Mechanical versus kinematical shortening reconstructions of the Zagros High Folded Zone (Kurdistan Region of Iraq)

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This work (Frehner et al., 2012) compares kinematical and mechanical techniques for the palinspastic reconstruction of folded cross sections in collision orogens. The studied area and the reconstructed NE–SW trending, 55.5 km long cross section is located in the High Folded Zone of the Zagros fold-and-thrust belt in the Kurdistan region of Iraq. The present-day geometry of the cross section has been constructed from field as well as remote sensing data (Figure 1a). In a first step, the structures and the stratigraphy are simplified and summarized in eight units trying to identify the main geometric and mechanical parameters. In a second step, the shortening is kinematically estimated using the dip domain method to 11%–15%. Then the same cross section is used in a numerical finite element model (Figure 1b) to perform dynamical unfolding simulations (Schmalholz, 2008; Lechmann et al., 2010) taking various rheological parameters into account.

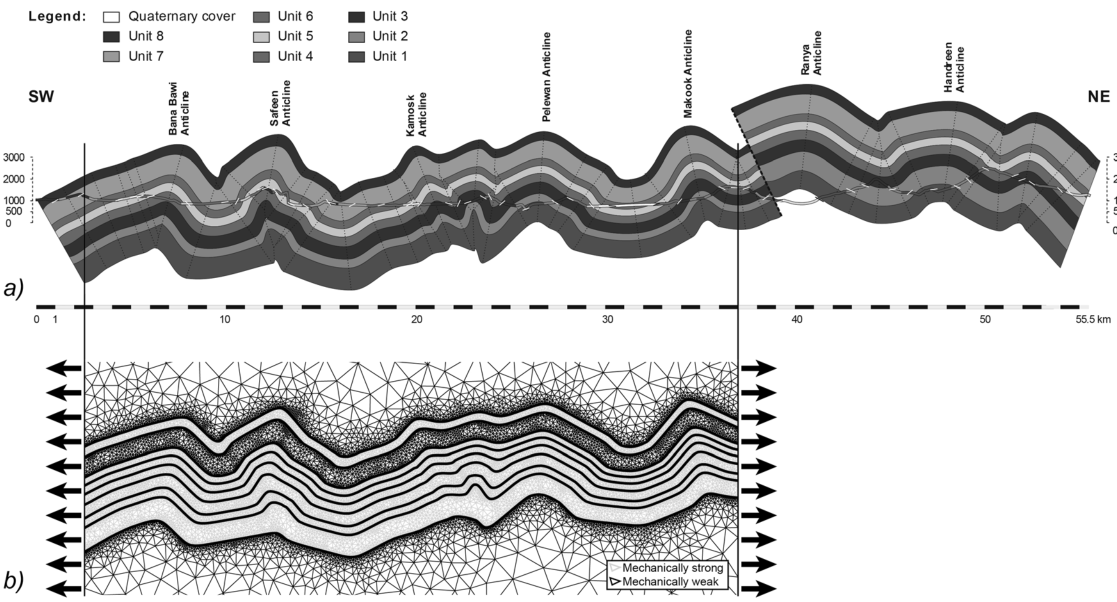

Figure 1. a) Geological cross-section through the Zagros Simply Folded Belt in NE Iraq constructed from field- and remote sensing data. b) Finite-element mesh of the SW part of the same cross-section used for numerical unfolding simulations.

The main factor allowing for an efficient dynamic unfolding is the presence of interfacial slip conditions between the mechanically strong units (Figure 2a). Other factors, such as Newtonian versus power law viscous rheology (Figure 2a) or the presence of a basement (Figure 2b), affect the numerical simulations much less strongly. If interfacial slip is accounted for, fold amplitudes are reduced efficiently during the dynamical unfolding simulations, while welded layer interfaces lead to unrealistic shortening estimates (Figure 2). It is suggested that interfacial slip and decoupling of the deformation along detachment horizons is an important mechanical parameter that controlled the folding processes in the Zagros High Folded Zone (Frehner et al., 2012). A similar conclusion has recently been found by Yamato et al. (2011) for the Iranian part of the Zagros fold-and-thrust belt using numerical forward modeling.

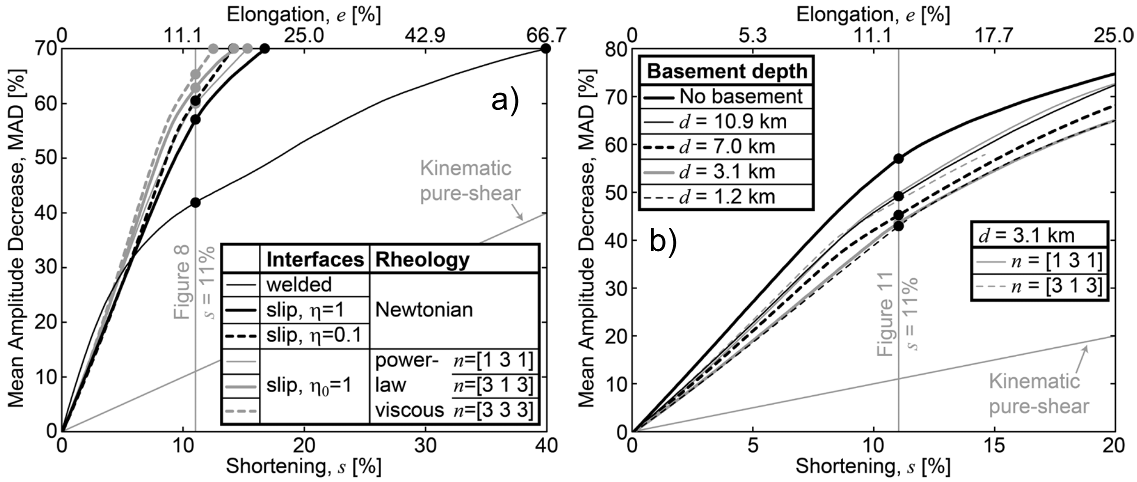

Figure 2. Mean amplitude decrease during the different progressive dynamical unfolding simulations without basement (a) and including a basement at depth d (b). The thick black line is the same in both subfigures. The legend in the top left corner in b) corresponds to simulations using a Newtonian rheology. The second legend corresponds to simulations using power law viscous rheologies. Kinematical pure shear is equivalent to a dynamical unfolding simulation with no mechanical difference between the layers (MAD = s).

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