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Fault related folds : An experimental investigation

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Fault related folds such as, the fault arrested fold, fault propagation fold, fault bend fold etc. are commonly observed along thrust fronts. In this context, we discuss on the conditions and modes of development of fault related folds in a mechanically active layered system. The study is entirely based on observations from analogue experiments. Layers of plasticene sheets were stacked one over another to produce a thick multilayer. The interfaces of sheets were lubricated with engine oil to produce a mechanical anisotropy in the multilayer. Slip surfaces were simulated artificially by inducing cuts in the multilayer. In order to ease slip along the cut the cut surface was smeared with engine oil. In some experiments the cut was terminated at a layer interface that contained a high amount of lubricant material. In this case the slip along the cut was transferred to the interface. In another set of experiment, the slip surface was made blind and the multilayer was confined by thick soft modeling clay to minimize the contact effect of the pushing plate. The model was deformed by moving a plate against the multilayer at one end and the hanging wall was either allowed move forward freely or was restricted by a rigid plate at the other end of the model. In these cases the footwall remained stationary and undeformed. To make both hanging wall and footwall active, the model was placed over thick soft clay and was deformed by moving two plates. The mode of development of the fault bend folds was somewhat different from that predicted by Suppe (1983). The kink planes initially did not initiate parallel to it but rotated. As a result, the stationary kink plane and the moving kink converged upward and the kink folds as confined within the multilayer. Fault-bend kinking finally affected the entire layer package and started to shift laterally in a manner shown by Suppe. The layers continued to steepen their dip while the kink planes remained at a fixed orientation. There was an inhomogeneous thinning of layers within the kink. For blind tip, passive footwall experiments steeply inclined sinuous folds formed at the ramp tip. These tip folds are geometrically similar to fault-propagation

folds in layered or foliated rocks. Tightness of the folds died away from the tip. The folds became asymmetric involving a hinge migration. With progressive deformation the steeper limb got steeper to accommodate the finite strain and ultimately stopped. For a ramp-flat-ramp type active footwall experiment at the upper bend a synform formed in the hanging wall while an antiform formed in the foot wall at the lower bend. Further shortening moved the hanging wall synform on the upper flat while the footwall antiform grew in amplitude and had a tendency to distort the slip plane. When bulk shortening was very large, fold instability developed in the multilayer in general and the slip plane was distorted. The ramp length of the slip plane shortened due to the distortion. The analogue modelling results provide a preliminary first order template in understanding the mechanism of fault-related folds.

Suppe, J. 1983. Geometry and kinematics of fault-bend folding, American Journal of Science, 283, 684-721.