The Emperor's New Clothes – the Discrepancy between Observation and Interpretation in the Canadian Rocky Mountains

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Quantitative cross section construction techniques have been applied to shallow fold-thrust belts for more than 50 years. They are based on a very simplified view of deformation, a limited variety of structures, and many assumptions that may not all apply. Based on these principles, three fold-thrust scenarios ("ramp-flat folds"), described as end members, are used in cross section construction and seismic subsurface interpretations: detachment fold, fault-propagation fold, and fault-bend fold (Fig. 1) They are considered to be the product of thrusting and appear in every current structural geology textbook.

Fault-propagation fold and fault-bend fold have no syncline in the immediate footwall and particularly the former is frequently applied to seismic interpretations of the Foothills (and other areas).In contrast, outcropping footwall synclines appear to be the rule in the Front Ranges; these cannot be explained by any currently accepted fold-thrust model. Such synclines typically disappear with depth in a cross section with no further data available.

The current fold-thrust models are obviously not exhaustive in describing the observed structures and they are also kinematically unrealistic. We therefore give two unifying models that explain all structures observed and show that folds in shallow fold-thrust belts like the Rockies are not always the product of thrusting. We further extend the standard models and view them in a progressive deformation with stages from detachment fold through fault-propagation fold to fault-bend fold. (Fig. 1)

It is concluded that balancing cross sections is based on the "reverse argument" that only structures are admitted that legitimize the technique even though such structures may be rare in nature. The technique should therefore only be used as a first approximation.

(Kraus and Williams, cont'd)

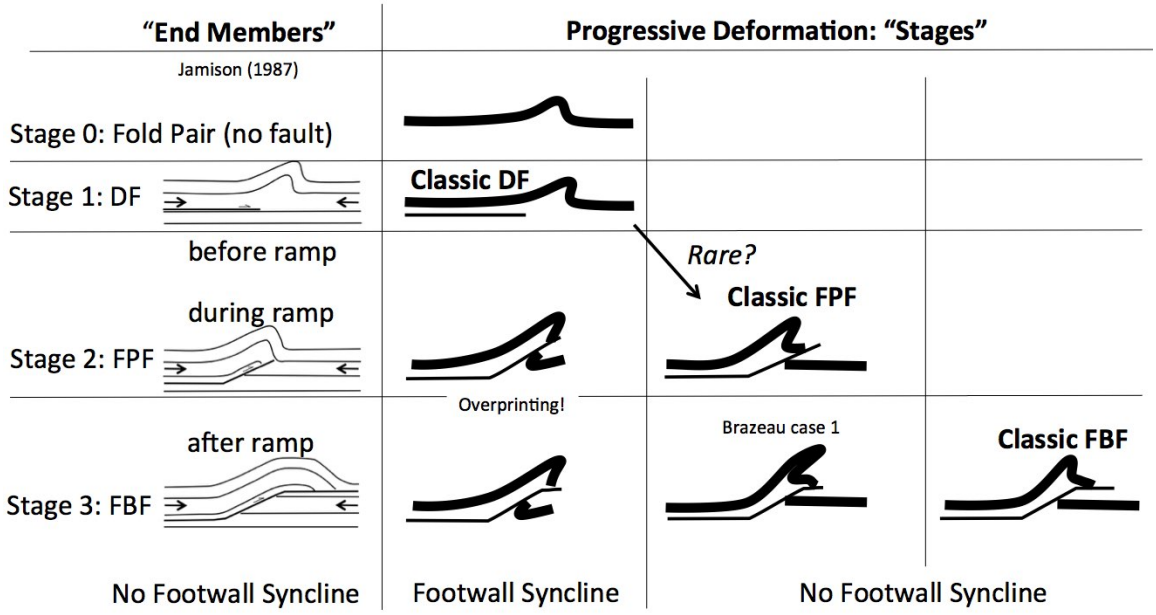

Figure 1: Extension of the currently accepted fold-thrust scenarios from the unrealistic "end members" of Jamison (1987) to more meaningful "stages" in a progressive deformation: anticline/syncline pair → detachment fold (DF) → fold-propagation fold (FPF) → fault-bend fold (FBF). Folds can initiate at any of these stages.

REFERENCE

Jamison, W.R., 1987, Geometric analysis of fold development in overthrust terranes: Journal of Structural Geology, v. 9, p. 207–220.