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Monitoring outcropping facies change in slope channels along individual clinothems, Neuquén Basin, Argentina

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Continuous exposure of 300m-high basin margin, Jurassic clinoforms in southern Neuquén Basin, Argentina, offers a rare opportunity to document downslope facies change along individual clinothems. Complete topset fluvial and shelfal deposits, foreset of muddy slope and coarse-grained filled channels, and bottomsets of stacked basin floor fans are constructed in a Jurassic back-arc setting. Coarse-grained infill of slope channels highlights slope timelines along the prograding deepwater margin. Mapping of the slope channel facies along the slope timeline reveals grain size and type of sediment gravity flow partitioning along the clinothem.

Vertical sedimentary logs, satellite images, digital elevation model (DEM) and drone photogrammetry are used to map downslope channel geometry and infill facies variations. The known grain size distribution of the topset is partitioned unevenly down into the upper slope, lower slope, and basin floor fan, related to the size of sediment conduits, sediment bypass, and types of sediment density flow. The channel fill in the study area has a trend of decreasing grain size and bed thickness with increasing depth from the shelf edge. The upper slope channels are filled with meter-thick, poorly sorted conglomerates and gravelly sandstones interpreted as debrites and high density turbidites, whereas the lower slope channels are filled with decimeter-thick interbedded low density turbidites and mudstone. Down-dip correlation highlights sandstone beds that thicken laterally into a conglomeratic upper-slope channel complex that decreases the coarse-grained portion from 100% to 65% as channel depth increases from 50 to 100m. Conglomeratic beds are non-existent in lower slope channels, but re-occur on basin floor fan along with low density turbiditic sandstones, suggesting lower-slope sediment bypass of some coarse-grained volumes and possible sediment density flow transition. The down-slope partitioning of grain size and bed thickness as well as a downslope change in channel architecture from laterally to vertically channel infill suggests that sinuous upper slope channels were able to pond cohesive debrites and high density turbidites, while less sinuous lower slope channels allowed more efficient bypass.This would explain the thin-bedded nature of lower slope channel fills and reoccurrence of conglomeratic debrite on basin floor.

This is a first attempt to monitor facies distribution in outcrops along a continuously exposed seismic scale basin-margin clinoform, providing a sedimentological analog to basins with limited lithological data. The study highlights the role of slope channel as the conduit of bypass sediments from clinoform topset to bottomset, and sediment density flows in distributing the grain size. Future study directions include identifying the allogenic and autogenic controls on slope channel geometry and sediment gravity flow distribution.