SHORT NOTES ON ALASKA GEOLOGY 1997

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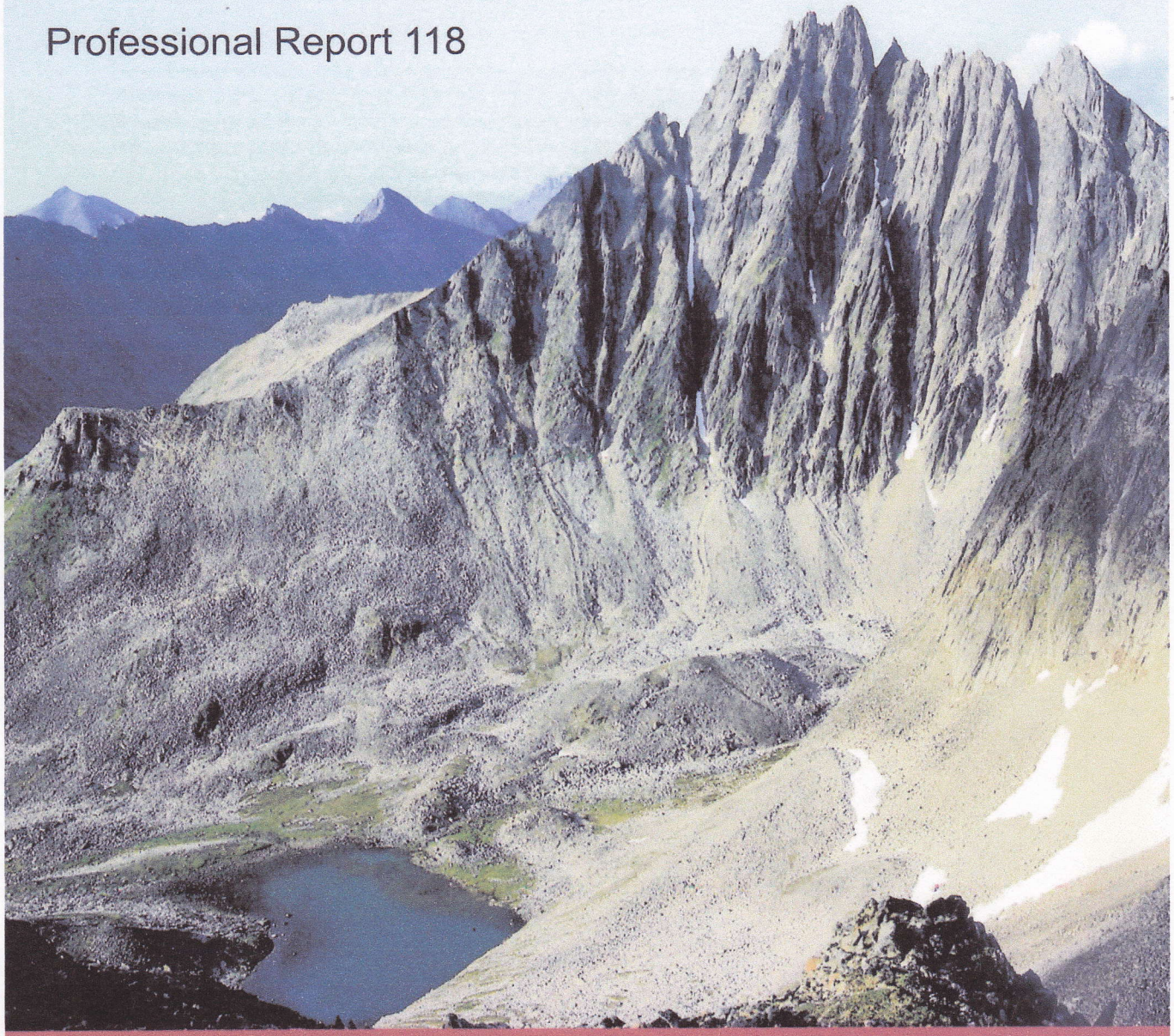

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Front cover: *View of central Kigluaik Mountains on the Seward Peninsula. Peaks are composed of Thompson Creek Orthogneiss of Late Proterozoic to Early Precambrian age and metamorphosed at upper amphibolite facies conditions about 91 million years ago. Photograph by J.M. Amato.*

Fairbanks, Alaska
1998

EMSIAN (LATE EARLY DEVONIAN) FOSSILS INDICATE A SIBERIAN ORIGIN FOR THE FAREWELL TERRANE

by
Robert B. Blodgett[1]

INTRODUCTION

Recent years have witnessed the rise of the hypothesis that nearly all of Alaska, as well as much of the western Cordillera of North America, is composed of numerous discrete, accreted tectonostratigraphic terranes (Coney and others, 1980; Jones and others, 1981, 1982, 1986, 1987; Nokleberg and others, 1994). The only exception to this in Alaska is represented by the small triangular area of the Nation Arch in east-central Alaska (fig. 1). This area is composed primarily of Precambrian and Paleozoic rocks that represent a continuation of similar rocks exposed farther to the east in the Ogilvie Mountains of the Yukon Territory. The autochthoneity of these east-central Alaskan Paleozoic rocks is supported by both lithic continuity and paleontological evidence. Faunal evidence for this is especially notable in Early Devonian age strata, as these contain faunas typical of North American miogeoclinal and cratonic strata in northwestern and Arctic Canada.

In this paper, however, attention is focused on newly acquired faunal data of important biogeographic significance from late Early Devonian (Emsian) age strata of two terranes, the Nixon Fork and Mystic, situated in west-central and southwestern Alaska. These terranes, along with Dillinger terrane, were recognized by Decker and others (1994) to be genetically related and were reduced in rank to subterranes of a larger terrane, termed the Farewell terrane (fig. 1). Other terranes in interior Alaska such as the Minchumina, East Fork, and Livengood are also probably genetically related to the Farewell terrane, and together represent a locally highly deformed continental margin sequence composed primarily of Neoproterozoic to Paleozoic strata. Previous interpretation of the gross lithostratigraphy and faunal affinities of the most well-studied subterrane, the Nixon Fork, has previously been suggested to indicate either fragmentation from or lithic continuity with northwestern Canada (Blodgett, 1983; Churkin and others, 1984; Blodgett and Clough, 1985; Rohr and Blodgett, 1985; Abbott, 1995). Newly acquired biogeographic data from Emsian (late Early Devonian) strata of the Farewell terrane, along with reconsideration of the affinities of faunas and floras of other time intervals (Middle Cambrian, Late Ordovician, and Permian), now have convinced the author that this continental margin sequence originated from the Siberian continent, rather than northwestern North America.

DEVONIAN BIOGEOGRAPHY

The study of Devonian marine biogeography has been the subject of considerable attention in the literature for nearly 30 years now. Most of these studies have relied on three primary groups: brachiopods (Boucot, 1974, 1975; Boucot and others, 1969; Johnson, 1970, 1971; Johnson and Boucot, 1973; Savage and others, 1979; Wang Yu and others, 1984); rugose corals (Oliver, 1973, 1976, 1977; Oliver and Pedder, 1979, 1984; Pedder and Oliver, 1990); and trilobites (Ormiston, 1972, 1975; Kobayashi and Hamada, 1975; Eldredge and Ormiston, 1979). Other faunal groups have also been studied to a lesser degree [that is, gastropods (Blodgett, 1992; Blodgett and others, 1988, 1990; Forney and others, 1981); and ostracodes (Copeland and Berdan, 1977; Berdan, 1990)], but are in virtually full agreement with established biogeographic patterns shown by the more common and better studied faunal groups mentioned above.

The highest level of provincialism in Devonian marine faunas occurred during the later two stages (Pragian and Emsian) of the Early Devonian (Boucot, 1975, 1988; Blodgett and others, 1988). Both before and after, the levels of provincialism vary from moderate to low, with the Middle Devonian evincing steadily declining levels of endemism from the Eifelian into the succeeding Givetian. The Late Devonian, including both the Frasnian and Famennian, is considered to be characterized by a remarkably high level of cosmopolitanism at the generic level, although undoubtedly detailed future study will still show distinct biogeographic provinces on the basis of the distribution of both species and some genera.

Rich, abundant, diverse megafaunas are known from both early Middle (Eifelian) and early Late (Frasnian) Devonian faunas of the Farewell terrane. The Eifelian faunas were thought to show their strongest similarities

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with those of northwestern Canada (Blodgett, 1983, 1992; Blodgett and others, 1990), although strong affinities are also noted to Siberia and the Urals (Baxter and Blodgett, 1994). Frasnian faunas of the Farewell terrane show close biogeographic ties to western North America, Novaya Zemlya, Taimyr, and Kolyma (Blodgett and Gilbert, 1992a; W.K. Braun *in* Blodgett, 1983, p. 128). Differentiation between Siberia and northwestern Canadian faunas during the Middle and Late Devonian is difficult, because both areas share many of the same genera, due to the moderate to low level of endemism during this time interval. To better differentiate faunas biogeographically between these areas, it is best to use evidence from the middle and late Early Devonian (Pragian and Emsian), when global endemism was relatively high. Unfortunately, until recently virtually no biogeographically useful collections of these ages were available to the author from this terrane. At this time, however, biogeographically distinctive Emsian collections have been examined from two localities, which now indicate strong Siberian and Uralian—rather than western or Arctic Canadian—affinities and origin for this terrane.

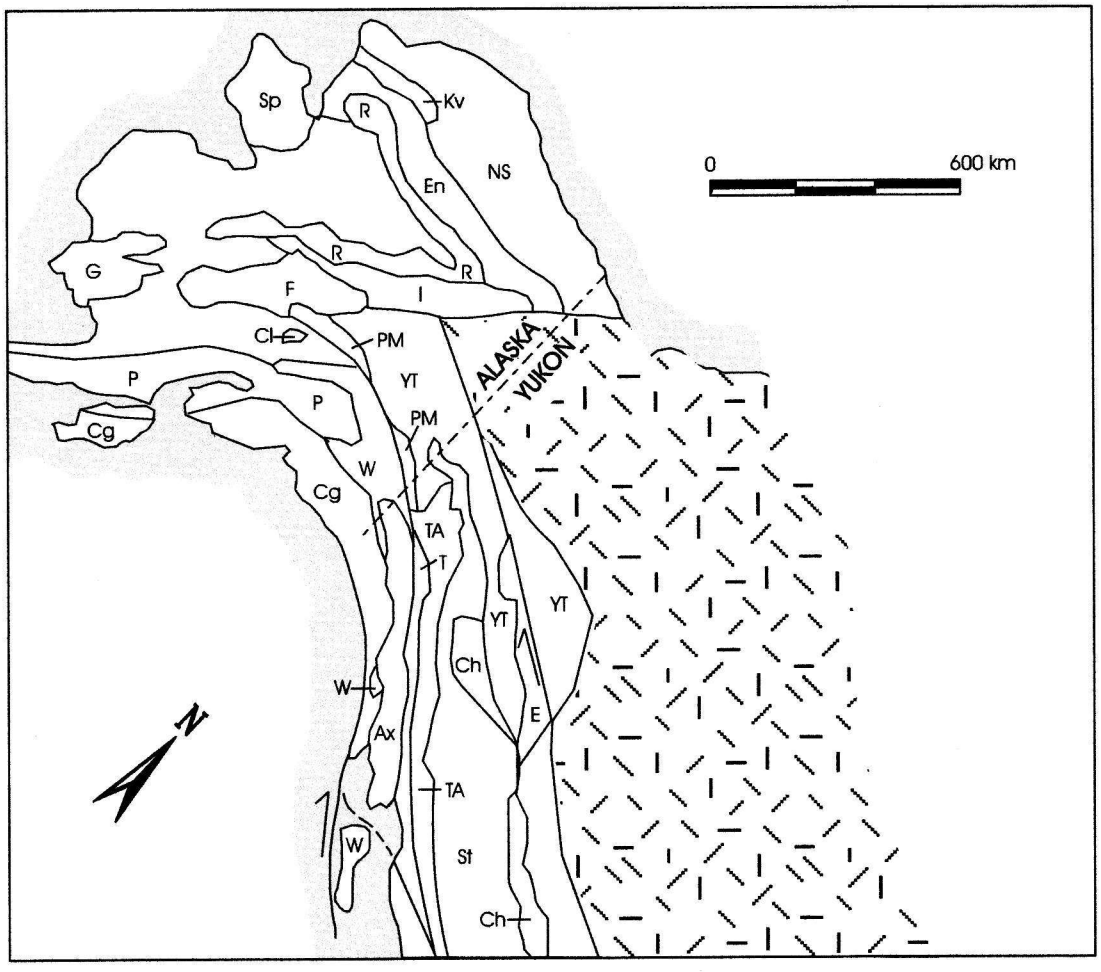

Figure 1. *Generalized map showing location of major tectonostratigraphic terranes in Alaska and northwestern Canada (modified from Coney and others, 1980). Dashed pattern, North American autochthonous basement. Barbed arrows indicate direction of major strike-slip movements. F - Farewell terrane; I - Innoko; R - Ruby; G - Goodnews; P - Peninsular; Cg - Chugach; Cl - Chulitna; W - Wrangellia; PM - Pingston & McKinley; Sp - Seward Peninsula; En - Endicott; Kv - Kagvik; NS - North Slope; YT - Yukon-Tanana; TA - Tracy Arm; Ax - Alexander; T - Taku; St - Stikine; Ch - Cache Creek; E - Eastern Assemblage.*

BIOGEOGRAPHICALLY DISTINCTIVE FAREWELL TERRANE EMSIAN FAUNAS

The first locality is from the Nixon Fork subterrane. It consists of a number of collections from three measured sections of a distinctive marker unit of limestone and minor shale of early Emsian age in the Medfra B-3 Quadrangle (fig. 2, loc. 1). This unit, which is about 150 m thick, is well exposed in a north-trending ridge, long known informally as "Reef Ridge" by mineral-company geologists. It is repeated twice by thrust faulting along this ridge, which is located in section 23, T. 24 S., R. 23 E. of that quadrangle. The entire succession is thought to represent shallow, subtidal to open shelf depositional environments (Chalmers and others, 1995). Carbonate rocks include packstone, wackestone, and mudstone; locally, favositid coral heads are common in the limy intervals, reaching up to 1 m in diameter. Some channels of probable tidal origin bearing reworked bioclasts and lithoclasts are present. Three prominent, richly fossiliferous shale intervals occur interbedded with the dominantly carbonate section; the shale intervals are thicker in the upper part of the section, as is characteristic of deepening-upward shelf sequences. This unit, bounded above and below by dolostone, forms a distinctive regionally mappable subunit within the Whirlwind Creek Formation of Dutro and Patton (1982), and should ultimately be given a separate stratigraphic name. Megafossils are especially abundant in the more shaly intervals, and include brachiopods, rugose and tabulate corals, leperditiid ostracodes, echinoderm ossicles, bivalves, gastropods, and trilobites. The brachiopod, rugose coral, and conodont faunal elements of this unit were briefly discussed by Blodgett and others (1995). Conodonts (identified by N.M. Savage) from throughout the unit indicate an early Emsian age (Polygnathus dehiscens Zone). Brachiopods and rugose corals (identified by R.B. Blodgett and A.E.H. Pedder, respectively) from this interval also indicate an early Emsian age.

Brachiopods are represented by over 30 species, of which the common element are rhynchonellids (notably uncinulids). Genera present include *Plicogypa, Stenorhynchia, Taimyrrhynx, "Uncinulus", Nordotoechia?, Spinatrypa, Nucleospira, Protathyris, Howellella,* and *Aldanispirifer*. Diagnostic species from this unit include *Plicogypa* cf. *kayseri* (Peetz), *Taimyrrhynx taimyrica* (Nikiforova), "*Uncinulus*" *polaris* Nikiforova, and *Howellella yacutica* Alekseeva. These species are known from various parts of Siberia (Kolyma, Taimyr, and Kuznetsk Basin) and Arctic Russia (Novaya Zemlya), and are unknown from equivalent age strata of east-central Alaska (Nation Arch area), or northwestern and Arctic Canada. Another strong Siberian linkage of the brachiopod fauna is shown by the presence of the brachiopod genus *Aldanispirifer*, described originally from northeastern Siberia, and also unknown from either northwestern or Arctic Canada. In fact, the now extensive collection of "Reef Ridge" brachiopods assembled by the author shows not even one species in common with equally extensive—but even more richly diverse—Emsian brachiopod fauna gathered by the author from the Ogilvie Formation of east-central Alaska and adjacent Yukon Territory. The latter formation forms a western terminus of the extensive carbonate platform that then constituted part of the miogeoclinal assemblage of the North American continent during late Early Devonian time.

Rugose corals identified by Pedder from the "Reef Ridge" unit consist mostly of solitary forms and dominated by relatively undiagnostic *Pseudoamplexus altaicus*, *Lithophyllum* spp., and rare *Zonophyllum* from 21.3 to 57.3 m. From 65.2 to 111.9 m corals include ***Rhizophyllum schischkaticum***, ***Lythophyllum*** spp., *Pseudoamplexus altaicus*, new species of *Zelophyllum*, *Acathophyllum*, and a new species. Pedder noted that although undescribed, these higher faunas are related to early Emsian Kolymian loop coral faunas of Siberia. Both the brachiopod and rugose coral element of this fauna is distinctly Siberian in character. Thus, it is now proposed that during Emsian time the Nixon Fork subterrane of the Farewell terrane was biogeographically part of the Uralian Region, which included faunas of both Siberia and the Urals.

The second locality is situated in the Mystic Subterrane, and consists of a small (but biogeographically highly significant) collection made by Bruce L. Reed (his locality 75AR67) in 1975 from Emsian age limestones. The locality was described as a "locally derived slump block" (Reed and Nelson, 1980, table 1, locality 17) in the Shellabarger Pass area, Talkeetna C-6 Quadrangle. The author has had an opportunity to examine this collection and has noted abundant two-holed crinoid ossicles, atrypid brachiopods, and the brachiopods *Ivdelinia*, *Eospirifer*, and *Janius*. The gypidulid genus *Ivdelinia* is a typical Old World Realm taxon, and is common in the Rhenish-Bohemian and Uralian Regions but almost wholly unknown in the Cordilleran Region of the Old World Realm which, in the Emsian, included the areas of Arctic and western Canada and Nevada. Only two species of *Ivdelinia* have been described from Emsian-Eifelian strata of the Cordilleran Region: these are *Ivdelinia grinnellensis* Brice, 1982 and *Ivdelinia* (*Ivdelinella*) *ellesmerensis* Brice, 1982, both of which occur in the Canadian Arctic Islands. The Shellabarger Pass *Ivdelinia* is quite distinct from both of the above species and is

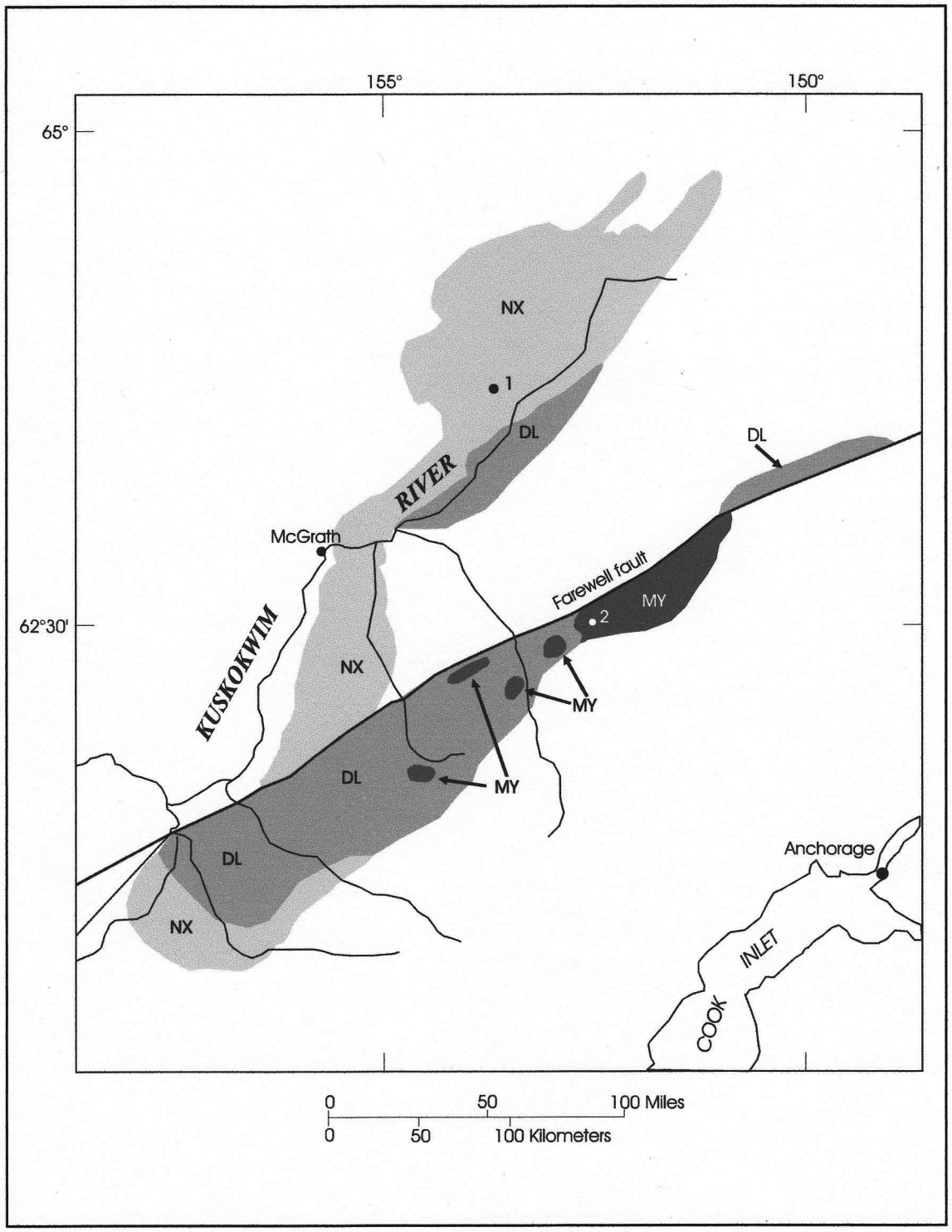

Figure 2. *Generalized geologic map of southwestern and west-central Alaska showing location of the two cited Emsian age fossil localities and component subterranes (Dillinger, Nixon Fork, and Mystic) of the Farewell terrane. Map modified from Blodgett and Gilbert (1992). Dillinger subterrane here includes East Fork terrane of Dutro and Patton (1982). Map symbols: 1, "Reef Ridge" area, Medfra B-3 Quadrangle; 2, Shellabarger Pass, Talkeetna C-6 Quadrangle; NX - Nixon Fork subterrane; DL - Dillinger subterrane; MY - Mystic subterrane.*

more closely related to species described from the Ural Mountains. Likewise, both *Eospirifer* and *Janius*, as well as the subfamily that includes them, the Eospiriferinae, are nearly totally unknown anywhere in Early Devonian or Eifelian strata of the Cordilleran Region of the Old World Realm. The only exception is the report of the genus *Janius* or *"Janius"* as an uncommon element in Emsian faunas of the Royal Creek area, Yukon Territory (Perry and Lenz, 1978; Savage and others, 1979, p. 196). In contradistinction, however, eospiriferinid brachiopods are reported as common elements in Emsian strata of Siberia (Kolyma, Kuznetsk Basin) and at numerous localities throughout the Uralian seaway. As with the Nixon Fork subterrane, the Emsian brachiopod fauna of the Mystic subterrane also appears to biogeographically belong to the Uralian, not the Cordilleran, Region of the Old World Realm.

BIOGEOGRAPHICALLY DISTINCTIVE FAREWELL TERRANE FAUNAS AND FLORAS OF OTHER AGES

In addition to the late Early Devonian examples discussed above, Farewell terrane fossil faunas and floras from other time intervals within the Paleozoic also indicate Siberian affinities and suggest a similar origin for this terrane. Two stratigraphically distinct, rich, diverse Middle Cambrian trilobite faunas were discovered in 1984 in Nixon Fork terrane strata of the Sleetmute A-2 Quadrangle. These were initially discussed by Palmer and others (1985), who considered both faunas to be representative of an outer-shelf environment and biogeographically of Siberian aspect, with faunal elements previously unrecognized in North America. Alternatively, it was later suggested by Babcock and Blodgett (1992) and Babcock and others (1993) that these southwestern Alaskan trilobite faunas of Siberian aspect may have dispersed in cool waters below the thermocline because they also show strong similarity to autochthonous outer-shelf faunas of North Greenland.

In Upper Ordovician (Ashgillian) strata of the Lone Mountain area (McGrath C-4 Quadrangle, west-central Alaska), a rich, diverse, silicified fauna of brachiopods and gastropods occurs, the most abundant element of which is the pentamerid brachiopod *Tcherskidium* (Rohr and Blodgett, 1985; Potter and others, 1988; Potter and Blodgett, 1992; Blodgett and others, 1992). This genus has not yet been unequivocally identified in North America, but is characteristic of Ashgillian faunas from Siberia (Kolyma, Taimyr, and Chukotka). The Lone Mountain form, occurring within strata previously assigned to the Nixon Fork subterrane, probably represents a new species of this genus, which is also present in the Shublik Mountains of the northeastern Brooks Range. Gastropods from the Lone Mountain section are most similar to species from the York Mountains of the Seward Peninsula (Blodgett and others, 1992), the latter area being considered to represent an eastward continuation of Chukotka.

Late Silurian (Ludlovian) algal reef complexes are widely recognized along the seaward outer margin of the Nixon Fork subterrane (Blodgett and others, 1984; Blodgett and Clough, 1985; Blodgett and Gilbert, 1992b; Clough and Blodgett, 1985, 1989) as well as in single isolated buildup present in Mystic subterrane (Rigby and others, 1994). The most abundant and characteristic faunal element of these peculiar algal buildups are aphrosalpingid sphinctozoans (Blodgett and others, 1984; Clough and Blodgett, 1985, 1989). These sponges previously had been recognized only in Upper Silurian strata of the Ural Mountains of Russia, but the occurrence of this group has recently been documented and illustrated by Rigby and others (1994) from southwestern and west-central Alaska (Nixon Fork and Mystic subterranes) and southeastern Alaska (Alexander terrane). Brachiopods co-occurring with aphrosalpingid sponges in algal buildups of both the Nixon Fork subterrane and Alexander terrane are also characterized by strong Uralian affinities (Blodgett and others, 1984).

Mamay and Reed (1984) briefly described and illustrated Permian plants from the conglomerate of Mt. Dall in the Talkeetna C-5 Quadrangle, central Alaska Range. They considered this flora to be derived from the Mystic terrane of Jones and others (1981). Although the flora shares some elements found in the southwestern part of the United States, its most distinctive element is the genus *Zamiopteris*, which is characteristic of Angaraland (Siberia) and is not known elsewhere in North America. On this basis, it was suggested by them that the Mystic terrane possibly was exotic and accreted to Alaska between post-Early Cretaceous and early Tertiary time.

CONCLUSIONS

Newly acquired biogeographic data on highly provincial late Early Devonian (Emsian) faunas from the Farewell terrane—which includes the previously defined Nixon Fork, Dillinger, and Mystic terranes—suggest that they probably had their origin as a rift block of the Siberian (or Angaraland) paleocontinent; alternatively, there was a separate tectonic entity in close enough proximity to the Siberian continent for reproductive communication to occur throughout most of the Paleozoic. Areas of close faunal ties include Kolyma, New Siberian Islands, Taimyr, Novaya Zemlya, the Uralian seaway, and the Kuznetsk Basin (fig. 3). Although the marine faunas of Siberia and nonaccreted

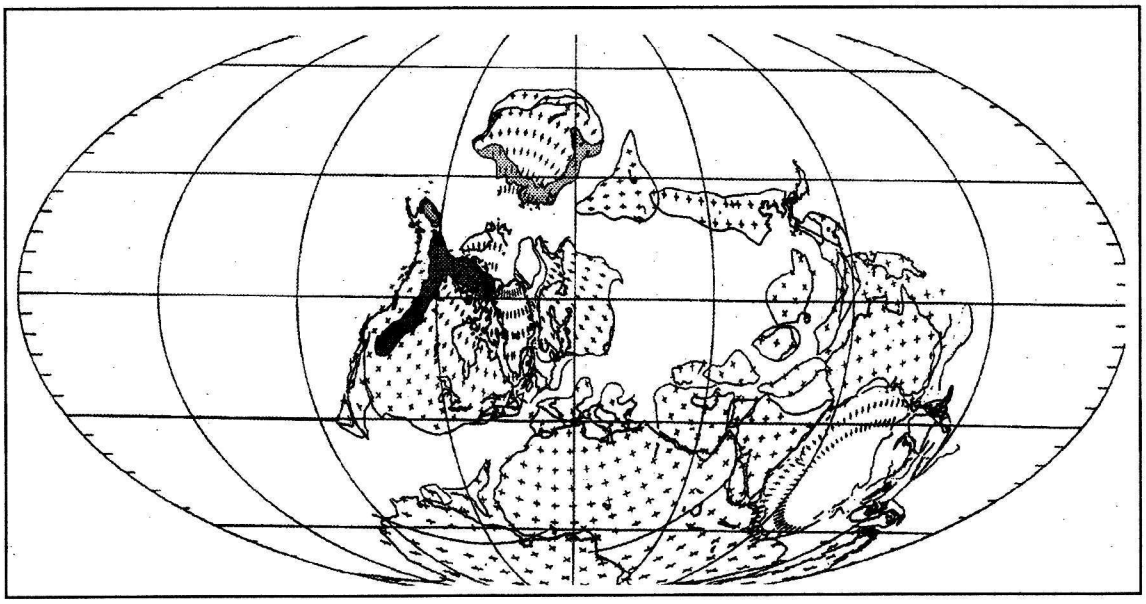

Figure 3. *Late Early Devonian (Emsian) global reconstruction showing areas of faunal linkage of Siberia (Kolyma, Taimyr, Kuznetsk Basin, Novaya Zemlya, and Uralian Seaway) and the Farewell terrane of Alaska (modified from Scotese and McKerrow, 1990). The dark-screened and light-screened areas indicate the distribution of Cordilleran Region and Uralian Region faunas, respectively. Although not included by these patterns, the Arctic Alaska terrane (shown in the figure as the block of northern Alaska and adjoining Chukotka, which has been rotated clockwise against the Canadian Arctic Islands) and the Alexander terrane of southeastern Alaska share many faunal affinities with the Farewell terrane during the Late Ordovician-Middle Devonian time interval, and likewise may represent Siberian rift blocks that have been subsequently accreted to North America.*

parts of northwestern North America are somewhat similar during the more cosmopolitan conditions that followed the Emsian in both the Middle and Late Devonian, the levels of provinciality are so high during the Emsian that most species—and many genera and even some families and subfamilies—of brachiopods are not shared at this time.

The strongly Siberian and Uralian cast to the Emsian brachiopod and coral faunas of the Farewell terrane suggest that this tectonostratigraphic entity was at that time either part of the Siberian continent or was close enough for close reproductive communication to occur. The frequent repetition of similar close faunal and floral ties both before and after agree with this interpretation and suggests possible close proximity between rocks of the Farewell terrane and the Siberian continent up until at least Permian time.

Extremely close faunal linkages also exist in the Emsian and Middle Devonian between the Farewell terrane and other tectonostratigraphic terranes of Alaska, most notably the Livengood, Arctic Alaska (including the Endicott, North Slope, and other terranes of earlier usage), and Alexander terranes (Blodgett, 1992; Blodgett and others, 1990; Baxter and Blodgett, 1994; Popov and others, 1994). These terranes, as with the Farewell terrane, also are probably of Siberian origin. Thus, the only truly North American part of Alaska during the late Early Devonian is represented by the Nation Arch area of east-central Alaska, where strata of the Ogilvie Formation contain typical species and genera characteristic of the similar-age North American miogeoclinal strata in the Yukon and Northwest Territories. Also, none of the Alaskan terranes bearing a major component consisting of Lower or Middle Paleozoic strata evince an "austral" or southwestern Pacific origin.

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