focused only on three of them. Precise leveling at three profiles, GPS observation in "micro network" and GPS permanent station NOKO.

The results of precise leveling will be discussed firstly. The measurement is performed at three profiles near Nový Kostel, Milhostov and Hartoušov village. Father the results from GPS campaign style observation in "micro network" (4–6 points situated around Nový Kostel) will be discussed and finally time series of coordinates of permanent station NOKO will be presented.

The leveling profiles were set up and populated with new point in the last 15 years. Profiles consist of the Czech Leveling Network (ČSNS) point and points that were stabilized by the Institute of Geophysics AS CR. All profiles are measured by precise leveling method in individual campaigns irregularly throughout the year. The results indicate instability of several individual point probably caused by problems with point realization. Any clear vertical shift that could be considered as a result of geotectonic process has not been realized until now.

Repeated GPS observation in „micro network"(4–6 points situated around Nový Kostel) is taken from 2003. This type of monitoring describes the studied area as quite stable. The relative differences in coordinates between campaign June 2003 and January 2011 are not bigger than 2mm in position and 10mm in height. On the other side we have quite interesting data from June 2003 to March 2004 period. In this period we can observe something like an extension of network which is completely corrected to previous scale in March 2004.

The antenna of permanent GPS station NOKO is placed on top of unused chimney of family house in Nový Kostel village. The house is in good condition with no signs of instability. Data from permanent station NOKO were processed with Trimble

Total Control software. The results show some seasonal variation but there are no proofs of clear connection to geotectonic activity. Only in January 2007 we recorded subsidence of station in scale of 10 mm which can indicate some reaction to quite important micro swarm seismic activity from the same time. (Mrlina and Seidl, 2008). But in general view it must be said this station looks quite stable. During the whole observation period since 2006 until now point has not changed its relative position by more than several millimeters. Time series of coordinates of permanent station NOKO will be presented.

In accordance with used geodetic techniques and their accuracy the whole area looks quite stable with exception of several events that can indicate some signal from geotectonic activity in the region. As example we can mention forward/reverse displacements in 1999–2000 found by GPS campaign style observation in the "main network" (about 25 points in Cheb basin and surrounding areas), extension of GPS "micro network" observed in 2003 and corrected in 2004, and subsidence of the NOKO station in January 2007. None of these events was indicated repeatedly by long term observation. As well, no differences bigger than 10mm in position and 15mm in height were observed in GPS "micro network" until now.

STUDY OF SUBSIDENCE ON FAULT'S ZONES ON MINING AREA

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ABSTRACT

This paper presents the method of numerical modeling of fault's zones on selected mining area. A study of subsidence for selected geological cross-sections located near Rudna mine have been calculated by using finite element method. This numerical method can simulate non-homogeneous, non-linear material behavior and complicated mine geometries. Faults zones were simulated in two variants: as a contact's line by changing the values of the friction coefficient or as a surface by changing Young's module of the material. The results of numerical modeling were verified by using the results of geodetic measurements.

GEODYNAMIC NETWORK SNĚŽNÍK – REPROCESSING AND ANALYSES OF SATELLITE DATA IN CZECH PART THROUGH PERIOD 1997–2011

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ABSTRACT

Latest studies of recent geodynamic movements going on fundamental geological structures of the Králický Sněžník are closely related to geodetic satellite measurements, especially to permanent and epoch GNSS satellite observations. For this reason the Institute of Geodesy, FCE–BUT established one regional Geodynamic Network Králický Sněžník for the GPS observations on 7 sites. As evident from names of the regional network, a special attention was devoted to a detection of mobility trends of the local blocks of Králický Sněžník Massif. The results confirm the larger horizontal and vertical movement trends within relatively small territory. All these and other detected contemporary geodynamic movements are presented and discussed. The research was supported by the EU project CZ 1.05/2.1.00/03.0097 within the regional centre "AdMaS", and with support of the project MSM 0021630519.

LOCAL QUASIGEOID MODELLING USING GRAVITY DATA INVERSION TECHNIQUE – ANALYSIS OF THE FIXED FACTORS OF DENSITY MODEL WEIGHTING MATRIX

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ABSTRACT

The paper presents analysis relating to the method of local modelling of quasigeoid, based on the solution of the linear inversion of gravity data problem. This approach has a possibility to use unreduced gravity data in the form of gravity disturbances or gravity anomalies and GNSS/leveling height anomalies. One of the main problems occurring in the application of the method is to determine the model weighting matrix, the purpose of which is to control the inversion process. This paper presents the analyses concerning the designation of certain constant coefficients appearing in the definition of the model weighting matrix.

RECENT GEODYNAMICS: SUPERPOSITION OF KINEMATICS IN FLUVIAL GEOMORPHOLOGICAL RECORD

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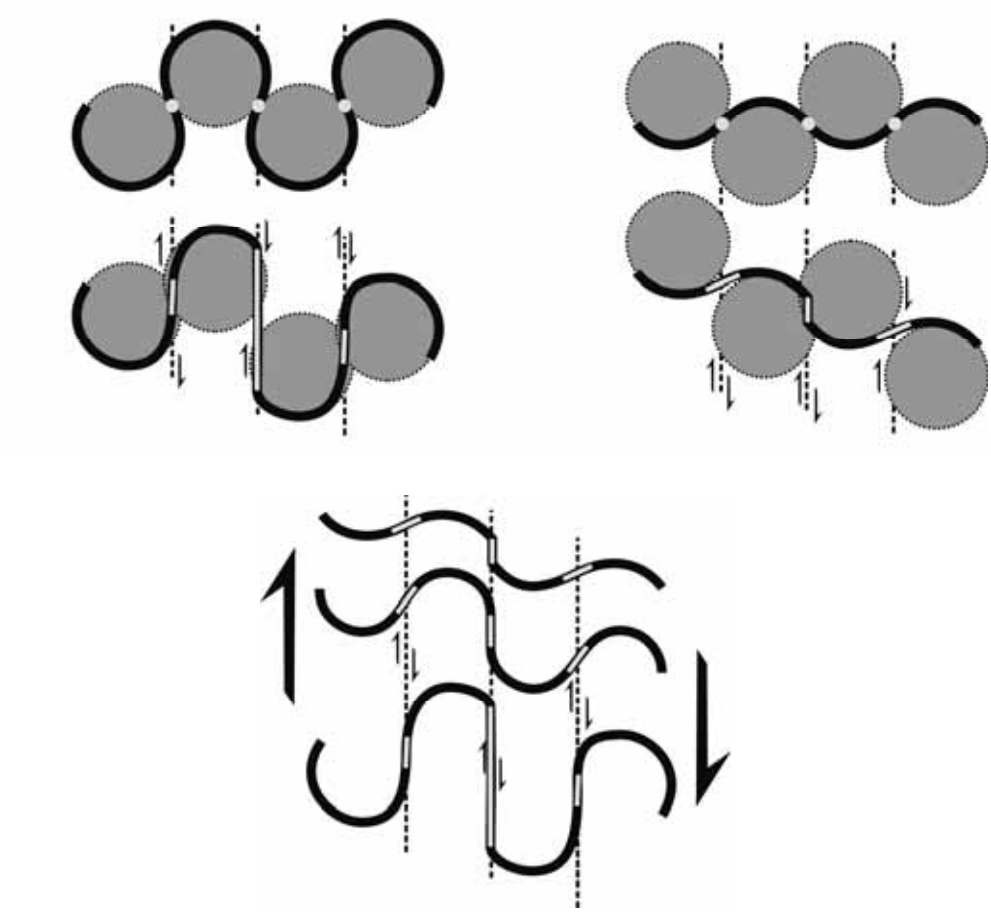
ABSTRACT

The effect of the **kinematic superposition** over the **morphogenic processes** is clear from a point of view of the physics and is just starting to be recognizable from the **geomorphologic features**. Proportions between the speeds (**velocities**) of recent processes deforming the near-surface part of lithosphere (**neotectonics**), fluvial erosional processes (e.g. of **channel forming erosion in solid rock**) and fluvial hydraulic processes (**flow of water in the channel of the river**), are approximately possible to determine as follow: [**0.0001–0.001**] / [**0.001–0.01**] / [**0.1–1**]. Above showed proportions remain on the level of the **at least 1 row** for the difference. Nevertheless, it is reaching the kinematic superposition of these processes. We can finally measure these effects by **geodetic**, **morphometric** and **hydrological** methods. Below is a scheme that shows **static** *versus* **dynamic** transformation of the river channel – i.e. **influence of the geodynamics on river channel shape at the flow of water in a know direction**…



PERMANENT GPS STATION IN KSIAZ GEODYNAMIC LABORATORY FOR SUPPORTING INVESTIGATION OF NEO-TECTONIC MOVEMENTS IN KSIAZ MASSIF

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ABSTRACT

In autumn 2010 a new permanent GPS station started observations in order to determine velocities and episodic rock movements on which the Ksiaz Geodynamic Laboratory was established. These studies are made for employment in common interpretation with registered large (one order of magnitude greater than tidal effects) non-periodic geodynamic signals, observed on water-tubes tiltmeters and horizontal pendulums. Studies conducted to date excluded instrumental and loading effects as a potential sources of that signal. Based on water-tube tiltmeter construction and its measure principles it appears that strong non-tidal signals have a geodynamic nature. To support investigation of this problem GPS data analysis are performed in different scales and using different processing methods in order to minimize the influence of fact that reference and determined stations cover several areas of Poland and Europe being affected by different geophysical processes, e.g. tectonic activity, post-glacial rebound, sedimentary compaction, anthropogenic effects.

NEOTECTONICS OF THE SOŁA RIVER BASIN, WESTERN CARPATHIANS, BASED ON SOME MORPHOMETRIC PARAMETERS

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ABSTRACT

In this paper, we test the applicability of some morphometric indices commonly used in tectonic-geomorphological studies to the area of the Outer Western Carpathians representing an Alpine fold-and-thrust belt. This belt was shaped largely in Miocene times and shows traces of Pliocene-Quaternary tectonic activity consisting mainly in some remnant folding and faulting. This is indicated by scarce examples of faulting within Quaternary strata, numerous cases of clast fracturing owing to palaeoearthquakes of relatively large magnitudes, as well as warping and tilting of Pleistocene and Holocene strath terraces. Analysis of selected morphometric indices (valley floor width-valley height ratio, riverbed gradients, stream length-gradient index, basin elongation ratios and others), conducted for the entire region and some chosen test areas in the westernmost part of the Outer Western Carpathians, namely the Soła River basin, proved their usefulness in detecting zones showing tendencies to young surface uplift. However, in the case of the stream length-gradient index (SL, Hack's index) a word of caution should be added, since the index is extremely sensitive to lithologic contrasts in the bedrock and its applicability to young tectonic analysis of fold-and-thrust belts appears to be strongly limited.

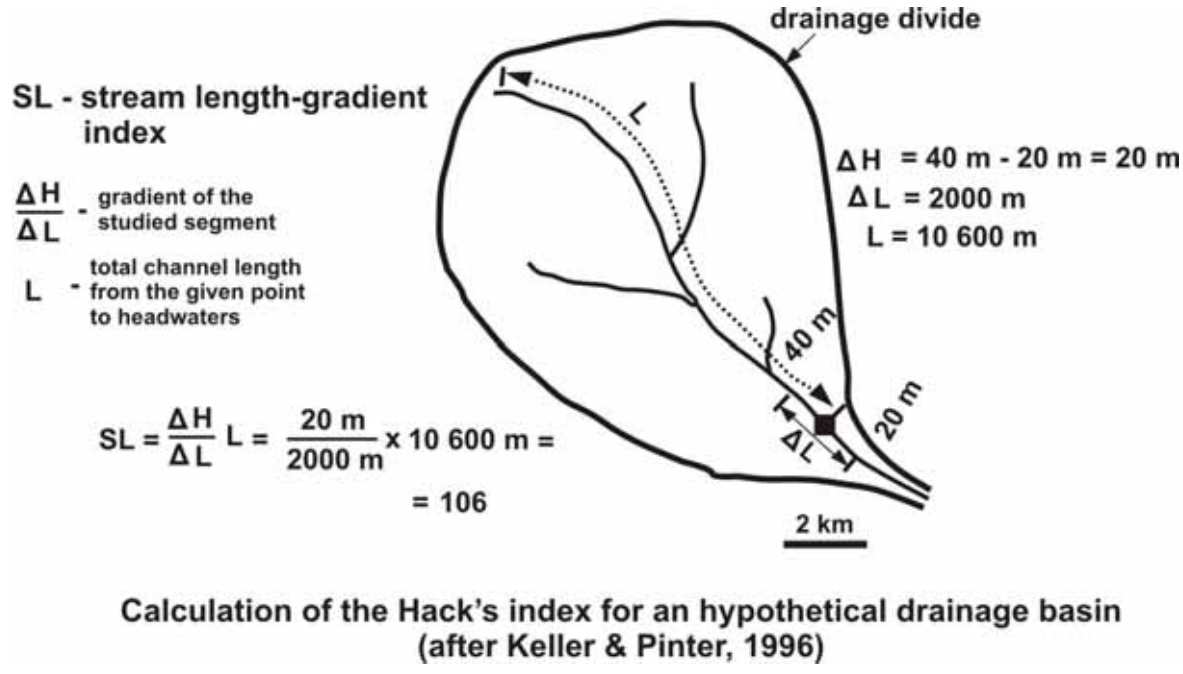

Fig. 1. Principle of calculating the stream length-gradient index

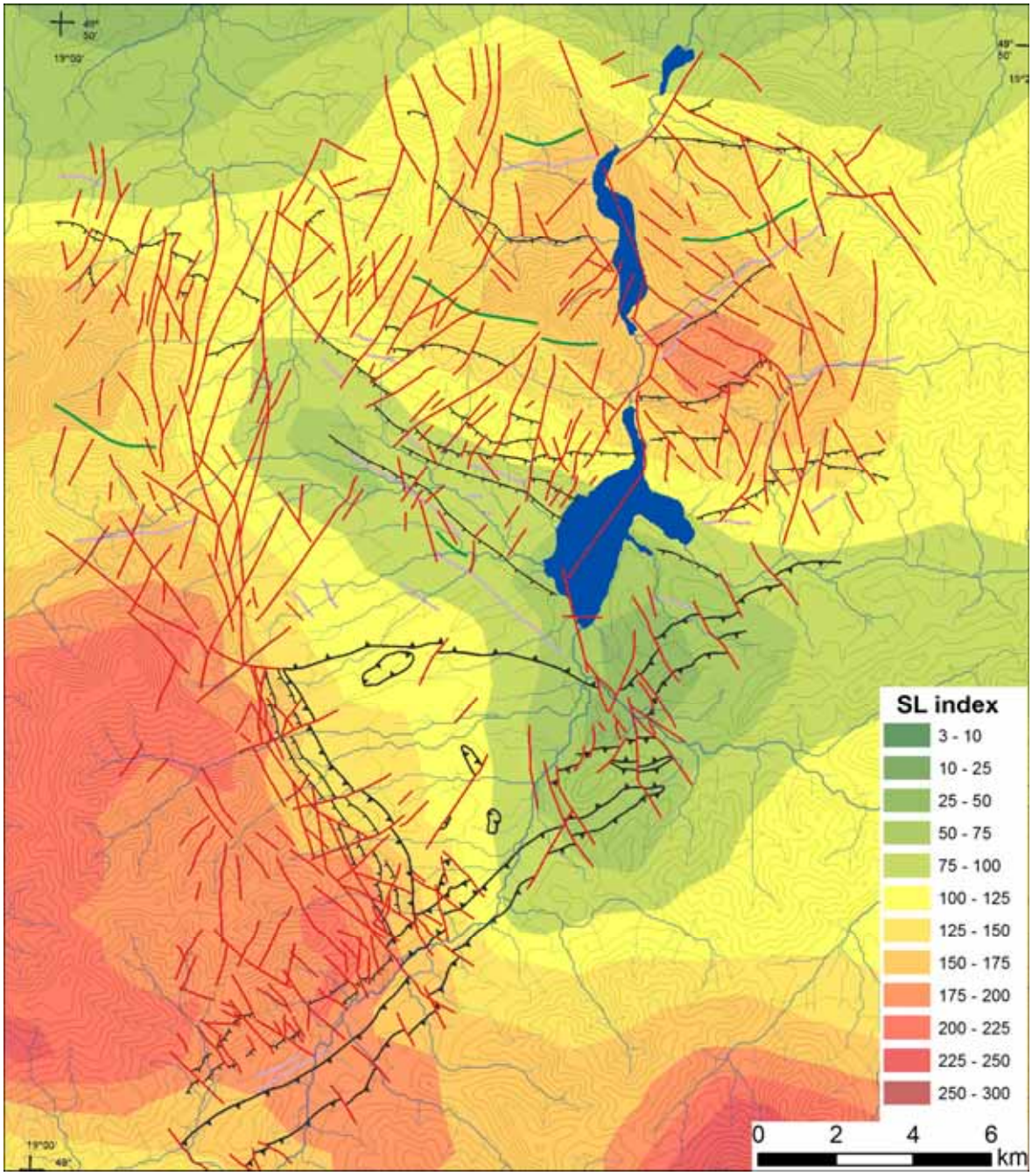

Fig. 2. Spatial distribution of SL index values over the Soła drainage basin (geology based on Nescieruk, 2002)

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