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Research paper

# The flexural margin, the foredeep, and the orogenic margin of a northern Cordilleran foreland basin: Cretaceous tectonostratigraphy and detrital zircon provenance, northwestern Canada

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ABSTRACT

Reconstructions of the Albian to Campanian foreland basin adjacent to the northern Canadian Cordillera are based on outcrop and well log correlations, seismic interpretation, and reconnaissance-level detrital zircon analysis. The succession is subdivided into two tectonostratigraphic units. First is an Albian tectonostratigraphic unit that was deposited on the flexural margin of a foreland basin. At the base is a shallow marine sandstone interval that was deposited during transgressive reworking of sediment from cratonic sources east of the basin that resulted in a dominant 2000–1800 Ma detrital zircon age fraction. Subsequent deposition in a west-facing muddy ramp setting was followed by east-to-west shoreface progradation into the basin.

Near the Albian–Cenomanian boundary, regional uplift and exhumation resulted in an angular unconformity at the base of the Cenomanian–Campanian tectonostratigraphic unit. Renewed subsidence in the Cenomanian resulted in deposition of organic-rich, radioactive, black mudstone of the Slater River Formation in a foredeep setting. Cenomanian–Turonian time saw west-to-east progradation of a shoreface-shelf system from the orogenic margin of the foreland basin over the foredeep deposits. Detrital zircon age peaks of approximately 1300 Ma, 1000 Ma, and 400 Ma from a Turonian sample are consistent with recycling of Mississippian and older strata from the Cordillera west of the study area, and show that the orogen-attached depositional system delivered sediment from the orogen to the foreland basin. A near syndepositional detrital zircon age of ca. 93 Ma overlaps with known granitoid ages from the Cordillera. After the shelf system prograded across the study area, subsequent pulses of subsidence and uplift resulted in dramatic thickness variations across an older structural belt, the Keele Tectonic Zone, from the Turonian to the Campanian.

The succession of depositional systems in the study area from flexural margin to foredeep to orogenic margin is attributed to coupled foreland propagation of the front of the Cordilleran orogen and the foreland basin. Propagation of crustal thickening and deformation toward the foreland is a typical feature of orogens and so the distal to proximal evolution of the foreland basin should also be considered as typical.



## 1. Introduction

Cretaceous strata of the northern mainland of Northwest Territories (Fig. 1) represent the northern extent of the Western Interior Basin of North America (*sensu* Miall et al., 2008). Even though the stratigraphic framework is fairly well established (e.g., Dixon, 1999), there are still significant refinements to be made based on outcrop studies, such as the assignment of the division between Lower and Upper Cretaceous strata (Thomson et al., 2011; Hadlari et al., 2013). Those refinements, accompanied by interpretations of seismic data allow for an updated synthesis of regional and tectonic stratigraphy.

Provenance interpretation of detrital zircon data requires an understanding of both the character and distribution of potential sources. Most often those potential sources are considered to be the

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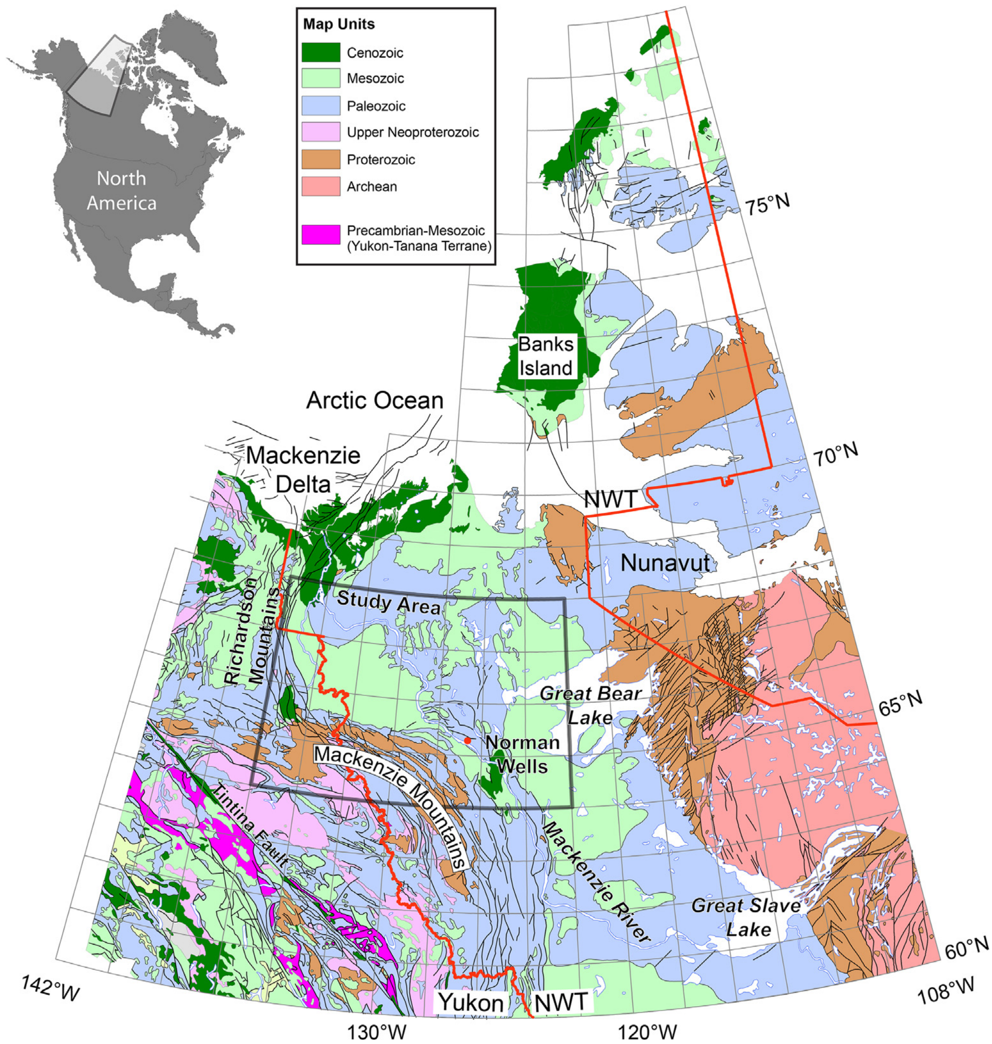


**Figure 1.** Geology of northwestern Canada after Wheeler et al. (1996).

original crystalline rocks, but detrital zircon grains can be multiply recycled within sedimentary systems (e.g., Sircombe and Freeman, 1999). It follows that a prerequisite for provenance interpretation, that is likely to be correct, is a catalog of age spectra from older strata. Ideally that catalog would be accompanied by knowledge of spatial distribution. Fortunately, the detrital zircon age spectra of Neoproterozoic, Cambrian, Devonian, and Mississippian strata in the vicinity of the Mackenzie Mountains region are known (Rainbird et al., 1992; Beranek et al., 2010; Lemieux et al., 2011; Hadlari et al., 2012) and we show herein that they compare very well with the detrital zircon ages and depositional framework of Cretaceous strata.

## 2. Geological framework

The North American Cordillera records two major orogenic phases that were related to Jurassic shortening across Intermontane pericratonic terranes (e.g., Yukon-Tanana terrane) and Early to mid-Cretaceous accretion of Insular terranes (e.g., Alexander terrane)(Monger et al., 1982).

Of interest for this contribution, and presently located in southeast Alaska (United States) and northwestern British Columbia (Canada), are the Alexander and Wrangellia terranes. The Alexander terrane records deformation between 118 Ma and 89 Ma associated with accretion to North America (Rubin and Saleeby, 1992). Wrangellia terrane was accreted to the North American margin just prior to 115–106 Ma metamorphism and deformation (e.g., Ridgway et al., 2002). In southern Alaska, the Early Cretaceous granitoids in pericratonic regions west of the Tintina Fault have an age range of ca. 123–99 Ma (see Hart et al., 2004; Morris and Creaser, 2008, and references therein). Early Cretaceous granitoids in Yukon Territory east of the Tintina Fault are ca. 109–90 Ma (see Hart et al., 2004; Morris and Creaser, 2008; and references therein). Along the eastern edge of the Cordillera (Fig. 1), strata within the Western Interior Basin (*sensu* Miall et al., 2008) are subdivided into two foreland basin successions correlated to the two principal Jurassic and Cretaceous orogenic events (Price, 1973; Beaumont, 1981; Cant and Stockmal, 1989). Part of the second foreland basin succession, Albian–Paleocene strata in the present study area south of the Mackenzie Delta and east of the Richardson Mountains unconformably overlie Paleozoic rocks (Dixon, 1999). Recently published biostratigraphy date the earliest deposits in the study area as early Albian, slightly older than a ca. 107 Ma bentonite, and highlight the presence of a mid-Cretaceous angular unconformity (Thomson et al., 2011).