Variscan Tectonic Evolution of the Sudetes

Zbigniew CYMERMAN

Polish Geological Institute, Lower Silesian Branch, ul. Jaworowa 19, 53-122 Wrocław, Poland

The Sudetes are composed of Proterozoic and Palaeozoic sequences affected by Cadomian, Caledonian and Variscan deformations and intruded by Cadomian and Variscan granitoids. Crustal blocks showing pronounced contrasts in stratigraphy and metamorphic grade are bounded by major ductile shear zones. Deformation of Variscan age commenced in Late Devonian time, locally concurrent with a phase of HP metamorphism, continued to Early Carboniferous time with crustal imbrication under widespread greenschist to amphibolite facies conditions. Extensive HT-LP recrystallization associated with Late Variscan granitoid intrusions has almost obliterated the earlier HP metamorphism evidence.

Structural, kinematic and radiometric data lead to new conclusions about the Variscan orogenic history of the Sudetes (Fig. 1). Two major structural events characterise the Variscan tectonic evolution of the Sudetes: (1) Late Devonian-Early Carboniferous regional-scale ductile thrusting, and (2) Early Carboniferous-Early Permian regional extension.

The Late Devonian-Early Carboniferous regional-scale ductile thrusting is characterised by: (i) a generally NNE-directed, dextral transpressional stacking of ductile nappes due to oblique collision of the Moldanubian and Moravian microplates in an eastern part of the Sudetes, and (ii) SW- to NW-directed, sinistral transpressional stacking of ductile nappes due to westward lateral extrusion of continental crust (the Izera complex -IZC and the South Karkonosze complex - SKC) in the western part of the Sudetes as a result of almost frontal indentation of the oceanic lithosphere (SOC) (Fig. 2). A geotectonic model for the evolution of the western part of the Sudetes is consistent with lateral escape as an important way of accommodating the early Variscan deformation in the Sudetes. This mechanism explains lateral expulsion as due to the indentation of the Sleza ophiolitic complex (SOC) along with the Góry Sowie complex (GSC) during the subduction of the Rheic Ocean.

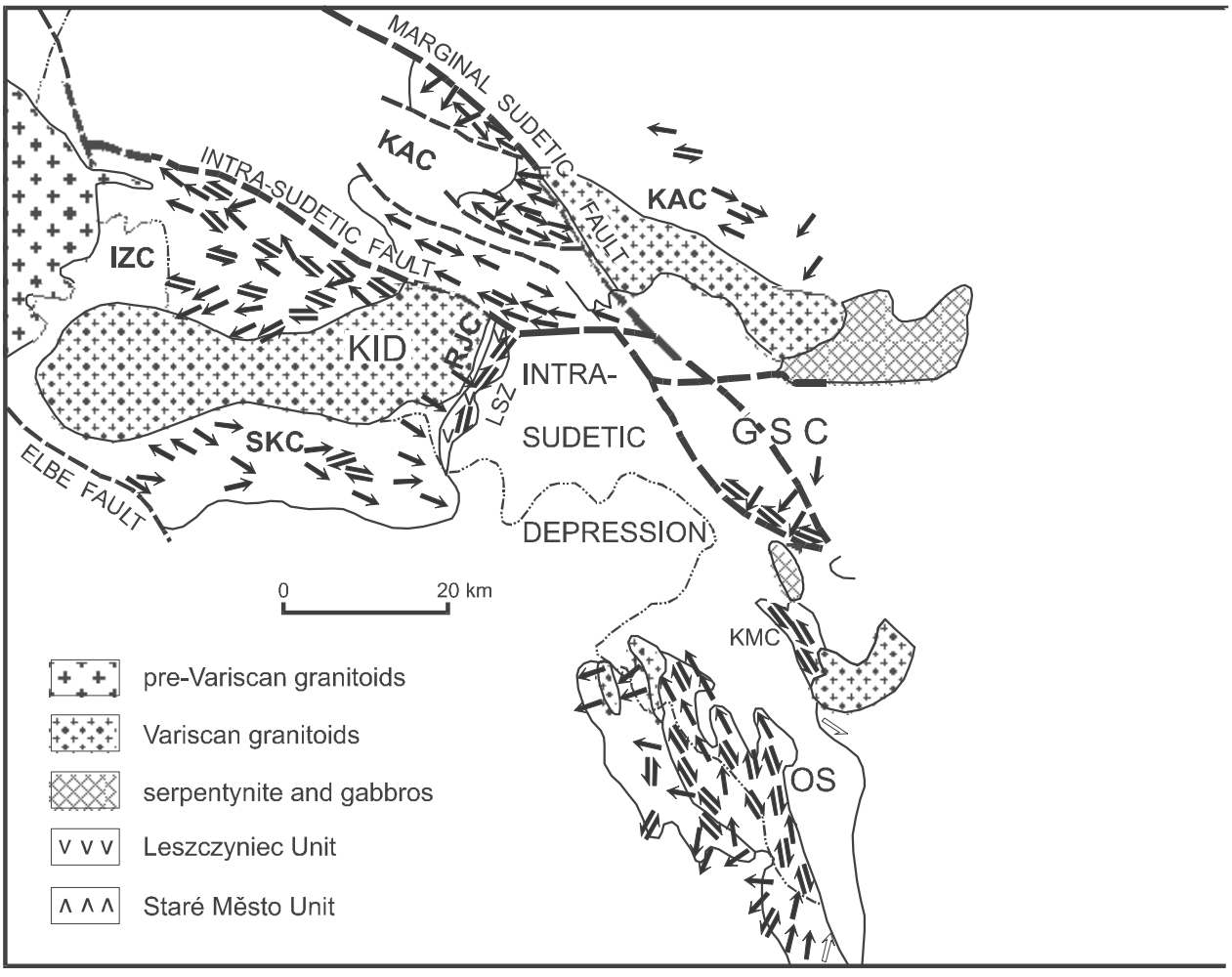

Fig. 1. Schematic structural-kinematic map of the Sudetes. Arrows indicate sense of shear.
ESD - East Sudetic Domes, GSC - Góry Sowie complex; IZC - Izera complex; KAC - Kaczawa complex; KMC - Klodzko complex; LSZ - Leszczyniec shear zone; NSZ - Niemcza shear zone; OSD - Orlica-Snieznik Dome; RJC - Rudawy Janowickie complex; SKC - South Karkonosze complex; SOC - Sleza ophiolite complex; SMC - Strzelin complex; ZSTSZ - Zloty Stok-Trzebieszowice shear zone.

Variscan deformation in the Sudetes might reflect a purely convergent setting that evolved into a transpressive setting during oblique convergence. Many regions of transpression exhibit structures, such as stretching mineral lineations, folds, foliations, and shear zones, with orientations that vary within these domains. In general, these have been interpreted as recording partitioning of strain in order to accommodate contraction, extension, and transcurrent motion either sequentially or simultaneously. The development of complex structures in transpressional shear zones in different part of the Sudetes is due to a heterogeneous distribution of strain across the transpression zones. A progression in the localisation of strain partitioning is very common in the Sudetes. Strain localisation may be the result of uplift during deformation moving the metamorphic complexes into progressively less ductile levels.

A late Variscan extensional tectonism in the Sudetes was associated with the uplift of the thickened domains. Relatively rapid post-Variscan cooling likely developed as a result of tectonic denudation associated with extensional faulting. A progressive evolution from deep ductile to shallow brittle deformation can be related to important fast exhumation of the thickened domains, promoted by migmatization and anatectic granitoids emplacement, like in the case of the Góry Sowie complex (GSC). These late, rapid uplifts with a late strong increase in the geotherm have been also observed in other parts of the Sudetes, usually associated with the development of the metamorphic core complexes, as the Karkonosze-Izera Dome (KID), the Orlica-Śnieżnik Dome (OSD), and the East Sudetic Domes (ESD) (Fig. 1).

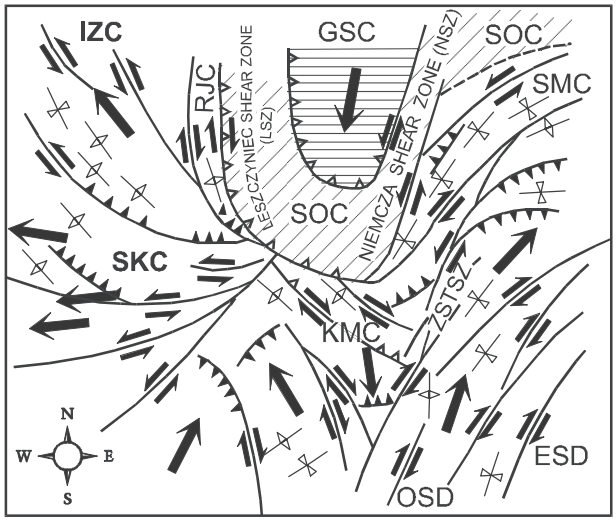

Fig. 2. Schematic model of the Variscan oblique accretion of the SOC and GSC crusts to the Saxothuringian (SKC and IZC) and the Moldanubian (OSD and SMC) crusts.