Foraminiferal and algal biostratigraphic dating of Upper Paleozoic core samples from 7933/4-U-3 well, Barents Sea, Norway

by

Vladimir I. Davydov

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1304 Adams St., Hollywood, FL, 33019, USA
Tel (1)954-3813842,
e-mail:fusus.paleo@gmail.com

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Author:
Vladimir I. Davydov.

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Summary:

The results of the biostratigraophic dating the Upper Paleozoic succession in 7933/4-U-3 Well, Barents Sea, Norway are presented. **11** core samples were processed and all of them yield datable foraminifera and algae. The biostratigraphy reveales the Upper Gzhelian through Lower Sakmarian succession in the well. The late Gzhelian, late Asselian and early Sakmarian assemblages are established. Two pontential sequence boundaries at approximately 180-170 m depth and at 139 m depth are suggested. The data provide precise correlation with standard type sections of the Upper Paleozoic succession of the Russian Platform and Urals.

Key words:
Core samples, biostratigraphy, foraminifera, algae, Upper Paleozoic, late Pennsylvanian, Lower Permian, correlation, Barents Sea

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Figure 2 Correlation of 7933/4-U-3 well succession with Russian Platform, Urals, and North America. Radiometric ages from Davydov et al., 2010 and Schmitz and Davydov, 2012.

Table 1. Distribution of foraminiferas and algae in the upper Paleozoic succession in 7933/4-U-3 well.

FUSULINID BIOSTRATIGRAPHIC DATING (FORAMINIFERA and ALGAE) OF UPPER PALEOZOIC FROM 7933/4-U-3 WELL, BARENTS SEA, NORWAY

1. **Introduction**

The core samples **for foraminiferal and algal biostratigraphic analyses** were studied from the 7933/4-U-3 well. Elleven samples were processed from small 2x5 cm cores. All samples yield identifiable formainifera and algae.

2. **Biostratigraphic dating and discussion**: **Foraminifera and algae**

Foraminifers were the primary chronostratigraphic tool for subdivision and correlation of Carboniferous-Permian strata within the entire Pangae margins (Ross, 1995) including Timan-Pechora and Barents Sea (Davydov, 1996, 1997, 1998; Grozdilova, 1966; Grozdilova and Lebedeva, 1961; Konovalova, 1991; Nilsson and Davydov, 1997; Nilsson et al., 1991). Overall, 46 foraminiferal zones are established for the entire Carboniferous with an average duration of 1.5–2.0 Ma. The zonation in Pennsylvanian is quite refined with zones duration between 0.2 Ma to 1.5 Ma and in Cisuralian it is 1 to 2 Ma (Davydov et al., 2012; Henderson et al., 2012). Foraminifers provided direct correlation of the Barents Sea region succession the Pennsylvanian-Cisuralian type sections in the Moscow Basin and Urals (Davydov, 1997; Nilsson and Davydov, 1997).

3. **Material**

11 samples were sliced into the thin plates to make oriented thin-sections. Totally 103 thin-sections were prepared for this study. 85 fossil taxa were identified. Among them, one taxon of incertus cedus (*Microcodium*), seven species of algae, 28 taxa of smaller foraminifera and 49 species of fusulinids.

4. Biostratigraphy and correlation

Three assemblages are recognized in the studied succession. The first one found in the depth 192.42 through 171.43 m and belongs to the upper Gzhelian. The second assemblage recovered in the depth 169.81 though 139.55 m is of upper Asselian and the fusulinids at the depth 138.46 up to the depth 96.8 belong to lower Sakmarian (Table 1).

Depth 192.42-171.43 m - Upper Gzhelian, Upper Pennsylvanian

A very diverse and abundant assemblage recorder in the depth and includes numerous *Microcodium*, algae, smaller foraminifera and fusulinids:

Algae: *Anchicodium gracilis* Johnson, *Anchicodium johnsoni* Endo, *Epimastopora japonica* (Endo), *Epimastopora symmetrica* (Johnson), *Ungdarella uralica* Maslov,

Smaller foraminifera: *Tolypammina* sp., *Glomospira pusiliformis* Reitlinger, *Ammovertella* sp., *Endothyra* sp., *Globivalvulina mosquensis* Reitlinger, *Globivalvulina granulosa* Reitlinger, *Globivalvulina rauserae* Reitlinger, *Globivalvulina pergrata* Konovalova, *Nodosinelloides aequiampla* Zolotova, *Tezaquina* sp., *Protonodosaria praecursor* (Rauser), *Palaeotextularia* sp ., *Palaeotextularia angusta* Reitlinger, *Palaeotextularia gibbosaeformis* Reitlinger, *Palaeotextularia vulgaris* Reitlinger, *Cimmacammina procera* Reitlinger, *Cimmacammina elegantula* Reitlinger, *Raphconilia* sp., *Raphconilia modificata* (Potievskaya), *Raphconilia recta* (Potievskaya), *Tetrataxis paraconica* Reitlinger,

Fusulinids: *Eostaffella acutissima* Kireeva, Eostaffella korobcheevi Rauser, *Millerella symmetrica* Manukalova, *Novella*? sp., *Ozawainella nikitovkensis* (Brazhnikova), *Grovesella tabasensis* Davydov & Arefifard, *Grovesella nevadaensis* Davydov, Schubertina sp., *Schubertina znensis* (Rauser), *Schubertina bluensis* (Ross & Sabins), *Schubertella galinae* Safonova, *Schubertella subkingi* Putrja, *Schubertella pseudomagna* Putrja & Leontovich, *Schubertella mosquensis* Rauser, *Parastaffella timanica* Rauser, *Kanmeraia pulchra* (Rauser & Belyaev), *Kanmeraia annae* (Grozdilova), *Schellwienia uberata* (Konovalova), *Schellwienia ordinata* (Konovalova), *Schellwienia lauta* (Konovalova), *Schellwienia rara* (Konovalova),

Schellwienia ordinata (Konovalova), *Schellwienia vozeiensis* (Konovalova), *Schellwienia salukaensis* (Konovalova), *Schellwienia krushiensis* (Alksne).

Most of the smaller foraminifera are long ranging taxa. Nevertheless, some specis of smaller foraminifera, such as *Nodosinelloides aequiampla* and *Protonodosaria praecursor* generally known to occur in the Permian, however, their FAD (first appearrence datum) is documented in upper Gzhelian of Timan-Pechora and Barents Sea (Davydov, 1997; Groves and Wahlman, 1997). *Tezaquina* usually considered Permian taxon (Vachard and Montenat, 1981), but has also been found in the upper Gzhelian in the well 7128/6-1 in Barents Sea (Groves & Wahlman, 1997). Similarly, *Raphconilia modificata* and *Raphconilia recta* that originally have been described from upper Ghelian and lower Permian in Donets Basin, were found in the upper Gzhelian of Central Asia (Davydov, 1988) and the Gzhelian and Asselian in Barents Sea (Groves & Wahlman, 1997).

The most significant taxa that designate the exact age are numerous *Schellwienia,* that dominate in the assemblage. The majority of them were first described from upper Gzhelian and lower Asselian in Timan Pechora Basin, but the FAD of these species is in the upper Gzhelian. The species *Schellwienia krushiensis* is widely distributed in the upper Gzhelian in Southern Urals, Donets Basin and Central Asia (Davydov, 1986a, b; Davydov, 1990; Davydov, 1992) and also from upper Gzhelian in Spitsbergen (Nilsson and Davydov, 1997). The age of the assemblage is precisely of late Asselian.

The algae recovered in this assemblage does not provide a precise age. The precence of green algae *Epimastopora* suggests warm water environments.

Depth 169.81-139.55 m - Upper Asselian, lower Cisuralian

The following fusulinids and algae were recovered in this depth:

Grovesella tabasensis Davydov & Arefifard

Grovesella nevadaensis Davydov

Schubertina bluensis (Ross & Sabins)

Schubertella mjachkovensis Rauser

Kanmeraia annae (Grozdilova)

Kanmeraia plicata (Shamov & Scherbovich)

Kanmeraia delicata (Skinner & Wilde)

Kanmeraia thompsoni (Skinner & Wilde)

Schellwienia katchgortica (Konovalova)

Schellwienia agnata (Konovalova)

Schellwienia urbana (Konovalova)

Schellwienia venusta (Konovalova)

Schellwienia biconica (Scherbovich)

Schellwienia ossinovkensis (Scherbovich)

Schellwienia nenetskensis (Grozdilova)

Algae:

Anchicodium johnsoni Endo

Tubiphytes obscurus Maslov

This assemblage is less diverse but includes quite diagnostic forms. Some of the species, such as *Grovesella tabasensis, Grovesella nevadaensis, Schubertina bluensis* and *Kanmeraia annae* are ranging from the previous assemblage. *Schubertella mjachkovensis* is long ranging species. *Kanmeraia plicata* has been originally described from upper Asselian and lower Sakmarian in the Urals (Shamov & Scherbovich, 1949) and distributed in these stratigraphic horizons in Timan-Pechora and Barents Sea (Konovalova, 1991; Davydov, 1997; Nillson & Davydov, 1997). *Kanmeraia delicata* and *Kanmeraia thompsoni* were first described from zones A and B of McCloud Limestone,

Shasta Lake, California (Skinner and Wilde, 1965), that correlated with Asselian of the Urals (Davydov, 1996). These species have also been found in upper Asselian and lower Sakmarian in Kolguev Island (S. Barents Sea) and Spitsbergen (Davydov, 1997; Nilsson & Davydov, 1997). The most diagnostic component of the assemblage are the dominant *Schellwienia*. Most of these species are endemic forms described from the upper Asselian of Timan-Pechora (Grozdilova & Lebedeva, 1961; Konovalova, 1991; Davydov, 1997) and Spitsbergen (Nilsson & Davydov, 1997). Two species, *Schellwienia biconica* and *Schellwienia ossinovkensis* are designated from upper Asselian in Russian Paltform (Rauser-Chernousova and Shcherbovich, 1958) and also found in upper Asselian in the *Urals (Chuvashov et al., 1990; Davydov, 1986b). Therefore the age of the assemblage is late Asselian.*

Depth 138.46-96.8 m – Lower Sakmarian, lower Cisuralian

The assemblage of this zone possessed the following species:

Globivalvulina mosquensis Reitlinger

Globivalvulina granulosa Reitlinger

Globivalvulina pergrata Konovalova

Nodosinelloides netchaevi (Cherdyntsev)

Geinitzina sp.

Tesaquina clivuli Vachard & Monterat

Protonodosaria praecursor (Rauser)

Protonodosaria rauserae Gerke

Palaeotextularia decurta Reitlinger

Raphconilia modificata (Potievskaya)

Raphconilia recta (Potievskaya)

Grovesella tabasensis Davydov & Arefifard

Grovesella nevadaensis Davydov

Schubertella subkingi Putrja

Schubertella pseudomagna Putrja & Leontovich

Schubertella mosquensis Rauser

Kanmeraia annae (Grozdilova)

Schwagerina scheljarensis (Konovalova)

Timanites pensus (Grozdilova & Lebedeva)

Timanites duplex (Grozdilova & Lebedeva)

Timanites elatus (Grozdilova & Lebedeva)

Timanites domesticus (Grozdilova & Lebedeva)

Timanites chinensis (Chen sensu Grozdilova & Lebedeva)

Timanites paraduplex (Grozdilova & Lebedeva)

Eopartafusulina plicata (Grozdilova & Lebedeva)

Eoparafusulina tschernyshewi (Schellwien)

Waeringella shoriensis Konovalova

Vernuilites verneuili (Moeller)

Algae Arhaelithophyllum sp.

All smaller foraminifera and the species of genera *Grovesella*, *Schubertella* and *Kanmeraia* range from the previous assemblage (Table 1). A very distinguishing *Timanites* and *Eopartafusulina* such as *Timanites duplex, Timanites elatus, Timanites domesticus, Timanites chinensis*, *Timanites paraduplex*, *Eopartafusulina plicata,* and *Eoparafusulina tschernyshewi* characteristic forms for the entire Tastubian, lower Sakmarian in Timan-Pechora, Barents Sea and Spitsbergen (Grozdilova & Lebedeva, 1961; Davydov, 1997; Nilsson & Davydov, 1997). *Schwagerina scheljarensis* and *Waeringella shoriensis* described from upper Tastubian in Timan-Pechora and also reported from this horizon in south Barent Sea (Davydov, 1997; Konovalova, 1991). *Vernuilites verneuili* is the index-species of the upper Tastubian fusulinid zone in the

Urals (Rauser-Chernousova, 1965). All in all the age of this assemblage is late Tastubian, early Sakmarian.

5. **Correlation**

Figure 2 provides the correlation of 7933/4-U-3 Well with regional sections in Spitsbergen, Bjørnøya, North Greenland and with international stratotype sections the Russian Platform and Southern Urals.

6. ACKNOWLEDGEMENTS

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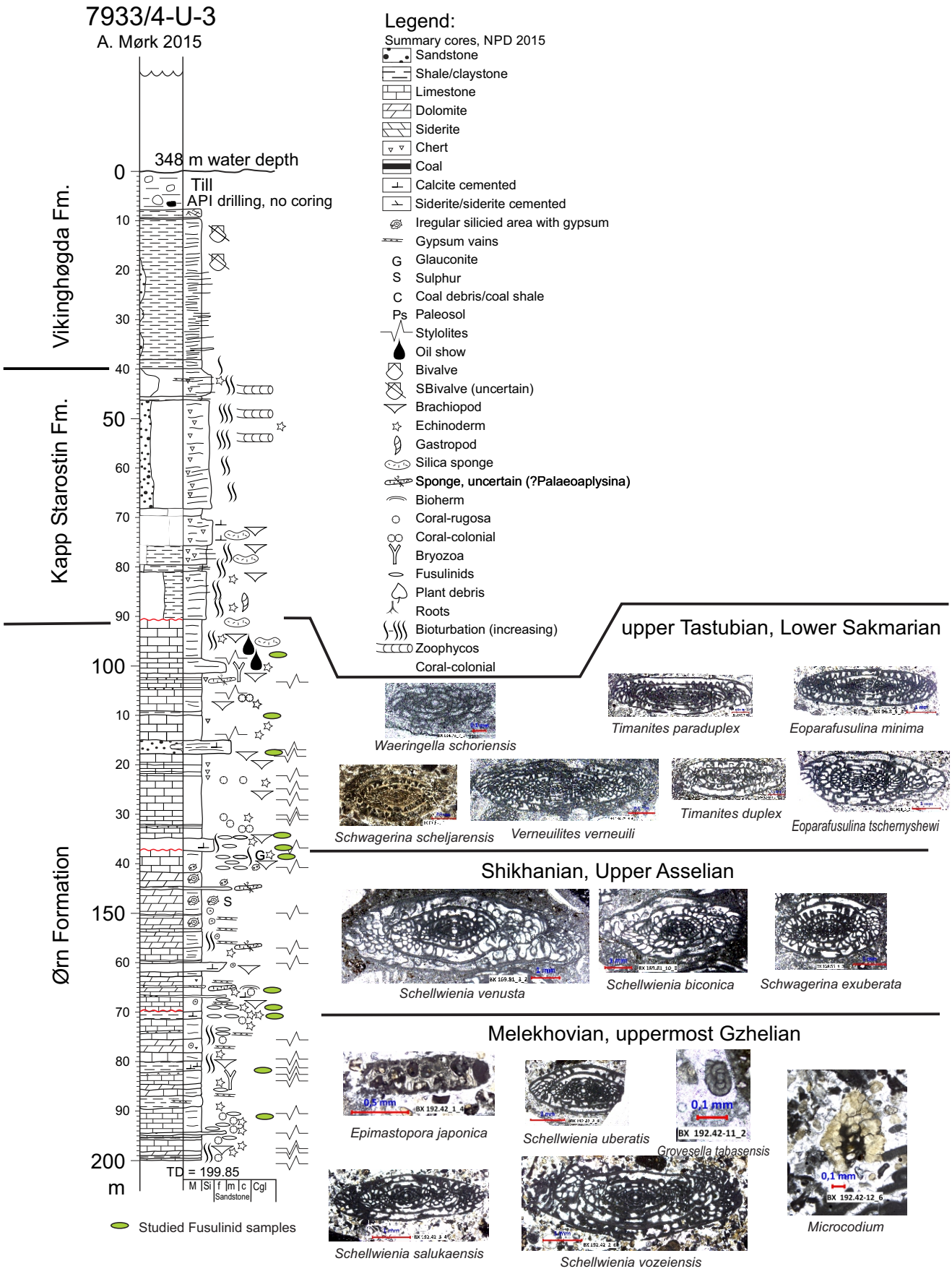

Figure 1. Stratigraphic log with studied samples and main taxa distinguishing the age of the assemblages.

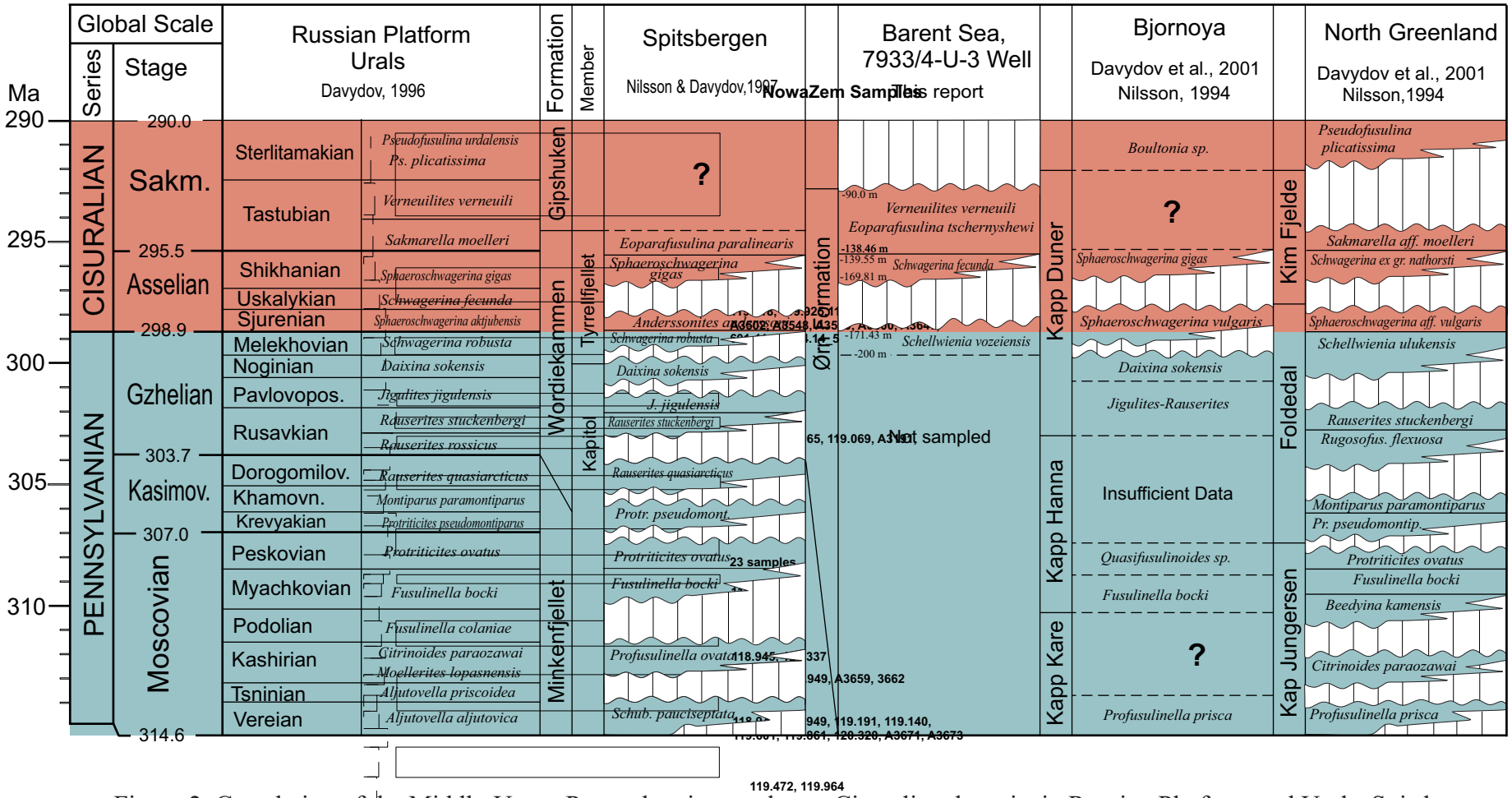

Figure 2. Correlation of the Middle-Upper Pennsylvanian ans lower Cisuralian deposits in Russian Platform and Urals, Spitsberge, Bjornoya, North Greenland and the succession of the 7933/4-U-3 Well.

		Well 7933/4-U-3 Depth, m									
		192.42	183.46	171.43	169.81	166.9	139.55	138.46	134.73	117.75	110.85	96.8
		Upper Gzhelian			upper Asselian			Sakmarian, Tastubian				
Taxa	Author											
Insertus cedus												
Microcodium		x										
Smaller Foraminifera												
Tolypammina	sp.		x									
Glomospira pusiliformis	Reitlinger	x										
Ammovertella	sp.	x										
Endothyra	sp.	x										
Globivalvulina mosquensis	Reitlinger	x						x				
Globivalvulina granulosa	Reitlinger	x		x			x	x		x		
Globivalvulina rauserae	Reitlinger			x								
Globivalvulina pergrata	Konovalova							x				
Nodosinelloides aequiampla	Zolotova	x										
Nodosinelloides sexangulata	Zolotova					x						
Nodosinelloides netchaevi	(Cherdyntsev)							x				
Geinitzina	sp.							x				
Tesaquina	sp.	x	x				x					
Tesaquina clivuli	Vachard & Monterat							x				
Protonodosaria praecursor	(Rauser)			x			x	x				
Protonodosaria rauserae	Gerke							x				
Deckerella mirabilis	Reitlinger	x					x					
Palaeotextularia	sp.	x	x	x	x							
Palaeotextularia angusta	Reitlinger	x					x					
Palaeotextularia gibbosaeformis	Reitlinger			x			x					
Palaeotextularia vulgaris	Reitlinger			x								
Palaeotextularia decurta	Reitlinger							x				
Cimmacammina procera	Reitlinger	x					x					
Cimmacammina elegantula	Reitlinger			x								
Raphconilia	sp.	x	x									
Raphconilia modificata	(Potievskaya)	x						x				
Raphconilia recta	(Potievskaya)	x	x					x				
Tetrataxis paraconica	Reitlinger	x										
Fusulinids												
Eostaffella acutissima	Kireeva	x										
Eostaffella korobcheevi	Rauser			x								
Millerella symmetrica	Manukalova	x										
Novella?	sp.	x		x								
Ozawainella nikitovkensis	(Brazhnikova)			x								
Grovesella tabasensis	Davydov & Arefifard	x		x			x	x		x		
Grovesella nevadaensis	Davydov	x		x			x	x		x		
Schubertina	sp.	x	x	x								
Schubertina znensis	(Rauser)	x		x								
Schubertina bluensis	(Ross & Sabins)			x			x					
Schubertella galinae	Safonova			x								
Schubertella mjachkovensis	Rauser						x					
Schubertella subkingi	Putrja			x				x				
Schubertella pseudomagna	Putrja & Leontovich							x				
Schubertella mosquensis	Rauser									x		
Parastaffella timanica	Rauser	x										
Kanmeraia pulchra	(Rauser & Belyaev)	x										
Kanmeraia annae	(Grozdilova)			x		x	x				x	
Kanmeraia plicata	(Shamov & Scherbovich)				x	x						
Kanmeraia delicata	(Skinner & Wilde)				x							
Kanmeraia thompsoni	(Skinner & Wilde)					x						
Schellwienia uberata	(Konovalova)	x	x	x								
Schellwienia ordinata	(Konovalova)	x										
Schellwienia lauta	(Konovalova)	x										
Schellwienia rara	(Konovalova)	x		x								
Schellwienia ordinata	(Konovalova)	x										
Schellwienia vozeiensis	(Konovalova)	x	x									
Schellwienia salukaensis	(Konovalova)	x	x	x								
Schellwienia krushiensis	(Alksne)			x								
Schellwienia katchgortica	(Konovalova)				x		x					
Schellwienia agnata	(Konovalova)				x							
Schellwienia urbana	(Konovalova)				x	cf.						
Schellwienia venusta	(Konovalova)				x							
Schellwienia biconica	(Scherbovich)				x							
Schellwienia ossinovkensis	(Scherbovich)				x							
Schellwienia nenetskensis	(Grozdilova)				x							
Schwagerina exuberata	(Shamov)											
Schwagerina nux	(Schellwien)											
Schwagerina scheljarensis	(Konovalova)										x	
Timanites pensus	(Grozdilova & Lebedeva)							x		x		
Timanites duplex	(Grozdilova & Lebedeva)							x	x	x		x
Timanites elatus	(Grozdilova & Lebedeva)							x				
Timanites domesticus	(Grozdilova & Lebedeva)							x				x
Timanites chinensis	(Chen sensu Grozdilova & Lebedeva)								x			x
Timanites paraduplex	(Grozdilova & Lebedeva)								x	x		x
Eopartafusulina plicata	(Grozdilova & Lebedeva)								x			
Eoparafusulina tschernyshewi	(Schellwien)											x
Waeringella shoriensis	Konovalova								x	x		
Vernuilites verneuili	(Moeller)								x			
Algae												
Anchicodium gracilis	Johnson	x										
Anchicodium johnsoni	Endo	x				x						
Epimastopora japonica	(Endo)	x										
Epimastopora symmetrica	(Johnson)	x										
Ungdarella uralica	Maslov	x										
Tubiphytes obscurus	Maslov						x					
Arhaelithophyllum	sp.								x	x		