THE PRE-METAMORPHIC HISTORY OF MOLDANUBIAN GRANULITES AND GFÖHL GNEISS IN LOWER AUSTRIA (BOHEMIAN MASSIF): CONSTRAINTS FROM TRACE ELEMENTS AND U-PB AGES OF ZIRCONS AND WHOLE-ROCK GEOCHEMISTRY

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The Gföhl Unit in the Austrian sector of the Molanubian Zone (Bohemian Massif) exposes large volumes of high- to ultra-high-grade Variscan metamorphic rocks of granitoid composition, mapped as “Gföhl Gneiss” and “granulite”. In an attempt to better understand the pre-metamorphic evolution history of these prominent rocks, we combined whole-rock geochemical (major, trace element and isotope data) with a LA-ICP MS zircon study (trace element and U-Pb analysis).

Based on whole rock geochemistry, the Gföhl Gneiss represents a felsic peraluminous, S-type granite. Remnant “magmatic” zircon domains with ages of ~ 480 Ma document an Ordovician protolith age for this rock type. Another group of inherited zircon cores are dated at around 550 Ma, indicating that the sedimentary source was deposited in Cambrian or lower Ordovician times. Ti-in zircon thermometry gives crystallization temperatures of ~750-850 °C for the granitic protolith, while “metamorphic” zircon overgrowth shells have higher Ti contents indicating that the Variscan metamorphism of the gneiss occurred at temperatures > 850 °C.

The granulites include predominately felsic and minor mafic variants. The former are leucogranites similar to the Gföhl Gneiss, the latter are peraluminous granodiorites with I-type or I/S transitional type source affinity in terms of their chemical composition. However, remnant magmatic zircon domains with oscillatory zoning show ages of ~ 440–400 Ma in both felsic and mafic granulites, hinting that they represent granitoid rocks that are younger than the Gföhl Gneiss protoliths. There is a marked difference in trace element compositions between the remnant magmatic zircons and the voluminous metamorphically grown zircons, which have lower P, Y and HREE but higher Ti contents. Ti-in-zircon thermometry indicates that the magmatic zircons formed at temperatures of 800–840 °C, whereas significantly higher temperatures of 890–940 °C are obtained from metamorphic zircons.