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Steep Microbial Boundstone-dominated Platform Margins: Examples and Implications

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Seaward progradation of several km's has been documented mostly for leeward margin low-angle carbonate slope systems with a dominant platform top sediment source. However, steep and high-relief margins fronting deep basins can also prograde and as such are somewhat perplexing. Characteristics of two prograding Carboniferous examples provide a model which may apply elsewhere: (1) outcrops in Asturias, northern Spain serve as important analogs for (2) hydrocarbon reservoirs in steep-sided isolated platforms of the North Caspian Basin, Kazakhstan, such as Tengiz. Seismic and well data from Tengiz corroborate outcrop patterns for slope development, showing progradation of up to 5 and more than 10 km, respectively, despite the high-relief (up to 600 m) and steep (~20-35°) nature of these margins. The two examples share a highly productive microbial boundstone factory extending from the platform break down the slope to nearly 300 m (or more) depth and a lower slope dominated by (mega)breccias and grain flow deposits derived from the margin and slope itself. The broad depth range of microbial boundstone increases the potential for production during both lowstands and highstands of sea level and thereby facilitates progradation independent from platform top derived sediment. Rapid in situ lithification of the boundstone provides stability to the steep slopes, but also leads to readjustment through shearing and avalanching. What controls the microbial cement boundstone formation remains a debate but its presence is a key factor controlling the progradational geometry of these and possibly other margins. This new model of "slope" shedding has implications for slope readjustment processes and resulting architecture, sequence stratigraphic interpretation, reservoir characterization, and reservoir modeling. Especially the isotropic

character of microbial boundstone will reduce the potential for coherent seismic reflections to develop and possibly invoke, under certain stress regimes, shattering and fracturing thereby generating significant non-matrix permeability. Key considerations are the contrasts with the Bahamian highstand shedding depositional model, slope progradation rates that range from 450 to >1500 m/My, and net growth rates of in situ boundstone of ˜1000 m/My, comparable to or higher than accretion rates for metazoan skeletal reef growth.