Sedimentology, Stratigraphy, and Reservoir Potential of the Lower Cretaceous Jackass Mountain Group, Southern Nechako Basin, Camelsfoot Range, B.C. - Preliminary Observations

J. Russell Goodin
Department of Earth Sciences
Simon Fraser University

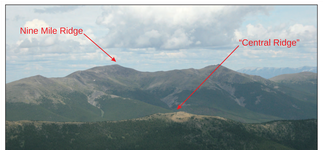
Peter S. Mustard
Department of Earth Sciences
Simon Fraser University

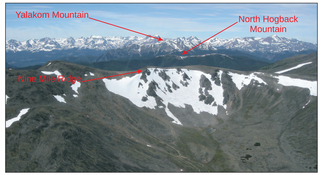
J. Brian Mahoney
Department of Geology
University of Wisconsin - Eau Claire

James W. Haggart
Geological Survey of Canada - Pacific Division
Natural Resources Canada

Abstract

The Lower Cretaceous Jackass Mountain Group (JMG), exposed along the southern margin of the Chilcotin Plateau (south-central British Columbia), is a >2 km-thick succession of marine and non-marine siliciclastic sandstone, minor mudstone, and lesser conglomerate, ranging in age from Hauterivian/Barremian to Albian or younger. The JMG was deposited in the Jura-Cretaceous Methow Basin, and appears to trend northward, beneath Cenozoic basalts into the Nechako Basin, which is currently the focus of renewed interest for hydrocarbon potential. Previous studies have suggested that the JMG is comprised dominantly of turbidites deposited in submarine fan complexes. The southern part of the study area does contain very thick (>1500 m), repeated, massive sandstone turbidite successions, which are interpreted as being deposited in sub-wavebase marine fan complexes. North of this, turbidites, while present, commonly show evidence of reworking in environments above storm wavebase. The central and northern areas are dominated by extensive non-marine, fluvial trough cross-bedded sandstone and floodplain siltstone. The precise age of these nonmarine facies is presently unknown, but detrital zircon samples from fluvial sandstones in this facies will at least provide a maximum age, and palynology samples will hopefully provide more specific age constraints and other biostratigraphic information. These observations suggest that a continuous, nonmarine to marine succession is preserved in this area, which possibly spans Barremian to Albian-Cenomanian time. Thick and moderately well-sorted cross-stratified fluvial sandstone packages in the northern Camelsfoot Range represent a new potential hydrocarbon reservoir system, which may have had better original porosity and permeability characteristics than the less well-sorted massive sandstone turbidites common in the southern Camelsfoot Range. Extensive fluvial and shallow marine facies associations in the JMG also support the interpretation that the JMG continues northward into the subsurface and may comprise the strata previously termed “Skeena assemblage,” which have been interpreted as containing “the most significant petroleum plays…” in the Nechako Basin. Ongoing geochronologic, geochemical, paleontologic, and porosity/permeability analyses will constrain basin evolution and reservoir suitability.





Purpose for Investigation

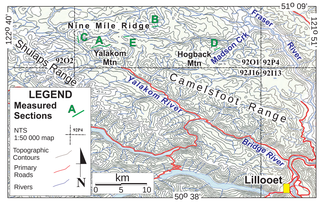
This MSc study is a subset of a regional multi-year project funded by Geoscience BC (active project 2006-014) and NSERC (Grant 611258), with principal investigators Peter S. Mustard and J. Brian Mahoney.

The principle focus of this investigation is the assessment of hydrocarbon potential in the subsurface of the basalt-capped “Nechako Basin”. Exposed strata of the Jackass Mountain Group in the Camelsfoot range are the closest and most volumetric sedimentary packages in the region. Analysis of this strata, along with seismic data and investigation of core from industry drill holes should shed some light on hydrocarbon possibilities in the region.

Aside from industry interest in oil and gas, there is some acedemic interest in the reconstruction and paleogeography of the Cretaceous Methow and Tyaughton basins. These basins, initially discussed by Kleinspehn (1982) and Garver (1992), are not well understood.

BC Location

Location of Measured Sections



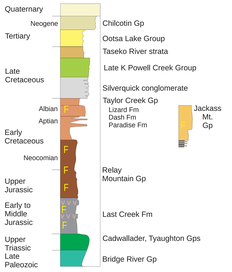
Introduction and Geologic Setting

During summer 2007, detailed examination of well exposed sections of the JMG in the Camelsfoot Range were conduted. The JMG is well exposed on several ridges in this area and volumetrically the most significant unit in the central and eastern Camelsfoot Range (Hickson et al, 1994, Schiarizza et al., 1997, Mahoney et al., in review). It forms the central part of a ~150 km long, southward-tapering wedge of mainly medium- to coarse-grained sandstone and polymictic conglomerate exposed between the Yalakom and Fraser fault systems.

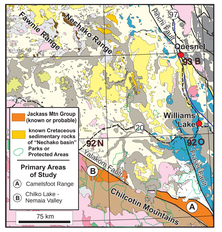
At and near Yalakom Mountain, northwest-trending JMG strata dip steeply and are slightly overturned towards the north in some areas. JMG units in this area overlie middle Jurassic rocks of the Ladner Group (Mahoney, 1994; Schiarizza et al., 1997). These basal JMG rocks are dominated by massive, green, medium- to coarse-grained, lithofeldspathic sandstones and interbedded siltstones. These form a >1500m thick unit on Yalakom Mountain that is correlative with the volcanic sandstone unit described by Schiarizza et al. (1997). JMG strata containing fossils of probable Barremian age are present about 200m below the base of this section, but above the basal unconformity with the underlying Lower to Middle Jurassic Dewdney Creek Formation, (GSC Loc. 74815; Poulton et al. in Schiarizza et al., 1997). New fossil collections from the upper part of the stratigraphic section north of Yalakom Mountain are of Albian age (*Brewericeras hulenense* zone). Thus, the full stratigraphic section of the JMG in the Yalakom Mountain area appears to range in age from Barremian to Albian.

From JMG strata in the Camelsfoot Range, five detailed stratigraphic sections were measured, 45 petrologic, 10 detrital zircon, 12 fine-grained geochemistry, 11 micro-, and 3 macrofossil samples were recovered. Section locations and thicknesses include approximately 1500 m on Yalakom Mountain (A on measured section map), 130 m on eastern Nine Mile Ridge (B), 130 m on western Nine Mile Ridge (C), 125 m on Madson Creek, north of Hogsback Mountain (D), and 70 m on a low-lying ridge in the central study area (E), between Beavertam and Watson Bar Creeks. Several additional traverses were also conducted in order to collect general rock type, structural, and fossil information.

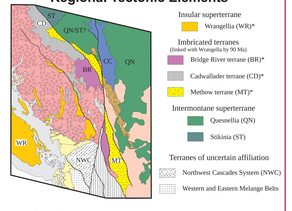
Simplified Stratigraphy of the Chilcotin Mountains



Simplified Regional Geology



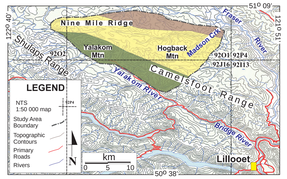
Regional Tectonic Elements



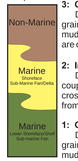
*includes overlying Jurassic-Cretaceous clastic succession

Facies Associations

As generalised on the right, Jackass Mountain Group strata in the Camelsfoot Range can be susbdivided into three major facies. It should be noted, however, that the geographic constraints of these facies are relatively ambiguous. This problem is a general result of poor exposure, remote access, the preliminary nature of this study, and the probability that the facies are laterally and internally variable across the 35 km strike of the this study area.



Interpretation

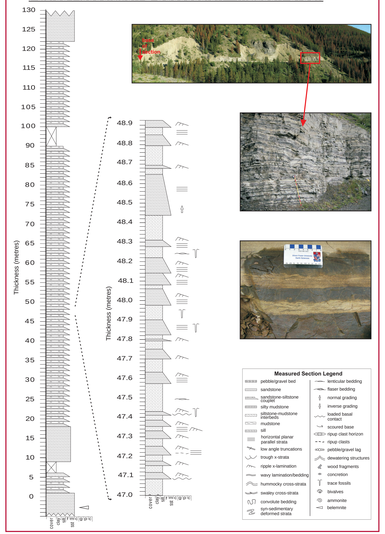


3: Cross-bedded Sandstone Facies Association
Dominant, green, cross-bedded, litho-feldspathic, medium-grained sandstone, interbedded with laminar or cross-stratified mudstones. Sandstones range in thickness from <10m to <70m and are overlain by coarsening-upwards mudstone successions.

2: Interbedded Sandstone/Siltstone Facies Association
Distinct “striped” sandstone/siltstone, commonly cross-stratified, couplets. Striped succession are interbedded with massive or locally cross-bedded medium-grained sandstones and range in thickness from <10m to >125m.

1: Green Massive Lithic Coarse Sandstone Facies Association
Dominantly thick (< 20m) massive, lithic, medium- to coarse-grained sandstone, interbedded with laminar and cross-stratified mudstones.

Facies Association 2 Succession - Madson Creek



Typical Facies Association 3 Outcrops - Nine Mile Ridge

Typical Facies Association 2 Outcrop - Madson Creek

Typical Facies Association 1 Outcrops - Yalakom Mountain

Ongoing and Future Research

Detrital Zircon Age Data: At least one detrital zircon sample was taken from each measured section. A total of six “high-priority” samples were selected for processing from the Camelsfoot Range and are currently being prepared for analysis in Spring 2008 at the University of Arizona.

Geochemistry: Twelve fine-grained geochemistry sample have been analyzed using an XRF at the University of Wisconsin - Eau Claire. Results are currently pending.

Fossil Age Data: The Jackass Mountain Group in the Camelsfoot Range contains a notable lack of fossils. Several fossils were collected from this year’s study area and are awaiting analysis. However, one belemnoid fossil from the basal Madson Creek section has been identified by James W. Haggart as *Acroteuthis,* suggesting a pre-Albian age.

Petrography: Approximately thirty-five petrographic thin sections have been prepared for analysis using a polarized petrographic microscope. Only six are currently ready.

Ichnology: Trace fossils will be analysed under the supervision of Dr. James MacEachern at Simon Fraser University. This should assist in the determination of appropriate facies designations.

Stratigraphy: The aforementioned analyses will be used to gain a better understanding of the stratigraphy and paleogeography of this part of the Cretaceous Methow Basin.

Hydrocarbon Potential: Facies, porosity/permeability, and total organic carbon analyses are currently underway.

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Acknowledgments

Special thanks goes to Pete Mustard for letting me take a whack at completing an MSc at Simon Fraser University., and not tossing me out the door a long time ago. Thanks to Geoscience BC and NSERC for funding this project. Brian Mahoney’s enthusiasm for field work, the Canadian Cordillera, geology, and everything else, really helped get this project off the ground. Thanks to Jim Haggart for the fossil calls…wish we could have found more. Thanks to lab mate Kate MacLaurin for pretending to listen to me rant about random bits of nonsense. A huge thanks to Scott Taylor at CC Helicopters in Lillooet, BC for getting us in and out safely every time. Our field assistants Alexandra Guy, Elizabeth Balgord, and Michelle Forgette did a great job…I couldn’t be doing this without you!