Contrasting magnetic fabrics in sedimentary rocks of the accretionary prisms of the Flysch Belt of the Western Carpathians and the Rhenohercynian Zone of E Bohemian Massif

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Abstract: The magnetic fabric of sedimentary rocks of the Flysch belt of the Western Carpathians is basically sedimentary in origin, in minority of specimens affected by very weak ductile deformation indicating only offscraping during subduction. On the other hand, the rocks of the Rhenohercynian Zone of E Bohemian Massif are often deformed strongly indicating relatively deep burial and return flow.

Introduction

Sedimentary rocks of the accretionary prisms involved in the process of subduction at convergent margins may undergo variegated deformations ranging from offscraping and frontal accretion to doubling back and flowing up the subduction zone (Moores & Twiss 1995).

The rock deformation can be investigated by various methods of structural analysis among which the anisotropy of magnetic susceptibility (AMS) is of special importance. This is probably because the sediments of accretionary prisms mostly contain no strain markers and the AMS is one of the most sensitive indicators of strain in rocks.

The AMS investigations of accretionary prisms carried out by the present author in the past 50 years revealed large differences in the magnetic fabric of accretionary prisms of the Alpine Flysch Belt of the Western Carpathians and the Variscan Rheno-hercynian Zone of the eastern Bohemian Massif Massif (for location of study areas see Fig. 1). The present paper aims to classify the differences in terms of deformation mode during subduction.

Flysch Belt

The magnetic fabrics in sedimentary rocks of the thrust sheets of the western sector of the Flysch Belt of the Western Carpathians range from essentially sedimentary to weakly deformational in origin (see Hrouda et al. 2009). The former magnetic fabrics are characterized by low degree of magnetic anisotropy, planar magnetic fabric, virtual parallelism of the magnetic foliations to the bedding and close relationship of magnetic lineations to the current directions, if observable. These magnetic fabrics are typical of the thrust sheets at both margins of the Flysch Belt (Ždánice and Silesian thrust sheets in the west and Bílé Karpaty and Oravská Magura in the east). The sheets were probably detached from the wedge relatively early and underwent deformations as more or less rigid bodies. The latter magnetic fabrics showing in places significant deflections of magnetic foliations from the bedding and of magnetic lineations from the current direction are typical of the central thrust sheets, the Rača and Bystrica ones, indicating the effect of ductile deformation probably associated with creation and motion of the thrust sheets.

Rhenohercynian Zone

The Variscan thrust sheets of the Rheno-hercynian Zone of the E Bohemian Massif show very variable magnetic fabrics and deformation fabric elements (e.g. Hrouda 1979). In the easternmost areas, the Hradec–Kyjovice Formation in the Nízký Jeseník Mts. and the Myslejovice Formation in the Drahany Upland, the degree of AMS is in general weak, the magnetic fabric is oblate, the magnetic foliation is mostly parallel to the bedding, subordinately tending to create a partial girdle in its poles and the magnetic lineation is presumably parallel to current direction. The strata create buckle folds of long wavelength whose magnetic fabric can be unfolded geometrically. In the central areas, represented for instance by the Moravice Formation in the Nízký Jeseník Mts. and the Rozstání Formation in the Drahany Upland, spaced cleavage and relatively

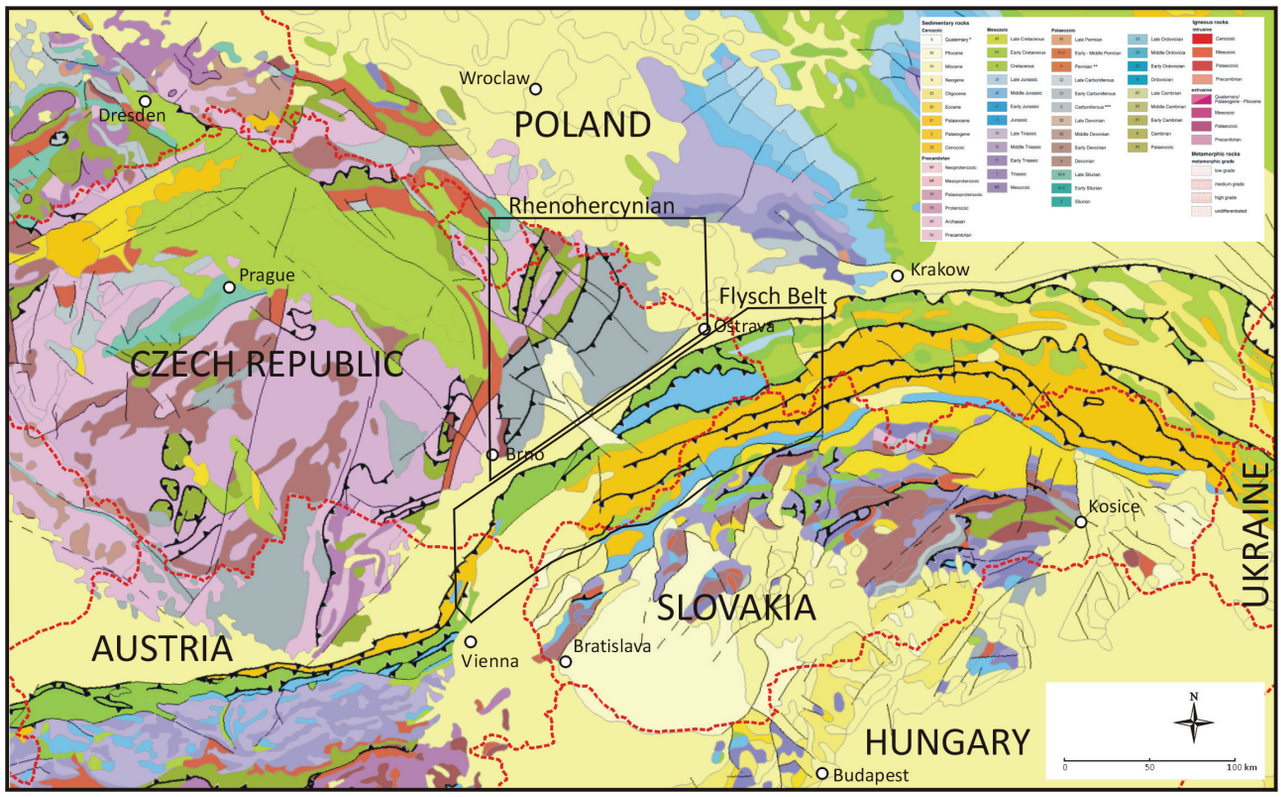

Fig. 1. Geological positions of the accretionary prisms of the Flysch Belt of the Western Carpathians and of the Rhenohercynian Zone of the eastern Bohemian Massif.

tight buckle folds can be observed. Magnetic foliation is still mostly parallel to the bedding, but the magnetic lineation is re-oriented into parallelism to the cleavage/bedding intersection lines. The magnetic fabric of the most folds can be unfolded only partially. In the western areas, the Benešov and Andělská Hora Formations in the Nízký Jeseník Mts. and Protivanov Formation in the Drahany Upland, cleavage folds and very well developed slaty cleavage occur. The degree of anisotropy is high, the magnetic fabric is planar, the magnetic foliation is parallel to the slaty cleavage and the magnetic lineation is parallel to the intersection lines between bedding and cleavage. The magnetic fabric in the folds is homogeneous, the folds cannot be unfolded at all. In the western-most area of the Andělská Hora Formation, the slaty cleavage is transposed into the metamorphic schistosity.

Tectonic implications

The story of the rocks of accretionary prisms during subduction process can be very concisely described as follows (following Moores & Twiss 1995). If the supply of the sediment is less than or equal to the capacity of the subduction zone, the sediment entering the subduction zone may be all subducted (Fig. 2a), partly subducted and partly underplated (Fig. 2b) or partly offscraped and frontally accreted, partly subducted, and partly underplated (Fig. 2c). If the sediment supply exceeds the capacity of the subduction zone, part of the sediment doubles back and flows up the subduction zone. If the deformation of the sediment involved in the doubling back and return flow is extreme, it may produce a tectonic mélange and the incoming sediment is offscraped and subducted, and the melange is underplated, offscraped and/or resubducted (Fig. 2d).

The magnetic fabric in rocks of the western sector of the Flysch Belt ranges from almost purely sedimentary in origin to very weakly deformational in origin. It corresponds to the magnetic fabric of the undeformed stage or the earliest deformation stage in terms of the magnetic fabric classification of the accretionary prisms by Parés et al. (1999) (see Fig. 3). In addition, there is no occurrence of the cleavage in the region and no indication of regional meta-morphism (Franců et al. 1999). These observations indicate that during the subduction process there was virtually no doubling back or even

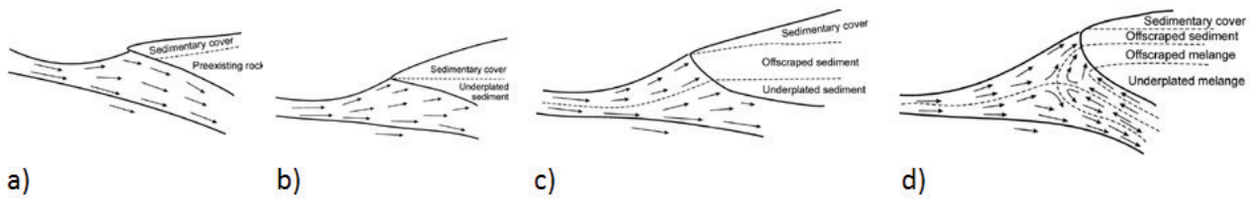

Fig. 2. Model of sediment flow at the inlet to the subduction zone. Adapted from Moores & Twiss (1995). Legend: **a** — all sediment is subducted; **b** — sediment is partly subducted and partly underplated; **c** — sediment is offscraped and underplated; **d** — sediment exhibits return flow.

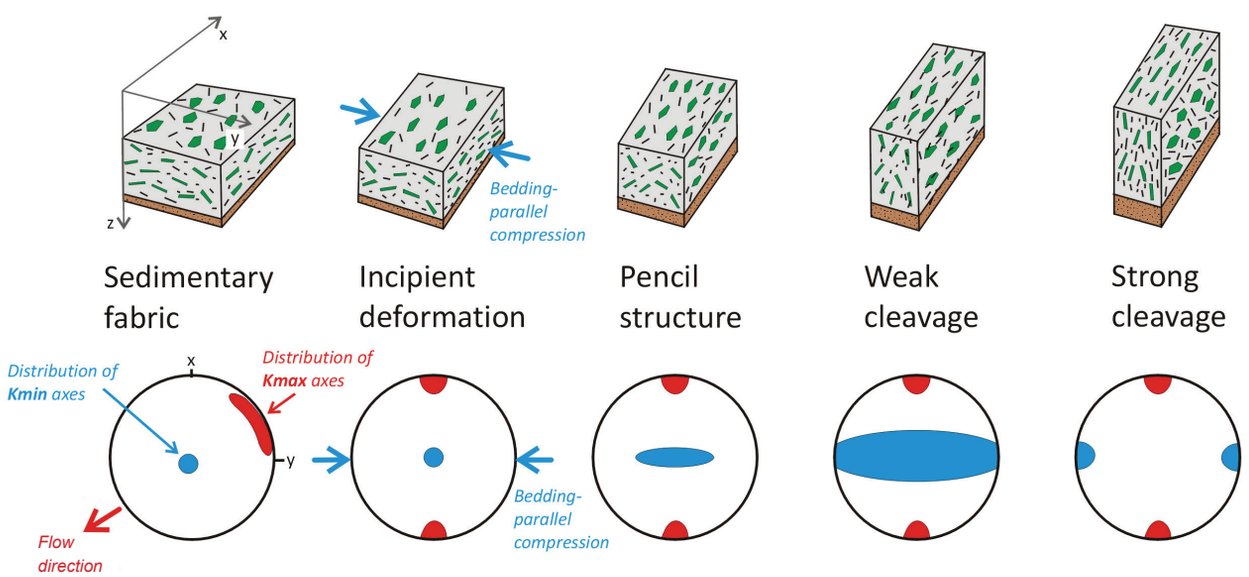

Fig. 3. Scheme of magnetic fabric development in progressively deformed sedimentary rocks. Adapted from Hrouda et al. (2009). Legend: Kmax — magnetic lineation, Kmin — magnetic foliation pole.

return flow. The capacity of the subduction zone was evidently at least equal to or larger than the supply of the sediment that was subducted, partly offscraped and accreted frontally (Hrouda et al. 2009).

The magnetic fabric in rocks of the Rheno-hercynian Zone of the eastern Bohemian Massif ranges from essentially sedimentary to strongly deformational in origin. It corresponds to the *Sedimentary Fabric* stage or the *Incipient Deformation* stage in the Hradec–Kyjovice and Myslejovice Formations, via *Pencil Structure* and *Weak Cleavage* stages in the Moravice and Rozstání Formations, to *Strong Cleavage* stage in the Andělská Hora and Protivanov Formations (see Fig. 3). The regional metamorphism ranges from diagenetic state in the eastern areas, through anchizone in the most areas, to even epizone in the westernmost area of the Andělská Hora Formation.

The strong ductile deformation and anchizonal metamorphism suggest that the rocks of the Zone were probably buried relatively deeply. This burial may have taken place during the passage of the sediments to the inlet of the subduction zone. The sediments may have appeared at the surface due to return flow. In addition, the magnetic fabric elements in the crystalline rocks neighbouring this Zone in the west show similar orientations as those of the Zone. This similarity can be interpreted as obtained during the same subduction process resulting in overprinting the older metamorphic fabrics.

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