Palaeozoic Polyphase Tectonothermal Record in the Krkonoše-Jizera Crystalline Unit (West Sudetes, Czech Republic)

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The northern and northeastern margins of the Bohemian Massif (the West Sudetes) are a complex mosaic of the distinguished crustal units which are considered to be suspected terranes defined according to autonomous stratigraphic, igneous and tectonometamorphic records. Terrane juxtaposition is the result of multiple collisions of the Gondwana supercontinent-derived microplates with Baltica and/or East Avalonia, and subsequent late Variscan large-scale shear movements.

In considerations on the terrane evolution of the West Sudetes a key role is attributed to the Krkonoše-Jizera Crystalline Unit (= terrane). The major part of this suspected terrane is occupied by large antiform of the Izera and Krkonoše gneisses (metamorphosed Cambrian to Ordovician granitoids). In the core parts it is intruded by the late Variscan Krkonoše-Jizera granite pluton. Its southern and eastern rims consist of the Early Palaeozoic metamorphosed volcano-sedimentary sequences of the South and East Krkonoše Complexes. The Ještěd Unit (comprising also the Late Devonian to Early Carboniferous volcano-sedimentary suite) represents an autonomous domain on the W of the Krkonoše-Jizera terrane. The above mentioned units are showing considerable diversity both in the metamorphic grade and protolith composition, and are tectonically bounded for the most part.

The succession of Palaeozoic tectonothermal events is recorded in the metamorphosed igneous and sedimentary rocks of the Krkonoše-Jizera terrane; the sequence of the events was precised by the Ar-Ar age determination method on micas. The results distinguished several prominent ages:

(1) ca. 465 Ma (Middle Ordovician) age on the detrital muscovite from the Ordovician (-Silurian?) quartzite of the Poniklá Group. A medium- to coarse-grained rock (of granitoid or migmatitic type) is presumed to be the source rock according to the muscovite grain dimensions. The age corresponds to the interval 450-500 Ma determined by Rb-Sr whole-rock method for the Izera and Krkonoše gneisses and Rumburk granite (considered to be the gneiss protolith) (Borkowska et al. 1980). It also approximates the 480-515 Ma range of the U-Pb and Pb-Pb zircon data which were measured on the various types of the Izera and Krkonoše gneisses and granites, and interpreted as the magmatic origin ages (e.g. Kröner et al. 1994). The origin of the granitoid protolith of the Izera and Krkonoše gneisses is considered to be related to the Early Palaeozoic incipient rifting of the Cadomian basement of the Lusatian and Krkonoše-Jizera terranes (Borkowska et al. 1980, Kryza and Pin 1997, Bialek 1998, Kachlík and Patočka 1998). The intracontinental rift tectonic setting is evidenced by the bimodal volcanism of the South and East Krkonoše (Winchester et al. 1995, Patočka et al. 1997, Fajst et al. 1998) and Kaczawa Mts. Complexes (Furnes et al. 1994) which peaked around the Cambrian/Ordovician boundary (Oliver et al. 1993, Bendl and Patočka 1995).

(2) ca. 360-365 Ma (Late Devonian) group of ages on the mafic blueschists of the East Krkonoše Complex. According to Maluski and Patočka (1997) they date cessation of the HP-LT metamorphic event (related to subduction of oceanic lithosphere?) which was rather ubiquitous in the Krkonoše-Jizera terrane (with the exception of the Ještěd Unit) (Kachlík and Patočka 1998) . The South Krkonoše Complex mafic metavolcanics display lower blueschist facies assemblages (Fediuk 1962, Fajst et al. 1998) documenting an incipient HP-LT metamorphism. The metabasites of Early Palaeozoic protolith age, which comprise relics of the early Variscan blueschist facies assemblages, are described also from the Lusatian Unit (Tröger 1936, Kramer 1988) and the Jáchymov Group in the Erzgebirge Mts. (Souček 1987). The mafic rocks showing certain effects of the Variscan subduction-related HP-LT metamorphism are thus distributed throughout the northern realms of the Bohemian Massif and may be interpreted as markers of a dismembered suture zone.

(3) ca. 340-345 Ma (Early Carboniferous) group of ages on the East and South Krkonoše metabasites. Maluski and Patočka (1997) considered this age to date the greenschist up to lower amphibolite facies metamorphic overprint which was subsequent to the early Variscan HP-LT metamorphic event, and connected with the onset of the Early Carboniferous tectonic uplift of the deeply subducted crustal slices (e.g. Kachlík and Patočka 1998).

(4) 320-325 Ma (the earliest Late Carboniferous) ages yielded by the Early Palaeozoic mafic mevolcanics and graphite phyllites as well as by the Izera and Krkonoše gneisses. They are interpreted as the time of the major late Variscan shearing and thrusting which produced the dominant composed NW-SE directed linear fabric of the Krkonoše-Jizera terrane. The later phases of this process may be contemporaneous with the Krkonoše-Jizera granite pluton emplacement dated at 328+/-12 Ma according to Rb-Sr whole-rock isochron (Pin et al. 1988).

(5) 313-314 Ma (Late Carboniferous) ages on the contact aureole rocks of the Krkonoše-Jizera granite and the related minette (e.g. Fediuk 1962). The ages show the uppermost limit of duration of the Variscan magmatic and tectonometamorphic processes, including the pluton metamorphic zone cooling below closing temeprature of micas, and the late-tectonic granite intrusions - e.g. of the leucogranites cross-cutting the Krkonoše-Jizera granite which provided Rb-Sr pooled isochron of 310+/-5 Ma (Mierzejewski et al. 1994).

The cooling age of 465 Ma of the detrital muscovite from the Ordovician(-Silurian?) quartzite indicates that the mineral iso-

topic system was undisturbed by the younger phases of tectonothermal history. However, the muscovites of two blueschist samples from the structurally underlying tectonostratigraphic subunit (from the transition between the East and South Krkonoše Complexes) provided ages of 320-325 Ma which evidence a complete resetting of the previous blueschist event (terminated at 360 Ma). On the contrary, in the East Krkonoše Complex, the LP-HT overprint at ca. 340-345 Ma simply followed the HP-LT event, and left its record quite undisturbed.

The Middle Ordovician detrital muscovite found in the Poniklá Group quartzite - providing the oldest determined Ar-Ar plateau age, i.e. the event (1) age - documents not only the Early Palaeozoic age of the above described (intracontinental rift-related?) granitoid intrusions in the Krkonoše-Jizera terrane (Borkowska et al. 1980, Bialek 1998 etc.) but also the lowermost age limit of the quartzite precursor sedimentation. The latter statement seems to be well correlated with the Ordovician age of the rather diversified deep-water ichnofossil assemblage from the roofing slates underlying the quartzites (Chlupáč 1997, Kachlík and Patočka 1998).

The distribution of the other Ar-Ar ages - dating the above mentioned orogenic events (2) to (5) - suggests that the Variscan polyphase tectonothermal development affected individual tectonostratigraphic units of the Krkonoše-Jizera terrane in different ways. The differences reflected the propagation of the orogenic wedge from the SE towards NW and different rates of exhumation in individual tectonic domains. The deformational front migration is evidenced by both inverse metamorphic pattern (from chlorite zone on the northwestern side up to garnet zone on the eastern side) and reversed stratigraphic ages (the Late Devonian to Early Carboniferous units are overthrust by several Early Paleozoic crustal slices). This structural pattern was modified by late postorogenic extension and shearing. The present position of the Krkonoše-Jizera terrane units is the result of the late Variscan (Late Carboniferous) juxtaposition.

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