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Contents

Editorial

This special volume is an outgrowth of the International Conference on the Bohemian Massif, assembled in Prague, Czechoslovakia, between September 26 and October 3, 1988, under the name "Bohemian Massif, its structure, pre-Mesozoic history and relation to European geological units".

This conference was the first meeting to discuss general aspects of the Bohemian Massif. Oral and poster contributions embraced a wide range of topics, namely:

a) Geological and geophysical structure of the Earth's crust and Upper mantle of the Bohemian Massif;
b) Geochronological and geochemical data and their significance for the development of the Bohemian Massif;
c) Orogenic, magmatic, metamorphic, sedimentary and metallogenic history of the Bohemian Massif up to the Mesozoic;
d) Geotectonic modelling.

The organizers tried to confront new models of a geotectonic history of the Bohemian Massif, to show the importance of modern methods and their application to the Massif.

This volume contains 63 contributions some of them of considerable length, some others presented as enlarged abstracts. The manuscripts have been reproduced mostly directly from material submitted by authors, only minor corrections and editorial changes had to be made. Thus, the authors themselves are responsible both for the contents and language of their contributions.

The papers are arranged alphabetically by first author.

As editor of this volume, I would like to draw the attention to some achievements and to inform briefly about the character and importance of contributions. I also appreciate invaluable help from my colleagues of the Geological Survey of Prague, especially the members of Editorial Department of this Survey.

Paper by Vl. Zoubek et al. can be taken as an introduction, because it shows a progress towards understanding of the structure and history of the Bohemian Massif. It clearly shows number of problems which remain, confrontation of stratigraphic concepts with tectonic ones and geosynclinal concepts with plate tectonic models. J. Vacek (chairman of the Conference) with his coauthors informs about the project "Stratigraphy" the main result of which is a set of 18 stratigraphic tables. They were on exhibition during the Session. Some most important achievements concerning the stratigraphy of the Bohemian Massif are summarized in this paper. Short review of geophysical investigations is given by M. Blížkovský et al. It summarizes some results recently gathered and interpreted by a team of geophysicists and geologists. Geological interpretation of a structural geologic map of the pre-Upper Carboniferous units is presented by O. Kumpera et al. This pattern mirrors a long-lasting complicated evolution induced by differentiated thermal regime. The whole Bohemian Massif has been developed from the mozaic of the continental crust nuclei. M. Vaněček's overview concerns the metallogeny of the Massif, history of research, chronological development of the metallogeny, evaluation of tectonic conditions affecting the metallogeny and metallogenic subdivision of the Bohemian Massif. His brief contribution shows that the metallogenic and also geological history of the Massif is so complex that there are still many fundamental problems to be solved. New structural map of the European basement is presented by J. Holubec. This map shows the Earth's crust divided into segments of inner arcuate organization. Segments have developed from the Archaean up to the Recent in the same tectonic pattern. The Bohemian Massif is subdivided into major tectonostratigraphic units by J. Chaloupský. This author emphasizes vertical movement and existence of long-living tectonic structures. Two papers concern the palaeomagnetic data derived from the rock units of the Bohemian Masif (M. Krs and M. Krs et al). Its position during the Upper Carboniferous and the Lower Permian was reconstructed showing tectonic deformations of the rotational character in the Upper Carboniferous, due to the Variscan orogenesis. Rock formations of the Middle and Upper Cambrian point to a drift from the southern hemisphere, approximately from 40° (± 10°) south latitude northwards.

Geophysics is represented by numerous papers. M. Blížkovský et al. inform about the linear structures. Seven such structures have been distinguished by means of interpretation of gravity, magnetic, radiometric, seismic and geoelectric data. Geoelectric measurements are described by J. Gruntorád et al. On this basis precise tectonic scheme was constructed for the uncovered part of the Bohemian Massif and tectonic zones localized. The results of geoelectrical methods were confronted with the results of gravimetry and magnetometry. K. Dědáček et al. write about new airborne geological survey and mention some

important conclusions drawn from it. Magnetic anisotropy is a subject described by F. Hrouda. NE part of the Massif display fabric data of the ductile deformation development. Magnetic fabric is deformational in origin not only in crystalline rocks but also in sediments. Orientations are similar in the two types of formations and from this it follows that there was at least one deformation phase that affected all the rock types and geological units. This phase overprinted originally sedimentary magnetic fabric and multistadial deformation of magnetic fabric in crystalline rocks. The relationship between the terrestrial heat flow and heat generation is evaluated by L. Ostřihanský. M. Chlupáčová et al. measured natural radioactivity in the Devonian metavolcanites. Th, U and K contents speak in favour of continental rift origin of primary volcanites.

Structural pattern and deformational history is an important subject of this volume. R. Benek reconstructs late-Variscan strike-slip movements in northern Central Europe; as to him Late Palaeozoic strike-slip movements belong to the main features of the last stage of the Variscan tectonic processes. The paper by E. Stein deals with a transitional area between two major tectonic unis, Saxothuringian and Moldanubian zones in the NE Bavaria. The results have been achieved mainly during the pre-site studies of the Continental Deep Drilling Project (KTB) in the target area Oberpfalz. Polyphase structural and metamorphic development in the Moldanubian region as well as in the Saxothuringian zone developed during the same orogenic event under low pressure and high temperature conditions. This metamorphism occurred 320 Ma ago. K. Schulmann et al. inform about the kinematics of Variscan shear deformation in Moldanubian polymetamorphic complex in SW Moravia. They defined the geometry of ductile thrusting during early Variscan compression and the geometry of later ductile to brittle-ductile extension. The ductile thrusting from the NW to the SE resulted from the original compressional tectonics. The ductile thrusting and thickening of the crust occurred probably before 345 Ma. History of deformation and metamorphosis in the Silesicum is reconstructed by J. Cháb et al. They define six deformational and four metamorphic events. The maximum temperature reached 500—600° C and maximum pressure more than 0.4 GPa. J. Plamínek applied recently proposed method of morphometric fold analysis to the set of more than 11,000 folds from the Bohemian Massif. Mechanics of formation of a nappe structure in the SE part of the Bohemian Massif is described by J. Jaroš. He concludes that the nappe structure is a dominant feature of at least western part of the Moravosilesian zone, including the eastern part of Moldanubicum, from Poland to Austria. R. Grygar's contribution concerns the geotectonic development of the Moravo-Silesian region, whereas J. Zapletal reconstructs the tectonic movements during the Viséan on the basis of conglomerate composition. The amount and maturity of conglomerates should reflect tectonic mobility and this author proves that they really do!

The study of magmatic, metamorphic and radiometric data leads to detailed modelling of parts of the Bohemian Massif. K. Vokurka and B. Kober investigated volcanites from the northern Bohemia in order to find their sources. Peridotite nodules seem to represent upper mantle fragments and they were brought to the surface during the Tertiary by ascending basaltic magma. This magma according to Sr isotope data might have been originated from the Earth's lower mantle. E. Fediuková summarizes PT conditions for the Bohemian and Moravian mantle rocks, i.e. eclogites, peridotites and mantle xenoliths. The range of T °C is 800—1232 whereas of P GPa 1.71—4.3. Two ophiolite complexes are situated on peripheral parts of the Bohemian Massif (Mariánské Lázně complex and Letovice complex). J. I. Wendt et al. determined U-Pb zircon ages from several Moldanubian rock units. The oldest rock unit in Bohemia is a foliated granodiorite within metasediments of the Varied Group (2,048 ± 12 Ma). Age range for detrital zircons of the source material of the Varied Group is 1,500—2,000 Ma, while 550 Ma is a minimum age for sedimentation of the Varied Group.

S. Vrána described a pattern of a polyphase evolution of imbricated crustal and upper mantle segments in the Moldanubian zone in southern Bohemia. J. Souček et al. studied geochemistry of gneisses of the eastern margin of the Bohemian Massif. Most of them are dominant by leucocratic lithologies. On the basis of major and trace element distribution the major component of the protoliths of the gneisses is shown to correspond to strongly differentiated upper crust, particularly acidic igneous material. There is also evidence for a sedimentary component. Saxothuringian zone, its magmatic history in the Erzgebirge (Krušné hory) Mts. and its relation to the geological history and structure, this is a subject described by A. Frischbutter et al. I. Wojciechowska presents a paper on metabasites in the Kłodzko metamorphic unit (Poland). Dating of metamorphic processes and geochemical data indicate that volcanites represent remnants of the oceanic crust. The contribution by R. Thomas contains a history of magmatism along the northern border of the Bohemian Massif according to experimental studies on silicate melt inclusions in rock-forming minerals. Rb-Sr systematics of granitoid rocks of the South Bohemian Pluton is given by S. Scharbert. Some granites represent mixtures of two contrasting types of granites. W. Kramer et al. studied rare elements in basic magmatic rocks near the northern margins of the Bohemian Massif, i.e. gabbroic, basaltic, shoshonitic and lamprophyric rock units. Their tectonic and also metallogenetic relations are mentioned. L. Kopecký, on the other hand, recognized the effects of the basement on the development of the Neoidic Ohře rift in Northern Bohemia. This basement markedly differs from the Moldanubian and

Saxothuringian zones in neighbouring areas. U. Schüssler et al. describe petrology and geochemistry of metabasites and gabbroic rocks from the Teplá—Domažlice zone. Amphibolites, metagabbros, and eclogitic relics of the Mariánské Lázně complex together with the amphibolites of the Černá Hora Massif exhibit a geochemical characteristics which compares well with modern mid-ocean ridge basalts. The pre-site studies of the German Continental Deep Drilling Project (KTB) led to a new paleotectonic concept for the western part of the Bohemian Massif, influenced by plate tectonic models. The essential point of this concept can be characterized as a collision and thrusting of the Moldanubian onto parts of the Saxothuringian zone. Subsequent to the collision both units were partly overthrusted by a nappe complex. Moldanubicum and Saxothuringicum were welded by a last low-pressure metamorphic event 330-320 Ma ago. H. Kreuzer et al. present the results of K-Ar dating in the Teplá—Domažlice zone,namely for the Mariánské Lázně metabasic complex. The data resemble the Early Devonian pattern determined for the Münchberg Gneiss Massif and the Ebendorf—Vohenstrauss zone of northeastern Bavaria. All the three units are remnants of a huge complex which suffered a metamorphic overprint, probably in the Early Devonian. Western Bohemian region appears also in paper by D. R. Bowes et al. The protoliths of the Mariánské Lázně complex contain rocks with ophiolite aphinities. Tectonic history of the Teplá—Barrandian segment of the Central European Variscides together with deformational phases is reconstructed. First author compares in second paper Scottish Caledonides with the Bohemian Massif. He sees major difference in the expression of the Variscan activity. In the Bohemian Massif new high grade metamorphic rocks developed including granulites. There was no major Early Palaeozoic tectonothermal event between the Cadomian and Variscan orogenies.

A. B. Vrevsky's paper concerns the eastern Baltic Shield. The oldest core of this shield is represented by Karelo-Kola geoblock which formed as a single entity about 2.6-2.5 Ga ago. The Austrian part of the Bohemian Massif is described by G. Fuchs. Moldanubicum is, as to this author, an agglomeration of Cadomian nuclei and Caledonian orogenic zones. F. Finger et al. present new data on the petrology of the Late Palaeozoic granitoid complex in the southern Bohemian Massif in Austria. Geological and petrological data are completed by ND and isotopic data. Older, syn-orogenic (Early Carboniferous) and younger, late- to post-orogenic (Upper Carboniferous) granitoids are differentiated. G. Hirschmann follows the connections between Moldanubicum, Bohemicum and Saxothuringicum from a lithostratigraphic viewpoint. The geological history of Central European Variscides is reconstructed according to a plate tectonic model. The units of the Bohemian Massif cannot be considered to have been far-travelled parts of different continents. They are no sufficient arguments in favour of large Palaeozoic oceans between some or all the units of the Bohemian Massif.

M. D. Krylova informs about joint Soviet-Czech research programme which has been concentrated on the oldest and highly metamorphosed parts of the Bohemian Massif — Moldanubicum. Geochemistry of biotites, garnets, diopside, hypersthene, kyanite and sillimanite is described. Some elements in metamorphic minerals are temperature indicators, as Ti, Ba, Cr and B. Their amounts increase with increasing temperature. F. Patočka reconstructs source rocks of the metamorphosed pelitic sediments on the basis of their minor element geochemistry. The paper by J. Jehlička deals with graphitization of organic matter in the Upper Proterozoic. Transmission electron microscopy reveals that detrital graphite occurs together with turbostratic carbon. In-situ formed graphite was not found. J. Bendl and K. Vokurka describe the origin of Blatná granodiorite, important part of the Central Bohemian pluton. It consists of 30—50 p.c. of mantle derived and 50—70 p.c. of crust derived material and crystallized at the time close to – 331 Ma. P. Tondar and G. Troll investigated zircons from Moldanubian leptynites in Bavaria. These rocks were originally rhyolitic Upper Proterozoic and Lower Palaeozoic volcanites.

Some sedimentary basins are described which might serve as good criteria of a Variscan orogenesis and pre-Variscan sediment distribution. J. Hladil's paper describes the zonality of carbonate sediments in Moravia and shows an impact of tectonic events on the distribution of Devonian carbonates. J. B. Miecznik reveals evolutionary history of the Intra-Sudetic basin in relation to the Variscan orogenesis. Short paper by G. Weiss deals with Carboniferous basin on the eastern margin of the Bohemian Massif. Two papers deal with so-called "Islet Zone", possible connecting link between the Barrandian and Moldanubicum (I. Chlupáč, V. Kachlík). First author sees in these metamorphosed Palaeozoic relics evidence for wide primary distribution of Palaeozoic sediments. J. Krejčí informs about interesting occurrences of hydrocarbons in crystalline rocks of the Bohemian Massif.

Set of papers deals with the metallogenesis. J. H. Bernard informs about the Project "Metallogeny of the Bohemian Massif 1986—1990" giving the age of pre-Variscan stratiform mineralization by isotopic data on lead in galenas. M. Štemprok's general paper characterizes tin and tungsten bearing granitoids. The author believes in the association of tin mineralization with mantle hot spots; that means, the effect of crust as well as of the mantle should be considered in interpretation of the metallogeny of the Bohemian Massif. Several papers concern specially Erzgebirge (Krušné Hory) Mts. as that by H. Kämpf et al. The Erzgebirge-Vogtland block is a classical tin-tungsten and fluorspar province in Europe. G. Tischendorf

reconstructs the history of silicic magmatism and metallogenesis in this area. H. J. Förster and G. Tischendorf describe tin-tungsten-molybdenum bearing granites of the same area and state that these postkinematic intrusive complexes belong to the most extensively physicochemically characterized felsic rocks within the Bohemian Massif. R. Seltmann et al. characterize tin-bearing endogenetic breccias of this area. J. K. Novák et al. inform about new discoveries about tin mineralization and define multiphase intrusions of granites and monzogranites. Last mentioned paper is by M. René and concerns the uranium mineralization in the western parts of the Bohemian Massif. He concludes that there is no direct relationship between the Variscan magmatism and uranium mineralization.

Conclusion

Numerous subjects discussed at the Conference revealed many unsolved problems. This is clear also from the Book of Abstracts which had been issued earlier. The lack of more comprehensive radiometric, paleontological and also petrological data leads to the confrontation of several evolutionary models of the Bohemian Massif. Some principle problems remain as "Is the Bohemian Massif mozaic of far-travelled terranes or is it a complex where vertical movements prevailed?" or "What is the age of Monotonous and Varied series of the Moldanubian zone?" "What was the main metamorphic event having affected these rocks?" "What was the role of strike-slip movements?" etc. We firmly believe that the avalanche of new data and application of modern methods within the realms of international projects will resolve many of these problems in the near future.

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