Incremental shortening calculation of the mixed-shear fault-bend folds

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Shear fault-bend folds are characterized by a long back-limb that dips more gently than the fault ramp [1]. During the folding growth, the back limb rotates and widens progressively through a combination of limb rotation and kink-band migration. Two end-member models of shear fault-bend folding theories, including simple-shear fault-bend folding (C=0.5) and pure-shear fault-bend folding (C=1), have been developed and widely applied. Mixtures of pure and simple shear (0.5<C<1) are possible and have been found in the natural. Few quantitative methods to limit the shear-index (C) of the shear fault-bend folds so far. The incremental shortening can be calculated based on a simplified equation that assumes the linear relationship between the shortening and the limb rotation angle of the back limb [2]. However, the relationship of these two parameters is nonlinear according to the shear fault-bend folding theory [1]. Calculation results of the linear model have large uncertainty.

Here, we develop a method to calculate the shear-index (C), providing an idea to improve the mixed-shear fault-bend fold models, and establishing a formula to calculate the incremental shortening based on the nonlinear relationship between the back-limb dip angle and the shortening. It is a more general method to calculate the incremental shortening of the shear fault-bend folds.

This model has been applied to the Tugulu anticline in the northern foreland of Chinese Tian Shan, which is a mixed-shear fault-bend fold based on previous studies [3]. Through an analysis of deformed fluvial terraces and growth strata, we develop the shortening history of the Tugulu anticline along the Hutubi River using our developed nonlinear model. Our results show that the Tugulu anticline has a shear-index of ~0.91 and a steady shortening rate of ~1.5mm/yr over the last 500ka.

References: