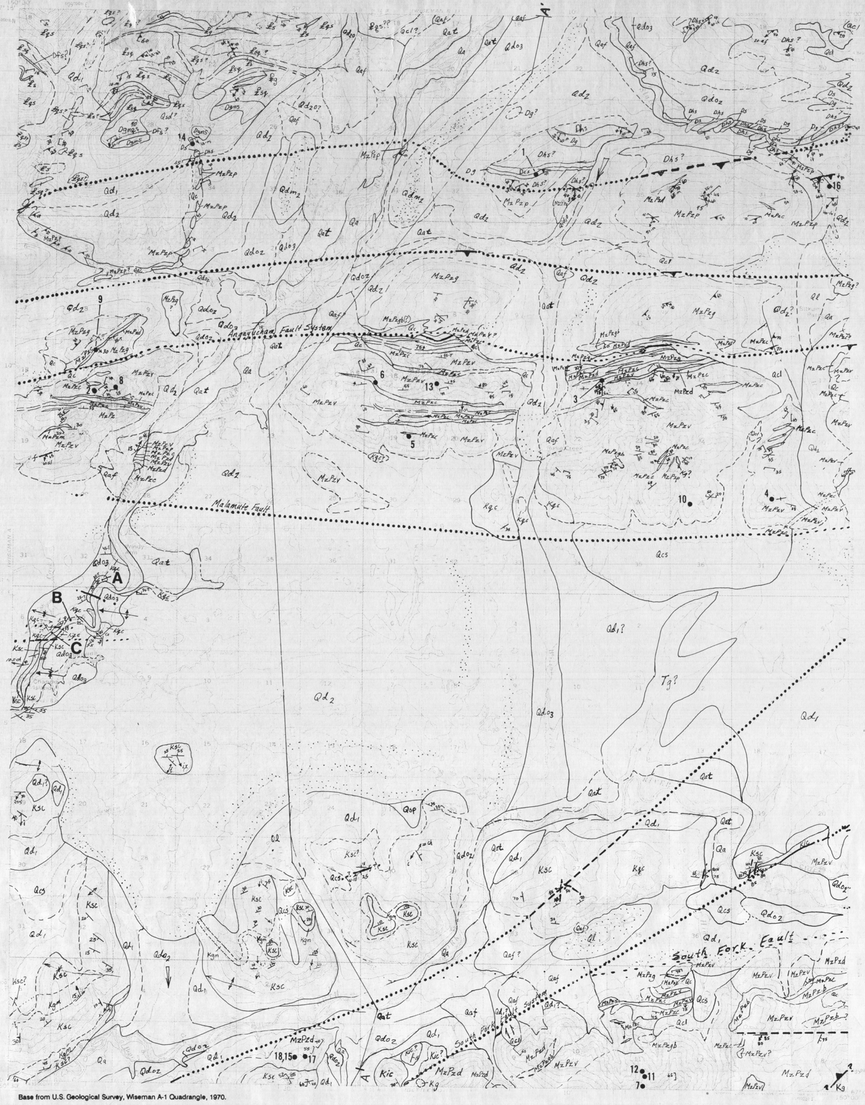
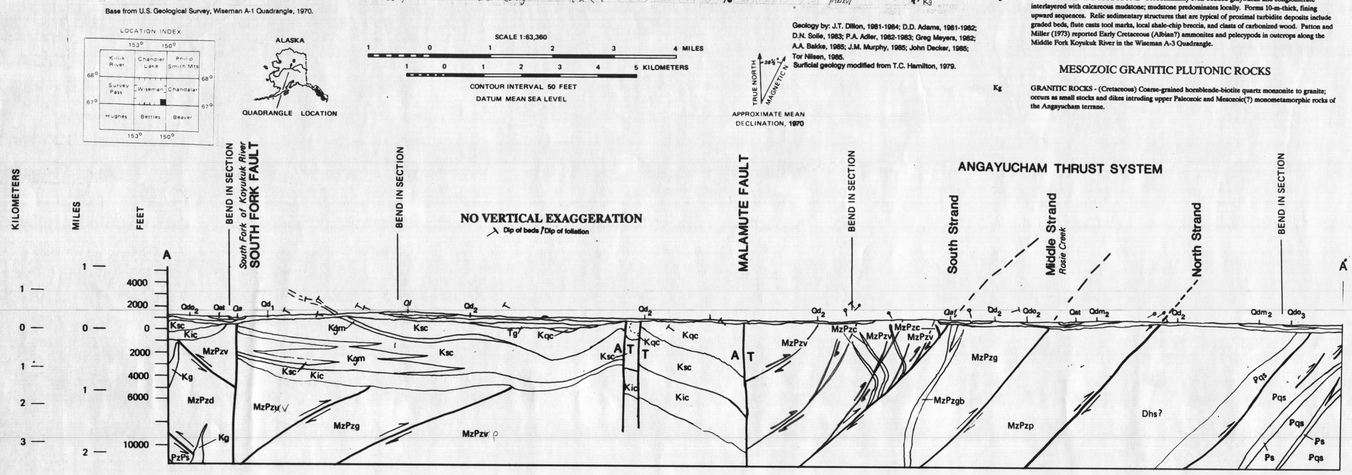
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DESCRIPTION OF MAP UNITS

QUATERNARY DEPOSITS
(modified from Hamilton,1979a)

ALLUVIAL DEPOSITS

Qa ALLUVIAL DEPOSITS, UNDIFFERENTIATED - Poorly sorted, moderately stratified mixtures of gravel, sand, silt, and clay. Largely modern alluvium.

Qat ALLUVIAL-TERRACE DEPOSITS - Poorly sorted, moderately stratified mixtures of sand and gravels; form terraces near modern streams.

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

Qsp ORGANIC SILT - Poorly stratified, organic-rich loess and silty peat in poorly drained areas; contains ice as lenses, wedges, and interstitial grains.

COLLUVIAL DEPOSITS

Qcl 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.

Qcs SOLIFLUCTION DEPOSITS - Very poorly sorted, nonstratified to weakly stratified sheets and aprons of stony, sandy silt and organic-rich silt, typically 1 m thick; active lobes subject to seasonal downslope movement.

Qct TALUS - Angular, unsorted, nonstratified, and generally unvegetated, unweathered rock debris; form cones and aprons along lower walls of mountain valleys and cirques.

LACUSTRINE DEPOSITS

Ql LACUSTRINE DEPOSITS-UNDIFFERENTIATED - Well sorted, stratified silt and clay that contains scattered dropstones; grade into sand near shorelines and fine gravel near stream mouths.

GLACIAL DEPOSITS

Itkillik Glaciation

Qdo_3 OUTWASH OF ITKILLIK PHASE II - Moderately well-sorted, stratified sandy gravel that contains subrounded cobbles and small boulders near moraine fronts and rounded pebbles downvalley. Forms terraced remnants of upstream and valley trains 15 to 25 m above modern flood plains in front of Itkillik Phase II moraines. Usually covered by <0.3 m of loess. Hamilton, Stuckenrath, and Stuiver (1980) reported radiocarbon ages of 13,000 and 30,000 yr B.P. for these deposits.

Qd_2 DRIFT OF ITKILLIK PHASE I - Very poorly sorted to poorly sorted, nonstratified to weakly stratified drift that ranges from silty, sandy gravel to clayey, stony silt with local stratified ice-contact deposits that consist of moderately to poorly sorted sand, sandy gravel, and silty, sandy gravel; contains faceted and striated boulders. Includes eroded arcuate end moraines and lateral moraines (Qdm_2) that extend from the mouths of Wild River and Middle Fork Koyukuk River. Outwash (Qdo_2) is compositionally similar to outwash of Itkillik Phase II but usually covered by a 0.5- to 4 m -thick loess blanket. Forms terraced remnants of aprons and valley trains 20 to 30 m above modern flood plains in front of Itkillik Phase I moraines (Qdm_2). Hamilton, Stuckenrath, and Stuiver (1980) estimated an age of 50,000 yr B.P. for these deposits.

Sagavanirktok River Glaciation

Qd_1 DRIFT - Poorly sorted, nonstratified drift that consists of silty, sandy boulder gravel to clayey, stony silt with locally well-sorted, stratified gravel. Generally covered by blanket of loess, solifluction lobes, and mushog deposits <3 m thick. Forms broad morainal ridges and hummocky ground moraine south of the Brooks Range. Hamilton (1979b) estimated a mid-Pleistocene age for these deposits.

TERTIARY(?) SEDIMENTARY ROCK UNITS

Tg? GRAVEL DEPOSITS - Well to moderately sorted, rounded to well-rounded pebble and cobble deposits in cuddied matrix of coarse sand. Stones are more rounded, sorted, and smaller and more quartzose than those in nearby glacial or post-glacial deposits. Probably older than deposits of the Sagavanirktok River Glaciation.

CRETACEOUS SEDIMENTARY ROCK UNITS

In the southern Wiseman A-1 Quadrangle, unmetamorphosed Albian and Cenomanian marine and nonmarine sedimentary rocks lie unconformably above basement rocks and unconformably below Quaternary deposits. In progressively younger Albian nonmarine units, clast types change from mafic igneous rock and chert to monometamorphic graywacke and siltstone, then to vein quartz and polymetamorphic schist. Measurements of cross-beds and pebble imbrications indicate paleocurrents are from the north, where mafic igneous rock and chert structurally overlie metamorphic graywacke and siltstone that overlie quartz-veined polymetamorphic schist. The sequence of clast types from mafic igneous rock and chert to vein quartz and polymetamorphic schist mark a progression to structurally lower units in the apparent source area and is evidence for unroofing of the Brooks Range metamorphic core during late Albian or Cenomanian time. This conclusion is consistent with Albian K-Ar cooling ages from metamorphic rocks of the Brooks Range (Turner, Forbes, and Dillon, 1979; Dillon and Smiley, 1984).

NONMARINE ROCK UNITS

Kqc QUARTZ-PEBBLE CONGLOMERATE AND SANDSTONE - Predominantly conglomerate and very coarse sandstone with angular grains and subrounded to rounded clast of vein quartz, graphitic schist, and quartzite derived from polymetamorphic rock units exposed to the north in the Brooks Range. Contains subordinate siltstone, mudstone, shale, carbonaceous shale, and coal. Planar and trough cross-beds, 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-grained clastic rocks. Sedimentary structures associated with plant fossils indicate rapid deposition near growing plants under both turbulent and nonturbulent conditions probably in a shallow-water environment on a delta or coastal flood plain (C.J. Smiley, written commun., 1979).

Several species of conifers and dicotelydons found at locations A, B, and C (table 1) were identified by C.J. Smiley (written commun., 1983). Smiley correlated this assemblage with late Albian to early Cenomanian floral zones of northern Alaska (Hollick and Martin, 1930) and estimated a late Albian age for these flora. Patton and Miller (1973) reported Late Cretaceous plant fossils in outcrops along the Middle Fork Koyukuk River near Tramway Bar.

Southern outcrops of this unit may unconformably overlie the metasedimentary-clast conglomerate (Kac; Brosge and Reiser, 1971). In northern outcrops of this unit, the contact with underlying rocks is concealed, except at its northern limit in the Wiseman A-5 and A-6 Quadrangles, where the unit lies unconformably on upper Paleozoic greenstone, chert, graywacke, and phyllite. In the Wiseman A-3 and A-4 Quadrangles, the contact may be a fault.

Kac METASEDIMENTARY-CLAST CONGLOMERATE - Cobble conglomerate that consists primarily of metagraywacke and phyllite clasts with subordinate greenstone and gabbro and red and green chert cobbles. Clasts derived mainly from monometamorphic sedimentary rocks of late Paleozoic to early Mesozoic age. Forms interbeds in upper portions of igneous clast conglomeratic (Kic).

Kic IGNEOUS-CLAST CONGLOMERATE - Cobble conglomerate with subordinate sandstone. Clasts include rounded greenstone and gabbro metagraywacke, and red and green chert cobbles with a few clast of phyllite, vein quartz, schist, granodioritic, and marble; clasts of metagraywacke are most abundant near the contact with metasedimentary-clast conglomerate (Kac). Clast fabric and trough cross-beds provide evidence for south-flowing paleocurrents. Clasts derived mainly from metaigneous rocks of Angayucham terrane.

MARINE ROCK UNITS

Kgm GRAYWACKE AND MUDSTONE - Predominantly even-bedded graywacke and conglomerate interlayered with calcareous mudstone; mudstone predominates locally. Forms 10-m-thick, fining upward sequences. Relic sedimentary structures that are typical of proximal turbidite deposits include graded beds, flute casts tool marks, local shale-chip breccia, and clasts of carbonized wood. Patton and Miller (1973) reported Early Cretaceous (Albian?) ammonites and pelecypods in outcrops along the Middle Fork Koyukuk River in the Wiseman A-3 Quadrangle.

MESOZOIC GRANITIC PLUTONIC ROCKS

Kg GRANITIC ROCKS - (Cretaceous) Coarse-grained hornblende-biotite quartz monzonite to granite; occurs as small stocks and dikes intruding upper Paleozoic and Mesozoic(?) noncometamorphic rocks of the Angayucham terrane.

UPPER PALEOZOIC AND MESOZOIC(?) MONOMETAMORPHIC ROCKS

METASEDIMENTARY ROCKS

Along the northeast and southeast margins of the Koyukuk basin, the upper Paleozoic to Mesozoic(?) rocks underlie thrust panels of oceanic rocks (Patton and Miller, 1973; Dillon, 1987). Although these metasedimentary units are not fossiliferous in the Wiseman A-3 or A-4 Quadrangles, they contain blocks and interbeds of Triassic and Mississippian biogenic chert in other areas (D.L. Jones, oral commun., 1983). In the Wiseman A-5 and A-6 Quadrangles, metamorphosed graywacke and siltstone (MzPzg) and phyllite (MzPzp) lie structurally beneath greenstone (MzPzv) that contains interlayers of upper Mississippian to Triassic chert (MzPzc) and Permian limestone (Patton and Miller, 1973). Locally in the Wiseman A-6 Quadrangle, graywacke and phyllite units are structurally or stratigraphically interlayered with the greenstone and chert sequences (MzPzv and Mzpzc).

In the Wiseman A-3 and A-4 Quadrangles, upper Paleozoic to Mesozoic(?) monometamorphic graywacke and phyllite (lowermost greenschist facies) with well-preserved clastic textures and sedimentary structures lie structurally or stratigraphically on Devonian and older polymetamorphic schist (upper greenschist to albite-epidote-amphibolite facies) with cleavages S_n and S_2. The structure and fabric of upper Paleozoic to Mesozoic(?) monometamorphic rocks contrast sharply with those of polymetamorphic Devonian and older schists exposed farther north. Parallelism of the youngest cleavage (S_2) in the polymetamorphic schist with semipenetrative cleavage in monometamorphic rocks in the Wiseman A-1 through A-6 Quadrangles provides evidence for synchronous metamorphism (M_2) of polymetamorphic and monometamorphic rocks.

Regional isotopic, structural, and stratigraphic data suggest that the M_2 metamorphism occurred in Late Jurassic or Neocomian time during movement of the Angayucham thrust system (Patton, Tailleur, Brosge, and Lanphere, 1977; Roeder and Mull, 1978; Dillon, Pessel, Chen, and Veach, 1980). S_2 cleavage was formed by post-Mississippian metamorphism (M_2) and is confined to the polymetamorphic rocks. Because of the contrasting metamorphic histories of the rocks, we hypothesize that the monometamorphic rocks were either a) structurally emplaced on polymetamorphic rocks along the Angayucham thrust system and metamorphosed during thrusting or b) unconformably deposited on polymetamorphic rocks after an older metamorphism (M_x) and then deformed and metamorphosed (M_2) during Late Jurassic and Neocomian movement of the Angayucham thrust system. The occurrence of mylonite along the contact between the polymetamorphic and monometamorphic rocks in the Wiseman A-2 Quadrangle is consistent with alternative 'a' above.

MzPzg METAMORPHOSED GRAYWACKE AND SILTSTONE - Pine- to medium grained metagraywacke with minor interbeds of brown metasiltstone and dark-gray, graphitic phyllite. Relic clastic texture and bedding are well preserved. Sole marks on several samples may be relic tool marks. Metagraywacke is composed of angular to subangular detrital grains of quartz (40 percent), rock fragments (35 percent), albite (10 percent), and tourmaline (trace) in a microcrystalline matrix (15 percent) of quartz, sericite, and chlorite. If K-feldspar was originally present, it has been converted to albite. Rock fragments consist primarily of chert but include clasts of graphitic metasedimentary and chloritic metavolcanic rocks. Metamorphic minerals include quartz + albite + sericite ± chlorite ± biotite ± white mica. Semipenetrative cleavage is defined primarily by sericite, chlorite, pyrite, and rare biotite, and metamorphic textures are similar to textural zone 2 of metagraywacke (Blake, Irwin, and Coleman, 1967). These textures and structures appear to be the result of one metamorphism, although locally, refolded folds and folded cleavages in the unit provide evidence for at least two deformational events.

MzPzp PHYLLITE - Dark-gray, graphitic phyllite with subordinate metasiltstone and metagraywacke interbeds. Similar in sedimentary and metamorphic mineralogy, texture, and structure to metamorphosed graywacke and siltstone unit (MzPzg).

MAFIC METAIGNEOUS ROCKS WITH CHERT LAYERS

Although only limited surface exposures exist of these units their subsurface extent is probably greater (see cross section). They are slightly metamorphosed (prehnite-pumpellyite or lower greenschist facies) pillow basalt and pillow breccia with chert interbeds. Numerous diabase dikes and sills and rare gabbro plugs intrude the units, and locally lenses of tuffaceous limestone are interbedded with the pillow basalt. Metaigneous rocks and chert form a thrust panel that structurally overlies the monometamorphic sedimentary rocks (MzPzg and MzPzp) and are unconformably overlain by Cretaceous sedimentary rocks. Correlated with the Angayucham volcanics of Prins, Eakins, and Garland (1971).

MzPzd MAFIC DIKES - Very dark-gray to dark- greenish-gray diabase; composed primarily of plagioclase and pyroxene with an ophitic texture. Locally includes gabbro, olivine gabbro (map number 17; table 2), clinopyroxenite (map number 15; table 2), and peridotite(?) (map number 18; table 2).

MzPzgb GABBRO - Dark-greenish dark-gray, medium-grained, composed of plagioclase + clinopyroxene ± orthopyroxene ± olivine.

MzPzv PILLOW BASALT - Amygdaloidal and varicolitic pillow basalt and pillow breccia and intrusions of diabase greenstone with local interlayers of limestone and chert (Mzpzc). Greenstone locally contains blastoporphyritic albite. Tuffaceous limestone interlayers in MzPzv in the Wiseman A-5 Quadrangle contain mixed Permian and Pennsylvanian fossils (Patton and Miller, 1973). Pennsylvanian fossils are bioclastic debris eroded from a Pennsylvanian source area; Permian fossils are bioclastic debris or indigenous fossils.

Mzpzc CHERT - Red, green, and gray, 10-m-thick, banded chert layers in pillow basalt and diabase (MzPzv). Late Mississippian, Pennsylvanian, Permian, and Triassic radiolaria have been found in this unit in the southern Wiseman, Chandalar, and Philip Smith Mts Quadrangles (D.L. Jones and B.C. Murchey, written commun., 1980, 1982, 1983). Imbricate thrust faulting within the greenstone and chert sequence is probably responsible for the juxtaposition of cherts of disparate ages in the Wiseman A-1 and Chandalar A-6 Quadrangles (D.L. Jones, oral commun., 1983).

PROTEROZOIC(?) OR LOWER PALEOZOIC(?) AND DEVONIAN(?) POLYMETAMORPHIC SCHIST UNITS

Because no fossils have been found in these units in the Wiseman A-1 Quadrangle and because most radiometric decoy series are reset by multiple metamorphic events, the age of the protolithis is uncertain. Correlative rocks, however, have been dated as Late Proterozoic and Devonian (Turner Forbes and Dillon, 1979; Dillon, Pessel, Chen, and Veach, 1979, 1980). For example, correlative marble units in the Wiseman A-5 Quadrangle contain Devonian(?) conodonts, and felsic schist interlayers within 'compositionally uniform schists' in the Wiseman A-6 have been radiometrically dated (Pb-Pb, zircon) as Devonian.

Compositionally uniform graphitic, quartzose feldspathic, and mafic schists of Devonian age are lithologically similar to other schists of Late Proterozoic(?) age, except the Devonian(?) schists lack banding and contain interlayers of felsic schist, blastoporphyritic felsite, talc schist, black quartzite, black marble, and phyre, locally fossiliferous gray marble. Together these Devonian(?) units form a package that can be traced, into faunally and radiometrically dated Devonian rocks in the Wiseman A-5 and A-6 Quadrangles and the Survey Pass and Amber River Quadrangles (Pessel and Brosge, 1977; Nelson and Grybeck, 1980; Hintzman, Smith, and Proffett, 1982). Devonian(?) units are also stratigraphically or structurally higher than lithologically similar Proterozoic(?) units.

Upper Proterozoic(?) or lower Paleozoic(?) units are distinguished from Devonian(?) units by the absence of metavolcanic rocks and the presence of compositionally heterogeneous bands and knots in the schist. In addition, Upper Proterozoic(?) or lower Paleozoic(?) units have a more complex metamorphic history than Devonian(?) units. These banded and knotty, compositionally heterogeneous units appear, structurally and metamorphically, to be the oldest rocks in the map area.

Some Proterozoic(?) rocks, especially the marbles and the greenschist, are compositionally uniform. Locally they occur as conformable bands with relic sedimentary contacts with the knotty schist. These compositionally uniform Proterozoic(?) units, however, may be Devonian(?) rocks incorporated into the Proterozoic(?) rocks by unrecognized structures.

At least two episodes of metamorphism (M_x and M_2) have affected the Upper Devonian(?) schists , and, three metamorphic events (M_x, M_{x+1} and M_2) appear to have affected the Proterozoic(?) banded schists. The youngest metamorphic event (M_2) is represented by semipenetrative, schistose, axial-plane cleavage (S_2) and probably occurred during Late Jurassic or Neocomian time. In Upper Devonian(?) rocks, an older metamorphic event (M_x) is evident from a penetrative schistosity (S_x) that is parallel to a lithologic layering and partially transposed by the younger schistosity (S_2). Schistosities were developed during two greenschist facies events. A third, older metamorphic event (M_{x-1}) may have formed the gneissic bands in the Proterozoic(?) banded schists. In the knotty schists, the bands were deformed into lens- and rod-shaped structures during the younger metamorphic events (M_x and M_2).

At least three generations of quartz veins are distinguished by crosscutting relationships among veins and cleavages, and folds formed during metamorphic events. Metamorphic structures are postdated by the youngest veins and predated by the oldest veins. Intermediate-age veins cut S_x but are cut by S_2 schistosities. Preliminary analyses of fluid inclusions in quartz veins from the Wiseman and Chandler Quadrangles show that the youngest veins were emplaced during cooler and more hydrous conditions than existed during emplacement of the older two generations of veins (Dillon, 1987).

Physical rock properties for metamorphic rocks in the Wiseman Quadrangle are listed in Hackett and Dillon (1982).

COMPOSITIONALLY UNIFORM SCHISTS OF DEVONIAN(?) AGE

Dhs HUNT FORK SCHIST - (Upper Devonian ?) Black quartz schist; locally contains graphite. This unit is correlative with the Hunt Fork Shale which crops out in the Wiseman Quadrangle 'D' tier, 'C' tier, and 'B' tier, except the B-1 Quadrangle (Dillon and others, 1986). The Upper Devonian Hunt Fork Shale in these quadrangles consists of black slate and phyllite, minor fossiliferous limestone; lithic wacke locally in upper part; basal quartz-chert clast conglomerate and sandstone.

Dg METABASITE - Dark-gray, medium-grained basic intrusive rocks. Consists of clinozoisite-epidote-actinolite-chlorite-albite greenschist; accessory minerals are calcite, garnet, white mica, sphene, rutile, magnetite, quartz, allanite, and apatite. Probably represents metamorphosed basic intrusive rocks: diabase, gabbro, and diorite dikes and sills.

Ds METAVOLCANIC ROCKS - Basic volcanic rocks consisting primarily of fine- to medium-grained chlorite, epidote, and albite. These metavolcanic rocks occur in lenses and interbeds in polymetamorphic rocks which probably represent flows, and are mapped in the field as 'greenschists'.

Dfs FELSIC SCHIST - Light-colored, fine-grained, chlorite-muscovite-quartz-albite schist with accessory apatite, zircon, rutile, biotite, allanite, talc, and pyrite. Biotite is partially replaced by chlorite.

Dcs CALC-SCHIST - Orange to beige, medium-grained chlorite-muscovite-talc-quartz-calcite schist and chlorite-quartz-muscovite-calcite schist composed of at least 25 percent muscovite + chlorite + quartz and 25 to 75 percent calcite. Distinguished from marble by its composition and well-developed schistosity.

Graphitic Schists

Dgms GRAPHITIC MUSCOVITE-ALBITE-QUARTZ SCHIST - Uniformly to slightly banded, dark-gray, fine- to medium-grained with accessory quartz + albite + rutile + pyrite + apatite + tourmaline.

Dgmqs GRAPHITIC MUSCOVITE-QUARTZ-SCHIST - Uniformly to slightly banded, dark-gray, fine- to medium-grained with accessory albite + chlorite + rutile + pyrite + apatite + tourmaline. Locally grades into black quartzite.

COMPOSITIONALLY UNIFORM POLYMETAMORPHIC SCHISTS OF PROTEROZOIC(?) OR EARLY PALEOZOIC(?) AGE

Pg METAMORPHOSED GABBRO AND DIABASE - Green, medium- to coarse-grained actinolite-epidote-chlorite-albite schist with accessory sphene + apatite + pyrite and relic gabbroic and diabasic textures. (In the Wiseman A-4 Quadrangle richterzite was identified by X-ray diffraction.)

Ps GREENSCHIST - Lithologically identical to Devonian(?) greenschist (Ds) and may be confused with it locally; differentiated by structural position and lithologic association.

POLYMETAMORPHIC BANDED SCHISTS OF PROTEROZOIC(?) OR EARLY PALEOZOIC(?) AGE

Pqs INTERBANDED QUARTZITE AND GRAPHITIC SCHIST - Predominantly white, medium-grained quartzite bands 0.5 cm thick with numerous dark-gray graphitic albite-chlorite-muscovite-quartz schist interbands 1 cm thick to lenses or knots. Bands probably represent metamorphically differentiated relics of interbedded quartzose and pelitic sediments. Accessory minerals are clinozoisite + pyrite + tourmaline + chloritoid + biotite + sphene + calcite + allanite.

Pwq INTERBANDED GRAPHITIC SCHIST AND QUARTZITE - Lithologically similar to interbanded quartzite and graphitic schist (Pqs) but contains <25 percent quartzite. Quartz veins are especially noticeable because the unit is dark colored. Locally includes graphitic schist.

DISCUSSION

METAMORPHISM

Units Pqs and Pwq are known as the 'rountzy-rock schist' of the southern Brooks Range 'schist belt'. Two or more metamorphic episodes have produced a distinct tectonic fabric within the country rock schist. Clastic lithologic bands transposed from bedding are evidence for the oldest metamorphic event ($M_x?$). A strong penetrative schistosity (S_2) locally cuts across the bands and deforms them into rods, but in most places the schistosity parallels the banding; therefore, the banding may have formed preacompressionsequent with schistosity (S_2) during metamorphism M_2. The schistosity and banding are disrupted and partially transposed by subsequent Late Jurassic or earliest Cretaceous semipenetrative cleavage (S_3) that is defined by middle greenschist-facies minerals and shows some slippage. Where semipenetrative cleavage cuts schistosity and banding at high angles, bands of quartzite and graphitic schist are disrupted into black and white lens and rods that result in the distinctive 'knotty' structure.

The lack of knotty structures in the Devonian rock units and intrusion of the Upper Devonian Wild River pluton (Dillon,Pessel,Chen,and Veach, 1980) into unit Pwq in the Wiseman B-3 Quadrangle are evidence of a pre-Late Devonian metamorphism of the banded schist. Greenschist and gabbro layers within the banded schist can be correlated with Proterozoic(?) mafic rocks interlayered with country rock in the Brooks Range 'schist belt' in the Hub Mountains area and the Amber mining district (Turner, Forbes, and Dillon, 1979).

FAULTS

Although the Angayucham thrust system is not well exposed in outcrop in the map area, evidence for its presence includes an abrupt transition from monometamorphic to polymetamorphic rocks and an abrupt 500 - west-southwest-trending step downward from high, varied magnetic values on the north to low, smooth values on the south. The Angayucham thrust system displaced Carboniferous, Permian, and Triassic rocks in its upper plate and is apparently responsible for Late Jurassic to Early Cretaceous metamorphic events. Mid-Cretaceous K-Ar cooling ages (Turner, Forbes, and Dillon, 1979) and the presence of post-metamorphic Albian molasse deposits (units Kqc, Kic, Kic) are consistent with Early Cretaceous thrusting events that have been attributed to obduction during plate convergence (Roeder and Mull, 1987; Dillon, pessel, Chen, and Veach, 1980).

The Malamute fault zone marks a geologic and topographic boundary along the South front of the Brooks Range in the Wiseman Quadrangles (Patton and Miller, 1973; Hamilton, 1979a). Our mapping provides further evidence that the west-trending trough between the foothills and the Brooks Range is a fault line scarp. The fault zone has been located by outcrop in the Wiseman A-5 and A-6 Quadrangles, cuts through upper Paleozoic metamorphic rocks and is composed of numerous steeply dipping gouge-and-breccia fault planes that separate phacoids and blocks of metamorphic rock. The fault is projected along a 150 west-trending step in the aeromagnetic contours and along a 20-degal step on a simple Bouguer-anomaly profile. Separation of this fault in the Wiseman Quadrangles is about 35 km to the right and is up on the north side; slip was not determined.

The Malamute fault displaces Upper Jurassic to Neocomian metamorphic rocks and the Angayucham thrust system in the Wiseman Quadrangles; therefore movement on the fault probably occurred after Neocomian time. Regionally, the massive to nonmarine facies change in the Albian-Cenomanian molasse deposits (Kgm to Ksc and Kic) parallel the Malamute fault zone and may be the result of movement on the fault in Albian time. Development of the Malamute fault may be related to post-thrusting isostatic rebound of the Brooks Range or the movement on the Tintina fault (Grantz, 1966, p. 30; Dillon, Tilton, Decker, and Kelly, 1987) or to both.

FOLDS

Many megascopic folds were identified in the field, but the larger, north-vergent recumbenet folds shown on the cross section were not located. Four lines of evidence indicate the existence and geometry of the larger folds: a) folds of this size and symmetry have been recognized in the Wiseman A-3, A-4, B-3, B-5, and B-4 Quadrangles; b) the repetition of lithologic units are best explained by folding even where hinge areas were not located; and c) semipenetrative cleavage (S_2) is axial planar to the mapped mesoscopic and megascopic folds; measurements of this axial-planar cleavage provides reference surfaces control of the geometry of the unmapped folds. In addition, the intersection of the younger semipenetrative axial planar cleavage (S_2) with the older, layer parallel penetrative cleavage (S_x) indicates the location of major fold axes.

GEOLOGIC MAP SYMBOLS

- Contact—Dashed where approximately located; dotted where concealed; dip direction shown where known; dip angle shown where measured
- Thrust fault—Sawteeth on upper plate; dashed where approximately located; dotted where concealed
- Fault—Dashed where approximately located; dotted where concealed
- Axis of syncline—Showing direction of dip of limbs and plunge of axis
- Axis of anticline—Showing direction of dip of limbs and plunge of axis
- A • Fossil-collection locality—Letter keyed to table 1
- 3 • Rock-sample with major-oxide geochemistry—Number keyed to table 2
- Strike and dip of beds
- Vertical beds
- Overturned beds
- Strike and dip of beds with bearing and plunge of paleocurrents
- Generalized strike and dip of planar structure
- Strike and dip of dike
- Strike and dip of schistosity; S1 = schistosity one, S2 = schistosity two
- Strike and dip of schistosity and parallel semipenetrative cleavage
- Strike and dip of schistosity and parallel semipenetrative cleavage with plunge of asymmetric fold (af), isoclinal fold (if), slickensides (sl or slk), cleavage (c), minerals (m), and fold axis (f1 = folding event one; f2 = folding event two)
- Trend and plunge of axis of asymmetric mesoscopic fold with axis in plane of schistosity; cross arrow indicates direction of rotation as viewed down fold axis
- Strike and dip of cleavage
- Horizontal lineation combined with other planer symbols

CORRELATION OF MAP UNITS

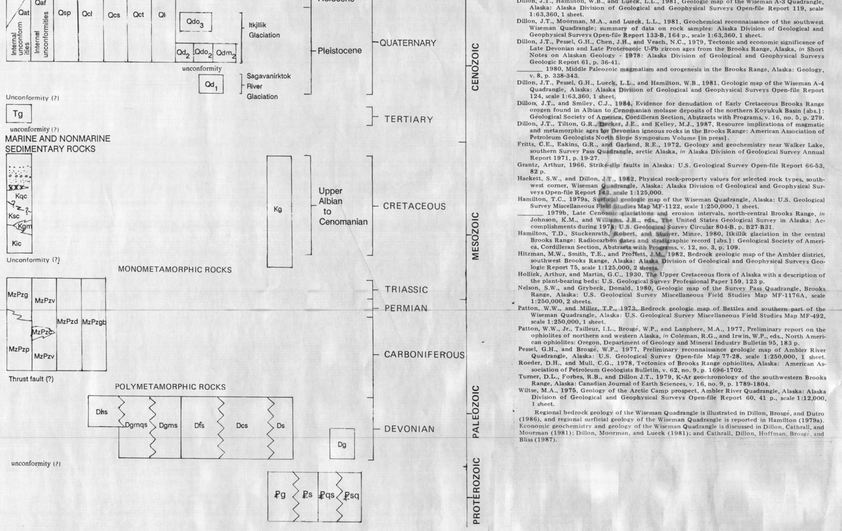


Table 1. *Upper Cretaceous plant and invertebrate fossils from Wiseman A-1 Quadrangle, northern Alaska (identified by C.J. Smiley, University of Idaho, Moscow, 1983).*

Map letter, Isernshot	Location	Fossil	Age and correlation
A(83CH335)	67° 07'00";150° 28'50"	Coalified wood chips Conifer shoots - Sequoia reichenbachii(?),Pityostrobus of G. ajoensis	Plant fossils are similar to Cretaceous "Shaktolik" flora along the Yukon River (Hollick and Martin, 1930, p. 156); the closest correlation is with upper Albian floras of the Nanushuk Group north of the Brooks Range.
B(83CH3251)	67° 09'23";150° 29'54"	Conifer shoots - Cephalotaxopsis	Conifers of the type are found in the Yukon River Shaktolik floras, the later (Senonian) Chignik flora of southwest Alaska and are also characteristic of Aptian to Albian floras of Siberia.
C(83CH-336)	67° 08'17";150° 28'36"	Fern - Cladophlebis of C. denticulata, Ginkos - G. digitata and G. pseudotaxifolia, Conifer shoots - Cephalotaxopsis, Sequoia reichenbachii(?), Pityostrobus of G. ajoensis	On the North Slope, the fern species is restricted to the Lower Part of Zone B (Upper Albian). The Ginkgo and conifers are types that are common in the Shaktolik flores (Hollick and Martin, 1930, p. 159) and throughout the Albian of the North Slope (except for S. ajoensis, which has not been found north of the Brooks Range).

Table 2. *Major-oxide analyses and CIPW norms of rocks in the Wiseman A-1 Quadrangle, northern Alaska*

Map Number	Sample Number	Rock Unit	Total	SiO2	Al2O3	Fe2O3	FeO	MgO	MnO	CaO	Na2O	K2O	TiO2	P2O5	LOI	H2O+	H2O-	Comments
1	83AC420	Dg	99.32	48.70	14.88	1.78	10.14	6.22	0.16	8.29	2.88	0.05	3.24	0.00	3.74	0.00	0.00	Basalt gabbro?
2	82PA025a	MzPzv	99.35	47.71	13.72	4.45	8.14	6.20	0.31	11.04	3.18	0.08	3.33	1.47	0.00	0.00	0.00	Basalt
3	82PA026b	MzPzv	98.75	48.17	13.48	3.35	8.54	6.21	7.08	11.17	2.84	0.02	0.69	1.16	0.00	0.00	0.00	Basalt
4	82PA040	MzPzv	99.09	48.05	13.63	4.44	7.78	5.89	7.60	4.09	0.24	0.07	2.80	0.00	2.97	0.00	0.00	Basalt
5	82PA082	MzPzv	99.28	54.44	16.15	3.74	6.12	0.19	3.43	7.97	3.06	0.05	0.80	0.00	0.31	0.00	0.00	Greenstone
6	82PA083	MzPzv	99.60	48.82	13.86	3.70	8.56	0.21	7.57	10.21	2.69	0.10	0.13	1.14	0.00	0.00	0.00	Greenstone
7	82PA102a	MzPzd	99.52	49.40	15.08	3.15	8.85	0.18	8.88	12.11	2.44	0.23	0.22	1.58	0.00	0.00	0.00	Metabasalt
8	82PA104	MzPzd	101.04	46.87	15.08	3.66	8.33	0.21	6.87	8.41	3.80	0.02	0.20	1.26	0.00	0.00	0.40	Pillow basalt
9	82CH041	MzPzd	99.15	47.01	12.91	2.21	13.36	0.23	5.54	5.83	3.39	0.05	0.45	3.17	0.00	0.00	0.00	Diabase dike
10	82CH058	MzPzv	99.82	48.58	17.80	4.14	6.06	0.15	3.91	8.64	4.02	0.48	0.16	2.26	0.00	3.18	0.00	0.33	Porphyritic basalt
11	82CH072a	MzPzd	99.39	47.47	14.84	3.15	9.04	0.18	8.19	11.22	2.20	0.14	0.14	1.83	0.00	1.01	0.00	0.00	Porphyritic basalt
12	82CH073	MzPzd	99.46	49.44	15.09	2.34	9.21	0.18	8.85	10.82	2.51	0.85	0.12	1.74	0.00	0.00	0.00	0.00	Gabbro
13	82CH083	MzPzv	99.79	48.13	13.97	2.67	8.81	0.20	7.63	12.90	1.98	0.10	0.07	1.09	0.00	2.05	0.00	0.39	Pillow basalt
14	82CH088b	Ds	100.28	50.47	16.44	11.69*	0.00	0.18	6.66	5.04	4.93	0.02	0.14	1.45	0.00	2.93