CRUSTAL-SCALE GEOMETRY OF THE RHENOHERCYNIAN FOLD AND THRUST BELT

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The Rhenohercynian of central Europe represents a foreland fold and thrust belt. It developed from the sedimentary prism of a stretched passive continental margin and is the lower plate with respect to the northern, active margin of the Saxothuringian to the south (Mid-German Crystalline High). West of the River Rhine, the DEKORP 1a–c section explores the Rhenohercynian crust from the Molasse Basin in the NW to the Hunsrück Mts in the SE. Construction and restoration of crustal scale balanced sections parallel to the seismic section was performed with the aim to reconstruct the basin geometry, the amount of crustal contraction, and the internal geometry of the belt.

Basin formation in the Rhenish Massif started on basement constituted of lower Paleozoic sediments and medium grade gneisses of Cadomian age. The early (continental) rifting event is not reliably documented. Peak crustal stretching occured during the late Lower Devonian recorded by strong subsidence, formation of growth faults, and widespread volcanism. During the Devonian and Lower Carboniferous a thick sedimentary pile (3 –12 km) of shallow marine clastics and carbonates was deposited. The restored overall basin geometry records nearly symmetrical crustal rifting with a broad differentiated depo-centre in its central parts (along and north of the Mosel axis), a marked rift-shoulder in the north (on top of the Brabant Massif), and a marginal plateau in the south (southern Hunsrück). The southernmost imbricates of the Rhenohercynian zone (Phyllite Zone) probably represent the strongly telescoped slope and rise sequences bordering a minor southern oceanic basin indicated by MOR-type metabasalts. Preserved relics of a former supracrustal nappe system in the southeastern Massif, the Giessen nappe, also contain MOR-type volcanics with MidDevonian cherts. These are superposed by flysch of Upper Devonian age. The small former ocean basin, which was parent to these rocks, must be rooted between the Rhenohercynian and Saxothuringian zones south of the above Phyllite zone.

The earlier extensional structures are strongly overprinted by collisional structures particularly in the southern part of the Rhenohercynian. They are better preserved in the middle and northern part and are represented by growth faults in the Early Devonian clastic shelf. Former listric normal faults are reactivated as reverse faults during collision.

The Rhenish Massif shows several changes in structural style from the northern foreland to the suture with the Saxothuringian microplate clearly depicted in the balanced section. In the north, thin-skinned deformation predominates with a major seismically well imaged basal detachment (at ca. 1.4 sec TWT), blind thrust splays, and concentric to box-type slightly NW-vergent folds. The Venn basement anticline is a ramp anticline and antiformal stack formed above a major infracrustal ramp at the margin of the Brabant Massif This margin originated during Lower Devonian crustal stretching and separates unrifted crust in the northwest from strongly rifted crust in the southeast (see above). The boundary coincides with the outer rim of the seismically transparent middle and lower crust in the DEKORP section. Towards the south the thick folded and cleaved Devonian basin filling progressively forms large imbricate fans separated by prominent SE-dipping thrusts. These structures branch off from a mid-crustal décollement, which can partly be seen in the DEKORP seismic section. This master décollement rises from about 6 s TWT in the south to about 4 sec TWT at the major intracrustal ramp of the Venn anticline. The crustal scale décollement at its actual depth of roughly 13 –16 km is located within the basement below the Devonian basin filling. This feature, which is in contrast to many other foreland thrust belts largely controls the different aspect of the internal geometry of the Rhenohercynian, where the strongly rifted deeper parts of the sequence with their complex internal geometry control a large part of the present outcrop. Large scale backfolding in the central part (Mosel syncline) and the southern margin of the Massif overprints this structural style which results – especially in the south – in an overturned steeply dipping stack. The continuation of the latter towards the south below the burried Mid German Crystalline Rise is well imaged seismically by its highly reflective nature which probably is due to the intercalation and imbrication of metabasalt and metasediment sequences from the former continental rise and the adjacent oceanic basin.

Late-orogenic kinematics of the Rhenish Massif involves oblique convergence and dextral strike slip along its southern suture during the early Upper Carboniferous. Postorogenic molasse deposits mark the onset of gravitational collapse of the thickened Variscan crust during the late Upper Carboniferous and the Permian, leading to the Saar-Nahe half graben on the former suture which resulted from inversion of the collisional structures.

The cross section shows a general increase of strain to the southeast in discrete steps across major thrusts. Net orogenic shortening of the upper crust of the fold and thrust belt is approximately 42%. It is mainly achieved by folding and tectonic stacking of the deformed basin filling. Overall shortening values vary between 10–30% at the northern front to 60–70% at the southern internal margin of the belt. The contribution of distributed ductile deformation – as recorded in the finite strain data – to overall horizontal shortening reaches values between 0% (orogenic front) and 50% (southern rim of the Massif).

THE TECTONOMETAMORPHIC EVOLUTION OF THE WESTERN PART OF THE TEPLA-BARRANDIAN (BOHEMIAN MASSIF, CZECH REPUBLIC)

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The western part of the Teplá-Barrandian terrane (TB), a main constituent of the Central European Variscan internides, consists of Upper Proterozoic siliciclastic sediments and volcanics both of which are affected by Cadomian and Variscan tectonometamorphic imprints. A characteristic feature of this area is the increase of metamorphic grade from E (very-low grade) towards the W and NW where Barrovian-type amphibolite facies conditions prevail. The metamorphic zoning indicates crustal tilting towards the center of the TB where Cadomian basement rocks are unconformably overlain by Cambrian to Mid-Devonian rocks (Barrandian syncline). With increasing metamorphism the amount of late Cadomian and Variscan plutonic rocks increases considerably.

Structural investigations of the Cadomian basement rocks clearly show that in low-grade metamorphic areas the Cadomian deformation is well preserved whereas in the higher metamorphic parts the latter are pervasively overprinted by Variscan structures. In order to separate the Cadomian from the Variscan phases, investigations of lower greenschist facies rocks, affected by contact metamorphism of Cambrian plutons, have proved to be most suitable.

The **Cadomian** orogeny includes 2 deformation phases (D_1, D_2) (see Fig.). D_1-structures are preserved as relics only. Thus, its kinematics and metamorphic conditions are difficult to ascertain. In areas of weak Variscan overprint, D_2-fold axes strike E-W. During D_2 the main foliation of the greenschist facies rocks (S_2) has formed which is mylonitic in most cases. Shear sense indicators reveal a top-to-N transport. The D_2-structures clearly post-date the Barrovian mineral assemblage (garnet, staurolite, kyanite) of the amphibolite facies parts. During the **Variscan** orogeny folds and thrusts (D_3), strike-slip faults (D_4), and late extensional faults (D_5) originated under lower metamorphic grade as compared with the Cadomian events (see Fig.). D_3-fold axes trend NE-SW to NNE-SSW, and the vergence of D_3-folds and associated thrusts changes markedly from NW (NW-vergence) to SE (SEvergence) suggesting a pop-up-like structure during the Variscan convergence. The latter occurred most likely during the Upper Devonian.

Strike-slip faulting along ENE trending steeply inclined shear planes (D_4) produced greenschist facies mylonites the shear sense of which is in most cases dextral. The strike-slip events clearly predate the intrusion of Variscan granitoids (330 – 320 Ma).

Late Variscan extension (D_5) is indicated by normal faults which frequently display an oblique component of shear. They are ductile and brittle in amphibolite-facies and greenschist-facies parts, respectively. In the Teplá region SE-directed normal faulting was active along steeply E-dipping amphibolite-facies shear planes. In the Domažlice area ENEdirected down-dip movements along N-dipping greenschist-facies shear planes are widespread. Thus, the extensional movements are exclusively directed towards parts with lower metamorphic grade (i.e. the center of the TB) suggest-