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# Uncertainty in interpreting fold-thrust forelimbs: implications of the over reliance on models and unrepresentative analogues

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Seismic imaging of sub-surface fold-thrust structures is challenging due to stratigraphy with high dips and stratigraphic discontinuities resulting from faulting and distributed deformation. The resulting poor quality seismic imagery makes interpretation of sub-surface fold-thrust structures uncertain. The use of 'so-called' end-member models to aid in interpretation of sub-surface fold-thrust structures provides a very limited range of geometries and fold-thrust relationships for sub-surface interpretation. Comparing field examples of fold-thrust structures to the range of end-member models available shows that they do not represent the diversity in structural geometries and fold-thrust relationships. Further, representations of these end-member models in textbooks and in published outcrop analogue photographs creates significant bias for future interpretations of fold thrust belts.

We compare classic outcrop examples of fold-thrust geometries with a range of other fold and fold-thrust examples in the same fold-thrust belts to show the diversity in structural style within a single fold-thrust belt. We further compare these outcrop analogues to the classic end-member models of Bally (1983) as illustrated for contractional settings by Shaw et al. (2006). Folds and thrusts do not generally comply with these 'simple' models, with thrust fault localisation controlled by a range of factors such as lithological heterogeneity that determines how the structure evolves through time.

These examples show that we need to improve understanding of how fold-thrusts evolve to better predict sub-surface structure in fold-thrust belts and to increase the range of models we apply to such interpretations. An improved understanding should decrease uncertainty in subsurface interpretation. We suggest that single deterministic end-member models should be replaced by a range of possible models that better represent the geometrical possibilities. Only when we embrace the uncertainty and the range of possibilities is it then possible to determine the probability of any one model.

Bally, A. W., 1983. Seismic Expression of Structural Styles. AAPG Studies in Geology -15. AAPG.
Shaw J. H., Connors, C., and Suppe J. (Eds). 2006. ST53 –Seismic Interpretation of Contraction Fault-Related Folds: An AAPG Seismic Atlas. AAPG.