Sedimentology, Stratigraphy, and Reservoir Potential of the Lower Cretaceous Jackass Mountain Group, Camelsfoot Range, British Columbia, Canada*

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Abstract

The Lower Cretaceous Jackass Mountain Group (JMG), within the Camelsfoot Range of south-central British Columbia (Locality A on Figure 1), is a >2 km thick succession of marine and nonmarine siliciclastic sandstone, minor mudstone, and lesser conglomerate, ranging in age from Hauterivian/Barremian to Albian. The JMG was deposited in the Jura-Cretaceous Methow Basin, but appears to trend northward into the subsurface beneath Tertiary basalts, which cover the Mesozoic portion of what has been termed, the "Nechako Basin." For this reason, detailed geologic analyses of sedimentary packages flanking the southern end of the Nechako Basin should provide more information on the reservoir suitability of Lower Cretaceous successions preserved in the subsurface of the basin. The JMG strata of this study area are a complex succession of sandstone-rich fluvial, shallow marine and deep-marine fan deposits, suggesting multiple possible reservoir targets may exist in the subsurface to the north.

Introduction

The Nechako Basin is part of the Interior Plateau physiographic region of British Columbia, and has been variously defined in terms of extent and age (Ferri and Riddell, 2006). Accurate assessment of the petroleum potential within the Nechako Basin requires a comprehensive understanding of the basin architecture developed within Cretaceous strata, which represent the most prospective targets in the subsurface. Modeling the subsurface distribution of these Cretaceous units requires detailed stratigraphic analysis of coeval, laterally adjacent strata exposed along the basin margins (Mustard et al., 2007). Lower Cretaceous strata in the Nechako Basin are mostly preserved in the subsurface and the lack of exploration in this basin means drill core for these strata are very rare. For this reason, study of the outcrop exposures of JMG in the Camelsfoot Range is an important test of reservoir potential of correlative Lower Cretaceous strata in the subsurface to the north. Previous studies have suggested that the JMG is comprised dominantly of turbidites deposited in submarine fan complexes (Kleinspehn 1982). This study tests these previous interpretations by conducting a detailed stratigraphic, sedimentologic, and petroleum potential study of a well exposed area of the JMG.

New Observations

The JMG is well exposed on several ridges in the Camelsfoot Range, upon which five detailed stratigraphic sections were measured (Figure 2), and several traverses conducted, during the summer of 2007. Aside from measured sections, samples were collected for detrital zircon, fine-grained sediment geochemistry, micro-/macrofossils, and petrographic analyses. Most of the research concerning this data is still in progress; however, several preliminary observations have been made.

Strata within the Camelsfoot Range study area can be divided into three generalised facies associations (FA 1 - 3), which have been interpreted to represent an overall shallowing upward succession. The southern, and stratigraphically lowest, association within the study area (FA 1; Figure 3) does contain very thick (>1500 m), repeated, massive sandstone and turbidite successions, which have been interpreted as sub-wavebase, marine fan complexes.

North of FA 1, and up section (FA 2 in Figure 3), "striped beds" of coupled sandstone and siltstone, commonly 5 to 20 cm thick, make up the most distinct and identifiable strata in the study area. Within FA 2, turbidites, while present, commonly show evidence of reworking in environments above storm wavebase, suggesting a shallower depositional environment than FA 1. The "striped beds" of FA 2 commonly interfinger with the more massive sands characteristic of FA 1 and are found in varying thickness throughout the entire width of the field area. Another common characteristic within FA 2 strata are well-preserved syn-sedimentary folds ranging in size from 1 to 20 m wide, as well as channel sands ≤ 20 metres wide. The northern areas (FA 3 in Figure 3) are dominated by extensive non-marine, fluvial trough cross-bedded sandstone, and floodplain siltstone. Cross beds in this unit are generally 1 to 3 metres in width. Common carbonized plant debris and minor root casts are characteristic components of FA successions. FA 3 represents the uppermost and most shallow facies association in the field area. It should be noted that the exact geographic constraints on facies associations 1, 2, and 3, are somewhat ambiguous. This is a general result of poor outcrop exposure, remote access, and the significant probability that these facies are laterally variable across the 45 km-wide strike of the study area.

Conclusions

Field results from this study demonstrate that the JMG is a much more complex and variable unit than previously believed. The presence of thick and moderately well sorted fluvial sandstone complexes and extensive shallow marine sandstone bodies, in addition to submarine fan sandstones, increases the number of potential hydrocarbon reservoir targets. Extensive fluvial and shallow marine facies associations in the JMG support the interpretation that this group continues north into the subsurface and comprises the strata previously termed "Skeena Assemblage", which has been interpreted as containing "the most significant petroleum plays..." in the Nechako Basin (Hannigan et al., 1994). Ongoing geochronological, geochemical, paleontological, and porosity/permeability analyses will further constrain basin evolution and reservoir suitability.

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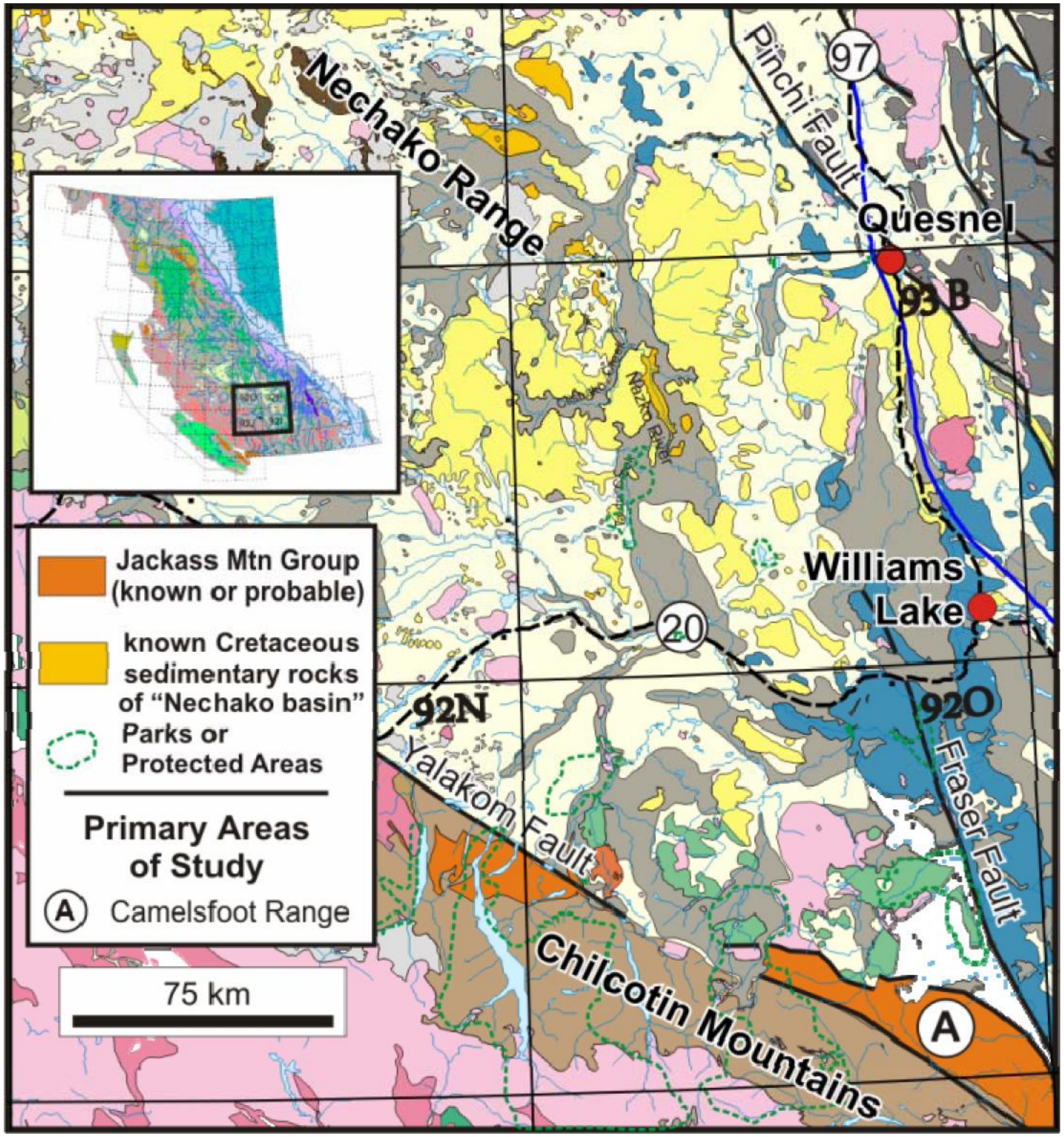

Figure 1. Regional geology and location of Camelsfoot Range study area (A on main map). The inset figure shows the study location within British Columbia.

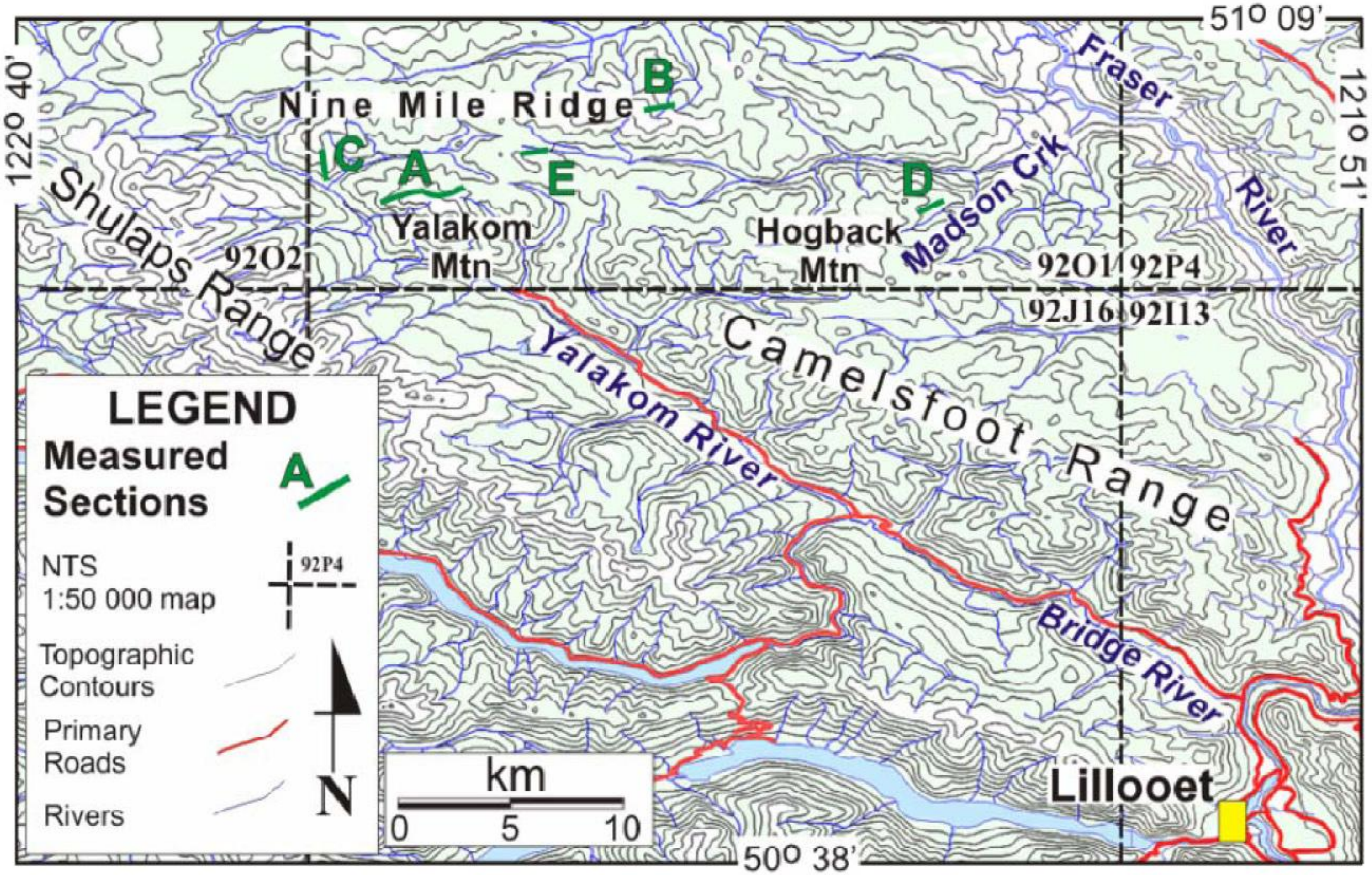

Figure 2. Location of measured sections in the Camelsfoot Range.

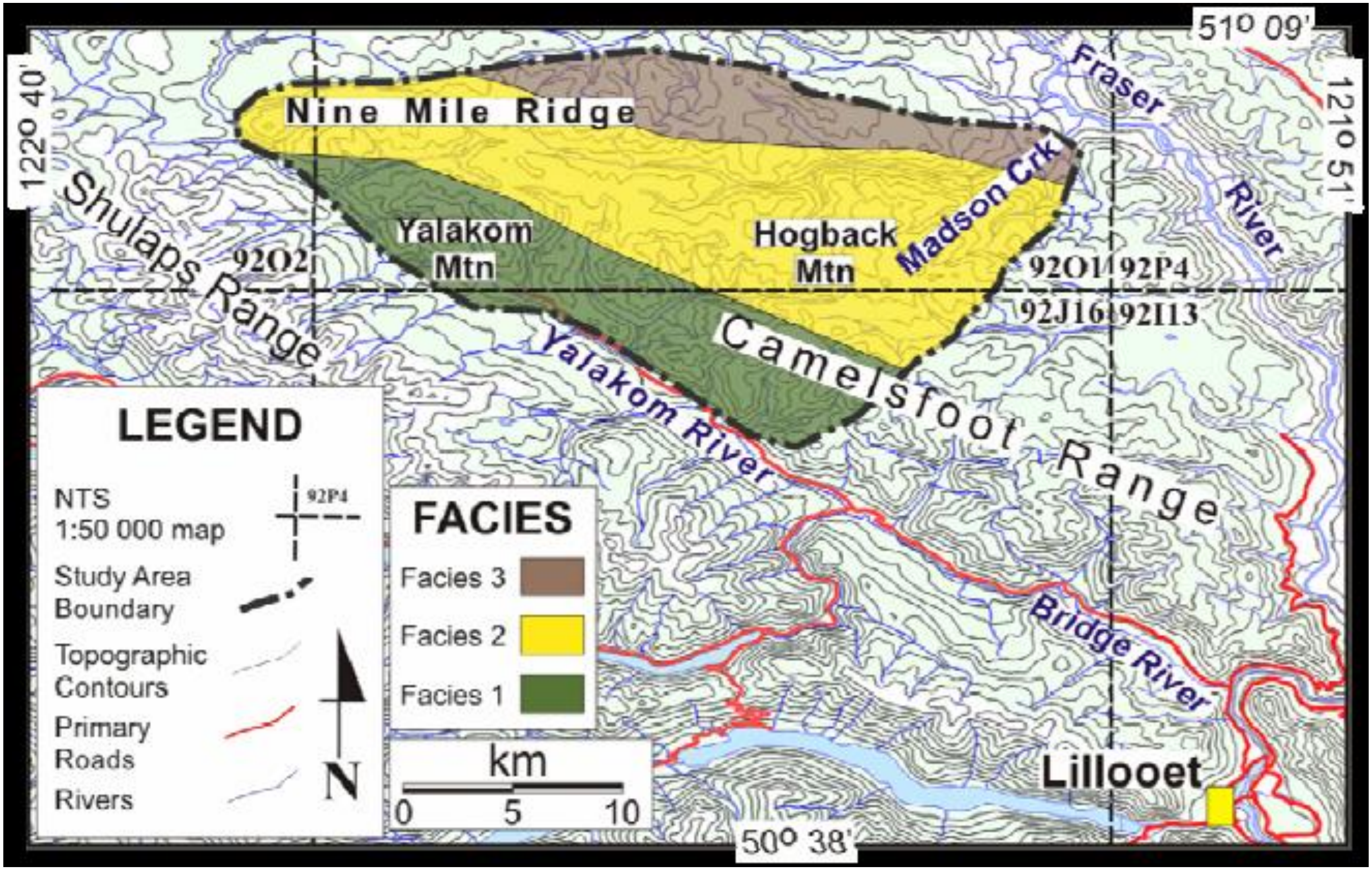

Figure 3. Map showing the study area boundaries and facies associations (FA) in the Camelsfoot Range.