The brittle rejuvenation of the S–K–M fault produced cataclastic rocks. A micro-breccia consists of small fragments of quartz-graphite schists within the very fine-grained matrix, with no concentration of ore minerals in those rocks. The occurrence of mineralization at Marcinków is connected with zone of a cemented tectonic breccia that is associated with the NNW-trending fault running almost parallel to the S–K–M fault and situated several hundred meters to the west of it. The NNW-SSE fault is steeply dipping toward NEE at an angle of 60–80°. Ore minerals: galena, sphalerite, chalcopirite are visible in hand specimen scale. The breccia consists of angular fragments of wall rock (mostly graphite shists), about 1 cm across, which are set in vein material. Components of vein material are mostly quartz, minor calcite and Pb, Zn, Cu, Fe, Sb, As, Ag-sulphides (Wołkowicz 1996).

The younger generation of faults is recognized. Those faults cut perpendicularly older fractures. These are NEE-trending sinistral strike-slip faults. In the vicinity of Kletno, some extension fissures associated with them, were sealed, and quartz-fluorite veins developed (Don 1988).

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Numerical Modeling of Magnetic Susceptibility of Rocks Deformed in Transpression Regime

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The model of transpression seems to be one of the most fruitful strain concepts in structural geology and it is broadly used in different geological settings on small or large scale. The aim of a geologist working with the model is to deduce from in situ measurements (collected samples) the possible flow parameters and relate them to macroscopic parameters of transpression which are the initial or final width of the transpression zone, the velocity and the angle of convergence. Answers to these questions are possible due to relatively simple mathematical description of transpression which enables us to compute temporal evolution of strain parameters in transpression zone. Suggested method is of particular significance for magmatic intrusions containing magnetic minerals of known properties. There is a growing number of natural examples of magmatic sills intruding steep transpressional zones where our method can be successfully applied in future (Parry et al. 1997).

Strain parameters can be measured indirectly by means of the AMS method. That is why we describe a procedure of modelling AMS development in transpression. The procedure is based on the relation of the tensor of magnetic susceptibility to the orientation tensor and on theoretic description of magnetic grains behavior in viscous matrix. As Hrouda and Ježek (1999) showed that there are no principal differences between spheroidal and triaxial magnetic particles, we can compute the rotation of magnetic grains using the displacement model developed by Willis (1977). AS follows from the model, the angular velocity of a rigid axial grain rotating in a viscous fluid is equivalent to March (1932) marker rotated at a reduced strain rate. Numerical computation of corresponding finite displacement tensor F can be expressed as

$$\mathbf{F} = (\mathbf{I} + (q\mathbf{E} + \mathbf{\Omega})\Delta t)^n$$

where $t = n\Delta t$ is time, E and Ω are symmetric and antisymmetric part of the velocity gradient tensor, and $q = (r^2-1)/(r^2+1)$, where r is grain axial ratio. The cases $q = 1$ and $q = -1$ correspond to Marchian markers – an arbitrarily slender needle and an arbitrarily thin plate, respectively. All other cases can be regarded as rigid particles following Jeffery (1922) equations but they are not necessarily of an ellipsoidal shape. By summation of magnetic susceptibilities of individual grains we compute the bulk magnetic susceptibility corresponding to finite strain accumulated in the transpression zone. On the graphs below we compare finite strain parameters to the corresponding AMS ones. Fig. 1: finite strain intensity $R = X/Y$ (vertical isolines) and Flinn's parameter of strain symmetry K (horizontal isolines). Fig. 2: Jelinek's parameters of AMS, degree of AMS, P (vertical isolines), and shape parameter, T (oblique horizontal isolines). The susceptibility was modeled for a system of prolate uniaxial magnetic grains which were initially oriented uniformly and then reoriented as Marchian needles (passive markers). Both graphs were plotted for different angles of convergence (obliqueness of transpression). The shortening on the horizontal axes of the diagrams expresses the width of the shortened zone in percentage of the initial width.

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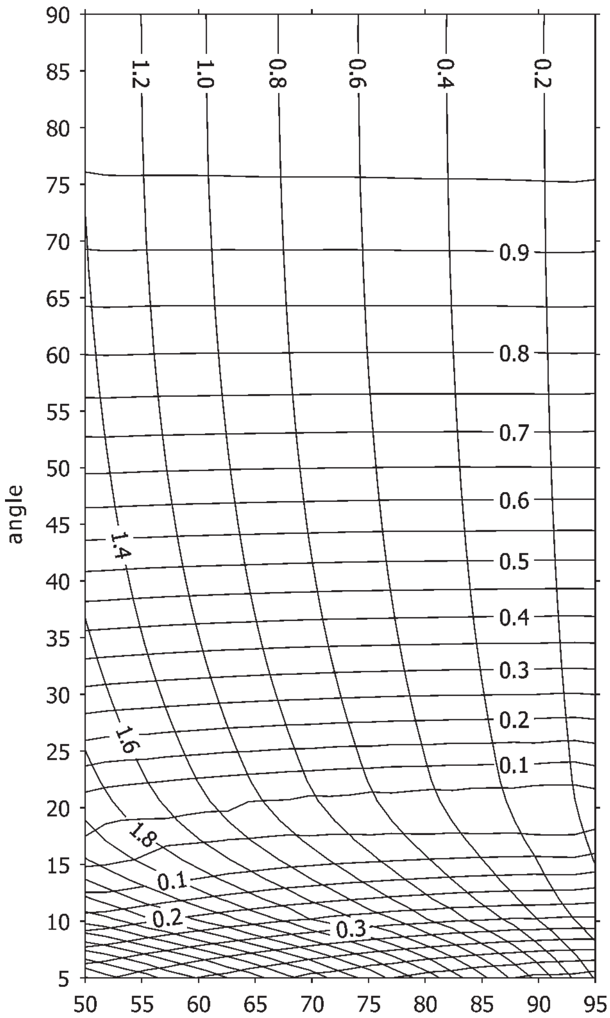

Fig. 1.

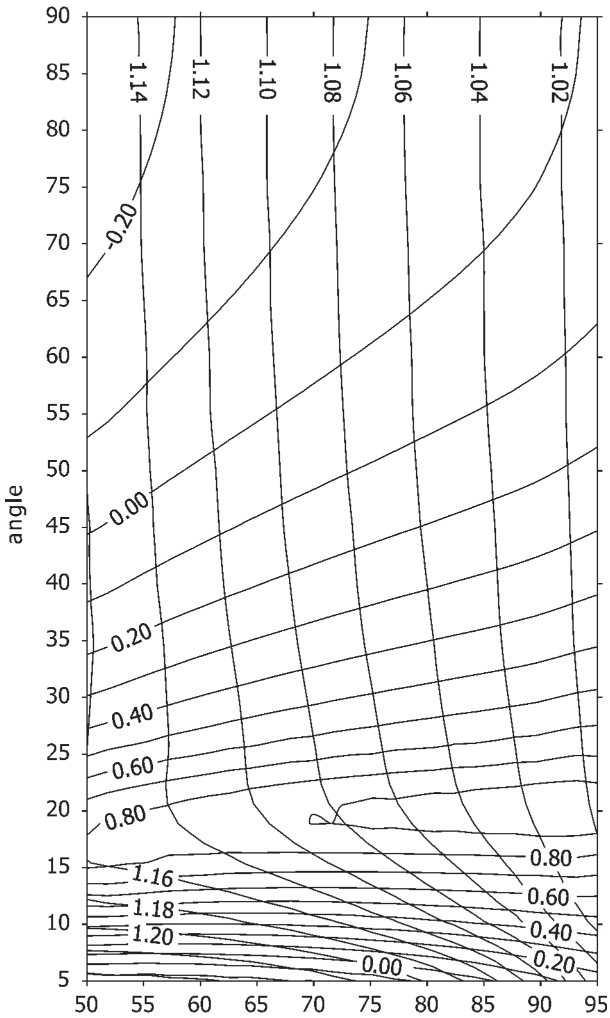

Fig. 2.

A Thin Viscous Sheet Model for Weak Zone Deformation

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A numerical approach is presented that enables us to simulate deformation in a weak zone surrounded by rigid or free boundaries. The approach is based on the thin viscous sheet approximation and is similar to that used by England et al. (1985) for modelling the deformation of the lithosphere. We consider a horizontal weak tabular domain subjected to viscous flow with no tractions at top and bottom surface. We assume that vertical gradients of the horizontal velocity are negligible which permits us to integrate the equations of motion over the vertical dimension and to work with vertical averages of stress and strain rate. Assuming linear relation between stress and strain rate ('Newtonian fluid'), the procedure leads to a system of elliptic partial differential equations for two horizontal velocity components. The system can be solved by the finite element method. Dirichlet and Neumann boundary condition may be applied to segments of the domain boundaries so that it corresponds to geological settings (rigid indenter, free inflow or outflow of material). The vertical strain rate and velocity are related to the horizontal velocity field by the incompressibility equation. The time development of the domain geometry is made by step by step moving the boundaries simultaneously with repeating solution of the governing equations for the velocity. At each time step we evaluate instantaneous strain rate and finite strain in a net of points in the domain. It has been described by Ježek et al. (2000) that the thin sheet model is sensitive to the angle of collision and may produce a zone dominated by lateral simple shear close to the indenter and a zone of dominant pure shear further away from the indenting boundary. Nevertheless, we show that these general features can strongly interfere with finite dimension of the modeled area and imposed boundary conditions.

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