Geophysical Research Abstracts, Vol. 7, 08925, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08925
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The origin of fault drag and its implications for the geometry and mechanics of faults

B. Grasemann (1), S. Martel (2), C. Passchier (3)

(1) Department of Geological Sciences, University of Vienna, Austria, (2) Department of Geology & Geophysics, University of Hawaii, USA, (3) Department of Geosciences, University of Mainz, Germany

By means of stress functions, we modelled the displacement of marker horizons along a single mode II fault in order to understand under what conditions normal and reverse fault drag develops. Fault slip generates a heterogeneous monoclinic displacement field, which essentially resembles “opposing circulation cells” with increasing displacement magnitudes towards the centre of the fault. Beyond some distance from the fault the magnitude of the displacements becomes insignificant. Marker lines meeting the fault at higher angles are deflected by the central part of heterogeneous displacement field and deform into a reverse fault drag. At lower angles, however, the marker lines pass the margins and the central part of the displacement cells and therefore deform into a reverse drag, which is superposed by a normal fault drag.

Our model bear several important implications for the geometry and the mechanics of faults: (i) Frictional resistance to slip along a fault cannot explain observations of fault drag and is therefore not the primary cause of fault drag. (ii) Understanding the spatial geometry and development of fault drag is important for discrimination of vertical separation and throw of normal and thrust faults. Faults recording no vertical separation in the far field inherently have a reverse drag on which a normal drag can be superimposed. (iii) The concept of roll-over anticlines forming above listric extensional faults may be alternatively explained by reverse fault drag. The reverse drag model may be a superior explanation for roll-over anticlines, especially for a normal fault that does not flatten into a subhorizontal detachment or are not listric at all.