The Results of the Geological Mapping in a Broader Surroundings of Šumperk, the Jeseníky Mts, Czech Republic

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Five new sheets of the geological maps of the 1:25,000 scale have been finished by the Czech Geological Survey in a broader vicinity of the town Šumperk (sheets 14–423, 14–412, 14–414, 14-421 and 14-423). The mapping covered the geological units along the contact of Lugicum (the eastern part of the Orlica-Snieznik Unit, the Staré Město Group and the eastern margin of the Zábřeh Crystalline Complex) and Silesicum (the Keprník and Desná units). Both Lugicum and Silesicum, differing in the character of protoliths and in the succession and P-T parameters of metamorphic events, underwent a complex polyphase tectonometamorphic development. The regional distribution of the units reflects mainly the kinematics of the Variscan tectonics.

The recent mapping supports the idea that the contact between Lugicum and Silesicum lies along the Ramzová line ("thrust") representing the steeply to W declined strike-slip with the left-handed movement. This boundary could previously have the thrust character (similarly as the Moldanubian thrust) and latter it was reworked to the strike-slip fault without occurrences of ultrabazic rocks. The Ramzová fault is accompanied with mylonites, locally with dolomite, ankerite, rarely chalcopyrite. The important metamorphic jump exists along this fault – the staurolite zone in the Staré Město Group vs. the biotite zone in the upper part of the Branná Group.

The contact between the orthogneisses of the Orlica--Snieznik Unit and the rocks of the Staré Město Group has a character of the thrust fault with local occurrences of serpentinites. The inner pattern of the Staré Město Group is scaled, the individual scales are separated by longitudinal faults. The previous thrust faults are emphasized by lenticular bodies of ultrabazic rocks and they are locally transformed to the low-angle faults typical for the extension regime.

The contact between the Keprník and Desná units has been also interpreted as a fault of the strike-slip type. Both these units, represented by their petrographically uniform cores and petrographically more varied covers, differ in the character of deformation and in the intensity of retrograde processes. But the polymetamorphic development and the segmentation to a range of scales and nappes are their common feature. The inner structure of the Branná Group, enveloping orthogneisses of the Keprník Unit core, has a thrust character. The mapping enabled to divide the Group into three distinguishable portions (scales) locally having considerable thickness or being tectonically entirely eliminated. The imbrication structure of the Desná Unit is well documented by the alternation of scales of metagranites and volcano-sedimentary rocks of the Vrbno Group.

The metamorphic grade of the Variscan metamorphism in the southern part of the Desná Unit varies from lower greenschist facies (chlorite zone) to medium amphibolite facies being attained at the western margin of this unit. The thermobarometric studies indicate the temperatures of 520–530 °C for garnet zone (chloritoid + garnet); 540–570 °C for staurolite zone (garnet + staurolite) and 570–600 (630) °C for staurolite – (kyanite) – sillimanite zone. No evidence of pressures exceeding about 5 Kb was found in the Variscan rocks in Silesicum. The character

Mantle Lithosphere of the French Massif Central: Three Domains Derived from Seismic Anisotropy

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We model structure of the mantle lithosphere of the French Massif Central (MC). Its seismic anisotropy, caused mainly by systematic orientation of olivine crystals, is derived from spatial variations of P-wave delay times and the shear-wave splitting observed at a dense network of mobile and permanent stations (Granet et al., 1995). In agreement with different features of the near-surface tectonics (e.g. Burg et al., 1990), the mantle lithosphere shows different characteristics in the western (Limousin) and the eastern parts of the MC (Babuška et al., 2002).

Three major lithosphere domains with different seismic anisotropy, derived from travel-time deviations of longitudinal waves and lateral variations of shear-wave splitting, are distinguished (Fig. 1). A suture in the deep lithosphere limits in the east the thick (100–140 km) lithosphere of the Limousin. The large-scale fabric of the mantle lithosphere is modelled there by inclined anisotropic structures of orthorhombic symmetry. The lineation, parallel with the high concentration of a olivine axes, dips to the west. The eastern MC is most probably composed of two lithosphere domains. In the northern part, the lithosphere is as thick as in the Limousin, but the anisotropy is modelled by hexagonal symmetry with the (a,c) foliation dipping to the east. In the southern domain the lithosphere is thinned to about 60–80 km and its fabric is weakened.

The distinct mantle boundary between the western and eastern MC, defined by the polarization of the fast split shear wave (Fig. 1), parallels the Sillon Houiller fault (SH) in the south and the Tauve-Aigueperse fault (TA) in the north with an offset of about 10–20 km to the east. The boundary between the north-

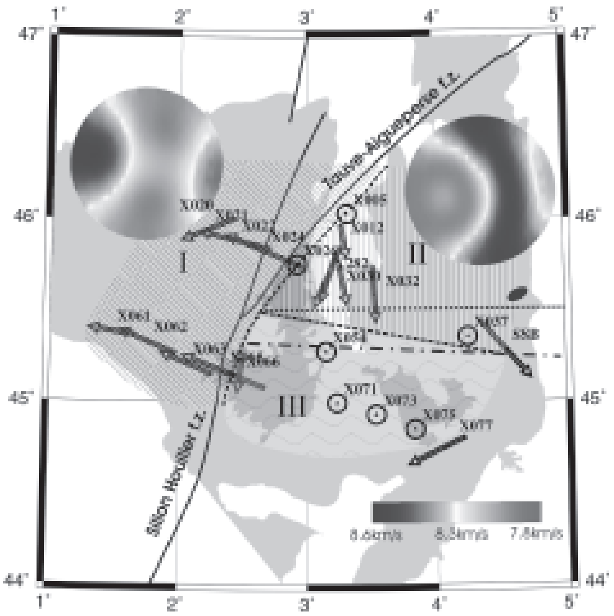

Fig. 1. Schematic map of the French Massif Central (MC, marked by light grey area with volcanoes in dark grey) showing three domains of the mantle lithosphere defined by different characteristics of seismic anisotropy. The E-W oriented dashed line denotes the boundary between domains II and III - the northern block with N-S oriented fast split shear waves (arrows) and the southern block with the "null" splitting (circles). The dotted and dot-dashed lines refer to boundaries defined by Lenoir et al. (2000) and Merle and Michon (2001), respectively. The black ellipse indicates the area of a granulitic/ultramafic association in the Monts du Lyonnais interpreted by Gardien et al. (1990) as remnants of a Paleozoic subduction. Arrows point in directions of the dipping fast shear waves. P-velocity distributions in anisotropic models based on inversion of P-residual spheres and its joint interpretation with shear-wave splitting parameters are shown in a lower hemisphere stereographic projection.

ern and southern domains of the eastern MC is less well determined by seismic anisotropy. However, additional geological (Merle and Michon, 2001) and geochemical (Lenoir et al., 2000) observations support its existence. The SH fault in the south and the TA fault in the north are the most prominent sutures which cut the entire lithosphere. However, our anisotropic inferences suggest that the upper crust of the MC was probably detached from the mantle lithosphere and displaced westward (Fig. 2).

We also suggest that the magmas feeding the Cenozoic volcanism of the Cantal and Mont Dore were channeled to the surface by the reactivated Variscan suture hidden in the mantle lithosphere. This suture represents a collisional boundary between Variscan microplates characterized by different orientations of their large-scale fabrics originating most probably in different periods and different tectonic environments.

Within the eastern MC, in the mantle lithosphere adjacent to the SH-TA suture, we observe a several tens of km wide transition between the two anisotropic patterns of P-wave velocities. In the south the transition is broader, the lithosphere is thinner and the original mantle fabric is weakened. The Cenozoic volcanism developed on both peripheral parts of the transition

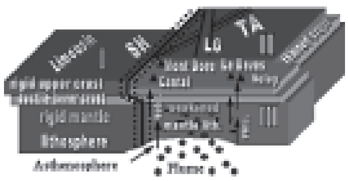

Fig. 2. Schematic 3D sketch of the Massif Central (MC) shows three lithosphere domains determined from seismic anisotropy. The suture between domains I and III, marked at the surface by the Sillon Houiller fault (SH), and its continuation to the north between domains I and II, marked at the surface by the Tauve-Aigueperse fault (TA), cuts the entire lithosphere, but its crustal and mantle parts are shifted. The thick and rigid mantle lithosphere of domain II was apt to rifting during the Cenozoic extension. On the other hand, a large part of the mantle lithosphere of domain III, which is less rigid above a mantle plume, thinned during the extension and its original fabric weakened. The reactivated (Variscan) mantle suture and peripheral parts of the weakened mantle lithosphere acted as a predisposition for creating open fractures for channeling ascending magma to feed the major volcanic centres during the Neogene and Quaternary.

(the Cantal and Deves). Further to the north, the transition narrows, mantle fabric is preserved and the lithosphere is thick.

The Limagne Graben probably developed above the brittle part of the transition in the rigid northern domain apt to rifting. On the other hand, in the weaker southern domain the Cenozoic extension accommodated by lithosphere thinning. Different Cenozoic histories in the MC may thus reflect different lithosphere properties of pre-existing micro-continents accreted before the Cenozoic event.

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