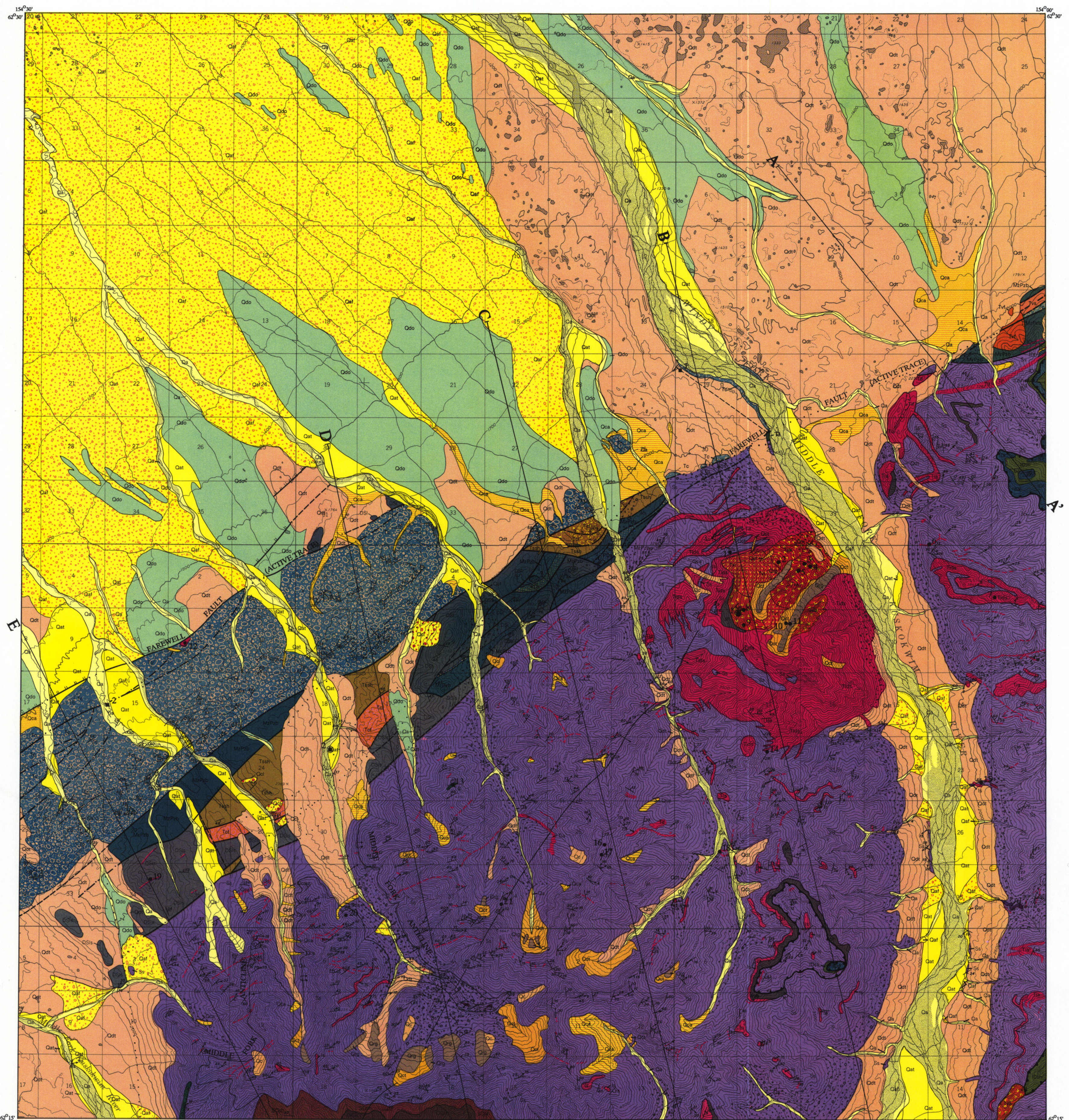
ALASKA DIVISION OF GEOLOGICAL &
GEOPHYSICAL SURVEYS



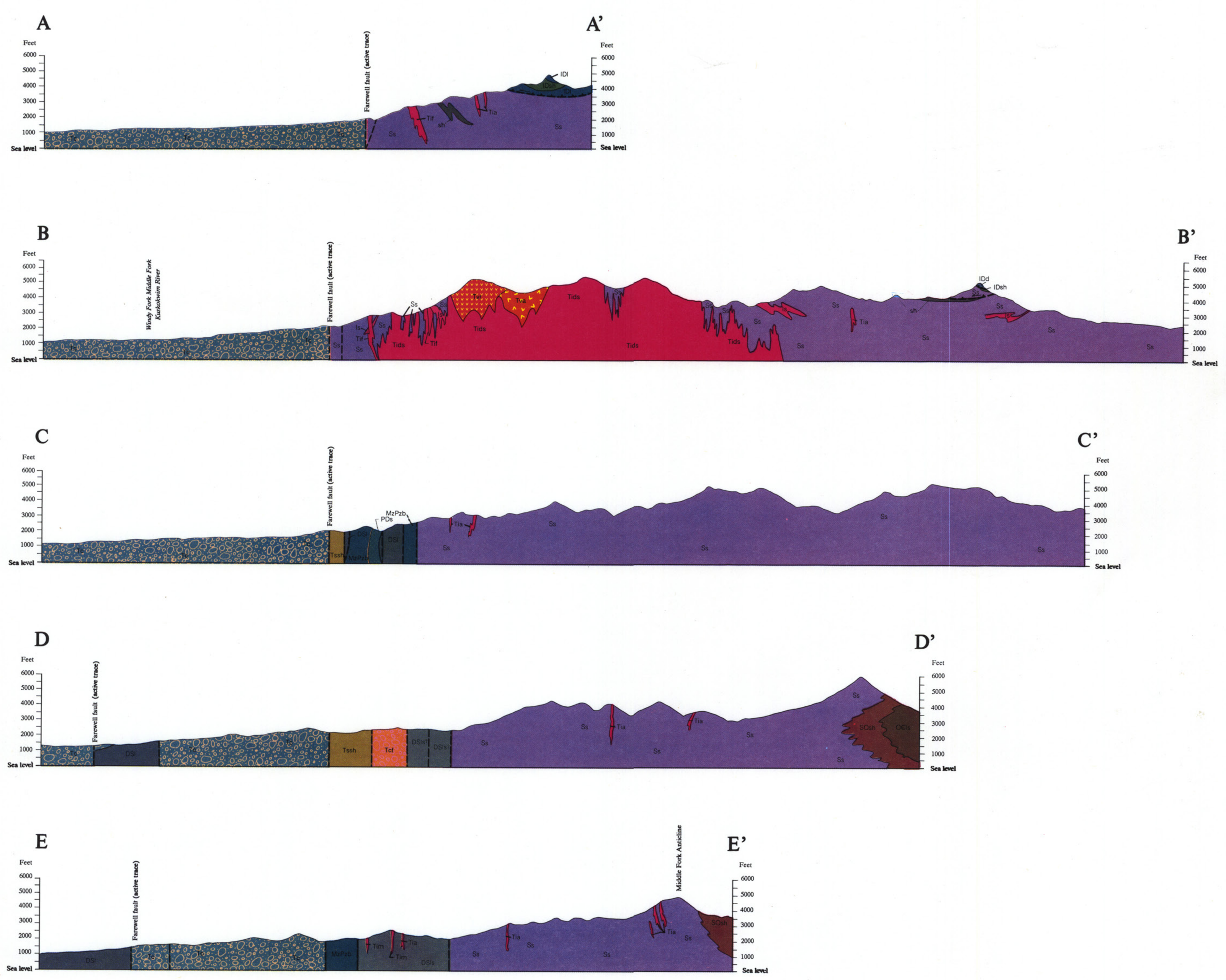
Base by U.S. Geological Survey, 1958.

Scale 1:63,360

CONTOUR INTERVAL 100 FEET
DATUM IS MEAN SEA LEVEL

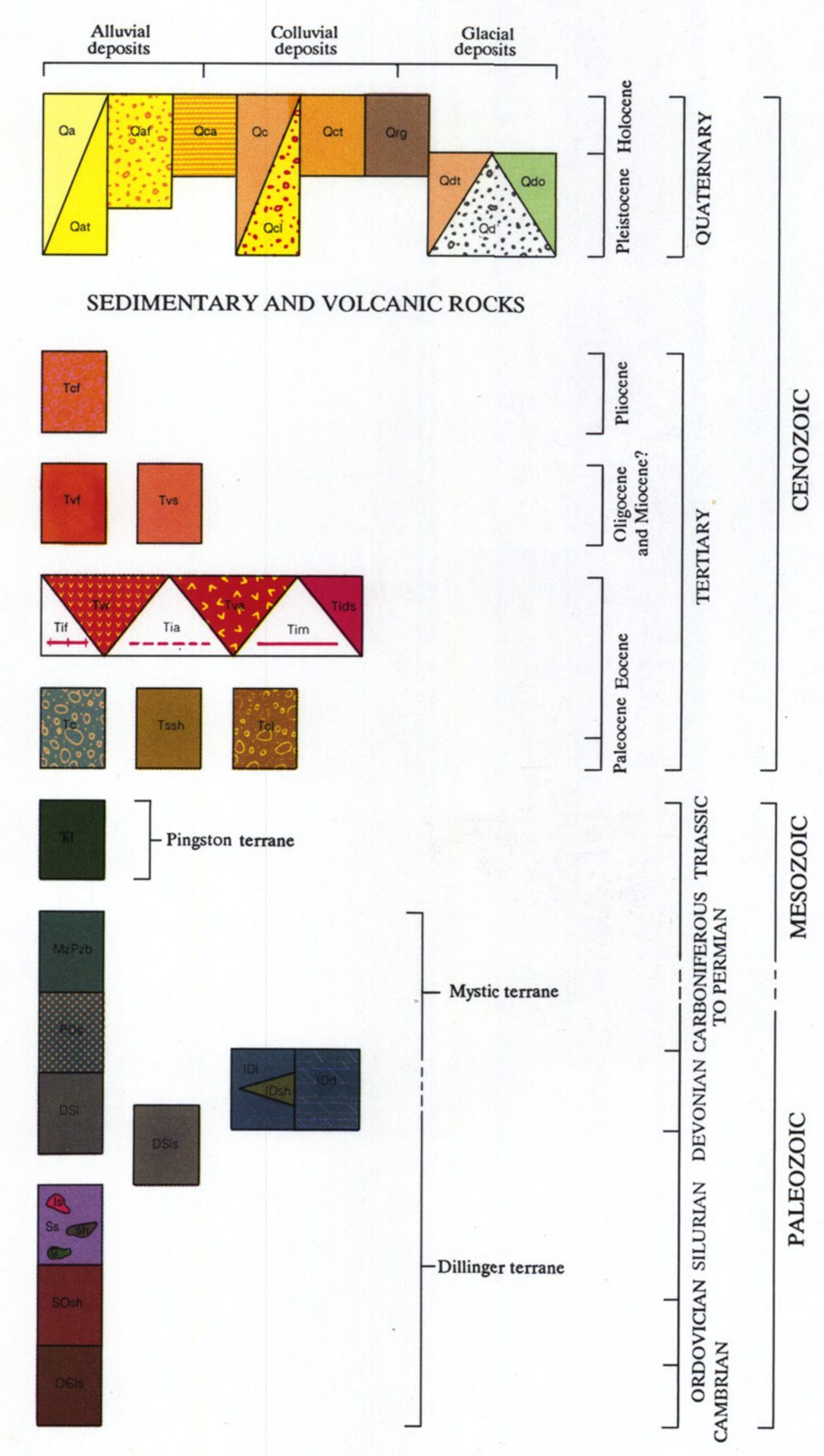
APPROXIMATE MEAN DECLINATION, 1958

Geology by W.G. Gilbert, D.N. Solie, J.T. Kline, and D.B. Dickey, 1981, with assistance from Kristin Kline and K.F. Bull. Cartography by A.G. Sturmann.



No vertical exaggeration in cross sections
Quaternary units not shown in sections

CORRELATION OF MAP UNITS



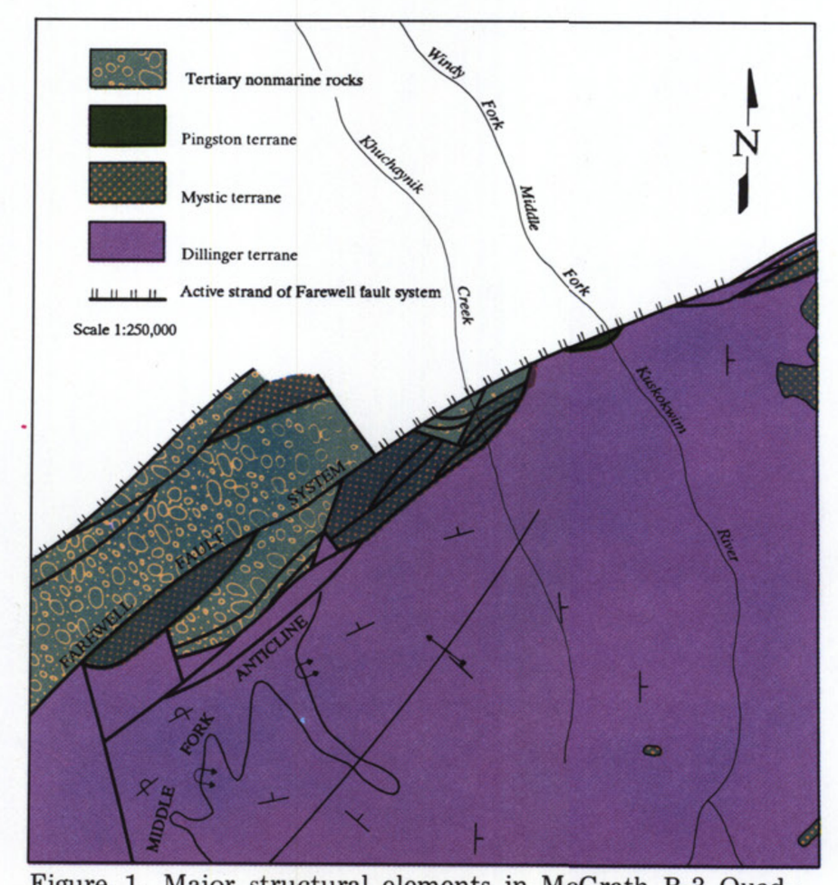


Figure 1. Major structural elements in McGrath B-3 Quadrangle, southwestern Alaska.

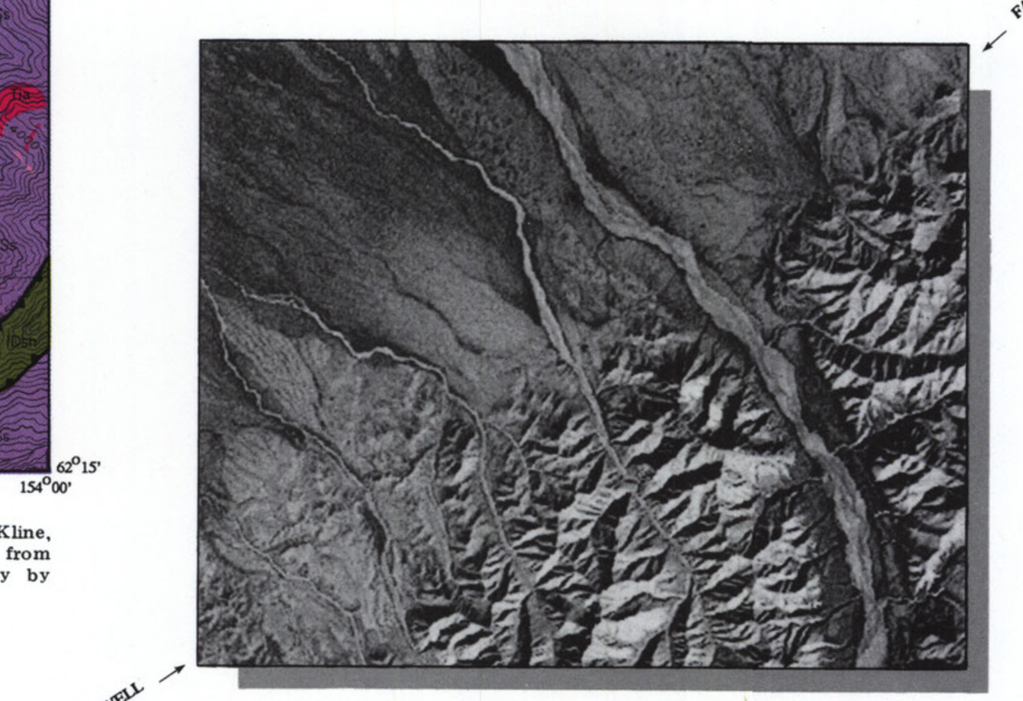


Figure 2. Landsat image, enlarged to scale of 1:250,000, showing trace of Farewell fault (between arrows) through central McGrath B-3 Quadrangle, southwestern Alaska. Image taken September 3, 1974.

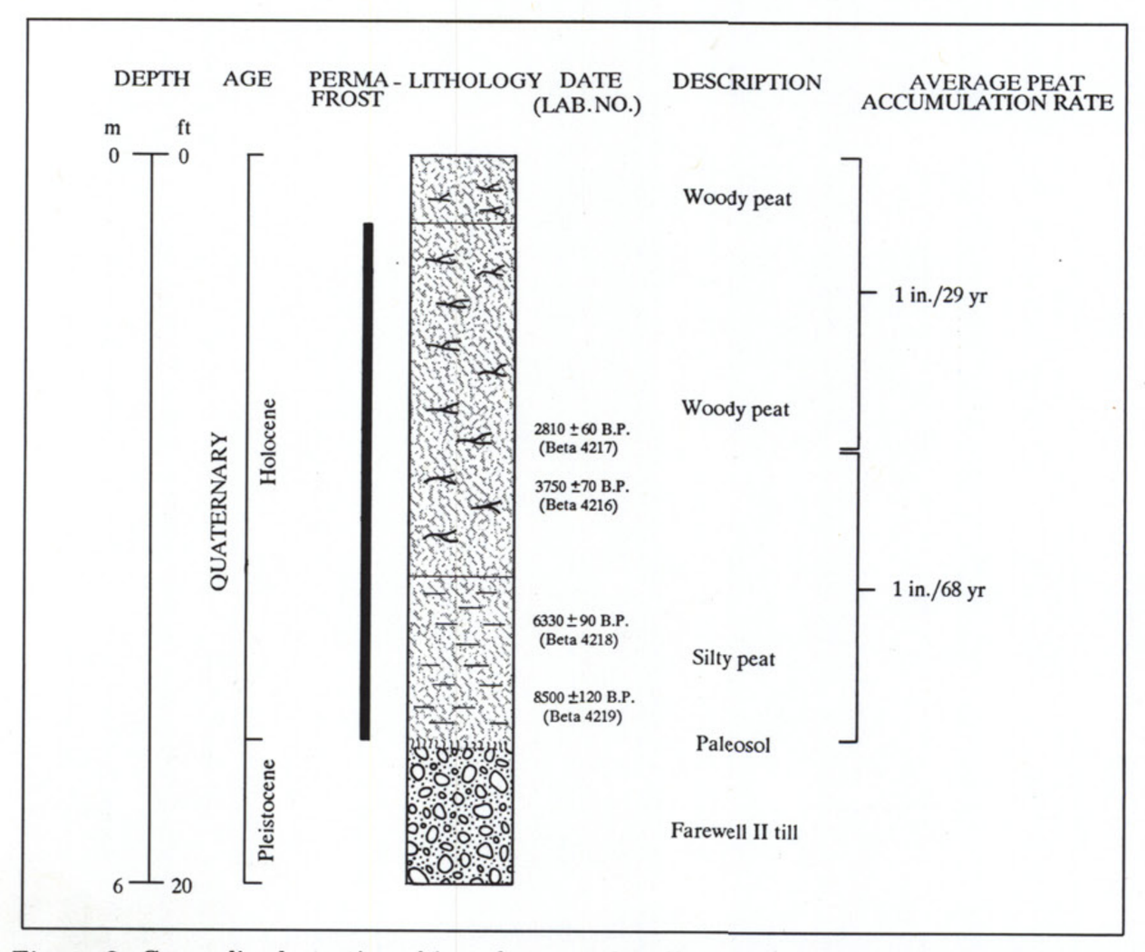


Figure 3. Generalized stratigraphic column and radiocarbon dates of peat section overlying Farewell II moraine, Windy Fork Middle Fork Kuskokwim River, McGrath B-3 Quadrangle, southwestern Alaska. Radiocarbon analyses were conducted by Beta Analytic, Inc., Coral Gables, Florida, 1982.

MAP SYMBOLS

Contact

High-angle fault - Dashed where inferred; dotted where concealed; queried where doubtful

High-angle fault with scarp - Hachures on downthrown side

Thrust fault - Sawteeth on upper plate

Photogeologic lineament

Anticline, showing trace of axial surface

Syncline, showing trace of axial surface

Strike and dip of beds - Commonly parallel to primary foliation in lower Paleozoic rocks

- Inclined
- Vertical
- Overturned (lower limb of Middle Fork anticline)

Bearing and plunge of lineation - May be combined with planar or other linear symbols

- F_i fold axes
- F_k fold axes
- Stretched clasts and minerals

Major-oxide sample locality (table 5)

K-Ar sample locality (table 2)

Fossil locality

Coal locality (tables 3 and 4)

Line of cross section

Line of columnar section

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Alluvial deposits

Qa ALLUVIUM, UNDIFFERENTIATED—Fluvial silt, sand, and gravel that form fans and flood plains. Thickness varies from a few feet in incised streams south of the Farewell fault system to hundreds of feet north of the fault system. (See table 1 for engineering properties.)

Qat TERRACE ALLUVIUM—Fluvial silt, sand, and gravel of various ages that compose fill and cut terraces; may also include strath terraces. In some places, mantled by an appreciable thickness of eolian or colluvial silt and a thick vegetation mat, especially where permafrost limits drainage. Older terrace deposits commonly contain highly weathered clasts in a silty matrix; thus the deposits may not be suitable as a source of construction materials. (See table 1 for engineering properties.)

Qaf ALLUVIAL-FAN DEPOSITS—Poorly to moderately well sorted fluvial silt, sand, and gravel that form deltoid fans, where tributaries join higher order streams, and extensive piedmont aprons, which flank the mountains along the Farewell fault system and extend northward several tens of miles. Fan accumulations in mountain trunk valleys tend to be coarse grained and poorly sorted due to steeper stream gradients and drastic seasonal fluctuations in stream energy. Apron deposits contain large quantities of subangular to subrounded gravel derived from drainages that head in the Alaska Range and are an excellent source of construction materials where not thickly mantled by eolian sand or silt (See table 1 for engineering properties.)

Colluvial deposits

Qca COLLUVIAL-ALLUVIAL DEPOSITS—Poorly to moderately sorted silt, sand, gravel, and diamicton of colluvial and locally fluvial origin, commonly forming alternating or interfingering stratified and unstratified lenses. Colluvial-alluvial sediments usually issue from gullies and steep minor tributaries with intermittent stream flow to form relatively small, steep fans along valley walls. Fans generally most active in early to late spring, when intense freeze-thaw cycles produce copious meltwater. Alluvial-colluvial apron deposits on north flank of Alaska Range near Farewell fault system are finer grained and subject to solifluction because of permafrost and spring flow along fault system. (See table 1 for engineering properties.)

Qc COLLUVIUM, UNDIFFERENTIATED—Typically unconsolidated, unsorted deposits derived primarily from mass-wasting processes. Includes primary products of bedrock erosion and retransported surficial deposits. Colluvium is widespread throughout quadrangle but is mapped only where appreciable thickness masks bedrock lithology and structure. (See table 1 for engineering properties.)

Qcl LANDSLIDE DEPOSITS—Chaotically deformed deposits derived from relatively sudden mass movement of bedrock or surficial deposits along planes of failure. Surface of deposits are characteristically very hummocky and lack integrated drainages. Recent landslides show additional surface disturbances, such as randomly tilted trees and torn vegetation mats

Qct TALUS—Angular, frost-riven bedrock transported by gravity down cirque headwalls, avalanche chutes, and steep slopes and gullies. Forms cones or aprons at or near angle of repose along valley walls. Distal ends may grade into rock glaciers

Glacial deposits

Qrg ROCK GLACIERS AND ROCK-GLACIER DEPOSITS—Unsorted, angular, frost-shattered cobbles and boulders, commonly containing considerable interstitial ice (up to 55 percent in active rock glaciers). Generally originate at 3,500 to 5,000 ft (1,100 to 1,500 m) in north-facing cirques and along steep valley walls of blocky-weathering, relatively resistant rock; may head in true glaciers or talus cones. Rock glaciers classified into morphologic types of Wahrhaftig and Cox (1959): 1) lobate, relatively small (75 to 450 m wide) forms at base of valley walls, movement toward valley axis; 2) tongue-shaped forms with head in abandoned cirques, longest dimension parallel to flow; and 3) transitional forms with head in true glaciers, elongate down valley in direction of flow. Front of active rock glaciers very steep and unstable

Qdt TILL—Unsorted to poorly sorted clay- to boulder-size material deposited directly by glacial ice. Cobbles and boulders commonly striated, subangular to subrounded, and polyhedrally faceted. Moraines on the piedmont commonly contain permafrost and thick surface peat deposits. (See table 1 for engineering properties.)

Qd THIN DRIFT OVER BEDROCK—Patchy, thin drift, including till and glaciofluvial deposits. Delineates former ice positions along valley walls but does not obscure underlying bedrock. Geochemical analyses of unit may be affected by presence of mineralized material moved long distances from parent sources

Qdo OUTWASH—Stratified drift, consisting of coarse, subrounded gravel with sand and silt lenses and partings, deposited by side glacial and proglacial meltwater streams. Deposits tend to fine down valley from former side and terminal glacial positions. Distal part of outwash bodies typically interfingers or merges with other alluvial deposits. (See table 1 for engineering properties.)

SEDIMENTARY AND VOLCANIC ROCKS

Tcf FELSITE CONGLOMERATE—Very thickly bedded, very poorly indurated, orange-weathering, light-brown granule-cobble conglomerate; contains minor, discontinuous beds of orange-red weathering coarse-grained sandstone. Conglomerate clasts are poorly sorted, rounded to subrounded, and consist of felsite (40 to 60 percent), lithic fragments (15 to 30 percent), and quartz (10 to 25 percent) in a coarse-grained matrix. Unit cross-bedded in a few places. Minimum thickness 300 m. Age assigned to late Tertiary on basis of lithologic similarity to upper Tertiary continental deposits to northeast (Wahrhaftig and others, 1969; Gilbert, 1979)

Tvf FELSITE AND TUFF—White to very pale gray-green, homogeneous felsite that forms a roughly circular plug, about 200 m diam, in T. 26 N., R. 28 W., sec. 11, near outer active strand of Farewell fault system. Contains disrupted inclusions of conglomerate (Tc) within few feet of felsite-conglomerate contact. In T. 27 N., R. 26 W., sec. 13, along eastern boundary of quadrangle, felsic tuff mantles underlying units. Age unknown but possibly related to Oligocene-Miocene(?) volcaniclastic unit (Tvs) of Bundtzen and others (1982)

Tvs VOLCANICLASTIC CONGLOMERATE, SANDSTONE, AND SILTSTONE—Poorly consolidated, tan-weathering, light green-gray volcaniclastic pebble conglomerate, sandstone, and siltstone in fault sliver along Farewell fault system at northeastern edge of quadrangle. Nonmarine, locally containing abundant leaf and stem fragments. May be derived from retransported deposits of felsite and tuff unit (Tvf). Tentatively assigned a Tertiary age by Bundtzen and others (1982)

Tif FELSIC SILLS AND DIKES—Felsic sills and dikes to 5 m thick. Generally light pink tan to white; aphanitic to fine grained, rarely medium grained; hypocrystalline to holocrystalline, with phenocrysts of plagioclase and alkali feldspar. Commonly coated with brown to orange gossan. Groundmass is typically highly altered, producing abundant secondary carbonate. Some samples contain fine-grained disseminated pyrite and display textural banding. South of volcanic center between Windy Fork and Khuchaynik Creek, rare spherulites, 1 to 2 mm diam, are present. Divitrification spherulites were also observed in a 3-m-thick dike of green glass in T. 25 W., R. 26 W., sec. 5

Tvr RHYOLITE—White to light gray-green, locally banded, hypocrystalline rhyolite. Typically consists of sericitic alkali feldspar and locally resorbed, fine-grained quartz phenocrysts in an aphanitic quartzo-feldspathic groundmass; devitrification spherulites are common

Tia ANDESITE AND TRACHYANDESITE SILLS AND DIKES—Andesite and trachyandesite sills and dikes to 10 m thick; may include some felsic and basaltic dikes. Typically green gray, fine grained, and hypidiomorphic-granular. Composed of up to 80 percent andesine (commonly very altered), up to 20 percent alkali feldspar, and minor amounts of highly altered hornblende, biotite, and pyroxene; apatite is a common accessory. Locally contain fine- to medium-grained plagioclase or hornblende phenocrysts and fine-grained disseminated pyrite. Alteration minerals include chlorite, carbonate, opaque minerals, and white mica. Sills and dikes are often subparallel to primary foliation. Contact effects in adjacent country rock are rare. Probably time-correlative with andesitic flows and lapilli tuff (Tva)

Tva ANDESITIC FLOWS AND LAPILLI TUFF—Dark-gray to green-gray andesite and basalt flows and light-to-dark green-to-gray, locally banded (red, green, purple, or white) lapilli tuff. Groundmass of flows is aphanitic to fine-grained intersertal and consists principally of andesine with abundant hornblende, clinopyroxene, opaque minerals, and rare quartz; fine- to medium-grained andesine and hornblende phenocrysts are common. Propylitization is pervasive, producing carbonate, chlorite, and epidote alteration products. Lapilli tuff is composed of subangular chlorite-rich fragments in a hypocrystalline groundmass. Whole rock sample from unit yielded K-Ar age of 37.2 ± 2.9 m.y. (table 2, loc. 1)

Tim MAFIC SILLS AND DIKES—Mafic sills and dikes to 5 m thick, generally dark-brown, fine-grained, panidiomorphic-granular; locally porphyritic or amygdaloidal. Consist of plagioclase (andesine to labradorite), clinopyroxene (titanaugite?), and opaque minerals, with hornblende, biotite, and apatite. Typically very weathered, commonly spheroidally. Compose minor portion of hypabyssal rocks in quadrangle

Tids DIKE SWARM—Subparallel swarm of predominantly andesitic dikes with minor felsic and mafic dikes (Tia, Tif, and Tim, undivided); includes slivers of phyllitic calcareous sandstone (Ss), which commonly has been silicified or altered to hornfels. Sandstone may also be highly pyritic and contain gossan zones, as at head of rock glacier in T. 26 N., R. 26 W., sec. 8

Tc CONGLOMERATE—Thinly to very thickly bedded, poorly to moderately indurated, buff-weathering, gray-brown granule-cobble conglomerate; contains minor sandstone, shale, and coal. Conglomerate clasts are moderately sorted, subangular to rounded, and consist mainly of quartz (20 to 40 percent), volcanic rock fragments (0 to 20 percent), other lithic rock fragments (30 to 70 percent), and scattered carbonaceous debris; matrix ranges from silt to granule conglomerate. Beds are massive to cross-stratified. Unit 1,460 m thick along Windy Fork (fig. 4). Eocene to middle Oligocene pollen found in equivalent sedimentary units (Atlantic Richfield Company in-house report, 1980), but conglomerate is petrographically similar to pre-Middle Eocene sandstone and shale unit (Tssh) (Dickey, 1984); thus unit is likely of Late Paleocene to Early Eocene age

Tssh SANDSTONE AND SHALE—Thinly to thickly bedded, moderately indurated, red-brown-weathering, buff lithoquartzose sandstone, interbedded with poorly indurated, laminated, fissile, carbonaceous shale and minor sandstone and mudstone. Clasts in sandstone are moderately sorted, subangular to subrounded, fine to very coarse grained, and consist mainly of argillite (30 to 60 percent), quartz (20 to 50 percent), carbonaceous material (0 to 20 percent), and volcanic rock fragments (0 to 10 percent). Siltstone and mudstone are locally vitreous and contain plant debris. Minimum thickness of unit 700 m. Sandstone and shale intruded by Middle to Upper Eocene dike and are petrographically similar to rocks of Tertiary conglomerate unit (Tc) (Dickey, 1984); thus sandstone and shale are also likely Late Paleocene to Early Eocene in age

Tcl LIMESTONE CONGLOMERATE—Thickly to very thickly bedded, poorly to moderately indurated, green-gray granule-cobble conglomerate in fault sliver near Khuchaynik Creek. Conglomerate clasts are very poorly sorted, subangular to rounded, and consist mainly of limestone (50 to 80 percent), basalt (5 to 50 percent), and undifferentiated lithic fragments (5 to 20 percent); matrix is clay to sand size. Beds appear structureless. Except for composition of clasts, unit is lithologically similar to Upper Paleocene to Lower Eocene conglomerate (Tc), but may be time equivalent to upper Tertiary felsite conglomerate (Tcf) (Dickey, 1984)

Pingston terrane

Trl QUARTZOSE LIMESTONE AND CARBONACEOUS SILTSTONE—Thinly bedded, discontinuous, medium-gray quartzose limestone in fault sliver along Farewell fault system, interbedded with carbonaceous siltstone. Unit isoclinally folded. Maximum structural thickness 130 m. Lithologically correlated with Upper Triassic Pingston limestone (Kline and others, 1986; Jones and others, 1983), located 35 km to northeast

Mystic or Dillinger terrane

MzPzb PILLOW BASALT—Dark-green to gray pillow basalt in fault slivers along northwest front of Alaska Range. Generally altered to carbonate and chlorite; contains unaltered olivine phenocrysts along Khuchaynik Creek. In T. 26 N., R. 27 W., sec. 10, basalt lacks defined pillow structures and intrudes or interfingers with laminated limestone unit (DSl). Basalt highly sheared locally. Thickness variable (<400 m). Age unknown, but unit tentatively assigned to upper Paleozoic or Mesozoic because of conformable contact with argillite, chert, and agglomerate unit (PDs)

PDs ARGILLITE, CHERT, AND AGGLOMERATE—Very thinly bedded, highly fractured, brown-weathering, black argillite, chert, conglomerate, and sandstone. Along Khuchaynik Creek in T. 26 N., R. 27 W., sec. 1, very thinly bedded, black chert is interbedded with altered green volcanic agglomerate; in T. 26 N., R. 27 W., secs. 1 and 2, unit contains beds of black and white chert and rounded quartz-chert granule conglomerate. Unit approximately 100 m thick. Radiolaria (fossil loc. 1) from chert suggest Mississippian age (D.L. Jones, U.S. Geological Survey, written commun., 1982); however, fossils from correlative unit in McGrath B-2 Quadrangle are Middle Devonian, Mississippian, and Middle and Late Pennsylvanian age (Bundtzen and others, 1982)

lDl ALGAL LIMESTONE—Massive, medium-gray limestone, containing algal-like laminations. Unit about 200 m thick. Corals from same unit east of quadrangle boundary in McGrath B-2 Quadrangle suggest an Early Devonian age (Bundtzen and others, 1982)

lDsh BLACK SHALE AND LIMESTONE—Sheared, organic black shale interbedded with minor platy, silty limestone, with phyllitic partings, and medium to thinly bedded, laminated, gray limestone. Thickness highly variable (>450 m). East of Windy Fork, unit situated between two layers of algal limestone (lDl). Shale tentatively assigned an Early Devonian age

lDd DOLOMITE—Light-gray, dolomitized algal limestone in southwestern part of quadrangle on peak 5252. Age uncertain, but dolomite tentatively correlated with Lower Devonian algal limestone (lDl)

DSl LAMINATED LIMESTONE—Thinly to very thickly bedded, medium-gray laminated limestone in fault slivers along northwest front of Alaska Range. Contains minor phyllite partings, limestone breccia, and algal structures; calcite veinlets locally abundant. Isoclinally folded. Locally structurally thickened to 1,100 m. Unit tentatively assigned Silurian to Devonian age because of lithologic similarity to Silurian to Devonian limestone unit (DSl) of Bundtzen and others (1982) in McGrath B-2 Quadrangle

DSls LIMESTONE AND SILTSTONE—Very thinly to thickly bedded, laminated, gray silty limestone and orange- to brown-weathering, gray phyllitic siltstone in fault slivers along northwest front of Alaska Range. Original thickness unknown due to faulting and poor exposure. Lithologically correlated with calcarenite, calcareous siltstone, and limestone unit (DSls) of Bundtzen and others (1987) and similar unit of Gilbert and others (1988)

Ss, ls, g, sh PHYLLITIC CALCAREOUS SANDSTONE—Predominantly very thinly to very thickly bedded, buff- to orange-weathering, gray to olive-green phyllitic calcareous sandstone interbedded with thinly laminated to thinly bedded, orange- to brown-weathering, black to gray or gray-green slate and phyllitic calcareous siltstone. Commonly grades into phyllitic siltstone, which, in a few places, displays cross-bedding and pyrite crystals on partings. Locally contains partings of thinly laminated, silver-weathering, gray phyllite and intervals of very thinly to thinly bedded, gray silty limestone

In hand specimen, calcareous sandstone is micaceous, very fine to very coarse grained, and locally displays cross- and graded bedding. Coarser clasts are commonly flattened and stretched. In thin section, sandstone may exhibit original detrital mineralogy and texture but commonly contains abundant secondary minerals and displays pervasive foliation defined by elongate, partially recrystallized framework grains and cataclastic shear planes. Framework grains include chert (20 to 40 percent), quartz (10 to 25 percent, with up to a third polycrystalline), fine-grained sedimentary rock fragments (25 percent), feldspar (0 to 20 percent, primarily plagioclase), carbonate grains (0 to 15 percent), and volcanic (0 to 10 percent) and metamorphic rock fragments (trace). Intergranular carbonaceous-chlorite matrix makes up 5 to 20 percent of the rock. Secondary minerals include carbonate (5 to 30 percent), white mica (10 to 25 percent), and opaque grains (0 to 5 percent, mainly pyrite).

Sandstone unit contains subparallel and cross-cutting quartz and calcite veinlets and is generally hornfelsed parallel to contact with igneous units. From outcrop to nappe scale, sandstone unit subisoclinally to isoclinally folded. Because of structural repetitions and faulting, original thickness unknown. Correlative with Silurian sedimentary units (mSs, mSa, mSl, uSsl, Sl, and Ss) of Bundtzen and others (1987)

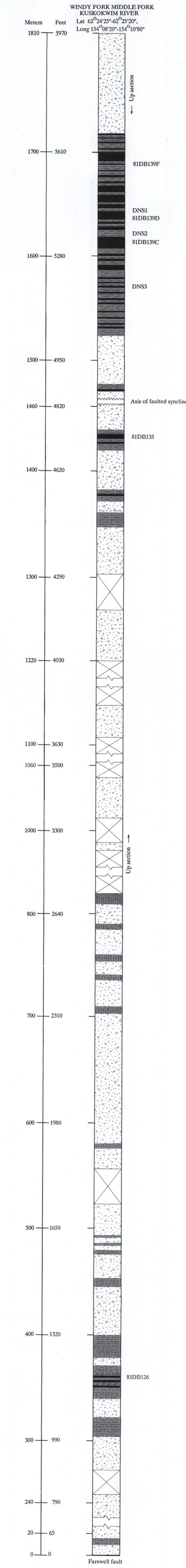
ls - Thinly to very thickly bedded, medium-gray-weathering, dark-gray, laminated limestone. Generally included in phyllitic calcareous sandstone unit (Ss) but mapped separately where thick

sh - Thinly laminated to thinly bedded, dark-gray to black, phyllitic argillite, shale, and slate. Generally included in phyllitic calcareous sandstone unit (Ss) but mapped separately where thick. Locally highly sheared and iron stained. Black shale between dike swarm (Tids) and andesitic flows (Tva) in T. 26 N., R. 26 W., secs. 6, 7, and 8, is only slightly phyllitic but is streaked with black carbonaceous material on cleavage surfaces and contains black, banded fine-grained sandstone

g - Discontinuous layers of locally sheared, locally phyllitic, medium-grained chlorite-hornblende-augite greenstone with malachite stains. Constitutes very small portion of phyllitic calcareous sandstone unit (Ss); mapped separately where thick

SOsh BLACK SHALE—Dark-gray to black, locally pyritic shale, siltstone, argillite, phyllite, and very fine grained sandstone in southwestern part of quadrangle; includes beds of fine- to medium-grained sandstone and scattered beds of silty limestone. Slightly to intensely sheared and folded. Shale is about 200 m thick but is structurally thickened in core of Middle Fork anticline. In adjacent quadrangles, unit contains Lower Ordovician to Lower Silurian graptolite-bearing horizons (Bundtzen and others, 1987; Gilbert and others, 1988)

OЄls SILTY LIMESTONE—Very thin to thin (<25 cm), lenticular beds of orange-weathering, light-gray silty limestone along southwestern border of quadrangle, interbedded with 1- to 5-cm-thick beds of gray siltstone and gray carbonaceous phyllite. Silty laminae in limestone commonly cross-bedded in several stacked cosets. Unit cut by calcite veinlets in a few places. Generally sheared along limestone-siltstone contacts and siltstone-phyllite partings. Deformed into tight chevron to subisoclinal folds that range from crenulations to nappes. Base of unit not exposed in map area



EXPLANATION

CONGLOMERATE—Poorly to moderately indurated, buff-weathering, gray-brown granule-cobble conglomerate. Clasts are poorly sorted, subangular to rounded, and consist of lithic fragments (25 to 60 percent), quartz (10 to 55 percent), and volcanic fragments (12 to 30 percent). Beds are massive to large-scale cross-stratified

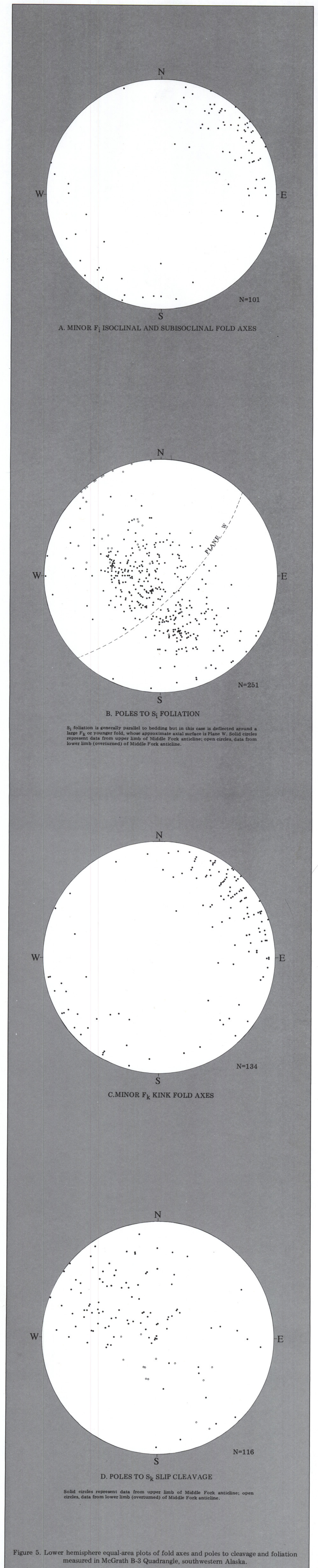
SANDSTONE—Thinly to thickly bedded, moderately indurated fine- to very coarse grained sandstone interbedded with conglomerate, siltstone and mudstone. Clasts are subangular to subrounded and consist of lithic fragments (43 to 68 percent), quartz (20 to 55 percent), feldspar (2 to 8 percent), and traces of carbonaceous material

SILTSTONE AND SHALE—Moderately indurated, brown to gray siltstone; and gray-weathering, black shale, containing various amounts of carbonaceous material. Unit thinly laminated to thinly bedded. Siltstone locally weathers in pods

CARBONACEOUS SHALE TO COAL—Highly friable carbonaceous shale, commonly containing leaf and wood fragments and small silt and mud lenses. Contains various amounts of silt and very fine sand grains. Grades to very thinly bedded coal. Unit highly weathered in outcrop

81DB000 Field number

Figure 4. Measured section of Tertiary conglomerate (Tc), Windy Fork Middle Fork Kuskokwim River, McGrath B-3 Quadrangle, southwestern Alaska (coal loc. 1). Beds in lower part of section strike northeast and dip steeply northwest; beds in upper part of section, north of axis of faulted syncline, dip moderately east-northeast. Section measured by D.B. Dickey and K.F. Bull, 1981; modified by J.T. Kline and D.N. Solie, 1982.



A. MINOR F_i ISOCLINAL AND SUBISOCLINAL FOLD AXES

B. POLES TO S_i FOLIATION

S_i foliation is generally parallel to bedding but in this case is deflected around a large F_k or younger fold, whose approximate axial surface is Plane W. Solid circles represent data from upper limb of Middle Fork anticline; open circles, data from lower limb (overturned) of Middle Fork anticline.

C. MINOR F_k KINK FOLD AXES

D. POLES TO S_k SLIP CLEAVAGE

Solid circles represent data from upper limb of Middle Fork anticline; open circles, data from lower limb (overturned) of Middle Fork anticline.

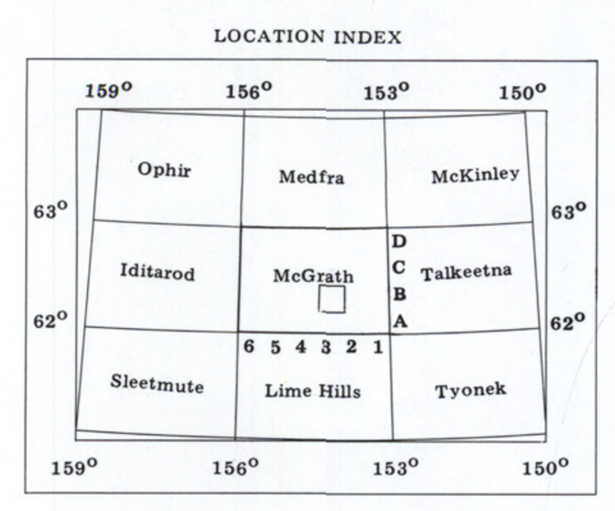
Figure 5. Lower hemisphere equal-area plots of fold axes and poles to cleavage and foliation measured in McGrath B-3 Quadrangle, southwestern Alaska.

GEOLOGIC MAP OF THE MC GRATH B-3 QUADRANGLE, ALASKA

By

Wyatt G. Gilbert, Diana N. Solie, and Jeffrey T. Kline

1989



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