

# PROFESSIONAL REPORT 91 PR91-SH1

# DESCRIPTION OF MAP UNITS

CORRELATION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

**IGNEOUS ROCKS** 

KAHILTNA TERRANE

MYSTIC TERRANE

DILLINGER TERRANE

Quadrangle, Alaska.

Figure 2. Bowser Creek zinc-copper-(lead) prospect

(map no. 4, table 4)

Massive pyrrhotite with

nalcopyrite, sphalerite and very minor galena

Quartz-carbonate gangue

with disseminated sulfides

Rock units are described in

Ferricrete gossan with

Disseminated pyrrhotite

Rock units are described in

Description of map units'

Massive pyrrhotite

Base of cliff

'Description of map units'

deposits

## UNCONSOLIDATED UNITS

piedmont of Post River valley. In major valleys, deposits tend to be poorly sorted;

ALLUVIUM, UNDIFFERENTIATED-Fluvial silt, sand, and gravel deposited by streams that form flood plains and fans. Grain size, sorting, and stratification vary according to stream size, flow regime, and source of bedload material. Unit ranges

from a few meters thick in incised streams near valley heads to 100 m thick on ALLUVIAL-FAN DEPOSITS-Poorly to moderately well-sorted silt, sand, and gravel that occur where tributaries join higher order streams or along eastern

coarse material is dominant because of steeper gradients and rapid seasonal TERRACE ALLUVIUM-Fluvial silt, sand, and gravel of varying ages occur as strath or fill terraces that result from episodes of alternate downcutting and aggradation. Locally, deposits may be mantled by appreciable thicknesses of eolian or colluvial silt, or both, and a thick vegetation mat, especially where

permafrost limits drainage COLLUVIAL-ALLUVIAL DEPOSITS-Poorly to moderately well-sorted silt, sand, gravel, and diamicton of colluvial and, locally, fluvial origins. Commonly contain alternating stratified and unstratified zones or lenses in gullies and steep

minor tributary valleys with intermittent or ephemeral streams. Colluvial-alluvial fans are generally most active in early to late spring when freeze-thaw cycles occur LANDSLIDE DEPOSITS-Chaotically deformed colluvium derived from catastrophic mass movement of bedrock or surficial deposits along planes of failure.

Units are characteristically very hummocky and lack integrated drainage. Recent landslides show surface disturbances, such as randomly tilted trees and disrupted

TALUS-Angular debris derived from frost riving of bedrock followed by rapid gravity transport on steep slopes, cirque headwalls, and in steep gullies and avalanche chutes; usually forms cones or aprons that lie at or near angle of repose

ROCK-GLACIER DEPOSITS-Unsorted, angular, frost-shattered boulders and

ctive rock glaciers). Rock glaciers are basically of three morphologic types: 1) lobate forms (50 to 200 m across) lie at base of valley walls with movement toward valley axis; 2) tongue-shaped forms head in cirques and have their longest dimension parallel to flow direction; and 3) transitional forms are elongated down-valley in direction of flow (heads are true glaciers and termini gradually grade into rock glaciers). Fronts of active rock glaciers are very steep and unstable. Rock glaciers commonly occur in north-facing cirques at 3,500 to 5,000 ft (1,067 to 1,525 m) elevation and erode blocky, weathered, resistant rocks.

TILL-Unsorted to poorly sorted clay, silt, sand, pebbles, cobbles, and boulders deposited by glacial ice. Cobble and boulder clasts are commonly polyhedral, faceted, striated, and subangular to subrounded. Permafrost and thick surface peat are common in moraines on piedmont slopes. OUTWASH—Glaciofluvial stratified drift that consists of subrounded gravel with sand and silt lenses and partings; deposited by sideglacial and proglacial meltwater

positions. Material deposited proximal to glacier (or former glacier) is generally coarser than distal material. Distal portions of outwash deposits generally grade ICE-CONTACT DEPOSITS-Stratified drift deposited in contact with melting glacial ice. Generally form kame terraces and kame and esker complexes marked

OUTWASH-TERRACE DEPOSITS—Unsorted to moderately sorted sand, gravel, and mixed debris deposited proximal to ice-marginal meltwater streams of

#### BEDDED ROCKS KAHILTNA TERRANE

SANDSTONE AND SHALE-Medium- to dark-gray, fine-grained lithic sandstone. siltstone, and shale. Sandstone contains angular to subangular clasts of chert and quartz (40 percent), lithic fragments (25 percent), volcanic clasts (25 percent) and feldspar (10 percent). Sandstone occurs in typically cyclic graded beds that range from 3 to 30 cm thick. Flutes, ripple marks, and flame structures are locally abundant. Unit is highly deformed, and low-angle cleavage is common. Large-scale isoclinal folds generally verge to the northwest. Thickness of unit is unknown, Inoceramus (table 5) of Early Cretaceous age was found at one locality; fossils of Late Jurassic age also occur regionally (Eakins and others, 1978).

### MYSTIC TERRANE

LIMESTONE-CHERT CONGLOMERATE-Distinctively tan- to red-weathering gray to brown, pebble-cobble limestone-chert conglomerate. Contains rounded lasts of limestone (40 percent), black to gray chert (40 percent), sandstone 10 percent), and shale (10 percent). The 160-m-thick section grades from lime stone breccia near its base to limestone-chert conglomerate midway through the section to chert-sandstone conglomerate near the top. Most clasts are about 3 cm diam with some >20 cm long. Unit overlies coarse-grained, graded 'Tab' Bouma interval that contains pebble-conglomerate channel deposits 1 to 3 m wide and about 1 m thick. Pebbles and cobbles in conglomerate are locally imbricated and have crude channel configurations. Fossil control is lacking. Unit is very similar to Devoĥian to Permian coarse-grained clastic deposits de-

IMESTONE-Medium- to dark-gray, rhombohedrally veined, carbonaceous, seriate or algal-like laminations 1 to 3 cm thick and un cherty limestone globules about 2 cm diam. Unit is isoclinally folded in southeastern corner of map area. Thickness is unknown, but outcrops suggest unit is 100 to 150 m thick.

SUBLITHIC SANDSTONE-Tan to brown, medium- to coarse-grained quartzose sublithic sandstone and pebble conglomerate. Composed of polycrystalline quartz (40 percent), lithic fragments (25 percent), chert (20 percent), albite (5 percent), and volcanic clasts (5 percent). Rip-up clasts and iron-stained concretions are very common; graded bedding is confined to coarse Bouma 'Tab' intervals with 'Tcde intervals notably absent. Thin sections lack detrital white mica and calcite cement characteristic of Silurian clastic units. Grains are subangular to subrounded in contrast to angular grains in older clastic units. Fragments of plant stems are locally abundant. Definitive fossils have not been found in the quadrangle, but we tentatively correlate the sublithic sandstone unit with sandstone and shale of Middle Devonian to Late Pennsylvanian age that occurs in the McGrath B-2 Quadrangle (Bundtzen and others, in preparation). Thickness is 900 to 1,200 m.

### DILLINGER TERRANE

CALCARENITE, CALCAREOUS SILTSTONE, AND LIMESTONE-Predominantly very thin to very thick bedded, buff- to orange-weathering, light- to nedium-gray phyllitic calcarenite; thin-laminated to thin-bedded, orange- to brown-weathering, gray to gray-green, phyllitic calcareous siltstone and very thin bedded, gray silty limestone. Calcarenite is micaceous, coarse- to fine-grained, with local cross-bedding and graded bedding; calcarenite is cataclastically deformed with clasts commonly flattened and stretched. Phyllitic siltstone commonly grades into calcarenite or limy siltstone; rarely has cross-beds or pyrite crystals on partings. Silver-weathering, thin-laminated, gray phyllite occurs locally as thin partings and beds up to several meters thick; subparallel and crosscutting quartz and calcite veinlets are common. Unit contains from 5 to 35 percent light-gray, thin-bedded, laminated limestone. Local presence of channelized limestone conglomerate, graded coarse pebble sandstone, and slumped carbonate breccia layers 1 to 2 m thick suggests proximal turbidite-fan and foreslope depositional environments. Unit is unfossiliferous, but overlies Upper Silurian limestone (uSl) and underlies Middle Devonian or younger units in McGrath B-2 Quadrangle (Bundtzen and others, in preparation). We estimate the thickness to be 300 to

LIMESTONE-Medium- to dark-gray, laminated to locally massive, partially ecrystallized limestone. Generally contains silty partings, algal-like structures, and characteristic veins of rhombohedral calcite. Slumped carbonate breccia and imestone conglomerate channels 1 to 6 m thick occur in northwestern corner of study area. Overlies Upper Silurian limestone (uSl) and underlies Middle Devonian units of Mystic terrane. Conodonts from one locality in this unit in McGrath B-2 Quadrangle are Emsian (Early Devonian) in age (Bundtzen and others, in preparation). Unit ranges from 100 to 300 m thick.

SANDSTONE AND SHALE-Brown to gray, medium- to coarse-grained, micaceous lithic sandstone, shale, and very minor limestone. Graded bedding, flute casts, ripple marks, and clast compositions are essentially identical to those found in other Silurian units in map area (mSs, mSa). Unit is unfossiliferous, but is probably equivalent to one or several Silurian clastic units described here and by Gilbert and Solie (1983). Locally contains medium- to dark-gray, recrystallized laminated limestone interbeds with minor phyllitic carbonaceous shale that is very similar to other Silurian limestone units in map area (mSl, uSl, lSl below) and to those described by Gilbert and others (1982). Thickness is unknown, but is at least 150 m in western part of study area.

LIMESTONE-Medium- to dark-gray, recrystallized, laminated limestone essentially lithologically identical to mSl unit. Apparently unfossiliferous and cannot be assigned to any particular part of Silurian System. Unit ranges from 20

THIN-BEDDED CALCAREOUS SANDSTONE, SHALE, AND LIMESTONEominantly thin-bedded, buff- to orange-weathering, phyllitic, calcareous lithic sandstone interbedded with thin-laminated, medium-gray to olive-green shale and light-gray limestone. Calcareous sandstone is micaceous, chert- and quartz-rich, very coarse grained to fine grained, and locally displays graded bedding. Flutes, ripples, and cross-bedding are uncommon, but clast compositions indicate a feld-spathic litharenite as in mid-Silurian sandstone (mSs). Subparallel and crosscutting carbonate veins are common. Unit is isoclinally folded, but we estimate a stratigraphic thickness of 300 to 400 m. Stratigraphically overlies Ludlovian (Upper Silurian) limestone (uSl).

LIMESTONE-Medium- to dark-gray, recrystallized, laminated limestone very imilar to mid-Silurian limestone (mSl), but contains graptolites of Ludlovian age in McGrath B-2 Quadrangle (Bundtzen and others, in preparation). Unit forms boundary between mid-Silurian sandstone (mSs) and Upper Silurian sandstone, imestone, and shale (uSsl). Unit ranges from 10 to 35 m thick.

LIMESTONE AND MINOR SILTY SANDSTONE-Medium- to dark-gray, rerystallized, laminated limestone interbedded with minor amounts of brown o gray, carbonaceous, graptolite-bearing silty sandstone that contains Wenlockian nid-Silurian) graptolites, including the Pristiograptus dubious zone (table 5). Unit ranges from 20 to 60 m thick, but is characteristically isoclinally folded.

SILTSTONE, SHALE, AND MINOR SANDSTONE-Light-gray, brown-weathering siltstone, shale, and minor lithic sandstone; sandy intervals contain crossninations, flute marks, longitudinal ripples, and graded 'Tbcde' to 'Tabcd' Bouma intervals that are 1/2 m thick. Sand to shale ratio is about 1:3. Unit is unfossiliferous, but interfingers with lower and middle part of mid-Silurian sandstone (mSs) and probably represents overbank deposit or interchannel part of turbidite fan. Ranges in thickness from 100 to 200 m.

SANDSTONE, CONGLOMERATE, SILTSTONE, AND MINOR SHALE-Meum-olive-gray to terra cotta, medium- to coarse-grained, massive- to locally thin-bedded, calcareous lithic sandstone, pebble conglomerate, and siltstone with ocal gray-shale intervals. Sandstone and conglomerate beds are primarily composed of polycrystalline quartz (30 percent), chert (20 percent), matrix (15 to 18 percent), detrital carbonate (15 percent), altered feldspar (5 to 10 percent), carbonate and iron cement (5 to 8 percent), and white mica (3 to 8 percent). Point counts of four sandstone samples indicate unit is feldspathic litharenite (after Folk, 1968) with a recycled orogen provenance (Dickinson and Suczek, 1979). Sandstones contain oscillation ripple marks, flute casts, graded bedding, and Bouma 'Tabed' intervals that suggest deposition by turbidity currents; planar cross-bedding is well defined in 'Tc' interval. Sand to shale ratio increases upward through unit. Unit probably formed in a mid-fan turbidite environment. Unit occurs between Lower and Upper Silurian limestone (uSl, lSl), is interbedded with mid-Silurian limestone (mSl), and overlies Wenlockian graptolite localities. Ranges from 200 to 350 m thick throughout map area.

LIMESTONE AND MINOR BLACK CHERT-Light- to medium-gray, thinweathering, graptolite-bearing, carbonaceous siltstone beds with local black crackled, recrystallized chert. Sheep Creek (McGrath B-2 Quadrangle) and several localities in map area contain late Early Silurian graptolite Cyrtograptus centrifugus. Unit ranges from 10 to 30 m thick.

SHALE, SILTSTONE, AND MINOR CHERT—Dominantly medium- to dark-gray, fissile, isoclinally folded carbonaceous shale and siltstone. Banded dark-gray to black chert, bioturbated siliceous siltstone, and tuffaceous sandy layers are interbedded with shale in upper 90 m of section. Local horizons (0.5 to 1 m thick) of shale-chip intraformational conglomerate occur near top of section. Graded beds 10 to 100 cm thick contain 'Tbcde' Bouma intervals that also occur in upper part of section. Sulfur-smithsonite(?) plumes on joint surfaces and uncommon stratiform pyritic zones (1 to 5 cm thick) distinguish this shale from similar younger Paleozoic strata. Churkin and others (1977), Bundtzen and others (1982), and Claire Carter (written commun., 1983) reported unit contains 11 graptolite zones that range from Tetrograptus approximatus to Monograptus spiralis, which occur in Ordovician to lower Lower Silurian rocks worldwide. Unit is roughly equivalent to Road River Formation in eastcentral Alaska and Yukon Territory. Unit is usually structurally thickened, but appears to range from 100 to 280 m thick in map area (MacDonald, 1983).

buff-weathering, light-gray, silty, laminated to cross-bedded limestone and edium-gray to olive-green shale. Limestone and shale interbeds range from 10 to 0 cm thick and average 25 cm thick. Cross-bedding in limestone usually occurs as several stacked tabular or wedge-shaped cosets 3 to 15 cm thick. Shale and siltstone interbeds are commonly ripple laminated with amplitudes of 2 to 60 cm. Limestone interbeds locally have graded 'Tbcde' Bouma intervals. Unit rarely cut by calcite veinlets; siltstone-shale partings commonly develop into micaceous phyllite along shear zones. Unit is isoclinally folded on scales from crenulations to nappes. Unit underlies earliest Ordovician Tetragraptus approximatus zones in overlying Ordovician to Lower Silurian shale (SOsh) and is tentatively correlated with Rabbit Kettle Formation of Cambrian and earliest Ordovician age in the Selwyn Basin of Canada's Yukon Territory (Gabrielse and others, 1973; Blusson, 1976). Base of unit is not exposed in map area; Gilbert (1981) estimated unit is 1,000 m thick in Cheeneetnuk River area.

SILTY LIMESTONE AND SHALE-Rhythmically layered, thin-bedded, orange-

GREENSTONE-Dark-olive-green, aphanitic, sheared greenstone sills or flows of deozoic age; distinguished from younger Tertiary to Cretaceous igneous rocks sed on deformational style and alteration. IGNEOUS ROCKS

Tif
FELSIC SILLS AND DIKES-Felsic sills and dikes up to 5 m thick; generally light-pinkish tan to white; aphanitic to fine grained, rarely medium grained; hypocrystalline and holocrystalline with phenocrysts of plagioclase and alkali feldspar; groundmass highly altered with abundant secondary carbonate. Some felsites contain fine-grained disseminated pyrite and have banding caused by variable grain size and texture. Commonly associated with brown to orange ferricrete gossan. Felsic dikes intrude Tertiary mafic dikes (Tim below).

QUARTZ PORPHYRY-Light-gray, brown- to tan-weathering, porphyro-aphani ic, quartz-feldspar porphyry; generally contains variable amounts of disseminated massive pyrite; on Bowser Creek, contains zinc, lead, and silver vein mineralization. Probably comagmatic with late phase of Tertiary quartz monzonite (Tqm) intrusions. K-Ar age of 60.4 m.y. obtained from Bowser Creek (table 1).

QUARTZ MONZONITE AND IGNEOUS BRECCIA (Bowser Creek and Post River plutons)—Light-gray, locally bleached, medium-grained, equigranular, hornblende-biotite quartz monzonite to granodiorite. Post River pluton is highly porphyritic and contains euhedral phenocrysts of orthoclase, whereas Bowser Creek pluton is dominantly intrusive breccia with clast diameters that range from centimeters to meters. Locally, igneous and sedimentary breccias (br) rim portions of main Bowser Creek pluton. K-Ar age of 61.8 m.y. obtained from Post River pluton (table 1). Xenoliths of more mafic phase abundant in Post River

Tim MAFIC SILLS AND DIKES-Mafic sills and dikes up to 5 m thick; generally dark brown, fine grained, idiomorphic-granular; locally porphyritic or amygdaloidal; on western boundary of quadrangle, locally contain abundant biotite and have ocellar textures that suggest lamprophyres. Limited major-oxide data (table 2) show that these sills and dikes are subalkalic to alkalic andesite and basalt. We believe mafic sills and dikes are comagnetic with 57.0-m.y.-old Middle Fork pluton mapped by Gilbert and Solie (1983).

ANDESITE-TRACHYANDESITE SILLS AND DIKES-Green-gray, fine-grained, hypidiomorphic-granular, occasionally porphyritic andesitic sills and dikes <20 m thick; often subparallel to primary foliation; contain <80 percent andesine (commonly very altered), <20 percent alkali feldspar, highly altered hornblende, and biotite or pyroxene or both. Alteration products are chlorite, carbonate, opaques, and white mica; apatite is common accessory mineral; fine-grained disseminated pyrite occurs locally. Contact effects rarely seen in adjacent country rock, but metalliferous skarn and breccia-pipe rocks are exposed near Bowser Creek in study area and in Veleska Lake area to the north (Bundtzen and others, 1982). Unit may include some felsic and basaltic dikes. Solie and others (1982) dated this unit as Tertiary age (K-Ar) in the McGrath B-2 and B-3 Quadrangles. Many dikes are shown schematically on geologic map.

MAFIC TO FELSIC DIKES-Undifferentiated.

NTRUSIVE DIKE SWARM-Subparallel swarm of predominantly andesitic dikes with several felsic and mafic dikes (Tia, Tif, Tim, undivided); includes slivers of Paleozoic strata that commonly show minimal to extreme effects of contact metamorphism and silicification. In western part of map area, unit forms 6-kmwide by 10-km-long zone that extends 15 km into McGrath A-3 Quadrangle (Gilbert and Solie, 1983).

HORNFELS-Brown to gray, massive to locally porphyroblastic, garnet-biotite ornfels derived from clastic and carbonate sedimentary rocks. Hornfels formed om limestone are rich in grossularite.

MAP SYMBOLS

-?--- Contact - Queried where questionable

··? U High-angle fault - Dashed where approximately located, queried where questionable, dotted where covered; U, upthrown side; D, downthrown side; arrows show apparent direction of movement ..? Thrust fault - Sawteeth on upper block, dashed where

dotted where covered Folds, showing trace of axial plane and direction of plunge Anticline Overturned anticline

approximately located, queried where questionable,

Overturned syncline Strike and dip of beds Inclined Vertical Horizontal Overturned Strike and dip of joints Inclined Vertical Strike and dip of cleavage

Strike and dip of foliation Bearing and plunge of primary subisoclinal fold axis Dip of dikes

K-Ar age-date locality (table 1) Major-oxide analysis (table 2)

Fossil locality (table 5)

Paleocurrent direction (table 3) Mine, mineral prospect, mineral occurrence (table 4)

Late Wisconsin ice limit

Holocene ice limit

orders should be addressed to the DGGS office in Fairbanks.