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The shape of the Variscan Belt in Central Europe: Strike-slip tectonics versus oroclinal bending

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The European Variscan belt sharply changes its trend in easternmost Germany and western Poland, where the ENE- to NE-striking structures are replaced by the ESE- to SE-trending ones. The structures of still another, NNE-SSW strike, take the lead, however, along the SE margin of the Bohemian Massif. The Variscan belt seems, thus, to make nearly a U-turn, encircling the Bohemian Massif from the north. This has been explained for almost a century by assuming a 180° oroclinal loop, in which the Rhenohercynian and Saxothuringian tectonostratigraphic zones inarm the core of the Bohemian Massif. According to this classical view, the outermost tectonostratigraphic zone of the Variscan belt, the Rhenohercynian Zone, continues eastward in the deep substratum of the Permian-Mesozoic basin and reappears at the surface along the eastern rim of the Bohemian Massif.

Since the late 1970s an alternative view has gained an increasing attention that postulates a dextral transpressional regime during the final accretion of the Variscan terranes. This transpressional tectonic context is believed to have resulted from sublatitudinal, right-lateral displacements between Gondwana and Laurussia. Near the Carboniferous-Permian boundary, Gondwana decoupled from the newly formed European Variscan belt and proceeded westward, toward the southern edge of the Laurentian segment of Laurussia, owing to the development of the Appalachian subduction system. Concomitantly with the peak of the Alleghanian orogeny during early Permian, the European Variscan belt experienced a crosscut of its major tectonic zones along a set of dextral strike-slip faults.

In this study, we investigate directions and continuity of structural trends in the external zones of the Variscan orogen in Poland and map a foreland extent of Variscan deformations using seismic, gravimetric-magnetic and borehole data. These permit us testing the orocline- vs strike-slip concepts and develop an overall kinematic model for the NE Variscides.

Matched filtering of isostatic gravity, guided by results of spectral analysis, along with other

derivatives of gravity and magnetic fields reveal a dominant WNW-ESE-trending pre-Permian structural grain in the external zones of the Variscan belt in Poland. This trend is confirmed by regional distribution of dips in Carboniferous and Devonian strata that were penetrated by boreholes beneath Permian-Mesozoic sediments. Seismic constraints on the position of the Variscan deformation front come from (1) the GRUNDY 2003 seismic experiment, combining wide-angle reflection-refraction measurements with the near-vertical reflection seismics in central Poland and (2) PolandSPAN and POLCRUST-01 deep reflection profiles in SE Poland. The WNW-ESE structural trend in the Variscan foreland is parallel to a set of major strike-slip fault zones in the area that are considered to convey a significant dextral displacement between Laurussia and Gondwana. The revised position of the Variscan deformation front shows a similar, uninterrupted, generally WNW-ESE trend, up to the SE border of Poland, which indicates an initial continuation of the more internal Variscan zones into the area of the present-day Carpathians. The geometry of the Variscan deformation front along with the pattern of the Variscan structural grain are inconsistent with the idea of an oroclinal loop affecting the external, non-metamorphic Variscan belt.