Geological Survey of Canada
Scientific Presentation 3

# NEW CRETACEOUS FOSSIL FAUNAS FROM SOUTHERN NECHAKO BASIN, BRITISH COLUMBIA: CONSTRAINING STRATIGRAPHIC CORRELATIONS AND ENVIRONMENTAL INTERPRETATIONS IN THE SEARCH FOR OIL AND GAS

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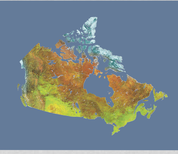
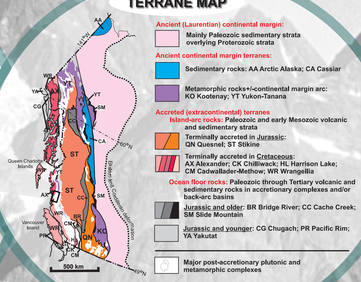


## INTRODUCTION

The Nechako basin is part of the Interior Plateau physiographic region of British Columbia, and has been variously defined in terms of geographic extent and age. Accurate assessment of the petroleum potential of the Nechako basin requires a comprehensive understanding of the basin architecture developed within the thick succession of Cretaceous clastic deposits which accumulated within the basin and which represent the most prospective targets in the subsurface. Modelling the subsurface distribution of these Cretaceous units requires a detailed stratigraphic analysis of coeval, laterally adjacent strata exposed along the basin margins, enabled by a comprehensive biostratigraphic framework, through which strata can be correlated confidently.

Ongoing research supported by the Geological Survey of Canada's Mountain Pine Beetle Project and the Province of British Columbia's *Geoscience BC* program is investigating the stratigraphy of Cretaceous rocks on the southern margin of Nechako basin, with the goal of elucidating depositional environments of these strata and their potential for harbouring economic oil and gas beneath the Nechako Plateau basalts to the north. Field studies are concentrated in the southwestern part of Taseko Lakes (92O) map-area and adjoining


## TERRANE MAP




**Ancient (Laurentian) continental margin:**
- Mainly Paleozoic sedimentary strata overlying Proterozoic strata

**Ancient continental margin terranes:**
- Sedimentary rocks: AA Arctic Alaska; CA Cassiar
- Metamorphic rocks+/-continental margin arc: KO Kootenay; YT Yukon-Tanana

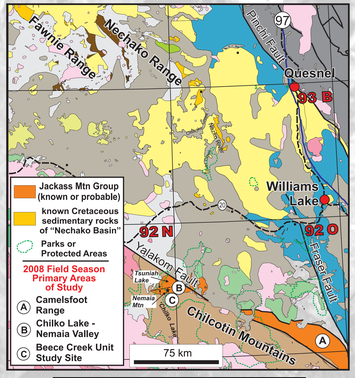
**Accreted (extracontinental) terranes**

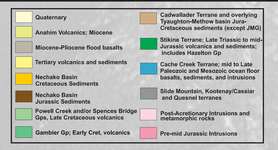
**Island-arc rocks:** Paleozoic and early Mesozoic volcanic and sedimentary strata
- Terminally accreted in Jurassic: QN Quesnel; ST Stikine
- Terminally accreted in Cretaceous: AX Alexander; CK Chilliwack; HL Harrison Lake; CM Cadwallader-Methow; WR Wrangellia

**Ocean floor rocks:** Paleozoic through Tertiary volcanic and sedimentary rocks in accretionary complexes and/or back-arc basins
- Jurassic and older: BR Bridge River; CC Cache Creek; SM Slide Mountain
- Jurassic and younger: CG Chugach; PR Pacific Rim; YA Yakutat

- Major post-accretionary plutonic and metamorphic complexes

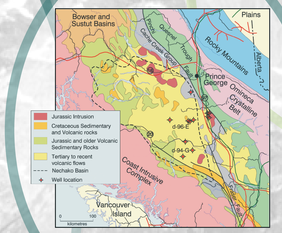
## GEOLOGIC MAP




(Modified from Mustard et al., 2008)

## NECHAKO BASIN



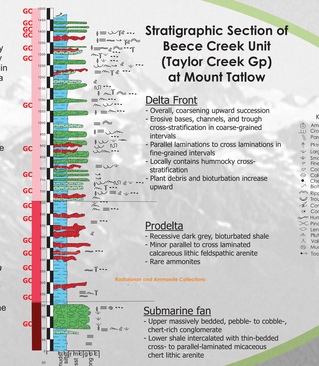

Regional geology, showing major Cretaceous units of the Nechako basin (original figure courtesy of BC Ministry of Energy, Mines and Petroleum Resources, Oil and Gas Division, Resource Development and Geoscience Branch)

## MICROFOSSILS

Strata exposed near Mount Tatlow are assigned to the Taylor Creek Group and are temporally equivalent with Jackass Mountain Group strata but separated from them by the dextral strike-slip Yalakom fault. Marine fossils have not been collected previously from the Mount Tatlow section, which has been interpreted as largely terrestrial in origin (Hunt, 1992). In addition to a single indeterminate juvenile ammonite, collected from a calcareous nodule within mudstones in the lower third of the section, a single sample containing radiolarian and foraminiferal microfossils has been collected, also from a calcareous nodule collected at the same stratigraphic level. These are the first radiolarians and foraminifers recognized from the Cretaceous of the Intermontane basins.

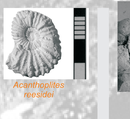
The microfossil fauna is pyritized and relatively poorly preserved. Radiolarians include abundant spherical and disc-shaped spumellarians (spinies and auxiliary features mostly dissolved), some large multicyrtid nassellarians, and some very small forams. The nassellarians include *Crolanium* sp., *Dictyomitra* sp., and *Obeliscoites* cf. *perspicus*, all common to the Aptian – Cenomanian, whereas the spumellarians (*Paronaella* cf. *communis* [Cenomanian-Turonian], *Pseudoaulophacus* sp. and *Patalula*? sp.) are more suggestive of the Cenomanian. Based on the zonation of ODogherty (1994) and other evidence, the radiolarian fauna is no older than mid-Albian, and is more likely Cenomanian in age. The assemblage further indicates that the lower part of the Mount Tatlow stratigraphic section is marine in origin.

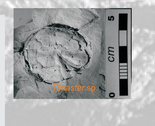
Foraminifera are rare and poorly preserved. Two planktic species are tentatively identified as *Hedbergella planispira*, ranging from Aptian to Turonian, and *Hedbergella amabilis*, ranging from Cenomanian to Coniacian. These age ranges support a Cenomanian age suggested by the radiolarian assemblage. Calcareous tests appear recrystallized as presumably calcite cubes are obstructing specific characteristics. Agglutinated benthic taxa are not age specific and include poorly preserved tests of the

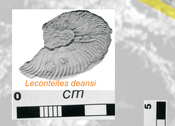


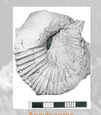

## MOLLUSCS

Hauterivian-Barremian faunas (identified by J.W. Haggart and J.A. Jeletzky) have been known for some time from within the Jackass Mountain Group, on the south flank of Yalakom Mountain in the Camelsfoot Range. The fossils are found in at the base of a 1.5 km-thick succession of pebbly sandstones to siltstones overlain by turbidites that gradually gives way up-section into shallow-marine strata of Albian age and even younger fluvial facies (Nine Mile Ridge area). Early Barremian fossils include trigoniid and pleuromyid bivalves as well as the ammonites *Ancyloceras* (*Acrioceras*) sp., *Protetragonites* sp., and *Shasticrioceras* sp. The fauna suggests deposition in


New collections of molluscan fossils from the Jackass Mountain Group have provided definitive recognition of Aptian marine strata within the southern Nechako region. Strata exposed along the canyon of the Fraser River south of Lytton have yielded the heteromorph ammonite *Shastoceras* sp., within an assemblage of marine bivalves and other ammonites. The faunal assemblage and outcrop sedimentology suggest the strata bearing these fossils formed in shelf environments, in contrast to the submarine fan environment usually ascribed to the Jackass Mountain Group. *Shastoceras* has been reported previously from the Aptian of northern California (Anderson, 1938), where it is diagnostic of the stage, as well as the Russian Far East; it is also represented in unpublished collections from Queen Charlotte Islands, British Columbia. Time-equivalent

Marine Albian fossils are rare in strata of the Jackass Mountain Group. In contrast, Early Albian fossils known from the Taylor Creek Group include the widely-distributed ammonites *Leconteites deansi* and *L. lecontei*, and *Anagaudryceras sacya*. Younger strata within the basin are represented by the ammonites *Brewericeras hulenense* and *Cleoniceras* (*Gryca*) cf. *perezianum* and the echinoid *Toxaster* sp. in the Taylor Creek Group, suggestive of late Early to mid-Albian, while the ammonites *Mortoniceras* and *Desmoceras*







## LITHOSTRATIGRAPHY

The age and general lithological character of strata in the subsurface of the Nechako basin are broadly known from industry drill holes (located on basin map figure), as well as through examination of isolated outcrops of Cretaceous intervals exposed beneath extensive Cenozoic volcanic and glacial cover (Ferri and Riddell, 2006; Riddell et al., 2007). The principal stratigraphic unit comprising the Cretaceous succession is the Jackass Mountain Group, spanning Barremian to Cenomanian (and younger?) age, and inferred to have been deposited in deep-marine, submarine-fan environments (e.g. Kleinspehn, 1985). Details of this succession within the basin, as well as regional facies patterns and basin architecture, remain poorly understood, however, and even the stratigraphic affinities of subsurface units are unclear. For example, Hunt (1992) identified some subsurface strata in the southern part of Nechako basin as possible Jackass Mountain Group strata but inferred a non-marine depositional environment for them. In contrast, Hannigan et al. (1994) assigned these rocks to the 'Skeena assemblage' (more commonly termed the Skeena Group), a generally non-marine Lower Cretaceous succession exposed along the northern margins of the Nechako basin. Clearly, significant work needs to be done to resolve ambiguities in regional correlations of Cretaceous strata and interpretations of depositional environments.

Recent field studies have recognized that the majority of Jackass Mountain Group strata in the southern Nechako basin region are actually composed of shallow-marine deltaic to fluvial facies. Wave-generated sedimentary structures are common in the rocks, as are



*coalified stump in fluvial facies*

*wave-dominated sedimentary structures*



*Jackass Mountain Group at Churn Creek*

*Widespread fluvial-deltaic complex bodes well for Nechako hydrocarbons*

***Paleoenvironments***

The presence in the Jackass Mountain Group of geographically extensive and extremely thick facies intervals interpreted to represent shallow marine and non-marine environments (Mustard et al., 2008) is surprising, given that previous work on the group interpreted it to be a product of submarine-fan deposition in relatively deep-marine environments (Kleinspehn, 1985; Schiarizza et al., 1997 did recognize some non-marine components within the Jackass Mountain Group in their regional synthesis). The implication is that a continuous, non-marine to marine succession is preserved in this area of Nechako basin, possibly spanning Barremian to Albian-Cenomanian time. The presence of thick and moderately well-sorted, cross-stratified fluvial sandstone packages provides 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 to submarine fan settings. The dominantly non-marine to deltaic nature of the succession explains why marine

## BIOCHRONOLOGY

| | | STAGE | AMMONITE / BIVALVE FOSSIL ZONE |
|---|---|---|---|
| CRETACEOUS | Upper | Maastrichtian | |
| | | Campanian | Widespread non-marine deposition throughout Intermontane region during Late Cretaceous time |
| | | Santonian | |
| | | Coniacian | |
| | | Turonian | Precise time of transition to non-marine facies not well established |
| | | Cenomanian | |
| | Lower | Albian | *Mortoniceras* spp.? *Grycia perezianum* / *Inoceramus anglicus* *Brewericeras hulenense* |
| | | Aptian | *Shastoceras* sp. / *Hamiticeras* sp. |
| | | Barremian | *Shasticrioceras* sp. |
| | | Hauterivian | *Simbirskites* spp. *Homolsomites* spp. |
| | | Valanginian | |
| | | Berriasian | *Buchia* spp. lineage |

***Proposed Molluscan Biostratigraphic Zonation***

New collections of mollusc fossils have provided new details of the biostratigraphic succession of molluscan taxa within the southern Nechako basin. A five-fold molluscan zonal succession for Barremian, Aptian, and Albian marine strata can

The distribution of Albian faunas and rocks in the study area suggest somewhat deeper water marine environments than seen in younger Cretaceous strata and it is suggested that accumulation of these deposits was likely resultant from high global sea-levels during Albian time. Very similar Albian faunas are also known from the Smithers and Hazelton map-areas to the north, the Bella Coola and Whitesail Lake area to the northwest, on Queen Charlotte Islands of the Insular Belt, and in the Howe Sound region near Vancouver. The wide distribution of contemporary Albian faunas and their association with deeper water facies, suggests widespread linkage of

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