Sediment dispersal patterns on a huge muddy shelf: middle Cretaceous Shaftesbury to Cardium interval, Alberta and British Columbia

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ABSTRACT

Although the geostrophic model of shelf sediment dispersal is well-established, few studies of muddy sediments deposited far from shore validate the predicted patterns. We have examined, over an area of about 100,000 km2 two large, mudstone-dominated transgressive-regressive cycles spanning Late Albian to Late Turonian (98-88 Ma). The lower cycle encompasses the Shaftesbury (including basal Blackstone Fm.) Fm. and Dunvegan delta complex. The upper cycle includes the Blackstone, Kaskapau and Cardium fms. The rocks have been divided into six intervals reflecting the broad paleogeographic evolution of the basin. Paleoflow data (about 1,500 measurements of wave ripple crests, combined-flow ripples, and gutter casts) were obtained from thinly-interbedded mudstones, siltstones and very fine sandstones representing a distal, storm-influenced shelf. Shoreline trends for the Dunvegan and Cardium are independently known from drilling data.

Wave ripples indicate that the prevailing wind blew from the NE throughout the studied interval. Gutter casts and combined flow ripples consistently indicate shelf flows directed to the SE. However, geographic and stratigraphic proximity to a shoreline results in wave ripples rotating to parallel that shoreline, and gutter casts become shore-perpendicular.

Models of shelf sediment transport by anticyclonic storms crossing the Western Interior Seaway (Slingerland & Keen, 1999) predict an initial, weak northerly geostrophic flow driven by southerly and SW winds. As the storm tracks eastward, the western margin of the seaway is affected by strong northerly and NE winds which drive a strong along-shelf geostrophic flow to the south and SE. Our observations show that only the SE-directed geostrophic flows are preserved.