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Compression along faults: example from the Bohemian Cretaceous Basin

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Abstract

Effects of horizontal north-south compression of Paleogene age have been found near significant fault lines in sedimentary rocks of the Bohemian Cretaceous Basin. Stress orientation, time relations and similarities with other areas of the Alpine foreland point to direct manifestations of tectonic processes in the Alpine-Carpathian orogenic belt.

Introduction

Hitherto, the majority of faults disturbing sediments in the Bohemian Cretaceous Basin was assumed to represent normal faults and hence even the Saxonian tectonics was considered as a tensional one. Developments in analytical methods investigating slickenside features (Arthaud, 1969; Angelier, Mechler, 1977; Angelier et al., 1982) allowed a more profound treatment of Post-Cretaceous tectonic events in the area in question.

Suitable area for this method is offered by the surroundings of the Lužice Fault. Frequent silicification of Cretaceous sandstone related with tectonic movements preserved frequently slickensides in the area. Similar conditions are near the Středohorský Fault around Česká Lípa, Dubá and Mšeno.

Paleostress orientation analysis along the Lužice Fault in Elbsandsteingebirge Mts., GDR

The Lužice Fault represents a reverse block fault tracing from the Ještěd Mts. foothill to Dresden (Klein, Soukup, 1963). Granite of the Lužice Massif in the Elbsandsteingebirge Mts. is thrown upon Cretaceous sediments along a fault plane tracing the Kirnitzsch river valley toward Hohenstein. Cretaceous sediments southerly from the fault are cropping out in stratigraphic range from the Lower Turonian to Coniacian being mostly represented by the facies of quartz "ashlar" sandstone with argillaceous sandstone intercalations or conglomerate layers (Fig. 1).

In the near surroundings of the fault a zone of several tens to hundreds of meters developed consisting of heavily jointed sandstone containing great amount of silicified belts and siliceous tectonic polishes (Fig. 1). According to Seifert (1932), this is a crushed and subsequently cemented zone made of clasts near the fault planes. The displacement attains here some 400 m (Wagenbreth, 1967). A summarizing result of slickenside surface analysis using methods of Angelier, Mechler (1977) and Angelier et al. (1982) along the Lužice Fault (Lichtenheiner Mühle, Kuhstall) is represented in fig. 2 a. The main component σ_1 of the strain generating the reverse fault had N—S to NNE—SSW orientation. In the dislocation zone itself, the most frequent slickenside orientations are those dipping under medium angles to N as well as antithetic ones dipping under medium angles to S.

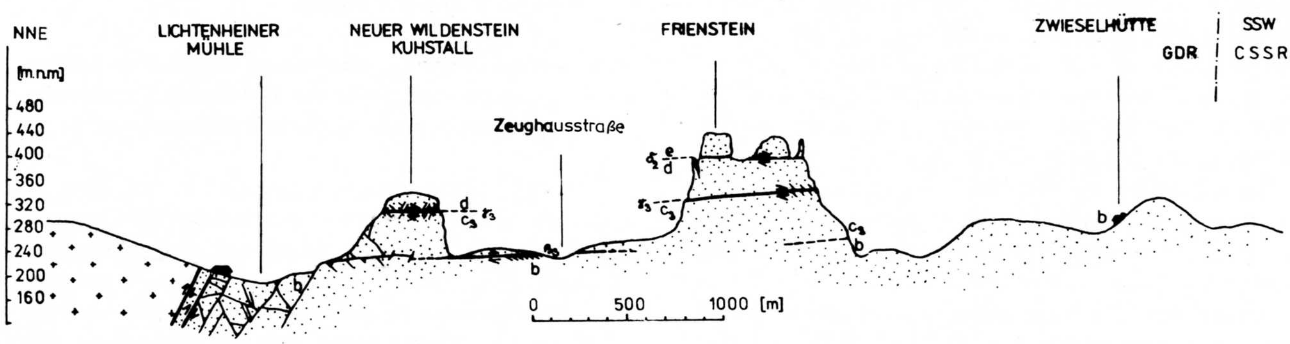

Fig. 1. Geological profile of the Elbsandsteingebirge Mts. between Lichtenheiner Mühle and eastern surroundings of Schmilka (Bad Schandau area).

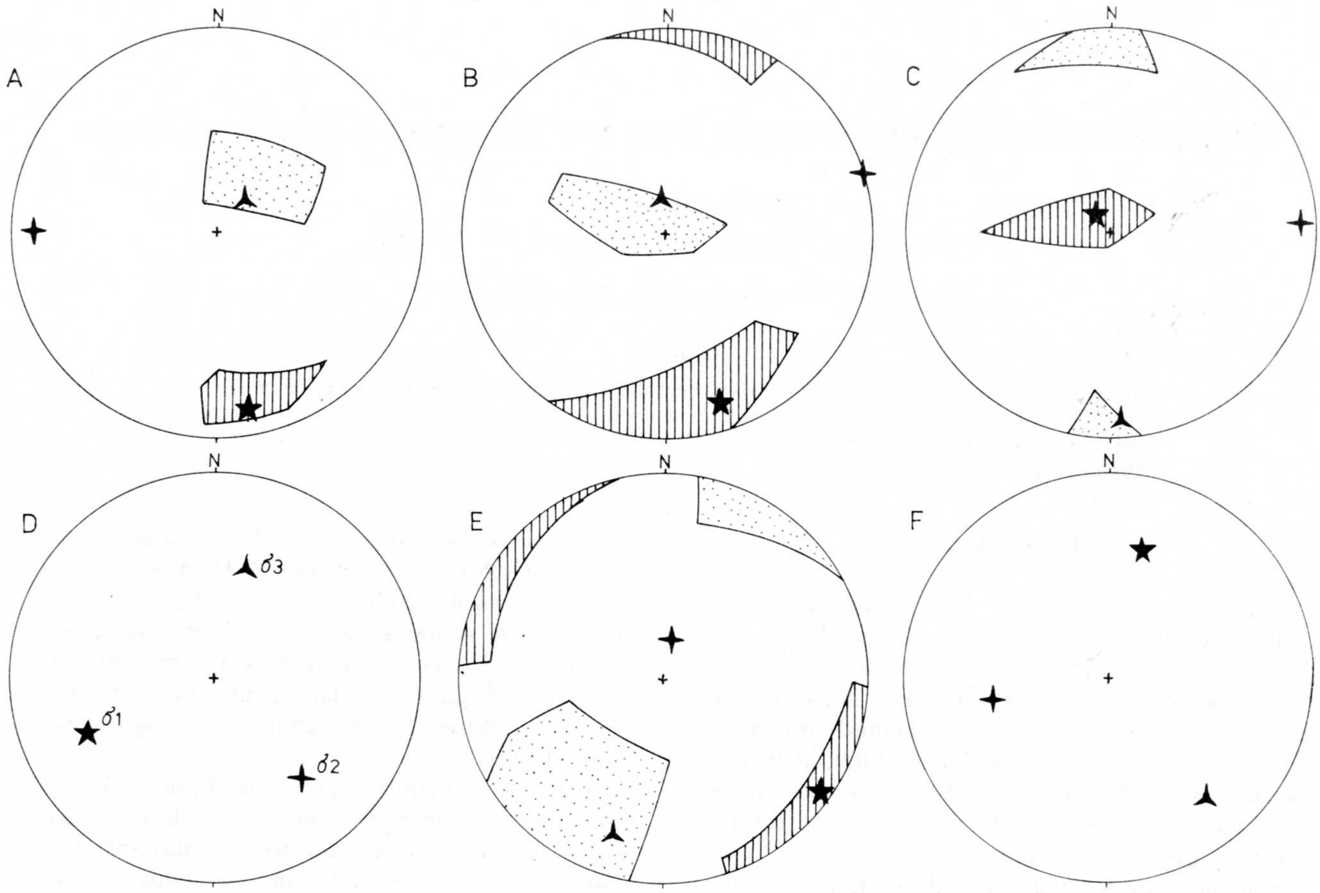

Fig. 2. Orientation of main axes of stress tensor in central parts of the Bohemian Cretaceous Basin. A — Lichtenheiner Mühle, B — Suché skály (α), C — Suché skály (β), D — Suché skály (γ), E — Suché skály (δ), F — Schneideberg near Dubá.

The frequency of such surfaces decreases with the growing distance from the fault and silicification preserves only along surfaces running parallel to bedding planes and the immediate surroundings. The N—S compression related with reverse faulting resulted here in shift-faulting within horizontally bedded sandstone (Fig. 1). Thrust surfaces generated along mechanically weaker intercalations with higher clay contents or in pronouncedly different mechanical texture than the surrounding rocks. These surfaces are separating several tens of meters thick quartz arenite layers devoid of deformational traces. The amount of displacement was not stated. Frequent and even silicified Riedel's shear surfaces point to the motion of the hanging wall to the south.

The Elbsandsteingebirge Mts. are characterized by the presence of so called "ashlar" jointing i. e. by two mutually perpendicular joint systems of subvertical orientation. Their orientations are almost the same in the entire area. The N—S trending joints are frequently open tension gashes whereas the E—W trending ones are more closed and, near to the thrust planes, point to connections with Riedel's shear surfaces. Probably, also the joint system developed here as the result of the same compression.

Effects of compressional tectonic phase along the Lužice Fault have already been studied in the Elbsandsteingebirge area (Seifert, 1932). The analysis of nivelled surfaces preceeding basalt eruptions disclosed the earlier age of reverse faults than is the age of basalt bodies (Wagenbreth, 1967). A subsequent tensional phase caused there only small normal faulting in the northerly blocks.

Paleostress orientation analysis of the eastern Lužice Fault along the margin of the Bohemian Cretaceous Basin between Malá Skála and Rovensko p. T.

The oldermost structural element in the area is a flexure creating margin to the Bohemian Cretaceous Basin between Malá Skála and Rovensko pod Troskami (Fig. 3a). The Korycany sandstone reveals here dips between 20°—40° and the middle limb of the flexure is sheared along with the upthrow of the NE block. The dip angle gradually increases and its orientations change northerly from Koberovy. Coin-