Enforcing Geological Consistency Through Interactive Seismic Flattening While Interpreting

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SUMMARY

Building a geologically consistent interpretation of a structurally complex area (thrust belts, flower-structures, etc.) is often a challenge, especially when the structure has to be interpreted from sparse data (e.g., 2D seismic lines) or when the quality of the seismic image is poor. A solution to these problems is to perform detailed interpretation in a domain in which the considered seismic section has been unfaulted and unfolded in a mechanically consistent way, without breaking the immersive experience of seismic interpreters. In this paper we present a software tool which performs a fully automated flattening process, which is tolerant to minor flaws in the input interpretation, able to handle the most complex structures (X, Y, λ, and thrust fault patterns), and integrated into a seismic interpretation platform. Two user workflows are proposed: (1) a QC of the structural and stratigraphic consistency of an already interpreted seismic section, and (2) an easy tracking of reflectors across faults, by interactively interpreting seismic horizons into a mechanically-flattened section, from which most tectonic deformation has been removed.
Introduction

Building a geologically consistent interpretation of a structurally complex area (thrust belts, flower-structures, etc.) is often a challenge, especially when the structure has to be interpreted from sparse data (e.g., 2D seismic lines) or when the quality of the seismic image is poor. Properly identifying reflectors across faults with large displacements, or in areas with little seismic signal correlation, can be particularly difficult. In a similar way correctly defining the location of fault surfaces and the contacts between them, while preserving coherent thicknesses and realistic fault displacement profiles, is arduous. A solution to these problems is to perform detailed interpretation in a domain in which the considered seismic section has been unfaulted and unfolded in a mechanically consistent way, without breaking the immersive experience of seismic interpreters.

Method and example

In this paper we present a fully automated flattening process, which is tolerant to minor flaws in the input interpretation, able to handle the most complex structures (X, Y, λ, and thrust fault patterns), and integrated into a seismic interpretation platform (Figure 1). This near-interactive process accommodates very well sparse, noisy, or locally inaccurate interpretation data, and scales from reservoir to basin. The structural consistency is enforced by the use of physical laws that govern solid mechanics. This process also automatically yields a watertight, faulted layer model of the interpreted section (Figure 2).

Conclusion

Two user workflows are proposed: (1) a control of the structural and stratigraphic consistency of an already interpreted seismic section, by verifying if it is properly balanced, and (2) an easy tracking of reflectors across faults, by interactively interpreting seismic horizons into a mechanically-flattened section, from which most tectonic deformation has been removed (pseudo chronostratigraphic space). All horizons and layers can simultaneously be visualized in both initial (faulted and folded) and flattened domains while they are being interpreted.