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Do experts use idealised structural models? Insights from a deepwater fold–thrust belt

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ABSTRACT

Theoretical models are often used to aid interpretation of geological data. For fold–thrust belts, structural and kinematic models have existed for over a century. While greatly contributing to our understanding of thrust systems, the usage of models can result in oversimplification and false kinematic interpretations. This paper investigates how and if experts use structural models in the interpretation of a seismic image from a deepwater fold–thrust belt. The results show that in the majority of cases experts produced interpretations that were compliant with key features in existing structural models. Those interpretations that were less compliant to existing models, better accounted for features present in natural and experimental analogues. This has implications for the general applicability of structural models in interpretation.

1. Introduction

Understanding the evolution of fold–thrust structures involves significant interpretation of geological data. Theoretical models have existed for over a century to aid in this (e.g. Willis, 1893; Suppe, 1983; Jamison, 1987; Suppe and Medwedeff, 1990; Erlsev, 1991), but the models define a simplified, mathematically constructible solution for a process that is not, in reality, simply explained. Theoretical models in geology create idealised analogues that can be further used in the interpretation of similar geological systems. This is, in general terms, a very useful approach but may also cause oversimplification of interpretations, especially as the geological system deviates from that for which the model was originally created. The models often fail to explain features observed in many natural fold–thrust structures, such as strain localisation, fault propagation and fault linkage.

We present the results of an expert elicitation exercise, in which we have used experts to gather their collective geological interpretation knowledge (in the sense of '*the Wisdom of Crowds*'; Surowiecki, 2004). Explicit expert elicitation techniques (e.g. Meyer and Booker, 1991; Cooke, 1991) have been used in science, notably within the nuclear waste disposal sector to evaluate interpretational uncertainty and risk (Aspinall, 2010). In our example, rather than asking experts to risk assess their own or others' interpretations, we use the collective interpretations of experts to investigate how theoretical fold–thrust models influence the interpretation of seismic data. We use the results to discuss the general usability of established theoretical models in the interpretation of fold–thrust structures. This case study uses high quality seismic reflection data from the toe-thrust sector of a gravity-driven deepwater fold and thrust belt, but the conclusions are more generally applicable to the application of models in data interpretation.

2. Data and experiment

2.1. The expert group

The exercise was performed at the American Association of Petroleum Geologists Hedberg Research Conference "*DeepWater Fold and Thrust Belts*" in October 2009. Hedberg Research Conferences are scientific meetings designed to gather scientists from both industry and academia with the aim of discussing state-of-the-art concepts, methodologies, case histories, and future directions relating to the conference subject (http://www.aapg.org/education/hedberg). Participation is selective and individuals apply, or are invited, to attend ensuring a diversity of key experts in

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