PhD Open Days

Integration of stratigraphic information into geostatistical seismic inversion

PHD IN PETROLEUM ENGINEERING

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1. Motivation

The growing of high quality seismic reflection data led to intensive studies in seismic attributes mainly due to their potential for prediction, characterization and monitoring of hydrocarbon reservoirs (Chen and Sidney 1997). A good seismic attribute is directly sensitive in the reproduction of a desired geologic feature or reservoir property of interest, which contains all the information derived from seismic data, allowing a better interpretation for structural geology, stratigraphy analysis and rock/pore fluid properties (Chopra and Marfurt 2005).

During the last decade there has been a growth associated with the application of geostatistical seismic inversion methodologies (e.g. Bortoli et al. 1992; Haas and Dubrule 1994; Soares et al. 2007; Azevedo et al. 2015) as a spatial inference techniques of the petro-physical properties of the subsurface geology. However, one of the main limitations of these iterative geostatistical seismic inversion methodologies is the lack of direct integration of subsurface structural geology, e.g. folds, faults, discontinuities.

2. Methodology

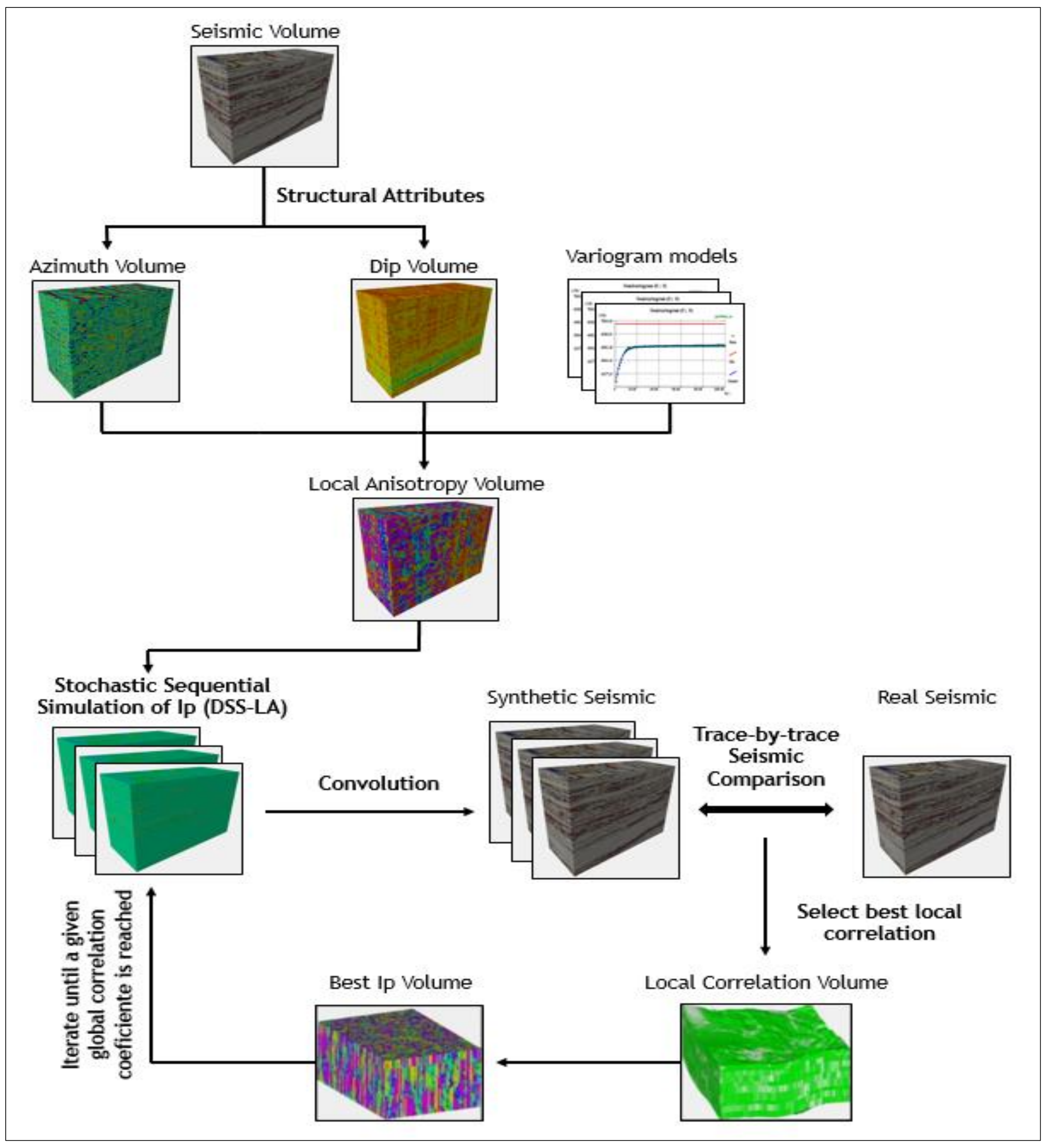

Figure 1: Schematic representation of the workflow used in this work with the integration of seismic reflection orientation into the iterative geostatistical seismic inversion process.

3. Case Study

The proposed methodology was applied to a real dataset composed by a volume of fullstack seismic data and two wells with acoustic impedance information. The study area is represented by an inversion grid of 443x369x375 cells with respect to i-, j- and k-directions with flat top and bottom. The volumes of structural seismic attributes were estimated using signal processing and structural methods taking into account the orientation of seismic reflectors from original cube.

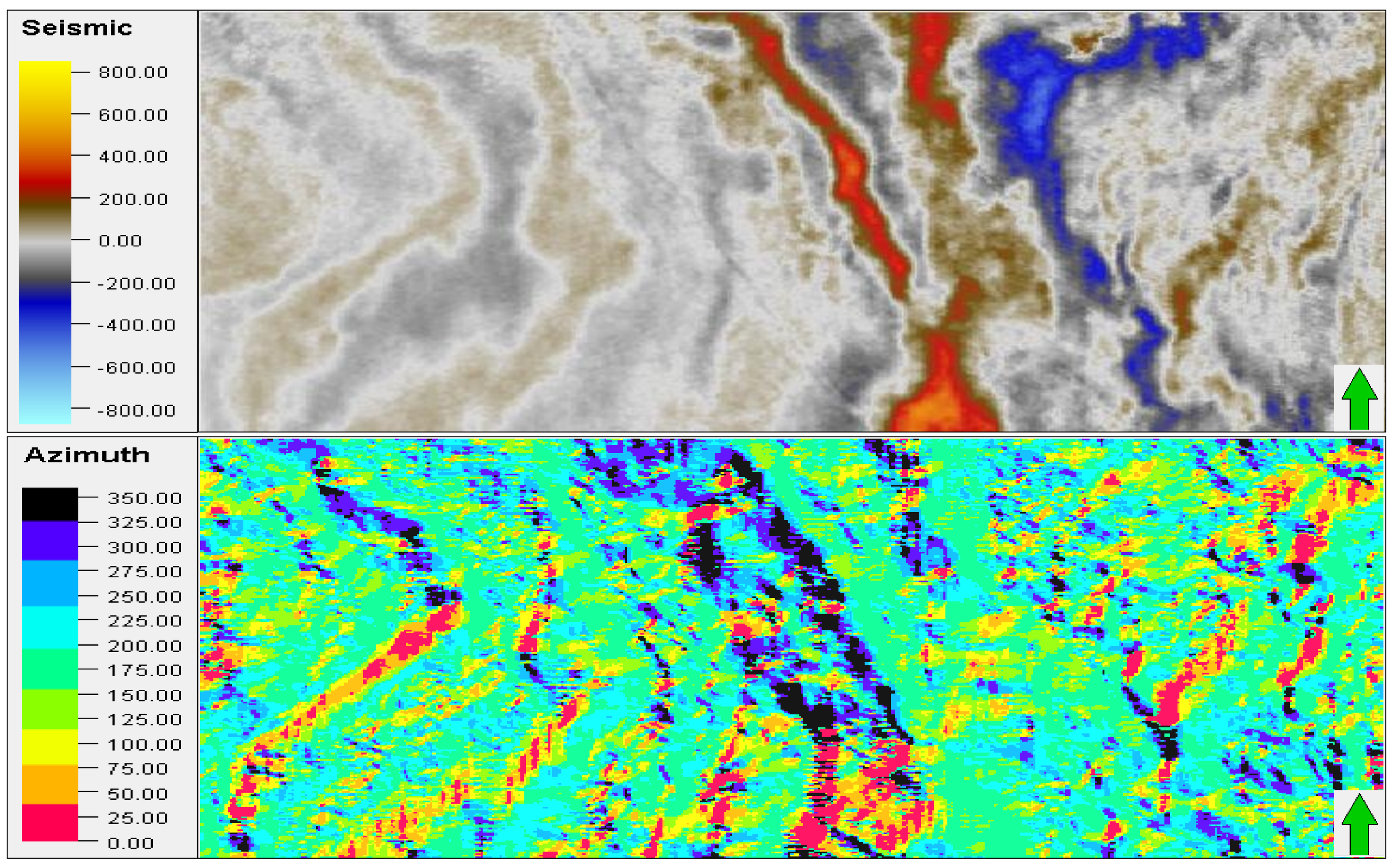

Figure 2: Horizontal time sections of original seismic volume (on the top) and the azimuth volume (on the bottom) estimated from structural seismic attributes.

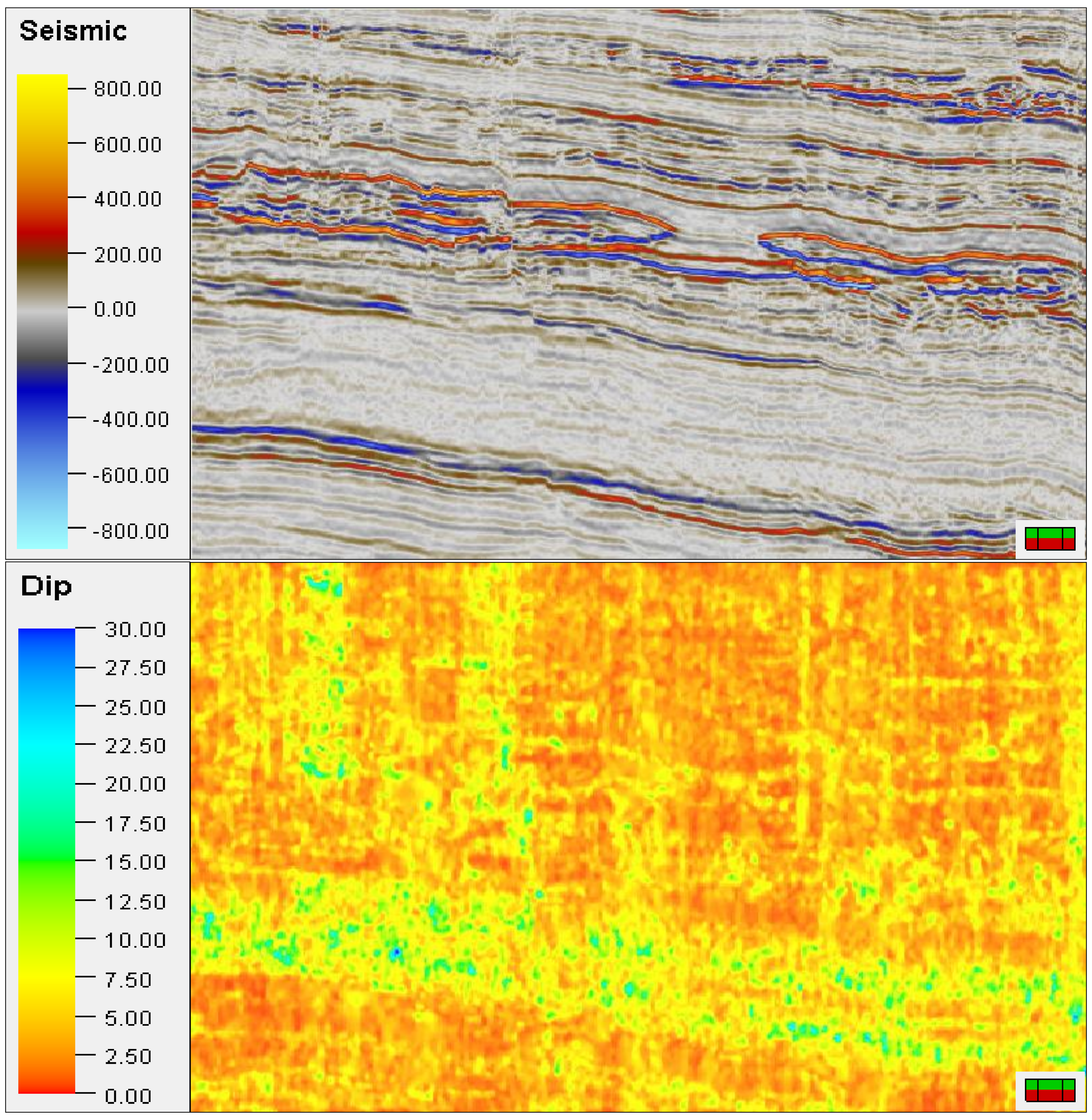

Figure 3: Vertical time sections of original seismic volume (on the top) and the dip volume (on the bottom) estimated from structural seismic attributes.

4. Conclusions

The integration of structural data within geostatistical seismic inversion methodologies was successfully applied leading to the generation of more robust and stratigraphically consistent models regarding the Earth subsurface geology. Moreover, the statistic elements and the spatial continuity models are well reproduced in the final solutions as retrieved from the available well-log data. It is worth to mention the important contribution of the proposed method in a more realistic reproduction of the elastic properties taking into account the structural information.

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