

Lower Permian (Asselian) ammonoids and conodonts from the Belcher Channel Formation, southwestern Ellesmere Island

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W.W. Nassichuk and C.M. Henderson¹
Institute of Sedimentary and Petroleum Geology, Calgary

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Abstract

A diverse fauna of Lower Permian ammonoids, including representatives of **Neopronorites**, **Daixites**, **Boesites**, **Agathiceras**, **Glaphyrites**, and **Emilites** is associated with representatives of the conodont **Streptognathodus** and the fusulinids **Pseudofusulina** and **Pseudofusulinella** in the lower part of the Belcher Channel Formation at Blind Fiord, southwestern Ellesmere Island. Ammonoids, conodonts and fusulinaceans all indicate an earliest Permian (Asselian) age.

Résumé

Une faune diverse d'ammonoïdés du Permien inférieur, y compris des représentants de **Neopronorites**, **Daixites**, **Boesites**, **Agathiceras**, **Glaphyrites** et **Emilites**, est associée à des représentants du conodonte **Streptognathodus** et des fusulinidés **Pseudofusulina** et **Pseudofusulinella** dans la partie inférieure de la formation de Belcher Channel, à Blind Fiord, dans la partie sud-ouest de l'île Ellesmere. Les ammonoïdés, les conodontes et les fusulinidés datent tous du Permien le plus ancien (Assélien).

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¹ Department of Geology, University of Calgary, Calgary, Alberta T2N 1N4

Introduction

Lower Permian ammonoids are widely distributed in the Sverdrup Basin and have been recorded from five formations representing nearshore, deltaic to deeper water basinal deposition from the lowermost Permian (Asselian) to uppermost Early Permian (Roadian). They have been described from Asselian limestone in the Hare Fiord Formation on Ellesmere Island (Nassichuk and Spinosa, 1972), from Artinskian strata in the Sabine Bay and Hare Fiord formations on Melville Island and Ellesmere Island (Nassichuk, Furnish and Glenister, 1966; Nassichuk, 1970), and also from an unnamed formation in southwestern Ellesmere Island that was earlier thought to belong to the Assistance Formation (Nassichuk, 1975). Roadian species are known from the Assistance and van Hauen formations on Melville, Devon and Ellesmere islands (Nassichuk, 1970, 1975).

The first ammonoid fauna ever recovered from the Lower Permian (Asselian-Artinskian) Belcher Channel Formation in the Sverdrup Basin is of Asselian age and contains elements remarkably similar to those described by Nassichuk and Spinosa (1972) from the lower part of the Hare Fiord Formation on northern Ellesmere Island. The ammonoids were discovered in a thin (10 cm) bed of micritic limestone 235 m above the base of the Belcher Channel Section exposed on the west side of Blind Fiord (Fig. 44.1, 44.2). Included in the ammonoid fauna are small and mainly

fragmentary representatives of *Neopronorites* Ruzhencev, *Daixites* Ruzhencev, *Boesites* Miller and Furnish, *Agathiceras* Gemmellaro, *Glaphyrites* Ruzhencev and *Emilites* Ruzhencev.

Stratigraphy

The Belcher Channel Formation is well developed between Blind Fiord and Troid Fiord in southwestern Ellesmere Island (Fig. 44.2) where it attains a thickness of nearly 1000 m. It is composed mainly of argillaceous and bioclastic limestone and is contained within the Marginal Clastic and Carbonate Belt of Thorsteinsson (1974). Between Blind Fiord and Troid Fiord, the Belcher Channel Formation overlies reddish weathering sandstone and sandy limestone of the Moscovian-Asselian Canyon Fiord Formation. It is alternately overlain by black shale of the lower van Hauen Formation or by greenish weathering, argillaceous limestone of an unnamed formation that grades laterally into the lower van Hauen Formation (Fig. 44.3; Nassichuk, 1975; Nassichuk and Wilde, 1977; Beauchamp, personal communication, 1985).

The Belcher Channel Formation is at least 806 m thick in the ammonoid-bearing section on the west side of Blind Fiord (Fig. 44.3) and a detailed description was provided by Nassichuk and Wilde (1977). The base of the formation is obscured and relationships with underlying strata are unknown.

In this section, the Belcher Channel consists of a succession of cyclical carbonates; individual 'cycles' indicate shoaling upward and include wavy bedded, argillaceous

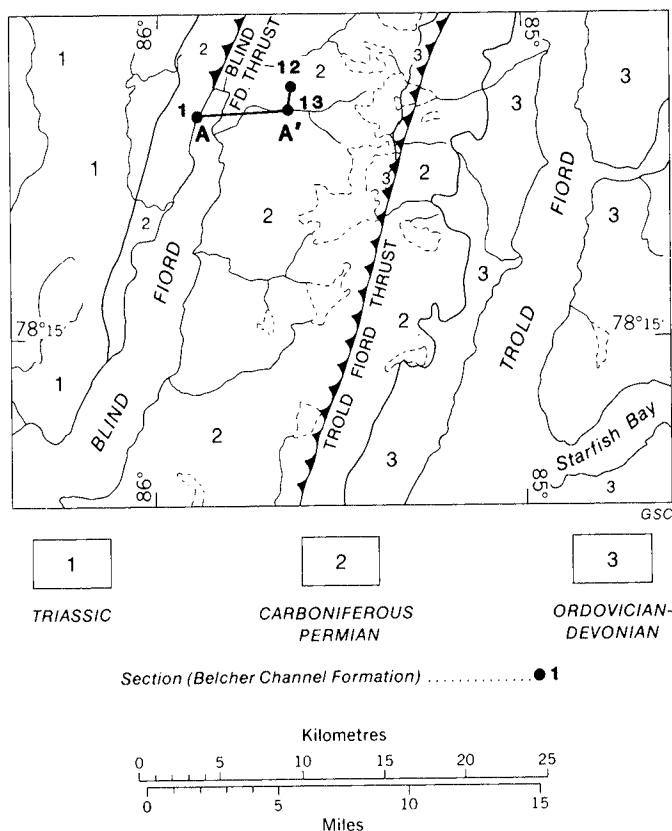


Figure 44.2. Generalized geological map of the area shown in the inset in Figure 44.1, displaying the distribution of Paleozoic and Mesozoic rocks in the Blind Fiord area, the locations of Section 1, from which fusulinaceans, ammonoids and conodonts were recovered from the Belcher Channel Formation, and sections 12 and 13. Carboniferous to Triassic strata are in the Sverdrup Basin and Ordovician to Devonian strata are in the Franklinian Geosyncline.

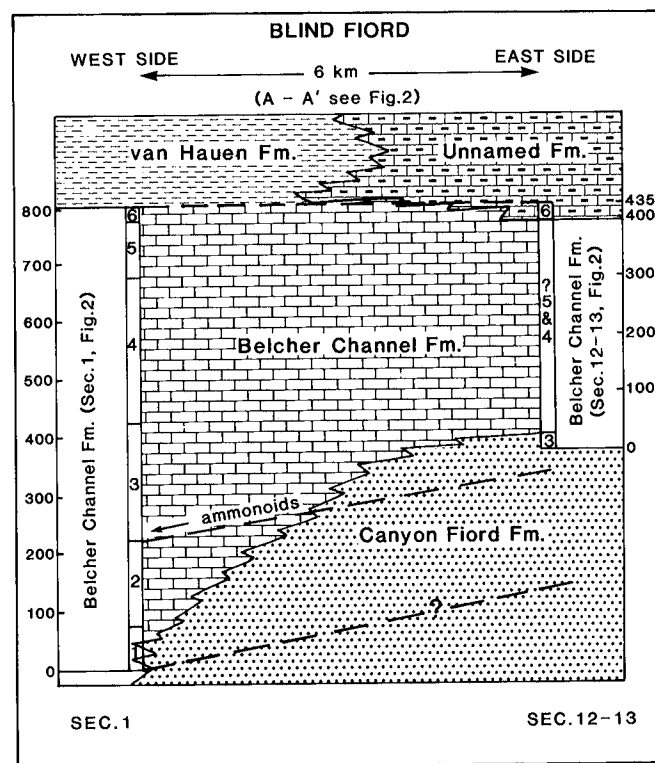


Figure 44.3. Schematic diagram of Lower Permian facies relationships across Blind Fiord. Conodont zones 1 to 3 are of Asselian age (Fig. 44.4) and zones 4 to 6 are of Sakmarian age (zone 6 may include lowest Artinskian strata). The geographic distance between sections on the west side and the east side of Blind Fiord is 6 km, but palinspastic reconstruction reveals that distance between them was probably considerably larger, possibly up to 25 km.

limestone, skeletal wackestone, and grainstone. Moreover, the formation is relatively sandy in its lower part where numerous recessive shaly beds occur. Its upper part, however, is characterized by a succession of thick, resistant carbonate mounds of Sakmarian age that contain the enigmatic organism *Palaeoaplysina* (Davies and Nassichuk, 1973).

Biostratigraphy

General remarks

Nassichuk and Wilde (1977) provided a brief outline of the status of the Carboniferous-Permian boundary in the Soviet Union and indicated that the position of the boundary has been controversial for more than 30 years. In the General Soviet Scale the boundary has been placed for many years between the uppermost Carboniferous (Gzhelian) *Daixina sokensis* Zone and the lowermost Permian (Asselian) *Schwagerina vulgaris-Schwagerina fusiformis* Zone. Some Soviet scientists insist, however, that the boundary should be placed at the top of the "*Schwagerina* beds"; that is, at the top of the Asselian, and others think that it should be placed at the base of the *Pseudofusulina uralica* Zone, which is within the Asselian Stage.

Ruzhencev (1950) recognized important distinctions between ammonoid faunas that he considered to be uppermost Carboniferous (Orenburgian), near Orenbourg in the southern Urals, and ammonoids that occur elsewhere in the Urals in apparently younger, Asselian strata. Stratigraphic relationships between Orenburgian and Asselian strata in the Urals remain obscure, but geological mapping in recent years has led some stratigraphers to conclude that differences between the two successions might reflect a change of facies; the upper part of the Orenburgian might be synchronous with the lower Asselian (Pnev, personal communication, 1975).

Recently, a new zone, the *Daixina bosbytauens-*
Daixina robusta Zone, was identified between the *Daixina sokensis* (Gzhelian) and *Schwagerina vulgaris-Schwagerina fusiformis* (Asselian) zones in the Darvaz region of central Asia and in the Urals (Kotlyar and Leven, personal communication, 1985). The zone contains ammonoids from the *Shumardites-Vidrioceras* "genozone" in the upper part of Ruzhencev's (1950) Orenburgian Stage. In addition to the fusulinaceans, after which the zone was named, it includes the first occurrences of *Occidentoschwagerina*, *Rugosochusenella paragregaria*, *Pseudofusulina kljasmica*, *Pseudofusulina modesta*, *Pseudofusulina pseudokrotowi*, *Pseudofusulina anderssoni*, *Pseudofusulina pseudoanderssoni* and *Daixina vozhlensis*.

As a result of decisions taken at a Plenary Session of the ISC Commission on the Carboniferous and Permian systems in the U.S.S.R. in 1984, the Carboniferous-Permian boundary is now placed at the base of the "new" zone in the General Soviet Scale. According to the Soviet scale, the upper part of the Orenburgian is contained within the Asselian Stage. The controversy over the boundary has not diminished, however, and many Permian specialists in the Soviet Union continue to support the traditional view that the boundary should be retained at the top of the "new" zone; that is, at the base of the *Schwagerina vulgaris-Schwagerina fusiformis* Zone.

Faunas in the Belcher Channel Formation at Blind Fiord

Nassichuk and Wilde (1977) indicated that fusulinaceans occurring from 135 m to 375 m above the base of the Belcher Channel Formation at Section 1 (Fig. 44.2) on the west side

of Blind Fiord are included in the Asselian assemblage zone of *Pseudofusulina plana* Skinner and Wilde. In addition to *P. plana*, the following are also contained in the zone: *Pseudofusulinella praeantiqua* Nassichuk and Wilde, *Pseudofusulinella tempelensis* Ross, *Pseudofusulinella biconica* Skinner and Wilde and *Pseudofusulina grinnelli* (Thorsteinsson). *Pseudofusulinella grinnelli* is particularly common near the base of the type section of the Belcher Channel Formation on Grinnell Peninsula, Devon Island (Harker and Thorsteinsson, 1960). Ross (in Nassichuk and Davies, 1975) assigned an Asselian age to several other species in the lower part of the type section, including *Eoparafusulina* sp., *Schwagerina* sp., *Pseudofusulina* sp., and *Pseudofusulinella* sp.

Several ammonoids recovered from 235 m above the lowest exposures of the Belcher Channel Formation at Section 1 (Fig. 44.2), including species of *Agathiceras*, *Neopronorites* and *Boesites*, are widely distributed from Upper Carboniferous (Moscowian) through much of the Lower Permian, and indeed, representatives of one of them (*Agathiceras*) extend into the Upper Permian. With the possible exception of the strata on Ellesmere Island, *Emilites* is unknown from strata either older or younger than Orenburgian; Movshovich et al. (1979) concluded that the Orenburgian occurrences in the Urals are in fact in their lower Asselian zone 3. Elsewhere, *Emilites* is known only from Texas, where *E. incertus* (Böse), from Virgillian (= Orenburgian) strata in the Gaptank Formation bears a very close resemblance to the Ellesmere Island species (W.M. Furnish, personal communication, 1986). *Glaphyrites* is common throughout the Upper Carboniferous, but is not known from strata younger than lowest Permian (Asselian). Similarly, *Daixites*, which previously was unknown outside the Ural Mountains, is confined to the interval between the uppermost Carboniferous (Orenburgian) to the lowest Sakmarian.

Accordingly, the ammonoid fauna does not provide a clear distinction between uppermost Carboniferous (Orenburgian) and lowermost Permian (Asselian) but, as discussed earlier, the General Soviet Scale includes the uppermost Orenburgian in the Asselian Stage. Nevertheless, the ammonoids from the Belcher Channel Formation appear to compare more favourably with upper "Orenburgian" and lower to middle Asselian species in the Urals than with upper Asselian species.

Whereas ammonoids and fusulinaceans have been studied for decades in the type area for the Permian in the Ural Mountains, conodont studies were initiated only recently. Already it has been demonstrated that conodonts will become as important in Permian biostratigraphy as they are in the rest of the Paleozoic and, indeed, in the Triassic. Movshovich et al. (1979) have identified three distinct conodont zones for the Asselian ("*Schwagerina* beds") in the Urals (see their zones 3, 4, 5 in our Figure 44.4). In ascending order, their zones are:

- 3) *Streptognathodus* (their *Gnathodus*) *simplex* - *S. elongatus* Zone
- 4) *Streptognathodus elongatus* - *S. wabaunsensis* Zone
- 5) *Streptognathodus barskovi* Zone.

It is difficult to compare lower and middle Asselian conodont faunas of Ellesmere Island with those in the Soviet Union because faunas in the former region are dominated by species of *Adetognathus* and in the latter by species of *Streptognathodus* (Fig. 44.4). Species of *Adetognathus* are generally considered to be long ranging, but one of us (CMH) has recognized several species in the lower (Asselian) part of the Belcher Channel Formation at Section 1 (Fig. 44.2). As taxonomic research on these species is at a preliminary stage, specific identifications cannot be presented in this

URAL MOUNTAINS, U.S.S.R. after Movshovich et al., 1979			BLIND FIORD (Sec.1 of Fig.2) S.W. ELLESMERE ISLAND, CANADIAN ARCTIC ARCHIPELAGO		
SYSTEM	STAGE	CONODONT ZONES	CONODONT ZONES this paper	LITHOLOGY and measurements (m)	FUSULINID ZONES after Nassichuk and Wilde, 1977
PERMIAN	ASSELIAN	5 <i>Streptognathodus barskovi</i>	3 <i>Streptognathodus elongatus</i> - <i>S. barskovi</i>	430	<i>Schwagerina whartoni</i>
				375	
		4 <i>S. elongatus</i> - <i>S. wabaunsensis</i>	2 <i>Adetognathus</i> spp. - <i>Idiogonathodus</i> sp.	*	<i>Pseudofusulina plana</i>
				**	
3 <i>S. simplex</i> - <i>S. elongatus</i>	1 <i>Adetognathus</i> spp.	230	<i>Pseudofusulinella thompsoni</i>		
		135			
CARB.	GZHELIAN			80	<i>Pseudofusulinella usvae</i> (group)
				18	15

Figure 44.4. Asselian conodont zones in the Ural Mountains and at Blind Fiord. Lithology column reflects thickness of individual cycles. (* = first appearance of *Streptognathodus barskovi*; ** = position of ammonoid locality).

summary report. As a result, the lower two assemblages indicated on the range chart (Fig. 44.4) are simply designated *Adetognathus* spp. The third conodont assemblage at Section 1 is dominated by *Streptognathodus* species that provide a direct comparison with faunas in the Urals. The ammonoids recorded from locality 1 occur at about the same level as the first appearance of *Streptognathodus elongatus*, whereas *S. barskovi* first appears 22 m above the ammonoid locality. *Streptognathodus barskovi* is restricted to the upper Asselian (zone 5 of Movshovich et al., 1979) in the Ural Mountain sequences. At Section 1, our boundary between zones 2 and 3, which is based on the appearance of *Streptognathodus* spp., can thus be correlated with the upper part of the *S. elongatus* - *S. wabaunsensis* Zone (middle Asselian) of Movshovich et al. (1979).

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