Strain analysis was done using quartz detrital grains as strain markers. Thin sections normal to cleavage plane and parallel and normal to fold axis were produced from each sample. Thin sections parallel to cleavage plane were also produced from 6 samples to check strain ellipsoid calculations. About 150 to 200 quartz grains were approximated by ellipses in computer image of each thin section using AutoCAD and saved in dxf format. Dxf files were converted into text files contained coordinates of four end points of the major and minor axes of ellipses approximating the grains. Text files were processed with INSTRAN software by Eric Erslev to calculate strain ratios using enhanced normalized Fry (EN-Fry) and mean object ellipse (MOE) methods (Erslev, Ge 1990). Chemical composition of samples (major elements, Rb, Sr, Zr, Y, Th, Pb) was studied using standard XRF method in chemical laboratory of the All Russian Geological Research Institute (VSEGEI), St. Petersburg.

Total amount of strain calculated after Nadai (Ramsay, Hubert 1983) has very strong correlation with the larges strain ratio (Rxz) and for simplicity we only discuss variation of the latter. Both EN-Fry and MOE methods show that Rxz varies from 1.1 to 2.0, increasing from normal limb (Rxz mean value is 1.4) to overturned limb (Rxz = 1.5) and hinge zone (Rxz = 1.7). Flinn parameter K is lower than 1.0 but increases from overturned limb to normal limb implying increasing of flattening with increasing of strain. Although mean Rxz values calculated by EN-Fry and MOE methods are similar, difference in Rxz vales for each sample varies from 0 to 15%. As far as sandstones are poorly sorted and often matrix-supported, this may affect precision of EN-Fry method and we assume that MOE gives more reliable strain estimation.

Correlation coefficient (r) between chemical composition and Rxz was calculated for all available elements. Three samples most decreases correlation were excluded from the following discussion. Correlation between chemical composition and strain estimation by MOE method is better, than for strain estimated by EN-Fry method supporting assumption on more reliability of MOE method. The best correlation between Rxz values and chemical composition is found for Ca (r = - 0.67), L.O.I. (r = - 0.67) and Pb (r = - 0.59). Lower but still recognizable correlation exists for K (r = 0.44), Al (r = 0.43), Sr (r = - 0.42), Si (r = 0.40), Rb (r = 0.38). There is no correlation (r < 0.2) for Ti, Fe, Mg, Na, Zr, Y, Th.

Strain/composition correlation is similar for normal and overturned limbs that implies no influence of location of the sample. The most evident negative correlation between strain and Ca content and L.O.I. reflects calcite dissolution and volume decrease under pressure solution. Sr is chemically similar to Ca and its content decreases as well. Increasing of K, Rb, Al and Si content points to K-gain hydrothermal processes represented by secondary sericite identified in most thin sections. More calculations are necessary to estimate total volume change.

Very similar results were reported by and Hippert (1998) from a narrow shear zones in greenschists, where breakdown of Ca-feldspar and K-feldspar and recrystallization of muscovite resulted in enrichment of K, Al, Si and Rb and depletion of Ca, Sr, Na and P. Close deformation mechanism is suggested for discussed sandstones and seems to be very important in greenschists. It differs from sub-greenschist shales where spaced cleavage zones are depleted in Si, Na, Ca, Mg, and Mn, and enriched in Zr, Ti, Al, P and Fe (Erslev, 1998)

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The Reduced Stress Tensor: Problems with Tilting and Block Rotation

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Analyses of fault kinematic data for the reconstruction of past and present tectonic stresses are now routinely done in neotectonic investigations. Standard procedures for brittle fault-slip data analysis and paleostress reconstruction are now well established (Angelier, 1989, 1994, Etchecopar et al., 1981, Michael, 1984). The inversion method is based on the assumption of Bott (1959) that slip on a plane occurs in the direction of the maximum resolved shear stress. Fault data were inverted to obtain the four parameters of the reduced stress tensor: the principal axis σ_1 (maximum compression), σ_2 (intermediate compression) and σ_3 (minimum compression) and the ratio of principal stress differences $R=(\sigma_2-\sigma_3)/(\sigma_1-\sigma_3)$.

Numerous field studies have demonstrated that case of obliquity is in fact unusual, but also that it generally results from rotation of pre-existing non-oblique fault system. It means that one principal stress axis is always vertical or approximately vertical. This effect results from gravity and the Earth‘s free surface, which constrains one axis to be vertical and the tectonic stress to be a plane horizontal stress, at least in most cases. The case that one principal stress axis is not vertical; in all probability the tilting or rotating of blocks are occurred expect some special cases (diapirism, magmatism, accretionary prism, ...). These measured raw natural data must be rotated to the original position. In many cases, the angle of rotation is defined by the dip of bedding. If not this correction, the calculations may lead to incorrect results and the computed reduced stress tensor is imaginary and problematic. The rotation to the original position is necessary from case to case. A very instructive example comes from the High Tatra Mts., where a block tilting occurs. The tilting of blocks resulted from the uplift of the High Tatra Mts. All the older deformation stages were rotated into an incorrect orientation and the original N-S compression has been changed to two deformation stages: N-S compression and N-S tension. The computed imaginary extensional tectonic regime caused reorientation of the inverse faults to normal faults during tilting.

The tilting and block rotation caused problems with true original orientation of principal stress axis that produced deformation. Knowledge of size and magnitude of block tilting and rotating is important for determination of real orientation of stress tensor during actual deformation stage.

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On the Mechanics of Basin Formation in the Pannonian Basin: Inferences from Analogue and Computer Modelling

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We present the results of a thrust fault reactivation analysis that has been carried out using analogue (sandbox) and numerical modelling techniques. The basement of the Pannonian basin is built up of Cretaceous nappe piles (Tari et al., 1993). Reactivation of these compressional structures and connected weakness zones is one of the prime agents governing Miocene formation and Quaternary deformation of the basin system. However, reactivation on thrust fault planes (average dip of ca. 30° with respect to a horizontal plane) in normal or transtensional stress regimes is a problematic process in terms of rock mechanics. The aim of the investigation was to analyse how the different stress regimes (tension or transtension/transpression), and geometrical and mechanical parameters (dip and strike of faults, frictional coefficients) effect the reactivation potential of pre-existing fractures.

Results of analogue modelling predicts that thrust fault reactivation under pure tension is possible for dip angle larger then 45° fault dip with normal friction on the fault plane. By making the fault plane weaker, reactivation is possible down to 35° dip angle. These values are confirmed by numerical modelling. Reactivation in transtensional manner can occur in a broad range of fault dip angle (from 35° to 10°) and strike angle (from 30° to 5° with respect to the direction of compression) when keeping the maximum horizontal stress magnitude at least three times bigger than the vertical or the minimum horizontal stress values.

Our research focussed on two selected study areas in the Pannonian basin system: the Danube basin and the Derecske trough in its western and eastern part, respectively. Their Miocene tectonic evolution as well as their fault reactivation pattern show considerable differences. The dominance of pure extension in the Danube basin (Tari et al., 1994) vs. strike-slip faulting (transtension) in the Derecske trough (Horváth and Rumpler, 1984) are interpreted as a consequence of their different geodynamic position in the evolving Pannonian basin system on one hand. On the other hand, orientation of the pre-existing thrust fault systems with respect to the Early to Middle Miocene paleostress fields (Fodor et al., 1999) also had a major influence on reactivation kinematics. Due to its close proximity to the collapsing Alpine orogen, the area of the Danube basin was characterised by an excess of gravitational potential energy (Bada, 1999) and, thus, high vertical stresses (σ_V) during Early Miocene basin formation. By the time the topography was attenuated (Middle Miocene) and σ_V was reduced, the stress field had rotated and the minimum horizontal stress axes (σ_h) became perpendicular to the main strike of the thrusts. The high topography and the rotation of σ_h could induce nearly pure (dip-slip) extension along the pre-existing low-angle thrusts. On the contrary, the Derecske trough was situated near the Carpathian subduction belt, with lower crustal thickness and no pronounced topography. This resulted in low σ_V values. The proximity of the retreating subduction slab provided lower values of σ_h and the oblique orientation of the paleostress fields with respect to the master faults of the trough led to the dominance of strike-