ABSTRACT

The formation of collisional orogenic wedges involves complex polyphase deformation and metamorphism. This study reveals the tectonic evolution, internal architecture and the timing of the Variscan orogenic wedge evolution in the Saxothuringian Domain (Bohemian Massif). The studied area is the Erzgebirge Crystalline Complex, characterized by numerous occurrences of the *(U)HP* rocks. In contrast, the surrounding metasediments have been scarcely studied, although they provide an important link between deep subduction and mid-crustal processes. Using field structural geology, petrology, thermodynamic modelling and geochronology (monazite U-Pb and mica $^{40}Ar/^{39}Ar$ dating), we constrained the *P–T* conditions and timing of four deformation events (D1-D4) identified by structural analysis. Several transects from the low-grade hanging wall phyllites to the footwall medium-grade micaschists have been investigated.

The first M1-D1 event is characterized by *HP–LT* minerals (garnet, chloritoid, phengite, paragonite, and rutile) defining the S1 foliation with an M1 peak pressure conditions increasing from 13 kbar and 520°C in phyllites to 25 kbar and 560°C in micaschists. The corresponding geothermal gradient of 6–11°C/km is typical for subduction environments. The M2-D2 event corresponds to the deformation and metamorphic overprint of the S1 fabric during partial decompression. The M3-D3 event is mainly developed in micaschists and becomes more intense towards the footwall. It is accompanied by the development of subhorizontal S3 cleavage and formation of *MP–MT* minerals (biotite, staurolite, muscovite and ilmenite). The M3 event reaches the peak temperature conditions of 5–9 kbar and 595°C representing a barrovian-type geothermal gradient of 17–30°C/km. Finally, all metamorphic fabrics were heterogeneously affected by the low-grade M4-D4 upright folding.

In order to link the ages with individual tectonometamorphic events, eight samples have been dated by monazite Laser-Ablation Split-Stream Inductively Coupled Plasma Mass Spectrometry and the $^{40}Ar/^{39}Ar$ geochronometer was used on micas to date 19 samples with CO_2-laser step-heating and *in-situ* UV-laser ablation. The resulting monazite ages and Rare Earth Elements patterns, coupled with white mica $^{40}Ar/^{39}Ar$ ages revealed that the phyllites experienced prograde metamorphism around 350 Ma followed by an exhumation at 345–340 Ma. The prograde *HP-LT* evolution in micaschists is constrained by large monazites in the matrix and oldest monazites enclosed in garnet core to be at least 339 Ma old. This suggests that the micaschists possibly entered the wedge slightly later than the phyllites. A following ductile thinning associated with the M3-D3 event was dated at 338–330 Ma. The monazite ages in micaschists and few $^{40}Ar/^{39}Ar$ ages in the deepest phyllites show that the region is then strongly affected by an event at ~330 Ma, interpreted as a lower-grade overprint during final exhumation or possible younger reactivation.

This study highlights the tectonic evolution marked by transition from the accretion of the subducted continental material to the building of the Saxothuringian orogenic wedge from ~360 to ~340 Ma. This process is manifested by thickening and partial exhumation within the wedge accompanied by ductile thinning in upper crustal levels. Finally, the late Variscan intracontinental deformation was responsible for orthogonal shortening, heterogeneous reactivation and final exhumation at 330 Ma. Based on our new data, we suggested that the Saxothuringian orogenic wedge could be divided into a younger inner part, formed by micaschists and *UHP* rocks, and an older outer part, formed by phyllites, both showing distinct metamorphic and structural evolution. The restoration of the wedge architecture reveals an early E-W zonation with *P–T* conditions increasing eastward and complexity of structural record as well as the change in lithology from units dominated by metasediments to units dominated by gneisses. The development of the current shape of the Erzgebirge antiformal dome resulted from subsequent orthogonal N-S shortening.

Keywords: Variscan orogeny, Saxothuringian orogenic wedge, Erzgebirge metasediments, thermodynamic modelling, monazite U-Pb and mica $^{40}Ar/^{39}Ar$ geochronology