PS 3D Seismic Interpretation and Internal Structural Architecture of the Maricá Mass-transport Complex, Northern Santos Basin, Brazil*

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Search and Discovery Article #11287 (2020)**
Posted January 13, 2020

*Adapted from poster presentation given at 2019 International Conference and Exhibition, Buenos Aires, Argentina, August 27-30, 2019
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Abstract

3D seismic data has been shown to be an excellent tool when studying large-scale folds and thrust belts generated by underwater gravity-driven movements, particularly when the focus is the linkage between proximal (extensional), external (contractional), and lateral (transcurrent) domains. The Maricá is a Maastrichtian (~65 M.a.) detached mass-transport complex, located 150 kilometers from the city of Rio de Janeiro, which has an area of 1015 m² and an average thickness of 150 meters. The present study focuses on understanding how the internal structural geometry is spread over the Maricá mass-transport complex and how this geometry varies across the different domains via 3D characterization and well data. The research provides visual characterization showing the relationship between structures and lateral variations within the complex. The first step focused on seismic interpretation of the chaotic horizons. A progressive internal disaggregation was identified, with the proximal domain showing normal faults and the external domain showing folds and thrust faults. The external domain also shows folding and thrusting, a response of the presence of a salt wall located at the toe of the complex. We were able to identify that the long axis of the rafts stays parallel to the Southwest flux direction, however in circumstances when compression is present, the axis tends to be perpendicular to the flux direction. The second step will focus on well data, where resistivity image logs will be interpreted to link seismic scale to well scale. The data was provided by the National Agency of Petroleum, Natural Gas and Biofuels (ANP) through a request at ANP's Exploration and Production Database. The complete 3D characterization serves as a reference when studying deformed regions with outcrops lacking quality or quantity providing foresight regarding lateral continuation. These results will assist future studies on outcrops and underwater mass-transport complexes because they are frequently present in many basins across the world, including those with petroleum exploration.

References Cited

Carlotto, M.A., and L.F. Rodrigues, 2009, O Escorregamento Maricá - anatomia de um depósito de fluxo gravitacional de massa do Maastrichtiano, Bacia de Santos: Boletim de Geociências da Petrobras, v. 18/1, p. 51-67.

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AAPG ICE 2019
27-30 August Buenos Aires, Argentina
International Conference & Exhibition

Abstract

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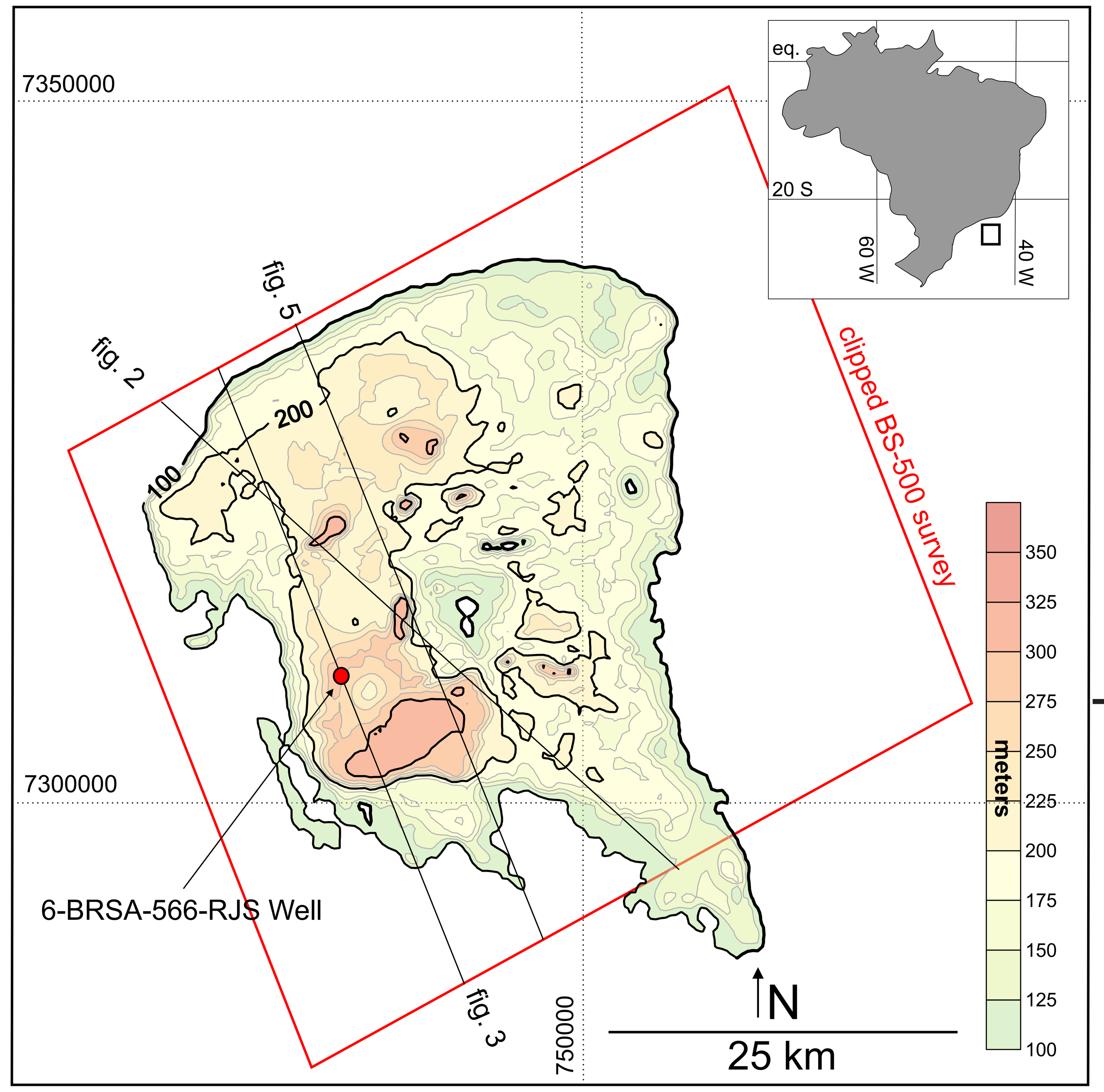
Maricá Mass-Transport Complex (MMTC)



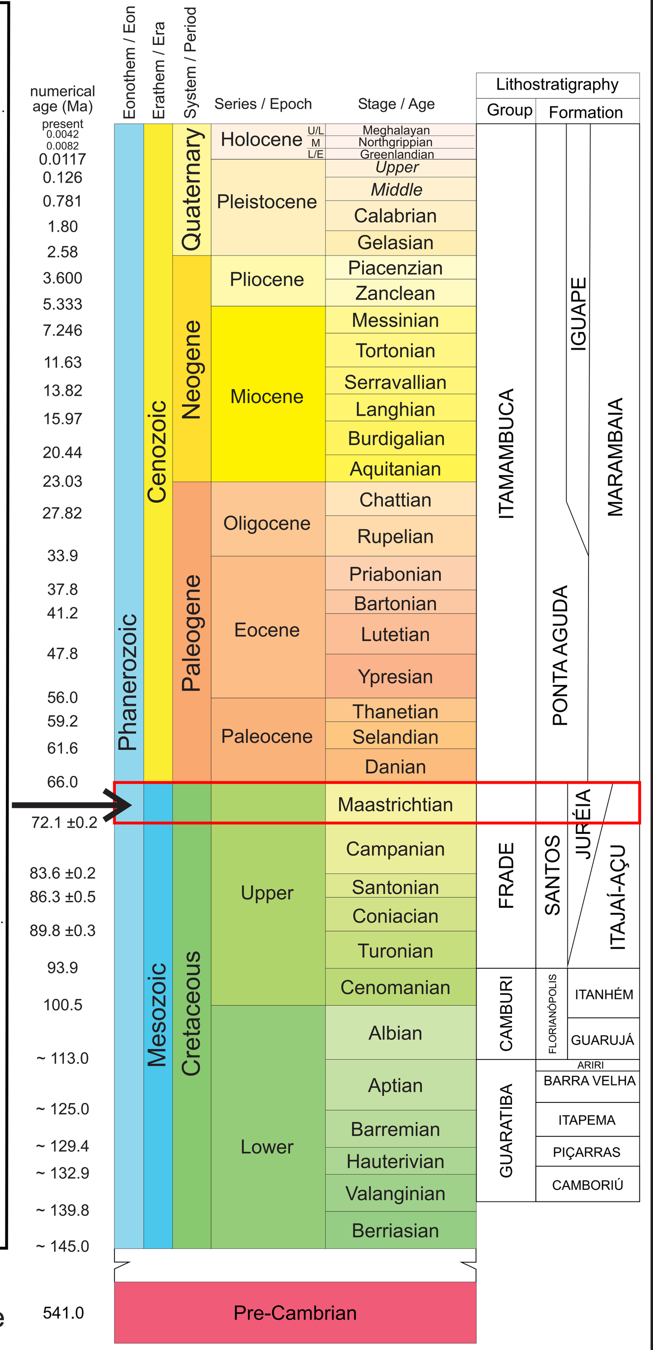


Figure 1. Location figure as well as an isopach map showing the location of the 2D seismic lines and the well used during this study. Also, Santos Basin's simplified stratigraphic chart showing the period of time when the mass-complex was triggered and deposited.

Moreira et al. 2007; Carlotto & Rodrigues 2009

Results

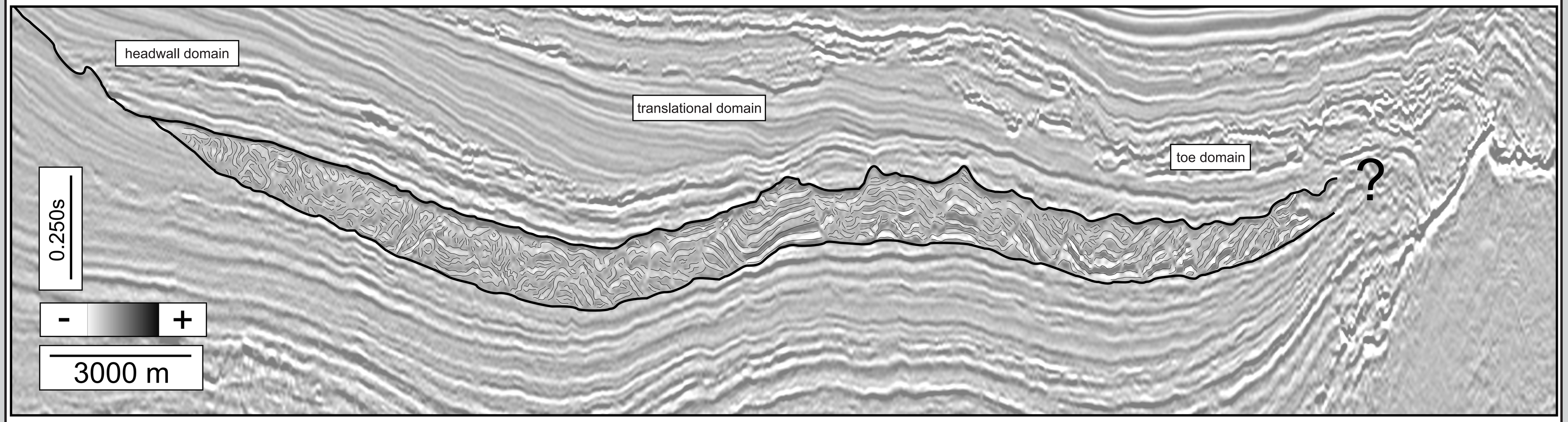
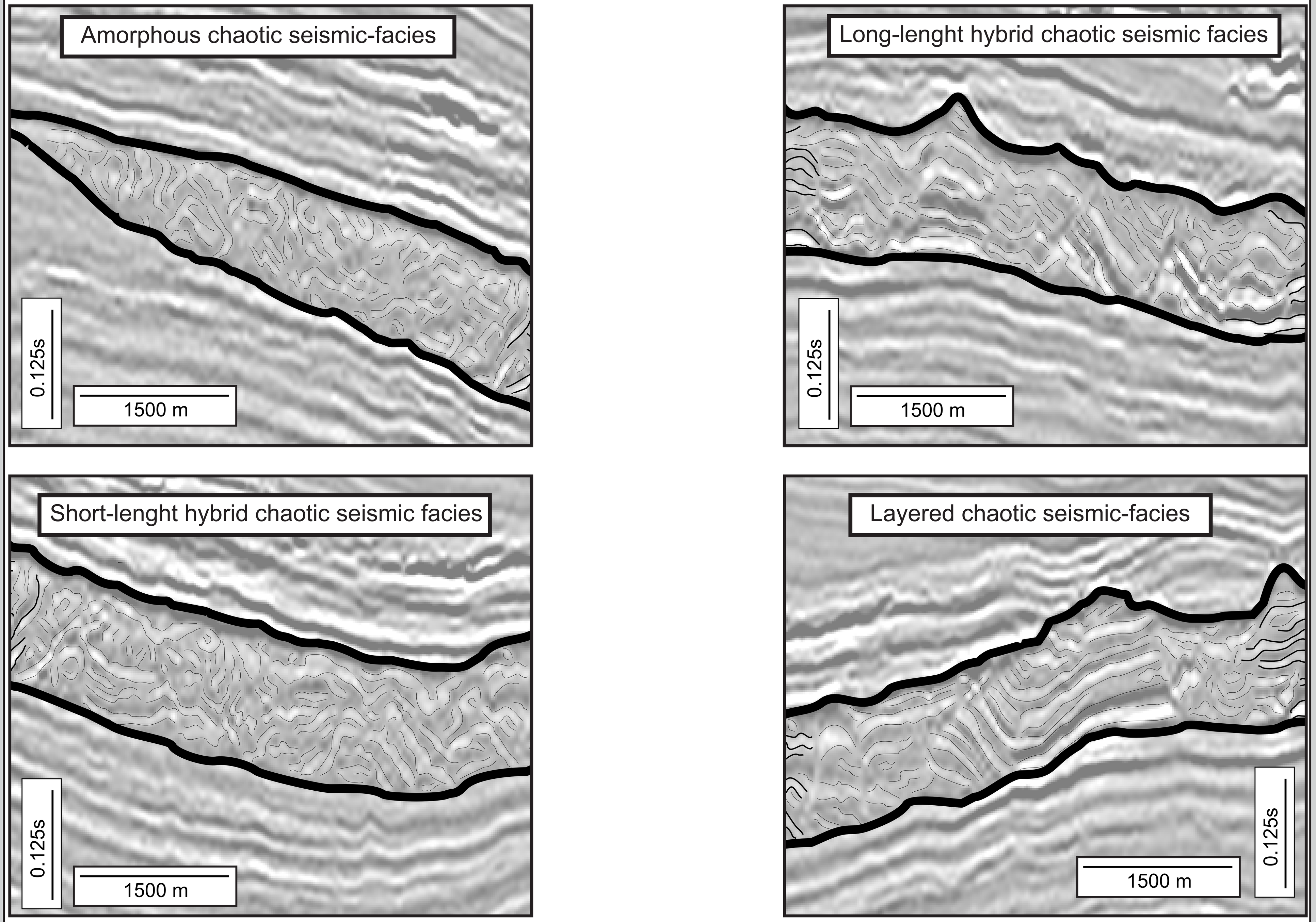


Figure 2. 2D Seismic line showing the general aspects of the MMTC. It is possible to identify the three different domains, commonly described in literature. The headwall domain is defined by a strong to weak linear positive contrast and has a similar dip angle with the seismic facies underneath it. The transitional domain starts when the linear contrast splits into two. The top surface is defined by a strong positive contrast, a response to the transition of turbidites to the Maricá MTC. The lower surface is usually defined when the chaosity of the MMTC facies stops and it is possible to identify the parallelism of the facies below it. The toe domain is characterized by the obstruction of the flow due to a salt wall. Internally it is possible to identify different chaotic seismic facies within the MMTC. An amorphous, located especially in the transition between the headwall and the translation domains. A layered facies inconstantly located in translation and toe domains. Lastly, a hybrid facies, which can be divided into two, a short-length and a long-length.



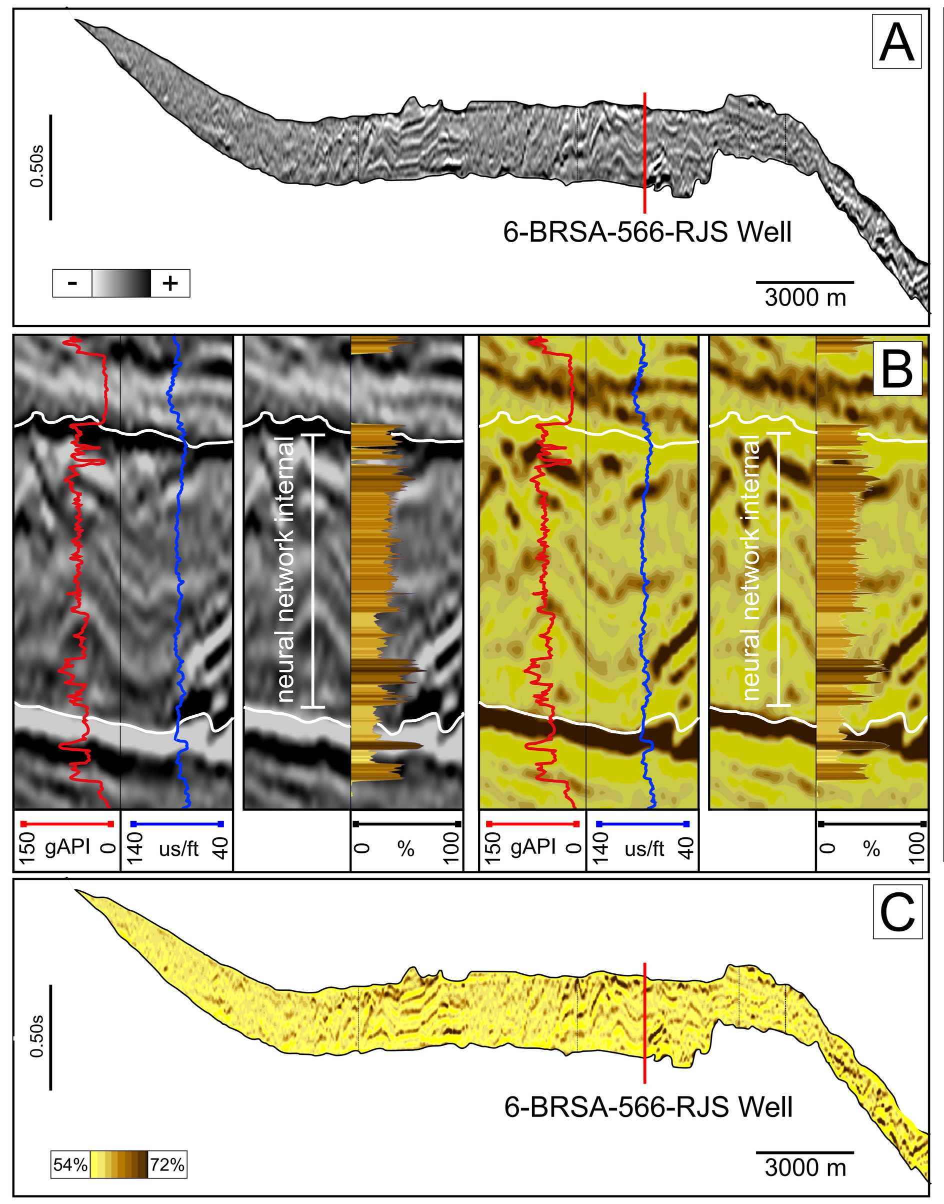


Figure 3. Neural Network training using a Vshale calculated log and the seismic reflectors. The Neural Network shows the variance of argilosity between the different areas of the MMTC. It is possible to identify that the proximal area has more sand when compared to distal areas. This idea leads to the assumption that amorphous chaotic seismic-facies relates to sand-rich lithology. When looking at the layered chaotic seismic-facies it is possible to identify an enrichment of shaly lithologies. Because of the essentially identical appearance of the long- and short-length hybrid chaotic seismic-facies when looking at the Neural Network, the origin is understood to have resulted from a cause other than lithology.

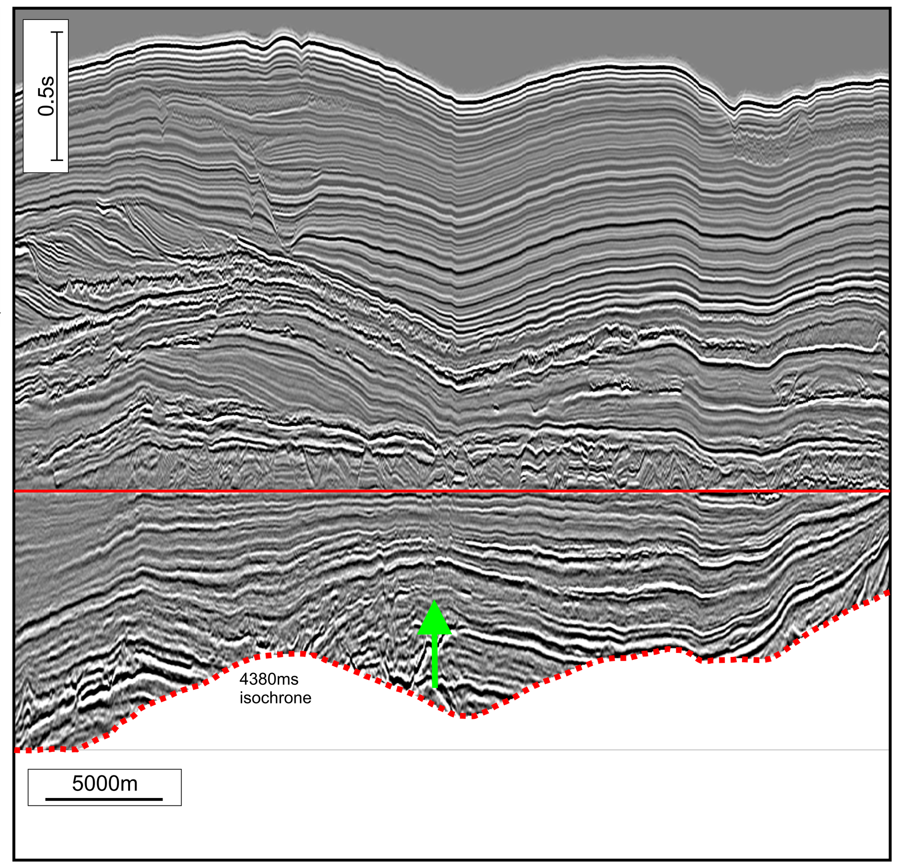


Figure 4. Flat scene using the lower surface of the MMTC as datum. This figure shows the pre-existing configuration when the complex was triggered and deposited (Maastrichtian). It is possible to identify that there was a major topographic feature (green arrow) that controlled the deposition. This topographic feature caused the change in acceleration and velocity of the chaotic flow. Short-length chaotic seismic-facies are related to higher velocities of flow when compared to long-length because short-lenght are interpreted as having high internal disaggregation, a result of higher velocities. Long-length chaotic seismic-facies have less internal disaggregation due to the continued continuity, and slower flow velocity, of the seismic reflectors.

Conclusions

- The topographic feature had a significant role in controlling the internal architecture of the complex as well as the morphology of the overlying rocks.
- The presence of the topographic featured caused the change of the slope inclination. This inclination induced the deceleration of the flow, resulting in the different chaotic seismic facies.

Aknowledgments

The authors would like to thank ANP for providing the seismic and well data and dGB Earth Sciences for providing an OpendTect academic license. Also the project "Avaliação dos Controles Sedimentológicos, Estratigráficos e Tectônicos na Distribuição e Qualidade de Reservatórios Siliciclásticos" for providing funding.

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