

# A Process Sedimentology Approach to Understanding the Deposition of Fine-Grained Mixed Siliciclastic-Carbonate Systems: A Case Study from the Altares Member within the Lower Triassic Montney Formation, Western Canada Sedimentary Basin

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## Summary

Although the up to 300m thick Lower Triassic Montney Formation predominantly consists of siliciclastic-dominated planar-laminated siltstone, a short-lived, mixed siliciclastic-carbonate interval is observed within the upper Middle Montney (Smithian-age), the Altares Member. This succession comprises a vertical cycles of carbonate and clastic dominated facies, suggesting recurrent paucity of terrigenous input into the basin and the establishment of carbonate factories on the shelf at this time. Overall, the Altares Member consists of centimeter- to decimeter-scale bituminous siltstone and very fine-grained sandstone, interbedded with bioclastic packstone to grainstone beds. These have been interpreted as deposited in proximal offshore to offshore transition settings, with shell material transported by storm-generated currents from more proximal settings, possibly low-relief biostromes. However, in this study detailed characterization of microfacies and depositional processes of the Altares Member document millimeter-scale grain size variability, the distribution of shell and carbonate material, sedimentary fabric, and sedimentologic heterogeneity. Within the siliciclastic-dominated beds, observed sedimentary structures include planar laminae, pinstriped laminae, wavy laminae, discontinuous planar laminae, and thin massive beds. In carbonate-dominated intervals sedimentary structures include planar laminae, wavy laminae, current ripples, thin massive beds, scour fills, and loading structures, with concretions. Shell material mainly consists of disarticulated and fragmented clams (*Claraia* flat clams), terebratulide brachiopods, and rare gastropods, ammonoids, fish, and ichthyosaur bones. A complex microfacies distribution within studied samples suggests that multiple processes deposited and reworked sediment including erosion and current reworking of the sea floor, suspension setting, bedload transport, and deposition from storm-generated flows. Microfacies are similar between carbonate-rich, mixed, and pure siliciclastic beds suggesting that sedimentary processes likely remained more or less the same throughout the deposition of sediment irrespective of the lithologies. Through this study, a better understanding of depositional processes associated with the short-lived period of carbonate deposition of the Altares Member and its larger association with the surrounding siliciclastic-rich Montney Formation can help further refine depositional models in mixed siliciclastic-carbonate systems.

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