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Fold-thrust structures: conceptual understanding, anchors and uncertainties

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Concepts are a critical element in our ability to understand and categorise natural phenomena. Indeed, the term fold-thrust belts is used to categorise the different natural phenomena that together define the set of structures commonly found in compressional tectonic settings. Within this over-arching term sub-terms are used to categorise the geometries and evolution of different sub-sets of structures. These categorizations (e.g. fault-bend fold, fault propagation fold etc.) include inherent conceptualisations of fold-thrust structure evolution. The concepts are dominated by geometrical constraints and for thrusting, by its nature, deformation localisation. We argue that the true interplay of the deformation characteristics and the controls that underpin folding and thrusting are not fully integrated or represented in these categorisations. Yet we are apparently anchored to these conceptual models of fold-thrust belts and their structures. Evidence suggests that anchoring occurs early; from teaching examples based on simple conceptual forms, that then dominate individuals' future conceptual models of structures and how they evolve. How we present and use models, at an early stage, to explain and represent concepts can have significant affects.

Here we present a series of case studies of fold-thrust belts that we use to observe the structural geometries and consider the different controlling mechanisms at play in their evolution. Our case studies span seismic interpretations of deep-water fold-thrust structures including the Niger delta and Sabah, and field outcrops at a range of scales from the Canadian Rockies to the French subalpine chain and the Variscan of S. Wales. We use these case-studies to reflect on the applicability of existing conceptual models to classify fold-thrust structures. In doing so we question whether the dominant existing concepts allow useful categorisation of fold-thrust structures to address questions such as: uncertainties in fault location, connectivity of fold-forelimb stratigraphy and the use of evolutionary models to predict fault displacements and fracture patterns. We propose that a greater range of conceptual models are required. New concepts that better represent the observed natural phenomena should improve understanding of uncertainties in fold-thrust belt models and inform probabilities of elements such as fault placement and linkage to help address outstanding questions in fold-thrust belt research.