EMPLACEMENT AND TRANSPORT OF FELSIC MATERIAL BELOW THE MOLDANUBIAN CRUST IN THE BOHEMIAN MASSIF. INSIGHTS FROM NUMERICAL MODELING

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The Bohemian Massif is a well-preserved part of the Variscan Orogeny with wide varieties of igneous and metamorphic rocks documenting both subduction and collisional events. Discrepancy exists about the number and forms of the microplates involved in the orogeny and direction of subduction that make it difficult to reconstruct tectono-magmatic evolution of the massif. The pressure–temperature conditions determined for the gneisses and granulites of the Bohemian Massif (Gföhl Unit in the Moldanubian zone) predict continental crust to be buried to mantle depths (> 100 km), than exhumed, shortly underwent ultrahigh-temperature metamorphism at lower crustal depth, and finally be exhumed to middle-to-upper crustal depths. There are two contrasting models explaining formation and exhumation of these rocks: a classical continental crust subduction model with its following exhumation, and a continental crust underthrusting, where the continental crust of the subducted plate penetrates the crust-mantle boundary of the overriding plate, and finally is extruded into middle crust. Few attempts to numerically reproduce the structures of the Bohemian Massif were made on the assumption on the “crustal underthrustig”, although none of the models focused on the appearing of this felsic material at the lower crustal level of the Moldanubian zone before the extraction. We investigate this problem using a coupled petrological-thermomechanical tectonic-magmatic numerical approach. The preliminary results show that any appearance of felsic crust with the required characteristics of the Gföhl Unit in the Moldanubian zone at the lower crustal level is possible only if the continental crust subducts to the deep levels and then exhumes upwards in the overlaying crust. There is two ways how the subducted continental crustal material could percolate into the overlying crust: either along the subduction channel or in form of diapir through the lithosphere of the overriding plate weakened by upward percolation of the extracted melts/fluids. In the first case the partially molten continental crust exhumes vertically towards the surface at the boundary between two plates and at the ongoing collision could theoretically expand towards the overlying plate and percolate the overlying crust a bit further. This scenario is quite close to the idea of “crustal underthrustig” for the Bohemian Massif. Nevertheless, it is difficult to explain the preservation of a continental block (Tepla-Barrandian block), and the appearance of ultra-high-temperature eclogites and peridotites in the Moldanubian zone. The exhumed material is composed in this case mostly from the subducted partially molten upper continental crust, including some eclogites and mantle from the low level (max. 2.5 GPa). The experiments with crustal diapirism show contrariwise the complex structures of the perculating diapirs including the blocks of the deeply subducted oceanic plate and the serpentinized mantle from the mantle wedge. Thus, the preliminary results of the numerical experiments do not support the “crustal underthrusting” model, but rather agree with an idea of initial subduction with subsequent exhumation of the felsic crust from the Gföhl Unit in form of a diapir, although none of the models can explain so far all geological-petrological data available.