# Jurassic-Lower Cretaceous Foreland Initiation in the Northern Alberta Basin: Sediment Distribution and Provenance of the Minnes and Nikanassin Groups

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## Summary

A foreland basin system is an elongate region of accommodation that forms between an orogenic belt and the adjacent craton. Foreland basin successions commonly consist of basal backbulge deposits, a forebulge unconformity, and foredeep deposits. Foredeep sediments are normally sourced from the tectonically active fold and thrust belt with minor contributions from the forebulge and craton (Schwab, 1986). Drainage patterns that develop in the foredeep typically consist of a series of tributaries that transport eroded detritus from the orogenic belt into an axial channel system. These axial rivers supply sediment to lacustrine and marine deposystems longitudinally.

Lower and Middle Jurassic strata have characteristics consistent with backbulge deposits (Asgardeen, 2003) with the first westerly derived sediments reported from the Middle Jurassic Pigeon Creek Member and the 'Grey Beds' of the Fernie Group (Poulton, 1988). By the Upper Jurassic and Lowermost Cretaceous, the Alberta basin was dominated by axial drainage (Eisbacher et al., 1974; Hamblin and Walker, 1979; Miles et al, 2009) and westerly sourced tributaries (eg. Hamblin and Walker, 1979; McMechan, 2006). Stott (1998) interpreted an extensive, thick coarse-grained sandstone package to be craton-derived, consisting of re-worked sediment transported ~500 km from the east. This interpretation is inconsistent with foreland basin drainage patterns recognized in modern settings and models. Uplift and erosion of detritus hundreds of kilometres from the active Cordillera, and subsequent transportion of the detritus back to the orogenic belt is unlikely. The sediment, which consists of coarse sandstone and conglomerate that is commonly associated with immature orogenic detritus, is inconsistent with long-distance transportation. In outcrop these sandstones are associated with metamorphic lithoclasts, volcanic clasts, and detrital carbonates, cherts, feldspars, and micas (Stott, 1998). In the subsurface detrital white micas are widespread. An alternative explanation is that uplift and exhumation of Upper Proterozoic and Cambrian quartz-rich sediments were distributed into the foreland from point sources on the western margin of the basin and reworked in an axial drainage network. Eisbacher et al. (1974) suggested that in southern Alberta the quartz and quartzites of Late Jurassic sandstones were probably derived from Lower Paleozoic clastics to the south with additional input possible from Upper Proterozoic and Cambrian

rocks exhumed to the west. Large clasts from the Lower Cambrian Gog Formation have been found in the Cadomin Formation (Schultheis and Norman, 1978), and it is therefore reasonable to suggest these Cambrian and Upper Proterozoic units were uplifted and likely contributed eroded detritus into the northern Alberta Basin during Minnes Group deposition.

Detailed stratigraphic mapping and core analysis confirms the presence of an axial trunk channel drainage system, and thus the presence of a foreland system by Late Jurassic (Miles and Hubbard, 2009). Major phases of orogenic uplift and degradation are recorded by development of important point-sources that delivered coarse clastics into the foredeep. Within the Minnes and Nikanassin groups in the subsurface of British Columbia and Alberta, these point sources are recorded as areas of high net to gross ratios that are adjacent to exposures of coarse clastics in the foothills. It is therefore possible that western and axial sources were potentially more important during deposition of the Minnes and Nikanassin groups than previously thought.

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