

GEOLOGIC MAP OF THE WISEMAN A-1 QUADRANGLE, SOUTHCENTRAL BROOKS RANGE, ALASKA

1989

DESCRIPTION OF MAP UNITS

QUATERNARY DEPOSITS (modified from Hamilton, 1979a) **ALLUVIAL DEPOSITS**

ALLUVIAL DEPOSITS, UNDIFFERENTIATED-Poorly sorted, moderately stratified mixtures of gravel, sand, silt, and clay. ALLUVIAL-TERRACE DEPOSITS-Poorly sorted, moderately stratified mixtures of sand and gravel; form stream terraces.

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,

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

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,

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.

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

LACUSTRINE DEPOSITS

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

Hamilton and others (1980) reported radiocarbon ages of 13,000 and 30,000 yr for these deposits.

Hamilton (1979a).

GLACIAL DEPOSITS 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 aprons 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.

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 (Qdmo) that extend from the mouths of Wild River and Middle Fork Kovukuk River. Outwash (Qdoo) 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 (Qdm₂). Hamilton and others (1980) estimated an age of 50,000 yr for these deposits. Moraines of the Itkillik Phase II do not occur in the Wiseman A-1 Quadrangle, but have been mapped to the north and northwest by

Sagavanirktok River Glaciation

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

TERTIARY(?) SEDIMENTARY ROCK UNITS

GRAVEL DEPOSITS-Well to moderately sorted, rounded to well-rounded pebble and cobble deposits in oxidized matrix of oarse sand. Stones are more rounded, sorted, and smaller and more quartzose than those in nearby glacial or post-

CRETACEOUS SEDIMENTARY ROCK UNITS

In the southern Wiseman A-1 Quadrangle, unmetamorphosed Albian to Cenomanian marine and nonmarine Quaternary deposits. In progressively younger Albian nonmarine units, clast types change from mafic igneous rock and crossbeds 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. Paleocurrer measurements are shown in figure 1. The sequence of clast types from mafic igneous rock and chert to vein quartz and polymetamorphic schist marks a progression to structurally lower units in the apparent source areas 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 and others, 1979; Dillon and Smiley, 1984). The Cretaceous sedimentary rock units are increasingly deformed and sheared in the southern part of the quadrangle due to strike-slip movement along the South Fork fault system.

NONMARINE ROCK UNITS

QUARTZ-PEBBLE CONGLOMERATE AND SANDSTONE-Predominantly reddish-brown, iron-stained pebble conglomerate, with lesser cobble conglomerate, and very coarse-grained sandstone with subrounded to rounded clasts 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 crossbeds, channels, clast imbrication, and normal and reverse grading occur in coarse clastic rocks; ripple marks, plant fossils, and worm burrows 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 slack-water environment on a delta or coastal flood plain (C.J. Smiley, written commun., 1979). This highly siliceous unit produces a distinctive vegetation assemblage, dominated by lichen and sparse, stunted trees.

Several species of conifers and dicotyledons found at locations A, B, and C (table 1) were identified by C.J. Smiley 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.

In the Wiseman A-1 Quadrangle, contact relations between the quartz-pebble conglomerate (Kqc) and the underlying metasedimentary-clast conglomerate (Ksc) are unclear. The quartz-pebble conglomerate (Kqc) may depositionally overlie the Angayucham volcanic rocks near Rosie Creek Pass. To the west, in the southern Wiseman A-4 Quadrangle, the quartz-pebble conglomerate unit may unconformably overlie the metasedimentary-clast conglomerate (Ksc; Brosgé and Reiser, 1971; Dillon and others, 1987). 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 and Mesozoic(?) greenstone, chert, graywacke, and phyllite units. In the Wiseman A-3 and A-4 Quadrangles, the contact may be a fault.

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 conglomerate (Kic) in the A-tier quadrangles to the west. IGNEOUS-CLAST CONGLOMERATE-Cobble conglomerate with subordinate sandstone. Clasts include rounded

greenstone and gabbro metagraywacke and red and green chert cobbles with a few clasts of phyllite, vein quartz, schist, granodiorite, and marble; clasts of metagraywacke are most abundant near the contact with metasedimentary-clast conglomerate (Ksc). Clast fabric and trough crossbeds provide evidence for S. 30° W.-flowing paleocurrents (fig. 1). Clasts are derived mainly from metaigneous rocks of Angayucham terrane to the north.

MARINE ROCK UNITS

outcrops along the Middle Fork Koyukuk River in the Wiseman A-3 Quadrangle.

METASEDIMENTARY-CLAST CONGLOMERATE-Cobble conglomerate that consists primarily of metagraywacke and

GRAYWACKE AND MUDSTONE-Predominantly even-bedded graywacke and conglomerate interlayered with calcareous udstone; mudstone predominates locally. Forms 10-m-thick, fining-upward sequences. Relict 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

MESOZOIC GRANITIC PLUTONIC ROCKS GRANITIC ROCKS-Medium-gray, coarse-grained hornblende-biotite quartz monzonite to granite; occurring as small stocks and dikes intruding upper Paleozoic and Mesozoic(?) monometamorphic rocks of the Angayucham terrane south of the South Fork fault. Monzonite, syenite and granite of the felsic Jim River pluton crop out within 5 km of the southern

boundary of the A-1 Quadrangle. The Jim River pluton contains two distinct suites: silica-saturated monzonite and syenite, and silica-oversaturated granite. Both suites yield K-Ar ages which average 107 ± 6 Ma, a single Rb-Sr wholerock isochron that yields an age of 112 ± 4 Ma, and an initial 87Sr/86Sr ratio of 0.70778 ± 0.00006 (Blum and others, UPPER PALEOZOIC AND MESOZOIC(?) MONOMETAMORPHIC ROCKS

METASEDIMENTARY ROCKS Along the northeast and southeast margins of the Koyukuk basin, upper Paleozoic to Mesozoic (7) rocks underlie thrust panels of oceanic rocks (Patton and Miller, 1973; Dillon, 1989). In the Wiseman A-1 Quadrangle north of Cathedral Mountain and northeast of Rosie Creek Pass, an Early Devonian age is indicated by palynofloral residues (Gottschalk, 1987) from the graywacke and siltstone unit (MzPzg). 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; Jones and others, in press).

Fossils from these metasedimentary rocks along the southern Brooks Range and the northeast and southwest flanks of the Ruby

geanticline indicate a maximum age range of late Early Devonian to Triassic or Early Jurassic; Murphy and Patton (1988) preferred

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). Murphy and Patton (1988) recently discussed this metaphyllite and metagraywacke thrust panel and recognized it for more than 500 km along the southern Brooks

facies), with well-preserved clastic textures and sedimentary structures which have undergone one metamorphic event, lie structurally on Devonian and older polymetamorphic schist (upper greenschist to albite-epidote-amphibolite facies) with S2 and S3 cleavages. 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 (S3) in the polymetamorphic schist with semipenetrative cleavage in monometamorphic rocks in the Wiseman A-1 through A-6 Quadrangles provides evidence for synchronous metamorphism (M₃) of polymetamorphic and monometamorphic rocks.

In the Wiseman A-1, A-3, and A-4 Quadrangles, upper Paleozoic to Mesozoic (7) graywacke and phyllite (lowermost greenschist

Regional isotopic, structural, and stratigraphic data suggest that the M3 metamorphism occurred in Late Jurassic or Neocomian time during movement of the Angayucham thrust system (Patton and others, 1977; Roeder and Mull, 1978; Dillon and others, 1980). S2 cleavage was formed by post-Mississippian metamorphism (M2) 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 from an older metamorphism (M2) and then deformed and metamorphosed (M3) 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.

METAMORPHOSED GRAYWACKE AND SILTSTONE-Dark-greenish-gray to very dark-gray, fine- to medium-grained metagraywacke with minor interbeds of brown metasittstone, dark-gray graphitic phyllite, coarse-grained sandstone, and medium-pebble conglomerate. Relict clastic texture and bedding are well preserved. Sole marks on several samples may be relict tool marks. Metagraywacke is composed of angular to subangular detrital clasts. Mineral percentages from our estimate and from averaged value (in parentheses) for point count data from Murphy and Patton (1988) are; guartz. 40 (43); rock fragments, 35 (45); and albite, 10 (9); in a microcrystalline matrix of 15 (10) percent quartz, sericite and chlorite. Tourmaline occurs in a trace amount. Potassium feldspar, if originally present, has been converted to albite. Rock fragments consist primarily of chert, but include clasts of graphitic metasedimentary and chloritic metavolcanic rocks. Chert, as a percentage of all rock fragments, averages 56 percent (Murphy and Patton, 1988). 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 metagraywackes of Blake and others (1967). These textures and structures appear to be the result of one metamorphism, although local, refolded folds and folded cleavages in the unit provide evidence for at least two deformational events. Gottschalk (1987) reported an Early Devonian age for palynofloral residues from this unit.

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 MAFIC METAIGNEOUS ROCKS WITH CHERT LAYERS

Discontinuous surface exposures exist of these units, but 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 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 Fritts and others (1971).

PILLOW BASALT-Dark-greenish-gray and dark-greenish-black, aphanitic, fine-grained, medium-grained, and locally coarse-grained or porphyritic (to 6mm), amygdaloidal and variolitic basalt, pillow basalt, and pillow breccia with local blastoporphyritic albite. Shearing is pervasive, quartz-veining and slickensides are common, and open-space-filling quartz crystals occur locally. Intrusions of diabasic greenstone with local interlayers of limestone and chert (Mzpzc) also occur. The thin, discontinuous limestone-to-marble bodies are < 10 m thick, light gray, medium to coarse grained. partially recrystallized, foliated, and locally contain crinoid ossicles and brachiopod and bryozoan(?) fragments. One marble body large enough to show at this map scale crops out on the south side of Twelvemile Mountain (MzPzm).

MARBLE-Light-gray, medium- to coarse-grained, partially to well-recrystallized, locally tuffaceous and foliated; locally contains greenstone clasts, crinoid ossicles, and brachloood and bryozoan(?) fragments. Marble locality on the south side of Twelvemile Mountain contains forams. Conodont data indicate a late Osagean (Early Mississippian) age and a CAI of 3.5 (Anita Harris, written commun., 1985). In the Wiseman A-5 Quadrangle, marble units may contain mixed Permian and Pennsylvanian fossils (Patton and Miller, 1973). In that area, Pennsylvanian fossils are bioclastic debris eroded from a Pennsylvanian source area; Permian fossils are bioclastic debris or indigenous fossils.

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;

SABBRO-Dark-greenish-gray, medium-grained, composed of plagioclase + clinopyroxene ± orthopyroxene ± olivine. Shearing is pervasive and alteration is extensive. Rocks of this gabbro unit typically occur as small, irregular bodies to 50 m wide and are distinguished in the field from the 'Intrusive dikes' unit (MzPzi) by dark color, mineralogy, equigranular texture, medium grain size, and locally intrusive contacts.

INTRUSIVE DIKES-Light-greenish-gray to mottled very light-gray and light-greenish-gray, fine- to medium-grained, very light-gray-weathering gabbro and diorite. Primary minerals include light-gray plagioclase (to 90 percent), light-green slinopyroxene (to 20 percent), opaque minerals (to 8 percent), and quartz (locally to 7 percent). Secondary minerals are pervasive and include white mica (to 10 percent), epidote (to 10 percent), carbonate (to 8 percent), chlorite (to 4 percent), and locally biotite (to 1 percent). These light-colored, foliated, sheared and altered dikes are late-stage differentiates related to the mafic metaigneous rocks (MzPzv, MzPzd, and MzPzgb) and are locally quartz-normative.

CHERT-Red, green, and dark-gray, to 10-m-thick, banded chert layers in pillow basalt and diabase (MzPzv). Chert nmonly grades to mudstone and siltstone. Locally chert contains wispy, discontinuous laminations 1 to 3 mm thick and is sometimes highly fractured with abundant silica veinlets. Middle to Late Mississippian faunal assemblages were recently reported (Gottschalk, 1987) for chert from the south side of Cathedral Mountain and 4 km northeast of Rosie Creek Pass. Late Mississippian, Pennsylvanian, Permian, and Triassic radiolaria occur in the southern Wiseman, Chandalar, and Survey Pass 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). Our mapping of volcanic rock-chert contact relations indicates faulted and depositional contacts and is consistent with other workers (for example: Sue Karl, oral commun., 1988). Although our map pattern shows relatively continuous chert horizons, these thin marker beds crop out discontinuously in the Wiseman A-1 Quadrangle.

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 K-Ar ages are reset by multiple metamorphic events, the age of the protoliths is uncertain. Correlative rocks in adjacent quadrangles, however, have been dated as Late Proterozoic and Devonian (Turner and others, 1979; Dillon and others, 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 probable Devonian age are lithologically similar

to other schists of Late Proterozoic(7) age, except the Devonian(7) schists lack banding and contain interlayers of felsic schist, blastoporphyritic felsite, talc schist, black quartzite, black marble, and platy, 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 Ambler River Quadrangles (Pessel and Brosgé, 1977; Nelson and Grybeck, 1980; Hitzman and others, 1982). Devonian(7) units are also stratigraphically or structurally higher than lithologically similar Proterozoic(7) units, or

Upper Proterozoic(?) or lower Paleozoic(?) units are distinguished from Devonian(?) units in the Wiseman A-1 Quadrangle by addition, Upper Proterozoic(?) or lower Paleozoic(?) units indicate a more complex metamorphic history than Devonian(?) units. These banded and knotty, compositionally heterogeneous units appear to be the oldest rocks, structurally and metamorphically, in

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 (M2 and M3) have affected the Upper Devonian(?) schists, and three metamorphic events (M1, M2, and M3) appear to have affected the Proterozoic(?) banded schists. The youngest metamorphic event (M3) is represented by semipenetrative, schistose, axial-plane cleavage (S3) and probably occurred during Late Jurassic or Neocomian time. In Upper Devonian(?) rocks, an older metamorphic event (M2) is evident from a penetrative schistosity (S2) that is parallel to a lithologic layering and partially transposed by the younger schistosity (Sg). Schistosities were developed during two greenschist-facies events. A third, older metamorphic event (M₁) 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 (M2 and M3). 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 S2 but are cut by S3 schistosities. Preliminary analyses of fluid inclusions in quartz veins from the Wiseman and Chandalar 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 and others, 1987).

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

COMPOSITIONALLY UNIFORM SCHISTS OF DEVONIAN(?) AGE

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

METABASITE-Dark-gray, medium-grained basic intrusive rocks. Consists of clinozoisite, epidote, actinolite, chlorite and

METAVOLCANIC ROCKS-Light-green and medium-green, fine- to medium-grained chlorite, epidote, and albite volcanic ocks. These basic volcanic rocks occur in lenses and layers in polymetamorphic rocks and probably represent flows;

hey are mapped in the field as 'greenschists' (table 2). FELSIC SCHIST-Light-colored, fine-grained, chlorite-muscovite-quartz-albite schist with accessory apatite, zircon, rutile,

piotite, allanite, talc, and pyrite. Biotite is partially replaced by chlorite. ALC-SCHIST-Orangish-gray to beige, medium-grained, chlorite-muscovite-talc-quartz-calcite schist and chlorite-quartzsuscovite-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.

Uniformly to slightly banded graphitic schists GRAPHITIC MUSCOVITE-ALBITE-QUARTZ SCHIST-Dark-gray, fine- to medium-grained schist with accessory rutile

SRAPHITIC MUSCOVITE-QUARTZ SCHIST-Dark-gray, fine- to medium-grained quartz-rich schist with accessory albite + prite + rutile + pyrite + apatite + tourmaline. Locally grades into black quartzitic lithologies.

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

METAMORPHOSED GABBRO AND DIABASE-Green, medium- to coarse-grained, actinolite-epidote-chlorite-albite schist with accessory sphene + apatite + pyrite and relict gabbroic and diabasic textures. Richterite identified by X-ray

GREENSCHIST-Light- to medium-green, fine- to medium-grained, actinolite-epidote-chlorite-albite greenschist. ologically identical to Devonian(?) greenschist (Ds) and may be confused with it locally; differentiated by structural position and lithologic association with other rocks of apparent Proterozoic(?) or early Paleozoic(?) age. POLYMETAMORPHIC BANDED SCHISTS OF PROTEROZOIC(?)

OR EARLY PALEOZOIC(?) AGE NTERBANDED QUARTZITE AND GRAPHITIC SCHIST-Predominantly white, medium-grained quartzite bands < 5 cm thick with numerous dark-gray, graphitic albite-chlorite-muscovite-quartz schist interbands and lenses or knots. Bands

probably represent metamorphically differentiated relics of interbedded quartzose and pelitic sediments. Accessory minerals are clinozoisite + pyrite + tourmaline + chloritoid + rutile + sphene + calcite + allanite. TERBANDED GRAPHITIC SCHIST AND QUARTZITE-Light-gray to white, medium-grained and fine-grained graphitebearing quartzite. Quartzite bands are <5 cm thick with numerous dark-gray, graphitic albite-chlorite-muscovite-quartz schist interbands and lenses or knots. Bands probably represent metamorphically differentiated relics of interbedded quartzose and pelitic sediments. Accessory minerals are clinozoisite + pyrite + tourmaline + chloritoid + rutile +

sphene + calcite + allanite. Lithologically this unit is similar to interbanded quartzite and graphitic schist (Pqs) but contains <25 percent quartzite. Quartz veins are especially noticeable because the graphite-rich rocks are darker Locally includes graphitic schist.

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Dillon and others (1989)

Units Pqs and Psq are known as the 'country 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. Gneissic lithologic bands transposed from bedding are evidence for the oldest metamorphic event (M1?). A strong penetrative schistosity(S2)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 penecontemporaneously with schistosity S2 during metamorphism M2. The schistosity and banding are disrupted and partially transposed by subsequent Late Jurassic or earliest Cretaceous semipenetrative cleavage (S3) 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 lenses and rods that result in the distinctive 'knotty' structure.

The lack of knotty structures in the Devonian rock units and the intrusion of the Upper Devonian Wild River pluton (Dillon and others, 1980) into the interbanded graphitic schist and quartzitic unit (Psq) 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 'Hub Mountain' area (Mt. Angayukaqsraq, northeastern Baird Mountains Quadrangle) and the Ambler mining district (Turner and others, 1979).

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-gamma, 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. In this area, mid-Cretaceous K-Ar cooling ages (Turner and others, 1979) and the presence of post-metamorphic Albian molasse deposits (units Kqc, Ksc, Kic) are consistent with Early Cretaceous thrusting events that have been attributed to obduction during plate convergence (Roeder and Mull, 1978; Dillon and others, 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 in outcrop in the Wiseman A-5 and A-6 Quadrangles, cuts through upper Paleozoic metamorphic rocks, and is composed of numerous steeply dipping, gouge-marked fault planes that separate phacoids and blocks of metamorphic rock. The fault is projected along a 150-gamma west-trending step in the aeromagnetic contours and along a 20-mGal step on a simple Bouguer-anomaly profile. Separation of this fault in the Wiseman Quadrangles is about 35 km right lateral and is up on the north side; slip was not determined. The 35 km of right-lateral, strike-slip movement is based on the apparent offset, from the Wiseman A-3 to the A-5 Quadrangle area, of the Angayucham volcanic rocks.

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 marine to nonmarine facies change in the Albian-Cenomanian molasse deposits (Kgm to Ksc and Kic) parallels 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. 38; Dillon and

evidence indicate the existence and geometry of the larger folds: (a) folds of this size and symmetry have been recognized in the Wiseman A-5, A-6, B-3, B-5,

and B-6 Quadrangles; (b) the repetition of lithologic units are best explained by folding, even where hinge areas were not located; and (c) semipenetrative

cleavage (S3) is axial-planar to the mapped mesoscopic and megascopic folds, so that measurements of this axial-plane cleavage provide reference surface

Many megascopic folds were identified in the field, but the larger, north-vergent recumbent folds shown on the cross section are schematic. Four lines of

control to the geometry of the unmapped folds. In addition, the intersection of the younger semipenetrative axial-plane cleavage (S3) with the older, layerparallel penetrative cleavage (S2) indicates the location of major fold axes. REFERENCES

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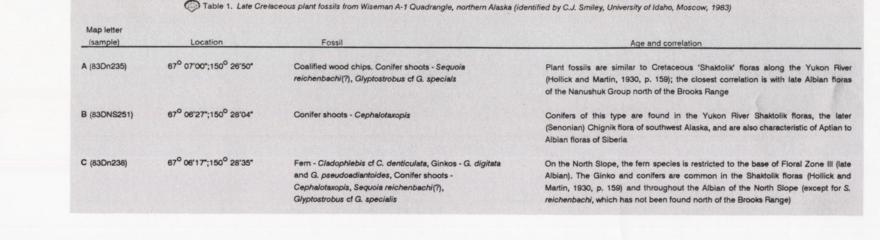
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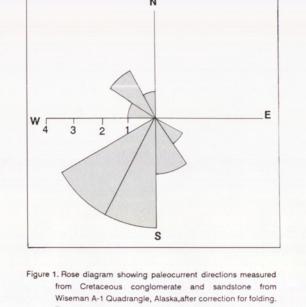
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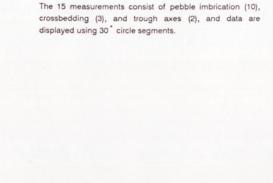
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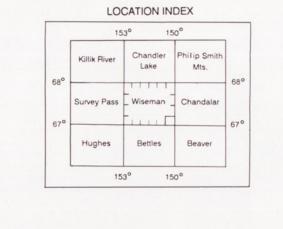
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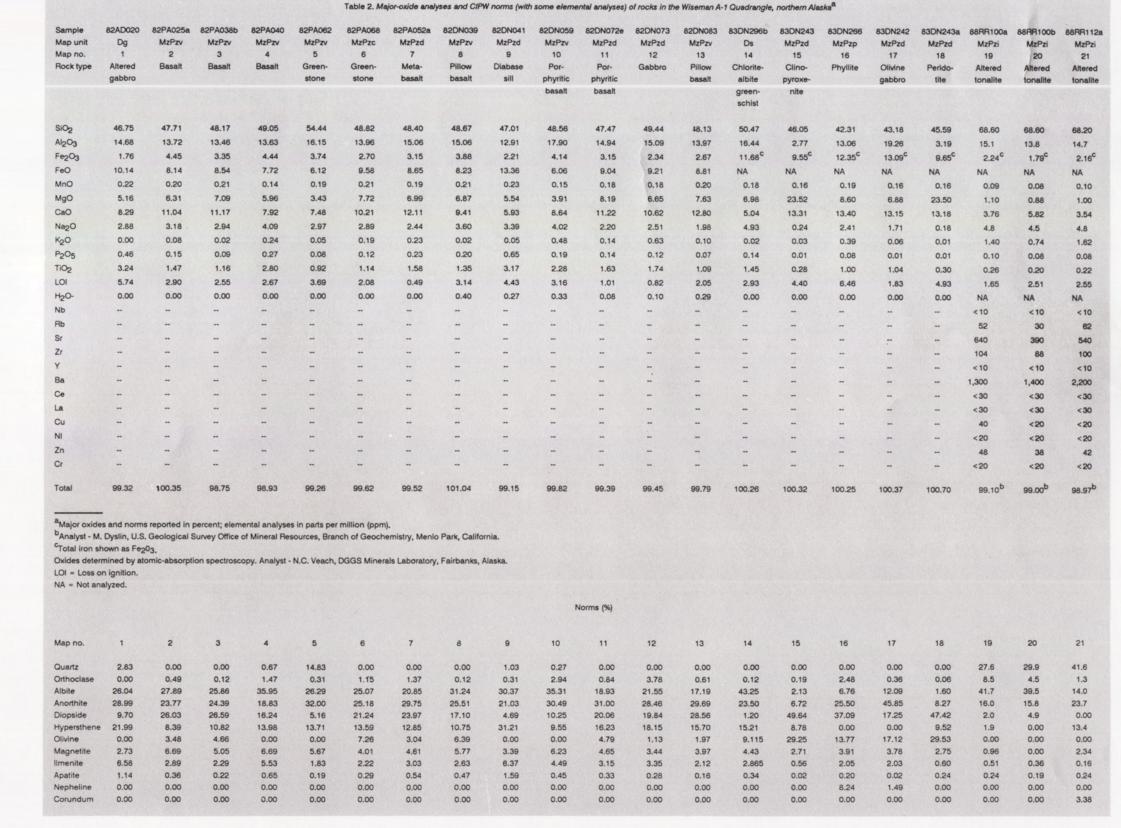
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Final compilation and editing of this map occurred after John Dillon's death, July 26, 1987. In his absence we made every effort to maintain consistency with John's work and to continue his high geologic standards; however, we accept responsibility for any omissions or

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misinterpretations. Rocky Reifenstuhl

Fairbanks, Alaska, May 1988

to the DGGS office in Fairbanks.

Arne Bakke