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Wave-Dominated Tidal Flat Deposits and Structurally Controlled Deposition within the Basal Cambrian Sandstone (BCS)

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The BCS is the focus point of increasing CCS (carbon capture and sequestration) efforts within the province of Alberta with lease agreements issued for 13 hubs. To date, tides appear to be the dominant depositional process with a variety of tidally-dominated depositional environments observed to date (Winkler *et al.,* 2011, Herbers *et al.*, 2023). However, observations within several cores show the presence of wavy, parallel-horizontal to low-angle laminated sandstone with interbedded hummocky cross-stratification and wave ripples, indicating that at least locally, wave energy dominated the depositional system. Bioturbation and accompanying heterolithic lithosomes are sporadic in occurrence. These deposits are interpreted as being deposited on open-coast tidal flats (Yang *et al*., 2005). Yang *et al*. (2005) interpreted the variable mud content as being controlled by seasonal variability through storm-activity. On the modern open-coast tidal flat systems of South Korea, storm-dominated conditions in the winter lead to sand-rich deposits, while tide-influenced conditions prevail in the summer resulting in more mud-rich heterolithic deposits (Yang *et al*., 2005). We interpret similar facies in the BCS, possibly controlled by storm seasonality. Importantly, mud-content is a critical control on vertical permeability as observed through full-diameter core analysis.

In addition to potential seasonal controls on the depositional facies, we observe sedimentologic and stratigraphic features consistent with syn-depositional faulting during BCS deposition. The 100/15-34-043-10W4/00 well presents an enigmatic case of exceedingly overthickened BCS strata totaling ~215 m in thickness. This is in stark contrast to usual thicknesses of around 40–80m. Core data is available from this well in both the upper and lower portions and confirms the presence of lithologies consistent with BCS deposition but inconsistent with the normal mud-rich deposits of the Earlie Formation. Core observations include convoluted bedding and soft-sediment deformation over several meters, consistent with fluidization of sediments. The paucity of primary sedimentary fabric over the entirety of both cores (~18 m) suggests significant tectonic activity of at least local origin. Sediments show little to no indication of being lithified prior to deformation, leading us to interpret the presence of active syn-depositional faults that are producing enormous amounts of accommodation. When coupled with abundant sediment supply, the syn-depositional tectonics result in extremely thick accumulations of BCS strata.

References

Herbers., D.S., Hauck., T.E., Gordon., J.B, 2023. Characterization of a saline aquifer unit as a prime candidate for CCS: Case study of the Basal Cambrian Sandstone, Canada. AGS Website Publication.

Winkler., M., 2011. Generation-4 Integrated Reservoir Modeling Report, Quest CCS. Alberta Energy Submission.

Yang, B.C., Dalrymple, R.W. and Chun, S.S., 2005. Sedimentation on a wave-dominated, open-coast tidal flat, south-western Korea: summer tidal flat–winter shoreface. *Sedimentology*, *52*(2), pp.235-252.