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Seismic geomorphology as a tool towards the understanding of gravity-driven sedimentation in deep water settings - an example from the Oligocene of the Campos Basin, Brazil.

Michael Holz (PPGEOF-UFBA), Armando De Carvalho (Universidade Federal da Bahia), ALEXSANDRO CERQUEIRA (Federal University of Bahia - GAIA)

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Introduction

Gravity-driven sedimentary processes are important agents for transporting sediments downslope into deep-marine environments. They shape sedimentary environments and control sediment deposition, influencing stratigraphic architecture and reservoir distribution. Each of these processes presents specific characteristics (e.g., type of movement, fluid rheology), hence their respective deposits exhibit diagnostic features that can be identified in seismic data. The scope of this work is: (1) a detailed characterization of the complex geomorphological architecture of gravity-driven deposits on an Upper Oligocene stratal slice in an important oil field in the offshore region of Campos Basin, and (2) the interpretation of the history of the deepwater sedimentation in that area.

Method

To carry out this study, data from fourteen wells and a 3D seismic dataset were used, consisting of 1.761 in-lines, 2.240 crosslines, and a depth range from 755 m to 6.035 m, covering an area of 616.36 km² across the Marlim, Marlim Sul and Marlim Leste fields in the Campos Basin. The extracted horizon slice separates an Oligocene sandstone system from a mass transport complex composed of Miocene shales and marls. The interpretation methodology was based on a seismic geomorphologic approach through standard seismic interpretation workflows by means of the classical technique of reflector termination mapping, delimiting key stratigraphic surfaces, and establishing the stratigraphic framework for the given time interval. Structural features (e.g., normal faults, inverse faults) and geomorphological features (e.g., channels, fans, rafts) were interpreted from a key horizon slice, and amplitude was used to derive seismic facies for the different geomorphological features.

Results and Conclusions

Gravity-driven sedimentation processes are triggered by relative base level changes and by syn-sedimentary tectonics. The resulting deposits are the outcome of several different sedimentary processes, involving slides, slumps, sandy or muddy debris flows, and different kinds of turbidity currents. All these features have been detected in different proportions and with a complex framework of superposition and interaction, which translates the actual complexity of deep-water deposition. The analysis has revealed the occurrence of debris flow deposits and turbidites, with channeled features, lateral accretions, and a distal submarine fan; and a slump deposit (MTC) with well-marked fold and thrust structures and rafted blocks. This system is locally eroding the channelized deposition and the submarine fan. The interpreted features were summarized in a schematic geological model, displaying the depositional complexity of the gravity-driven deposits and heralding the importance of seismic-geomorphological studies to detect and delimit potential hydrocarbon accumulations.