more than 15 m (49 ft) of mudstone with thin sandstone interbeds. The thick-bedded sandstone beds in the lower part of the sequence are typically several tens of centimeters thick, graded, and display Bouma T_{a-b} or T_{a-b-c} intervals. Although many of these sandstone beds are visibly lenticular, the associated thin mudstone interbeds extend laterally across the exposure, unchanged in thickness or lithology. This thin-bedded transitional sequence consists of graded sandstone beds, 5 to 15 cm (2 to 6 in.) thick, that displays Bouma T_{b-c} intervals. The mudstone unit that caps the succession consists of bioturbated mudstone with thin (mostly less than 5 cm, 2 in.) sandstone interbeds. Paleocurrents in the upper and lower parts of the succession (predominantly as recorded in ripples and ripple bedding) trend dominantly southwest. The transitional sequence, however, displays a consistent 30° deflection of currents to the south; in addition, these strata are inclined slightly more steeply to the south than the beds above or below.

I interpret this overall fining-upward sequence as resulting from lateral migration of a channel within the submarine canyon. The thick-bedded sandstone beds represent deposition on the flank of the channel; the lenticularity of these beds suggests that they were not deposited by a pure turbidity current but were carried by additional (or other) mechanisms, such as fluidized flow. The mudstone interbeds reflect predominantly pelagic deposition in the intervals between sediment gravity flows. The thin-bedded sandstone sequence represents a levee facies deposited primarily from tractive currents associated with the gravity flows that spilled over the channel and were deflected slightly to the south by the slope on the outer side of the levee. The upper, predominantly mudstone part of the section was deposited as pelagic sediment interspersed with overbank flows that traveled down the general slope of the submarine-canyon floor. An erosional surface with 3 to 4 m (10 to 13 ft) of relief near the top of the thick-bedded sandstone, covered by a mudstone breccia talus, records an episode wherein the channel reversed its migration direction and locally eroded the upper channel-flank deposits.

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Relative Role of Waves and Tides in Development of Transgressive and Regressive Coastal Sequences

Close examination of coastal morphology and related sediment bodies reveals that the commonly used terms "wave dominated" and "tide dominated" are in many places applied improperly. Such terminology provides little data that the geologist can use in establishing the various process parameters that prevailed in ancient coastal depositional environments. In addition to the absolute and relative size of waves and tides, it is also necessary to consider other factors which contribute to coastal morphology such as tidal prism, sediment availability, topographic relief, and rates of relative sea level change. Interaction of these factors may create a wide variety of stratigraphic sequences.

Several of these additional factors differ strikingly depending on whether or not the setting is one of shoreline progradation or marine transgression. In the absence of a delta, progradation generally leads to a simple, relatively straight shoreline, which tends to limit tidal currents to inlets, if present. Transgression caused by a relative rise in sea level may promote shoreline irregularity and embayment, and thus the potential for a larger tidal influence. Progradation occurs under conditions of ample sediment supply relative to the rate of sea level change, whereas transgression causes entrapment of sediment in coastal bays and rivers, thus reducing the amount of sediment available to the open marine setting.

Nondeltaic progradational deposits, accordingly, are likely to be considered wave dominated regardless of wave size or tidal range. Waves are more effective in distributing and reworking the sediment along a straight progradational coast than are tidal currents, and, in addition an ample amount of sand is available on the shoreface for this reworking. Shoreface deposits typically are the major component of a nearshore progradational sequence.

Transgressive deposits, however, are more likely to be considered tide-dominated even where wave size and regional tidal range are unchanged from those prevailing under conditions of progradation. Coastal irregularity creates refraction patterns that dissipate wave energy over broad areas, and so tidal flow within embayments becomes an important process. Most of the available sediment resides in these embayments and bears the stamp of reworking by tidal currents. Shoreface deposits are likely to be sporadically distributed and of inconsequential volume.

Deltas constitute a potential exception to the foregoing generalization. Many deltas are dominated by riverine processes and little influenced by either waves or tides. Moreover, deltas that form in areas of extreme tidal range can generate a complex shoreline during progradation and thereby mimic the embayed coast. Such tide-dominated deltas, however, typically form in areas of broader irregularity of coastline. Sufficient progradation may smooth this larger scale coastal configuration and thereby diminish the tidal influence.

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Stratigraphy and Sedimentology of Ledge Sandstone in Arctic National Wildlife Refuge Northeastern Alaska

Data collected from four measured sections of the Ledge Sandstone member of the Ivishak Formation are presented. These sections are located in the Arctic National Wildlife Refuge (ANWR) in northeastern Alaska. The Ledge Sandstone is the time equivalent of the Ivishak sandstones that form the reservoir in the Prudhoe Bay field, east of the study area. The ANWR region is of interest for oil and gas exploration owing to the numerous oil seeps on the coastal plain and surficial expression of possible subsurface antiforms.

The Ledge Sandstone in ANWR consists primarily of a massive, thickly bedded, very fine to fine-grained, well-sorted quartz sandstone. Thin beds of silt occur locally. Rare conglomeratic and pebbly zones are found within the unit. Porosity is negligible in the Ledge, owing to siliceous cementation. Bedding planes, where discernible, are predominantly planar with some low-angle cross-bedding. The bases of beds typically contain load features.

The thick sandstones are separated by thin siltstone intervals ranging from less than an inch to several feet in thickness. Although the thicker siltstones appear laterally continuous, the thinner beds generally are lenticular over short distances (10 to 20 ft; 3 to 6 m). Cementation of the siltstone appears sporadic, varying laterally and vertically within the unit. Burrowing is extensive in the siltstone intervals. Typically, burrowing cannot be detected in the sandstones because of the obliteration by lithification and diagenetic processes. Fossils are sparse throughout the unit, even in the poorly lithified silts. Some bivalve shells have been preserved intact, but lack any distinct orientation.

These data are consistent with a shallow marine environment, within wave base. This contrasts with the nonmarine conglomerates and sandstones of Prudhoe Bay. Time-equivalent units to the south and west consist primarily of cherts and shales of probable deep marine origin, with some arkosic sandstones and dolomites