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Bulletin 358

**ZONATION AND CORRELATION OF MIDDLE
BOREAL BATHONIAN TO
LOWER CALLOVIAN (JURASSIC)
AMMONITES, SALMON CACHE CANYON,
PORCUPINE RIVER, NORTHERN YUKON**

T.P. Poulton



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Oxycerites birkelundi from GSC locality 93570, see Plate 35.

PREFACE

Ammonites have long been recognized to be among the finest tools for correlation of Mesozoic rocks and have served as the inspiration for many current ideas on fossil species concepts, on the style and rate of evolution, and on paleobiogeographic provincialism.

This study describes the ammonites from a single, richly fossiliferous, and well exposed locality in northern Yukon where a succession of seven faunas is present. A new zonation for northwestern Canada is proposed based on this succession. The ammonites are mainly Boreal, and correlations of each zone with the published successions across the Arctic are discussed. The presence of some fossils with Pacific affinities contributes to resolution of the long-standing problems of correlation of Bathonian zones intercontinentally, via northern Yukon and Western Canada. Eight new species and one new genus are described.

Stratigraphic paleontological studies such as this lead to the development of widely accepted standards of correlation, essential tools in reconstructing the geological framework of Canadian sedimentary basins and evaluating their mineral and hydrocarbon resources.

OTTAWA, 1986

R.A. Price
Director General
Geological Survey of Canada

PRÉFACE

On reconnaît depuis longtemps l'utilité des ammonites dans la corrélation des roches mésozoïques; elles ont servi également de guide dans l'évolution de concepts traitant des espèces fossiles, par leur style et leur avancement évolutif, et ainsi que leur provincialisme paléobiogéographique.

Cette étude décrit des ammonites provenant d'une localité unique, très fossilifère du Yukon septentrional où se situe une succession comprenant sept faunes. Cette succession a fourni la base de données qui nous permet de proposer une nouvelle zonation pour le Canada du nord-ouest. Les ammonites sont, pour la plupart, boréales, et des corrélations de chaque zone avec des successions de l'Arctique déjà rapportées y sont discutées. La présence de quelques fossiles ayant des affinités avec ceux du Pacifique contribue à la résolution de problèmes de longue durée portant sur la corrélation intercontinentale des zones bathoniennes, via le Yukon septentrional et le Canada occidental. On y décrit huit nouvelles espèces et un nouveau genre.

Des études stratigraphiques et paléontologiques telles que celle-ci nous mène à l'élaboration des standards de corrélation reconnus globalement. De tels standards sont essentiels à la compréhension de la structure géologique des bassins sédimentaires du Canada et à l'évaluation de leur potentiel économique en ressources minérales et en hydrocarbures.

OTTAWA, 1986

R.A. Price
Le directeur général
de la Commission géologique du Canada

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ZONATION AND CORRELATION OF MIDDLE BOREAL BATHONIAN TO
LOWER CALLOVIAN (JURASSIC) AMMONITES, SALMON CACHE CANYON,
PORCUPINE RIVER, NORTHERN YUKON

Abstract

The Middle Bathonian through Lower Callovian ammonites from the Salmon Cache Canyon section on Porcupine River are dominantly Boreal, represented by an upward succession of *Arctocephalites*, *Arcticoceras* and *Cadoceras* species. They are very similar to equivalent faunas in northern Alaska, East Greenland and northern Siberia, but differ at the species level, so that a new zonation for northern mainland Canada is proposed. In upward succession, the zones are: *spathi*, *porcupinensis*, *amundseni*, *frami*, *harlandi*, *ishmae* (from East Greenland; restricted), *barnstoni*, and *bodylevskiyi*. Correlations with the Boreal zonations elsewhere are suggested. Additionally, a small proportion of Pacific and cosmopolitan ammonites in the collections permit further refinement of the correlation of the Boreal with the Pacific and ultimately with the Northwest European standard zonation. The Boreal Bathonian-Callovian boundary is placed in the interval between the *barnstoni* and *bodylevskiyi* Zones.

One new genus is proposed – *Loucheuxia*, of subfamily Eurycephalitinae. New species erected are *Arctocephalites spathi*, *A. porcupinensis*, *A. praeishmae*, *A. amundseni*, *A. frami*, *A.(?) belli*, *Loucheuxia bartletti*, and *Oxyerites birkelundi*.

Keywords: *Bathonian*, *Callovian*, *ammonites*, *Yukon*, *Arcticoceras*, *Arctocephalites*, *Cadoceras*, *Keplerites*, *Louchuxia*, *Oxyerites*.

Résumé

Des ammonites d'âge Bathonien moyen au Callovien inférieur, provenant de la coupe de Salmon Cache Canyon et située sur la rivière Porcupine, sont pour la plupart boréales. Elles sont représentées par une succession ascendante des espèces d'*Arctocephalites*, d'*Arcticoceras*, et de *Cadoceras*. Elles ressemblent beaucoup aux faunes équivalentes localisées en Alaska septentrional, au Groenland oriental et en Sibérie septentrionale; cependant, elles se distinguent au niveau espèce, ce qui a mené à l'établissement d'une nouvelle zonation proposée pour le Canada continental nordique. En succession ascendante, les zones sont les suivantes: *spathi*, *porcupinensis*, *amundseni*, *frami*, *harlandi*, *ishmae* (du Groenland oriental; restreinte); *barnstoni*, et *bodylevskiyi*. Des corrélations accompagnées de zonations boréales provenant d'ailleurs sont suggérées. De plus, une proportion mineure d'ammonites cosmopolites et du domaine pacifique présente dans les collections permet la corrélation plus précise entre le domaine boréale et le domaine pacifique, et, en fin de compte, la corrélation peut se faire aussi avec la zonation standard de l'Europe du nord-ouest. La frontière boréale du Bathonien au Callovien se situe dans l'intervalle entre les zones de *barnstoni* et de *bodylevskiyi*.

On propose l'établissement d'un nouveau genre, *Loucheuxia*, de la sous-famille Eurycephalitinae. Donc, les nouvelles espèces établies sont: *Arctocephalites spathi*, *A. porcupinensis*, *A. praeishmae*, *A. amundseni*, *A. frami*, *A.(?) belli*, *Loucheuxia bartletti*, et *Oxyerites birkelundi*.

Mots clés: *Bathonian*, *Callovian*, *ammonites*, *Yukon*, *Arcticoceras*, *Arctocephalites*, *Cadoceras*, *Keplerites*, *Louchuxia*, *Oxyerites*.

INTRODUCTION

The Boreal Bathonian section at Salmon Cache Canyon on Porcupine River is of interest for two reasons. Firstly, it exposes a succession of closely spaced concretionary layers that are richly fossiliferous, possibly the most biostratigraphically complete single section of its age anywhere in the Boreal Realm, and certainly the most complete section outside of eastern Greenland. The section, therefore, potentially provides a standard succession for the Boreal Bathonian of Arctic North America, and contributes in a major way to the development of an intercontinental Boreal Bathonian standard. Secondly, together with the predominant Boreal ammonite species, there also occur others with southern affinities. Some of these, together with a consideration of the ammonite succession elsewhere, permit some further elaboration of the correlation of the Boreal zonation with that of the circum-Pacific succession and with the Northwest European standard zonation. Unfortunately, these last ammonites belong mainly to genera that are long ranging and are too rare and poorly preserved to identify specifically, so that unequivocal correlations are not yet possible. Unlike most Boreal successions elsewhere, these faunal elements indicate access to Pacific seas to the south (Poulton, in press).

Outside of the typical area of Northwest Europe, recognition of the Bathonian-Callovian boundary remains elusive because of the absence of the critical guide fossils due to faunal provincialism. Although this interval is not well exposed in the Salmon Cache Canyon section, the ammonites present contribute to the resolution of this problem indirectly via correlation with East Greenland.

Only the Salmon Cache Canyon section and its faunas are described here. There are numerous other occurrences of equivalent faunas (see Poulton, 1978; Poulton et al., 1982), but they are mostly from localities that do not provide a succession of fossiliferous horizons or additional faunal data. They will be dealt with in a later publication. Because of their importance, the ammonite species found in this section are profusely illustrated, in order to document their variation within individual beds where possible, and their range of variation from one bed to another. Description of the ammonite faunas has required the description of many specimens collected as loose material below the section. For some of the less common, non-Boreal species, which are particularly significant forms for correlation southward, loose material is all that is available. Many of the loose specimens can be assigned confidently to the bed from which they came because of their association in a single concretion with a variety of other characteristic fossils, or because the character of the matrix of the concretion allows it to be compared with a particular lithologically distinctive bed in the section.

Faunal provincialism

Ammonoids, because of their rapid evolution displayed in a complex morphology, their abundance in marine rocks worldwide, and the wide geographic distribution of individual species, remain the principal guide fossils for correlation of Mesozoic marine rocks. Faunal provincialism, however, sets limits to what can be achieved in worldwide correlation. In

practice, therefore, the succession of faunas must be recognized in each faunal province independently, and final interprovincial synthesis is achieved by correlation in regions of overlap. To this day, precise correlation of many of the zones of the Arctic Middle Jurassic with those of Northwest Europe and the western part of the Americas has not been achieved (e.g. Callomon, 1958), and a complete zonation for the Middle Jurassic of the circum-Pacific area is still lacking. Furthermore, the faunas present in the Jurassic of many areas, including some in Northern and Western Canada, are still undescribed, and the succession in some critical areas remains poorly documented.

The fact that marine Jurassic faunas exhibit provincialism was discussed extensively first by Neumayr (1883), with regard to the Upper Jurassic of Europe. He also expressed the basic principal that underlies provincialism, and gave some interpretations of its causes. That distinct faunal provinces in the Jurassic existed as far back as Bajocian time was recognized by Arkell (1956), who simplified distribution patterns into three faunal realms - Tethyan, Pacific and Boreal. Imlay (1965) discussed the evidence for, and application of, the faunal realms to North America in particular. The literature on Mesozoic marine faunal provincialism is large and is not reviewed here (see Jeletzky, 1971 for such a discussion), and hypotheses regarding its causes are many. Some amount of latitudinal climatic differentiation, together with restricted patterns of circulation in marine basins, in large part due to the interference by continental masses, seem to be widely accepted and sufficient causes for the distribution patterns as we see them.

With increasing knowledge of ammonite distributions arising from continued taxonomic work around the globe, it is apparent that neither their biogeographic patterns nor the biostratigraphy are as well understood or as clearcut as has been thought, even in Europe (e.g. Ziegler, 1980). For example, the abundance of phylloceratids and the presence of *Cadomites* in the mainly Boreal faunas described in this report is surprising, and indicates the premature character of generalizations regarding Jurassic ammonite distributions in the western Americas.

Faunal provincialism has made correlation of the European type Bathonian successions with those outside Europe difficult. Only recently have Bathonian rocks and fossils been widely recognized outside of Northwest Europe. The greatest advances were first made in the Arctic Atlantic areas, principally East Greenland.

Among the first of the Arctic species to be described was *Ammonites ishmae* Keyserling (now *Arcticoceras*), found in an isolated position in northern European Russia (Keyserling, 1846). Its similarity to European *Macrocephalites* led early workers to conclude that it was of Callovian age (the Callovian was, at that time, included in the Upper Jurassic). Other species that were ascribed to the Middle Jurassic could not be matched exactly with those of Europe, and a number of new names were introduced. Some were compared with *A. ishmae* of northern Russia. Given European generic identifications, collections over wide areas of the Arctic were dated as Callovian. Finally, it was recognized by Spath (1928, 1932) that the Arctic ammonites represented new genera - *Arcticoceras*, *Arctocephalites*, and *Cranoccephalites* - that are entirely unknown in the classical areas of Europe. Spath (1932) dated these Arctic genera as Late Bathonian and Early Callovian, mainly on the strength of their general similarities and supposed phylogenetic relationship to the Indo-European *Macrocephalitidae*, at that time believed to range into the Bathonian more extensively than is currently thought.

