of isotope age dating, the situation in pluton was interpreted (l.c.) as an imperfect mixing of distinct sources and/or pulse character with AFC mechanism.

Voluminous granite magmatism dominated the Hercynian orogeny across the entireEuropean realm over the time interval of 150 million years (400–250 Ma). Indeed, for the Western Carpathians belonging to the Alpine Neoeurope, four granite-forming events have been recognized within the Hercynian basement (Petrík and Kohút 1997). The oldest event reflecting initial collision of Meso-Hercynian stage is represented by intrusion of peraluminous S-type granites (405–380 Ma), subsequently sheared onto orthogneisses during the main collision period (Poller et al. 2000b) in the Tatra Mountains. The hypercollision – peak stadium of orogeny is broadly connected with melting of muscovite-rich peraluminous S-type granites, terminated around 340 Ma. The Neo-Hercynian stage is characterized by delamination involving high heat flows from mantle induced melting of lower crustal calk-alkaline I-type, causing the intrusion of MME-bearing granites 310–300 Ma ago. The collapse of the Hercynian orogeny connected with post-orogenic uplift and lithospheric thinning was associated with small intrusions of A/S-type granites. It is noteworthy that except for the S-type orthogneisses, all three principal granite-forming stages were identified in the Veľká Fatra composite granite massif.

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Evolution of the Horst-Graben Structure in the Central Slovakia Volcanic Field

Vlastimil KONEČNÝ and Jaroslav LEXA

Geological Survey of Slovak Republic, Mlynská dol. 1, 817 04 Bratislava, Slovakia

Konečný et al. (1975, 1978) demonstrated that volcanic rocks of the Central Slovakian Volcanic Field (CSVF) cover a spectacular system of horsts and grabens with relative displacement amplitudes of up to 3000 m. The most prominent features of this system there are (Fig. 2): (a) dominant N-S trending horsts and grabens at the central part of the system, (b) mostly NE-SW trending horsts and grabens elsewhere, (c) obscured NW-SE trending structural elements, (d) volcano-tectonic features including Kremnica graben, Štiavnica caldera and resurgent horst, Javorie graben, Poľana depression and (e) a frequent occurrence of asymmetric horsts and grabens, including halfgrabens. Related tilting of tectonic blocks shows at the North a N-S trending axis of symmetry (Nemčok and Lexa 1990).

Evolution of the horsts and grabens took place during Badenian to Early Pannonian times (16.5–9 Ma), and since its beginning to the end was accompanied by an extensive, mostly andesitic volcanic activity giving rise to a number of andesite stratovolcanoes (Fig. 3). Relationship of their marginal faults to dated volcanic formations gives us a clue to details of their history.

The oldest grabens are those trending NW-SE, which localized major volcanic centres and controlled the extent and thickness of Early Badenian sediments and volcanics. With the exception of grabens between Prievidza and Strháre they are mostly obscured by younger N-S and NE-SW trending horsts and grabens. The present structural pattern is mostly a result of the strong Late Badenian (to Early Sarmatian ?) extension giving rise to N-S and NE-SW trending grabens. The most intensive subsidence was accompanied by effusions of mafic lavas, perhaps as a response to related crustal thinning. Structural evolution during the Late Badenian time included also evolution of volcanotectonic depressions and/or calderas in central zones of major andesite stratovolcanoes, accompanied by eruptions of differentiated rocks. During the Sarmatian time an active horst and graben evolution was restricted to the western half of the CSVF, especially to the surroundings of the Žiar basin. A related uplift of the Kremnica and Hodruša – Štiavnica resurgent horsts was accompanied by extensive rhyolite volcanism. The youngest subsidence took place during the Early Pannonian in the Žiar and Bátovce basins. Some differential movements during the Pliocene and Quaternary time are indicated by a relative displacement of river terraces.

Evolution of the horst-graben system took place in the hinterland of the evolving Tertiary Carpathian arc. A back arc extension related to the subduction rollback and contemporaneous uplift of asthenospheric mantle was the major driving force (Lexa and Konečný 1998). Changing orientation of horsts and grabens with time corresponds to the observed changes in the orientation of the principal stress axis due to a gradual collision of the ALCAPA block with the European Platform margin (Nemčok et al. 1993).

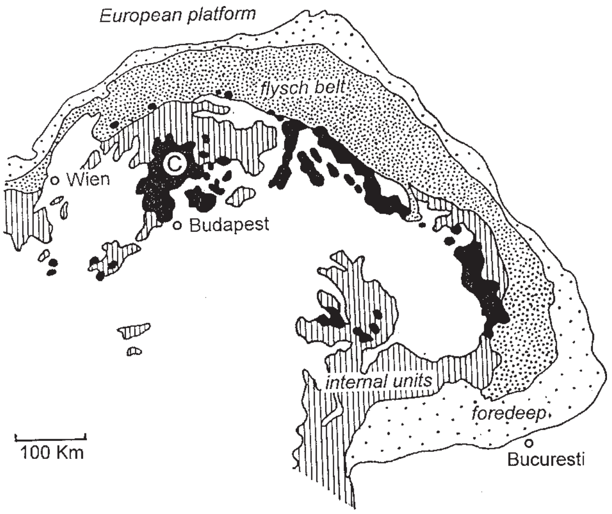

Fig. 1. Position of the Central Slovakian Volcanic field (C) among the Neogene to Quaternary volcanics (black) of the Carpatho–Pannonian region.

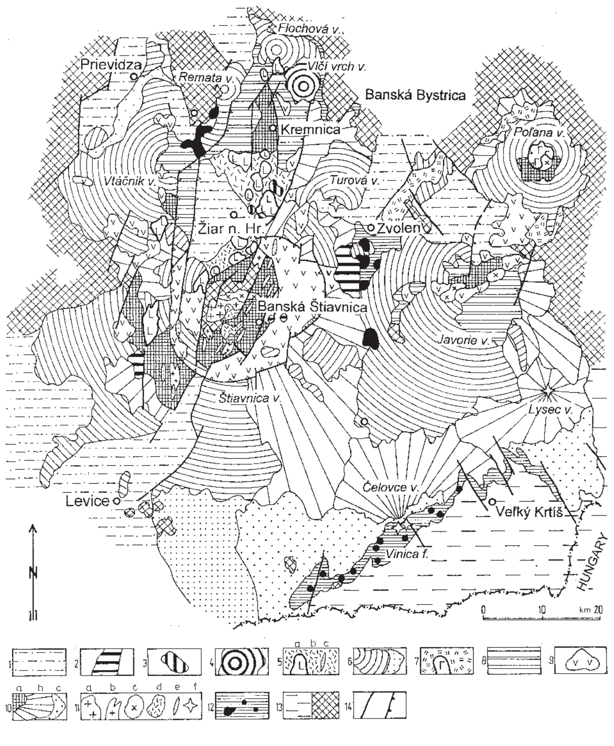

Fig. 2. Morpho-structural scheme of pre-volcanic basement in the Central Slovakia Volcanic Field (based on interpretation of geophysical data and drilling, Konečný et al. 1975, 1978). 1 – faults limiting uplifted and subsided blocks, 2 – faults limiting: a – graben, b – caldera, c – volcano-tectonic horsts, 3 – depressions: a –shallow part, b – deep part, 4 – elevations: a – upper part, b – outcropping basement, 5 – geophysical indications of subvolcanic intrusive complexes, 6 – extent of volcanics, 7 – state boundary.

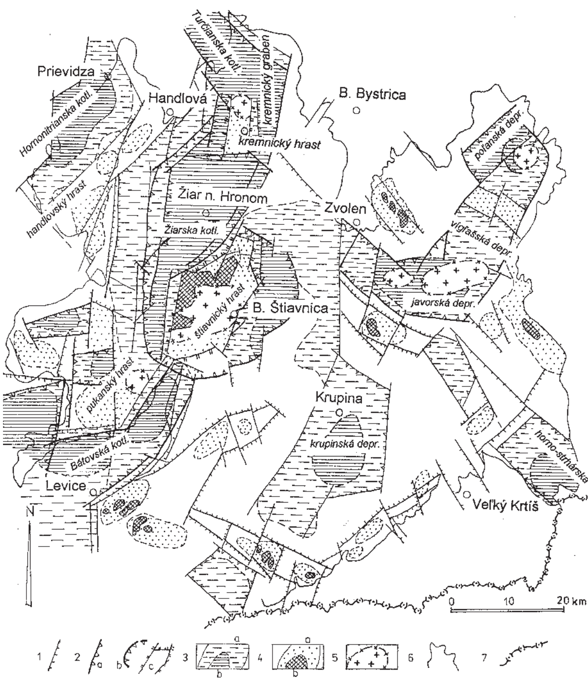

Fig. 3. Structural scheme of the Central Slovakian Volcanic Field (Konečný et al. 1995). 1 – sediments of intravolcanic depressions, 2 – alkali basalt volcanic products (Late Pannonian–Quaternary), 3 – lava flows and sills of aphanitic calc-alkaline basalts/basaltic andesites (Early Pannonian), 4 – stratovolcano of porphyritic calc-alkaline basalts/basaltic andesites (Early Pannonian), 5 – rhyolite domes/dome flows (a), dykes (b) and pyroclastic and epiclastic rocks (c) of the Jastrabá Formation (Late Sarmatian), 6 – Sarmatian andesite stratovolcanoes and reworked marine facies, 7 – rhyodacite domes/dome flows and related pumice tuffs and reworked tuffs of the Strelníky Formation (Early Sarmatian), 8 – effusive complexes of basic to intermediate andesites filling grabens (Late Badenian), 9 – domes/dome flows of intermediate to acid andesites filling grabens and caldera (Late Badenian), 10 –Early to Middle Badenian andesite stratovolcanoes: a – propylitized complex of the central zone, b – stratovolcanic complex of the proximal zone, c – reworked marine or fluvial facies, 11 intrusions: a – granodiorite, b – granodiorite porphyry, c – diorite and diorite porphyry, d – quartz-diorite porphyry sills, e – quartzdiorite porphyry dykes, f – necks, 12 – extrusive domes and reworked breccias of garnet-bearing andesites (Early Badenian), 13 – pre-volcanic basement: a – Early Miocene sediments, b – older rocks, 14 –faults: a – normal, b – limiting grabens and calderas.

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Phase Changes in Medium -Temperature Metagranites – – An Example of the St. Catherina Dome and its Continuation below the North Bohemian Basin (Krušné hory Mts., Bohemian Massif)

Jiří KONOPÁSEK[1] and Bedřich MLČOCH[2]

[1] *Institute of Petrology and Structural Geology, Faculty of Sciences, Charles University, Albertov 6, 128 43 Praha, Czech Republic*

[2] *Czech Geological Survey, Klárov 3, 118 21 Praha 1, Czech Republic*

St. Catherina dome is exposed at the western margin of the Bohemian Massif in the central part of the Krušné hory Mountains. Its core and northern limb are represented mainly by Neo-Proterozoic porphyritic granitoids deformed with various intensity during the Variscan orogeny. Similar metagranitoids appear in boreholes which reached the basement of the North Bohemian Basin. These metagranites were interpreted by Mlčoch (1994) as a direct continuation of the St. Catherina dome to the E under the Tertiary sediments.

Several metamorphic and microstructural changes can be observed in metagranites with low intensity of deformation and these are identical in samples from the exposed part of the St. Caterina dome and from the basement of the North Bohemian basin. Phase changes are represented mainly by the crystallization of garnet on the contact between biotite and plagioclase. Garnets rich in calcium and manganese form several ?m thin rims around biotite crystals. Biotites in immediate vicinity are unstable and form microscopic intergrowths with quartz or feldspars. Garnet also appears as irregular clusters within muscovite-rich domains usually associated with fine-grained alumosilicate. These muscovite-rich domains probably represent pseudomorphs after some Al-rich minerals (cordierite?) forming primary mineral assemblage of undeformed granite.

Microstructural observations suggest that the crystallization of garnet is a result of the reaction $Plg + Bt + SiO_2 = Kf + Gt + H_2O$ or, alternatively $Plg + Bt + SiO_2 = Ms + Gt$ in the CNKFMASH system. We have performed estimates of metamorphic temperatures using garnet-biotite thermometer and these preliminary results show that garnet originates at temperatures of 600–650 °C. We have no direct evidence, which of K-bearing phases represents product of the above-described reaction. However, it is likely that the later formulation is correct as the stabilization of K-feldspar at the expense of muscovite and biotite is restricted to relatively high temperatures. Preliminary estimates of metamorphic temperatures provide values fairly well corresponding to those estimated for the Krušné hory parautochthon. Further work will be focused on thermodynamic modelling of garnet-producing reactions in terms of pressure and temperature. Particularly the pressure estimates are crucial for understanding the tectonic relationship between orthogneisses of the St. Catherina dome and the overlying high-pressure metasediments.

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