Gravity surveys show that the limit of basement promontory extend about 100 kilometres towards the internal part of the orogenic root from todays exposure of the orogenic front. Combined structural and petrological studies revealed that the orogenic lower crust (high-pressure granulites and mafic eclogites) was vertically extruded from depths of about 70 kilometres parallel to the western steep margin (ramp) of the basement promontory. The observed transition from steep to flat fabrics occurs in different depths from 35 to 15 kilometres and is marked by different P-T-t paths of exhumed lower crustal blocks. The vertically extruded rocks are reworked by flat fabrics reflecting the flow of hot material into some horizontal channel developed between the upper boundary (flat) of the basement promontory and the overlying orogenic lid. The flow kinematics in this horizontal channel are controlled by plate movements as documented by structural and paleomagnetic investigations. A simple 2D thermokinematic model is used to show that the differences in P-T-t paths are controlled by three major parameters: thickness of the indenter, plate velocity and thermal structure of the orogenic root. We suggest that the exhumation of orogenic lower crust in large hot orogens is an extremely heterogeneous process controlled by local parameters, essentially driven by indentation. Orogenic flat fabrics commonly reported in hot orogens result neither from lower crustal flow nor gravity driven collapse of an orogenic system but rather reflect the deformation fronts and geometries of crustal indentors.

Extraction of Morphotectonic Features from High-Resolution Photogrammetric DEM (Mecsek Mts., Hungary)

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Photogrammetric digital elevation models (DEMs) belong to the 2nd generation of DEMs. Compared to the preceding generation usually achieved by interpolation between contour lines, these are produced from aerial orthophotos. Under optimal conditions, they provide higher resolution and are devoid of some interpolation errors typical of the first generation.

A methodology developed earlier for tectonic feature extraction from traditional DEMs (Jordan et al., 2003, 2005; Sebe 2005) is applied on the photogrammetric DEM of Mecsek Mts. (SW Hungary). Mecsek Mts. and their foreland are characterized by the dominance of strike-slip fault systems and the presence of neotectonic (latest Miocene – Pliocene – Quaternary(?)) activity including young vertical movements. The area has already been studied from the aspect of tectonic geomorphology using DEM, traditional geomorphology and geology, and new concepts about young evolution history have been outlined (Sebe et al. 2006). The objective of the present study is to further improve our understanding on the tectonics of the area and to compare the two DEM types (contour-based and photogrammetric) in terms of morphotectonic interpretation.

Anthropogenic features such as roads and bridges were first removed from the photogrammetric DEM by means of mathematical morphology image processing methods. Detailed digital terrain analysis applied smoothing filters to the DEMs using a sequence of kernel sizes in order to detect morphotectonic features on various scales ranging from local to regional. For each re-scaled DEM several morphometric parameters of tectonic significance, such as aspect, slope, curvatures, directional derivatives and local relief were calculated and displayed as maps. These maps were analysed visually and statisctically to locate geomorphic features of tectonic origin. Tectonic study was enhanced by the examination of drainage network extracted from the DEM (for methods see Jordan et al. 2003).

Results show that the new photogrammetric DEM with a resolution higher than that of the traditional contour-based type provides important additional information, in particular along major morphotectonic features such as fault scarps and linear valleys, although it also has its characteristic error types that can hinder tectonic interpretation to a certain extent. In the photogrammetric DEM more fault lines and other tectonic features could be located, many of which are not indicated in geological maps. The new DEM seems to be especially useful in areas of low relief.

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Gravity Modelling of the Krkonoše-Jizera Pluton

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A detail gravimetric survey (in the scale of 1:25 000, i.e. with the density of 4–5 stations per 1 sq. km) was realized in the northern Bohemia during 2001–2003. The total extent of the surveyed area was 800 sq. km. It included the eastern marginal part of the Lužice (Lusatian) Granodiorite Massif, the Jizera Metamorphic (mostly orthogneiss) Complex, the Ještěd-Kozákov Belt of the South Krkonoše Metamorphic Complex and the substantial Jizera part of the Krkonoše – Jizera Granite Pluton.

The data processing and interpretation stages which followed the field works during 2004–2006 embraced an enlarged rectangular area sized 90 km (W-E) and 65 km (N-S), i.e. the area of 5850 sq. km situated on the German–Polish–Czech borderland. The corners demarcating this enlarged area are situated near the towns of Reichenbach (NW)–Zlotoryja (NE)–Trutnov (SE)–Mnichovo Hradiště (SW). The evaluated area includes the whole Krkonoše – Jizera Pluton, the whole Jizera Metamorphic Complex, substantial part of the Kaczawa Metamorphic Complex, the whole South Krkonoše Metamorphic Complex, the South Krkonoše Piedmont Late Paleozoic Basin, the eastern part of the North Sudetic Depression and the marginal part of the Czech Cretaceous Basin. The unified gravimetric maps of this extended area were compiled using gravimetric data advanced by the Polish Ministry of Environment in Warszaw, by the Saxonian State Department of Environment and Geology in Dresden, and by the CGS-Geofond in Prague.

The regional (low pass) map is depicted in the Fig. 1. The most remarkable gravity anomaly is a large gravity zone L1-L2-L3 situated in the central part of the area studied. This zone is almost 100 km long with the axis drawn-out in the direction of WSW-ENE. Three partial gravity lows are developed along this axis. The westernmost low (L1) reaching –51 mGal is situated in the northern marginal part of the Czech Cretaceous Basin, the central low (L2) with the extreme of –40.5 mGal occurs in the Jizera part of the Krkonoše – Jizera Pluton (in the surroundings of the town of Liberec) and the largest eastern partial low (L3) of –48 mGal is on the northern Polish slope of the Krkonoše Mts. in the southern vicinity of the town of Jelenia Góra. All the three partial minima represent the effect of the low-density variscan granite rocks of the Krkonoše – Jizera Pluton (in case of the L1 low there is also a substantial influence of the "light" Cretaceous sediments covering the buried granites). The large Jizera Metamorphic Complex situated to the N of the Krkonoše – Jizera Pluton which is mostly built by various kinds of orthogneisses and migmatites also partly contributes to the central gravity low.

The partial lows L1 and L2 are separated one from another by the local gravity high H1 caused by the Proterozoic to Early Paleozoic sedimentary-volcanic sequences building the Ještěd-Kozákov Mountain Belt.

The steepest horizontal gradients rim the main gravity low especially on its southern and eastern margins. In the direction to the South, it reflects the density contrast toward the South Krkonoše Metamorphic Complex built by metamorphosed Proterozoic and Early Paleozoic sedimentary-volcanic sequences covered by the South Krkonoše Piedmont Late Paleozoic Basin. The Late and Early Paleozoic Complexes cause the gravity high H2. In the direction to the E the steep horizontal gradient manifests the contact with the Kaczawa Metamorphic Complex covered partially also with the Late Paleozoic Formations. The Kaczawa Complex and its Late Paleozoic cover create the gravity highs H3 and H4.

The gravity modelling focused to the shape and deep position of the Pluton body was solved using the software GM-SYS along the two almost 150 km long profiles. The first one of the S-N direction started in the Czech Cretaceous Basin, crossed over the western Jizera part of the Krkonoše – Jizera Pluton (partial gravity low L2) and finished in the Odra Lineament Zone. The second one of the SSW – NNE direction began also in the Czech Cretaceous Basin, crossed over the gravity high H2, the western partial gravity low (L3), then the whole Fore-Sudetic Block and finished also near the Odra Lineament Zone. The resulting models show very steep (almost vertical) southern wall of the Pluton. The bottom boundary of the Pluton is expected to be in depth of about eight kilometers in the Jizera Mts. and to ten kilometers in the Krkonoše eastern part of the Pluton.

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