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**Structural Uncertainties: Do We Need a New Paradigm for the Seismic Structural Interpretation?**

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**SUMMARY**

On the basis of a field study, we discuss the need of a new paradigm for the construction of structural models. Indeed, within the traditional framework, building a 3D consistent fault network model consists in: first, picking faulting evidences on 3D seismic images and then, according to a priori concept derived from tectonic history, manually extrapolate in a consistent manner these evidences. The extrapolation step is actually the interpretation task that any structural geologist performs to build a 3D model from the observed evidences. However, such interpretations should not be considered as unique for uncertainty assessment and management. Therefore, we argue for the use of a stochastic system which will perform the extrapolation task (i.e. the construction of the 3D structural model). However, this computer method needs to be fed with similar geological knowledge as used in manual interpretation, such as structural style or interaction between faults of different tectonic origins. Integrating this conceptual information within a numerical system remains a key challenge.
Abstract

Structural uncertainties are recognized to have a primary impact on hydrocarbon reserve estimation and production forecast. The term “structural uncertainty” relates to fault geometry, extension and linkage for seismically resolved faults; fault existence and location for subseismic faults; stratigraphic geometry close and away from faults.

Numerical solutions have been proposed to handle structural uncertainties such as the stochastic perturbation of a base case (Thore et al. 2002), the stochastic implementation of subseismic faults in a reservoir model (Holden et al. 2003) or the sequential stochastic construction of fault networks (Cherpeau et al. 2010, Julio & Caumon 2013).

We propose to demonstrate the potential of this last methodology at reservoir scale to improve the management of structural uncertainties through a field case application on which:

- due to the relatively low seismic resolution, the structural model (location of faults, fault connections and resulting fault blocks) is the main uncertainty on the geology of this field;
- detailed synthesis of static and dynamic data have shown that flow barrier and reservoir compartmentalization rely almost exclusively on the presence of faults (most of them being below seismic resolution) and on their dynamic properties (mostly sealing property induced by crystallization along the fault plane).

On the basis of this study, we discuss the need of a new paradigm for the construction of structural models. Indeed, within the traditional framework, building a 3D consistent fault network model consists in: first, picking faulting evidences on 3D seismic images and then, according to a priori concept derived from tectonic history, manually extrapolate in a consistent manner these evidences. The extrapolation step is actually the interpretation task that any structural geologist performs to build a 3D model from the observed evidences. However, such interpretations should not be considered as unique for uncertainty assessment and management.

Therefore, we argue for the use of a stochastic system which will perform the extrapolation task (i.e. the construction of the 3D structural model). However, this computer method needs to be fed with similar geological knowledge as used in manual interpretation, such as structural style or interaction between faults of different tectonic origins. Integrating this conceptual information within a numerical system remains a key challenge.

On the basis of the presented study, first answers are proposed such as how to respect relationships between faults resulting of different tectonic events. We show that handling structural uncertainties requires to (i) define geological facts (such as observations and concepts) and uncertainties; (ii) transfer geological information and concepts to a structural modeling system; (iii) process information in a stochastic manner in order to build 3D structural models sampling the uncertainty space. Finally, we discuss the relevance of the proposed approach by analyzing the dynamic response of produced models with regard to the production history.

References


