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DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

The map contains diverse Quaternary surficial deposits. Quaternary depositional and erosional processes have produced a diverse landscape with distinctive scenic and physiographic features. Detailed examination of these processes and features was beyond the scope of the project however future studies should include investigations of the surficial geology.

Qu — UNDIFFERENTIATED SURFICIAL DEPOSITS -- Includes alluvium, colluvium, talus, landslides, glaciofluvial deposits, moraines, and sand dunes. Surficial deposits are either related to or reflect glacial processes and the extremes of climate in the region. Alluvium is widespread along the Atigun and Sagavanirktok Rivers and occurs as ephemeral point and transverse bars. Older alluvium in the Sagavanirktok valley forms terraces along the active channel. Colluvium and slope wash form thin layers on the steep slopes. Solifluction lobes and nuzzles are common on more gentle soil covered slopes. Talus forms aprons on steeper bedrock slopes. Below shale outcrops, the material is usually less than a few centimeters in the maximum dimension however the talus below the carbonate and coarse clastic bedrock slopes is often several meters in diameter. Landslide deposits occur primarily in areas with shale as the predominant bedrock type. Major landslides are found along the Atigun River gorge on both the north and south side of the river. Avalanche debris is common in the Atigun valley above the gorge with the largest number of avalanche chutes on south facing slopes. Glaciofluvial deposits include glaciolacustrine and beach deposits in the Atigun valley and Galbraith Lake north and south of Atigun gorge. Drift deposits are found along the lower end of Atigun gorge and in the drainages southwest of Galbraith Lake.

Hamilton (1978) has mapped morainal ridge deposits in T10S, R10E and in an area northwest of Galbraith Lake. Longitudinal dunes occur in the lower Atigun valley above the gorge and southeast of Galbraith Lake.

SEDIMENTARY ROCKS

Kfm — FORTRESS MOUNTAIN FORMATION (Lower Cretaceous) Polymictic conglomerate, sandstone, siltstone and shale. The conglomerate is composed of boulder to granule size clasts of red, black, gray, and green chert, white quartz pebbles, carbonate fragments, and igneous rocks. The beds range from several meters of massive material to thin layers less than a centimeter thick. Matrix material includes fine to medium quartz grains cemented by iron oxides producing the distinctive red coloration of the unit. The red to gray-green sandstone is composed of quartz and lithic fragments. Siltstones and shales are dark gray and are interbedded with layers of plant debris up to a meter thick. Brosgé et al (1979) have reported Early Cretaceous (Albian) pelecypods at three localities in the map area. Thickness more than 400 m.

Ko — OKPIKRUAK FORMATION (Lower Cretaceous) Dark gray siltstone and shale at the base and fine sandstone and minor conglomerate at the top of the section. Brosgé et al (1979) have reported Early Cretaceous (Valanginian) pelecypods (Buchia sp.) at eight localities within the map area. Thickness more than 300 m.

KJoK — OKPIKRUAK FORMATION, KONGAKUT FORMATION, AND KINGAK SHALE, UNDIVIDED (Lower Cretaceous and Jurassic). Highly deformed black shale and siltstone unit containing Late Jurassic and Early Cretaceous pelecypods. The unit is in fault contact with the Okpikruak and Shublik Formations.

Trs — SHUBLIK FORMATION (Upper, Middle, and Lower Triassic). Lower part includes dark gray shale and medium to dark gray siltstone. The shale horizons contain abundant organic material and phosphate and pyrite nodules. Pyrite nodules up to 15 cm in diameter are common along the north side of the Atigun gorge. The middle part of the unit is thin to thick-bedded light-gray, silty, fossiliferous limestone and dolomite. The limestone is also phosphatic and locally contains abundant chert. The upper part is minor thin-bedded silty shale. The lower shale sequence and the carbonate sequence both have gamma radiation signatures over three times the regional background. The limestone outcrop on the north bank of the Atigan River contains abundant pelecypods (Monotis sp.) and Brosgé et al (1979) have noted Triassic ammonites in the unit.

Ps — SIKSIKPUK FORMATION (Lower Permian). Dark gray shale, red and green argillite, and minor medium gray siltstone.

The shale and argillite contain pyrite and weather orange to red. Minor light gray orange weathering carbonate lenses up to 4m meter thick interfingerue with the shale and argillite. Barite occurs as lenses parallel to bedding and as anastomosing veinlets. The barite lenses often contain pyrite and siderite concretions. Early Permian brachiopods are found in the carbonate lenses. Brosgé et al (1979) mapped the sequences as Sadlerochit Group undifferentiated, however, there are several problems with assigning the Permian rocks in the Atigun gorge to the Sadlerochit Group undifferentiated. First, all of the known fossil localities include only Early Permian fauna; thus, the rocks could only be assigned to the Echooka Formation (Permian) and not the Ivishak Formation (Lower Triassic). Second, the lithology is more similar to the Siksikpuk Formation than either formations of the Sadlerochit Group. The Siksikpuk Formation contains locally abundant barite and the Permian rocks in the Atigun gorge contain barite lenses and nodules. At the type locality the formation is 107 meters thick; however, in the Atigun canyon the sequence has been structurally thickened and is over 600 meters thick.

IPMlu — LISBURNE GROUP, UNDIVIDED (Permsylvanian and Mississippian). Gray limestone and dolomite, argillaceous limestone, and dark gray to black chert. The Lisburne Group has been subdivided into three formations the Wachsmuth limestone of early Mississippian age, the Alapah Limestone of late Mississippian age and the Wahoo Limestone of Pennsylvanian and Permian age.

The Wachsmuth Limestone has been divided into four members which include: shaly limestone member, crinoidal limestone member, dolomite member, banded chert and limestone member. The Alapah Limestone is divided into the following nine members from oldest to youngest: shaly limestone member, dark limestone member, platy limestone member, banded limestone member, black chert-shale member, light-gray limestone member, fine grained limestone member, chert nodule member, and upper limestone member.

The type section for the Wachsmuth and Alapah Limestone is at Shainin Lake. Sections and lithologies have been described by Bowsher and Dutro (1949), Patton (1957), Brosgé and others (1962), Porter (1965) Reed (1968), Armstrong and others (1970), Armstrong and Mamet (1977, 1978), and Brosgé and others (1979).

The Wahoo Limestone has been divided into two informal members (Brosgé and others (1962). The lower member is medium gray, fine-to coarse-grained, limestone with minor chert. The upper member is a coarse grained crinoidal limestone with minor interbeds of shale and thin-bedded shaly limestone. The base of the upper member is characterized by black nodular chert.

Mlu — Upper part of Lisburne Group -- Included the upper part of the Alapah limestone including; the light-gray limestone member, fine-grained limestone member, chert nodule member, and upper limestone member; and the Wahoo Limestone. The map unit is a medium to light gray weathering limestone and dolomite sequence. It is composed of fine to medium grained medium gray limestone and dolomite with subordinated black nodular to lenseidal chert.

Mll — Lower part of Lisburne Group -- Includes: the lower five members of the Alapah Limestone including; shaly limestone member, dark limestone member, platy limestone member, banded limestone member, and black chert-shale member, and the Wachsmuth Limestone. The map unit is a dark to medium gray weather limestone, dolomite, and shale sequence. It is composed of fine to medium grained dark gray limestone and dolomite containing abundant nodular chert and black to dark gray thinly laminated shale.

MK — KAYAK SHALE (Mississippian) Black to dark gray clay shale, and minor silty shale and shaly limestone. The shale contains pyrite and weathers orange to red. Dark gray limestone lenses up to 10 meters thick contain abundant fossils and pyrite and weathers yellow, orange and red. Ironstone nodules are abundant in the shale sequences. The absence of barite lenses and nodules distinguishes the unit from the Siksikpuk Formation.

DK — KANAYUT CONGLOMERATE UNDIVIDED (Upper Devonian) Gray-red and orange-weathering conglomerate, sandstone and minor shale. The conglomerate is composed of chert and quartz pebbles with minor shale fragments. The matrix includes quartz and chert and the cement is predominantly silica. The sandstones are dominantly quartzite with silica and minor iron oxide cement. Conglomerate layers are massive and the sandstones are crossbedded. Both the sandstones and conglomerates contain minor disseminated pyrite and disseminated galena was noted near sample locality 145. Minor black to dark gray shale occurs locally with poorly preserved plant fossils.

GEOCHEMISTRY

One hundred sixty seven stream sediment samples were collected from the map area and were analyzed by atomic absorption spectrophotometry for copper, lead, and zinc. The analyses are listed in Table I.

Of the 167 samples collected, 21 are anomalous in one or more elements and 4 are anomalous in 2 elements. Table II lists the anomalous samples and the relative degree of anomality. There are 9 samples anomalous in copper, 3 in lead and 13 in zinc.

Copper anomalies were found in streams draining the Siksikpuk and Shublik Formations, the Jura-Cretaceous undivided rocks and the Okpikruak Formation. Lead anomalies were found in streams draining the Kanayut Conglomerate, Kayak Shale, and the Lisburne Group undifferentiated. Zinc anomalies were found in streams draining the Kayak Shale, the Lisburne Group, and the Siksikpuk and Shublik Formations.

The Kanayut Conglomerate and Kayak Shale are host to 2 lead and 2 zinc anomalous samples. The Lisburne Group is host to 1 lead and 6 zinc anomalies. The Siksikpuk Formation is host to 3 copper and 4 zinc anomalies and contains all of the identified barite mineral occurrences in the area. Four of the eight barite occurrences are spacially associated with copper and zinc anomalous samples. The Shublik Formation is host to 3 copper and 2 zinc anomalous concentrations. The Jurassic and Cretaceous undivided rocks contain 1 anomalous sample while the Okpikruak contains two samples anomalous in copper.

Figures 1, 2, and 3 are fourth degree trend surface plots of the residuals for copper, lead, and zinc concentrations respectively. The plots show a northeast-southwest trend for all three elements, in addition to the stratigraphic control of the base metal mineralization, the majority of the anomalous samples are spacially associated with a major fault zone that parallels the Atigun gorge and strikes northeast-southwest.

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Table I

Stream Sediment Sample Analyses
(Atomic Absorption Spectrophotometry)

Sample No.	Cu (PPM)	Pb (RRS)	Zn (PPM)
PC 001	9.000	0.	125.000
002	9.000	0.	100.000
003	15.000	0.	100.000
004	15.000	0.	110.000
005	8.000	0.	70.000
006	16.000	0.	130.000
007	9.000	0.	110.000
008	12.000	0.	95.000
009	10.000	0.	75.000
010	42.000	0.	75.000
011	30.000	0.	70.000
012	32.000	0.	75.000
013	49.000	0.	75.000
014	45.000	0.	95.000
015	33.000	0.	110.000
016	35.000	0.	105.000
017	23.000	0.	95.000
018	35.000	0.	65.000
019	29.000	0.	105.000
020	26.000	0.	95.000
021	28.000	0.	85.000
022	39.000	0.	70.000
023	10.000	0.	100.000
024	16.000	0.	95.000
025	13.000	0.	100.000
026	23.000	0.	100.000
027	16.000	0.	235.000
028	11.000	0.	90.000
029	24.000	0.	175.000
030	36.000	0.	115.000
031	16.000	0.	75.000
032	39.000	0.	75.000
033	16.000	0.	115.000
034	11.000	0.	105.000
035	32.000	0.	65.000
036	8.000	0.	95.000
037	23.000	0.	130.000

Table I continued

Sample No.	Cu (PPM)	Pb (RRS)	Zn (PPM)
PC 038	14.000	0.	140.000
039	13.000	0.	120.000
040	9.000	0.	230.000
041	5.000	0.	135.000
042	10.000	0.	90.000
043	7.000	0.	50.000
044	11.000	0.	85.000
045	15.000	0.	125.000
046	8.000	0.	145.000
047	13.000	0.	100.000
048	19.000	0.	120.000
049	10.000	0.	80.000
050	10.000	0.	100.000
051	17.000	0.	150.000
052	17.000	0.	100.000
053	9.000	0.	90.000
054	13.000	0.	95.000
055	6.000	0.	95.000
056	26.000	0.	120.000
057	26.000	0.	80.000
058	21.000	0.	125.000
059	13.000	0.	105.000
060	9.000	0.	80.000
061	17.000	15.000	85.000
062	10.000	0.	110.000
063	22.000	0.	75.000
064	20.000	0.	115.000
065	23.000	0.	230.000
066	13.000	0.	80.000
067	21.000	0.	105.000
068	28.000	0.	100.000
069	30.000	0.	110.000
070	32.000	0.	140.000
071	13.000	15.000	80.000
072	30.000	0.	105.000
073	25.000	0.	85.000
074	10.000	0.	90.000
075	13.000	0.	85.000
076	28.000	0.	120.000
077	17.000	0.	90.000
078	23.000	0.	130.000
079	20.000	0.	115.000
080	51.000	0.	275.000
081	31.000	0.	280.000
082	53.000	0.	165.000
083	45.000	0.	290.000
084	56.000	0.	200.000
085	75.000	0.	240.000
086	43.000	0.	110.000
087	61.000	0.	310.000
088	100.000	0.	265.000
089	65.000	0.	165.000
090	51.000	0.	165.000
091	46.000	0.	60.000
092	41.000	0.	65.000
093	66.000	0.	55.000
094	43.000	0.	55.000
095	28.000	0.	125.000
096	23.000	0.	95.000
097	23.000	0.	100.000
098	63.000	0.	70.000
099	18.000	0.	195.000
100	40.000	0.	75.000
101	33.000	50.000	90.000
103	29.000	0.	125.000
104	26.000	0.	100.000
105	12.000	0.	100.000
106	19.000	0.	245.000
107	29.000	0.	150.000
108	16.000	0.	115.000
109	44.000	0.	180.000
110	35.000	0.	110.000
111	45.000	0.	110.000
112	28.000	0.	130.000
113	15.000	0.	95.000
114	25.000	0.	240.000
115	24.000	0.	120.000
116	14.000	0.	100.000
117	17.000	0.	100.000
118	16.000	0.	85.000
119	10.000	0.	100.000
120	20.000	0.	125.000
121	17.000	0.	125.000
122	14.000	0.	160.000
123	17.000	0.	130.000
124	15.000	0.	120.000
125	19.000	0.	150.000
126	13.000	0.	120.000
127	21.000	0.	165.000
128	16.000	0.	90.000
129	15.000	0.	70.000
130	35.000	0.	95.000
131	13.000	0.	85.000
132	8.000	0.	80.000
133	21.000	0.	95.000
134	16.000	0.	135.000
135	15.000	0.	135.000
136	13.000	0.	105.000
137	10.000	0.	100.000
138	15.000	0.	145.000
139	15.000	0.	125.000
140	40.000	0.	135.000
141	14.000	0.	110.000
142	10.000	0.	140.000
143	16.800	0.	150.000
144	15.000	0.	125.000
145	10.000	0.	100.000
146	16.000	0.	230.000
147	30.000	0.	110.000
148	14.000	0.	100.00
149	9.000	0.	75.000
150	12.000	0.	100.000
151	41.000	0.	110.000
152	16.000	0.	115.000
153	52.000	0.	110.000
154	36.000	0.	90.000
155	38.000	0.	115.000
156	31.000	0.	105.000
157	29.000	0.	100.000
158	30.000	0.	110.000
159	23.000	0.	75.000
160	25.000	0.	95.000
161	19.000	0.	80.000
162	29.000	0.	100.000
163	35.000	0.	85.000
164	41.000	0.	100.000
165	35.000	0.	95.000
166	32.000	0.	80.000
167	26.000	0.	95.000
168	31.000	0.	80.000

Figure 1: Fourth degree trend surface plot of the residuals of copper analyses.

Figure 2: Fourth degree trend surface plot of the residuals of lead analyses.

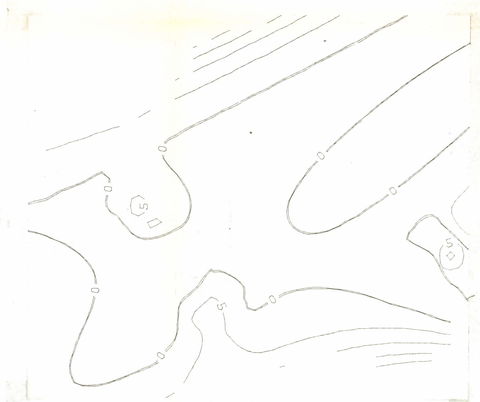

Figure 3: Fourth degree trend surface plot of the residuals of zinc analyses.

TABLE II *

ATIGUN CANYON

Stream Sediment Sample Descriptions and Trace Element Concentrations

Sample Number	Sample Description (All Description of Map Units)	Weakly Anomalous Elements 90ZC.L.	Anomalous Elements 95ZC.L.	Strongly Anomalous Elements 98ZC.L.
78 PC027	Mll			Zn
040	PMlu			Zn
041	PMlu			Pb
065	PMlu			Zn
071	MK,DK			Pb
080	Ps	Cu		Zn
081	Ps			Zn
082	Ps	Cu		
083	Ps			Zn
084	Ps	Zn	Cu	
085	Ts			Cu
087	KJoK			Cu
088	Ts			Cu
089	Ts			Cu
090	Ko	Cu		
099	MK	Zn		
101	MK,DK			Pb
104	Ps,PMlu			Zn
118	Ps,PMlu			Zn
146	Mll,MK			Zn
153	Ko	Cu		