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Geochemistry, zircon U–Pb and Hf isotopic compositions of lower crustal rocks from the Góry Sowie Massif (Central Sudetes, SW Poland): New insights on the sedimentary origin and tectono-thermal evolution

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Devonian HP–UHP lithotectonic associations represent a pivotal element of Paleozoic evolution of the European Variscan belt across the continent from Portugal to Poland. The Góry Sowie Massif (GSM), located in the Central Sudetes, represents one of the best preserved outcrops of lower crustal rocks that experienced a protracted Devonian tectono-metamorphic history at the easternmost extremity of the belt. The area is surrounded by Devonian ophiolite remnants and Devonian to Carboniferous sedimentary basins in the northern and southern part, respectively. The GSM is mainly composed of paragneisses and subordinate orthogneisses, metabasites and granulite. The dominantly sedimentary association and the overall geotectonic setting contrast with the other km-scale granulite complexes in the Bohemian Massif that are dominated by felsic granulites and late Cambrian orthogneisses that experienced 340 Ma HP metamorphism. Weak Carboniferous overprint makes the GSM a key locality to better understand the Devonian stages of formation of HP granulites and provenance of the whole pre-Devonian lithological association. New U–Pb and Lu/Hf analyses were carried out on zircons from 4 migmatitic paragneisses, 3 felsic biotite-poor granulites and 2 biotite-rich granulites in the northern part of the GSM, and combined with geochemical analyses in order to constrain a source provenance and tectono-thermal history of the area. The paragneisses dominated by stromatic migmatite and felsic granulites occur as hundred meter-scale bodies associated with metric lenses of amphibolites, mafic and ultramafic rocks in the northern part of the massif.

Under CL, zircons from paragneisses and granulites show similar patterns characterized by oscillatory cores (Th/U>0.1) overgrown by dark homogenous metamorphic rims (Th/U<0.1). The cores record abundant Cambro–Ordovician population (492–545 Ma) and few Neoarchean to Proterozoic clusters, whereas the metamorphic rims yield younger ages between 381 and 402 Ma. In contrast, zircons from biotite-rich granulites provide a main peak at 499–531 Ma with a small younger cluster at 396–425 Ma and a minor older population at Neoarchean to Proterozoic. The main Cambro–Ordovician zircon populations show either positive εHf values (from 0 to +10) with TDMs between c. 0.68 to 1.2 Ga, pointing to production of juvenile magmas and could be consistent with a magmatic arc setting, or negative εHf values (from 0 to -21) with TDMs between 1.2 and 2.3 Ga, pointing to mixing process between juvenile magmas and Eburnean-Archean crustal component.

Based on classification and tectonic setting discrimination diagrams, the protoliths of granulites and paragneisses are geochemically analogous to graywacke and point to an active continental arc depositional setting dominated by Cambro-Ordovician detritus. The Cambrian sedimentary and possibly also felsic and mafic volcanic rock association was subsequently metamorphosed by a Middle Devonian HP tectono-thermal event coeval with the emplacement of the Devonian ophiolitic rocks surrounding the area. Therefore, the Devonian HP event is possibly related to large scale oceanic/continental subduction.