Tectonic Influences on Late Devonian-Early Mississippian Depositional Systems, Southern Alberta

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The existence of tectonism related to Antler orogenesis during the Late Devonian and Early Mississippian in western North America has been known for a long time. However, few studies from the subsurface of western Canada have documented the effects of Antler orogenesis on the adjacent cratonic platform, in contrast to those that have documented these tectonic effects in the Cordillera.

Mapping within a multidisciplinary study examining the regional biostratigraphy, stratigraphy and source-rock organic geochemistry of Late Devonian to Early Mississippian strata in southern Alberta revealed the extent to which tectonism influenced depositional patterns. Biostratigraphic and stratigraphic data indicate that significant episodes of uplift and erosion occurred during deposition of the Big Valley Formation of the Wabamun Group and the coeval upper part of the Costigan Member of the Palliser Formation. There may have been two episodes. One occurred during the late Famennian Lower to Upper *postera* conodont zones and the other occurred during the early part of the Lower *expansa* Zone, prior to deposition of the overlying organic-rich, highly radioactive black shale of the Exshaw Formation. Uplift and erosion of the Big Valley and upper Costigan Member occurred along a high centred roughly on the Fifth Meridian, but left erosional outliers. Both of these units increase in thickness to the east and west of this high area.

Subsequent subsidence and transgression during the later part of the Lower *expansa* conodont zone resulted in deposition of the lower black shale of the Exshaw Formation and its equivalent, the lower Bakken Formation, in eastern Alberta, although the Exshaw black shale was thinned over the high. This black shale is conformably overlain by siltstone and sandstone of the upper member of the Exshaw Formation and the middle member of the Bakken Formation, respectively. The former unit thickens abruptly at about the position of the Early Cretaceous edge of the

Cutbank Channel, perhaps as a result of tectonic inversion(?) along a deep-seated basement fault. Deposition of these units was terminated perhaps in the early Tournaisian *sandbergi* conodont zone by a short period of erosion. Subsidence and transgression led to deposition of the basal black shale of the Banff Formation and its equivalent, the upper black shale member of the Bakken Formation. These units and the upper siltstone and middle sandstone members of the Exshaw and Bakken formations were uplifted and eroded more or less along the Fifth Meridian. Erosional outliers of the basal Banff and upper Bakken shale were left by this uplift and erosion in the eastern part of our study area. The lower black shale of the Exshaw Formation may have been deeply incised into, or removed, during this same event in southwestern Alberta.

The uplift of the erosional high centred along the Fifth Meridian is interpreted to represent development of a peripheral bulge associated with Antler orogenesis and foreland basin development to the west during the Late Devonian and Early Mississippian. The history of orogenesis is complex and may involve episodic uplift and(or) migration of a peripheral bulge during the interval. These movements would have also affected subsidence rates that, interacting with sea level changes, produced the stratal patterns observed in our study area.