

The Early Boreal Fauna of the Western Interior Seaway

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Summary

Fossils from the Early Cretaceous Clearwater Formation in the Fort McMurray area of northeastern Alberta are the southernmost recorded boreal fauna of the early Western Interior Seaway. Two faunal assemblages in distinct sedimentary facies occur within the lowermost 20 m of the Clearwater Formation Shale: a lower bivalve-dominated assemblage in sandy shale that represents offshore deposition above storm wave base; and an upper ammonite-dominated assemblage in shale that represents offshore deposition below storm wave base. The upper faunal assemblage consists almost entirely of the ammonite *Beudanticeras* in various growth stages. Two forms of *Beudanticeras* are present: a microconch with a relatively simpler suture pattern and constrictions that appear at a relatively small size and a macroconch with a more complex suture pattern and constrictions that only appear at a relatively large size. Based on this recognition of sexual dimorphism, *Beudanticeras (Grantziceras) glabrum* is recognized as a microconch and *B. (G.) affine* as a macroconch of the same species. The name *B. (G.) glabrum* is the senior synonym and *B. (G.) affine* is the junior synonym, which should be suppressed. This also necessitates renaming the *Beudanticeras affine* Zone as the *Beudanticeras glabrum* Zone.

Introduction

Deposition of the Early Cretaceous Clearwater Formation in the Fort McMurray area of northeastern Alberta marks the establishment of fully marine conditions, following deposition of the continental to marginal marine McMurray Formation. The Clearwater Formation provides the earliest faunal record of the Western Interior Seaway in this area. The fauna is endemic to the northern part of the Western Interior Seaway, known as the Boreal Sea. It is distributed northward from the Fort McMurray area to the Peace River region (McLearn 1931), Alaska (Imlay 1960, 1961; Jones 1967), Mackenzie River valley (Warren 1947) and Axel Heiberg and Ellesmere islands (Jeletzky 1980), based on the reported occurrences of *Beudanticeras (Grantziceras) glabrum*. The genus *Beudanticeras* has a global distribution in cold water seaways, such as the Lower Greensand of the United Kingdom (Casey 1961).

As the Clearwater Formation consists largely of shale, it is difficult to collect fossils from naturally occurring outcrops as the shale weathers deeply and any fossils disintegrate. Occasional cemented siltstone horizons within the shale are often the only horizons that preserve invertebrate fossils in natural exposures. Large-scale excavations for oil sands mining provide an unprecedented opportunity to obtain intact, unweathered specimens from shale. Palaeontological construction monitoring in the oil sands region is increasingly becoming a regulatory requirement, particularly for excavation of smaller project components that can be safely monitored.

Monitoring in the oil sands region has yielded invertebrate collections that are large enough to: revise historic taxonomic descriptions that were based on sparse material; investigate the occurrence of dimorphism in ammonites; and analyze facies differences in assemblages.

Methods and Materials

The specimens illustrated in this document were collected during palaeontological construction monitoring along the east valley slope of the Athabasca River, approximately 90 km north of Fort McMurray. Stratigraphic and sedimentological data were collected from active cut faces. Fossils were collected from spoil and from the active cut faces with the cooperation of the equipment operators. Specimens were stabilized with Vinac in the field, cleaned and prepared in the laboratory, and resealed with Vinac.

Approximately 100 specimens of the ammonite *Beudanticeras* were obtained from shale at the Athabasca River locality. The specimens are compressed but not entirely flattened. The original shell material is preserved, and suture patterns are sometimes visible through the translucent shell. Ontogenetic changes and the suture patterns were documented for the ammonite *Beudanticeras* and used to interpret sexual dimorphism.

Faunal Assemblages

The lowermost 20 m of Clearwater Formation shale show a deepening trend within the marine palaeoenvironment. The percentage of sand and the number of sandstone lens decreases with increasing distance above the contact with the basal Wabiskaw Sandstone. Two distinct faunal assemblages can be recognized.

The lower faunal assemblage of bivalves, snails and rare ammonites was deposited in an offshore environment above storm wave base. It is a parautochthonous-allochthonous assemblage where deposition occurred in a mainly quiet water environment with occasional storm disturbance. Fossils were added to the depositional environment through natural mortality rates with normal background sedimentation.

The upper faunal assemblage of ammonites, bivalves, scaphopods and rare snails was deposited in an offshore environment, below storm wave base. It is a parautochthonous assemblage where deposition occurred in a quiet water environment. Fossils were added to the depositional environment through natural mortality rates with normal background sedimentation. Many of the ammonites floated in the water column before burial and show bioerosion. As disarticulated bivalves and small accumulations of wood and ammonites are present, there was weak wave or current influence in this environment, despite being below normal storm wave base.

The Ammonite *Beudanticeras (Grantziceras) glabrum*

Beudanticeras (Grantziceras) glabrum (Whiteaves) was first described in 1889 from the Peace River area, near Fort Vermillion. This was followed in 1892 by description of a second species, *B. (G.) affine* (Whiteaves), from the District of Athabasca. Specimens of these species have been poorly illustrated and there has been no modern review of the taxonomy. They are typically considered separate species; however, Jones (1967) questioned this separation. The only difference he could see was the nature of the suture, which is more complexly interlocked with narrower and more highly incised elements in *B. (G.) affine*. This taxonomic problem was investigated by studying the ontogeny and suture patterns in ammonites from the Athabasca River locality.

The ontogeny of *Beudanticeras* in the Athabasca River collections is conservative. Through ontogeny, the ammonite elongates slightly. The relative proportion of the umbilicus to the maximum shell diameter remains approximately the same. Ornamentation, where preserved, consists only of bundled striae. A specimen is considered mature if it shows constrictions, which mark a temporary cessation in growth.

Constrictions are subtle features in *Beudanticeras* (Plate 1). They are generally absent on most small specimens. Where they occur on small specimens, this suggests that the specimen is a microconch. Conversely, specimens that lack constrictions or only show constrictions after they

have reached a large size may be macroconchs. The pattern is further supported by sutures that are less interlocked with broader elements occurring on specimens that have constrictions at a small size, and sutures that are complexly interlocked with narrower and more highly incised elements occurring on specimens that only have constrictions at a large size. Since this suture pattern is the defining difference between *Beudanticeras* (*Grantziceras*) *glabrum* and *B. (G.) affine*, it is more likely a sexually dimorphic trait rather than a species difference.



Note: Scale bars = 1 cm. Arrows indicate constrictions.

Plate 1: A and B). *Beudanticeras* (*Grantziceras*) *glabrum*-Type Ammonite and Sutures (microconch); C and D). *Beudanticeras* (*Grantziceras*) *affine*-Type Ammonite and Sutures (macroconch)

Conclusions

Based on observed sexual dimorphism in *Beudanticeras*, *B. (Grantziceras) glabrum* is recognized as a microconch and *B. (G.) affine* as a macroconch of the same species. The name *B. (G.) glabrum* is the senior synonym and *B. (G.) affine* is the junior synonym, which should be suppressed. The *Beudanticeras affine* faunal zone should correspondingly be renamed the *Beudanticeras glabrum* faunal zone.

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