

A New Interpretation of Early Jurassic Basin History in Western Canada

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The geodynamics and stratigraphy of the Cordilleran foreland basin in Western Canada have been studied in great detail; however the earliest stages of the foreland basin are not well understood. Questions remain concerning how the region evolved from a stable margin to a retro-arc foreland basin, and at what time this transition began. Subsidence analysis and regional isopach patterns can be used to shed light on the enigmatic early stages of foreland basin development. Moreover, these approaches can yield new insight into the tectonic factors controlling deposition in Western Canada during Jurassic time.

The Green Beds of the Upper Jurassic Fernie Formation are foredeep deposits, and are considered the earliest foreland basin deposits in Western Canada (Poulton, 1989). However, recently developed models of foreland basin depozones (e.g. DeCelles and Giles, 1996) provide the basis for expanded tectono-stratigraphic interpretations of Lower, Middle, and Upper Jurassic strata. We propose that portions of the Lower Jurassic strata (e.g., Gordondale, Red Deer, and possibly the Nordegg members of the Fernie Formation) were deposited in a backbulge depozone, on the cratonward side of a nascent tectonically-caused forebulge. Unconformities overlying the Lower Jurassic strata, most notably the Oxfordian-age unconformity below the Green Beds, are interpreted to indicate the low accommodation setting associated with a forebulge, which has been postulated previously (Poulton, 1989). We agree that the overlying Green Beds of the Fernie Formation were deposited in the foredeep of the foreland basin.

The interpretation of a backbulge depozone for portions of the Lower Jurassic sedimentary strata in western Alberta is based on several observations. Isopach patterns of Lower Jurassic strata in western Alberta thin to both the east and west, indicating a sill or bathymetric high existed along the western margin of the region. A semi-isolated basin is further supported by geochemical data that indicate Lower Jurassic strata were deposited in a restricted marine basin (Riediger and Coniglio, 1992). This depositional setting is entirely consistent with a backbulge depozone, where the bathymetric high along the western margin of the region is a forebulge. The Jurassic stratigraphic succession also supports a backbulge-forebulge-foredeep interpretation. Foredeep deposits, such as the Green Beds, are commonly underlain by an

unconformity associated with a forebulge, similar to the ca. Oxfordian-age unconformity (e.g. Poulton, 1989). Strata underlying the forebulge unconformity (e.g., Gordondale Member) are often suspected to have been deposited in a backbulge depozone (DeCelles and Horton, 2003). Lastly, ample evidence indicates deformation and tectonic loading of the lithosphere along the western margin of North America had begun by Early Jurassic time in southern Canada (Murphy *et al.*, 1995; Ghosh, 1995). The load associated with this deformation provides a likely means of deflecting the lithosphere and creating a forebulge and backbulge.

The calculation of subsidence curves along several profiles across the foreland basin provides further insight into the Early Jurassic-Cretaceous basin history of Western Canada. The interpretation that portions of the Lower Jurassic strata form the backbulge deposits of a foreland basin system is the earliest model proposed from the stratigraphic record. A more detailed understanding of foreland basin initiation in Western Canada will lead the way for a comparison of timing and initiation across the Canada-United States border.

References

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