THE GYPIDULID BRACHIOPOD GENUS *CARINAGYPA* IN LATE EMSIAN (LATEST EARLY DEVONIAN) STRATA OF THE SHELLABARGER PASS AREA (FAREWELL TERRANE), DENALI NATIONAL PARK & PRESERVE, SOUTH-CENTRAL ALASKA

ROBERT B. BLODGETT[1], VINCENT L. SANTUCCI[2], VALERYI V. BARANOV[3] and MONTANA S. HODGES[4]

[1]Consulting Geologist, 2821 Kingfisher Drive, Anchorage, Alaska 99502, email: robertbblodgett@gmail.com; [2]Senior Paleontologist, National Park Service - Geologic Resources Division, 1849 C Street, NW, Room 2644, Washington, D.C. 20240, email: vincent_santucci@nps.gov; [3]Institute of Diamond and Precious Metals, Yakutsk Research Center, Siberian Division, Russian Academy of Sciences, pr. Lenina 39, Yakutsk, 677980, Sakha Republic (Yakutia), Russia, email: vbaranov@diamond.ysn.ru; baranowvalera@yandex.ru; [4]Professor, 5100 Sierra College Boulevard, Rocklin, CA, 95677, email: montanashodges@gmail.com

Abstract—We describe a new species of the Early Devonian-early Middle Devonian (late Lochkovian-Eifelian) brachiopod genus *Carinagypa*, here named *Carinagypa robecki* n. sp. The species occurs in a measured section of an unnamed late Emsian age (late late Early Devonian) limestone unit exposed in the Shellabarger Pass area, Talkeetna C-6 1;63,360 scale quadrangle, Denali National Park & Preserve, south-central Alaska. It is part of a diverse brachiopod fauna found in the basal strata of the Mystic sequence of the accreted Farewell terrane. The new species is closest in external form to *Carinagypa indirigica* (Sidyachenko *in* Alekseeva et al., 1996) from the Kolyma region of northeastern Russia. It differs in the development of two closely spaced plicae situated parallel to the shell midline in full-sized adult or gerontic specimens. The close affinities of this new species with a related form in late Emsian strata of Northeast Asia, together with the presence of other brachiopod taxa of Siberian affinities from the Shellabarger Pass area, suggest that the Farewell terrane is of rift origin, and probably was originally part of the Siberian paleocontinent.

INTRODUCTION

In this paper we report the first occurrence of the distinctive Early-early Middle Devonian (late Lochkovian-Eifelian) gypidulid brachiopod genus *Carinagypa* from the Shellabarger Pass area, Denali National Park and Preserve, south-central Alaska (Fig. 1). It is part of a diverse brachiopod fauna of late Emsian age found at the base of the Mystic sequence here, and it is deemed critical to document yet another biogeographically significant brachiopod taxon from this locality. Morphologically, the Shellabarger Pass brachiopods exhibit a northeastern Russian character of the fauna, rather than an alliance with northwestern cratonic North America.

In recent years, the concept that nearly all of Alaska, as well as much of the western Cordillera of North America, is composed of numerous, discrete accreted tectonostratigraphic (or lithotectonic) terranes (Coney et al., 1980; Jones et al., 1981, 1982, 1986, 1987; Silberling et al., 1992, 1994; Nokleberg et al., 1994) has come into general acceptance within the geologic community. The only exception to this is the triangular area of east-central Alaska, more or less bounded on the northwest by the Porcupine River, on the west by the Cretaceous flysch belt of the Kandik Basin, and on the southwest by the Yukon River. This region, which includes the Nation Arch, represents the westernmost (in present-day coordinates) continuation of Precambrian and Paleozoic rocks of the North American craton exposed farther east in the Ogilvie Mountains of the Yukon Territory.

Gilbert and Bundtzen (1984) considered the Dillinger and Mystic terranes to represent a single stratigraphic succession of Paleozoic to Triassic age, preferring to apply the term "sequence" to each. They considered the underlying Dillinger sequence to be a Cambrian to Lower Devonian deep-water succession that is overlain by the Mystic sequence, which consists of laterally variable Devonian to Triassic (?) shallow-water to nonmarine sedimentary rocks and intrusive and extrusive mafic and ultramafic rocks. The type area of the Mystic sequence is Mystic Pass, near Shellabarger Pass, and is situated approximately 11 mi. (17.7 km) NW of the Emsian limestone outcrop discussed here.

GEOLOGIC SETTING

The specimens described here are from the base of the Mystic sequence of the Farewell terrane of southwestern and west-central Alaska. The Mystic terrane was originally named by Jones and Silberling (1979) and described further by Jones et al. (1981) as a separate tectonostratigraphic entity of full terrane rank. More recently, Decker et al. (1994) recognized that the Mystic terrane, as well as the Nixon Fork and Dillinger terranes, were genetically related, and all were reduced in rank to subterranes of a larger terrane, termed the Farewell terrane. Gilbert and Bundtzen (1984) considered the Dillinger and Mystic terranes, each of whose type sections are close to one another, to represent a single stratigraphic succession of Paleozoic to Triassic age, preferring to the term "sequence" to each. They considered the underlying Dillinger sequence to be a Cambrian to Lower Devonian deep-water succession overlain by the Mystic sequence, consisting of laterally variable Devonian to Triassic? shallow-water to nonmarine sedimentary rocks with intrusive and extrusive mafic and ultramafic rocks. The close stratigraphic relationship between the Dillinger and Mystic sequences has been documented by stratigraphic studies by Blodgett and Gilbert (1992) to the southwest in the Lime Hills D-4 and D-5, 1:63,360 scale quadrangles. The Nixon Fork subterrane, defined originally as a full-rank terrane by Patton (1978), represents a predominately shallow-water carbonate platform whose lower part is mostly laterally equivalent to deeper-water Cambrian to Lower Devonian rocks of the Dillinger subterrane (Blodgett, 1983; Blodgett and Gilbert, 1983; Bundtzen and Gilbert, 1983; Gilbert and Bundtzen, 1983).

Until the late 1990s, most interpretations of the gross lithostratigraphy and faunal affinities of the best-studied subterrane of the Farewell terrane, the Nixon Fork subterrane, had indicated either fragmentation from or lithic continuity with northwestern Canada (Blodgett, 1983; Churkin et al., 1984; Blodgett and Clough, 1985; Rohr and Blodgett, 1985; Abbott, 1995). Newly acquired biogeographic data from Lower Devonian strata of the Farewell terrane, together with reconsideration of the affinities of the faunas and floras of other time intervals, indicate that this continental margin sequence



FIGURE 1. Index map of Alaska showing location of Shellabarger Pass.

originated by rifting away from the Siberian continent, rather than northwestern North America (Blodgett and Brease, 1997; Blodgett, 1998; Blodgett et al., 2002a). Much of this rifting appears to have occurred during Late Devonian to early Carboniferous time (Blodgett et al., 2010).

Richly fossiliferous Devonian rocks of the basal part of the Mystic sequence are well exposed in the Shellabarger Pass area, Talkeetna C-5 & C-6 quadrangles of south-central Alaska. The pass is situated in the remote western part of the Preserve portion of Denali National Park & Preserve. Field work was first seriously attempted there in the mid-1970's and was followed by our 1996 summer field work with financial support from the National Geographic Society to study an unnamed limestone unit that forms the ultimate local base of the Mystic sequence. Two separate limestone packages are separated by a siliciclastic/chert unit. The lower limestone interval is of Emsian (late Early Devonian) age and is known from only one outcrop. The upper limestone interval, representing the vast majority of Devonian limestone outcrops in Shellabarger Pass, is of Frasnian (early Late Devonian) age. The fauna from the Emsian limestone includes around 20+ species of brachiopods, rugose and tabulate corals, sponges (Rigby et al., 2009), and trilobites. Common brachiopod genera observed from the Emsian outcrop include *Carinagypa*, *Ivdelinia*, "*Clorinda*", *Myriospirifer*, *Sibirirhynchia*, *Spinatrypa*, *Spinatrypina*, *Punctatrypa*, *Carinatina*, *Opsiconidion*, and *Teichertina*. Previous work (Blodgett and Brease, 1997, Blodgett, 1998, Blodgett and Boucot, 1999, Garcia-Alcalde and Blodgett, 2001, and Blodgett et al., 2002) indicate a much stronger Eurasian component to the Farewell terrane, as opposed to the Cordilleran fauna known from east-central Alaska and Yukon Territory of westernmost Laurentia. This overwhelmingly Eurasian aspect suggests that the host terrane, the Farewell terrane, was a continental fragment of Siberian origin.

The Frasnian limestone fauna has not yet been thoroughly reinvestigated taxonomically, but it is a proposed target for our future study. Preliminary identifications indicated the presence of the brachiopod genera *Schizophoria*, *Productella*, *Atrypa*, *Spinatrypa*, *Allanaria*?, *Tenticospirifer*, *Cyrtospirifer*, *Crurithyris*, *Eleutherokomma*, *Gypidula*, "*Camarotoechia,*" *Ladogioides*?, *Theodossia*, *Emanuella*?, and *Tylothyris*, as well as rugose and tabulate corals, the trilobite *Scutellum*, and the ammonoid *Manticoceras*.

EMSIAN LIMESTONE UNIT IN SHELLABARGER PASS

A north-south trending stratigraphic section was measured along the eastern side of a small hillock situated near the center of the NE¼, SW¼, NE1/4, sec. 15, T28N, R18W, Talkeetna C-6 1:63,360 scale quadrangle, latitude 62°31'21"N., longitude 152°35'32" W. (Fig. 2), at an elevation slightly above 700 m (2,400 feet). The section, consisting of 38.7 m (127 ft) of lime mudstone and wackestone, was measured in an unnamed late Emsian-age limestone unit (Fig. 2). See Blodgett and Boucot (1999) and Blodgett et al. (2002a) for a description of the locality. These beds appear to stratigraphically or structurally overlie bedded cherts.

This lithologic unit locally forms the base of the Mystic sequence on the north flank of the Alaska Range (Blodgett and Gilbert, 1992; Gilbert and Bundtzen, 1984, Savage and Blodgett, 1995). Typically, the unit appears to be ~50 m (164 ft) thick through much of the central Alaska Range from Shellabarger Pass and to the west into Lime Hills C-5, C-6, D-4, and D-5, 1:6 3,360 scale quadrangles (Blodgett and Gilbert, 1992; Bundtzen et al., 1994; Blodgett et al., 2002a). The Emsian limestone is closely associated with underlying strata of the Dillinger sequence in the Lime Hills D-4, 1-63,360 scale quadrangle, composed here of deep-water turbiditic sandstone, siltstone, shale, and sparse limstones; however, a direct contact with the overlying Mystic sequence has not been observed (Blodgett and Gilbert, 1992). The youngest fauna in the local Dillinger sequence is found in a limestone containing a predominately pelagic fauna consisting of abundant dacryoconarid tentaculitids, orthoconic natutiloids, and undetermined bivalves. A single species of conodont, *Pandorinellina optima*, was found, indicative of a Lochkovian (but not earliest Lochkovian) to Pragian age (Blodgett and Gilbert, 1992).

Fossils recovered from nearby beds indicate a latest Emsian age, based on the presence of conodonts identified by N.M. Savage as belonging to the *Polygnathus serotinus* Zone, as well as the taxonomic composition of the associated megafauna, including abundant brachiopods, rugose and tabulate corals, trilobites, sphinctozoan sponges, and distinctive two-hole cirral crinoid ossicles, commonly assigned to *Gasterocoma*? *bicaula* Johnson and Lane (1969), and rare gastropods. These distinctive two-hole cirral ossicles are common throughout the section, as they are in most shallow-water, open-marine platform carbonate environments in Emsian strata of Alaska and northwestern Canada. Brachiopods were previously described from this section by Blodgett and Boucot (1999) and Garcia-Alcalde and Blodgett (2001). The megafauna from the Emsian unit occurs throughout the fossil lime mudstone that forms the section, and its composition suggests a relatively shallow-water environment developed within photic zone depths on a carbonate shelf.

The section is situated at fossil locality 17 (field number 75AR67 of Bruce Reed) identified on the geologic map of Reed and Nelson (1977, 1980), and its base is situated on the north side of the hillock (see Fig. 2). The locality is situated in the Mystic terrane of Jones et al. (1981), which was recognized by Decker et al. (1994) to be genetically related to the adjacent Dillinger and Nixon Fork terranes. All of these terranes were subsequently reduced in rank to subterranes of a larger terrane, termed the Farewell terrane by Decker et al. (1994).

PREVIOUS STUDIES OF THE LATE EARLY DEVONIAN (EMSIAN) LIMESTONE OF SHELLABARGER PASS

The Emsian limestone body that is the subject of this study is the oldest Devonian interval recognized within the Dl unit of Reed and Nelson (1977, 1980). It forms the oldest stratigraphic interval within the Mystic sequence of Gilbert and Bundtzen (1984). Reed and Nelson (1980) recognized the Dl

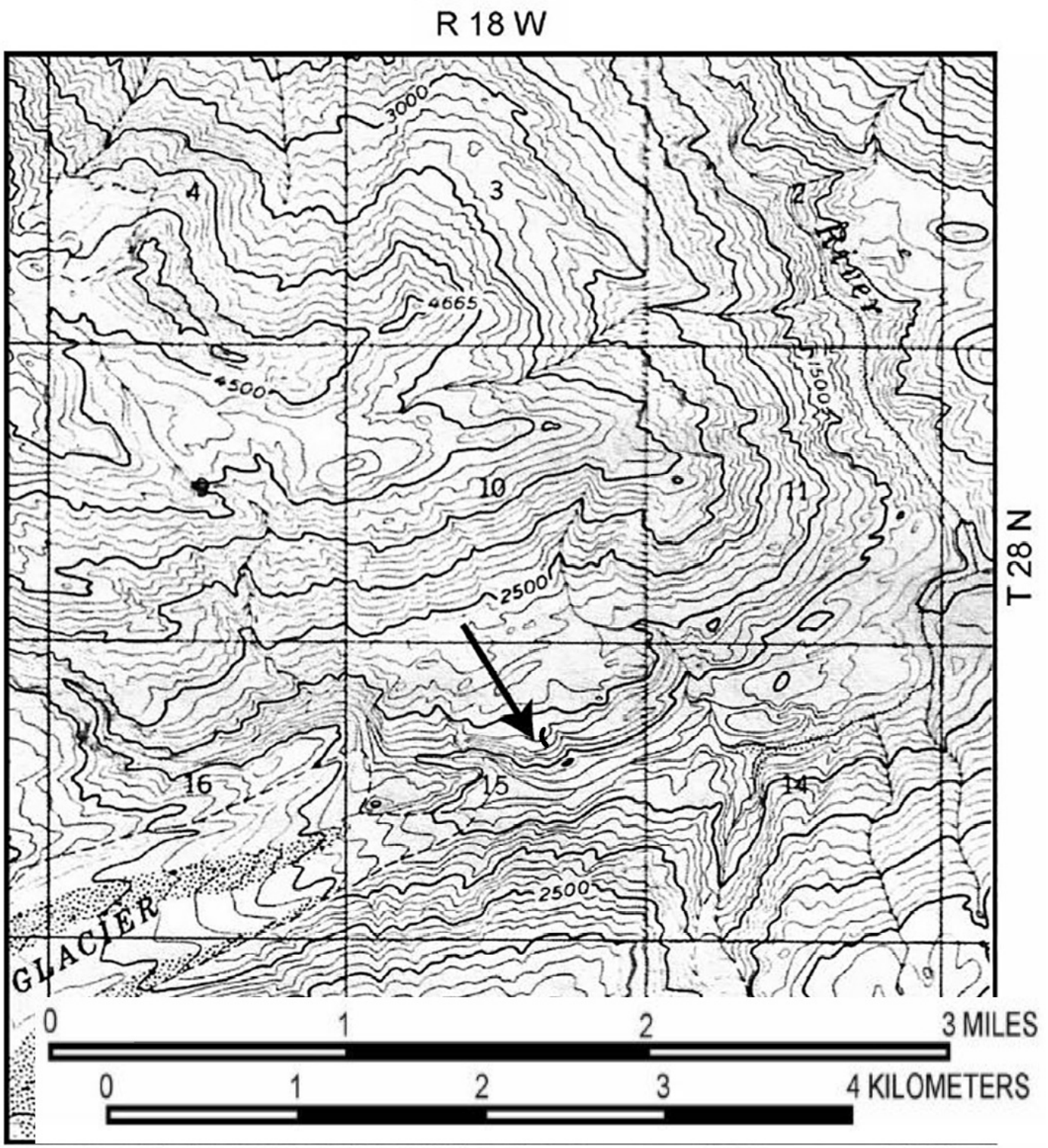


FIGURE 2. Map showing location of Late Early Devonian (Emsian) limestone outcrop in Shellabarger Pass, Denali National Park & Preserve, Talkeetna C-6 quadrangle, south-central Alaska. Line indicates measured section. Base of section located at its northern end.

unit as representing a Middle and Upper Devonian limestone near Shellabarger Pass that is more than 95 m (312 ft) thick. They noted that the Dl unit locally includes discontinuous gray limestone beds of late Early or Middle Devonian age (at their locality 17), which they suggested was a locally derived slump block. Detailed field examination of the surrounding area by Blodgett in late July 1996 indicated that the exposure is actually an *in-situ* outcrop of a late Emsian age limestone that is separated by a thick section of siliciclastic beds from a much more prominent, thick unit of Frasnian age that forms the majority of the Dl unit of Reed and Nelson (1977, 1980). Brachiopods, trilobites, echinoderms, and corals were listed in both papers from locality 17, but detailed taxonomic information was not provided. J.T. Dutro, Jr., in an unpublished USGS E&R report dated February 2, 1976 (Shipment number A-75-18), reported on the fauna from this locality (field number 75AR67 (=USGS collection 9589-SD) and listed the following: *Gasterocoma*? *bicaula* Johnson and Lane (distinctive two-holed crinoid ossicles); *Dohmophyllum* sp. (rugose coral); horn coral, indet.; the brachiopods *Gypidula* sp., *Havlicekia* sp., *Nikiforovaena* sp., *Carinatina*? sp., and *Atrypa* spp.; and the trilobites *Weberopeltis* sp. and *Dechenella*? spp. Dutro suggested a late Early or early Middle Devonian age for this collection.

Subsequently, the paleontological specimens reported here were collected during late July 1996. This additional fossil material allowed for a more detailed taxonomic assessment of the Emsian fauna of Shellabarger Pass. Both Blodgett and Brease (1997) and Blodgett (1998) pointed out the very strong similarities of these collections with collections from Siberia and the Urals, rather than with the North American Cordillera. Blodgett (1998) noted the brachiopods from this exposure included atrypid brachiopods, and the genera *Ivdelinia* and *Janius*, all which were more Uralian in character, rather than Cordilleran. The *Ivdelinia* was noted to be quite distinct from the several North American occurrences, and more closely related to species from the Ural Mountains.

Blodgett and Boucot (1999) described and illustrated two eospiriferinid brachiopod species from the Emsian limestone unit: *Myriospirifer* n. sp. aff. *Myriospifer myriofila* Havlíček (later established as the new species, *Myriospirifer breasei* Garcia-Alcalde and Blodgett, 2001), and *Janius* cf. *J. vetulus* (Eichwald). Both species were noted to indicate a very strong faunal alliance with northeastern Eurasia, suggesting an earlier rift origin from that region. Other notably Eurasian brachiopods were also discussed (but not illustrated), including a species of the gypidulinid genus *Ivdelinia*, very closely allied to a species previously described from the Urals. Another distinctive brachiopod discussed was *Sibirhynchia alata* (Khodalevich), a species known from the Emian-Eifelian of the Urals and Kolyma (the latter part of Northeast Russia).

Garcia-Alcalde and Blodgett (2001) formally described and illustrated *Myriospirifer breasei* as a new species from the Emsian limestone, replacing the previously reported *Myriospirifer* n. sp. aff. *Myriospirifer myriofila* Havlíček of Blodgett and Boucot (1999). This species was named in honor of Phil F. Brease, former U.S. National Park Service geologist, who assisted Blodgett during late July 1996 in the collection of the Emsian brachiopod fauna of Shellabarger Pass.

Blodgett et al. (2002a, fig. 8) reillustrated two eospiriferind brachiopod species from this locality: *Myriospirifer breasei* Garcia-Alcalde and Blodgett, 2001 and *Janius* cf. *J. vetulus* Eichwald). As noted earlier, it was remarked that both taxa were much more common at numerous Emsian localities in Siberia (Kolyma and Kuznetsk Basin), the Urals and Novaya Zemlya, and part of Central Asia of the former Soviet Union. In the same paper (Fig. 7) was illustrated the biogeographically distinctive gypidulinid genus *Ivdelinia*, widespread in Europe, North Africa, the Uralian region, and Kolyma of northeastern Russia, but almost unknown in the Cordilleran Region of the Old World Realm, which in the Emsian included Arctic and western Canada and Nevada. Two occurrences of the genus *Ivdelinia* are noted in the Canadian Arctic Islands, but clearly differ from the Shellabarger species, which, according to its external morphology, appears more closely related to species described from the Urals. Also of note is the occurrence of the rhynchonellid brachiopod *Sibirirhynchia alata* (Khodalevich) in the Shellabarger collections, which is known from Emsian-Eifelian strata of the Urals and Kolyma. Other brachiopod taxa noted in Blodgett et al. (2002a) include *Opsicondion*, *Teichertina*, *Carinagypa* (cited as *Gypidula* therein), a clorindinid, *Atrypa*, *Spinatrypa*, *Carinatina*, and *Puctatrypa* (*Undatrypa*).

SYSTEMATIC PALEONTOLOGY

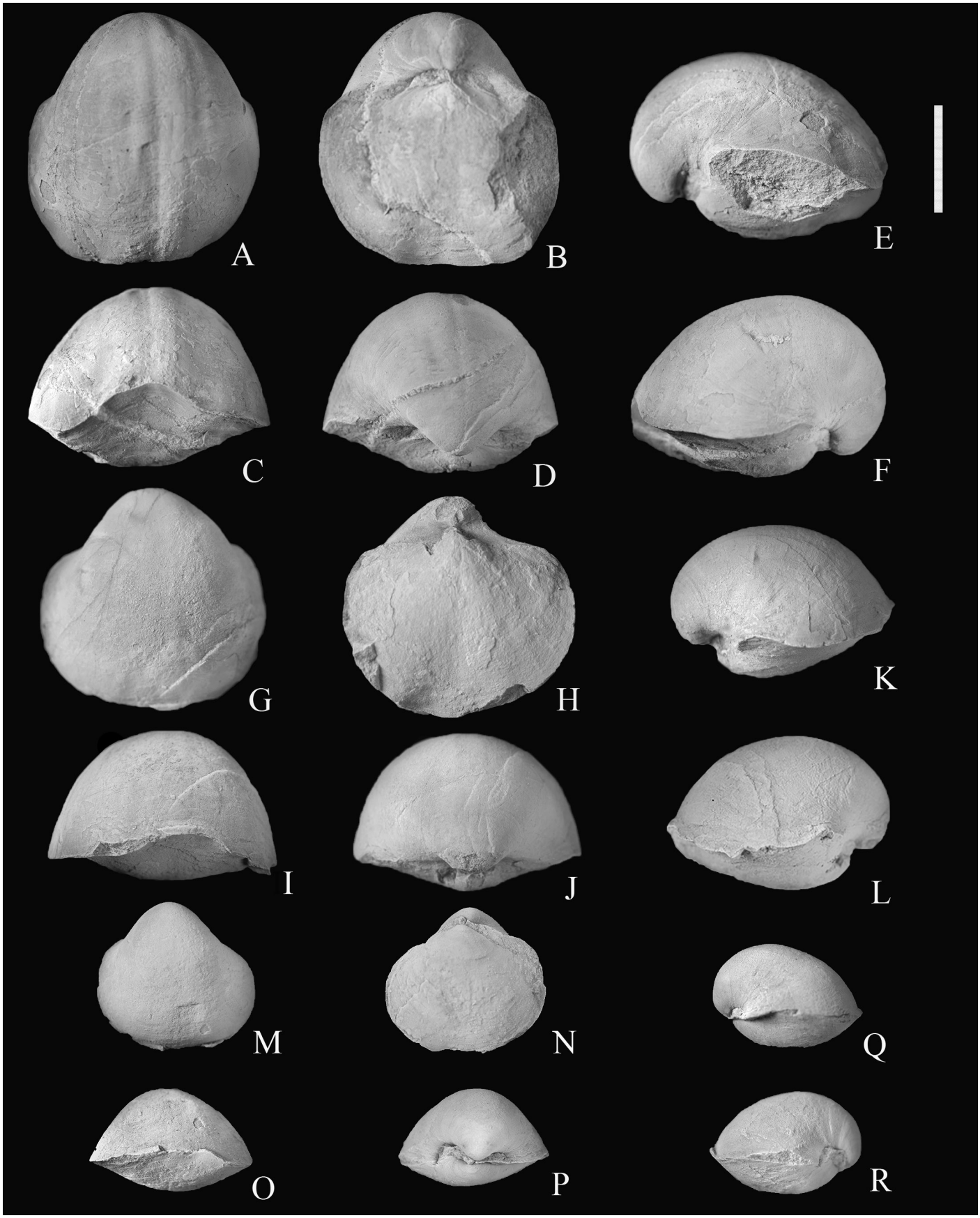
Repository: The brachiopod specimens described in this paper are deposited at the Alaska Geologic Materials Center (prefix AKGMC), Anchorage, Alaska.

Order Pentamerida Schuchert and Cooper, 1931
Suborder Pentameridina Schuchert and Cooper, 1931
Superfamily Gypiduloidea Schuchert and LeVene, 1929
Family Gypidulidae Schuchert and LeVene, 1929
Subfamily Gypidulinae Schuchert and LeVene, 1929
Genus *Carinagypa* Johnson and Ludvigsen, 1972
Subgenus *Carinagypa* Johnson and Ludvigsen, 1972

Type species: *Gypidula loweryi* Merriam, 1940

Discussion: Johnson and Ludvigsen (1972) proposed the genus *Carinagypa* to include gypidulinid genera characterized by the presence of dorsal carinae and essentially smooth to faintly plicate shells. Brice (1982) subsequently segregated *Carinagypa* into two subgenera: *Carinagypa* (*Carinagypa*) and *Carinagypa* (*Aseptagypa*) Brice, the type species of the latter subgenus being *C*. (*Aseptagypa*) *maclareni* Brice. The primary distinction between the two subgenera is the lack of a ventral median septum (resulting in a complete free spondylium) in the latter subgenus. A few other essentially smooth gypidulinid species have been proposed which do indeed have dorsal carinae, and these necessitate a thorough systematic review to sort out their proper taxonomic assignment. As currently known, members of the genus *Carinagypa*, have a stratigraphic range of Lower Devonian-Early Middle Devonian (late Lochkovian-Eifelian). Representatives of the genus can be found in Nevada, western Canada, the Canadian Arctic Islands, south-central and east-central Alaska, and Northeast Russia. In the Revised Brachiopod Treatise (Blodgett et al., 2002b), the genus was indicated to also be present in the Czech Republic, an error which is unaccounted for in origin. One of us, RBB, was the senior author of the Gypiduloidea section, and in checking his original manuscript given to A.J. Boucot to type into a larger chapter in the Treatise covering the Pentameridina, found no mention made of the Czech Republic.

FIGURE 3. (facing page) *Carinagypa robecki* n. sp.; **A-F**, ventral, dorsal, anterior, posterior, anterior, lateral and opposing laterval views of holotype (articulated specimen): AKGMC-4; **G-L**, ventral, dorsal, anterior, posterior, anterior, lateral and opposing lateral views of paratype (articulated specimen): AKGMC-5; **M-R**, ventral, dorsal, anterior, posterior, lateral and opposing lateral views of paratype (articulated specimen): AKGMC-6; all specimens from 50-51 feet (15.24-15.54 m) above base of measured section of an unnamed late Emsian age limestone unt, Shellabarger Pass, Denali National Park, Talkeetna C-6 quadrangle, south-central Alaska. Scale bar = 10 mm (applied to all views).


A
B
E
C
D
F
G
H
K
I
J
L
M
N
Q
O
P
R

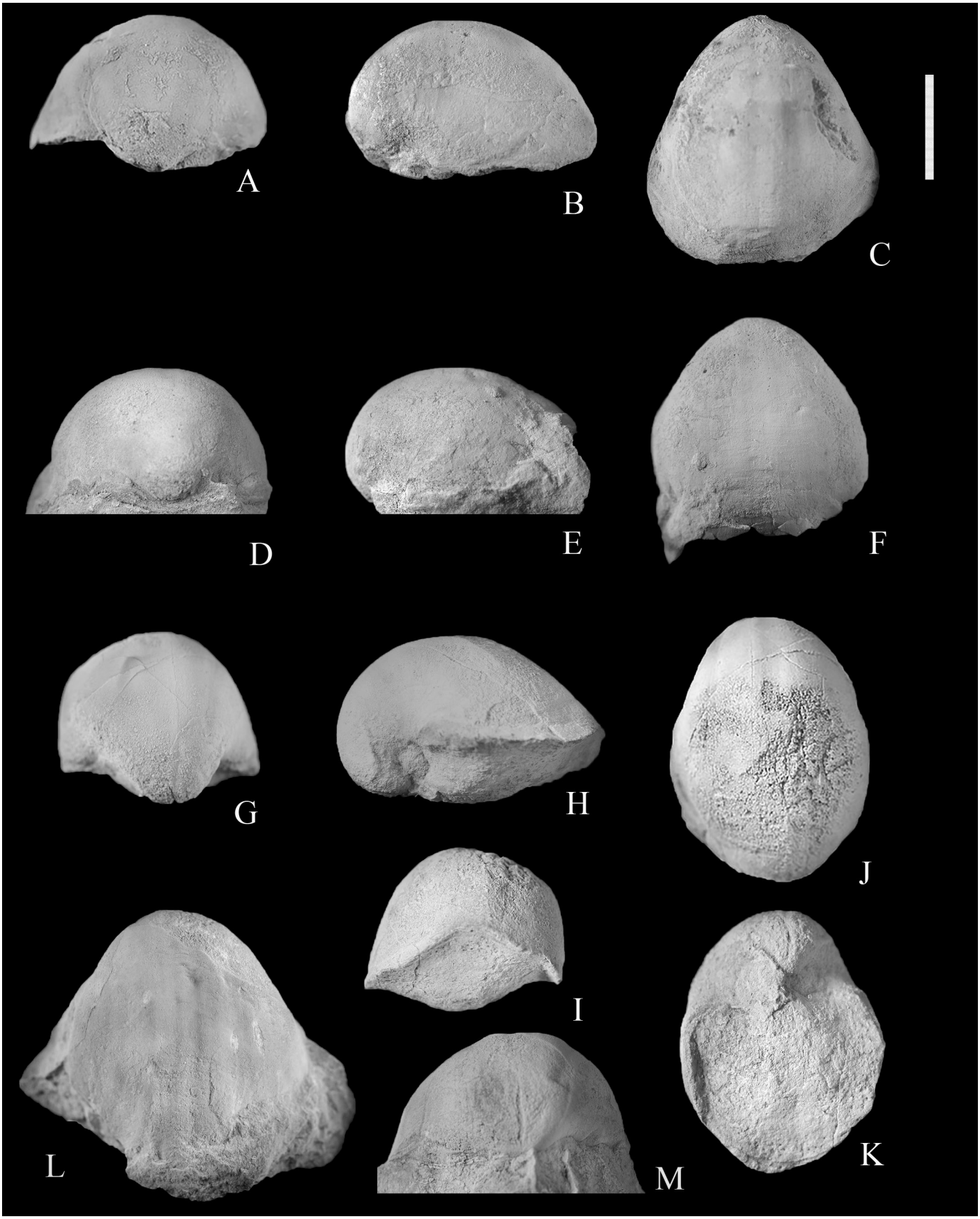

A
B
C
D
E
F
G
H
J
I
L
M
K

FIGURE 4. (facing page) *Carinagypa robecki* n. sp. **A-C**, posterior, lateral, and ventral views of paratype (isolated ventral valve): AKGMC-7, 44+ feet (13.4 m) above base of measured section of unnamed Emsian limestone unit; **D-F**, posterior, lateral and ventral views of paratype (isolated ventral valve): AKGMC-8, 44+ feet (13.4 m) above base of measured section of unnamed Emsian limestone unit; **G-K,** posterior, lateral, anterior, ventral and dorsal views of paratype (articulated specimen): AKGMC-9, 44+ feet (13.4 m) above base of measured section of unnamed Emsian limestone unit; **L-M**, ventral and posterior views of paratype (isolated ventral valve): AKGMC-10, from 50-51 feet (15.24-15.54 m) above base of measured section. Note two well lateral plications developed anteriorly parallel to shell midline. All specimens from unnamed measured section in unnamed late Emsian limestone unit, Shellabarger Pass, Denali National Park & Preserve, Talkeetna C-6 quadrangle, south-central Alaska. Scale bar = 10 mm (applied to all views).

Composition (using original author usage, followed by subgenus assignment recognized here):

1. The type species *Gypidula loweryi* Merriam, 1940 (=*Carinagypa* (*Carinagypa*). Emsian, Nevada, western Canada (Yukon Territory), Canadian Arctic Islands. [See also Johnson (1970), Johnson and Ludvigsen (1972), Brice (1982) and Jones and Smith (1985)].

2. *Gypidula praeloweryi* Johnson, 1970 (=*Carinagypa* (*Carinagypa*). Late Pragian and early Emsian, Nevada, western Canada (Yukon Territory) [see also Perry (1984)].

3. *Carinagypa aseptata* Johnson, 1975a (=*Carinagypa* (*Aseptagypa*), late Emsian, Canadian Arctic Islands, Yukon Territory, east-central Alaska. [See also Johnson and Kendall (1976), Perry et al. (1974, cited as *Carinagypa* sp. therein), Blodgett (1978), Jones and Smith (1980), and Brice (1982).

4. *Carinagypa careopleura* Johnson, 1975b (=*Carinagypa* (*Carinagypa*), Lochkovian and Pragian?, Canadian Arctic Islands and Yukon Territory.) [See also Smith (1980) and Perry (1984)].

5. *Carinagypa* (*Aseptagypa*) *maclareni* Brice, 1982 (=*Carinagypa* (*Aseptagypa*), late Emsian-Eifelian, Canadian Arctic Islands. [See also Jones (1982)].

6. *Gypidula recurrens* Meyer, 1913 (=*Carinagypa* (*Aseptagypa*)? according to Brice (1982), late Emsian-Eifelian, Canadian Arctic Islands.

7. *Gypidula indigirica* Sidyachenko *in* Alekseeva et al., 1996 (=*Carinagypa* (*Carinagypa*), late Emsian, Northeast Russia (Kolyma). The serial sections provided by Sidyachenko *in* Alekseeva et al., 1996, Figure 6 clearly shows the presence of ventrally directed carinae on the dorsal brachial apparatus, indicating that species should be assigned to the externally similar *Carinagypa*, rather than to *Gypidula*. Sidyachenko *in* Alekseeva et al., 1996, p. 52 gives the distribution of the species as Lower

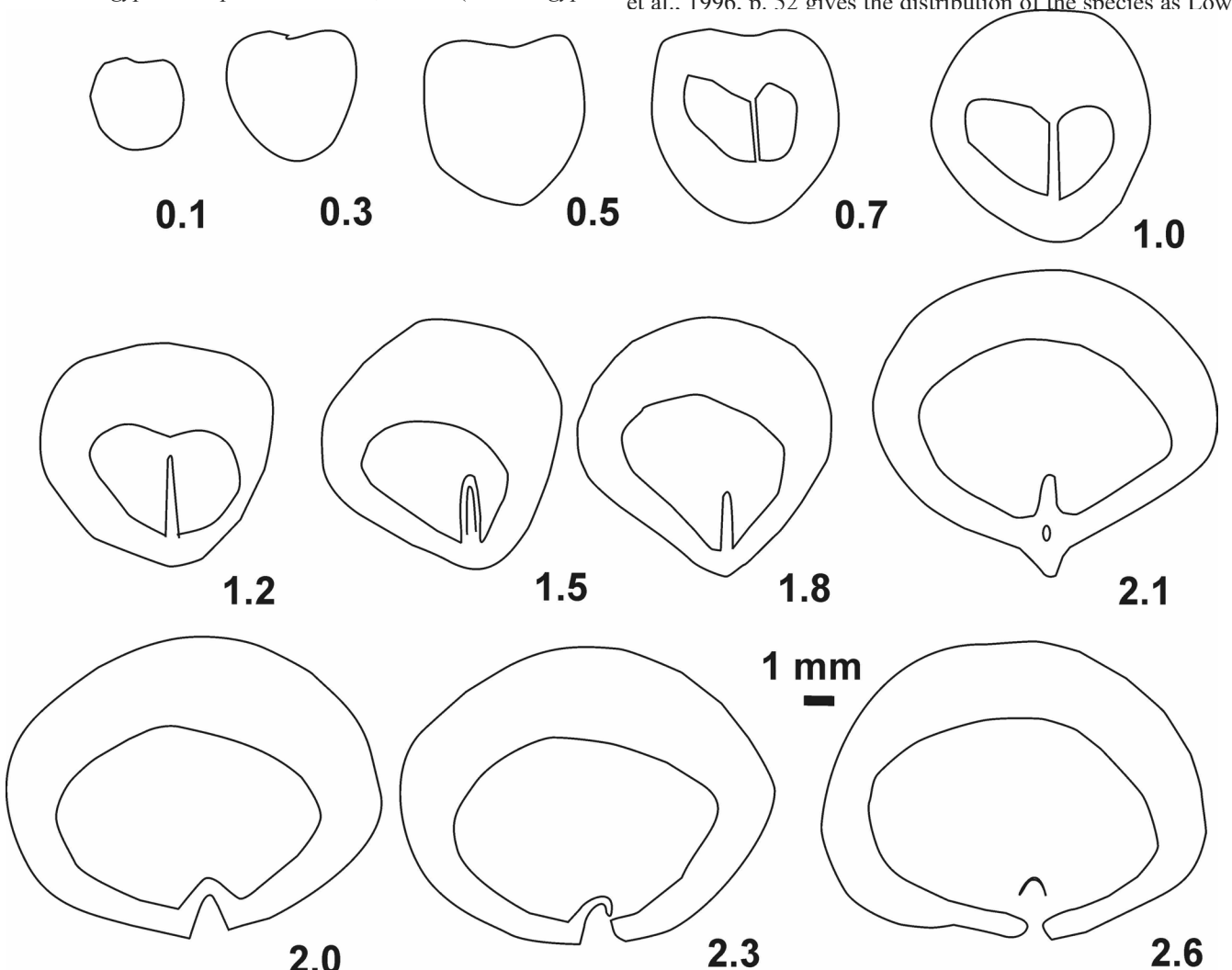


FIGURE 5. Selected transverse serial sections illustrating the internal structure in an isolated ventral valve of *Carinagypa robecki* n. sp.; paratype AKGMC-8; late Emsian, Shellabarger Pass, Denali National Park and Preserve, Talkeetna C-6, south-central Alaska. Distances were measured in mm from the posterior end of the valve. Scale bar represents 1 mm; original length 24.0 mm.

and Middle Devonian, Emsian and Eifelian Stages of North-East Russia, *Ivdelinia ivdelensis* and *Zdimir-Megastrophia uralensis* Zones. Specific stratigraphic units in which it occurred were noted to be the Vechernii, Urultin, upper half of the Khobochalo, and upper half of the Golyshev Suites. However, one of the present authors notes that age of the Khobochalo Suite in the Tas-Kahyakhtakh Ridge was mistakenly dated by R.E. Alekseeva and A.I. Sidyachenko to the late Emsian-Eifelian. According to our data (Alkhovik and Baranov, 2001), the occurrence of the holotype of *Carinagypa* (*Carinagypa*) *indigirica* is confined to the base of the Geremgandya Suite, the age of which is dated by conodonts as at the beginning of the late Emsian.

8. *Ivdelina* (*Ivdelinella*) *salairica* Gratsianova, 1998 (=?*Carinagypa* (*Carinagypa*), early Emsian, Salair, West Siberia. This species is questionably assigned by us to *C.* (*Carinagypa*) based on its relatively smooth shell and the seeming presence of ventrally directed carinae in the dorsal valve. This species bears further investigation, as it differs from all other *Carinagypa* species in the presence of very weakly developed plications especially visible in the posterior regions of both valves. Possible assignment of this species to *Carinagypa* was earlier indicated by Franchi et al., 2012, based on a suggestion by R.B. Blodgett.

Species *Carinagypa robecki* n. sp.
Figs. 3-5

Diagnosis: Specimens of *Carinagypa* with a pair of well developed, closely spaced, very low flattish, broad costae that flank opposing sides of the shell midline that are clearly visible in fully adult-sized individuals.

Description: Shell medium-sized (the holotype, one the largest specimens, measuring in length 24.2 mm and having a width of 23.0 mm), outline pentagonal, equidimensional in younger specimens, becoming slightly elongate in full-sized adults; strongly biconvex in lateral view, hinge line weakly curved, nearly straight, inequivalved; ventral valve nearly as twice as thick as dorsal valve; ventral valve umbo strongly arched and incurved so that ventral beak almost comes into contract with opposing dorsal beak; ventral valve strongly convex, with moderately well-developed, shallow fold, especially visible on more fully grown adult specimens; a pair of well-developed, closely spaced, very low, nearly flat broad costae occur on opposing sides the ventral valve midline; the costae primarily are visible in fully adult-sized individuals; lateral flanks of ventral valve evenly rounded; dorsal valve weakly convex, with dorsal sulcus only becoming visible at mid-valve length, being shallow and wide thereafter; anterior commissure unisulcate; weak concentric growth lines present on both valves; internally in the ventral valve, a short median septum is present, anterior of which is a short free-hanging spondylium.

Comparison*:* The new species very closely resembles the original description and illustrations given for *Carinagypa indigirica* (Sidyachenko *in* Alekseeva et al., 1996), differing only in the presence of a distinct pair of closely spaced, broad, flattish costae being developed primarily in the largest specimens. This consistent difference is considered here to represent a feature of species rank. Of note is the fact that more juvenile specimens tend to be subrounded and subequal in both length and width, while older, more mature specimens become markedly elongate (see Figs. 4A-B, 5C, J-K). Another feature of distinction is the smaller size of individuals found in populations of *Carinagypa robecki* n. sp., compared to the other species of *Carinagypa*.

Occurrence: *Carinagypa robecki* n. sp. is essentially restricted to two horizons in the measured section: (1). 44+ feet (13.4 m) above base of measured section, where it is common, and (2). 50-51 feet (15.24-15.54 m) above base of measured section, where it is abundant and the most common brachiopod species found here. In both collections (both are relatively large in total specimens), the species consists of infrequent articulated specimens, with more common disarticulated ventral valves. No isolated dorsal valves were observed. In addition, this species is also present at 60 feet (18.3 m) above the base of the measured section, where one articulated specimen and seven disarticulated (free) ventral valves. The latter collection was relatively small in total fossil specimens compared to the two above-mentioned collections.

Measurements: The following four articulated specimens have the following measurements: AKGMC-4 (holotype), length 24.2 mm, width 23.0 mm, height 17.3 mm; AKGMC-5 (paratype), length 21.3 mm, width 21.7 mm, height 14.4 mm; AKGMC-6 (paratype), length 14.0 mm, width 15.3 mm, height 9.6 mm; AKGMC-9 (paratype), length 25.1 mm, width 19.5 mm, height 16.2 mm.

Etymology: The species name is in honor of Edward C. Robeck, Ph.D., Director of Education & Outreach, American Geosciences Institute, in recognition for his contributions to science education nationally and internationally. His work has inspired and empowered teachers and students to engage with the wonders of science and the natural world.

Types: Holotype, AKGMC-4, Fig. 3A-F; paratype, AKGMC-5, Fig. 3G-L; paratype, AKGMC-6, Fig. 3M-R; paratype, AKGMC-7, Fig. 4A-C; paratype AKGMC-8, Fig. 4D-F; paratype, AKGMC-9, Fig. 4G-K, Figure 5; and paratype AKGMC-10, Fig. 4L-M. AKGMC-4, 5, 6, and 10 are from 50-51 feet (15.24-15.54 m) above the base of the measured section; AKGMC-7, 8, and 9 are from 44+ feet (13.4 m) above the base of the measured section.

CONCLUSIONS

The newly established species *Carinagypa robecki* n. sp. and the accompanying late Emsian brachiopod fauna of the Shellabarger Pass area consistently show their closest paleobiogeographic affinities with fauna of northeastern Russia, furthering the idea of a rift origin of the Farewell terrane from the Siberian paleocontinent. Many brachiopod species remain to be described from the late Emsian Shellabarger Pass fauna, which should be a fruitful area for future investigations.

ACKNOWLEDGMENTS

Blodgett thanks the Committee for Research and Exploration of the National Geographic Society for providing funds in 1996 which permitted five days of fieldwork in the Shellabarger Pass area of south-central Alaska in late July of the same year. He also thanks Phil F. Brease (deceased) and Pam Sousanes of the U.S. National Park Service, Denali National Park, for their able assistance in the field. Carl Bentley, helicopter pilot for Era Helicopters, capably got us into and out of the remote and beautiful area of the central Alaska Range. The Alaska Division of Geological & Geophysical Surveys of Alaska is also acknowledged for providing several brief reconnaissance helicopter trips into the Shellabarger Pass area to Blodgett in the early 1980s. We also are indebted to Christopher L. Hodges (Sacramento State University) for his help in the formal drafting of several figures. We are also grateful to the continued support of Denny Capps (Park Geologist, Denali National Park and Preserve, Denali Park, Alaska) for our studies of the paleontology and stratigraphy of Denali National Park and Preserve.

This work greatly benefited from the recent (post-1995) collaborative efforts on the part of other paleontologists who have studied or made observations of our fossil materials from the Shellabarger Pass area. These include the following individuals: Jenaro L. Garcia-Alcalde (Oviedo, Spain, Devonian brachiopods), Alan E.H. Pedder (Sidney, British Columbia, Canada, Devonian corals), Norman M. Savage (University of Oregon, Eugene, Devonian conodonts), and J. Keith Rigby, Sr. (Provo, Utah, deceased, Devonian sponges).

We are deeply grateful to Peter E. Isaacson (University of Idaho, Moscow, Idaho) and Justin S. Tweet (National Park Service, Cottage Grove, Minnesota) for their thoughtful reviews of this manuscript.

REFERENCES

Abbott, G., 1995, Does Middle Cambrian rifting explain the origin of the Nixon Fork terrane? [abst.]. Geological Society of America Abstracts with Programs, v. 27, no. 5, p. 1.

Alekseeva, R.E., Sidyachenko, A.I., Baranov, V.V., Afanaseva, G.A., Grunt, T.A., Komarov, V.N., Lazarev, S.S., and Manankov, I.N., 1996, Atlas devonskikh brachiopod severo- vostoka rossii. (Vostochnaya Yakutiya, Magadanskaya Obl.). Moskva, "Nauka". Trudy Paleontologicheskogo Instituta, v. 266, 227 p.

Alkhovik, T.S., and Baranov, V.V., 2001, Stratigrafiya nizhnego devona Vostochnoi Yakutii (Severo-Vostok Rossii): Yakutskii filial izdatelstava SO RAN, Yakutsk, 149 p.

Blodgett, R.B., 1978. Biostratigraphy of the Ogilvie Formation and limestone and shale member of the McCann Hill Chert (Devonian), east-central Alaska and adjacent Yukon Territory: [M.S. thesis]: University of Alaskam Fairbanks, 142 p.

Blodgett, R.B., 1983, Paleobiogeographic implications of Devonian fossils from the Nixon Fork terrane, southwestern Alaska; *in* Stevens, C.H., ed., Pre-Jurassic Rocks in Western North America Suspect terranes. Pacific Section, Society of Economic Paleontologists and Mineralogists, Los Angeles, California, p. 125-130.

Blodgett, R.B., 1998, Emsian (Late Early Devonian) fossils indicate a Siberian origin for the Farewell terrane; *in* Clough, J.G., and Larson, F., eds., Short Notes on Alaskan Geology 1997: Alaska Division of Geological & Geophysical Surveys, Professional Report 118, p. 53-61.

Blodgett, R.B., and Boucot, A.J., 1999, Late Early Devonian (late Emsian) eospiriferinid brachiopods from Shellabarger Pass, Talkeetna C-6 quadrangle, south-central Alaska and their biogeographic importance; further evidence for a Siberian origin of the Farewell and allied Alaskan accreted terranes: Senckenbergiana Lethaea, v. 72, p. 209-221.

Blodgett, R.B., Boucot, A.J., Rohr, D.M., and Pedder, A.E.H., 2010, The Alexander terrane − a displaced fragment of Northeast Russia? Evidence from Silurian-Middle Devonian megafossils and stratigraphy: Memoirs of the Association of Australasian Paleontologists, v. 39, p. 323-339.

Blodgett, R.B., Boucot, A.J., and Rong Jia-Yu, 2002b, Superfamily Gypiduloidea Rzhonsnitskaya, 1956; *in* Kaesler, R.L., ed., Treatise on Invertebrate Paleontology. Part H. Brachiopoda revised, v. 4: Rhynchonelliformea (part). Geological Society of America, Inc. and University of Kansas. Boulder, Colorado, and Lawrence, Kansas, p. 1005-1020.

Blodgett, R.B., and Brease, P.F., 1997, Emsian (late Early Devonian) brachiopods from Shellabarger Pass, Talkeetna C-6 quadrangle, Denali National Park, Alaska indicate Siberian origin for Farewell terrane: Geological Society of America, Abstracts with Programs, v. 29, no. 5, p. 5.

Blodgett, R.B., and Clough, J.G., 1985, The Nixon Fork terrane − part of an *in-situ* peninsular extension of the Paleozoic North American continent: Geological Society of America, Abstracts with Programs, v. 17, no. 6, p. 342.

Blodgett, R.B., and Gilbert, W.G., 1983, The Cheeneetnuk Limestone; A new Early(?) to Middle Devonian formation in the McGrath A-4 and A-5 Quadrangles, west-central Alaska: Alaska Division of Geological & Geophysical Surveys, Professional Report 85, 6 p.

Blodgett, R.B., and Gilbert, W.G., 1992, Upper Devonian shallow-water marine siliciclastic strata and associated fauna and flora, Lime Hills D-4 quadrangle, southwest Alaska; *in* Bradley, D.C., and Dusel-Bacon, C., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1991: U.S. Geological Survey, Bulletin 2041, p. 106-115.

Blodgett, R.B., Rohr, D.M., and Boucot, A.J., 2002a, Paleozoic links among some Alaskan accreted terranes and Siberia based on megafossils; *in* Miller, E.L., Grantz, Art, and Klemperer, S.L., eds., Tectonic Evolution of the Bering Shelf-Chukchi Sea-Arctic Margin and Adjacent Landmasses: Geological Society of America, Special Paper 360, p. 273-290.

Brice, D., 1982, Brachiopodes du Devonien inferieur et moyen des formations de Blue Fiord et Bird Fiord des les arctique canadiennes: Geological Survey of Canada, Bulletin 326, 175 p.

Bundtzen, T.K., and Gilbert, W., 1983, Outline of geology and mineral resources of the upper Kuskokwim region, Alaska: Journal of the Alaska Geological Society, v. 3, p. 101-119.

Bundtzen, T.K., Laird, G.M., Blodgett, R.B., Clautice, K.H., and Harris, E.E., 1994, Geology of the Gagaryah River area, Lime Hills C-5 and C-6 quadrangles, southwest Alaska: Alaska Division of Geological & Geophysical Surveys, Public-Data File 94-40, 17 p., 1 sheet, scale 1:63,360.

Coney, P.J., Jones, D.L., and Monger, J.W.H., 1981, Cordilleran suspect terranes: Nature, v. 288, p. 329-333.

Decker, J., Bergman, S.C., Blodgett, R.B., Box, S.E., Bundtzen, T.K., Clough, J.G., Coonrad, W.L., Gilbert, W.G., Miller, M.L., Murphy, J.M., Robinson, M.S., and Wallace, W.K., 1994, Geology of southwestern Alaska; *in* Plafker, G., and Berg, H.C., eds., The Geology of Alaska. The Geology of North America, volume G-1. Geological Society of America, Boulder, Colorado, p. 285-310.

Franchi, F., Schemm-Gregory M., and Klug, C., 2012, A new species of *Ivdelinia* Andronov, 1961 from the Moroccan Givetian and its palaeoecological and paleobiogeographical implications: Bulletin of Geosciences, v. 87, p. 1-11.

Garcia-Alcalde, J., and Blodgett, R.B., 2001, New Lower Devonian (Upper Emsian) *Myriospirifer* (Brachiopoda, Eospiriferinae) species from Alaska and northern Spain and the paleogeographic distribution of the genus *Myriospirifer*; *in* Frýda, J., Blodgett, R.B., and Mergl, M., eds., Havlíček Volume: Journal of the Czech Geological Society, v. 46, no. 3/4, p. 145-154.

Gilbert, W.G., and Bundtzen, T.K., 1983, Paleozoic stratigraphy of Farewell area, southwest Alaska Range, Alaska: Alaska Geological Society Symposium, New Developments in the Paleozoic Geology of Alaska and the Yukon, Anchorage, Anchorage, 1983, Program and Abstracts, p. 10-11.

Gilbert, W.G., and Bundtzen, T.K., 1984, Stratigraphic relation between Dillinger and Mystic terrenes, western Alaska Range, Alaska: Geological Society of America, Abstracts with Programs, v. 16, no. 5, p. 286.

Gratsianova, R.T., 1998, Novyi vid ivdeliniii (brakhiopody) iz nizhnego devona saliara I ego znachenie dlya paleobiogeografii, p. 47-54, *in* Novosti paleontologii i stratigrafii, Vypusk 1. Prilozhenye k zhurnaly "Geologiya i Geofizika", v. 39.

Johnson, J.G., 1970, Great Basin Lower Devonian Brachiopoda: Geological Society of America, Memoir 121, 421 p.

Johnson, J.G., 1975a, Late Early Devonian brachiopods from the Disappointment Bay Formation, Lowther Island, Arctic Canada: Journal of Paleontology, v. 49, p. 947-978.

Johnson, J.G., 1975b, Devonian brachiopods from the *Quadrithyris* Zone (Upper Lochkovian), Canadian Arctic Archipelago: Geological Survey of Canada Bulletin 235, p. 5-57.

Johnson, J.G., and Kendall, G.W., 1976, Late Early Devonian brachiopods and biofacies from central Nevada: Journal of Paleontology, v. 50, p. 1113-1128.

Johnson, J.G., and Lane, N.G., 1969, Two new crinoids from central Nevada: Journal of Paleontology, v. 43, p. 69-73.

Johnson, J.G., and Ludvigsen, R., 1972, *Carinagypa,* a new genus of pentameracean brachiopod from the Devonian of western North America: Journal of Paleontology, v. 46, p. 125–129.

Jones, B., 1982, Lower Devonian brachiopods from the 'Bird Fiord' Formation of the Vendom Fiord Area, Ellesmere Island, Arctic Canada: Journal of Paleontology, v. 56, p. 1375-1396.

Jones, B., and Smith, G.P., 1980, Lower Devonian brachiopods from

the Eids Formation, Southwest Ellesmere Island, Arctic Canada: Journal of Paleontology, v. 54, p. 675-695.

Jones, B., and Smith, G.P., 1985, Taxonomy and distribution of brachiopods in the Devonian Eids Formation of Southwest Ellesmere Island, Arctic Canada: Journal of Paleontology, v. 59, p. 418-437.

Jones, D.L., and Silberling, N.J., 1979, Mesozoic stratigraphy−The key to tectonic analysis of southern and central Alaska: U.S. Geological Survey, Open-File Report 79-1200, 37 p.

Jones, D.L., Silberling, N.J., Berg, H.C., and Plafker, G., 1981, Map showing tectonostratigraphic terranes of Alaska: U.S. Geological Survey, Open-File Report 81-792, 20 p., 2 sheets, scale 1:2,500,000.

Jones, D.L., Silberling, N.J., and Coney, P.J., 1986, Collision tectonics in the Cordillera of western North America: examples from Alaska; *in* Coward, M.P., and Ries, A.C., eds., Collision Tectonics: Geological Society, Special Publication 19, London, p. 367-387.

Jones, D.L., Silberling, N.J., Coney, P.J., and Plafker, George, 1987, Lithotectonic terrane map of Alaska (west of the 141st meridian): U.S. Geological Survey, Miscellaneous Field Studies Map 1874-A, 1 sheet, scale 1:2,500,000.

Jones, D.L., Silberling, N.J., Gilbert, W.G., and Coney, P.J., 1982, Character, distribution, and tectonic significance of accretionary terranes in the central Alaska Range: Journal of Geophysical Research, v. 87, p. 3709-3717.

Merriam, C.W., 1940, Devonian stratigraphy and paleontology of the Roberts Mountain region, Nevada: Geological Society of America, Special Paper 25, 114 p.

Meyer, O.E., 1913, Die devonischen Brachiopoden von Ellesmereland: Videnskaps-Selskabet i Kristiania, Report 2nd Norwegian Arctic Expedition in the Fram 1898-1902. v. 29, 43 p.

Nokleberg, W.J., Moll-Stalcup, E.J., Miller, T.P., Brew. D.A., Grantz, A., Reed, J.C., Jr., Plafker, G., Moore, T.E., Silva, S.R., and Patton, W.W., Jr., 1994, with contribution on specific regions by Blodgett, R.B., Box, S.E., Bradley, D.C., Bundtzen, T.K., Dusel-Bacon, C., Gamble, B.M., Howell, D.G., Foster, H.L., Karl, S.M., Miller, M.L., and Nelson, S.W., 1994, Tectonostratigraphic terrane and overlap assemblage map of Alaska: U.S. Geological Survey, Open-File Report 94-194, 53 p.

Patton, W.W., Jr., 1978, Juxtaposed continental and ocean-island arc terranes in the Medfra quadrangle, west-central Alaska; *in* Johnson, K.M., ed., The United States Geological Survey in Alaska: Accomplishment during 1977: U.S. Geological Survey, Circular 772-B, p. B38-B39.

Perry, D.G., 1984, Brachiopoda and biostratigraphy of the Silurian-Devonian Delorme Formation in the District of Mackenzie, the Yukon: Royal Ontario Museum, Life Sciences Contributions (Toronto), v. 138, 243 p.

Perry, D.G., Klapper, G., and Lenz, A.C., 1974, Age of the Ogilvie Formation (Devonian), northern Yukon: Based primarily on the occurrence of brachiopods and conodonts: Canadian Journal of Earth Sciences, v. 11, p. 1055-1097.

Reed, B.L., and Nelson, S.W., 1977, Geologic map of the Talkeetna Quadrangle, Alaska: U.S. Geological Survey, Miscellaneous Field Studies Map 870-A, 1 sheet, scale 1:250,000.

Reed, B.L. and Nelson, S.W., 1980, Geologic map of the Talkeetna quadrangle, Alaska: U.S. Geological Survey, Miscellaneous Investigations Series Map I-1174, 15 p., scale 1:250,000.

Rigby, J.K., Blodgett, R.B., and Anderson, N.K., 2009, Emsian (Late Early Devonian) sponges from west-central and south-central Alaska: Journal of Paleontology, v. 83, p. 293-298.

Rohr, D.M., and Blodgett, R.B., 1985, Upper Ordovician Gastropoda from west-central Alaska: Journal of Paleontology, v. 59, p. 667-673.

Savage, N.M., and Blodgett, R.B., 1995, A new species of the conodont *Amydrotaxis* from the Lower Devonian of southwestern Alaska; *in* Combellick, R.A., and Tannian, F., eds., Short notes on Alaska Geology 1995: Alaska Division of Geological & Geophysical Surveys Professional Report 117, p. 69-73.

Schuchert, C., and Cooper, G.A., 1931, Synopsis of the brachiopod genera of the suborders Orthoidea and Pentameroidea, with notes on the Telotremata: American Journal of Science, series 5, v. 22, p. 241-255.

Schuchert, C., and LeVene, C.M., 1929, Brachiopoda (Generum et Genotyporum Index et Bibliographia); *in* Pompeckj, J.F., ed., Fossilium Catalogus, vol. 1: Animalia, Pars 42. W. Junk, Berlin, p. 10-25.

Silberling, N.J., Jones, D.L., Monger, J.W.H., and Coney, P.J., 1992, Lithotectonic terrane map of the North American Cordillera: U.S. Geological Survey, Miscellaneous Investigations Series Map 1-2176, 2 sheets, scale 1:5,000,000.

Silberling, N.J., Jones, D.L., Monger, J.W.H., Coney, P.J., Berg, H.C., and Plafker, G., 1994, Lithotectonic terrane map of Alaska and adjacent parts of Canada; *in* Plafker, G., and Berg, H. C., eds., The Geology of Alaska. Geological Society of America. The Geology of North America G-1, 1 sheet, scale 1:2,500,000.

Smith, R.E., 1980, Lower Devonian (Lochkovian) biostratigraphy and brachiopod faunas, Canadian Arctic Islands: Geological Survey of Canada Bulletin 308, 155 p.