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Integrating Seafloor and Outcrop Observations of Upslope-Migrating Bedforms to Refine Interpretations of Deep-Water Stratigraphy

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Summary

Deep-water canyon-channel-fan systems are globally important hydrocarbon reservoirs and records of extensive sediment routing to the oceans throughout Earth's history. However, our understanding of depositional processes within these systems has been previously limited due to a lack of observations from analogous modern environments and has relied heavily on other methods, including the sedimentary record itself. Recently, high resolution marine datasets have provided novel insight into seafloor processes and new potential to re-evaluate and validate depositional models. For example, upslope-migrating bedforms are now found abundantly in active turbidity-current-dominated settings around the world and have been associated with supercritical flow conditions. In this study we integrate modern and ancient datasets to examine the sedimentological and three-dimensional architectural characteristics of upslope-migrating bedform deposits and their application to interpretations of deep-water stratigraphy.

We use repeat bathymetric surveys from two modern environments, the Squamish Prodelta (British Columbia, Canada) and Monterey Canyon (California, USA), to reconstruct the stratigraphic products of upslope-migrating bedforms with 13 – 140 m wavelengths and 0.3 – 10 m wave heights. Our findings are compared to aid in interpretation of deep-water successions within the Nanaimo Group (British Columbia, Canada) and the Tres Pasos Formation (Patagonia, Chile). Bedform deposits in all datasets are typically several meters to 10s of meters long/wide, < 1 m thick, and make up successions of low-angle, backstepping, trough-shaped lenses composed of massive sands/sandstones. These sedimentary structures are associated with supercritical flow conditions, low-aggradational bedforms, and high degrees of sediment transport and deposit reworking. Collectively, our results establish geometric and architectural criteria for recognition and interpretation of upslope-migrating bedform deposits in the rock record. Their identification and occurrence in ancient successions has important

implications for paleo-environmental interpretations as well as hydrocarbon reservoir predictions in deep-water deposits.