Geophysical Research Abstracts, Vol. 9, 06611, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06611

Three-dimensional slip distribution and fault-drag: mechanical modelling of a natural fault system

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In three-dimensions, fault systems may consist of a complex network of soft- and/or hard linked fault segments. Because of the mechanical interaction between the fault segments through local stress-perturbation, the slip distribution along fault systems is rather complex with points of maximum slip, which are generally not at the center of a fault segment or with segments recording multiple points of maximum local slip. Heterogeneous displacement fields along single faults or fault systems result in deformation of marker horizons in the host rocks. Therefore the deformed marker horizons (i.e. fault drag) are also a function of the geometry of the fault system and can be used to derive information about the mechanical interaction of soft- and/or hard linked fault segments. In order to understand these geometrical and mechanical interrelated parameters we first describe the three-dimension geometry of a natural complex fault system with isolated and linked fault segments including the deformation of marker horizons. A structural model including the fault system and displaced marker horizons was constructed from serial section perpendicular to a centimeter-scale frictional-viscous fault in phyllonitic rocks using the discrete modelling software GOCAD. Displaced marker horizons were used to construct geometric parameters like displacement contours on the fault segments. The fault system was imported as a triangulated irregular network into the three-dimensional numerical mechanical modeling software Poly3D in order to determine the stress conditions and associated displacements near the faults. The modeled displacement and fault drag of marker horizons can be directly compared with the structural model of the natural example confirming the geometrical consequence of stress perturbation as a result of interaction between fault segments.