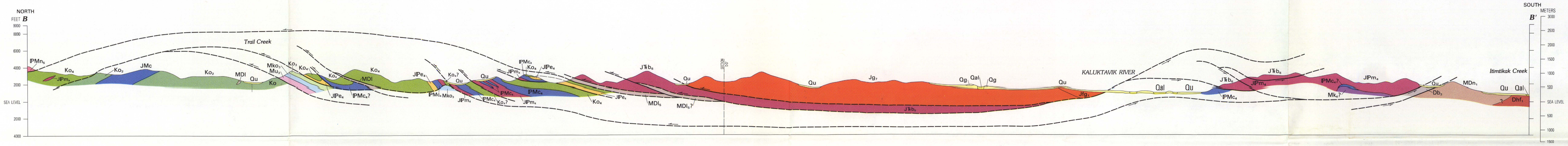
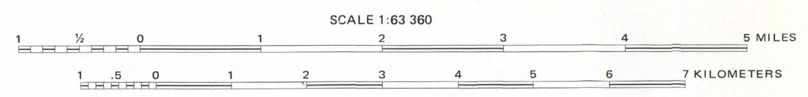
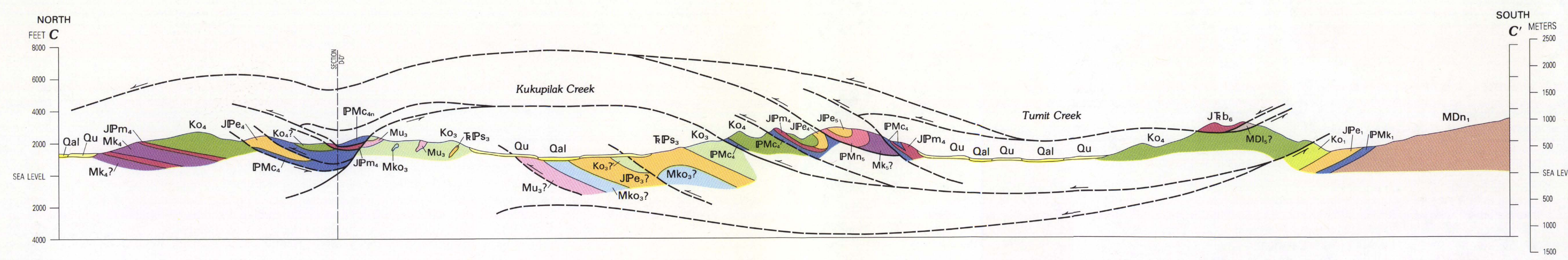
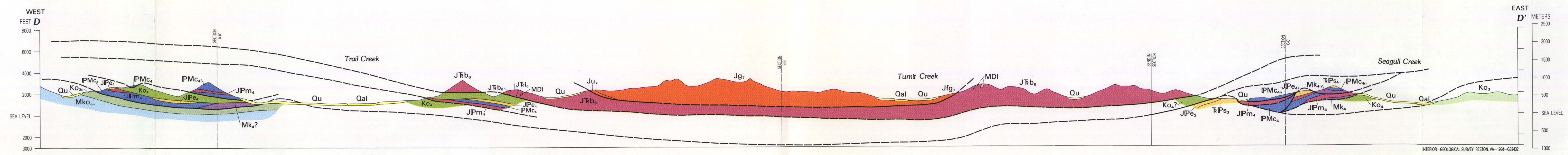






These cross sections are intended to show the generalized relations between allochthons. Detailed relations between rock units are largely schematic. In a few areas, there are folds or faults shown on the cross sections in order to rationalize the apparent structure, but they are not included on the map. Rock units have not been extrapolated beneath the color on the sections, although thrust faults are schematically illustrated below the color.

See sheet 1 for explanation of map symbols.



INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1984—G82432

CROSS SECTIONS TO ACCOMPANY

RECONNAISSANCE GEOLOGIC MAP OF SOUTH-CENTRAL MISHEGUK MOUNTAIN QUADRANGLE, ALASKA

By
Inyo Ellersieck, S. M. Curtis, C. F. Mayfield, and I. L. Tailleur

1984

INTRODUCTION

This map is one of a series of three reconnaissance geologic maps of the southern Misheguk Mountain quadrangle (fig. 1). Because the geology in all three map areas is similar, a composite map explanation has been designed to facilitate their combined use and provide the reader with a better perspective of the regional geology. There are some rock units and allochthons which do not occur on all three maps. In the explanation, only the allochthons and rock units that appear on the accompanying map are colored.

Devonian to Cretaceous sedimentary rocks make up most of the bedrock in the southern part of the Misheguk Mountain quadrangle. We believe that these rocks were originally laid down as sedimentary deposits on an extensive continental platform located south of the rocks presently exposed in the southern Brooks Range. Marine deposition appears to have been nearly continuous, with only minor interruptions, from the Devonian through Middle Jurassic. Upper Devonian rocks comprise two distinct and coeval sedimentary successions. One is mostly composed of shallow-water limestone and dolomite, mapped as the Baird Group, and the other is a near-shore clastic wedge, mapped as the Noatak Sandstone, Kanayut Conglomerate, and Hunt Fork Shale. Mississippian rocks record a variety of sedimentary facies including shallow-water limestone and clastic rocks, mapped as the Kogruk, Utukok, and Nuka Formations, and basinal shale, chert, and micritic limestone, mapped as the Kayak Shale, Kuna Formation, Tupik Formation, black chert, and black chert and limestone. The rapid facies changes in Upper Mississippian rocks may have been produced by aulacogen development across the previously formed Devonian and Early Mississippian continental platform. We suspect that the middle or late Carboniferous was the time in which the granitic source area for the arkose in the Nuka Formation was rifted away from the south edge of the platform, leaving behind a wide continental shelf on which Pennsylvanian and younger sedimentary rock materials were deposited.

A major change occurred during the Late Mississippian or Pennsylvanian as clastic and shallow-water carbonate sedimentation ceased, and a condensed succession of deep-water sedimentary materials was deposited. From the Pennsylvanian to the Middle Jurassic, radiolarian chert and siliceous shale of the Etivluk Group (Mull and others, 1982) were deposited over all the older sedimentary rocks of the shelf. During the Late Jurassic and Early Cretaceous another major change in sedimentation occurred as this old continental shelf was broken up and successively superimposed in broad allochthonous sheets during the Brooks Range orogeny. In the early stages of the orogeny two distinct suites of igneous rocks predominantly composed of either pillow basalt, mapped as the Copter igneous sequence, or periodotite and layered gabbro, mapped as the Misheguk igneous sequence, were thrust on top of the sedimentary rocks of the shelf. The new mountain range shed extensive flyschoid deposits of mudstone and graywacke on its north and south flanks. The sedimentary materials that were deposited on the north side of the Brooks Range are called the Okpikruak Formation. As the area affected by tectonism grew larger, many of the Lower Cretaceous flyschoid deposits, with possible olistoliths composed of older rocks (Mull and others, 1976; Mull, 1979), also became greatly deformed and displaced by thrust faults.

The Late Jurassic and Early Cretaceous orogeny produced numerous thrust faults with up to tens of kilometers displacement. In localized areas where thrust faults are closely spaced, the structure is so complex that the terrane can be characterized as a "broken formation" (Hsu, 1968). The direction of thrust juxtaposition was such that upper thrust sheets traveled relatively northward over lower sheets. Total displacement of rock units across thrust faults was great enough to superimpose coeval rocks of different sedimentary facies so that rock units in one thrust sheet may be lithologically different from coeval rock units above and below. This difference is especially evident in Mississippian rocks, which appear to have had more complex facies patterns in their original basins of deposition than did the younger rock units. Numerous tight folds, many with southward-dipping axial planes, were also developed in the rocks during the thrusting period. After the time of major thrust displacement (post-late Albian), additional tectonism warped the thrust sheets into broad folds cut by some high-angle faults and relatively minor thrust faults.

In order to describe our understanding of the complex stratigraphy and structure in the Misheguk Mountain quadrangle, most rock units on this map are grouped into the named sequences and allochthons shown in figure 2. On this map, the word "sequence" is used as a stratigraphic term, meaning either a distinctive column of sedimentary rocks that were deposited contiguously or a group of associated and distinctive igneous rocks which are of wide geographic extent. Thrust sheets that contain the same or similar sequences are herein grouped together into structural units called "allochthons." In contrast, previous reports often use the same terms, such as "thrust tectonic unit," "structural sequence," or "thrust sequence," for both lithostratigraphic and tectonostratigraphic units. This previous terminology can be confusing because there is commonly a lack of distinction between stratigraphic and structural terms. Table 1 compares the named allochthons on this map with analogous terminology used in other reports.

Various parts of the same sequence are commonly superimposed several times in adjacent thrust sheets. Faults that bound thrust sheets may occur at any horizon within a sequence, so that each thrust sheet usually contains only part of a complete sequence. Thrust faults that separate thrust sheets with different sequences are mapped as "intersequence thrust faults," and those that separate thrust sheets with the same sequence are mapped as "intrasequence thrust faults."

Thrust sheets with the same sequence almost always occur in the same structural stacking position relative to thrust sheets with different sequences. This relation has permitted us to construct the generalized model for the stacking positions of the various allochthons and sequences shown in figure 2. This model shows the relative structural position of the allochthons, and a schematic east-to-west cross section of the Misheguk Mountain quadrangle shows the distribution of stratigraphic and igneous sequences within each allochthon. We believe that the simplest and most reasonable way to reconstruct the original depositional positions of the sequences is to unstack the allochthons in a regular manner such that upper allochthons are successively unstacked south of lower allochthons. When the sedimentary sequences are unstacked in this way, the sequences in the Nuka Ridge allochthon would have been deposited farthest to the south and the sequence in the Brooks Range allochthon farthest to the north. The igneous sequences of the Copter Peak and Misheguk Mountain allochthons were probably formed south of the sequences in the Nuka Ridge allochthon. The approximate relative locations of the sequences prior to thrust dislocation can be viewed on the right side of figure 2 if each lower sequence is considered to have been located contiguously north of the adjacent sequence(s) above.

Although post-Early Cretaceous erosion removed large parts of the upper allochthons from the area, they were never continuous across the quadrangle, as shown on figure 2. Instead, the allochthons are commonly in the form of large lens-shaped bodies or folded sheets a few hundred meters to tens of kilometers across and a few meters to a kilometer or more in thickness. In most vertical sections some of the allochthons are absent and others are internally repeated by intrasequence thrust faults. Some allochthons thin or pinch out southward. These observed relations may indicate that parts of some sheets were displaced northward by gravity gliding or that a complex folding and thrust faulting process operated.

In a few places a structurally lower allochthon, as shown in figure 2, appears to be locally thrust or folded over an allochthon known to be structurally higher in most of the region. For example, at the west end of the Poktovik Mountains on the southwestern Misheguk Mountain quadrangle map (lat 68°4.5′ N., long 161°20′ W.), the Ipnavik River allochthon is thrust over the Copter Peak allocthon. Along the east side of upper Trail Creek on the south-central Misheguk Mountain quadrangle map (lat 68°30′ N., long 160°20′ W.), the Kelly River allochthon is thrust over the Ipnavik River allochthon. Also, along the middle part of the Anisak River on the southeastern Misheguk Mountain quadrangle map (lat 68°26.5′ N., long 159°29′ W.), the Kelly River allochthon is locally thrust or folded over the Ipnavik River allochthon. See the appropriate geologic map or figure 3 for geographic locations. However, these examples cover only a small area on the maps, and they appear to be unusual.

In addition to abrupt facies changes across intersequence thrust faults, there are also more gradual facies changes between some stratigraphic sequences that occur at similar structural levels. These changes are most commonly noticeable in the Upper Mississippian and Lower Pennsylvanian rocks. Where two similar sequences occur at about the same structural level, they were probably deposited contiguously and displaced about the same amount by thrust faults. In such cases, the two similar sequences are grouped into the same allochthon. For example, this kind of gradual facies change occurs in an approximate east-west direction between an eastern facies, the Endicott sequence (Mull, 1979) or foothills sequence (Tailleur and others, 1966), and a western facies, the Key Creek sequence (this report) which compose the Brooks Range allochthon in the central and western Brooks Range (Mayfield and others, 1978). Within the Misheguk Mountain quadrangle, the Eli sequence and Kelly sequence are grouped into the same allochthon, because they are composed of similar sequences which occur at approximately the same structural level. Where the two sequences are in thrust-fault contact south of Kuruk Creek (southwestern Misheguk Mountain quadrangle map), the Eli sequence is structurally higher, a relation which suggests that in this area, the Kelly sequence was deposited north of the Eli sequence. Facies changes not separated by thrust faults of major displacement also probably occur between the Picnic and Wulik sequences and the Ipnavik and Nachralik Pass sequences. These are discussed in the next section.

Map symbols for rock units are numbered for easy identification of each allochthon. Each subscript number represents a different allochthon, and each lower case letter, a lithologic unit.

UNCERTAIN RELATIONS BETWEEN ALLOCHTHONS AND SEQUENCES

Where outcrops are poor or where facies changes may have been relatively rapid, continuity between sequences in similar structural positions may be difficult or impossible to establish. For example, the Picnic Creek allochthon has two lithologically similar stratigraphic sequences, called the Wulik and Picnic sequences. In the southern part of the Misheguk Mountain quadrangle, the Wulik sequence is mapped only west of long 161° W. and the Picnic sequence is mapped only east of long 161° W. Because the differences in these stratigraphic sequences are probably due to gradational facies changes, rather than separation by major thrust faults, they are mapped as separate sequences within the same allochthon.

Within the Ipnavik River allochthon, mafic sills are rare west of the Kugururok River and common east of the Kugururok River. Sills are also rare in what appears to be a lower thrust sheet of the Ipnavik River allochthon east of the Kugururok River. The sequence of rocks with few mafic sills is called the Nachralik Pass sequence, and the one with numerous mafic sills is called the Ipnavik sequence (fig. 2). These two similar sequences are distinguished within this allochthon, because the presence or absence of mafic sills could have important structural implications in some areas. The Nachralik Pass sequence is distinguished by map symbols that have the letter "n" following the allochthon number. For example, the black chert unit, identified as IPMc_{4n}, in the Nachralik Pass sequence is stratigraphically equivalent to the black chert rock unit identified as IPMc_4 in the Ipnavik sequence.

The Nachralik Pass sequence is also lithologically similar to the Picnic sequence, so much so that they are difficult to distinguish where the Kelly sequence does not occur between them. For example, in the central part of the Misheguk Mountain quadrangle, there is a possibility that these two sequences may be the same sequence which has been thrust into different structural levels. However, it is more likely that the Picnic and Nachralik Pass sequences were deposited respectively north and south of the Kelly and Eli sequences, with the Picnic sequence deposited near the Wulik sequence and the Nachralik Pass sequence deposited near the Ipnavik sequence, as shown in figure 2.

The Bogie and Bastille sequences occur in the same structural level, beneath the Copter Peak allochthon (if it is present), and above the Ipnavik River allochthon and other underlying allochthons. For this reason, both sequences are included in the Nuka Ridge allochthon. The two sequences, although similar in many respects, appear to have some stratigraphic differences. The Nuka Formation in the Bogie sequence is underlain by the Kayak Shale, whereas rocks in the Bastille sequence that are possibly coeval to the Nuka Formation are conformably underlain by limestone or silty and sandy limestone. The limestone unit (unit MDl_5) underlying the Etivluk Group in the Bastille sequence has not been precisely dated with fossils and is assigned its age on the basis that it conformably overlies fossiliferous Devonian limestone and regionally correlates with Devonian and Mississippian limestone units in other sequences. Should further investigation locate fossil evidence that the Nuka Formation and the upper part of the limestone unit of the Bastille sequence are coeval, the age disparity would be removed. The two sequences might therefore have been deposited contiguously, with a local embayment of the Kayak Shale in parts of the Bogie sequence. However, should further investigations show that the limestone unit of the Bastille sequence is not younger than Devonian in age, then it is probable that the Nuka Formation and Kayak Shale were deposited above this limestone which would make the Bogie and Bastille sequences a single sequence. Since rocks of the Bastille sequence and Nuka Formation are not found in contact with each other, their relative positions prior to thrusting are not known, and the trend of this possible facies change is unknown.

The location of intrusion of the Misheguk igneous sequence ultramafic rocks into the Earth's crust relative to the location of extrusion of the Copter igneous sequence pillow basalts is uncertain. The contact between these sequences is always a thrust fault, with the Misheguk on top. No remnants of the Misheguk-type rocks are found within or at the lower contact of the Copter Peak allochthon. Although both the Copter Peak and Misheguk Mountain allochthons have been included in the dismembered ophiolites of Patton and others (1977), we find no evidence to indicate that these rocks are necessarily of the same origin. The basement upon which the Copter Peak basalts were erupted is either a shallow-water Devonian limestone, or it is not preserved. The petrology of the Misheguk Mountain allochthon is typical of the lower parts of many ophiolites (Patton and others, 1977; Roeder and Mull, 1978; Zimmerman and Soustek, 1979), indicating that it is probably a remnant of oceanic crust which lay south of the Arctic Alaska continental plate prior to the Brooks Range orogeny. The basalts which were probably erupted atop the Misheguk Mountain plutonic rocks have been eroded away and are no longer preserved in the quadrangle.

ACKNOWLEDGMENTS

We wish to acknowledge R. C. Crane (of Standard Oil of California) for providing us with detailed information about some outcrops that we did not visit, and Crane and C. G. Mull for helpful discussions about the structural evolution of the western Brooks Range.

FOSSIL TABLE

Table 2 is a list of the fossils which have been identified from the area encompassed by the south-central Misheguk Mountain quadrangle geologic map. Most fossils were collected in the summer of 1978 during fieldwork for this mapping project. However, they also include previously unpublished fossil collections dating back to the 1960's. A few of the collections were made by geologists from the petroleum industry and dated by U.S. Geological Survey paleontologists.

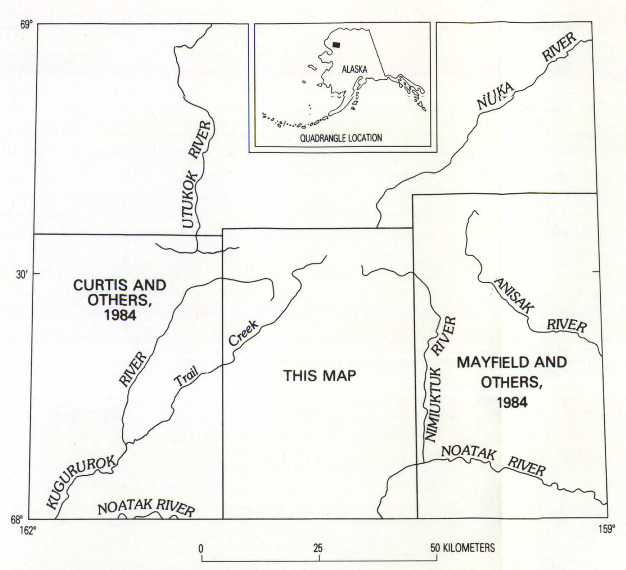


FIGURE 1.—Location of the Misheguk Mountain quadrangle, this map, and the two adjacent maps of this series.

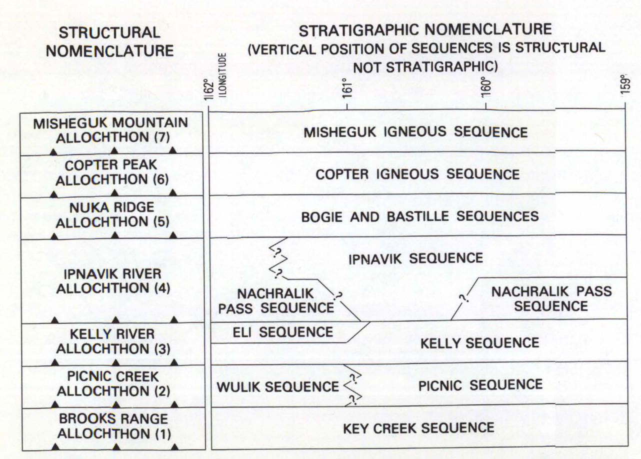


FIGURE 2.—Diagram showing the usual stacking positions of the structural units (allochthons, 1 lowest and 7 highest) and stratigraphic units (sequences) in the south half of the Misheguk Mountain quadrangle. Although the lowest thrust sheets of the Brooks Range allochthon are not exposed in the quadrangle, field relations from other areas indicate that the base is in fault contact with relatively autochonous rocks, (Mull and others, 1976; Mull and Tailleur, 1977). Allochthon contacts shown by thrust faults. Lateral and vertical positions of stratigraphic and igneous sequences are shown as a schematic cross section from west to east across the quadrangle.

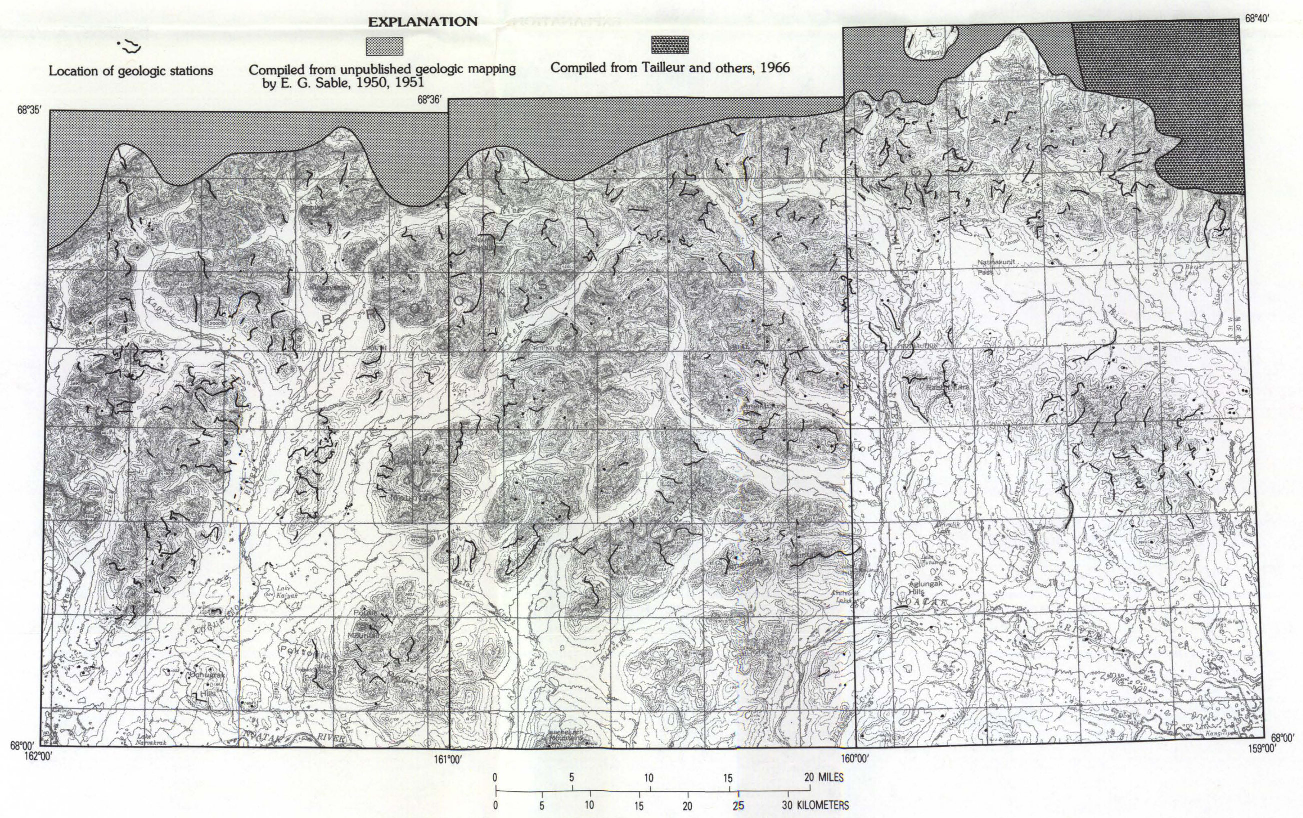


FIGURE 3.—Locations of field traverses used by the geologists who compiled this map and areas of geologic mapping from other studies which are reinterpreted for this report.

TABLE 1.—*Comparison of allochthons in this report with equivalent structural units of other authors*

This report	Ellersieck and others, 1979	Mayfield and others, 1979	Mull, 1979	Churkin and others, 1979	Mayfield and others, 1978	Martin, 1970	Snelson and Tailleur, 1968; Tailleur and Brosgé, 1970	Tailleur and others, 1966
Misheguk Mountain allochthon	Misheguk Mountain thrust sequence	Misheguk Mountain thrust sequence	Misheguk sequence	Not distinguished	Misheguk Mountain thrust sequence	Ultrabasic pluton sequence	Misheguk thrust tectonic unit	Not distinguished
Copter Peak allochthon	Copter Peak thrust sequence	Not distinguished	Misheguk sequence	Not distinguished	Misheguk Mountain thrust sequence	Ultrabasic pluton sequence	Misheguk thrust tectonic unit	Not distinguished
Nuka Ridge allochthon	Nuka Ridge thrust sequence	Not distinguished	Nuka sequence	Not distinguished	Nuka Ridge thrust sequence	Nuka Ridge sequence	Nuka Ridge thrust tectonic unit	Nuka Ridge sequence
Ipnavik River allochthon	Ipnavik River thrust sequence	Ipnavik River thrust sequence	Ipnavik sequence	Not distinguished	Ipnavik River thrust sequence	Ipnavik sequence	Ipnavik thrust tectonic unit	Ipnavik sequence
Kelly River allochthon	Kelly River thrust sequence	Kelly River thrust sequence	Kelly sequence	Not distinguished	Kelly River thrust sequence	De Long sequence	Kelly thrust tectonic unit	Not distinguished
Picnic Creek allochthon	Picnic Creek thrust sequence	Kuruk Creek thrust sequence	Not distinguished	Not distinguished	Northwestern Brooks Range thrust sequences	Not distinguished	Wulik thrust tectonic unit	Sequence at Kiligwa River (eastern facies)
Brooks Range allochthon	Brooks Range thrust sequence	Brooks Range thrust sequence	Endicott sequence (eastern facies)	Kagvik structural sequence	Northwestern Brooks Range thrust sequences North central Brooks Range thrust sequence (eastern facies)	Brooks Range sequence Ivotuk Hills sequence (eastern facies)	Foothills thrust tectonic unit	Foothills sequence Assemblage on Drenchwater Creek Sequence at Mount Bupto (eastern facies)

TABLE 2.—*Selected fossils from south-central Misheguk Mountain quadrangle*

Map number	Field number	Latitude North	Longitude West	USGS collection number	Fossil age	Map unit	Fossil type	Identified by
1	78Ek62	68°32′18″	160°19′00″	—	Pennsylvanian to Early Permian	TRIPs_2	Radiolaria	B. K. Holdsworth
2	78Cx29C	68°32′04″	160°15′05″	—	Late Mississippian to Early Permian, probably Pennsylvanian	IPMc_2	Radiolaria	B. L. Murchey
3	78Md75E	68°32′27″	160°08′33″	—	Early Pennsylvanian	JIPe_2/ IPMc_2 contact	Radiolaria	B. K. Holdsworth
3	78Md75E	68°32′27″	160°08′33″	—	Early Pennsylvanian (Morrowan)	JIPe_2/ IPMc_2 contact	Conodonts	B. R. Wardlaw
4	78Cx24D	68°33′02″	160°03′30″	—	Pennsylvanian to Permian	TRIPs_1	Radiolaria	B. L. Murchey
5	78Md160C	68°26′18″	160°58′20″	—	Mesozoic	JIPe_4	Radiolaria	B. L. Murchey
6	78Tr171A	68°25′54″	160°55′12″	—	Late Triassic	JIPe_4	Radiolaria	B. L. Murchey
7	78Tr171B	68°25′49″	160°55′17″	—	Mesozoic	JIPe_4	Radiolaria	B. L. Murchey
8	78Tr90B.1	68°26′42″	160°34′36″	—	Late(?) Triassic	JIPe_4	Radiolaria	B. K. Holdsworth
9	78Cx38D	68°27′39″	160°18′54″	—	Mesozoic	JIPe_4	Radiolaria	B. L. Murchey
10	78Md90A	68°28′52″	160°05′18″	—	Late Triassic	JIPe_{4n}	Radiolaria	B. K. Holdsworth
11	77EK39	68°19′22″	160°46′12″	—	Triassic	JTRb_6	Radiolaria	B. K. Holdsworth
12	78Ek58	68°19′56″	160°45′42″	—	Triassic	JTRb_6	Radiolaria	B. K. Holdsworth
13	78Md114D	68°10′45″	160°27′48″	—	Triassic	JIPe_4	Radiolaria	B. K. Holdsworth
14	78Md160A	68°26′09″	160°57′15″	9993–SD	Middle Devonian [1]CAI=3	Dsl_5	Conodonts	A. G. Harris
15	78Ek116F	68°11′21″	160°46′42″	27416–PC	Late Mississippian [1]CAI=2½-3	Mk_4	Conodonts	A. G. Harris
16	78Tr120A	68°12′06″	160°10′42″	9992–SD	Middle to Late Devonian [1]CAI=4	Db_3	Conodonts	A. G. Harris
17	77Tr11.9	68°28′21″	160°53′18″	10352–SD	Middle Devonian (Givetian)	Dl_5	Brachiopods, corals, stromatoporoids	J. T. Dutro, Jr.
18	78Tr178A	68°28′27″	160°53′31″	10175–SD	Possibly Middle Devonian	Dsl_5	Brachiopods, cephalopods	J. T. Dutro, Jr.
19	78Tr170B	68°25′33″	160°49′12″	10174–SD	Early or middle Late Devonian	Dl_5	Brachiopods	J. T. Dutro, Jr.
20	78Tr185F	68°17′33″	160°58′18″	—	Possibly Devonian	Db_{3e}	Amphipora, coral	J. T. Dutro, Jr.
21	66Tr148	68°00′06″	160°44′48″	8174–SD	Late Devonian	Dhf_1	Brachiopods	J. T. Dutro, Jr.
22	66Tr147	68°00′15″	160°39′15″	8173–SD	Late Devonian	Dhf_1	Brachiopods, cephalopods	J. T. Dutro, Jr.
23	78Ek67D.2	68°30′43″	160°33′36″	—	Possibly Late Devonian	Db_4	Brachiopods	J. T. Dutro, Jr.
24	78Cx34E	68°29′48″	160°32′12″	—	Early Mississippian	Mu_3	Brachiopods	J. T. Dutro, Jr.
25	78Cx188E	68°27′17″	160°59′43″	—	Probably late Middle Devonian to early Late Devonian	Dsl_5	Brachiopods	J. T. Dutro, Jr.
26	78Cx238E	68°18′05″	160°55′24″	—	Probably late Middle Devonian to early Late Devonian	Db_{3e}	Brachiopods	J. T. Dutro, Jr.
27	[2]AH21	68°34′54″	160°50′49″	M2999	Early Cretaceous	Ko_3	Pelecypods	D. L. Jones
28	[2]AH26	68°34′18″	160°51′15″	M3000	Early Cretaceous	Ko_3	Pelecypods	D. L. Jones
29	78Tr91E3	68°27′12″	160°34′06″	—	Late Mississippian (Visean) (Mamet Zone 11 or younger)	IPMc_4	Foraminifera	B. L. Mamet
30	78Cx37E	68°27′48″	160°24′36″	—	Late Devonian (probably Famennian)	Dl	Foraminifera	B. L. Mamet
31	78Cx237B	68°21′33″	160°49′12″	—	Late Devonian (late Famennian) (Mamet Zone 2 or older)	Db_{3e}	Foraminifera	B. L. Mamet
32	78Tr83A	68°27′55″	160°10′18″	M7427	Early Cretaceous (late Valanginian)	Ko_4	Pelecypods	D. L. Jones J. W. Miller
33	78Ek135C1	68°20′39″	160°50′26″	—	Late Devonian to Early Mississippian (Mamet Zone 6)	Db_{3e}	Foraminifera	B. L. Mamet
34	78Tr112A	68′25′58″	160°00′54″	M7436	Late Jurassic or Early Cretaceous	Ko_4	Pelecypods	D. L. Jones J. W. Miller
35	78Cx85E	68°20′09″	160°00′12″	M7432	Early Cretaceous (Berriasian)	Ko_{4n}	Pelecypods	D. L. Jones J. W. Miller
36	78Cx85C1–2	68°20′06″	160°01′10″	M7430 M7431	Early Cretaceous (late Valanginian)	Ko_{4n}	Pelecypods	D. L. Jones J. W. Miller
37	78Cx32E	68°31′00″	160°22′04″	M7429	Late Jurassic or Early Cretaceous	Ko	Pelecypods	D. L. Jones J. W. Miller

[1]Conodont color alteration index (CAI)-estimated maximum temperatures reached during diagenesis: CAI=2½-3 (120-150° C); CAI =3 (120-160° C); CAI=4 (about 200° C).
[2]Collected by geologists from British Petroleum Company.