Presentation for Alaska Geological Society

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Mixed deepwater systems from the North Slope to offshore

Since the Pikka-Horseshoe and Willow discoveries, oil and gas explorers have been encouraged to think: “What are the sedimentary processes controlling the abundance of anomalously thick sandstone reservoirs on the North Slope – from shelf to deepwater basin plain?” While these discoveries contain somewhat unusual deposits that explorers were unable to comfortably fit into the preexisting 21st century marine sedimentology paradigm, these discoveries highlight that marine sedimentary successions are more complex than originally interpreted and can be placed along a spectrum of sedimentary processes derived from fluid turbulence to matrix strength, and from along slope to downslope (Fig. 1, Verma *et al.*, 2022).

Prior to the last 5-10 years, the search for deepwater conventional turbidite reservoirs promoted a singular focus on sediment transport and depositional models dominated by downslope processes. Turbidites, debrites and transitional flow deposits were interpreted to be responsible for diverse submarine fan depositional systems comprised of elegantly interconnected canyon, channel, levee, splay and overbank environments. Today, along-slope as well as downslope (i.e., turbidity current) processes are interpreted to sculpt the modern deepwater seafloor (Fig. 2, Rotzien *et al*., 2022; Hernández-Molina *et al*., 2022). Ancient stratigraphic successions in revered outcrops such as the Annot Sandstone (Grès d’Annot) in France also reveal evidence of along-slope sediment transport and deposition. In response, wildcatters and academic researchers alike have refreshed interpretations and depositional models to communicate new observations on mixed deepwater sedimentary systems to scientific and industry communities as oil price remains high in the near term.

This presentation focuses on deepwater sedimentary processes and deposits, their predictive attributes and their 3D heterogeneity. While much of the global knowledge on deepwater has been generated through decades of oil and gas drilling (Fremin *et al*., 2022), a firm understanding of deepwater sedimentary processes is essential for many scientific and business endeavors that take place in the water column, at the seabed, and into the subsurface, as well as onshore projects that involve deepwater sedimentary intervals (Sears *et al*., 2022). Professionals and students in the fields of oil and gas exploration and production, carbon capture, use and sequestration, geothermal, wind, solar, aquaculture, mining, military, insurance and government are invited to participate in this discussion on the past, present and future of *deepwater*.

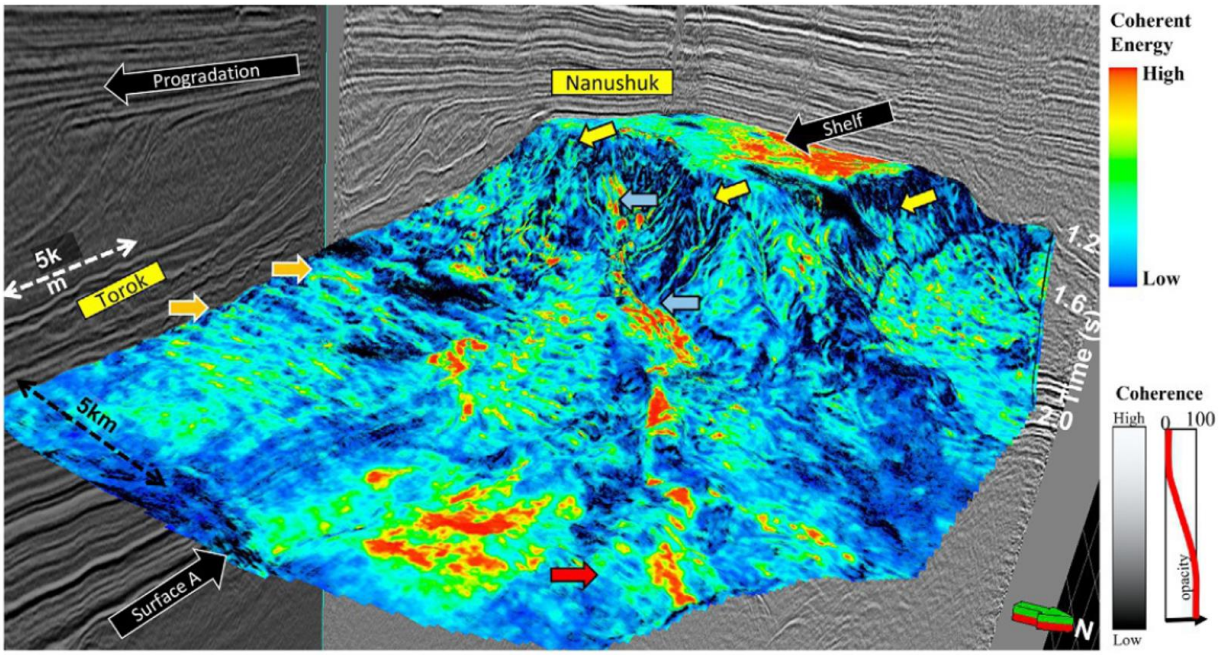

Figure 1. A 3D view of the Nanushuk and Torok intervals with three seismic amplitude walls surrounding a coherent energy plot co-rendered with a multispectral coherence along *Surface A*. Orange arrows point to ~5-km-long sinuous crested features that are interpreted as sediment waves or other large bedforms. Yellow arrows mark the upper extent of some slope channels and gullies that collect and carry sediment from the Nanushuk system downslope to the Torok. Blue arrows mark the middle canyon and the canyon-channel transition zone. The red arrow shows one of the frontal lobe complexes that sourced sediment from the canyon. Figure from Verma *et al.* (2022).

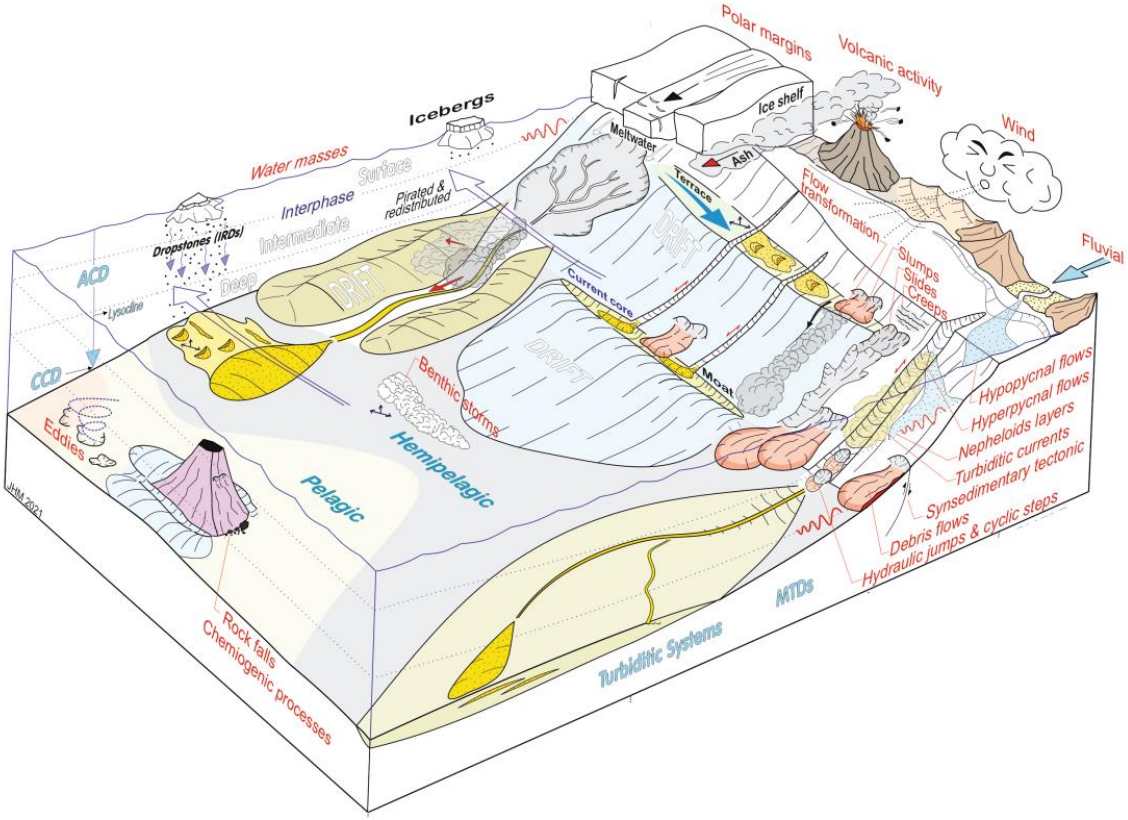

Figure 2. Marine and deep marine processes and deposits drawn by F. J. Hernández-Molina in Rotzien *et al.* (2022).

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