Traces of the Pre-Variscan Tectono-Thermal Event in Rocks of the Orlica-Śnieżnik Dome

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The sequence of deformations, established for the Stronie formation and referred to the history the Orlica-Śnieżnik Dome (OSD) gneisses could be interpreted as one continuous process starting from subhorizontal shortening caused by collision between two different crustal units forming East and West Sudetes, and subsequent orogenic uplift with subvertical shortening and flattening strain (Murtezi and Jastrzębski 2004, Murtezi 2005). Shortening and associated constriction of the first stage (D1) led to the development of upright folds with N-S trending axes in rocks of the Stronie formation and to constrictional stretching along the N-S direction of the Śnieżnik gneisses. Intrusion of the Śnieżnik metagranites took place in the extensional environment at c. 500 Ma (Turniak et al. 2000), Sharp intrusive contacts of metagranites with angularly unconformable relations to the schistosity of the enveloping metasedimentary rocks indicates that the Stronie formation was already deformed prior to the intrusion of the Śnieżnik gneiss protolith. At this point it is necessary to consider the possibility of existence of any deformational episodes (D0) that affected rocks of the Stronie formation prior to D1. Structural record connected with such an early deformational event (or sequence of events) within rocks of the Stronie formation is strongly obliterated by the later developed sequence of structures and in result very difficult to distinguish. As the Sudetes constitute a mosaic of terranes it is possible that early deformation and metamorphism of the studied rocks resulted from the interaction between crustal units later amalgamated to form the Sudetic part of the Bohemian Massif. At the opposite sides of the Sudetes are situated two crustal blocks generally formed of the Cadomian basement intruded by the lower-Paleozoic plutons, these units are: the Lausitz-Izera block on the west and the Bruno-Vistulicum on the east. Units situated in between form a mosaic in which different authors distinguish different number of terranes marking out their frontiers in different places. According to one of the newest interpretation of terrane distribution in the Sudetes proposed by Aleksandrowski and Mazur (2002), the OSD as a part of the Moldanubian (Gföhl) terrane took part in the bilateral collision with the Tépla-Barrandian terrane on the west and with the Moravian and Brunovistulian (Silesian) terranes on the east. Postulated by these authors, intra-Devonian subduction of the Central Sudetic oceanic basin and finally collision of the OSD as a part of the Moldanubian domain with the units adjacent to the west (Cadomian basement of the Tepla-Barrandian) can be taken into account as a process responsible for buttressing activity of the OSD and piling-up of crustal slices forming now the Silesian domain (SD). The OSD had to collide with units situated to the W and E as a previously consolidated crustal block. In this view, the western margin of the OSD constitutes a major discontinuity (a terrane boundary) and so, the OSD would have occupied the more internal part of the collision zone than the SD. It is in disagreement with the observed in rocks of the OSD decrease of metamorphic grade (from maximum at the boundary with the SD) towards the contact with the Nové Město Belt in the SW. Under this circumstances it may be the case that a suture zone between the crustal fragment represented by the OSD and units situated to the W should be located further westward, beyond the Nové Město Belt.

Basing on the comparison of the P-T-d record of rocks from the OSD and the SD, the earliest recognisable (having still distinguishable sequence of structures in rocks of the OSD) stage of deformation – D1, can be classify as the event that proceeds the Variscan collision of those two units (can result from the western collision of the OSD or even be a pre-Variscan). Nevertheless, this event starts the Variscan P-T-d path proposed for rocks of the OSD, considered as a record of the collision between the OSD and the SD. Fact that this event has no clear structural record in rocks of the SD can be explained by the lateral movements along the N-S direction on the late stage of the collision, shifting primarily colliding parts of the West Sudetes and the Bruno-Vistulicum. Despite these facts, lithotectonic architecture of the OSD provides some evidence on the existence of deformation that precedes the emplacement of the 500 Ma granite having intrusive discordant contacts. Inclusions of the gneissic enclaves in the 500 Ma metagranite, described by Grześkowiak and Żelaźniewicz (2002) in the Międzygórze anticlinorium can indicate on an older deformation of the surrounding rocks (probably Cadomian basement and Stronie formation volcano-sedimentary cover). This early tectono-metamorphic imprint can be a trace of a Cambro-Ordovician tectono-thermal event connected with the separation of a Variscan terrane assemblage due to progressive subduction and rifting at the northern margin of Gondwana continent. An extensional environment created during this event could be the location for the postulated early deformation and metamorphism of the Stronie formation. The Śnieżnik metagranites would have been emplaced into such, already deformed, supracrustal cover. Similarly in rocks of the Silesian domain Schulmann and Gayer (2000) distinguish at least one pre-Variscan tectonic event.

Significant improvement in the isotopic age evidence is required for the further progress in revealing the pre-Variscan history of the OSD and other Sudetic units. Despite the fact that the today observed tectonic architecture of the OSD is a result of a Variscan collision (or series of collisions) between Sudetic terranes, it seems reasonable to conclude that development of the earliest structures observed in rocks of the Stronie formation at in part of the OSD gneisses took place before Variscan orogeny.

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Thrusts and Folds in the Neyriz Ophiolite and Associated Rocks, Iran

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As the youngest collisional orogenic belt, the Zagros orogenic belt, has caused widespread folding and thrusting relative to crust thickening and uplifting, and was recognized generally by the international geoscientific community (e.g., Ricou; Alavi 1980, 1994; Pamic, et al.). The southeastern part of Zagros orogenic belt is located in around of Neyriz region and comprises a number of NW--striking thrust faults, ductile-brittle shear zones, folds, ophiolite, ophiolite mélange and tectonic slices. Ophiolites are major features of an orogenic belt and they are dominantly oceanic crust and mantle emplaced by collision of mantle-rooted thrust fault with a continental margin or island arc. Ophiolite nappes thus represent remnants of lithospheric plates; their basal thrusts are remnants of subduction zones. The Neyriz ophiolite is part of the upper mantle and Tethyan oceanic crust that stretched along the Zagros suture. The ophiolite consists of several small and large thrust sheets each having its own internal layering. Rocks in this complex are include compositionally layered, serpentinized peridotites (mainly harzburgites, lherzolites, dunites and pyroxenites), both massive and layered gabbros, sheeted dikes, pillow lavas, and thinly and uniformly bedded Jurassic to Upper Cretaceous radiolarian cherts interbedded with red lutites and thin beds of pelagic limestones (Nadimi 1999, 2002). Compositionally layered amphibolites and metamorphosed sedimentary rocks as schists have observed locally. In the central part of the Neyriz area, the ophiolite thrust sheets transported over the Upper Cretaceous shallow-water shelf/platform carbonates and overlain unconformably by the uppermost Cretaceous limestones (Tarbour Formation). The initial emplacement as slivers of Neo-Tethyan oceanic crust over the Afro-Arabian continental shelf must have been a Cenomanian-Maastrichtian event (Alavi 1980, 1994). Sheets of recrystallized limestones that strongly sheared and/or brecciated at their contacts are also presents.

In cross section, major thrust sheets show an imbricate pattern. Within each thrust sheet, rocks intensely folded and sheared. Folds are of angular parallel type and disharmonic; shear zones are brittle with discrete, anastomosing shear planes and associated cataclasites. Structurally, the northeastern high mountains, the ophiolite, and southwestern units are characterized by NW-SE trending folds and thrusts, which exhibit shortening in a NE-SW direction and show evident southwestward thrusting in general. The northeastern limit of the ophiolite thrust sheets distinguished by a system of breaching thrusts, which has resulted in transportation of the Mesozoic continental shelf sedimentary rocks over the ophiolites and severe crushing, and intermingling of various rock units. And also the southwestern limit of the ophiolite thrust sheets distinguished by a system of nappes and interesting folds in beds of pelagic limestone and radiolarites, which has resulted in obduction of the ophiolite and associated sedimentary rocks over the Mesozoic continental shelf sedimentary rocks of the Arabian platform. The radiolarites and pelagic limestones have shortened about 35–40 % during folding.