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The 'Anisian Wedge': Insight on the Complexity of the Montney-Doig Boundary

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Summary

The Lower Triassic Montney Formation, in the subsurface of western Alberta and eastern British Columbia, consists primarily of dark grey, calcareous and dolomitic siltstone. However, isolated areas have an interval of interbedded pervasively bioturbated and diminutively bioturbated strata that caps the top of the formation, which has informally been called the 'Anisian Wedge' (Zonneveld and Moslow, 2015; Zonneveld et al., 2015; Furlong et al., 2016; Davies and Hume, 2016; Zonneveld et al., 2016). Similar intervals have been referred to as the 'Gordondale' Sandstone (Davies et al., 1997; Davies and Hume, 2011) and the Moig Sandstone (LaMothe et al., 2007; LaMothe, 2008) within the Pouce Coupe, Pouce Coupe South, Progress and Gordondale fields. The interval is spatially complex, and has commonly been overgeneralized and overlooked.

The 'Anisian Wedge' is lithologically, ichnologically and paleontologically distinct from underlying and overlying strata (Zonneveld and Moslow, 2015; Zonneveld et al., 2015; 2016; Furlong et al., 2016). Lithologically, grain size varies from fine silt to fine sand, with isolated gravels, rip up clasts, phosphate nodules, phosphatic ooids and phosphatic sand beds. The unit is commonly bounded at the top and base by unconformities, with phosphatic, gravel lag deposits and/or *Glossifungites* ichnofacies preserved at the base. Trace fossils present include robust *Phycosiphon* and *Rosselia*, with subordinate *Teichichnus, Palaeophycus, Planolites, Skolithos* and *Zoophycos*. Pervasively bioturbated zones are dominated by *Rosselia* surrounded by a dense fabric of *Phycosiphon* and have high bioturbation intensity (BI=5-6). Diminutively bioturbated intervals are mainly composed of small *Phycosiphon, Palaeophycus* and *Planolites* and bioturbation intensity is variable (BI=0-6). Paleontological assemblages include bivalves, gastropods, lingulid brachiopods (which all occur within the Montney and Doig Formations), and spiriferid brachiopods, terebratulid brachiopods, echinoderm spines and crinoid ossicles (which are quintessential components of the Middle Triassic fauna).

Petrophysically, the 'Anisian Wedge' has distinct spectral gamma, resistivity and bulk density logs. Within spectral gamma logs, the uranium component increases, whereas the potassium component slightly decreases and the thorium component remains consistent. There is an overall increase in resistivity logs, and density porosity logs increase at the base of the unit, which relates to the relative increase in porosity.

Interestingly, the 'Anisian Wedge' provides a unique example of a spatially widespread and diverse ichnological assemblage, which is not seen anywhere else within the Montney Formation. A few higher diversity assemblages have been identified and interpreted as being associated with environmental refugia, or areas of oxygenated water within the shallow marine realm (Beatty et al., 2008; Zonneveld et al., 2007, 2010a, 2010b), but these intervals occur in localized areas. Overall, trace fossil suites within the Lower Triassic of Canada have been characterized as simple, low-diversity, and low-abundance (Zonneveld, 2011), however the 'Anisian Wedge' suggests otherwise.

Biostratigraphic data suggests that the boundary between the Montney and Doig Formations is diachronous, with latest Lower Triassic and earliest Middle Triassic occurring both above and below the boundary (Wilson et al., 2014; Golding et al., 2015). However this may be due to the 'Anisian Wedge' being overlooked and has resulted the diachronous nature of the boundary being over-exaggerated. Understanding the sedimentological, ichnological and paleontological attributes of the 'Anisian Wedge' will help refine the Montney-Doig boundary and help resolve the complexities associated with the boundary.

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