1) Neoproterozoic para-autochtohnous metagranitoids reworked at conditions corresponding to amphibolite facies
2) "Lower crystalline unit" (LCU) is a thrust sheet composed of porphyritic orthogneisses metamorphosed at conditions equal to ca 600 °C at 14 kbar.
3) "Upper crystalline nappe" (UCU) formed by high temperature orthogneiss that contains inclusions of high-pressure granulites metamorphosed at ca 750-800 °C and 15-17 kbar.

The parent rock – porphyritic metagranitoids in heterogeneously deformed piles have similar initial grain-size distributions, space positions and phase fractions (23% K-feldspar, 30% plagioclase and 35% quartz). The shapes of individual mineral phases were traced from photographs. Rxz as well as Ryz values have been estimated using modified Rf/ϕ method based on incremental destraining of elliptical objects (Lisle, 1993). The average deformation was calculated from area weighted strain values. The calculated data were plotted in Flinn diagram where individual constituent phases from each sample were connected by tie lines with a circle representing bulk strain value. K-feldspar appears as a stronger mineral in the LCU orthogneiss, whereas quartz and plagioclase show higher strain intensities. Shapes of strain ellipsoids for each mineral show narrow span in Flinn's diagram. This span widens in samples with higher bulk strain intensity. High deformation intensity is accompanied with a switch in relative deformability, so that quartz becomes stronger than K-feldspar. In moderately deformed UPU orthogneiss quartz shows very low strain intensities, while feldspars are deformed more intensely. The shapes of strain ellipsoids are prolate and closer to each other in high bulk strain intensity sample. This suggests that quartz becomes more deformed, while feldspars contribute to the bulk strain less significantly than in moderately deformed sample. These data are also presented in diagram of bulk strain against ratios of strain intensities of individual minerals for the given sample, which are expressed using Ramsay's D value, $D=[(Rxy)^2+(Ryz)^2)]^{1/2}$). Highest strain ratios are achieved between D_{Kf}/D_{qtz} and D_{plg}/D_{qtz} for low strain intensities in high-grade orthogneisses. Relatively weak D_{kf}/D_{plg} ratio suggests similar yielding of both mineral phases. However, D_{Kf}/D_{qtz} and D_{plg}/D_{qtz} ratios are systematically decreasing with high bulk strain intensities indicating common yielding of all mineral phases. The medium-grade orthogneiss plots show very low strain ratios of all mineral phases irrespective to the bulk strain, which indicate only weaker degree of strain partitioning.

Microstructural and quantitative textural analysis including grain size measurements, grain shape and grain boundaries were carried out to determine deformation mechanisms in the orthogneisses. The LCU orthogneiss shows fracturation and myrmekite reaction-driven disintegration of K-feldspars. Quartz forms lenses to ribbons with highly curved grain boundaries. Plagioclase shows tiny grain size (X0 µm) for all strain intensities. The UPU orthogneiss shows blebs of quartz composed of large (up to 5 mm) grains with straight boundaries. These inclusions are surrounded by monomineralic bands of K-feldspar and plagioclase. Feldspars show equigranular mosaic with abundant triple point junctions and straight grain boundaries. The interstitial plagioclase and quartz coating K-feldspar grains may indicate minor contribution of melting in high-energy structural sites. Grain-size statistics of quartz from the LCU show an increasing grain size and spread with increasing deformation, which also holds for the UCU samples. Feldspars show slight increase in grain size in samples from the LCU; the aspect ratio is almost constant for plagioclase. In the UCU samples the grain size rapidly decreases, whereas the aspect ratio remains stable and low. The crystal preferred orientation (CPO) was measured for quartz, plagioclase and K-feldspar in a weakly deformed sample from the para-autochtonous unit and in the highly strained sample from the LCU using the EBSD method. Strong CPO pattern of quartz is consistent with basal <a> and prismatic <a> glide systems while CPO of plagicolase is absent. Recrystallized K-feldspar shows strong CPO being consistent with activity of (010)<001> slip. The strongly deformed sample shows weaker CPO for quartz as well as weakening CPO for K-feldspar indicating persistent activity of (010)<001> glide system.

The competency paradox between feldspars and quartz in high-grade rocks is explained by contribution of melt enhanced grain boundary sliding (diffusion creep) in feldspars, which increases their ductility with respect to dislocation creep of strong quartz. In lower degrees of deformation, the K-feldspar is strong exhibiting brittle deformation coupled with dislocation creep, while quartz deforms entirely in dislocation creep field. The weakest plagioclase shows grain boundary sliding probably enhanced with important fluid influx. With increasing strain, the K-feldspar and quartz deformation is probably accompanied with a switch in active slip system, which is responsible for strengthening of quartz. This study shows the importance of detailed microstructral and deformation studies of polyphase rocks to evaluate more realistic relative strength-competency of rock forming minerals in the crust.

The Northern Part of the Izera-Karkonosze Block: Fragment of the Saxo-Thuringian Passive Margin

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The northern part of the Izera-Karkonosze Block, composed of Neoproterozoic granodiorites, greywackes, mica schists and c. 500 Ma granites, belonged to the trailing edge of the Saxo-Thuringian terrane which resulted from the break-up of Gondwana. By the early Devonian (Nowak et al., in preparation), this passive edge underwent extension and rifting. A swarm of the WNW-trending subvertical basic dykes intruded continental crust presumably parallel to the rift axis. Their geochemical features classify them into WP and MOR-like (E- and N-types) basalts. Parental magmas formed two evolutionary trends, of which one was connected with an enriched astenospheric plume-type region, whereas the other was derived from a lithospheric source region contaminated with continental crust. The switch between the two trends, occurring in the Devonian, reflected the end of lithospheric extension and the onset of subduction (Nowak, 2003). Changes in geodynamic conditions were recorded by rocks in the northern part of the Izera-Karkonosze Block.

The presently exposed dykes of mostly fine-grained gabbros and dolerites intruded the c. 500 Ma Izera granites in early Devonian times. They were emplacing along subvertical fractures within the then largely undeformed granitic host and eventually either fed volcanos or terminated relatively high in the upper crust. Textural data show that basic rocks started to be metamorphosed under static condtions at similar shallow depths, probably in still extensional regime. The pre-tectonic greenschist metamorphism was assisted by a remarkably high heat flow testifying to the probable proximity of the plume head.

Further LP/MT metamorphism continued concurrently with multiple shearing which produceed composite foliation in both basites and country granites. Deformation was localized mostly within the basites owing to discrete rheological contrast between the two lithologies. Early mylonitization was not associated with any significant change in depth level of the rocks involved (those presently exposed). The deformation was mostly accomplished by steep oblique to dip-slip shearing, with left-lateral reverse and normal components, depending upon the attitude of the dyke walls. This suggests subhorizontal/subvertical orientation of the maximum principal stress, permutation of the stress axes and probably low differential stress. It is inferred that such a regime in the Izera-Karkonosze section of the Saxo-Thuringian plate was attained later during the Devonian, when it started to descend owing to subduction which soon terminated at c. 360 Ma (Maluski and Patočka, 1997). While passing through the peripheral bulge region of the descending plate, the Izera-Karkonosze section yielded to the early heterogeneous deformation bringing about steeply oriented shear zones in which the primary basites became transformed to amphibolites and the primary granites to augen and laminated gneisses. Subduction continued probably at zero deviatoric stresses, thus with no recognizable strain, until it stopped when the Izera-Karkonosze section arrived at a depth of c. 20–25 km. The Izera amphibolites and gneisses yielded then to metamorphism at a significantly increased pressure but only slightly elevated temperature, the conditions consistent with the inferred subduction regime. Further metamorphism at the upper greenschist to lower amphibolite facies occurred syntectonically with the exhumation of the Izera rocks back to shallow crustal levels during early Carboniferous convergence when the Saxo-Thuringian plate collided with Bohemia. Structural data on the shallowly to moderately plunging stretching lineations and associated kinematic indicators from the Izera amphibolites and gneisses show that the metamorphic peak and the exhumation were accomplished in oblique-slip dextral regime along WNW-trending foliation planes, with southward thrust component. Ar-Ar isotopic data locate this event at an interval of 345-335 Ma (Marheine et al., 2002) and miospore data from the adjacent Intra-Sudetic Basin constrain it to pre-late Viséan times (Turnau et al., 2003). Late extensional collapse took place when the Izera rocks resided at shallow depths controlled by very low greenschist facies conditions.

Accordingly, it is suggested that the Izera fragment of the Saxo-Thuringian passive margin preserved in the northern part of the Izera-Karkonosze Block underwent multiple deformation and metamorphic events which included (1) the early Devonian plume-related extension associated with intrusion of basic magmas derived from an enriched astenoshperic source, (2) convergence and subduction to lower crustal depths later in the Devonian which triggered heterogeneous shearing and greenschist metamorphism of the subducted rocks, and (3 exhumation back to shallow crustal levels during the continued convergence and plate collision in pre-late Viséan times.

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