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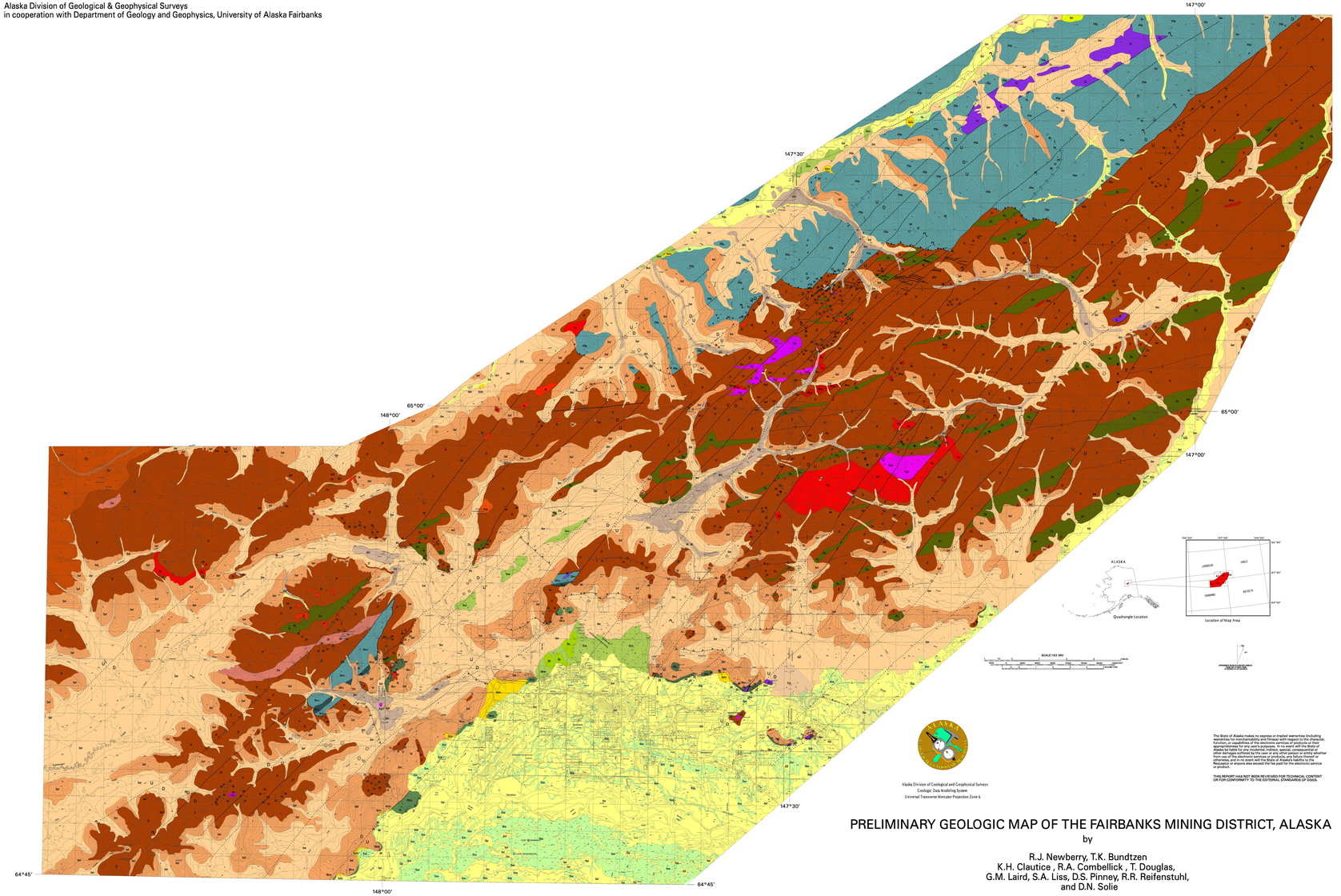

PRELIMINARY GEOLOGIC MAP OF THE FAIRBANKS MINING DISTRICT, ALASKA

by

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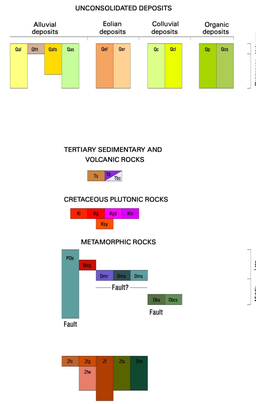
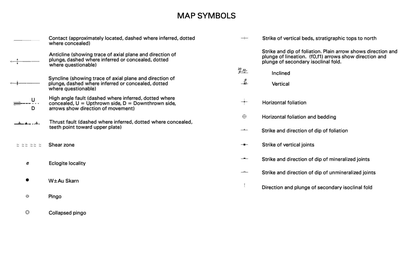
1996

CORRELATION OF MAP UNITS



MAP SYMBOLS



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Description of Surficial Deposits

Unconsolidated Deposits

(Surficial units modified from Péwé, 1958; Péwé and Bruand, 1963; and Williams and others, 1959. Geologic-unit designations used formerly on these maps are shown in parentheses.)

Alluvial Deposits

Qal Flood-Plain Alluvium: Well-stratified lenses and lenses of unconsolidated silt, sand, and gravel in active flood plains of streams. Gravel, where present, consists of rounded quartz, quartzite, gneiss, granite, and schist clasts up to 20-cm diameter. (Qal)

Qht Reworked Creek Gravel Tailings: Placer-mine dredge tailings consisting of unconsolidated, poorly stratified, rounded gravel, sand, silt, and clay in modern creeks. Clasts are mostly quartzite, gneiss, and schist. Color tan to brown with much iron staining. Unidentified gravel is buried except where exposed in walls of excavations. (Qht)

Qafs Silt-Bet Deposits: Alluvial-fan deposits overlying flood-plain alluvium/sand and gravel deposits in the Silt-Bet area (Hamilton, 1978). Consists of poorly sorted, locally bedded, unconsolidated mixture of water-transported rock fragments and blocks moved down slope by gravity. Perennially frozen; no large ground-ice masses. (Qafs)

Qas Swale and Slough Deposits: Poorly stratified lenses and layers of unconsolidated stream-laid silt and silty sand. Rarely well sorted with 10-30 percent clay. Color brown to grayish blue; mottled with carbonaceous material. Contains fine to medium sand, 1-5 percent gravel, and high ice content, chiefly as interstitial ice, veins, and wedges. (Qas)

Eolian Deposits

Qaf Bethesda Loess: Massive, homogeneous, unconsolidated eolian silt. May include some reworked material as much as 1 meter thick, containing from 10 percent to 30 percent sand. Color is dark brown to dark yellowish brown. Contains 1-3 thin carbonaceous layers and tip iron oxide stains. Thickness 1 to several tens of meters. (Qaf) Generally not mapped on most hill tops and upper slopes where it is thin. (Ql)

Qer Retransported Silt: Eolian silt retransported from hills to lower slopes and valley bottoms. Massive, homogeneous, unconsolidated, well sorted with less than 10 percent clay. Color brown to yellowish brown. Contains fine sand and mica, locally cemented by limonite. Contains organic material, especially in valley bottoms. Perennially frozen with large masses of ground ice. May overlie frenchus or Tertiary gravel in valley bottoms. (Qer)

Colluvial Deposits

Qc Colluvium: Poorly sorted silt, sand, and gravel derived by frost action and weathering of underlying bedrock and accumulating in aprons at the base of slopes. (Qc)

Qcl Landslide Deposits: Heterogeneous mixture of fractured bedrock,retransported silt, and possibly sand and gravel deposited by sliding during instability of slopes. Commonly forms hummocky ridges and depressions and irregular with arcuate low hummocky ridges and disgraded headwall scarps. (Qls)

Organic Deposits

Qp Peat: Perennially frozen brown to black peat with high ice content, composed of dense undecomposed plant remains consisting mostly of Sphagnum mosses. (Qp)

Qps Organic Silt: Organic-rich silt deposits of lowland bogs; incorporates much peat. Color dark brown to black. Contains 10-30 percent clay. Forms a thin patterned cap. Brown to grayish black, locally mottled by decomposed vegetation. Perennially frozen with numerous large masses of ground ice. (Qps)

Description of Bedrock Units

Tertiary Sedimentary and Volcanic Rocks

Subaerial and subaqueous basalt and associated volcaniclastic sedimentary rocks (Ts) and basalt (Tbc) of Tertiary age (Wahrhaftig, 1968; Péwé, 1975) in the southeastern portion of the study area. The basalts are chemically transitional between Bulanitic and alkalic basalts (Turner, 1968). Subaerial basalt flows are commonly vesicular and olivine rich. Thick, massive, pyroxenite breccias are recognized by Bottino and Weber (1982) in exposures on Birch and Sage Hills, which indicate subaqueous depositional environments in the Tertiary Basalt. Fossil wood and leaf impressions from Sage Hill have been dated as early Tertiary age for eruptions of the basaltic magmas.

Ts Tertiary Basalt: Dark-Gray, mature weathered, very fine grained to aphanitic, massive to vesicular basalt and associated volcaniclastic rocks. Locally contains leaf and plant stems including Metasequoia that indicate middle Eocene age. Exposed in the southeastern part of the study area on Sage Hill, Stanley Hill, Rourth (Bun) Hill, Birch Hill and Juneport Creek (mid) K-Ar and Ar-Ar whole rock isotopic ages of 51 to 56 Ma (Bundtzen and Reeves, 1995; this study). Moderately resistant where exposed.

Tbc Concealed Tertiary Basalt: Subaerial basalt as in Ts unit that is covered by Quaternary deposits. Interpreted from aeromagnetic data (DOGGS, 1975). aeromagnetic anomalies in southeastern portion of study area (DOGGS, 1975).

Tg Tertiary Conglomerate and Sandstone: Cinnetish gray, generally poorly consolidated conglomerate and sandstone. Conglomerate is the dominant clastic sandstone matrix exposed on Fourth of (Lily Hill) in Ruthenka Creek drainage. Pebbles of greenstone, manzon phyllite, and black subsilician chert indicate provenance from the Yukon-Tanana Terrane to the southeast. Northeast-directed paleent drainage patterns in the study area were not investigated. Association with Tb unit and presence of Metasequoia suggests Tertiary age. Nonresistant and poorly exposed.

Cretaceous Plutonic Rocks and Related Alteration

Isotopic ages from Ar-Ar; K-Ar; U-Pb, and Rb-Sr techniques indicate that Cretaceous plutonism in the Fairbanks district occurred in at least three pulse intrusions at 110 Ma, and quartz-rich intrusions at 88 Ma Ma. Three element and Sr isotopic data by Blum (1983) and from this study indicate that the Cretaceous granites are S-type, derived from anatectic crustal products formed from a common, crustally-contaminated, subduction-related, magmatic source.

Kd Altered Dikes: Tan to gray, usually bimodal, altered quartz porphyry, lamatite, granodiorite and undifferentiated mafic dikes. Compositional continuity, where mafic, are based mainly on limited trace element data and petrographic similarity. Less hydrothermally resistant, due to alteration.

Kgd Granodiorite: Medium to light gray, medium to coarse grained, equigranular to porphyritic, hornblende biotite granodiorite; Ct ranges from 65 to 70 percent. Forms stocks in the Ester Dome and Cleary Summit area ranging from 89 to 96 Ma from Rb-Sr, Ar-Ar, and K-Ar methods (Blum, 1983; Albiigi, 1987; this study). Unit is resistant and underlies or forms prominent upland "flatiron" in the Gilmore, Pedro and Ester areas.

Kg Granite: Light gray, rare weathered, medium to coarse grained, typically porphyritic, biotite granite. Contains significant gold mineralization in Fairbanks district. Forms stocks in the Fairbanks area. Unit is resistant blocky bedrock exposures. Ar-Ar ages range from 88 to 95 Ma in Lincoln Creek and Gilmore Dome bodies (Blum, 1983; Albiigi, 1987; this study).

Kqd Tonalite and Quartz Diorite: Medium gray-fine to medium grained, equigranular, biotite, pyroxene, hornblende tonalite and quartz diorite. Very resistant and forms rugged rubble outcrops in Pedro Dome region. Yields 92 Ma K-Ar, and 88±10 isotopic ages (Blum, 1983; this study)

Km Nepheline Syenite: Medium gray, distinctively brownish-red altered, subhedral, fine grained phaneitic, K-feldspar rich, nepheline apatite syenite. Forms stocks in the Ruby Creek area. Contains significant gold-copper-molybdenum pyrite up to 4 vein or long dimension oriented along foliation structure. Solidstated texture may be from primary magmatic processes or from a high grade, solid state metamorphism or metamorphism that affected the metamorphic rocks throughout the study area. Rarely phenocrysts contains anorthoclase, diopsidic, pyroxenes, and biotite. Yields 92 Ma K-Ar age (Blum, 1983). Unit is resistant and forms Q. Monteagus, written commun., 1996). Forms resistant blocky rubble in O'Connor Creek valley.

Rhyolite Dikes: Tan to gray, usually bimodal, altered, quartz porphyry, lamatite, granodiorite and undifferentiated mafic dikes. Compositional continuity, where mafic, are based mainly on limited trace element data and petrographic similarity. Less hydrothermally resistant, due to alteration.

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Khd Hornfels and Skarn: Variably colored, massive to coarsely crystalline, biotite rich schistose hornfels and garnet-hydorthosite-amphibolite skarn mainly developed in Birch Hill sequence. Skarn contains variable amounts of gold,tachnitite mineralization, and is botanically and spatially associated with W-Mo granitic bodies (Albiigni, 1987). Generally recrystalized due to contact metamorphism from nearby granitic intrusions. Unit is mapped in Birch Hill Sequence is present near the W-Mo Curlew stock on Base Dome.

Regionally Metamorphosed Rocks

Regionally metamorphosed rocks of the Ruthenka mining district are part of the Yukon-Tanana Terrane (Foster and others, 1994), and have been subdivided into the Chatanika and Tatonduk River terranes (Dusel-Bacon and others, this map). They include: (1) the orthgite hosting Chatanika Terrane of calcareous, quartzofeldspathic metasedimentary and metavolcanic schist and gneiss and an amphibolite facies metasedimentary and metavolcanic schist package that underlies the Ruthenka Schist in the Ruthenka Schist area; and (2) a sometimes thicker package of schist, quartzite, and amphibolite that has undergone prograde amphibolite and retrograde greenschist facies metamorphism; and (3) the Birch Hill Sequence of metasedimentary and metavolcanic schist, gneiss, and phyllite that were subjected to greenschist facies conditions. All Eoal major metamorphic rock packages are in tectonic contact with each other and with surrounding rocks. Rocks in the Birch Hill Sequence and the Proterozoic to Upper Paleozoic(?) rocks, and have been correlated with rocks exposed elsewhere in the Yukon-Tanana Terrane (see table 1).

Chatanika Terrane

The Chatanika Terrane was defined by Robinson and others (1990) as a high grade metamorphic rock sequence containing type-C eclogites (Coleman and others, 1965). It is subdivided into the Ruthenka Schist, Birch Hill Sequence, Birch Creek Schist, quartzite, and amphibolite (Swanbank and Forbes, 1975; Swanbank and Forbes, 1976; Robinson and others, 1990). Rocks in the terrane typically show P/T conditions of 11 kilobars and 600 - 700 °C or clearly brewing Ar/Ar. Geochronologic data (Albiigi, 1987; Blum, 1983; Foster and others, 1983; Mohr, 1991; Reiser and others, 1996; this study) indicate that the eclogite bearing Chatanika Terrane may contain Devonian-Mississippian protoliths that were subjected to high grade metamorphism in Permian-Triassic(?) time. The Chatanika Terrane is always in thrust contact with the underlying Ruthenka Schist.

Pzu Eclogite Bearing Schist Amphibolite, and Quartzite: Variably colored, light gray to dark green, fine to coarse grained dumpolitic, lenabakeit, metamorphosed mafic dikes, and undifferentiated schist and gneiss. Contains eclogite: (1) garnet clinopyroxene rocks (eclogite) with distinctive pale-green garnet and green clinopyroxene; (2) garnet amphibolite with distinctive pale-green garnet and pale-green plagioclase; (3) garnet amphibolite difficult to distinguish from eclogite; (4) dark-green garnet-hornblende-plagioclase-quartz coarse-grained calcareous muscovite schist; (5) dark-gray garnet-biotitegar muscovite schist; (6) dark-gray muscovite quartzite; and (7) nearly black, impure graphitic schist. Unit is moderately resistant and forms rubble crops. PZu unit is generally nonresistant, and forms subdued slopes in the northern portion of the map area. e=eclogite locality.

Metamorphosed Granitic Rocks

Mzu Orthogneiss: Light gray, distinctly lan weathered, coarse grained, subhilkaed, biaxis-porphyritic, K-feldspar, biotite, muscovite granodiorite gneiss exposed in two, narrow, northeast trending belts that intrude the Ruthenka Schist in the southeastern part of the study area. Yields 92 Ma K-Ar age (Blum, Monteuxon, written commun., 1996) determined from a sample on Pedro Creek; 88±10 Ma ages (Blum, 1983; Albiigi, 1987; Reiser and others, 1996; this study, others, 1996) that intrudes "Chena River Sequence," which we regard as part of the Ruthenka Schist. Mag unit is moderately resistant, and forms coarse rubble wherever exposed.

Muskox Sequence

The Muskox Sequence (Dmz, Dma, Dmsc) is herein named after exposures in the Muskox Subdivision area, and consists of metamorphosed andesitic, basalt, and rhyolitic volcanic rocks and associated sedimentary rocks that underlie the Birch Hill sequence and Ruthenka Schist. Rocks in the Muskox Sequence were metamorphosed under greenschist facies conditions. Metarhyolite yielded a U-Pb zircon age of 369 Ma (Aleinikoff and Nokleberg, 1989) that dates the timing of the Muskox Sequence's volcanic-alkalites. Based are trace element signatures. The Muskox sequence was originally mapped as part of the Cleary Sequence by Robinson and others (1990). Similar rocks were mapped as part of the Cleary Sequence in the Kantishna Hills (Reiersen, 1981), the Bonnifield area in the Upper Chena River Area (Smith and others, 1996), and the Delta Schist in the Big Delta quadrangle (Dusel-Bacon and others, 1994). The contact between the Muskox Sequence is in fault contact with the Ruthenka Schist to the Muskox Subdivision and Base Dome areas.

Mzu Metarhyolite: Light gray, tan weathered, medium to coarse grained, porphyritic, quartz-feldspar metarhyolite and metadacite. Unit is mainly exposed in an abandoned tailin lower area on the top of Muskox ridge.

Dmsc Amphibolite: Medium to dark green, medium grained, hornblende schist and amphibolite. Contains hornblende, plagioclase, biotite, epidote, and quartz and retrograde actinolite, albite, chlorite, and zoisites. Amphibolite contains low TiO2 values that differ somewhat from amphibolites exposed elsewhere in the Ruthenka Schist. Unit is generally nonresistant.

Dmz Biotite Schist: Medium to dark gray, distinctly brown weathered, medium grained highly schistose, quartz bearing, chlorite, biotite, mafic schist. Exposed in a northeast trending belt in the Muskox Subdivision area along the southeastern flank of Base Dome. Moderately resistant and forms stable outcrops in road cuts.

Birch Hill Sequence

The Birch Hill Sequence was defined by Robinson and others (1990), and consists of a thick, mappable sequence of biotite schist, quartzite, and minor amounts of chlorite schist and impure marble (Dbs). The type sections lie in well exposed cuts and in natural outcrops that form the southern edge of Birch Hill on Birch Creek and in the Chatanika River valley. Rocks in the Birch Hill Sequence are the units of the Birch Hill sequence underlie nearly a single metamorphic event that reach greenschist facies conditions. The Birch Hill Sequence is correlative with the Birch Creek Schist (Foster and others, 1983; Mohr, 1991; Reiser and others, 1996; Hallenburg, 1966; Gilbert and Bundtzen, 1979) and the Dan Creek Unit in the Upper Chena River area (Smith and others, 1996).

Dbs Slate, Phyllite Tuff, and Quartzite: Dark gray, locally bleached, fine grained, thin bedded, slate, phyllite, and quartzite. Unit is mapped in Ruthenka Creek (+/- 1 mile) belots of light gray feldspathic tuff that contains disseminated barite in Birch Hill area. Mineral assemblage includes chlorite, albite, illite and quartz. Unit is moderately resistant due to high quartz content in interbedded quartzite beds.

Dbc Calcareous Schist and Impure Marble: Light gray, tan weathered, coarse grained calcareous schist and impure marble. Exposed in a northeast trending belt on the top of Base Dome and in Universal Hill area. Generally nonresistant due to high carbonate content.

Ruthenka Schist

The Ruthenka Schist as defined by Robinson and others (1990) comprises the dominant rock types in the Ruthenka mining district. The Ruthenka Schist consists of interbedded biotite schist, quartzite, chlorite schist, graphitic schist, quartzite, quartzite grit, marble, chlorite schist, amphibolite, and a distinctive magnetite-rich biotite schist. Nearly 90 percent of the metamorphic rocks in the Ruthenka Schist are biotite schist and gneiss. As originally defined, the Ruthenka Schist was described as a sequence of metamorphosed sedimentary and volcanic rocks that was subjected to greenschist facies metamorphism. Hallenburg (1966) suggested that the Ruthenka Schist was a bimodal dominiccarns and metamicrocarbic assemblage of rocks known as the Cleary Sequence. During our studies, we have not recognized the Cleary Sequence as a bimodal assemblage of rocks. Rocks that we have mapped as Monteuxonite and metamodular metabasalt mapped in the Muskox Sequence during this study was originally included in the Cleary Sequence (Robinson and others, 1990). Rocks mapped as Ruthenka Schist are similar to those of the Chena River Sequence as described by Robinson and others (1990). The distinction between the Chena River Sequence and Ruthenka Schist was based on the fact that rocks in the Chena River Sequence were subjected to greater conditions where as the latter was subjected only to greenschist facies conditions. Detailed microprobe work conducted during this study (Joy and Newberry, 1996) indicates that the metamorphic rocks in the Ruthenka Schist formerly mapped as Chena River Sequence have analogous elemental TiO2 and Al2O3 values. Rocks mapped as Ruthenka Schist are similar to amphibolites in the Chena River Sequence and Ruthenka Schist are interpreted to be correlative. The Ruthenka Schist is correlative with the Chena River Sequence of Robinson and others (1990) in the Ruthenka Schist package. Although the Ruthenka Schist occurs structurally above the Birch Hill Sequence, the Ruthenka Schist is interpreted to be correlative with similar packages of metamorphic amphibolite facies (Dusel-Bacon and others, 1994; Alaska Range (Csibert and Bundtzen, 1994), the Upper Chena River Area (Smith and others, 1996), and the Big Delta quadrangle (Dusel-Bacon and others, 1994), which are regarded as pre-Devonian probably Proterozoic in age.

Dmg Quartz Muscovite Schist, Quartzite, and Chlorite Quartzose Schist: Light to medium gray, fine to coarse grained, quartzite, quartz muscovite schist, and garnet biotite quartz muscovite schist. Biotite have been altered to chlorite. Contains abundant quartz veins. Unit is moderately resistant and forms subdued rubble crop throughout map area.

Dms Amphibolite, Magnetite Rich Biotite Schist, Quartzose Schist, and Marble: Heterogeneous unit of variably colored, gray to green, fine to coarse grained, garnet hornblende amphibolite, magnetite bearing biotite schist, quartzose schist, and marble. Unit is mapped in the Ruthenka Schist, "white schist," Zia as shown on the geologic map was originally mapped by Robinson and others (1990) as part of both the Chena River and Cleary Sequences. Contains hornblende, plagioclase, biotite, chlorite, biotite, and garnet and retrograde chlorite, albite, actinolite, and epidote. Amphibolites contain high TiO2 and exhibit major oxide and trace element signatures that are similar to amphibolites in the Chena River Sequence (Ti). Zia unit appears as linear magnetic anomaly on an aeromagnetic survey (Ogdnich Surveys and Processing, 1995) due to magnetite content of biotite schist. Rocks are moderately resistant and form subdued outcrops against a high angle fault zone contains numerous scheelite bearing veins. Bleached, light gray muscovite quartzose "white schist" were originally mapped as Cleary Sequence rocks by Robinson and others (1990). Cellalite major oxide chemistry and trace element data collected during this study do not support this interpretation. Rather presence of metamorphic garnet, biotite, and hornblende in "white schist" (Newberry, 1989) indicate a metasedimentary parentage. Zia is generally resistant and forms subdued rubble crop throughout map area.

Dmm Marble: Light gray, medium to coarsely crystalline, muscovite rich marble. When Qtz is in the vicinity of a W-Au skarn, small lobulate structure. Solidstated texture may be from primary magmatic processes or from a high grade, solid state metamorphism or metamorphism that affected the metamorphic rocks throughout the study area. Rarely phenocrysts contains anorthoclase, diopsidic, pyroxenes, and biotite. Yields 92 Ma K-Ar age (Blum, 1983). Unit is resistant and forms Q. Monteagus, written commun., 1996). Forms resistant blocky rubble in O'Connor Creek valley.

Dmc Metaconglomerate: Light gray coarse grained, quartz rich porphyroclastic metaconglomerate that contains stretched pebbles of quartz and quartzite. Unit is mapped in the Ruthenka Schist in a belt transit for about 10 kilometers in the Murphy Dome area. Very resistant and forms blocky rubble and outcrops.

Dmu Metaandesine Grit: Light to medium gray quartz-rich, porphyroclastic metaandesine grit and conglomerate. Contains stretched pebbles filled with Zfs units. Probably originally a quartz rich sedimentary rock deposited in continental margin environment. Similar to "grits" of Robinson and others (1990) mapped as part of the Cleary Sequence. Chena River area (Smith and others, 1996), which are regarded as Late Precenozoic quartzofeldspathic metasandstones. Very resistant and underlies the Murphy Dome upland in northwestern portion of map area.

Zhe Bleached Feldspathic Quartzose Schist: Light gray, bleached, muscovite and biotite bearing, feldspathic schist. The Zfw unit is mapped in a northeast trending belt in the Ruthenka Schist in the Ester Dome area on the southeastern flank of Ester Dome. Moderately resistant and forms blocky rubble in road cuts.