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The blueschits from the Kopina Mt., West Sudetes, Poland – what do they tell us about accretion of the Variscides?

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Blueschists are tracers of sutures, thus marking fossil subduction zones at convergent plate boundaries and providing important constraints on plate tectonic reconstructions. Their occurrences are scarce in the Variscan belt owing to a strong collisional overprint but just because of that each locality deserves particular attention. The Variscan blueschists must have formed during the early stage of the Variscan Orogeny and may represent a vestige of missing marginal basins fringing the Rheic Ocean at the onset of subduction.

The studied rocks from the Kopina Mt. consist mainly of garnet, glaucophane, clinozoisite-epidote, chlorite-I, titanite, hematite and quartz. The original high-pressure assemblage is overprinted by later, lower pressure paragenesis, which comprises mostly Ca-amphiboles, chlorite-II, albite and K-feldspar. The latter occurs in polymineral inclusions in other phases together with albite and chlorite that are interpreted as phengite breakdown products. Garnet shows chemical compositional variation from Alm54Prp3Grs30Sps13 in the cores to Alm66Prp4Grs29Sps1 in the rims. The almandine zoning is bowl-shaped, whereas spessartine profiles show bell-shaped trends. The grossular and pyrope contents are generally constant throughout the grain. Rather gradual changes in the chemical zoning suggest a progressive, one-step garnet growth pattern. Glaucophane, although commonly well preserved, in some cases disintegrates to the albite-chlorite assemblage.

The pressure-temperature (P-T) conditions were estimated using the phase equilibrium modelling in the NCKFMMnASHTO system using the Perple_X software. The compositional isopleths cross cut in the stability field of Grt+Gln+Ep+Chl+Pheng+Ttn+Hem+Q. P-T estimates indicate that the peak conditions occur at c. 14-17 kbar and 470-500°C, which corresponds to quite a low geothermal gradient in the range of 8-10°C/km.

The P-T conditions estimated lie on a low temperature geotherm that is typical for a relatively cool subduction of the oceanic crust. Therefore, the origin of the studied rocks dates back to the time preceding accretion of the eastern Variscides and defines one of the key tectonic boundaries in the Bohemian Massif. A mechanism for syn-collisional emplacement and exhumation of the Kopina blueschists can be tentatively explained through activation of the double subduction system operating towards the east. First subduction commenced already in the Early Devonian and operated beneath an island arc located in proximity to the Saxothuringian margin, within the Rheic Ocean. After the mid-Devonian exhumation of the Central Sudetes allochthon, another subduction system was initiated along the eastern margin of the Rheic Ocean, beneath the Brunia microplate. Subducted oceanic crust of the Rheic Ocean (including the Kopina Mt. blueschists) reached peak metamorphic conditions in the Late Devonian, the event pronounced by a continental arc volcanism along the Brunian margin. Exhumation of the subducted oceanic crust was accommodated by the slab roll-back, which is inferred from the bimodal age and spatial distribution of the volcanic activity within the Brunian active margin. Shortly after the Kopina Mt. blueschists exhumation this eastern subduction system became probably inactive. In contrast, the western one involving the Saxothuringian margin was still operating leading to the subsequent collision with Brunia in the Early Carboniferous that produced a widespread high temperature overprint mostly wiping up the earlier metamorphic history.