ward transport of the UHP rocks under eclogite facies conditions, monitored by blastesis of primary pargasite, occurred at different time and in different geodynamic setting.

In the eclogites no fabric can be assigned to the mineral relicts of the UHP event, thus deformation at the extreme P-T conditions remains undeciphered. A pronounced metamorphic layering expressed by garnet-rich/garnet-poor and occasional pargasite layers developed during the HP syntectonic eclogitic metamorphism. The earliest recognizable deformation in eclogites is marked by asymmetric aggregates of garnet or pyroxene, with pargasite in pressure shadows and by oblique growth of pargasite in the amphibole layers. They indicate oblique thrust associated with some dextral slip component due to top-to-the-SW/W movement marked by steep stretching lineation. The eclogites started their way to the surface from a depth of c. 120–100 km. At a depth of c. 70–60 km they already possessed a metamorphic layering associated with SW/W-directed thrusting, which may suggest exhumation of the Chemenda type. During the upward transport eclogites were fragmented into smaller bodies. At a depth of c. 35–30 km, eclogitic bodies became emboddied into streaky gneisses. Crustal fluids brought about the retrograde amphibolites with distinct fabric in localized shear zones. At a similar depth gneisses and eclogites were intruded and encompassed by a high-T porphyritic granite in which they form xenoliths subjected to further boudinage during subhorizontal constriction and ensuing sinistral oblique slip. These occurred still at high temperature evidenced by a polygonal fabric of dynamically recrystallized plagioclase. The sinistral shearing (top-to-the-N) imparted to the rocks exposed at Nowa Wieś subhorizontal stretching lineation, oblique fabric, subvertical folding, and subhorizontal boudinage at temperature of 560–640 °C and relatively shallow depth of 6–4 kbar. These features started to develop still at mid-crustal levels, possibly owing to lateral tectonic escape. The last ductile event recorded by the studied rock assemblage is normal faulting to the E. This represents the final stage of exhumation of the eclogites which occurred under extensional conditions of a collapsing orogen.

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Chromium Anomaly in Devonian Metapelite at Petrov (Northern Moravia, Czech Republic)

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The setting

The samples were collected during regional geological mapping of the Czech Geological Survey (•áček et al., 2000) at the old "fuchsite" locality near Petrov nad Desnou (Šumperk District, Northern Moravia, Czech Republic). The locality called formerly "Rauhbeerstein" is situated on the mountain ridge 1000 m south from the Sobotín railway station, 1700 m NNW from the top of Petrovský vrch Hill, 778.4 m (Fig. 1). Kretschmer (1911) gives first report on "fuchsite" from Petrov, much later Němec (1971) provided analytical data. The occurrence has a character of small blocks and loose chips restricted to very small area of some tens square meters. New geological mapping has shown, that the Cr-rich mica schist is situated in tectonic slice, only several tens meters thick surrounded by amphibolites of the Sobotín amphibolite massif (see •áček, 2000). The rocks are facially connected with mica schists and quartzites of a lower part of volcanosedimentary Vrbno Formation. Both Vrbno Formation (Devonian) and underlying Prevariscan Desná Unit (with extensive Sobotín amphibolite massiv of unknown age) underwent amphibolite facies (staurolite – kyanite/sillimanite zone) of Variscan metamorphism.

Rocks and minerals

Samples have variable mineral composition corresponding to the following rock types (see also Table 1):

1) garnet – staurolite mica-schist (samples 322/2, 3, 4)
2) staurolite (kyanite) hornfels (samples So-1, 322/1)
3) plagioclase (staurolite) schist (samples 322/5, 6).

Individual rock types are connected by continuous transitions. Strips and lenses of quartz are frequent. From 7 thin sections, 2 were studied using microprobe (samples So1 and 322/1, see Tables 2 and 3).

Muscovite is nearly colourless to grass-green according to the percentage Cr_2O_3, with greenish tint in thin section. Its quantity in rocks may reach about 35 vol.%. The concentration of Cr rapidly changes, from 0.0 to 0.92 wt.% of Cr_2O_3. New data correspond well to those of Němec (1971) who reported

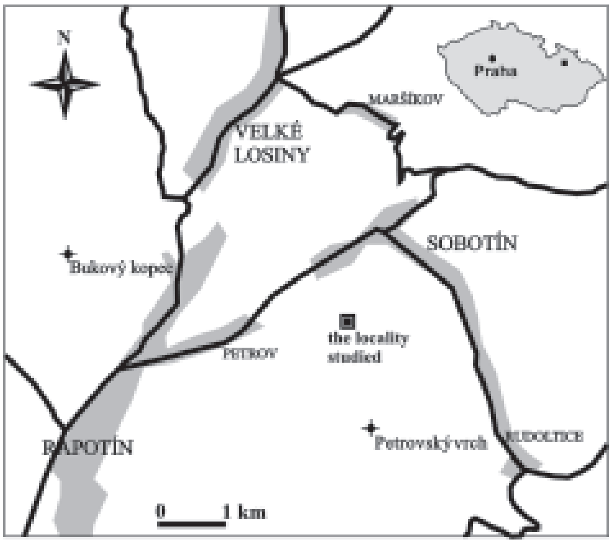

Fig. 1. Sketch map with situation of Cr-anomaly at Petrov.

sample	So-1	322/1	322/2	322/3	322/4	322/5	322/6
staurolite	40	50	15	40	15	25	5
sillimanite	–	–	–	–	2	2	7
kyanite	20	–	–	–	4	–	8
garnet	2	1	15	10	5	–	–
muscovite	20	28	35	25	35	10	3
quartz	5	10	12	15	15	5	15
plagioclase	10	5	20	6	22	55	60
ilmenite	3	4	2	3	1	3	1

*chlorite is a common accesorry, in addition accessory biotite and rutile occur in sample 322/1

Tab. 1. Estimated mineral composition (vol. %) of Cr-bearing rocks from Petrov*.

sample	322/1	So-1
staurolite	0.46 – 1.87	0.11 – 0.49
muscovite	0.46 – 0.92	0.0 – 0.21
garnet	0.19 – 0.57	0.0 – 0.22
ilmenite	0.15 – 0.31	0.16 – 0.35
chlorite	0.30 – 0.82	–
rutile	1.00	–
kyanite	–	0.17

Tab. 2. Cr2O3 concentrations (wt.%) in coexisting minerals from Petrov.

sample	322/1	322/1	So-1	322/1	322/1
mineral	muscovite	muscovite	staurolite	staurolite	garnet
SiO2	44.44	45.19	26.60	26.59	36.67
TiO2	0.52	0.35	0.78	0.71	–
Cr2O3	0.49	0.92	0.28	1.59	0.57
Al2O3	34.39	34.32	53.28	51.28	19.97
FeOtot	1.86	1.80	14.75	14.36	35.36
MnO	–	0.11	0.48	0.09	4.74
MgO	0.55	0.44	1.33	1.54	1.75
CaO	–	–	–	–	0.76
Na2O	2.21	2.24	–	–	–
K2O	8.67	9.02	–	–	–
total	93.13	94.39	97.48	96.16	99.82

*LINK eXL, Czech Geological Survey, Prague, I. Vavřín, analyst

Tab. 3. Microprobe data for muscovite, staurolite and garnet from Petrov*.

0.13–0.93 wt.% of Cr_2O_3 for green mica and about 0.02 wt.% for "normal" muscovite.

Staurolite forms deep-brown porphyroblasts up to 7 mm long, euhedral, frequently corroded, with abundant inclusions of quartz and ilmenite. The quantity of staurolite (rarely also of garnet and kyanite) may increase enormously (up to 50 vol.%), giving rise to staurolite (garnet-kyanite) hornfelses (Table 1). Staurolite is relatively highly ferroan with XMg = 0.14–0.18 and has slightly elevated TiO_2 concentration (0.40–0.78 wt.%). The concentration of Cr_2O_3 ranges between 0.27–1.87 wt.%, and grows toward rim. The chromian staurolite displays unusual pleochroism: X – pale gray-green, Y – yellow-brown, Z – pale yellow.

Garnet forms rounded porphyroblasts up to10 mm (mostly 2-5 mm) in size. Flat prograde zoning and relatively small chemical variability was observed: Alm0.69–0.80 Sps0.10–0.23 Prp 0.06–0.10 Grs 0.01–0.04. The concentration of Cr varies from 0.0 up to 0.57 wt.% Cr_2O_3 (equal to 0.0–1.8 mol.% of uvarovite component) but the average content is about 0.40 wt.% Cr_2O_3.

Kyanite is prismatic, up to 5 mm long, greyish to pale blue. It contains 0.17 wt.% Cr_2O_3 (Němec gives 0.22 wt.%). Fine fibrolitic sillimanite grows as elongated strips in high-strain foliation domains and locally replaces kyanite. Plagioclase is albite with 2–5 mol.% of anorthite component. Chlorite, ilmenite, rutile and biotite are minor to accessory and their Cr contents are given in Table 2.

Genetic interpretation

The protolith of the rocks studied represents an extraordinary Al-rich and relatively Si-poor metapelite. The approximate chemical compositions of the samples studied calculated on the base of data summarized in Table 1 and microprobe analyses, yielded 25–43 wt.% of Al_2O_3 and 40–64 wt.% of SiO_2. Such a chemistry can correspond well to a redeposited weathering crust (product of lateritic weathering?) of underlying crystalline complex (see also René, 1983). Chromium was most probably concentrated due to sorption in weathered zone of metabasites.

Němec (1971) gave a different interpretation, considering the Cr anomaly at Petrov as a product of Cr migration from metabasites of Sobotín amhibolite massif into mica schists during regional Variscan metamorphism. He argued for a close connection of Cr-schists with amhibolite and elevated Cr-concentration in hornblende (0.2 wt.%). However, several additional Cr-anomalies indicated by "fuchsite" are scattered between Jeseník and Šumperk (see label "fuchsite" in Burkart, 1953; Kru•a, 1973). They are always asssociated with the same rock types: Devonian aluminous schists or muscovite quartzites but not necessarily in proximity of amphibolite. On the other hands, there are many occurrences of metabasites of the Sobotín amphibolite massif (potentially Cr-enriched) associated with mica-schists without apparent Cr-mineralization. Recent geological and geochemical study has shown that most probably the whole sequence of Devonian aluminous rocks of the Vrbno Formation, outcropping along with western margin of the Desná Unit between Rejvíz and Šumperk, displays elevated Cr. Chromium concentration in mica-schists and plagioclase schists associated with quartzites varies between 100–200 (400) ppm (•áček and Cháb, 22 unpublished analyses). The elevated Cr abundances indicate that the material from weathered metabasites played a role during the deposition of basal part of the Devonian sequence of the Vrbno Formation. Cr-muscovite occurrences indicate the places of local Cr-enrichment in aluminous metasediments containing a significant proportion of weathering products of metabasites.

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Magma Chamber Construction during Crustal Thickening and Subsequent Exhumation: An Example of Interplay between Magmatic and Tectonic Processes from the Central Bohemian Batholith (Bohemian Massif)

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The Central Bohemian Batholith (CBB), exposed along a major tectonic boundary between two juxtaposed major crustal units (upper crustal Teplá-Barrandian Zone and lower to middle crustal Moldanubian Zone), consist of multiple intrusions of calc-alkaline to potassium-rich granitoids, syenitoids and mafic rocks emplaced during ~351–341 Ma. To the NE of the CBB, country rocks are characterized by low degree of regional metamorphism and comprise Neoproterozoic to Lower Paleozoic volcanic and clastic sedimentary sequences, whereas high-grade migmatites and orthogneisses of the Moldanubian Zone crop out to the SE. The early stages of magmatism in the CBB are recorded by biotitic orthogneisses (370 Ma), which are considered to represent the oldest intrusive events of the CBB, preserved in roof pendants and stoped blocks. Based on geochemical and petrological data, the CBB intrusions are interpreted as mostly island arc granitoids with involved mantle-derived mafic magmas situated above subduction zones.

In the present study, following our previous research on the emplacement of the Sázava tonalite (~349 Ma) during highly oblique transpression (•ák et al., 2001), we evaluate the structural evolution and mainly concentrate on fabrics and structural analysis, complemented by microstructural and AMS data of Kozárovice intrusion (equigranular and phenocrystic granodiorite), Blatná (~346Ma) and Červená granodiorite (in the central part of the CBB) and its internal contacts. The Kozárovice intrusion is characterized by strongly developed steep NE-SW trending magmatic foliations and sub-horizontal magmatic lineations superimposed on older flat relict magmatic fabric of variable orientations. Along contacts with roof pendants, the pre-existing magmatic structures were overprinted by margin-parallel narrow zone of sub-solidus deformation. Both magmatic and subsolidus fabrics are concordant with contractional structures in the host rocks and reflect synmagmatic wrench-dominated transpressional tectonics in the area. Structural pattern of the Blatná granodiorite is more complex, showing both steep magmatic fabrics trending mainly NE-SW, corresponding to transpressional structures in the Kozárovice granodiorite (in NW part of intrusion), and younger magmatic fabric dipping at moderate angles to NNW in the SE part of intrusion. This fabric is parallel to elongation of the intrusion and marks the onset of tectonic switching from transpressional to extensional tectonics. Zones of subsolidus deformation are developed along both NW and SE margins of the Blatná granodiorite. A narrow zone of sub-solidus fabric adjacent to the contact between the Kozárovice and the Blatná granodiorite implies short time interval between these two intrusive events, where the former one was at least partly solidified at the time of intrusion of the Blatná granodiorite. Up to 10 km wide zone of sub-solidus to solid-state deformation developed along SE margin of the CBB (the Červená granodiorite) displays extensional SE-side-up kinematics with moderately dipping stretching lineations being associated with exhumation of the Moldanubian Zone.

Preliminary AMS data from the Kozárovice and Blatná granodiorites confirm that magnetic fabric is in most cases consistent with the observed mesoscopic structures. Magnetic susceptibility ellipsoids show both prolate and oblate shapes, magnetic foliations dip at steep to moderate angles approximately to the NW, whereas magnetic lineations are either subhorizontal (corresponding to transpressive sub-horizontal magmatic lineations) or moderately dipping as a result of subsolidus extensional deformation.

We demonstrate on a given example of the CBB that magmatic processes and internal fabrics of plutons may record complete structural history and evolution of island arcs, i.e., the initial contraction and crustal thickening (Kozárovice granodiorite) and subsequent collapse and exhumation of orogenic root (Moldanubian Zone) – the Blatná granodiorite. Furthermore, the presence of transpressional and extension-related magmatic and subsolidus fabrics within single intrusion suggests rapid switch of tectonic regimes in comparison to pluton cooling rates and shows how complex and dynamic are processes attributed to magma ascent and emplacement during contractional and extensional