Slovak Geol. Mag., 6, 2-3(2000), 198–199

Tectonosedimentary formations of the Pieniny Klippen Belt (Orava, Slovakia): structural styles of melanges and olistostromes

LENKA BAKOVÁ & JÁN SOTÁK

Geological Institute, Slovak Academy of Science Bratislava, Severná 5,
974 01 Banská Bystrica, Slovak Republic

Abstract. The paper deals with structural investigation in tectonosedimentary formations of the Pieniny Klippen Belt. Záskalie Breccias are considered to be a tectonic melange, showing pinch-and-swell structures, shistosity, expressive S/C fabric, systems of Riedel shears, pressure shadows, etc. On the contrary, a chaotic formations with gravitational slumps and drag folds in the Krivá section are indicative of olistostromes.

Key words: Pieniny Klippen Belt, Upper Cretaceous, tectonic melange, olistostrome

The term olistostrome and melange has been used to designate the chaotic units with block-in-matrix fabric. The chaotic units originate in responce of synsedimentary deformation (olistostromes) and tectonic deformation (melanges), or in influence of both processes (tectonosomes). Recognition of olistostromes from melanges is based on structures induced tectonically. In the Western Carpathians, the chaotic units occur mostly in the Pieniny Klippen Belt, which was designated as a melange already by Andrusov (1938). Lithosome- and melange-like units of the Pieniny Klippen Belt are well exposed in outcrops near Záskalie and Krivá, where they have been studied from the structural point of view.

In the Klippen belt near Záskalie the Upper Cretaceous sediments of the Kysuca Unit are exposed. They consist of breccias (the so-called Záskalie Breccias) belonging to the Gbelany Formation. The Záskalie breccias are composed of sharply angular blocks of marly limestones, which are embedded in a shaly matrix with oriented fabric. The blocks are separated to form a boudinage, which are flattened and elongated in a matrix flow direction. Boudinage developed through necking and swelling of beds (pinch-and-swell structures), which reflects a strain efficiency and shear movement in inhomogenous units. Shear concentration in the ductile claystones was compensated by fracturation and strike-parallel extension of rigid blocks along the Riedel (R_1) shears, observed as domino-like structures. Systems of Riedel (R_1) fractures are filled up with calcite. Orientation of elongated blocks and Riedel (R_1) elements indicates top-to-the-SSW shear movement. Original S_o bedding is identifiable in pressure shadows along the necked parts of blocks. Mudstone matrix shows secondary schistosities, developed as S_1 and S_2 foliations. Their combination originates an expressive S/C fabric. S_1 and S_2 planes bear slickenslides, offsets and stretching lineations. This planes are marked by parallel sets of fibrous calcite veins, which were formed through detachment and buckling of dilatation fissures under shear deformation and fluid overpressure (Capuano 1994, Stoneley 1984). Secondary schistosity S_2 is observed as planes with sigmoidal deflection of S_1 indicating the shear sense. Observed S/C structures indicate the top-to-the-SSW shearing. Sequence in the middle part of profile is deformed into tight and isoclinal subhorizontal folds with SSW vergency. Mudstones from around the folds are intensively sheared, exhibiting the S/C fabric and boudinage of marly limestones. Záskalie Breccias are superimposed by the Gbelany Fm., which exhibits a less intensity of tectonic deformation. Sequence of the Gbelany Fm. is overturned in position, which is documented by the appearance of hieroglyphs on the upper bed surfaces. Tectonic slices with overturned position occur together with those in the normal position (Jablonský 1994). Schistosity in claystones is developed non-systematically. The sandstones show an intensive synsedimentary folding, while the surroundings of folds lack the tectonic deformation. The structures described above from the Záskalie Breccias are indicative of tectonic melange.

Chaotic formations of different type are exposed in the Klippen belt near Krivá. They belong to the Nižná Succesion of Upper Cretaceous sediments, which occur in normal position (hieroglyphs on the lower bed surfaces). The formation consists of various sediments of submarine fans, like turbidite and conglomeratic deposits and block accumulations. Turbidite sequences are deformed via sliding in a form of large-scale drag folds with axes trending SW. Drag folds occur within the gravitational slumps, where the sandstones show pinch-and-swell structures and pass progressively to broken formations.

The contact with underlying undeformed beds is overprinted by bedding parallel slip, as is indicated by smooth surfaces and slickenslides. The breakage of the formation was accompanied by the development of small-scale normal faults. The formation changes the dip and inclination of beds towards the NE. In this part of cross section the formation contains a coarse grained and boulder conglomerates, which form a channel infills. Structures observed in the Krivá section are not indicative of the tectonic melange. They resulted rather from the deformation of unlitified sediments, which were folded and broken due to gravitational instability. In this sense, the chaotic units in the Krivá section are considered to be a tectonosedimentary formation, i.e. an olistostrome (endoolistostrome *sensu* Okamura 1991). The paper is a contribution to the VEGA grant N_O 7068.

References

Andrusov, D., 1938: Geologický výskum vnitřního bradlového pásma v Západních Karpatech. III. Tektonika. Rozpr. St. geol. Úst. Čs. Republ., 9, 1–135.

Capuano, R.M., 1994: Evidence of fluid flow in microfractures in geopressured shales. Am. Ass. Petrol. Geol. Bull., 77, 8, 1303-1314.

Jablonský, J., 1994: Kňažia – Jelšava. In: Cretaceous and Paleogene paleogeography and geodynamics of the Alpine – Carpathian – Pannonian region. Field workshop, Depart. Geol., Comenius University, 20-22.

Okamura, Y., 1991: Large-scale melange formation due to seamount subduction: An example from the Mesozoic accretionary complex in Central Japan. Jour. Geology, 99, 661-674.

Stoneley, R., 1994: Fibrous calcite veins, overpressures, and primary oil migration. Am. Ass. Petrol. Geol. Bull., 77, 8, 1427-1428.