The structure of shear zones according to mathematical modelling and interpretation of maps

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Experimental laboratory results and field research show that the first stage of a shear process usually manifests by second order structures. In the presence of external compression, the most common of them are Riedel shears and conjugate Riedel shears. In some cases, the main fault is formed immediately after the appearance of Riedels. In other cases, the shear zone remains at the stage of second order structures for a long time. In the present work we study whether it is possible to determine how dangerous the shear zone is in terms of the formation of a main fault without increasing the external load.

We use an approximate analytical method to calculate the parameters of stress field in the neighborhood a Riedel system formed under a shear load in case of external compression. The calculation is performed for various values of the internal friction angle, the coefficient of friction on the shear sides, and the ratio of the distance between adjacent Riedels to the size of each Riedel. The calculation shows that, for certain values of parameters, the areas of high maximal Coulomb stress occur between adjacent Riedels. The directions of principal stress axes in these areas predetermine the development of new discontinuities connecting the initial Riedels and hence the formation of the main fault. In other cases, the areas of high maximal Coulomb stress occur near the tips of the Riedels. Then the directions of the principal stress axes indicate the possibility of the Riedel shears growing in the initial direction. If the internal friction angle and the coefficient of friction are fixed, then the main parameter that affects the formation of areas of high maximal Coulomb stress and hence of the connecting discontinuities is the typical distance between adjacent Riedels.

Topographic maps interpretation gives the qualitative confirmation of the dependence of the main fault formation on the Riedels' frequency. Comparison of megatracks frequency isolines and location of recognized large faults shows the highest faults density is near large faults.