GeoConvention 2014 FOCUS | adapt refine sustain

Comparison of Slope Channel Deposits from the Shelf Edge to Lower Slope: Evidence for Changes in Erosion, Sediment Transfer, and Deposition (Magallanes Basin, Chile)

Aaron P. Reimchen[1], Stephen M. Hubbard[1], Benjamin G. Daniels[1], Brian W. Romans[2], and Lisa Stright[3]
[1]Department of Geoscience, University of Calgary, Calgary, Alberta
[2]Department of Geosciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia
[3]Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah

Deep-water slope channels are important conduits that cross continental slopes and facilitate sediment transfer from the shelf to the deep ocean. Since currents within deep-sea channels are inherently difficult to monitor in the modern, outcrop investigation offers an opportunity to better understand fundamental processes in these settings. The focus of this study is to analyze slope channel deposits in outcrop that can be directly correlated to coeval shelf edge units along a 25 km-long slope clinoform surface (Fig. 1). Objectives include a sedimentological comparison of upper slope to lower slope channel units, which facilitates insight into the variable deposition of sand along conduits like submarine canyons and slope valleys. As such, the outcrop analogue provides context for exploration of reservoirs on the continental margins of Canada and abroad.

The Upper Cretaceous Tres Pasos Formation of southern Chile consists of a depositional, dip-oriented cross-section exposure of a progradational shelf margin sequence (Fig. 1; Hubbard et al., 2010). It features clinoforms with > 1000 m of relief that are up to tens of km long. These deposits record the progressive infilling of the deep-water Magallanes foreland basin with non-marine through deep-marine deposits. One of the documented surfaces, the Puma Clinoform, represents a sequence boundary characterized by river-dominated shelf-edge deposits and incisions up to 60 m deep. > 20 km downslope of the shelf edge, slope channel deposits are exposed at Arroyo Picana (Fig. 1). This outcrop belt offers an opportunity to characterize the variable record of channelized erosion, sediment transfer and deposition longitudinally along the paleoslope.

The emphasis of this study is detailed documentation of slope channel stacking patterns on the Puma Clinoform at Arroyo Picana. In addition, intra-channel facies distribution trends and stratal geometries are investigated. Data was collected through sedimentological sections and traditional field mapping techniques, as well as high-resolution differential GPS surveying. Geo-referenced data points are used to construct a 3-D architectural model of the channel complex, which is the foundation for characterization and quantification of stratigraphic architecture and facies distribution patterns.

The Arroyo Picana outcrop consists of two distinctive channel complexes: (1) the earliest phase of channelization was dominated by traction transport of gravel and coarse-grained sand within a composite conduit at least 800 m wide. Overall, this basal complex (17 m thick) displays

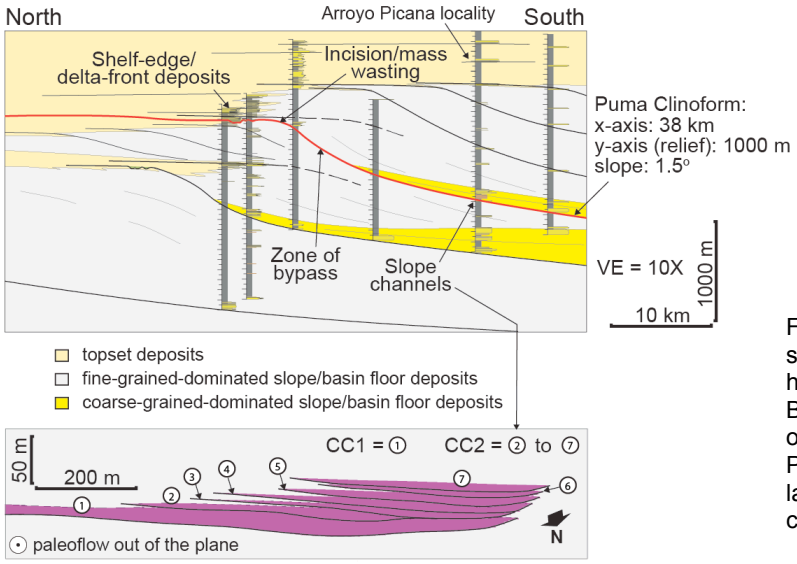

Figure 1. Overview of slope clinoform system in the Magallanes basin, highlighting the Puma Clinoform (from Bauer, 2012). Below, is a cross-section of slope channel complexes from the Petrel model. Channel complex 1 is labeled "1". The various channels of channel complex 2 are numbered 2-7.

disorganized internal architecture with a high degree of bed and sedimentary body amalgamation; these strata represent the establishment of a slope conduit, associated with degradation of the seafloor and bypass of sand and mud downslope (cf., Deptuck et al., 2003). (2) The second channel complex consists of a series of six individual channels that are 195 to 270 m wide, and more aggradational in nature. They are characterized by an overall systematic, lateral stacking pattern (Fig. 1). These channel bodies are 8 to 11 m thick, asymmetrical in cross-section, and commonly characterized by basal erosion surfaces overlain by siltstone drapes or mudstone-clast conglomerates. Sandstone beds transition laterally towards inner channel margins to thinly inter-bedded sandstone and mudstone.

Conclusions

Strata comprising two middle- to lower-slope channel complexes in the Tres Pasos Formation outcrop belt (Magallanes Basin, Chile) are ~ 55 m thick, and contain an intricate record of erosion, sand bypass and deposition. These characteristics contrast channelform bodies on the coeval shelf-edge and upper slope that are filled by fine-grained facies, through which coarse-grained sediment largely bypassed. The results of this work shed insight into reservoir distribution within channelized slope systems on continental margins, as well as perspective reservoir-scale heterogeneites.

Acknowledgements

This research is supported by the Chile Slope Systems Consortium (Chevron, ConocoPhillips, Statoil, Shell, Nexen, Marathon, Talisman, Anadarko, BG Group, BP, and BHP Billiton), as well as NSERC. Schlumberger graciously provides software licenses for Petrel.

References

Bauer. D.B. 2012. Stratigraphic evolution of a high-relief slope clinoform system, Magallanes Basin, Chilean Patagonia: Unpublished M.Sc. Thesis, University of Calgary, 130 pp.

Deptuck, M.E., Steffens, G.S., Barton, M., and Pirmez, C., 2003. Architecture and evolution of upper fan channel-belts on the Niger Delta slope and in the Arabian Sea. Marine and Petroleum Geology, v. 20, p. 649-676.

Hubbard, S.M., Fildani, A., Romans B.W., Covault, J.A., and McHargue, T.R., 2010. High-relief slope clinoform development: Insights from outcrop, Magallanes Basin, Chile. Journal of Sedimentary Research, v. 80, p. 357-375.