STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES

THE CHEENEETNUK LIMESTONE, A NEW EARLY(?) TO MIDDLE DEVONIAN FORMATION IN THE MCGRATH A-4 AND A-5 QUADRANGLES, WEST-CENTRAL ALASKA

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STATE OF ALASKA

Bill Sheffield, *Governor*

Esther C. Wunnicke, *Commissioner, Dept. of Natural Resources*

Ross G. Schaff, *State Geologist*

Cover photograph: *View west toward Cheeneetnuk Thrust. Upper plate of thrust consists of the Cheeneetnuk Limestone (dark), which overlies an unnamed dolomite unit (light). Photograph by W.G. Gilbert, 1978.*

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THE CHEENEETNUK LIMESTONE, A NEW EARLY(?) TO MIDDLE DEVONIAN FORMATION IN THE MCGRATH A-4 AND A-5 QUADRANGLES, WEST-CENTRAL ALASKA

By
R.B. Blodgett[1] and W.G. Gilbert[2]

INTRODUCTION

This report names and describes the Cheeneetnuk Limestone, a new lithostratigraphic unit exposed in the McGrath A-4 and A-5 Quadrangles, west-central Alaska (fig. 1). The Cheeneetnuk Limestone immediately overlies the uppermost dolomite unit in a stratigraphic column of lower Paleozoic strata exposed in the White Mountain area (Sainsbury, 1965, fig. 2). Sainsbury (1965) described part of the local Ordovician to Devonian section in a 6,000- to 6,500-ft-thick sequence in which he noted only Middle(?) Ordovician and Devonian(?) faunal horizons; he did not establish any formal lithostratigraphic units.

Subsequent field investigations by DGGS (1977-1979) resulted in the first detailed geologic map of the region (Gilbert, 1981). Within the sequence of Paleozoic rocks mapped by Gilbert on the northwest side of the Farewell fault, map unit 'mDlc', a limestone, is equivalent to the Cheeneetnuk Limestone. Various taxonomic groups of a well-preserved, rich, diverse, silicified megafauna from the upper part of this unit have been studied by House and Blodgett (1982) and Rigby and Blodgett (1983).

CHEENEETNUK LIMESTONE

The Cheeneetnuk Limestone consists of a sequence of well-bedded, dark-gray, argillaceous, micritic limestone. The formation is prominently exposed along the northwest bank of the southwest-flowing Cheeneetnuk River, after which it is named. The formation is exposed in a northeast-trending belt across the map area, as shown on plate 1.

The 457-m-thick (1,500 ft) type section of the Cheeneetnuk Limestone is located in sections 16 and 21, T. 23 N., R. 32 W., Seward Meridian, McGrath A-5 Quadrangle (fig. 2; pl. 1). The base of the formation is the conformable contact with the underlying unnamed dolomite unit (unit 'lDd' of Gilbert, 1981) exposed in section 21. The top of the unit is exposed at the conformable contact with the overlying unnamed argillite and chert unit (unit 'uPzac' of Gilbert, 1981) in section 16.

The contact between the underlying unnamed dolomite unit and the Cheeneetnuk Limestone is gradational, and dolomitic horizons occur within the lower part of the Cheeneetnuk Limestone. The underlying dolomite unit is typically lighter colored (light-gray, pink, or white) and commonly has a sacchroidal texture. The base of the Cheeneetnuk Limestone is marked by the first appearance of bedded, dark-gray, micritic limestone. The lower 93 m (300 ft) of the formation is finely laminated and lacks observable macrofossils. The interval between 93 and 278 m (300 and 990 ft) lacks laminations and contains a sparse, nondiverse fauna of favositid corals, dendroid tabulate corals, stromatoporoids, and crinoid ossicles. The upper part of the formation [78 to 457 m (990 to 1,500 ft) above the base] is characterized by several thick beds of the crowded remains of a richly diverse open-marine fauna. These beds, which are separated by even thicker intervals of unfossiliferous micrites, contain abundant silicified remains of brachiopods, rugose and tabulate corals, gastropods, bivalves, rostroconchs, nautiloids, goniatites, tentaculitids, trilobites, ostracodes, crinoid ossicles, sponges, stromatoporoids, and calcareous algae. The contact with the overlying unnamed argillite and chert unit (unit 'Pzac' of Gilbert, 1981) is both abrupt and conformable.

AGE

Only the upper 156 m (510 ft) of the type section of the Cheeneetnuk Limestone (localities 79RB6 and 79RB8-79RB11, fig. 2) and several isolated localities within the upper part of the formation yielded age-diagnostic fossils. Dissolution of limestone in acid indicates that conodonts are extremely scarce. Only one age-diagnostic conodont was recovered, *Polygnathus costatus costatus* (localities 79RB8 and 79RB10; identified by N.M. Savage). Within the Eifelian Stage, Klapper and Ziegler (1979, figs. 3-4) showed a global range for *P. costatus costatus*, from the *costatus costatus* Zone into the overlying *australis* Zone. An early Eifelian age is indicated for both localities within the Cheeneetnuk Limestone.

Goniatites have been described from localities

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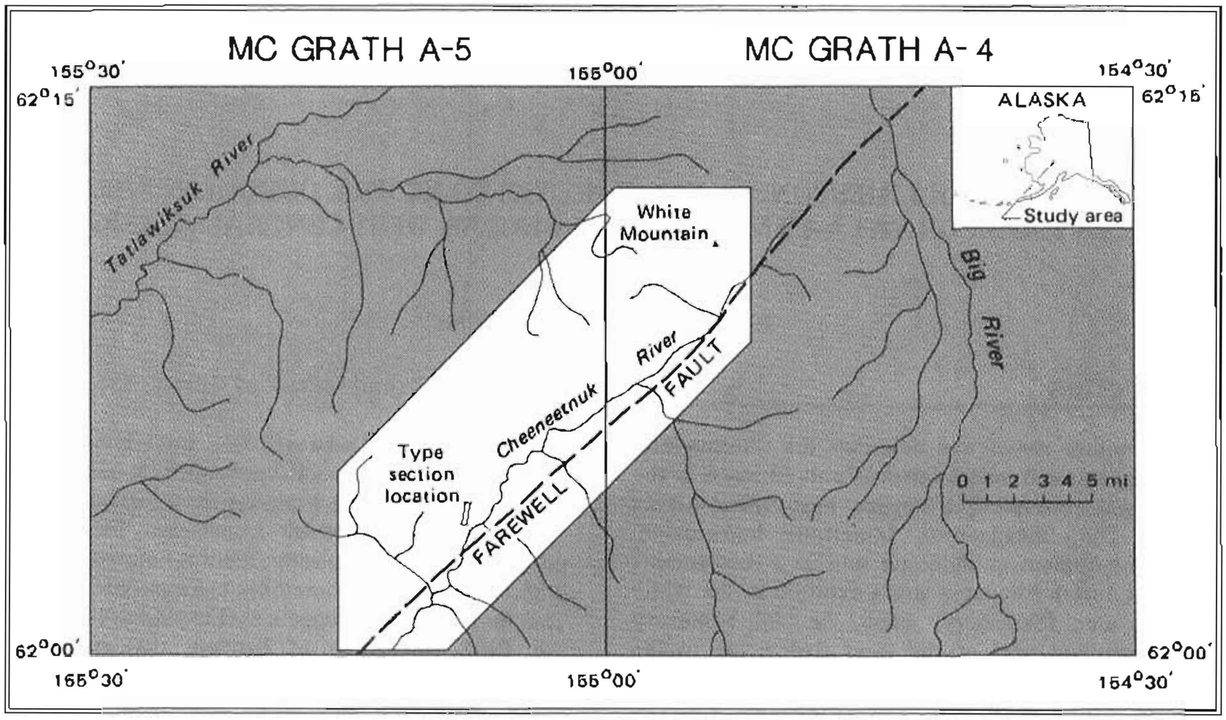

Figure 1. Location of study area in the McGrath A-4 and A-5 Quadrangles, Alaska.

79RB8 and 79RB9 (House and Blodgett, 1982). House identified *Pinacites* sp. juvenile and *Foordites* cf. *platypleura* (Frech) from locality 79RB8, and *Pinacites jugleri* (Roemer), *P.* cf. *jugleri* and *Subanarcestes*? sp. from locality 79RB9. The closest analogues of these fauna are from Europe and North Africa (House and Blodgett, 1982, p. 1873); representatives of the genus *Pinacites* were not previously recognized in the Americas. Although the *Pinacites jugleri* Zone has been assigned to the upper Eifelian Stage, taxa of that zone may range somewhat earlier (House and Blodgett, 1982, p. 1875). This extended range is in accord with Klapper and others (1978) and Chlupac and others (1979), who demonstrate that the base of the *Pinacites jugleri* Zone is near the base of the *Polygnathus costatus costatus* Zone in the Chotec Limestone of Czechoslovakia.

Brachiopods from the Cheeneetnuk Limestone are essentially limited to the upper part of the formation. Although the brachiopod fauna is consistent with an early Eifelian age, it is not age definitive. Brachiopod faunas of early Eifelian age are poorly known from coeval strata of northwestern Canada and the western Cordillera of the United States, to which the Cheeneetnuk Limestone faunas are most closely allied. Rugose corals from the upper part of the formation indicate a probable Eifelian age. Several taxa [(*Cystiphylloides* sp. cf. *C. macrocystis* McLean (locality 79RB4); *Lekanophyllum* sp. cf. *L. mediale* McLean (locality 79RB12); and *Sociophyllum* sp. cf. *S. glomeratum* (Crickmay) (locality 79RB11)] are comparable to species of the Hume Formation (W.A. Oliver, Jr., written commun., 1980, 1981) of Eifelian age. Corals from the Cheeneetnuk Limestone are listed in Oliver and others (1975, table 14).

Trilobites from the upper part of the formation that were identified by A.R. Ormiston (written commun., 1981) include *Camsellia* n. sp. (localities 79RB6, 79RB20), *Dechenella* cf. *D. setosa* (79WG184), *Basidechenella*? sp. (locality 79WG184), *Fusinipyge*? sp. (locality 79RB4), and *Otarion* sp. (locality 79RB9). Ormiston (written commun., 1981) reported the genus *Camsellia* " ...has been known only from the Hume Formation, District of Mackenzie, Northwest Territories. Its presence in these Alaskan collections would tend to strengthen the Hume affinities of other faunal groups from the McGrath Quadrangle collections and would support an Eifelian age."

We conclude that the uppermost part of the Cheeneetnuk Limestone is of early Eifelian (early Middle Devonian) age. The lack of datable fossils in the lower part of the Cheeneetnuk Limestone and in the underlying unnamed dolomite unit make a positive age determination impossible. On the basis of the relative thickness of the Cheeneetnuk Limestone, we suggest that its base extends into the Lower Devonian Series.

PALEOECOLOGY

The basal 93 m (300 ft) of the Cheeneetnuk Limestone is finely laminated and lacks observable megafaunal remains. The fine lamination of probable algal origin, the micritic lithology, and the absence of fossils and any evidence of bioturbation suggest deposition in restricted, upper intertidal to supratidal quiet water.

The interval from 93 to 278 m (300 to 990 ft) contains a low-diversity fauna of *in-situ* hemispherical favositid and dendroid tabulate corals and *Amphipora* packed biomicrite. The predominance of the sticklike stromatoporoid *Amphipora* is typical of fore-reef, interreef-platform, and back-reef environments (St. Jean, 1971, p. 1402). However, the general absence of more open-marine faunas such as brachiopods and rugose corals suggests that these beds were deposited in stagnant, somewhat hypersaline (lagoonal), shallow-water conditions. The upper 156 m (510 ft) of the formation consists of prominent, thick beds that contain the silicified remains of a rich, diverse, open-marine fauna. The articulated condition of the brachiopod shells and the nonabraded nature of the shelly fossil remains indicate *in-situ* faunas that represent temporary incursions of open-marine conditions into a restricted environment. The presence of calcareous green algae, such as the receptaculitid *Sphaerospongia tesselata* (localities 79RB8 and 79RB9) and the dasyclad genus *Coelotrochium* (localities 79RB4, 79RB6, 79RB8, 79RB9, 79RB11, 79RB12, and 79WG184), indicates these beds were deposited in photic-zone depths.

The fossil-rich beds are separated by much thicker, nonfossiliferous intervals that probably represent continued deposition in a shallow-water, slightly restricted environment, probably under lagoonal conditions.

The sequence of paleoenvironments in the Cheeneetnuk Limestone suggests an upward-deepening section, starting with basal supratidal-intertidal laminates that grade upward into restricted lagoonal micrites. Continuing upward, the lagoonal micrites interfinger with thin tongues of open-marine limy muds that are ultimately replaced by deep-water siliceous muds and oozes of the unnamed argillite and chert unit. Although reef buildups were not observed in the Cheeneetnuk Limestone, their existence in a more seaward position seems probable because it would explain the overall dominance of quiet-water, somewhat restricted (hypersaline-lagoonal) conditions in the formation.

REGIONAL GEOLOGIC SETTING AND CORRELATION

The Cheeneetnuk Limestone forms the uppermost horizon within an Ordovician to Middle Devonian carbonate-platform sequence exposed on the north side of the Farewell fault in the McGrath A-4 and A-5 Quadrangles (Gilbert, 1981). Ordovician to Devonian strata on the southeast side of the Farewell fault are represented primarily by deep-water rocks; the only recognized shallow-water rocks occur at the top of the sequence (Mamet and Plafker, 1982; Gilbert and Bundtzen, 1983; Bundtzen and Gilbert, 1983). Grantz (1966) suggested that 100 km (62 mi) of dextral displacement occurred along the Farewell fault during Late Cretaceous and Cenozoic time. Tentative correlation of offsets of

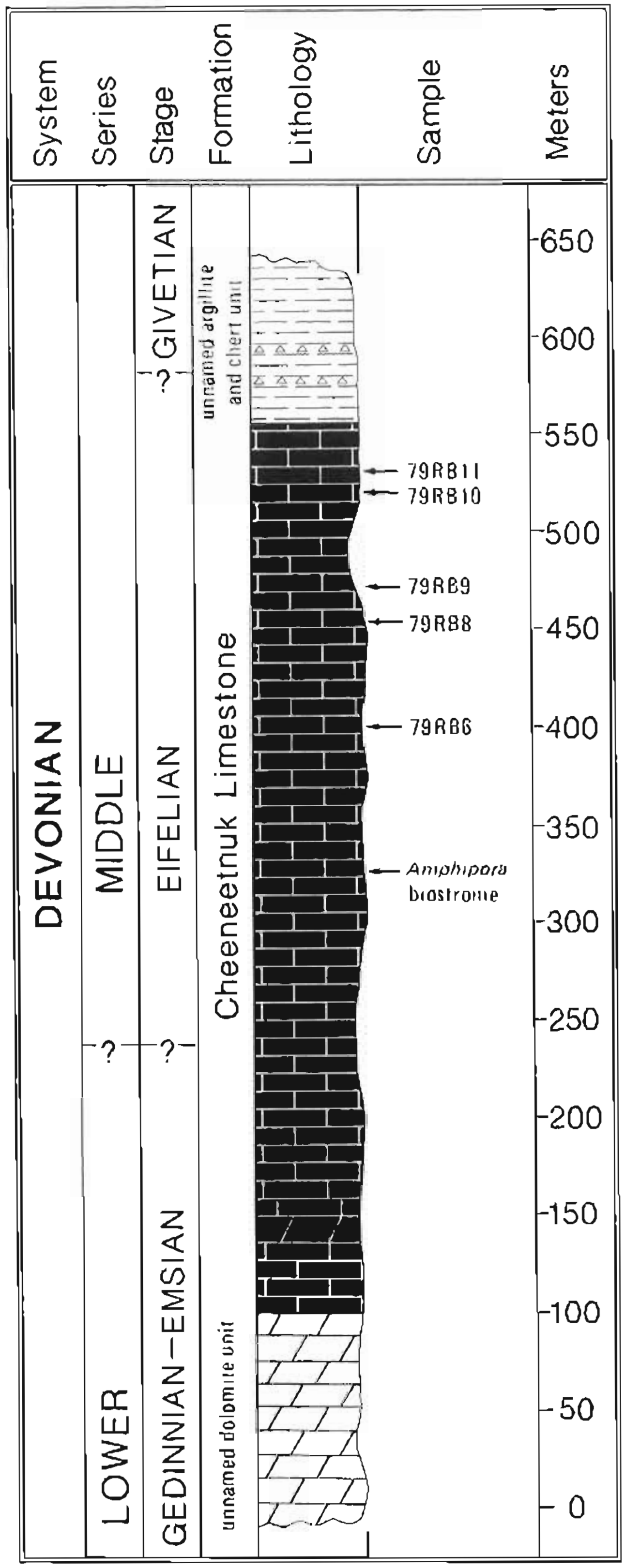

Figure 2. Stratigraphic section that includes the type section of the Cheeneetnuk Limestone. See plate for location and appendix for sample data.

the truncated trends of shallow-water platform and deeper water rocks across the Farewell fault suggests a right-lateral displacement of about 68 km (43 mi).

The Ordovician to Devonian shallow-water platform rocks extend to the southwest where they terminate in the Sleetmute and Taylor Mountain Quadrangles as the Holitna Group of Cady and others (1955). To the northeast in the Medfra Quadrangle, a similar sequence of Ordovician to Devonian shallow-water platform-carbonate rocks is also present (Patton and others, 1980; Dutro and Patton, 1981).

Much of pre-Cenozoic Alaska, exclusive of the east-central part of the state, may consist of accreted allochthonous terranes and microplates (Berg and others, 1978; Churkin and Carter, 1979; Churkin and Eberlein, 1977; Coney and others, 1980; Jones and others, 1981, 1982). The allochthonous origin of the Nixon Fork terrane possibly is indicated by its abrupt northern boundary (along the Susulatna Lineament) with rocks of the Innoko terrane (Patton, 1978; Patton and Gilbert, 1982), which are characterized by Upper Paleozoic and Mesozoic chert and volcanic rocks, indicative of "...oceanic or island arc affinities" (Patton, 1978, p. B39). However, Patton and Moll (1982, p. 77) indicate that Innoko terrane rocks were derived from the 'Yukon-Koyukuk sea,' a marginal ocean basin of late Paleozoic to early Mesozoic age, thrust southeastward onto Precambrian and early Paleozoic metasedimentary rocks of the Ruby Geanticline. If the latter case is correct, then the Nixon Fork terrane may have originally been contiguous with the Precambrian and early Paleozoic sedimentary rocks of the Ruby Geanticline (Ruby terrane of Coney and others, 1980; Jones and others, 1981).

Some workers believe that the facies difference between the Nixon Fork and Dillinger terranes represents a general increase in water depth to the southeast during early and mid-Paleozoic time (Dutro and Patton, 1981; Churkin and Trexler, 1981; Gilbert and Bundtzen, 1983). Deep-water facies are recognized within a lower Paleozoic sequence described by Churkin and others (1977) in the Terra Cotta Mountains; by Bundtzen and others (1982, 1984), Gilbert and others (1982), and Gilbert and Solie (1983) in the McGrath Quadrangle; by Gilbert (1981) and Bundtzen and Gilbert (1983) in the McGrath and Lime Hills Quadrangles south of the Farewell fault; and by J.M. Hoare (written commun., 1979) along the west bank of the Swift River in the Lime Hills C-7 Quadrangle. The proximity of the Nixon Fork and Dillinger terranes and the presence of allodapic limestones obviously derived from the shallow-water, platform-carbonate environment strongly supports the association of the deep- and shallow-water facies through geologic time. A remarkably similar facies transition is found in the Mackenzie Mountains in northwest Canada (Cecile, 1978).

If the Nixon Fork-Dillinger terrane is truly allochthonous in respect to cratonic North America, its post-Devonian displacement is minor. This conclusion is based on the very close paleobiogeographic affinities of the Nixon Fork terrane shelly faunas with coeval faunas from the Canadian cordillera, as indicated by the following faunal elements: early Middle Devonian brachiopods from the Cheeneetnuk Limestone; early Middle Devonian corals from the Cheeneetnuk Limestone (W.A. Oliver, Jr., written commun., 1980); early Middle Devonian trilobites from the Cheeneetnuk Limestone (A.R. Ormiston, written commun., 1981); Early Devonian ostracodes from the south flank of Limestone Mountain, Medfra B-4 Quadrangle (J.M. Berdan, written commun., 1981); and early Late Devonian ostracodes from the unnamed Frasnian limestone on the south side of the Farewell fault in the McGrath A-5 Quadrangle (W.K. Braun, written commun., 1982). Blodgett (1983) gives a more detailed discussion of the paleobiogeographic affinities of the Devonian faunas of the Nixon Fork terrane.

Potter and others (1980) indicated that a Late Ordovician brachiopod fauna from the Nixon Fork terrane (White Mountain area, McGrath A-4 Quadrangle) shows closest affinities with a fauna from the upper member of the Jones Ridge Formation of east-central Alaska and Yukon Territory, which was then part of North America (Payne and Allison, 1981). Available paleobiogeographic evidence indicates that the Nixon Fork terrane may represent an *in-situ* miogeoclinal tract that flanked the southeast side of the Ruby Geanticline or a rifted miogeoclinal 'sliver' derived from the vicinity of the Canadian Cordillera.

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APPENDIX

DESCRIPTION OF FOSSIL LOCALITIES[3]

79RB4 (USGS 10060-SD) Lat. 62°04'03" N., long. 155°07'05" W. NE1/4 SW1/4 NW1/4 SE1/4 sec. 22, T. 23 N., R. 32 W., Seward Meridian (McGrath A-5 Quadrangle). Silicified fossils recovered from talus of limestone scree slope on the west side of the southeast-flowing stream in sec. 22.

79RB6 (USGS 10321-SD) Lat. 62°04'28" N., long. 155°09'21" W. NE1/4 SW1/4 NE1/4 NW1/4 sec. 21, T. 23 N., R. 32 W., Seward Meridian (McGrath A-5 Quadrangle), elevation approximately 2,500 ft. Silicified, 1.5-m-thick (5 ft) fossil horizon, 156 m (503 ft) below top of the Cheeneetnuk Limestone.

79RB8 (USGS 10061-SD) Lat. 62°04'33" N., long. 155°09'23" W. NE1/4 NW1/4 NE1/4 NW1/4 sec. 21, T. 23 N., R. 32 W., Seward Meridian (McGrath A-5 Quadrangle). Approximately 3.0-m-thick (10 ft) silicified fossil horizon, 102 m (333 ft) below the top of Cheeneetnuk Limestone.

79RB9 (USGS 10062-SD) Lat. 62°04'33" N., long. 155°09'23" W. NE1/4 NW1/4 NE1/4 NW1/4 sec. 21, T. 23 N., R. 32 W., Seward Meridian (McGrath A-5 Quadrangle). Approximately 3.0-m-thick (10 ft) silicified fossil horizon 82 m (269 ft) below the top of Cheeneetnuk Limestone.

79RB10 (USGS 10094-SD) Lat.. 62°04'39" N., long. 155°09'25" W. NE1/4 SW1/4 SE1/4 SW1/4 sec. 16, T. 23 N., R. 32 W., Seward Meridian (McGrath A-5 Quadrangle). Silicified fossil horizon 34 m (113 ft) below top of the Cheeneetnuk Limestone.

79RB11 (USGS 10095-SD) Lat.. 62°04'50" N., long. 155°09'25" W. NE1/4 SW1/4 SE1/4 SW1/4 sec. 16, T. 23 N., R. 32 W., Seward Meridian (McGrath A-5 Quadrangle). Silicified fossil horizon 25 m (83 ft) below the top of Cheeneetnuk Limestone.

79RB12 (USGS 10063-SD) Lat.. 62°05'15" N., long. 155°07'27" W. SE1/4 SW1/4 NE1/4 NW1/4 sec. 15, T. 23 N., R. 32 W., Seward Meridian (McGrath A-5 Quadrangle). Rubble crop of silicified fossils just above a band of prominent white dolomite on the south side of an east-dipping slope.

79RB20 (USGS 10097-SD) Lat.. 62°12'03" N., long. 154°59'43" W. Center of SW1/4 NE1/4 sec. 5, T. 24 N., R. 31 W., Seward Meridian (McGrath A-4 Quadrangle).

79WG184 (USGS 10098-SD) Lat.. 62°13'02" N., long. 154°53'40" N. SE1/4 SE1/4 NE1/4 NE1/4 sec. 31, T. 25 N., R. 30 W.,Seward Meridian (McGrath A-4 Quadrangle).

[3]U.S. Geological Survey coral collections submitted to W.A. Oliver, Jr., for identification.

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