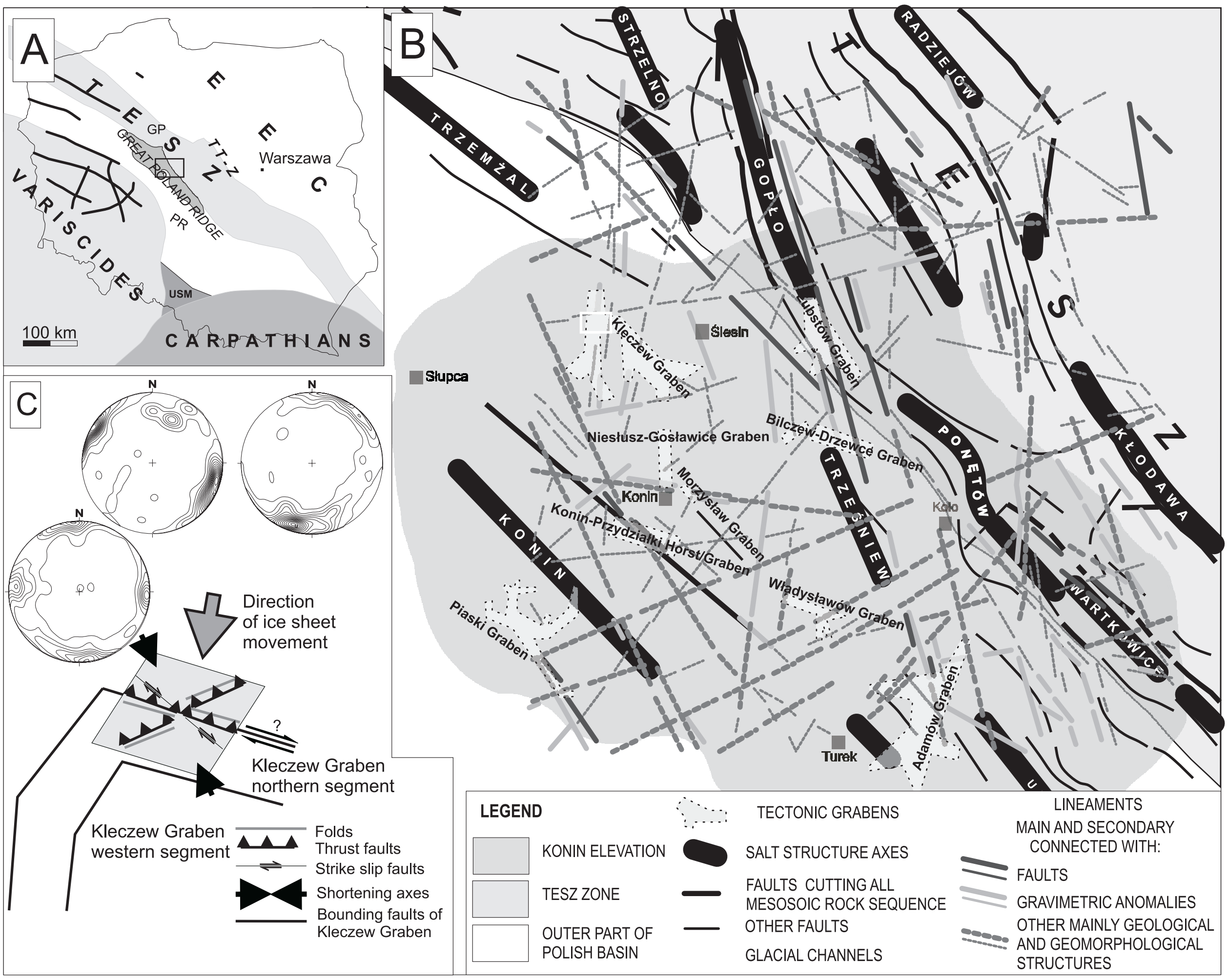

Fig. 1. A: Tectonic sketch of Poland (after Dadlez 1998, modified) showing the Konin Elevation area (black frame). B: Structural sketch of Konin Elevation, compiled after structural maps of Marek (1977), Graniczny (1991), Kasiński et. all (1997) and Widera (1998); white frame shows area of detailed structural and kinematic studies of glacialy induced deformations. C: Orientation of glacialy induced deformation structures (proglacial structural domain) in the vicinity of bounding fault enclosing from NNE the northern segment of the Kleczew Graben. The contour plots show distribution of B-type lineation within Odranian glacial tills T2 (subglacial structural domain).

Influence of Strain on the Chemical Composition of Low-Grade Metamorphic Sandstones: Example from Talass Alatau, Kyrgyzstan

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26 oriented samples for strain analysis and chemical study were taken from an overturned regional-scale synclinal fold in low-grade metamorphic Neoproterozoic – early Paleozoic sandstones near the Central Talass Thrust that separates low-greenschist facies rock units from close in age non-metamorphosed succession (Khudoley, 1993). All samples were taken from the same bed and have very similar composition. Typical sandstone specimen is poorly sorted, fine- to medium-grained, matrix- to grain-supported and comprises 60-70% quartz, 10-15% feldspar, 10-15% lithic fragments with some mica and magnetite. Most of lithic fragments as well as matrix are replaced with chlorite and mica and their primary composition is often not identifiable. Evidences for pressure solution are widespread but are best expressed in hinge zone and overturned limb of the fold.

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