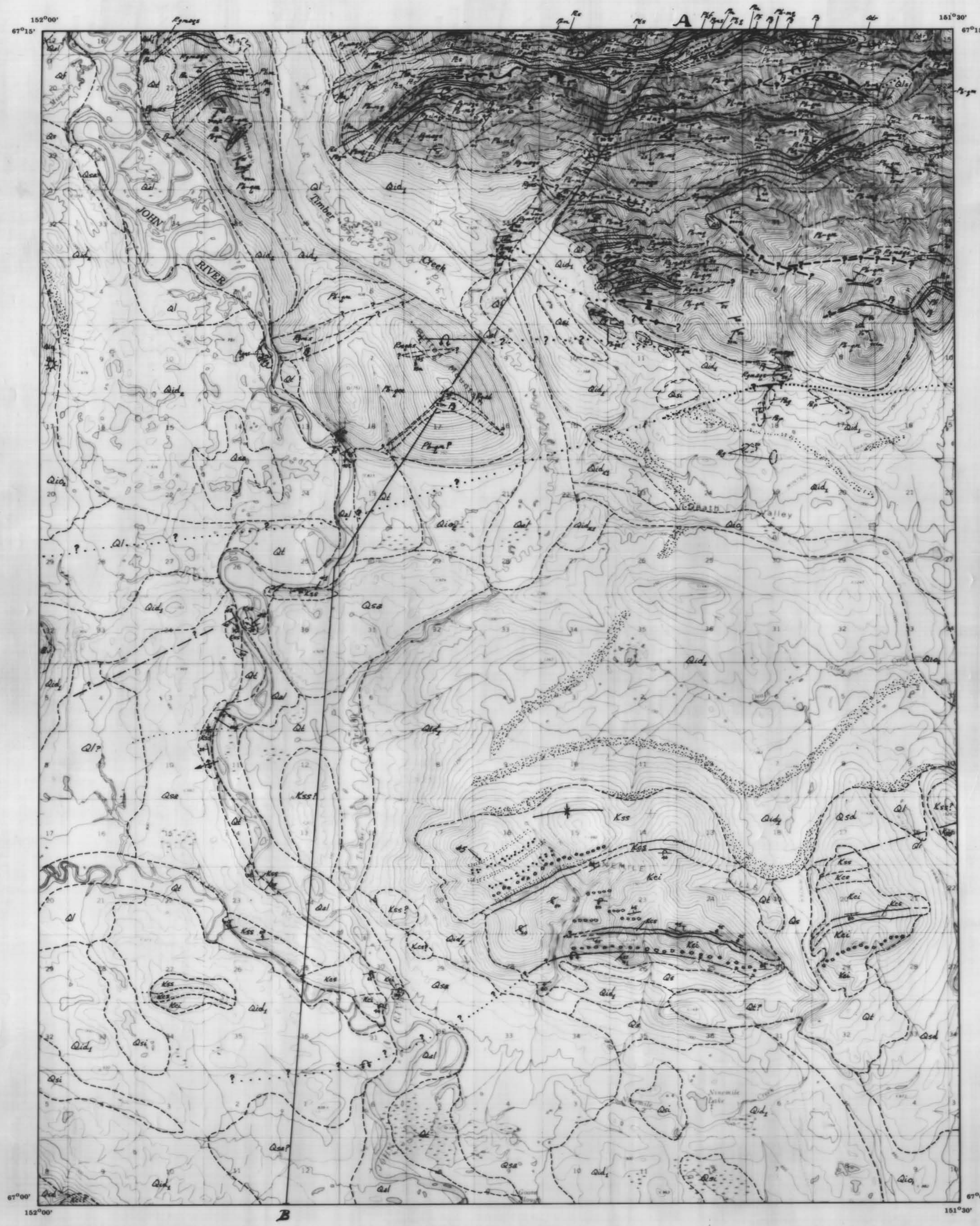


Base from U.S. Geological Survey, Wiseman A-4 Quadrangle, 1970.

Scale 1:63,360

1 0 1 2 3 4 miles

1 0 1 2 3 4 5 kilometers

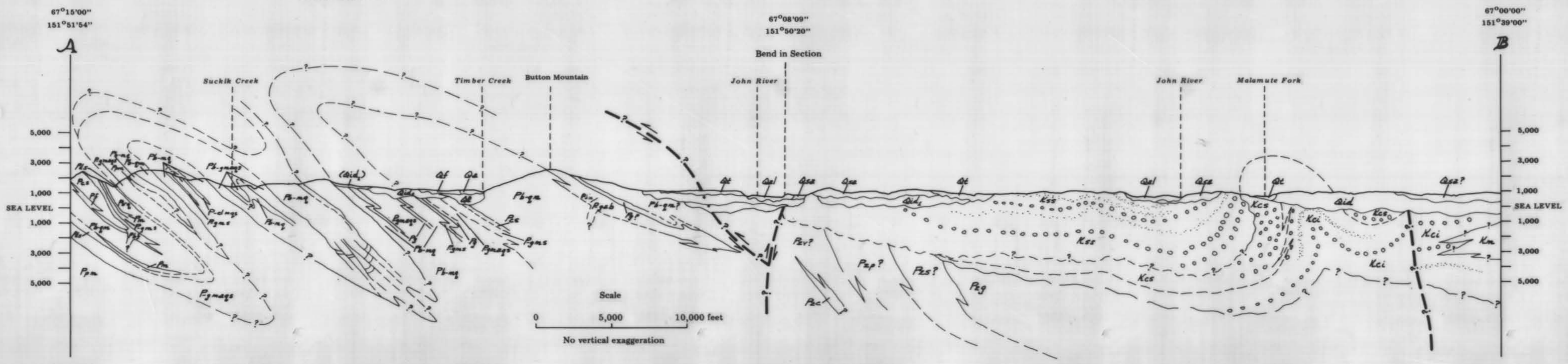
CONTOUR INTERVAL 50 FEET

DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1970.

Geology by J.T. Dillon, 1977-1981; G.H. Pessel, 1977; Larry Lueck, 1980; and W.B. Hamilton, 1977. Quaternary geology modified slightly from T.D. Hamilton, 1980. Plant fossils identified by C.J. Smiley.

Cartography by G. M. Laird



GEOLOGIC MAP OF THE WISEMAN A-4 QUADRANGLE, ALASKA

By J. T. Dillon, G. H. Pessel, Larry Lueck, and W. B. Hamilton

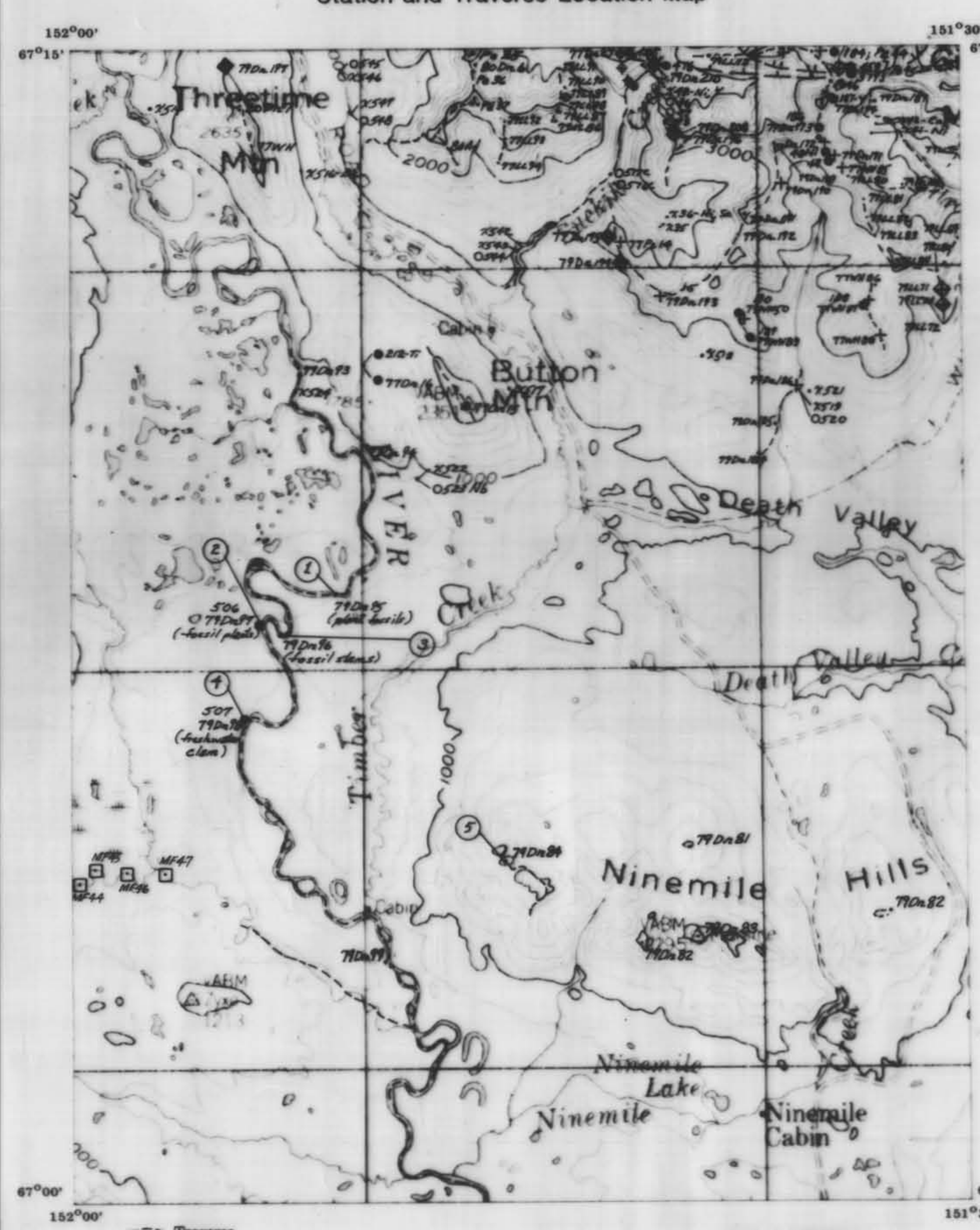
1981

TABLE 1. FOSSIL LOCALITIES

Fossils identified by C.J. Smiley (written comm., 1979)

Map No.	Field No.	Latitude	Longitude	Fossils
1	79Dn95	67°07'52"	151°50'54"	Dicotyledon leaf, coalified stem fragments, *Paracredneria*? (freshwater clam)
2	79Dn96	67°07'26"	151°53'03"	Sand casts of stems
3	79Dn97	67°07'31"	151°53'40"	Coal or carbonaceous shale, coalified wood chips, unidentifiable dicotyledon leaf fragments; conifer shoots including *Sequoia reichenbachi* and *Cephalotaxopsis microphylla laxa*
4	79Dn98	67°06'13"	151°54'10"	Carbonaceous shale, *Sequoia reichenbachi*, *Cephalotaxopsis heterophylla*, *C. microphylla laxa*, *conites* sp., *Populites* sp., *Credneria inordinata*, *Unio* sp. (freshwater clam)
5	79Dn84	67°04'28"	151°45'30"	Unidentified dicotyledon leaf fragments

Station and Traverse Location Map



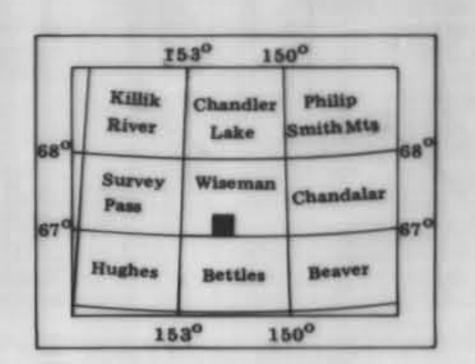
- Traverse
- Fossil locality
- Station
- Gravity station
- Rock-sample location
- Rock sample with thin section
- Rock sample with major-oxide geochemistry and thin section
- Radiometric age date plus above
- Rock sample for assay; anomalous elements shown*
- Pan-concentrate sample assayed; anomalous elements shown*
- Stream-sediment sample assayed; anomalous elements shown*
- Garnet isograd, garnets inside barbs
- Tremolite isograd, tremolite inside barbs

Scale 1:125,000

0 1 2 miles

*Assay refers to quantitative and semiquantitative determinations; results and anomalies are listed in AOF-133A & B (in press).

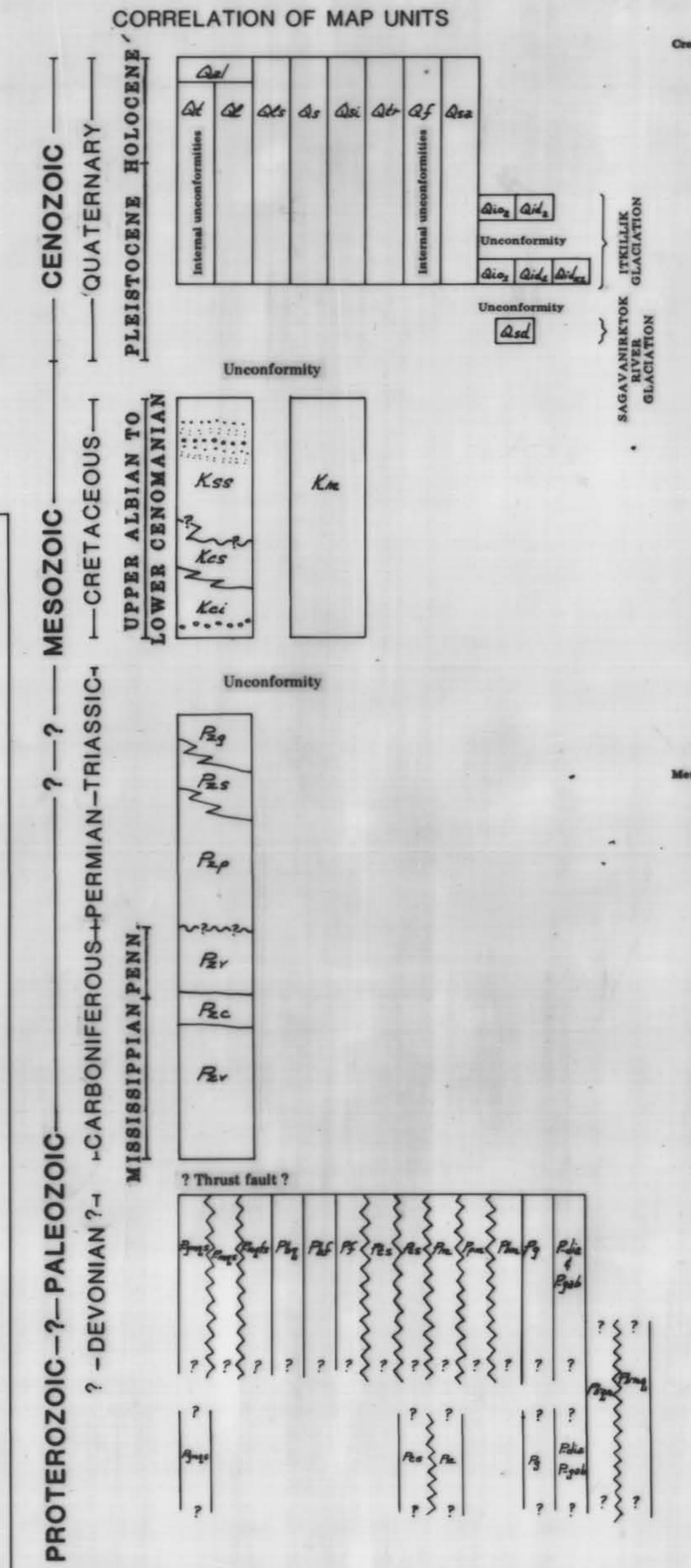
QUADRANGLE LOCATION



LOCATION DIAGRAM

EXPLANATION

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

QUATERNARY UNITS
(slightly modified after Hamilton, 1979a)

Alluvial Deposits

Qal ALLUVIUM, UNDIFFERENTIATED — Mainly Holocene stream deposits of poorly sorted, moderately stratified mixtures of gravel, sand, silt, and clay

Qt ALLUVIAL TERRACE DEPOSITS — Poorly sorted, moderately stratified sand and gravel deposits generally mantled by sod; forms terraces near modern streams

Qf ALLUVIAL FAN AND FAN-DELTA DEPOSITS, UNDIFFERENTIATED — Fan-shaped deposits of nonstratified, poorly sorted, angular rock debris in alpine fans and poorly to moderately sorted and stratified mixtures of subangular gravel and sand in larger stream valleys. Grades into lacustrine and deltaic deposits of well-sorted and stratified silt, sand, and fine gravel at downstream end of fan-delta deposits

Colluvial Deposits

Qls LANDSLIDE AND FLOW-SLIDE DEPOSITS, UNDIFFERENTIATED — Unsorted and nonstratified to poorly sorted and stratified, coarse to fine, angular rubble in matrix of finer rock debris; forms lobes below detachment scars, slide tracks, and steep rock walls

Qtr TALUS RUBBLE -- Angular, unsorted, nonstratified, and generally unvegetated and unweathered rock debris; forms cones and aprons along lower walls of mountain valleys and cirques

Qrg ROCK-GLACIER DEPOSITS -- Very poorly sorted, nonstratified, coarse, angular rock debris in matrix of fine rubble, silt, and ice; forms lobate and tongue-shaped deposits. Active rock glaciers are unvegetated and unweathered with steep frontal slopes; may be underlain by stagnant glacial ice. Inactive rock glaciers are slightly weathered and vegetated, morphologically subdued, and generally lack interstitial or stagnant glacial ice

Qs SOLIFLUCTION DEPOSITS — Very poorly sorted, nonstratified to weakly stratified sheets and aprons of stony, sandy silt and organic-rich silt; usually more than 1 m thick; active lobes subject to seasonal downslope movement

Qsi ORGANIC SILT — Poorly stratified organic-rich silt and silty peat containing ice as lenses, wedges, and interstitial grains; consists largely of loess, organic material, and solifluction deposits in poorly drained areas

Qsa SAND — Moderately sorted fine to medium sand with parallel and crossed bedding. Locally contains thin interbeds of organic silty fine sand. Grades downward into lacustrine deposits. Deposited by slow moving streams within basins dammed by end moraines in John River Valley

Lacustrine Deposits

Ql LACUSTRINE DEPOSITS, UNDIFFERENTIATED — Well-sorted, stratified silt and clay containing scattered dropstones; grades into sand and fine gravel near shorelines and stream mouths, respectively

Glacial Deposits

Itkillik Glaciation

Qio_2 OUTWASH OF ITKILLIK PHASE II — Moderately well-sorted and stratified sandy gravel containing subrounded cobbles and small boulders near moraine fronts decreasing to rounded pebbles down valley; usually covered by less than 0.3 m of loess; forms terraced remnants of aprons and valley trains 15-25 m above modern flood plains in front of Itkillik II moraines. Hamilton & others (1980) report radiocarbon ages of 13,000 and 30,000 yr before present (b.p.)

Qid_2 DRIFT OF ITKILLIK PHASE II — Poorly to very poorly sorted, nonstratified to weakly stratified drift ranging from silty, sandy gravel to clayey, stony silt with locally stratified ice-contact deposits of moderately to poorly sorted sandy gravel

Qio_1 OUTWASH OF ITKILLIK PHASE I — Sandy gravel, as described for Itkillik Phase II; usually covered by a blanket of loess 0.5-4 m thick. Forms terraced remnants of aprons and valley trains 20-30 m above modern flood plains. Age estimated at 50,000 yr b.p. (Hamilton & others, 1980)

Qid_1 / Qid_{k1} DRIFT OF ITKILLIK, PHASE I — Poorly to very poorly sorted, nonstratified to weakly stratified drift ranging from silty, sandy gravel to clayey, stony silt, with local stratified ice-contact deposits consisting of moderately to poorly sorted sand, sandy gravel, and silty, sandy gravel; contains faceted and striated stones up to boulder size; includes eroded, arcuate end moraines and lateral moraines that extend from mouths of Wild River and Middle Fork of Koyukuk River. Age as with Qio_1 above. Subunit (Qid_{k1}): kame and kame terrace deposits, designates extensive, thick ice-contact stratified sand and gravel deposits associated with drift of phase I

Sagavanirtok River Glaciation

Qsd DRIFT — Poorly sorted, nonstratified drift consisting of silty, sandy boulder gravel to clayey, stony silt with locally well-sorted and stratified gravel; generally covered by blanket of loess, solifluction, and muskeg deposits more than 3 m thick; forms broad morainal ridges and hummocky ground moraine south of Brooks Range. Estimated to be mid-Pleistocene (Hamilton, 1979b)

MESOZOIC ROCK UNITS

Cretaceous Rock Units

Km MARINE GRAYWACKE AND SLATE — Predominantly even-bedded graywacke interlayered with calcareous slate; slate predominates over graywacke locally. Relic sedimentary structures and clasts include graded bedding, flutes, tool marks, local shale-chip breccia, and carbonized wood. Patton and Miller (1973) report Early Cretaceous (Albian?) ammonites and pelecypods in outcrops along Middle Fork of Koyukuk River (A-3)

Kss NONMARINE GRIT, SANDSTONE, CONGLOMERATE, MUDSTONE, AND CARBONACEOUS SHALE — Predominantly grit (very coarse sandstone with angular grains), sandstone, and conglomerate composed of subrounded to rounded clasts of graphitic schist, vein quartz, and quartzite; lesser amounts of siltstone, mudstone, shale, carbonaceous shale and coal. Conglomerate, grit, sandstone, and coal indicated by circles, heavy dots, light dots, and cross hatching, respectively, where differentiated. Planar and trough crossbeds, channels, clast imbrication, and normal and reverse grading occur in coarse clastic rocks; ripple marks, plant fossils, worm burrows, bird-footprint molds, and freshwater pelecypods occur in fine clastic rocks. Sedimentary structures associated with plant fossils provide evidence for rapid deposition near growing plants under conditions that were turbulent in some places "but nonturbulent in others (C.J. Smiley, written comm., 1979). Deposition was by fluvial processes, probably on a delta or coastal flood plain with slack-water environments. Smiley (written comm., 1978, 1979) identified several species of conifers and dicotelydons from plant fossils at location 2 and correlates this assemblage with late Albian to early Cenomanian floral zones of northern Alaska; he estimates the most probable age of these flora to be late Albian. Southern extent of unit apparently lies on Kcs, perhaps unconformably (Brosgé & Reiser, 1971). Northern contact is concealed in Wiseman A-4 and A-3 Quadrangles but lies unconformably on and laps northward onto, upper Paleozoic greenstone, chert, graywacke, and phyllite at its northern limit in the Wiseman A-5 and A-6 Quadrangles. Clasts are representative of lithologies exposed to north in southern schist belt

Kci IGNEOUS CLAST CONGLOMERATE -- Mainly cobble conglomerate (indicated by circles where differentiated) with subordinate sandstone. Clasts are rounded cobbles of greenstone and gabbro, metagraywacke, red and green chert, and a few cobbles of phyllite, vein quartz, schist, granodiorite, and marble. Clasts of metagraywacke most abundant near contact with unit Kss. Clast imbrication and trough-set cross-beds provide evidence for southward-flowing paleocurrents

Kcs METASEDIMENTARY CLAST CONGLOMERATE — Interbeds in upper unit Kci; differs from unit Kci only in its predominance of metagraywacke and phyllite clasts

UPPER PALEOZOIC ROCK UNITS

Metasedimentary Rock Units

Pzg METAMORPHOSED GRAYWACKE AND SILTSTONE — Fine- to medium-grained metagraywacke with subordinate interbeds of locally differentiated dark-gray, graphitic phyllite (Pzp). Well-preserved relic clastic texture and bedding; possible sole markings on several samples may be relic tool marks. Angular to subangular detrital grains of quartz (40%), albite (8%), biotite (2%), white mica (2%), tourmaline (tr), and rock fragments (35%) occur in microcrystalline matrix of quartz, sericite, and chlorite. No K-feldspar was recognized. If K-feldspar was originally present, it has been converted to albite. Most rock fragments are chert but about 20% are graphitic or chloritic metasediments(?). Metamorphic mineralogy is quartz + albite + sericite ± chlorite ± biotite ± white mica; semipenetrative cleavage s(1) defined primarily by sericite, chlorite, pyrite, and rare biotite; metamorphic textures similar to textural zone 2 of metagraywackes (Blake and others, 1967); metamorphic textures and structures appear to result from one metamorphism, although quartz vein in one sample is complexly folded and axial plane of fold parallels s(1)

Not fossiliferous. Contains interbeds or interlayers of Pzs and Pzp. Units Pzs, Pzp, and Pzg may be late Paleozoic or Triassic because they appear to lie on greenstone with chert interlayers of Late Mississippian to Early Pennsylvanian age (see unit Pzc, below) and Permian carbonates (Patton and Miller, 1973) and are unconformably overlain by Cretaceous conglomerate. Units Pzg, Pzs, and Pzp (Wiseman A-6 Quadrangle) appear to be interlayered with greenstone and chert sequence (Pzv and Pzc). Well-preserved clastic textures and sedimentary structures, lower greenschist-facies mineralogy, and presence of only one set of metamorphic structures in units Pzs, Pzp, and Pzg contrast sharply with tectonite fabric, upper greenschist to albite-epidote-amphibolite facies mineralogy, and polymetamorphic structures of Devonian - Proterozoic(?) polymetamorphic schists to north. The parallel orientation and similar appearance of the latest metamorphic structures in the polymetamorphic schist and the S(1) cleavage in the upper Paleozoic rocks is evidence that the metamorphism of both rock units occurred synchronously. On the basis of regional considerations, the last metamorphism occurred during Early Cretaceous time (Dillon and others, 1980)

Pzs METASILTSTONE — Orange- to brown-weathering metasiltstone with subordinate interbeds of phyllite and metagraywacke. Generally finer grained than unit Pzg but of similar lithology

Pzp PHYLLITE — Dark-gray graphitic phyllite with subordinate metasiltstone and metagraywacke interbeds interlayered within Pzs

Pzc CHERT — Red, green, and gray, 10-m-thick chert interbeds in unit Pzv. Radiolaria (Paronaella impella Ormiston) are evidence for Late Mississippian or Early Pennsylvanian age (D.L. Jones and B.C. Murchey, written comm., 1980)

Pzv GREENSTONE — Amygdaloidal and variolitic basaltic greenstone with marble and chert interlayers correlated with Angayucham volcanics (Fritts and others, 1971). Greenstone locally contains blastoporphyritic albite. Oxidized chlorite is only metamorphic mineral identified. Pillows and agglomeratic structures recognizable in best exposures. Chert interlayers described above. Marble interlayers in Wiseman A-5 Quadrangle contain Permian fossils (Patton and Miller, 1973). Pzq, Pzs, and Pzp appear to be interlayered with Pzv in Wiseman A-6 Quadrangle, but contacts are not exposed

MIDDLE PALEOZOIC AND PROTEROZOIC (?) POLYMETAMORPHIC SCHIST UNITS

No direct evidence for age of these rock units exists; regional age data summarized in Turner and others (1979) and Dillon and others (1980) are compatible with Devonian or Proterozoic ages. No rocks of intermediate age have been identified in the schist belt west of Baird Mountains. A Devonian age is more likely for compositionally uniform metasedimentary rocks.

Compositionally Uniform Polymetamorphic Rock Units

P-gmaqs GRAPHITIC SCHIST — Uniform to slightly banded, dark-gray, fine- to medium-grained graphitic, commonly pyritic schist. Metamorphic mineralogy designated as follows: g = graphitic; a = black albite; b = biotite; gar = garnet; c = calcite; cl = chlorite; m = muscovite; q = quartz; s = schist; minerals listed in order of increasing abundance. For example, g.m.q.s designates graphitic-muscovite-quartz schist with muscovite subordinate to quartz; any combination of minerals may occur. Unit contains accessory rutile + apatite ± tourmaline. In some cases, uniform graphitic schist represents subdivision of polymetamorphic banded schist Pb-mq and Pb-qm described below

P-clmqs QUARTZ SCHIST — Uniform to slightly banded quartz schist with little or no graphite and pyrite; metamorphic mineralogy designated by acronyms as shown for graphitic schists. Unit contains accessory rutile + apatite ± tourmaline

P-maqs / P-mqfs FELDSPATHIC QUARTZ SCHIST — Uniform to slightly banded gray, medium- to coarse-grained, feldspathic schist; metamorphic mineralogy designated by abbreviations in order of increasing abundance. "f" indicates undifferentiated feldspar; most feldspar is albite ("a"); no K-feldspar identified. Albite locally more abundant than quartz (P-m.q.a.s.). Accessory rutile + apatite ± pyrite ± tourmaline. Locally uniform feldspathic schist is subdivision of polymetamorphic banded schist (Pb-mq and Pb-qm) described below

Pbq BLACK QUARTZITE — Black, blocky, graphitic, and pyritic, muscovite quartzite

Pbf BLASTOPORPHYRITIC FELSIC SCHIST — Creamy to yellowish, blastoporphyritic chlorite-muscovite quartz-albite schist with accessory garnet + calcite + pyrite + zircon ± allanite ± sphene ± clinozoisite. Very coarse, probable relic-porphyritic alkali feldspar (now replaced by albite, muscovite, and quartz) is set in a medium-grained, schistose groundmass of albite, quartz, muscovite, chlorite, calcite, and garnet. Probably represents intrusive equivalent of nearby finer grained felsic schists (Pf). Both types of felsic schists are regionally associated with stratiform copper deposits. Poorly defined vegetation 'kill zones' occur along strike

Pf FELSIC SCHIST — Light-colored, fine-grained, calcareous, chlorite-muscovite-quartz-albite schist with accessory apatite + zircon + rutile ± biotite ± allanite ± talc ± pyrite. Biotite is being replaced by chlorite. Albite forms medium-grained porphyroblasts. Calcite varies from 3% to 20% and more calcareous varieties change along strike into calc-schist (Pcs) and talc schist (Pts). The fine-grained calcareous felsic schist with intermixed calc-schist and talc schist may represent calcareous and bentonitic felsic metatuffs. Calcareous metatuffs were probably originally deposited in an oceanic environment. Similar felsic schist from the Wiseman A-6 Quadrangle yields a 365 ± 10 m.y. Pb-Pb zircon age (Dillon and others, 1980)

Pts TALC SCHIST — Pale-green, fine-grained calcite-muscovite-talc-quartz-albite schist with associated calc-schist (Pcs) and felsite (Pf). Coarse pyrite cubes common. Up to 15% of rock composed of talc. May be a bentonitic metatuff

Pcs CALC-SCHIST — Orange to beige, medium-grained muscovite-quartz-calcite schist and quartz-muscovite-calcite schist; distinguished from marble by its well-developed schistose texture and composed of (muscovite + quartz) >25% and calcite = 25%-75%

Pm MARBLE — Gray, medium-grained marble and quartz marble in layers less than 20 cm thick; grades into calc-schist (unit Pcs) with increasing mica and quartz content

Ppm PLATY GRAY MARBLE — Medium- to dark-gray, medium-grained, graphitic marble with accessory muscovite and quartz. Weathers into thin (<1 cm) plates parallel to relic lithologic layering and schistosity. Apparent relic thin-bedding and high graphite content are evidence for deposition in a restricted, organic-rich environment

Pbm PLATY BLACK MARBLE — Black to dark-gray, platy-weathering marble similar to Ppm above. Includes platy gray marble where it contains coarse, black-calcite pseudomorphs of clasts(?) or plant material(?)

Psk TREMOLITE SKARN — Dark-gray, coarse-grained, quartz-calcite-tremolite hornfels with accessory epidote + clinozoisite + sphene ± albite ± muscovite ± chlorite ± biotite ± garnet. Cut by many arsenopyrite veins. Appears to grade into Ppm. Probable cause of thermal metamorphism is emplacement of blastoporphyritic felsic schist (Pbf)

Pg GREENSCHIST — Medium-grained, clinozoisite-epidote-actinolite-chlorite-albite greenschist with accessory calcite, garnet, white mica, sphene, rutile, magnetite, quartz, allanite, and apatite. Occurs in lenses and layers in polymetamorphic rocks representing flows, dikes, and sills

P-dia / P-gab METAMORPHOSED DIABASE OR GABBRO — Green, medium- to coarse-grained, actinolite-epidote-chlorite-albite schist with accessory sphene, apatite, and pyrite; relic diabasic or gabbroic texture (as abbreviated). Actinolitic amphibole from station 77Dn15 determined by X-ray diffraction to be richterite

Polymetamorphic Banded Schists

Pb-mq INTERBANDED QUARTZITE AND GRAPHITIC SCHIST WITH QUARTZITE >25% — White, medium-grained, quartzite bands less than 5 cm thick with dark-gray, graphitic, albite-chlorite-muscovite-quartz schist interbands. Accessory minerals are clinozoisite + pyrite + tourmaline ± chloritoid ± rutile ± sphene ± calcite ± allanite. Three prominent ages of quartz veins are distinguished by their relationship to metamorphic structures and degree of deformation.

Two or more metamorphic episodes have produced a strong tectonic fabric. Lithologic bands are paralleled by a penetrative schistosity, and are probably not the oldest metamorphic structure. The schistosity and banding are disrupted and partially transposed by subsequent (Cretaceous?) semipenetrative cleavage that shows some slippage and mineral growth. As a result, where cleavage cuts schistosity at high angles, bands are disrupted into distinctive black and white lenses and rods appearing as knots and streaks in outcrop. This "knotty" structure is distinctive of this unit and of unit Pb-qm below. Pb-mq grades southward into Pb-qm with a decrease in proportion of quartzite. Units Pb-mq and Pb-qm are widely referred to as 'country-rock schist' of the southern Brooks Range schist belt.

The great structural complexity of unit Pb-mq evince a long and complex metamorphic history involving two and possibly three metamorphic events. Youngest semipenetrative cleavage is probably Cretaceous. Older schistosity is post-Upper Devonian because it occurs in Upper Devonian rocks in Wiseman B-3 Quadrangle; Wiseman B-3 Upper Devonian rocks lack evidence for the third and oldest metamorphic event suggested by structures in Pb-mq and Pb-qm. Pb-qm and Pb-mq may have pre-late Devonian metamorphic history; supporting evidence is intrusion of Pb-mq in Wiseman B-3 Quadrangle by the Upper Devonian Wild River Pluton (Dillon and others, 1980). Greenschist and gabbro layers provide lithologic evidence for correlation with Proterozoic(?) mafic rocks interlayered with country rocks of Brooks Range schist belt in Ambler District (Turner and others, 1979)

Pb-qm INTERBANDED GRAPHITIC SCHIST AND QUARTZITE WITH QUARTZITE <25% — Contains less quartzite than Pb-mq but otherwise similar; grades into Pb-mq to north; quartz veins particularly noticeable because of dark color of unit Pb-qm

SYMBOLS

- Pingo
- Moraine ridge
- Topographic lineament
- Landslide tracks
- LITHOLOGIC CONTACT — Solid line where contacts located within 100 m; dashed Quaternary unit contacts taken with local modifications from Hamilton (1979a); dashed contacts not as well located; shorter dashes indicate increased uncertainty of location; dotted where concealed. Queries between dashes indicate inferred sedimentary or transposed sedimentary contact; queries at end of contact indicate uncertain continuity and trend
- HIGH-ANGLE FAULT — Solid line where located within 100 m; shorter dashes and dots as above. Queries between dashes indicate contact is probably high-angle fault. Queries at end of fault indicate uncertain continuity and trend
- LOW-ANGLE APPARENT THRUST FAULT — Solid line, dashes, queries, and dots as for high-angle fault above. Barbs on upper plate
- Plunging anticline defined by folded schistosity; dotted where concealed
- Plunging syncline defined by folded schistosity; dotted where concealed
- Horizontal lineation combined with other planar symbols
- Attitude of overturned bedding, arrow indicates dip is approximate
- Syncline and anticline in bedded rocks
- Overturned anticline in bedded and foliated rocks
- Overturned syncline in bedded and foliated rocks
- Attitude of bedding; top (T) indicates geopetal evidence was found
- Attitude of cleavage surface with pencil lineation (P) plunging 10°; m = mineral lineation, f = small fold, af = asymmetric fold, if = isoclinal fold
- Attitude of schistosity
- Strike and dip of cleavage
- Strike and dip of schistosity and parallel semipenetrative cleavage
- Strike of schistosity and parallel semipenetrative cleavage; dips not equal
- Approximate apparent attitude of bedding or cleavage
- Trend and plunge of lineation defined by crenulation (c), plunging 10°; m = mineral lineation, f = small fold; af = asymmetric fold, if = isoclinal fold, p = pencil lineation
- Trend and plunge of axis of asymmetric small fold (af) with axis in plane of schistosity and clockwise rotation as viewed down fold axis
- Fossil locality
- Direction of paleocurrents estimated from clast imbrication (i) and crossbeds (x)

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