Permo-Carboniferous volcanism in Central Europe: an overview of volcanological and petrological aspects

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The Variscan Orogen and its northern foreland were affected by intense volcanic activity in the Late Palaeozoic times, culminating in the Late Carboniferous - Early Permian. This post-collisional volcanism was closely associated in space and time with regional extension, wrench faulting, Basin and Range-style tectonics, graben formation and deposition of continental siliciclastic successions. Over 2 km thick accumulations of dominantly felsic volcanic rocks occur in the North-East German Basin, largely concealed underneath several kilometres of younger deposits. Thinner, bi- to poly-modal volcanic sequences, crop out further south-east in numerous intramontane troughs in Saxony, in Lower Silesia (including the Sudetes region) and in northern Bohemia. The felsic volcanic rocks were emplaced as shallow-level laccoliths, lava domes with associated pyroclastic deposits and ignimbrites, whereas the mafic rocks erupted as lava flows from fissures and shield-type volcanoes, or intruded as high-level sills. Diatremes and related phreatomagmatic deposits are found in some basins; calderas with related rhyolitic ignimbrites are most typical of uplifted inter-basinal basement highs. Trachyandesitic shield volcanoes, rhyolitic maars, multivent lava-dominated volcanic centres, ignimbrite-related caldera, together with associated laccoliths and sills were identified in the Intra-Sudetic Basin. Recent studies in the Krkonose Piedmont Basin and in the central part of the Intra-Sudetic Basin reveal also accumulations of pyroclastic and other volcaniclastic deposits of basaltic to andesitic composition, possibly related to pyroclastic cones.

The Permo-Carboniferous volcanic rocks between the northern/central Germany and the northern Bohemia were erupted through a heterogeneous collage of terranes accreted to the southern margin of Laurussia during the Variscan Orogeny. Palaeogeographic reconstructions point to the closure of oceanic basins and subduction of both oceanic and continental lithosphere underneath that region in Devonian-Carboniferous times. The volcanic rocks discussed typically show calc-alkaline, supra-subduction zone-like geochemical and isotopic signatures. These characteristics in mafic rocks may partly be inherited from their lithospheric mantle sources modified by subduction-related metasomatism, and partly may reflect interaction of mantle-derived magmas with crustal components during shallow-level differentiation processes. The formation of more evolved, andesitic to rhyolitic magmas, is mainly attributed to assimilation-fractional crystallization processes. The geochemical variations in space and time, both on regional and local scales, reflect mantle heterogeneities, as well as specific differentiation processes operating in distinct volcanic systems. However, detailed interpretations are hampered by still insufficient data on individual volcanic centres, on the emplacement age of successive volcanic units, by the general paucity of primitive-composition lavas, and by the post-magmatic alteration of volcanic rocks, variably obscuring the original mineralogy as well as the geochemical and isotopic signatures.