STATE OF ALASKA

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GEOLOGIC REPORT NO. 35

Geology and Geochemistry Sithylemenkat Lake Area Bettles Quadrangle, Alaska

By

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GEOLOGY AND GEOCHEMISTRY OF THE SITHYLEMENKAT LAKE AREA BETTLES QUADRANGLE, ALASKA

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ABSTRACT

An area of 44 square miles was mapped and 140 geochemical samples were taken across a linear belt of ultramafic intrusives extending along the eastern margin of the Koyukuk basin (figure 4).

Rocks in the area include two Alpine ultramafic intrusive belts containing pyroxenite, peridotite, gabbro, and diabase. One belt is located at the margin of the Koyukuk basin and the other is intrusive into schist, five miles southeast. The remainder of the area is underlain by schist and diabase and an intrusive granite batholith that extends far east of the map area. In places the granite contains almost no mafic minerals, but has a few percent tourmaline. The peridotite is much chloritized and serpentinized. Only minute amounts of sulfides (pyrite and pyrrhotite) were found in the ultrabasic rocks and in peripheral basic rocks.

A scattering of geochemical stream sediment samples were anomalous in nickel, containing as much as 5000 ppm. The nearly complete lack of pyrite in and around the peridotite suggests a low sulfur content during its crystallization, with no early liquid sulfide phase formed. As a result the nickel content of the intrusive is contained in the silicate minerals.

Several samples anomalous in tin were found in areas underlain by granite. The region holds promise as a tin province.

INTRODUCTION

The map area is along the southeast margin of the Koyukuk basin. The area was selected at the suggestion of W. W. Patton of the U. S. Geological Survey because of the possibility that the ultramafic body at the north edge of Sithylemenkat Lake might contain nickel. This body and similar rocks 4 1/2 miles to the southeast are parts of two Alpine ultramafic belts. These belts are localized along thrust faults which border the Koyukuk basin. The west end of an extensive granite, in places tourmaline-bearing, is also present in the map area.

Stream sediment geochemical sampling clearly reflects the underlying bedrock. Near the ultramafic bodies nickel, cobalt, chromium, and iron tend to be high. Areas near or underlain by granite tend to have scattered anomalous amounts of one or more of the following: tin, beryllium, boron, and niobium. A moderate copper, lead, and zinc anomaly was found in one area at the edge of the Koyukuk basin. This anomaly warrants further geochemical sampling. The nickel and tin associations indicate potentials that deserve regional geochemical investigations beyond the map area.

Sithylemenkat and Tokusatatquaten Lakes provide the only easy access to the region by fixed wing aircraft. The field work was limited to the vicinity of these lakes. There are no inhabitants, roads, or trails in the region. Field work was done from June 12 through July 9, 1968. Thanks are due for the able and cheerful assistance of Robin Marks, who collected most of the geochemical samples. The cordial cooperation of the U. S. Geological Survey in performing analyses of the geochemical samples is much appreciated.

THE RELATION OF LANDFORMS TO GEOLOGY

The map area lies along the northwest edge of the Ruby geanticline. Distribution of highlands and lowlands is similar to that in Cretaceous time when the sediments of the Ruby geanticline were shed into the Koyukuk geosyncline (Payne, 1955).

Regional glaciation has scooped out the basin of Sithylemenkat Lake behind a ridge of resistant mafic and ultramafic rocks. Outlet Creek* has cut into this ridge (Outlet Ridge*) and is in process of draining the lake, as is shown by the presence of an old shore line 50 feet above the lake level.

The ridge NE of Sithylemenkat Lake (NE Ridge*) is underlain by resistant rocks, diabase on the north half and quartz-mica schist to the south.

The diabase and schist have been intruded by a large body of granite that extends for many miles east of the map area. The granite is less resistant to erosion than the diabase and schist and therefore forms a lowland between the ridge and Sithylemenkat Lake. In places east of the lake this has a cover of glacial drift. In highland areas the granite forms distinctive rounded knobs.

The ridge SE of Sithylemenkat Lake (3040T Ridge*) marks a relatively resistant terrain consisting of greenschist, mafic and ultramafic dikes and plugs, and greenstone. Offset of the southern portion of the ridge reflects cross faulting of the greenschist-quartz mica schist contact. The north end of the ridge runs into a broad tundra-covered slope probably underlain by granite.

The higher elevations on the ridge contain three antiplanation terraces. These are gently inclined tundra- or rubble-covered surfaces which have bedrock outcrops along parts of their upper and lower edges. These surfaces are produced by plucking of bedrock at the upper side and viscous flow of a surficial layer of rock and ice down the terrace and over the scalloped lower edge--like frosting sliding off the top of a warm cake. The highest terrace has exposed boulders up to several feet long, whereas the lower terraces are tundra-covered.

GLACIAL DEPOSITS

Below about 900 feet elevation the slopes south and east of Sithylemenkat Lake are mainly covered with muskeg and only a little float is exposed. East of the lake above an elevation of about 1000 feet exposures of glacial drift were seen. It is likely that a large part of the lowland around the lake may contain glacial deposits covered by vegetation. One exposure of drift consists of nonactive frost polygons containing angular

*Name given for use in this report

to subangular clasts (mainly less than a foot across), much silt, and some 1/8 inch fines. Clasts are 70% mafic igneous and 30% granitic. The lack of clear glacial features indicate a pre-Wisconsin age for the glaciation.

RECENT ICE-PUSH RIDGE AROUND SITHYLEMENKAT LAKE

Sithylemenkat Lake is bounded on all sides but the south by a recent ice-push ridge. This is best developed along the east side, where it rises about eight feet above lake level. It is composed of granite sand (smaller than 1/2 inch) with about five percent angular dark schist clasts (1/2 - 4 inches). At about 50 to 100 foot intervals angular to subangular granite boulders up to 10 feet long protrude from the gravel. In places there are several ridges, paralleling the lake, with the older ones successively farther from the lake as shown by the amount of cover by moss and trees. The youngest ridge, at the edge of the lake, has loose sand and no moss. The older ridges may be lower or higher than the ridges closer to the lake. The ridge system is still forming and is a result of wind-driven push from the ice in the lake during periods when the beach gravel is not frozen.

GENERAL GEOLOGY

The oldest rock type in the area is schist which varies from black quartz-muscovite-graphite schist near the diabase on NE Ridge to quartz-mica schist farther east. Diabase intrudes the schist and granite intrudes both the diabase and schist. W. W. Patton, Jr., (personal communication) has correlated the diabase with Jurassic diabase on the south side of the Brooks Range. Intrusion of the granite was probably about contemporaneous with the uplift of the Ruby geanticline in Cretaceous time.

On 3040T Ridge greenschist is in contact with the schist and is cut by small diabase and ultramafic plugs and dikes. These are tremolitized and chloritized and are surrounded by a recrystallized and tremolitized aureole in the greenschist. The greenschist is interpreted as sheared diabase intruded by diabase plugs and ultramafic dikes. The extensive chloritization and tremolitization in and around the ultramafic rocks is interpreted as due to the action of ground water on the rocks while still hot during intrusion.

The ridge at the north edge of Sithylemenkat Lake (Outlet Ridge) is underlain by an Alpine ultramafic complex consisting of serpentinized peridotite(?) overlain by pyroxenite, which is overlain in apparent conformity by gabbro. The ultramafic rocks are much sheared and serpentinized, particularly along the south side of the ridge. The straight contact, along this side of the ridge, is probably a major high angle thrust fault.

DESCRIPTIONS AND RELATIONSHIPS OF ROCK TYPES

Schist

The most common schist is light brown weathering, crenulated, quartz-muscovite schist with layers of granular glassy quartz up to 1/4 inch thick. In some areas north and west of 3040T Ridge the quartzose layers predominate and the rock is a quartzite schist.

In places the quartz layers are microfolded and boudined. Southeast of the diabase on NE Mountain bedrock is graphite-rich coal-black schist with rounded quartz grains (2-4 mm diameter) and granular quartz layers. About 1 1/4 miles west of Tokusatatquaten Lake, this rock grades into medium gray quartz-muscovite schist with prominent quartz rods, masses, and folded layers, some much deformed. The various types of schist grade into one another and no clear cut mappable units were recognized.

Post-kinematic euhederal to subhederal andalusite of contact metamorphic origin was found near the diabase contact in the black schist described above and also in schist near the granite about 1.2 miles west of Tokusatatquaten Lake.

Metadiabase

As seen from Sithylemenkat Lake, NE Ridge is a dark, rubble-covered plateau standing above lower wooded slopes broken by light gray patches of granite rubble and outcrop. Metadiabase forms talus on the upper slopes and, near the top, rubble (altiplanation?) terraces bounded by bedrock scarps. The rock is fine grained, homogeneous, and non-foliated, with fibrous greenish black amphibole visible under a hand lens. The rock is composed of actinolitic hornblende and plagioclase grains (up to 1-2 mm long) with a subophitic texture. Albite and epidote are present in the groundmass along with accessory sphene, magnetite(?), and pyrite. It is a diabase downgraded by low-grade thermal metamorphism, probably as a result of intrusion of the adjacent granite.

Evidence for origin of the metadiabase is conflicting. Evidence for a flow origin is the 1-2 mm grain size; the amygdules and veins of prehnite-carbonate-albite-apatite; and the irregular aspect of the outcrops with their curved layers, bulbous cleavage blocks, and intermixed thin and thick layers. Evidence for an intrusive origin is the presence of euhederal andalusite crystals in the adjacent schist. A shallow intrusive origin appears the most likely.

Occasional specks of chalcopyrite are present in the diabase, but no copper stain was seen.

On 3040T Ridge metadiabase is present around most ultramafic bodies. The rock is fine grained (1 mm average), medium greenish gray, nonfoliated and forms coarse blocky talus and rubble. Its appearance is similar to the metadiabase on NE Ridge except for being slightly lighter in color. It is made up of actinolitized or partly actinolitized augite grains in a matrix of saussuritized plagioclase. Some augite grains contain cores of biotite. This rock is intrusive and is probably closely related in age and origin to the diabase on NE Ridge.

Ultrabasic Rocks on 3040T Ridge

Peridotite -- Peridotite forms distinctive yellow-ochre to moderate reddish-brown weathering tors on 3040T Ridge. No similar rock was seen in the other ultramafic areas. On freshly broken surfaces this rock is dark greenish gray, and has dark cleavage faces of olivine. It has a cataclastic texture with diamond-shaped magnesium-olivine grains (up to 3 mm in diameter) in a sheared chloritic matrix crowded with tiny tremolite and olivine crystals. There is a rude foliation but no composition banding. The weathered outcrops have a rough surface with yellow-ochre olivine phenocrysts standing in bas-relief above a reddish brown background. Joints weather out deeply and joint blocks weather to rounded shapes up to three feet in diameter.

A few black-weathering cross-fiber asbestos veinlets (1/8 inch) are present, but no sulfides were seen.

The original rock before alteration is believed to have been a peridotite composed of olivine phenocrysts and pyroxene containing scattered tiny olivine inclusions. The pyroxene has subsequently been altered completely to chlorite with shreds of actinolite disseminated through it, but the olivine remains. This may be due to temperatures generally too low to form serpentine from the olivine, but high enough to chloritize the pyroxene. Some of the magnetite aligned parallel to the foliation of the rock indicates that alteration was synkinematic. Alteration is thought to have occurred during emplacement rather than later when the nearby granite was intruded.

Pyroxenite, greenstone, and greenschist -- Pyroxenite forms the large steep sided knob 0.8 mile west of the summit of 3040T. The rock is greenish dark gray, and weathers light brown to greenish gray, not as red or as deeply etched as the peridotite on 3040T Ridge. The pyroxenite is composed of chlorite containing disseminated ($\pm$0.4 mm) grains of Mg-olivine and tremolite, plus minor augite and pyrite. It is similar to the chloritized peridotite at 3040T Ridge, except that it lacks olivine phenocrysts. The rock probably originated as a sieve-structured pyroxenite with olivine inclusions in which the pyroxene has been selectively chloritized and tremolitized as at 3040T Ridge. The pyroxenite appears to grade into banded greenschist on the SE side of the knob. A halo of greenstone, unrecognized in the field, must lie between the olivine-bearing intrusive and the greenschist.

Two pyroxenite dikes on the knoll 0.6 mile WNW of the summit of 3040T are surrounded by a light greenish gray greenstone, which in turn is surrounded by greenschist. The greenstone contains widely scattered grains of chalcopyrite.

Similarly, a halo of greenstone gradational with the greenschist is present adjacent to an ultramafic body 0.5 mile N30E of 3040T summit. The greenschist is fine grained, dark greenish gray, and has good planar foliation. At this locality greenschist has rough lines of actinolite grains in a quartz-albite(?) matrix with occasional larger biotite-cored actinolite grains which have been rotated by shearing within the rock. Similar biotite-cored grains of augite (mentioned earlier) are present in the diabase in a locality near the top of the mountain. In some exposures faint isoclinal folding can be seen. The greenschist is interpreted to be a sheared diabase. This greenschist grades, over a distance of 40 feet, into directionless greenstone with tremolite porphyroblasts in a fine-grained, chlorite-albite(?) matrix. The greenstone is evident recrystallized greenschist produced by heat from the nearby ultramafic intrusive.

At the three localities described above greenstone halos are present around ultramafic dikes intruded into greenschist. Elsewhere metadiabase, judged by its subophitic textu to be intrusive, surrounds the ultramafic dikes. No greenstone was recognized around diabase, but the two rock types are deceptively similar in appearance in the field and a greenstone halo may be present around diabase also. All of the rocks have been subjected to greenschist facies metamorphism which has converted them to largely chlorite-tremolite-actinolite rocks. Temperatures were too low for the extensive formation of serpentine, except along the probable fault on the south side of Outlet Ridge.

Outlet Ridge Ultramafic-gabbro Igneous Complex

The ultramafic-gabbro complex underlying Outlet Ridge is part of an extensive belt of similar rocks that extends along the SE margin of the Koyukuk geosyncline (W. W. Patton, Jr., personal communication).

West of Outlet Creek ultramafic rocks form a distinctive linear ridge (Outlet Ridge) which rises abruptly from the tundra and is covered by fine yellow-brown rubble of serpentinite, pyroxenite, and partly serpentinized ultramafic rock. The ridge has a peculiar ridge and swale topography indicative of large braided faults or lithologic variation. No composition banding was seen in outcrops in the area west of Outlet Creek. On the south side of the ridge the rock is sheared serpentinite with minor magnesium-olivine [altered peridotite(?)] which grades into less sheared pyroxenite on the north side of the ridge. In this northern area the knobs and ridges are composed of massive brown-weathering granular pyroxenite, whereas in the swales the ground is littered with green serpentine rubble. Along the south side shearing is seem in a small scale in the outcrops. These have greasy green slickensided serpentine shears bounding unsheared ovoid blocks or pillows of brown serpentine up to 1-2 feet in diameter. The knob and swale topography and the serpentine-encased pillows are the result of shearing on large and small scales, respectively.

The brown-weathering knobs on the north side of the ultramafic body and the unweathered dark rocks along Outlet Creek, as determined by several X-ray diffraction* (XRD) determinations, are pyroxenite containing mainly augite with traces of tremolite, chlorite, and minor magnesium-olivine. North of the area of hydrothermal alteration in one thin section the rock consists mainly of equant grains of augite up to 3 mm in diameter with granulated borders (mortar structure). Minor patches of magnetite and serpentine and a veinlet of serpentine are also present. Only one specimen from the entire body contained appreciable orthopyroxene.

East of Outlet Creek the contact between ultramafic rock and gabbro is fairly well exposed in rubble and a few outcrops. The vegetation changes within a few feet across the contact from scattered spruce and barren rubble over the ultramafic rock to tundra and thick spruce on gabbro. Serpentine float and fairly continuous bands of pyroxenite (XRD: augite with a trace of tremolite) in the gabbro above the ultramafic rock indicate that ultramafic layers are present in the gabbro. All measured attitudes of the composition layering of gabbro dip north. Presumably the west-trending gabbro-ultramafic rock contact dips north also. Thus, the ultramafic layers are located near the base of the gabbro.

The position of ultrabasic rock below and interbanded up into gabbro is consistent with the relations west of Outlet Creek where serpentinized peridotite(?) underlies pyroxenite

Sulfides were seen in only one outcrop on Outlet Ridge (400 feet SE of #26). A sample from this locality (table 2) has an estimated 2% pyrrhotite and assayed 0.21% Ni, the highest nickel analysis in the map area.

Gabbro

Gabbro forms well-timbered or brushy rounded hills north of the Outlet Ridge ultrabasic body and is bounded on the north by a moderately steep slope down to flats underlain by Cretaceous (?) rocks. A prominent gabbro scarp about 150 feet high extends along the north edge of Sithylemenkat Lake for about 0.7 mile.

The gabbro is a medium-grained (1-3 mm) grayish green rock, mottled by light greenish feldspars and dark gray pyroxenes. The elongation and preferred orientation of these minerals give the rock a rude foliation. All measured attitudes show moderate north dips.

*All X-ray defractions for this report were done by Michael Mitchell of the Alaska Division of Mines and Geology

At the east end of the scarp at the north end of Sithylemenkat Lake the rock consists of augite (N_y=1.69±0.005, 2V=54°) partly altered to hornblende, chlorite, and magnetite; and plagioclase (An_{69}±5). At the west end of this scarp, near the ultramafic body, the gabbro is much saussuritized and contains felted masses of tremolite along shears.

Sulfides were not seen in the gabbro and the one sample analyzed contains 0.003% nickel (table 2).

Relations of the Gabbro and Ultramafic Rocks in the Outlet Ridge Ultramafic Igneous Complex

The generally lenticular outlines of the ultramafic body, the probable fault along its nearly straight south margin, and the lenticular shearing around pillows indicate tectonic structural control of intrusion. A single peridotite dike about 20 feet wide (XRD: augite with minor plagioclase and a trace of chlorite or serpentine) was found to cut gabbro (600 feet E of #24), indicating intrusive igneous activity. The interlayering of gabbro and underlying ultramafic rock parallel to the contact suggests gravity settling of mafic crystals in a magma chamber. This combination of features suggesting tectonic emplacement, intrusion, and crystal settling is consistent with the mechanisms suggested by Thayer (1967) for the emplacement of Alpine ultramafic complexes, i. e., gravity settling at depth with some dike intrusion followed by tectonic emplacement of the whole composite body. However, the abaundant presence of pyroxene in the ultramafic rock contrasts with Thayer's description of olivine-rich ultramafic rocks in Alpine complexes.

Hydrothermal Alteration Zones in the Outlet Ridge Ultramafic Body

Two silicified areas are present in the ultramafic body west of Outlet Creek. The smaller of these is located 1500 feet N35E of #31. It is a northwest-trending zone, measuring about 50 x 150 feet, and consisting of light brown to pale reddish brown-weathering silicified country rock with reticulated quartz veinlets. There is weak gossan, and no sulfides were seen. The larger silicified area (table 1) extends along a WNW-trending valley which is the only prominent lineament cutting the ultramafic body. This area has a central zone of silicified and moderately limonitized country rock cut by seams and masses of quartz and vuggy chalcedony veinlets containing euhederal quartz crystals. Partly surrounding the central zone is a zone of slightly-to-nonlimonitized serpentinite speckled with tiny (1/2 mm) octahederal grains of magnetite. At the northwest end of the peripheral zone a small pod of magnetite a few feet across is present in an area of serpentinite. This is the only concentration of magnetite found in the peripheral zone.

Other areas of very minor hydrothermal activity are indicated by small runs of white quartz-dolomite float in a few places in the ultramafic area.

These nonserpentinized quartz-limonite (-dolomite) areas are the result of postserpentine hydrothermal activity, which has moved quartz, iron, chromium, and nickel into zones of late shearing. The absence of anomalous amounts of copper (table 1) is evidence against the presence of a nickel deposit at depth. Nickel-sulfide bodies tend to contain appreciable amounts of copper which could be expected to be mobile enough to produce strong anomalies in a hydrothermal zone.

Age of the Ultramafic-Mafic Igneous Complex

The presence of gabbro clasts in Cretaceous(?) conglomerate along the north edge of Outlet Ridge indicates a probable pre-Cretaceous age for the mafic-ultramafic complex. Patton (personal communication, 1968) tentatively assigns a Jurassic age to this rock on the basis of correlation with mafic igneous rocks present along the Brooks Range, in particular with a mafic igneous complex having a Jurassic potassium-argon age in the Christian quadrangle (190 miles ENE of Sithylemenkat Lake). The complex consists mainly of gabbro, diabase, basalt, diorite, and also in smaller amounts: leucogabbro, anorthosite, pyroxenite, and peridotite (Reiser and others, 1966). Chloritization and saussuritization are widespread in these rocks. They are largely intrusive.

Dating of Alpine peridotites in the Cascades (Ragen, 1967) indicates that pre- syn- and post-kinematic ages may be present in a single province and that caution is necessary in dating on the basis of rock type.

It is considered that the mafic igneous complex in the Christian quadrangle is similar in type to the similar complex in the Sithylemenkat Lake area and that a Jurassic age is the best estimate possible at present.

Granite

Highlands underlain by granite have distinctive medium light gray rounded knobs. In lower areas the granite is usually covered by soil and vegetation. West of Tokusatatquate Lake rude alignments of tors, knobs, and bands of outcrops are probably a function of varying concentrations of joints. No banding or preferred orientation of mineral grains is visible in outcrops anywhere in the area. In places a poorly developed sheeting due to subhorizontal joints 1-3 feet apart seems to roughly conform to the general topography. This could be exfoliation parallel to the surface of the granite. The contact of the granite with its wall rocks is sharp and irregular. This intrusive contact and differences in the plunge of minor fold structures (crenulations, etc.) in the schist indicate that the granite is a discordant intrusive body which has deformed the country rock.

The granite is mainly a medium light gray-weathering light gray porphyritic rock composed of perthitic K-feldspar phenocrysts up to 5 cm long in a medium grained (1-5 mm) groundmass of perthitic K-feldspar, quartz, slightly saussuritized oligoclase to andesine (An_{15-37}) and subhedral to euhederal biotite containing inclusions of both zircon with pleochroic halos and magnetite. Quartz veins were seen in a few places. At #81 soil above a quartz vein three feet wide contains 70 ppm tin. In two areas west of Tokusatatquaten Lake two clearings in the timber (#92, 93) with exposures of tourmaline granite and a little rose quartz in the float gave 30 and 70 ppm tin in the soil. Tourmaline was identified visually in several areas near the north end of the granite body. Inclusions are not abundant. Where present they consist of rounded mafic feldspar-biotite-quartz rocks and porphyritic granitic dike rocks.

Fine-grained nonporphyritic alaskite bands up to several hundred feet wide are present on the hill slope NE of Sithylemenkat Lake. The rock is medium-grained (2-3 mm) with granitic texture and is made up of anhederal quartz (20%), and orthoclase along with minor amounts of subhederal albite and very minor amounts of muscovite and biotite. In some areas up to a few percent tourmaline is present. The albite grains have a patchy alteration to limonite.

The granite is generally covered near the contacts with the surrounding rocks. In one place it was seen to be fine-grained and cut by dikes of porphyry granite, but in general it is not finer grained near the contact. East of Tokusatatquaten Lake 1.2 miles, euhederal andalusite of contact metamorphic origin is present in quartz-sericite schist near the granite contact. In most areas the schist is not visibly changed by the presence of nearby granite.

The origin of the quartz-mica schist has interesting regional implications. In the field and in thin section it appears to be a normal regionally metamorphosed rock whose intrusion by granite was an entirely separate event that occurred after it had cooled. It is possible, however, that the metamorphism was associated in origin with the intrusion of the granite, so that the metamorphism is merely an aureole around the granite. Present field and microscopic data favors two separate thermal events: regional metamorphism and granitic intrusion.

Vein Quartz Gravel

In the Koyukuk flats north of Outlet Ridge, patches of quartz gravel with clasts to three inches in diameter and yellow-brown fines were seen in two low mounds and as similar pea-sized quartz float in several frost boils farther north. The quarts clasts are medium grained, with some crystal faces visible, have cavities with crystal faces, slickensided surfaces with light limonite stain, and epidote filled shears. The gravel has the appearance of vein quartz and could possibly be the surface expression of a large quartz vein running parallel to the edge of the basin.

Farther west, along the edge of the basin, pebble conglomerate float is present. The clasts are similar to those in the gravel described above. Both of these units seem most likely to represent vein quartz eroded during the time of Cretaceous sedimentation in the Koyukuk Basin from schist lying above the ultramafic intrusive. No gabbro or ultrabasic fragments were seen in the gravel, although gabbro or diabase clasts were seen in other conglomerate float along the edge of the basin.

GEOLOGIC HISTORY

1. Deposition of clayey and carbonaceous fine grained sediments (Devonian?).

2. Deformation and regional metamorphism of sediments to form quartz-muscovite schist and graphitic schist.

3. Thrusting along the edge of the Koyukuk Basin and intrusion of diabase of 3040T Ridge. Jurassic(?).

4. Shearing of this diabase by continued thrusting transforming it to greenschist. Jurassic(?).

5. Intrusion of mafic-ultramafic igneous complexes as large masses containing different types of igneous rocks: (1) diabase, pyroxenite, and peridotite on 3040T Ridge; (2) gabbro, pyroxenite, and peridotite at Outlet Ridge. Uplift, with gabbro clasts deposited in Koyukuk Basin conglomerate. Partial alteration of mafic and ultramafic rocks to chlorite, tremolite, actinolite, serpentinite, and saussurite during intrusion. Jurassic(?).

6. Shallow intrusion or extrusion of diabase of NE Ridge. Jurassic(?).

7. Intrusion of granite accompanied by uplift and deformation of the schist country rock. Major sedimentation in Koyukuk Basin at this time (Cretaceous).

8. Regional glaciation, possibly in Illinoian time. Sithylemenkat Lake basin scooped out and the glacial drift east of the lake deposited.

9. Recession of the regional glacier and filling of Sithylemenkat Lake.

10. Lowering of Sithylemenkat Lake by cutting down of Outlet Creek.

TECTONICS

It is postulated here that during Jurassic(?) time steep thrust faults bordering what was to become the Koyukuk geosyncline were active for a considerable period. These tapped deep zones and mafic and ultramafic magmas were intruded and to varying extents affected by tectonic movements. Tectonic emplacement of the mafic-ultramafic complex at Outlet Ridge is suggested by the internal shearing on all scales, particularly in the serpentinized peridotite(?) along the nearly straight south margin. This margin is interpreted as a major fault separating the serpentinite from the diabase(?). On 3040T Ridge the mafic and ultramafic bodies have been intruded as magma into greenschist considered to be a sheared early member of the mafic series. Thus in the northern belt tectonism followed intrusion and in the southern belt intrusion followed tectonism. Recurrent thrusting has tectonized all but the youngest intrusives. The sediments mapped in the basin are of Cretaceous age, so this faulting may have been connected with the initial sinking of the basin and uplift of the Ruby geanticline (Payne, 1955).

The mafic and ultramafic rocks are of regional extent and indicate the regional extent of the steep thrust faulting along the margins of the Koyukuk geosyncline. Patton (verbal communication) has found similar rocks for a great distance along the southeast margin of the Koyukuk geosyncline. Similar mafic rocks of Jurassic(?) age with associated serpentinite bodies have been mapped by Patton and Miller (1966) along the north edge of the Koyukuk geosyncline.

The intrusion of the granite was an apparently separate event, later than the thrusting and mafic activity. It was probably synchronous with uplift of the basin margin in Cretaceous time.

GEOCHEMISTRY

The analyses of stream sediment samples (table 3 and figure 2) and the few soil samples taken in the map area reflect sharp differences in composition between sediments derived from granite and those from ultramafic rock. Both of these are different from the sediments of the ancient land surface in the lowland immediately north of Outlet Ridge.

Ultramafic Association
(nickel, chromium, cobalt, iron)

This association is best shown in the creeks peripheral to the ultrabasics of Outlet Ridge. Here stream sediment samples mostly contain the following:

Nickel	equal to or greater than 200 ppm
Iron	equal to or greater than 5%
Cobalt	equal to or greater than 50 ppm
Chromium	equal to or greater than 200 ppm

(samples considered: 7, 9, 11, 14, 15, 19, 25 thru 31)

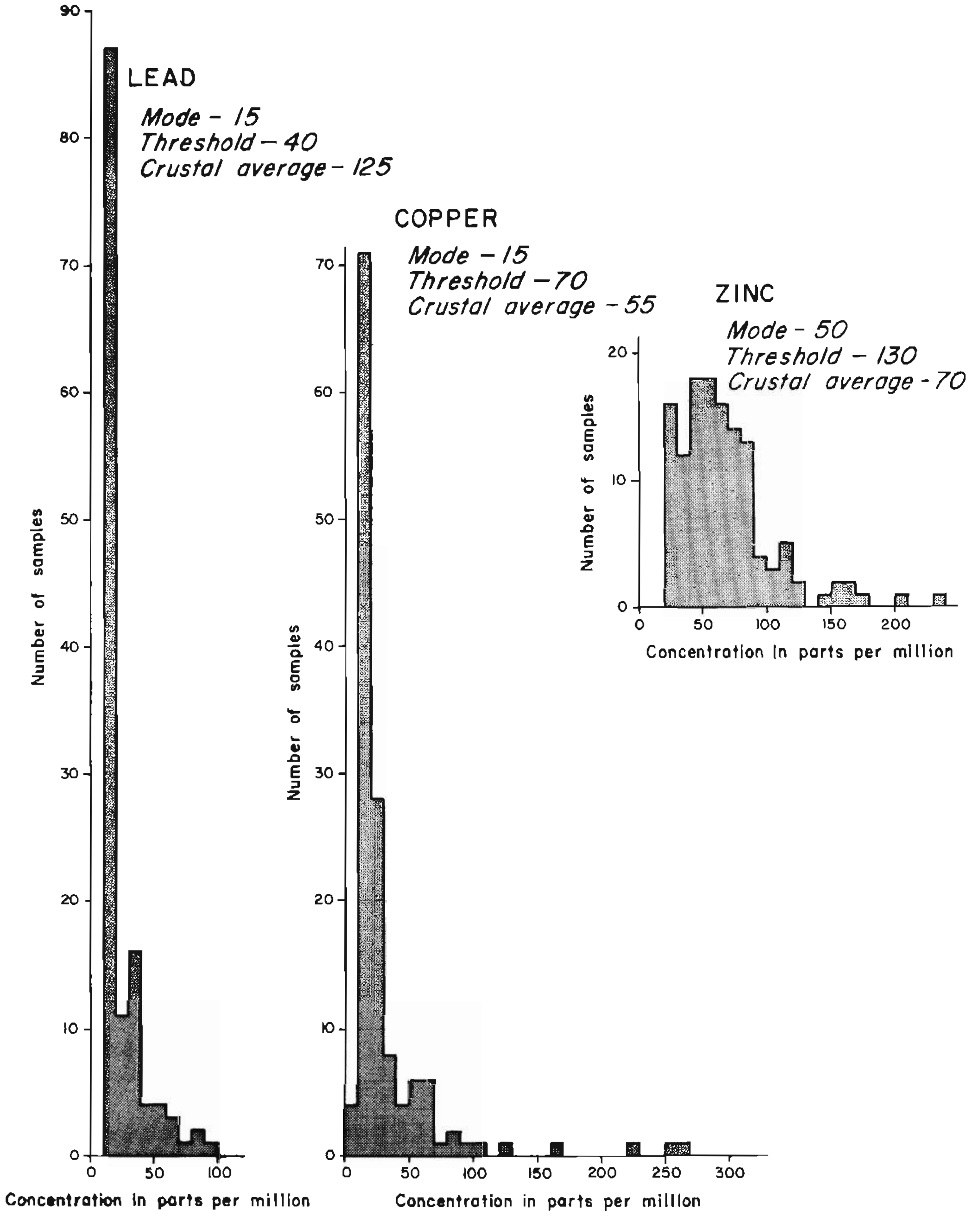

Figure 2
Frequency – concentration graphs for lead, copper and zinc in geochemical samples from the Sithylemenkat Lake map area

Of these, only sample 7 contains an anomalous amount of copper and that may be related to the old land surface rather than the ultrabasic rock.

Similar anomalies at stations 32, 123, and 124 indicate ultrabasic rocks in their respective drainages. The moderate cobalt-chromium anomaly at station 48 may indicate unmapped ultrabasic rocks in that drainage.

The anomalies in samples 54 and 57 reflect the ultrabasic rocks on 3040T Ridge.

The lack of any consistent copper anomalies associated with ultrabasic rocks in the map area is a fairly good indication that significant nickel-sulfide deposits are not present.

Granitic Association
(tin, boron, beryllium, niobium,
strontium, lead, silver, bismuth)

Areas underlain by granite or near granite contain many stream sediment samples with 30 ppm tin or more, plus anomalous amounts of one or more of the other elements of this association. At station 93 anomalous amounts of all the elements listed above, including 70 ppm tin, are present in light brown residual soil containing less than one percent vein quartz and underlain by nonporphyritic granite. This area and numerous other local areas underlain by granite represent a slight concentration of late stage elements of pegmatitic affiliation.

An unmapped body of granite is probably located in the drainage of sample 44.

Lowland Assemblage

The creeks immediately north of the Outlet Ridge ultrabasic, along the edge of the Koyukuk Basin, contain both ultrabasic and granitic assemblage anomalies plus copper, lead, zinc, calcium, titanium, and barium anomalies. The calcium, titanium, and barium are normally concentrated in areas of accumulating sediments and are not of significance for ore deposits in this area. The copper, lead, and zinc anomalies may be related mineralization detected by sample 10 (see below).

Geochemical Sample #10*

	Au	Cu	Pb	Zn	Fe	Mg	Ag	B	Be	Bi	Co	Cr	Ni	Sn
U.S.G.S.	(0.02)	(220)	(60)	(60)	7.0	10.0	5.0	1000	100	700	700	2000	2000	1000
DMG**	(0.1)	(290)	(63)	(63)			(3.0)		70	200	300	2500	2500	650

* Samples in parentheses analyzed by atomic absorption, all others by emission spectrometer

**Atomic absorption analyses by Namok Cho, Alaska Division of Mines and Geology
Emission spectrometer analyses by Michael Mitchell, Alaska Division of Mines and Geology

Sample #10 is very high in several elements. It contains not only the copper-lead-zinc-gold-silver and the tin-boron-beryllium-bismuth assemblages, which could occur in a telescoped deposit, but also the nickel-chromium-cobalt-iron assemblage associated with the ultramafic body. The sample is medium gray clayey mud taken from a small frost boil in an area of tundra cover and open spruce forest. There were a few fragments of serpentine in the mud, a diabase outcrop 100 feet west, and the ultrabasic about 500 feet east. There was no sign of mineralization in the area. The sample would seem to indicate a telescoped tin-silver deposit which has picked up ultramafic elements on the way up through the crust of the earth. Contamination during analysis seems ruled out by the exotic mixture of elements that are present. The copper and zinc anomalies northwest of the sample suggest that it is real and bears further investigation.

Accuracy of Emission Spectrometer Data

It can be seen in table 2 that many of the emission spectrometric copper and lead values vary widely from the atomic absorption values for these metals in the same table. Sixteen of these aberrant samples were analyzed in the Alaska Division of Mines and Geology laboratory by atomic absorption. Comparison with the U. S. Geological Survey atomic absorption data was very close. It is concluded that many of the high and low emission spectrometric values on table 2 do not reflect the metal content of the samples. However, the fairly close correspondence between suites of anomalously abundant elements and types of bedrock seems to indicate that there is considerable value to the figures, even if complete faith cannot be placed in them.

Possibilities for Ore Deposits in the Map Area

Nickel -- Ultrabasic rocks commonly contain 0.1% to 0.3% nickel and 80 ppm copper locked up in the silicate minerals. The nickel contents of the ultramafic rocks in the map area fall within this range or below (table 2). If sufficient sulfur is available during the early stages of crystallization of an ultramafic magma, a separate sulfide melt forms and tends to make a concentration of nickel with varying amounts of copper. The presence of appreciable amounts of pyrite in or around the ultramafic would indicate that sulfur may have been available during crystallization for the formation of nickel sulfide ore. Only very minor amounts of pyrite were found in the map area.

Geochemical stream sediment anomalies for nickel are usually present near ultramafic bodies. Nickel sulfide ore is indicated where anomalous amounts of copper are associated with the nickel. The serpentinization and hydrothermal activity in the ultramafic area would be expected to mobilize both nickel (from either the silicates or any sulfide bodies) and copper (from sulfide bodies). The lack of significant copper anomalies in, or marginal to, the serpentinite or hydrothermal zones is a fairly good indication that nickel-copper sulfide ore bodies are not present in the map area. The information for this analysis of the conditions necessary for nickel sulfide deposits was taken from Chamberlain (1968).

If appreciable amounts of sulfur are present in the country rocks farther along this ultramafic belt to the NE or SW, nickel sulfide deposits are likely to occur. A geochemical stream sediment survey along this belt is highly recommended.

Tin and Beryllium -- The granite and a number of stream sediments in granite areas are anomalously high in tin and beryllium. Nine such stream sediment and soil samples contain 30 ppm or more tin. Ten samples from fresh granite (table 3) contain an average of 32 ppm tin with a standard deviation of 12 ppm. The world average content of tin in granite is 3 ppm (Taylor, 1964). Beus (1969) has compiled analyses of granites from several districts in Russia which contain tin deposits. Ninety-five percent of the samples contained 15 ± 4 ppm tin. Intrusives averaging 20 ppm or more tin (with a minimum of 10 samples taken) have at least 16 chances in 100 of containing an ore body.

Beus also considers that granites favorable for tin are favorable for beryllium and several other rare metals as well. Two samples of the granite contain 8 and 16 ppm beryllium. The world average of beryllium in granite is 5 ppm (Taylor, 1964). Eleven stream sediment samples taken in granite areas contain 15 ppm or more beryllium.

Further stream sediment sampling for tin around the margin of the granite seems warranted. A coarse net of bedrock granite samples taken from the entire granite batholith east of the map area might outline favorable areas for more detailed stream sediment sampling. This approach would be effective for beryllium also.

Basin margin -- The scattering of copper, lead, and zinc anomalies along the edge of the Koyukuk Basin near the west end of the Outlet Creek ultramafic body may indicate the presence of undiscovered ore and warrants further geochemical sampling.

Table 1

Samples from the Outlet Ridge Hydrothermal Zone[a]

Location							
Central Zone	Ni	Cr	Cu	Pb	Zn	Co	Sn
27 (8C130)[b]	0.21%	0.30%	15 ppm	26 ppm	52 ppm	150 ppm	0 ppm
A (8C139)	0.30[c]	0.28[d]	13[c]	16[c]	21[c]		16[c]
Peripheral zone							
B 8C133	0.21[c]	0.60[d]	10[c]	80[c]	38[c]		20[e]
C 8C136	0.21[c]	0.68[d]	20[c]	64[c]	20[c]		14[e]

Rock descriptions:

27 and A = Silicified-limonitized serpentine with chalcedony veinlets
B = Pale olive serpentinite rubble containing disseminated 1/2 mm magnetite octahedrons
C = Light yellowish-brown serpentinite containing specks of magnetite

(a) - Location shown on geologic map
(b) - Emission spectrometer analysis by U. S. Geological Survey
(c) - Atomic absorption analyses by Namok Cho, Alaska Division of Mines and Geology
(d) - X-ray spectroscopic analyses by Paul Anderson, Alaska Division of Mines and Geology
(e) - Emission spectrometer analysis by Michael Mitchell, Alaska Division of Mines and Geology

Table 2

Nickel contents of nine Ultramafic Rock Samples

Sample No.		Nickel Content*	Rock Type	Location
8C	17	0.206%	Sheared serpentinite	North side Outlet Creek, 400 feet east of #26
8C	20	0.003%	Gabbro boulders	Shore Sithylemenkat Lake, north end
8C	35	0.112%	Altered peridotite	Summit spire, 3040T Ridge
8C	38	0.040%	Altered peridotite	Spire 750 feet S77°W of summit spire 3040T Ridge
8C	118	0.128%	Black serpentinite layer in gabbro	1000 ft. contour on hill 900 feet northwest of Sithylemenkat Lake
8C	127	0.076%	Altered peridotite	Small knob, 700 feet northwest of west end of hydrothermal zone on Outlet Ridge
8C	188	0.073%	Altered peridotite dike 60 ft. wide	Tor 2000 feet north of 3040T summit
8C	198	0.112%	Altered pyroxenite	Large knob 0.8 mile west of 3040T Summit
8C	211	0.007%	Altered peridotite	Isolated knob 1.7 mile N65°E of 3040T summit

* Atomic absorption analyses by Namok Cho, Alaska Division of Mines and Geology

Table 3

Tin contents of granite in the Sithylemenkat Lake area

Field No.	Sn ppm*	Location
8L22-1	22	2200 feet east of #22
8L23-1	26	2200 feet east of #22
8L91-2	32	#102
8C85	62	700 feet west of #87
8C156	34	2600 feet west of #94
8C164	32	1300 feet west of #108
8C169	24	1500 feet west of #111
8C222	20	500 feet northeast of #102
8C226	26	3000 feet northeast of #110
8C228	38	1000 feet southeast of #69

Average 31.6ppm

Standard deviation 12 ppm

Values are estimated to be ±50%

Beryllium contents estimated to range from 5 to 15 ppm

*Emission spectrometer analyses by Michael Mitchell, Alaska Division of Mines and Geology

Table 4 ATOMIC ABSORPTION AND SEMIQUANTITATIVE EMISSION SPECTROGRAPHIC

Map No.	Field No.	Gold(b)	Copper(b)	Lead(b)	Zinc(b)	Iron	Magnesium (%)	Calcium (%)	Titanium (%)	Manganese	Silver	Boron	Barium	Beryllium	Bismuth
1	L- 83	0.02*	67.00	76.00	160.00	7.00	0.70	0.20	0.70	700.00	0.0	200.00	700.00	5.00	0.0
2	L- 84	0.02*	10.00*	25.00*	80.00	3.00	0.70	0.0	0.20	150.00	0.0	150.00	200.00	1.50	0.0
3	L- 82	0.02*	10.00*	25.00*	66.00	3.00	0.30	0.30	0.15	300.00	0.0	30.00	500.00	3.00	0.0
4	L- 81	0.02*	80.00	80.00	200.00	5.00	1.50	0.20	0.50	200.00	0.0	200.00	700.00	3.00	0.0
5	L- 80	0.02*	35.00	34.00	90.00	5.00	2.00	2.00	0.20	500.00	0.0	30.00	300.00	3.00	0.0
6	L- 78	0.02*	160.00	38.00	110.00	10.00	3.00	3.00	0.30	1000.00	0.50	30.00	50.00	0.0	0.0
7	L- 79	0.02*	260.00	42.00	110.00	10.00	3.00	3.00	0.50	1000.00	0.0	30.00	100.00	0.0	0.0
8	L- 65	0.02*	54.00	25.00*	140.00	0.70	0.50	0.30	0.15	100.00	0.0	30.00	70.00	0.0	0.0
9	L- 77	0.02*	19.00	32.00	44.00	7.00	7.00	1.00	0.15	700.00	0.0	30.00	150.00	0.0	0.0
10	C-124	0.02*	220.00	60.00	60.00	7.00	10.00	1.50	0.15	700.00	5.00	1000.00	100.00	100.00	700.00
11	L- 64	0.02*	13.00	25.00*	48.00	7.00	5.00	1.00	0.70	700.00	0.0	100.00	500.00	0.0	0.0
12	L- 63	0.02*	250.00	25.00*	60.00	15.00	3.00	2.00	0.70	1000.00	0.0	10.00	70.00	0.0	0.0
13	L- 62	0.02*	10.00*	25.00*	66.00	3.00	0.15	0.10	0.50	150.00	0.0	200.00	300.00	0.0	0.0
14	L- 60	0.02*	25.00	32.00	62.00	5.00	3.00	5.00	0.20	700.00	0.0	30.00	500.00	1.50	0.0
15	C-107	0.02*	27.00	25.00*	50.00	5.00	0.50	0.30	1.00	300.00	0.0	200.00	700.00	0.0	0.0
16	C-110	0.02*	80.00	22.00	40.00	15.00	5.00	5.00	0.70	1000.00	0.0	30.00	200.00	0.0	0.0
17	C-109	0.02*	42.00	25.00*	70.00	15.00	5.00	5.00	0.70	700.00	0.0	10.00	300.00	0.0	0.0
18	C-108	0.02*	60.00	54.00	150.00	7.00	2.00	1.00	1.00	500.00	0.0	200.00	1500.00	0.0	0.0
19	C-106	0.02*	50.00	46.00	150.00	7.00	1.00	0.30	1.00	700.00	0.0	300.00	1000.00	0.0	0.0
20	C-105	0.02*	40.00	60.00	84.00	3.00	0.70	0.50	0.50	20.00	0.0	150.00	300.00	7.00	0.0
21	C-104	0.02*	10.00*	26.00	38.00	2.00	0.30	0.05	0.50	150.00	0.0	700.00	500.00	0.0	0.0
22	C-103	0.02*	10.00*	25.00*	62.00	3.00	1.50	0.30	0.70	300.00	0.0	200.00	500.00	0.0	0.0
23	C-102	0.02*	46.00	37.00	36.00	3.00	0.70	0.20	1.00	200.00	0.0	700.00	700.00	7.00	0.0
24	L- 50	0.02*	10.00*	25.00*	25.00	3.00	1.50	0.50	0.15	300.00	0.0	20.00	200.00	2.00	0.0
25	L- 49	0.02*	10.00*	25.00*	25.00	10.00	3.00	1.50	0.30	1500.00	0.0	150.00	500.00	2.00	0.0
26	L- 47	0.02*	10.00*	25.00*	25.00	3.00	3.00	0.70	0.15	300.00	0.0	30.00	300.00	2.00	0.0
27	-130	0.02*	15.00	26.00	52.00	10.00	3.00	2.00	0.07	1000.00	0.0	20.00	70.00	5.00	0.0
28	L- 46	0.02*	10.00*	25.00*	25.00	3.00	2.00	1.00	0.15	300.00	0.0	30.00	300.00	2.00	0.0
29	L- 66	0.02*	39.00	26.00	92.00	5.00	1.50	0.50	0.50	500.00	0.0	30.00	500.00	3.00	0.0
29	L- 67	0.02*	10.00*	25.00*	25.00	5.00	2.00	2.00	0.20	700.00	0.0	200.00	200.00	1.00	0.0
30	L- 68	0.04*	20.00	25.00*	25.00	15.00	5.00	0.0	0.15	1500.00	0.0	30.00	150.00	0.0	0.0
31	L- 69	0.02*	15.00	25.00*	64.00	5.00	3.00	3.00	0.50	700.00	0.0	30.00	500.00	5.00	0.0
32	L- 70	0.02*	23.00	25.00*	38.00	7.00	5.00	2.00	0.50	1000.00	0.0	15.00	700.00	0.0	0.0
33	L- 71	0.02*	20.00	25.00*	46.00	5.00	3.00	5.00	0.50	1000.00	0.0	15.00	500.00	1.50	0.0
34	L- 72	0.02*	10.00*	25.00*	25.00	3.00	0.70	0.70	0.15	300.00	0.0	15.00	200.00	3.00	0.0
35	L- 73	0.02*	10.00*	25.00*	28.00	7.00	2.00	2.00	0.50	700.00	0.0	100.00	300.00	7.00	0.0
36	L- 51	0.02*	20.00	25.00*	35.00	5.00	2.00	3.00	0.20	1500.00	0.0	70.00	200.00	1.00	0.0
37	L- 55	0.02*	10.00*	25.00*	25.00	3.00	7.00	0.70	0.30	700.00	0.0	30.00	200.00	1.50	0.0
38	L- 52	0.02*	10.00*	25.00*	25.00	2.00	0.70	0.30	0.10	200.00	0.0	50.00	200.00	3.00	0.0
39	L- 76	0.02*	10.00*	25.00*	32.00	3.00	0.70	0.50	0.15	300.00	0.0	70.00	200.00	3.00	0.0
40	L- 74	0.02*	20.00	30.00	58.00	3.00	0.30	0.15	0.15	150.00	0.0	15.00	150.00	2.00	0.0
41	L- 75	0.02*	10.00*	25.00*	30.00	3.00	0.50	0.20	0.15	200.00	0.0	30.00	300.00	5.00	0.0
42	L- 56	0.02*	12.00	25.00*	28.00	3.00	1.50	0.50	0.20	300.00	0.0	200.00	500.00	0.0	0.0
43	L- 57	0.02*	11.00	25.00*	86.00	7.00	1.50	0.15	0.30	700.00	0.0	70.00	300.00	0.0	0.0
44	L- 10	0.02*	24.00	25.00*	54.00	7.00	1.00	0.20	0.50	500.00	0.0	150.00	150.00	7.00	0.0
45	L- 53	0.02*	10.00*	25.00*	25.00	1.00	0.30	0.20	0.10	150.00	0.0	30.00	150.00	5.00	0.0
46	L- 54	0.02*	10.00*	25.00*	25.00	0.70	0.50	0.20	0.15	200.00	0.0	20.00	200.00	5.00	0.0
47	8L- 6	0.02*	37.00	25.00*	45.00	15.00	2.00	1.50	0.70	700.00	0.0	100.00	700.00	2.00	0.0
47	8L- 7	0.02*	21.00	25.00*	40.00	10.00	2.00	1.50	0.70	1500.00	0.0	100.00	700.00	1.50	0.0
48	L- 24	0.0	10.00*	25.00*	20.00	2.00	1.50	1.00	0.15	300.00	0.0	10.00	300.00	3.00	0.0
48	L- 25	0.0	0.0	0.0	0.0	7.00	2.00	2.00	0.30	2000.00	0.0	50.00	500.00	1.00	0.0
48	8L- 9	0.02*	27.00	25.00*	70.00	10.00	2.00	1.50	0.70	700.00	0.0	150.00	700.00	1.50	0.0
49	L- 23	0.04*	10.00*	80.00	42.00	3.00	0.70	0.70	0.70	500.00	0.0	200.00	500.00	7.00	0.0
50	L- 22	0.20*	18.00	25.00*	50.00	7.00	2.00	2.00	0.50	700.00	0.0	200.00	700.00	3.00	0.0
51	L-105	0.02*	82.00	25.00*	90.00	3.00	3.00	1.00	0.15	1000.00	0.0	30.00	500.00	1.50	0.0
52	L- 21	0.02*	15.00	40.00	83.00	5.00	1.00	5.00	0.30	300.00	0.0	100.00	300.00	7.00	0.0
53	L- 20	0.04*	34.00	30.00	76.00	7.00	1.50	2.00	0.50	700.00	0.0	150.00	500.00	0.0	0.0
54	C-193	0.04*	24.00	25.00*	32.00	7.00	5.00	5.00	0.50	700.00	0.0	70.00	500.00	0.0	0.0
55	L- 18	0.04*	100.00	24.00	60.00	10.00	3.00	3.00	0.50	700.00	0.0	30.00	1000.00	0.0	0.0
56	C-207	0.02*	56.00	26.00	160.00	5.00	1.50	0.0	0.20	150.00	0.0	100.00	500.00	5.00	0.0
	Limit of determination					0.05	0.02	0.05	0.001	20	0.5	10	20	1	10

EXPLANATION

(a) Sample locations shown on geologic map. Stream sediment samples were taken from creeks below water level wherever possible. Samples were analyzed by the U.S. Geological Survey, mainly in their Anchorage laboratory. Total metal contents in parts per million, unless indicated otherwise. Values with asterisks have been detected, but are below value shown. Values given as 0.0 are below the limit of determination
(b) Atomic absorption
(c) Milliliters dithizone, cold extractable heavy metals test of Hawkes (1963)
(d) C-2' = stream sediment sample taken from a stream two feet wide
D-6" = soil sample taken at a depth of five inches below surface of soil

Map No.	Field Test(c)	Sample Type(d)	Description of Bedrock, Soil, Etc.
1		D-4"	Frost boil
2		D-3"	Quartz conglomerate
3		C-2'	Quartz sand
4		D-4"	Frost boil, quartz pebbles
5		D-4"	Yellow soil
6		C-2'	Serpentine, silicified tan "gossan" float
7		C-2'	Serpentine, silicified tan "gossan" float
8			Swamp silt near lake
9		C-2'	Serpentine, bedrock, creek almost dry
10		D-2"	Frost boil, blue mud w/serpentine fragments. Bedrock probably diabase
11	2	D-7"	Brown soil
12		D-5"	Swamp clay
13		D-5"	Rounded vein quartz, serpentinite float
14		D-4"	Ultra basic-gabbro contact
15		D-1'	Lake bank, float quartz pebbles to 2" dia.
16		D-4"	Frost boil, float gabbro, diabase, vein calcite
17		D-8"	Brown soil, gabbro float
18		D-6"	Frost boil w/dark clay float-quartz pebbles

ANALYSES OF GEOCHEMICAL SAMPLES FROM THE SITHYLEMENKAT LAKE AREA

Cobalt	Chromium	Copper	Lanthanum	Molybdenum	Niobium	Nickel	Lead	Scandium	Tin	Strontium	Vanadium	Yttrium	Zirconium	Map No.
10.00	100.00	50.00	30.00	0.0	0.0	150.00	70.00	15.00	0.0	200.00	300.00	30.00	500.00	1
0.0	15.00	20.00	30.00	0.0	0.0	5.00	0.0	5.00	0.0	0.0	70.00	15.00	150.00	2
10.00	50.00	10.00	30.00	0.0	0.0	30.00	100.00	0.0	0.0	0.0	30.00	0.0	70.00	3
15.00	300.00	50.00	50.00	0.0	0.0	100.00	150.00	30.00	0.0	0.0	300.00	50.00	300.00	4
15.00	150.00	0.0	0.0	0.0	0.0	100.00	30.00	15.00	0.0	150.00	150.00	15.00	150.00	5
50.00	300.00	150.00	0.0	0.0	0.0	150.00	0.0	50.00	0.0	0.0	150.00	15.00	0.0	6
50.00	700.00	300.00	0.0	0.0	0.0	500.00	20.00	50.00	0.0	0.0	200.00	15.00	0.0	7
10.00	70.00	20.00	30.00	0.0	0.0	150.00	20.00	5.00	0.0	0.0	30.00	10.00	30.00	8
100.00	2000.00	0.0	0.0	0.0	0.0	700.00	30.00	10.00	10.00	0.0	100.00	0.0	20.00	9
700.00	3000.00	500.00	0.0	0.0	0.0	2000.00	150.00	5.00	1000.00	0.0	160.00	0.0	20.00	10
50.00	1000.00	30.00	20.00	0.0	0.0	1500.00	0.0	15.00	0.0	0.0	150.00	20.00	300.00	11
30.00	150.00	300.00	0.0	0.0	0.0	150.00	0.0	50.00	0.0	0.0	300.00	15.00	0.0	12
5.00	150.00	0.0	0.0	0.0	0.0	70.00	0.0	7.00	0.0	0.0	70.00	10.00	200.00	13
20.00	1500.00	15.00	20.00	0.0	0.0	200.00	50.00	30.00	50.00	100.00	150.00	30.00	100.00	14
0.0	70.00	100.00	30.00	0.0	0.0	200.00	30.00	15.00	0.0	0.0	300.00	15.00	500.00	15
100.00	500.00	150.00	0.0	0.0	0.0	150.00	0.0	100.00	0.0	150.00	700.00	0.0	10.00	15
100.00	300.00	150.00	0.0	0.0	0.0	150.00	0.0	70.00	0.0	500.00	1000.00	0.0	0.0	17
15.00	200.00	150.00	50.00	0.0	0.0	150.00	300.00	50.00	0.0	0.0	500.00	50.00	500.00	18
7.00	200.00	150.00	30.00	0.0	0.0	300.00	150.00	30.00	0.0	0.0	500.00	15.00	500.00	19
0.0	30.00	30.00	30.00	0.0	0.0	70.00	150.00	10.00	0.0	0.0	150.00	50.00	300.00	20
5.00	30.00	50.00	30.00	0.0	0.0	30.00	30.00	7.00	0.0	0.0	150.00	20.00	200.00	21
0.0	30.00	20.00	20.00	0.0	0.0	150.00	0.0	7.00	0.0	0.0	200.00	30.00	300.00	22
5.00	200.00	100.00	70.00	0.0	0.0	70.00	200.00	70.00	30.00	0.0	500.00	70.00	500.00	23
10.00	150.00	0.0	20.00	0.0	0.0	150.00	50.00	7.00	30.00	100.00	50.00	0.0	30.00	24
50.00	700.00	20.00	0.0	0.0	0.0	300.00	15.00	7.00	0.0	0.0	150.00	0.0	70.00	25
10.00	500.00	7.00	0.0	0.0	0.0	200.00	15.00	0.0	0.0	0.0	30.00	0.0	0.0	26
150.00	5000.00	15.00	0.0	0.0	0.0	5000.00	10.00	15.00	0.0	0.0	50.00	0.0	30.00	27
10.00	500.00	5.00	0.0	0.0	0.0	200.00	15.00	0.0	0.0	0.0	50.00	0.0	70.00	28
15.00	200.00	30.00	50.00	0.0	10.00	300.00	20.00	20.00	0.0	0.0	150.00	30.00	100.00	29
10.00	200.00	15.00	0.0	0.0	0.0	300.00	30.00	7.00	0.0	0.0	150.00	0.0	30.00	29
150.00	3000.00	20.00	0.0	0.0	0.0	3000.00	0.0	15.00	0.0	0.0	150.00	0.0	0.0	30
15.00	500.00	50.00	70.00	0.0	0.0	300.00	50.00	15.00	0.0	300.00	150.00	15.00	70.00	31
100.00	1500.00	50.00	0.0	0.0	0.0	1500.00	10.00	15.00	0.0	0.0	150.00	10.00	30.00	32
20.00	300.00	50.00	30.00	0.0	0.0	150.00	50.00	20.00	0.0	500.00	150.00	15.00	150.00	33
5.00	50.00	0.0	0.0	0.0	0.0	30.00	70.00	5.00	0.0	0.0	150.00	0.0	30.00	34
10.00	200.00	15.00	30.00	0.0	0.0	70.00	70.00	15.00	10.00	100.00	200.00	15.00	300.00	35
20.00	500.00	10.00	70.00	0.0	0.0	100.00	20.00	15.00	0.0	150.00	200.00	0.0	20.00	36
5.00	30.00	30.00	0.0	0.0	10.00	20.00	20.00	5.00	0.0	0.0	30.00	0.0	70.00	37
7.00	50.00	0.0	0.0	0.0	0.0	30.00	30.00	0.0	0.0	0.0	20.00	0.0	30.00	38
0.0	30.00	20.00	0.0	0.0	0.0	20.00	150.00	0.0	0.0	0.0	30.00	0.0	30.00	39
0.0	50.00	0.0	30.00	0.0	0.0	20.00	30.00	5.00	0.0	0.0	150.00	15.00	30.00	40
10.00	70.00	0.0	70.00	0.0	0.0	30.00	20.00	7.00	0.0	0.0	100.00	10.00	50.00	41
15.00	150.00	30.00	0.0	0.0	0.0	50.00	20.00	10.00	0.0	200.00	150.00	10.00	70.00	42
15.00	50.00	30.00	20.00	0.0	0.0	70.00	0.0	15.00	0.0	0.0	200.00	10.00	150.00	43
10.00	10.00	150.00	70.00	0.0	30.00	0.0	160.00	7.00	70.00	100.00	50.00	70.00	700.00	44
7.00	30.00	0.0	0.0	0.0	0.0	10.00	30.00	0.0	0.0	0.0	30.00	10.00	30.00	45
10.00	30.00	10.00	0.0	0.0	0.0	20.00	20.00	5.00	0.0	0.0	30.00	0.0	30.00	46
15.00	300.00	70.00	50.00	0.0	0.0	150.00	30.00	20.00	0.0	100.00	200.00	30.00	300.00	47
15.00	300.00	70.00	30.00	0.0	0.0	150.00	15.00	15.00	0.0	0.0	200.00	30.00	500.00	47
10.00	150.00	0.0	0.0	0.0	0.0	50.00	30.00	7.00	0.0	0.0	50.00	0.0	30.00	48
50.00	300.00	30.00	150.00	0.0	10.00	100.00	15.00	20.00	0.0	100.00	150.00	30.00	150.00	48
15.00	300.00	70.00	30.00	0.0	0.0	150.00	15.00	20.00	0.0	0.0	200.00	15.00	300.00	48
5.00	30.00	5.00	200.00	0.0	30.00	10.00	50.00	16.00	0.0	100.00	50.00	70.00	1000.00	49
15.00	200.00	30.00	100.00	0.0	15.00	100.00	70.00	20.00	0.0	100.00	150.00	15.00	150.00	50
15.00	100.00	50.00	30.00	0.0	0.0	70.00	20.00	15.00	0.0	0.0	100.00	15.00	70.00	51
10.00	70.00	15.00	70.00	0.0	20.00	30.00	100.00	15.00	30.00	0.0	100.00	30.00	200.00	52
70.00	300.00	30.00	20.00	0.0	0.0	100.00	30.00	30.00	0.0	100.00	200.00	15.00	300.00	53
20.00	700.00	50.00	70.00	0.0	10.00	200.00	0.0	30.00	0.0	0.0	150.00	50.00	200.00	54
20.00	300.00	150.00	20.00	0.0	15.00	150.00	10.00	50.00	0.0	150.00	300.00	30.00	200.00	65
15.00	150.00	100.00	70.00	0.0	10.00	50.00	50.00	20.00	20.00	100.00	150.00	20.00	200.00	56
5	5	2	20	5	10	5	10	5	10	50	10	5	10	

Map No.	Field Test(c)	Sample Type(d)	Description of Bedrock, Soil, Etc.
19		D-6"	Dk. gray mud, shale, sandstone, float
20		D-5"	Frost boil, gabbro float
21		D-2"	Moss underlain by vein quartz gravel
22		D-6"	Vein quartz gravel under 2" black soil
23		D-4"	Frost boil w/black soil, shale frags.
24	1	C-15'	
25	2	C-15'	
26	1	C-15'	
27		D-2	Limonite soil on south slope of gossan
28	1	C-15'	
29	9	D-1'	Swamp mud
29a	3	D-1'	Swamp mud
30	5	D-4"	Diabase float
31	5	C-1'	Swamp mud
32	2	D-3"	Frost boil, biotite diorite float
33	3	D-2"	Dry creek, no float
34	2	C-1'	No float
35	2	C-1'	No float
36	1	D-2"	Dry creek
37	1	D-1"	Top ice-push ridge
38	3	C-6"	Swamp trickle, 10 ft. from lake

Map No.	Field Test(c)	Sample Type(d)	Description of Bedrock, Soil, Etc.
39	1	C-1'	
40	4	C-6"	Swampy creek
41	3	D-2"	Inorganic silt, dry creek bed
42	1	D-1"	Dry creek
43	5	D-1"	Dry lake bottom
44	7	C-3"	
45	1	C-1'	Swamp drainage
46	1	D-2"	Soil, back side of ice-push ridge
47	16	C-7'	Silt from bank of creek
47	9	C-7'	Silt from creek floor
48	3	C-2'	Sand bar at mouth of creek
48a	3	C-2'	10 ft. up creek from mouth
49	10	C-2'	Swamp drainage
50	5	C-3'	Granite bedrock
51	4	C-1"	
52	4	D-2"	Granite bedrock
53	12	C-3'	
54		C-6"	White feldspar sand and gray silt
55	9	D-2"	Greenschist
56		D-4"	Schist-greenstone contact 10% vein quartz float

Map No.	Field No.	Gold(b)	Copper(b)	Lead(b)	Zinc(b)	Iron	Magnesium (%)	Calcium (%)	Titanium (%)	Manganese	Silver	Boron	Barium	Beryllium	Bismuth
57	L- 14	0.02*	25.00	26.00	70.00	5.00	3.00	1.50	0.50	700.00	0.0	70.00	700.00	0.0	0.0
58	L-110	0.10*	21.00	30.00	74.00	3.00	2.00	0.50	0.15	300.00	0.0	50.00	500.00	5.00	0.0
59	L-111	0.10*	25.00	25.00*	84.00	2.00	1.00	0.20	0.15	200.00	0.0	30.00	300.00	7.00	0.0
60	L-112	0.02*	10.00*	25.00*	50.00	2.00	1.50	0.50	0.15	150.00	0.0	50.00	300.00	7.00	0.0
61	L-113	0.02*	11.00	25.00*	56.00	3.00	1.50	0.50	0.20	150.00	0.0	50.00	500.00	7.00	0.0
62	L-114	0.04*	10.00*	25.00*	44.00	3.00	1.50	0.20	0.30	200.00	0.0	200.00	300.00	5.00	0.0
63	L-115	0.04*	11.00	25.00*	80.00	3.00	1.50	0.50	0.20	300.00	0.0	150.00	500.00	15.00	10.00
64	L-116	0.02*	10.00*	25.00*	48.00	3.00	1.00	0.50	0.20	300.00	0.0	30.00	600.00	20.00	0.0
65	L- 28	0.20*	10.00*	25.00*	50.00	3.00	0.50	1.00	0.20	200.00	0.0	200.00	300.00	10.00	0.0
66	L- 26	0.10*	15.00	35.00	75.00	3.00	0.50	0.70	0.20	300.00	0.0	30.00	200.00	15.00	0.0
66	L- 27	0.20*	10.00*	25.00*	42.00	3.00	0.50	1.00	0.15	200.00	0.0	70.00	300.00	10.00	0.0
67	L- 29	0.10*	10.00*	25.00*	50.00	3.00	0.70	0.70	0.30	200.00	0.0	30.00	500.00	7.00	0.0
68	L- 30	0.20*	10.00*	25.00*	50.00	5.00	0.50	0.50	0.20	300.00	0.0	30.00	200.00	10.00	0.0
69	L- 45	0.20*	14.00	25.00*	46.00	3.00	0.30	0.70	0.30	500.00	0.0	150.00	300.00	7.00	0.0
70	BL- 1	0.10*	10.00*	54.00	47.00	3.00	0.30	0.10	0.30	150.00	0.0	50.00	300.00	3.00	0.0
70	BL- 2	0.02*	30.00	25.00*	60.00	3.00	0.70	0.70	0.30	500.00	0.0	150.00	500.00	7.00	0.0
71	L- 33	0.20*	10.00*	25.00*	56.00	5.00	3.00	1.00	0.20	700.00	0.0	200.00	500.00	10.00	0.0
72	L- 32	0.04*	10.00*	25.00*	64.00	5.00	0.70	3.00	0.70	1000.00	0.0	200.00	300.00	15.00	0.0
73	L- 31	0.0	0.0	0.0	0.0	5.00	0.70	1.50	0.70	200.00	0.0	500.00	300.00	7.00	0.0
74	C- 65	0.02*	10.00*	28.00	78.00	3.00	0.50	0.20	0.15	500.00	0.0	15.00	200.00	5.00	0.0
75	C- 10	0.04*	70.00	58.00	80.00	10.00	2.00	1.50	0.70	700.00	0.0	100.00	700.00	1.00	0.0
76	C- 70F	0.02*	34.00	25.00*	70.00	10.00	0.70	0.07	0.70	200.00	0.0	300.00	1000.00	1.00	0.0
77	BL- 5	0.04*	68.00	30.00	80.00	10.00	1.50	0.50	0.50	500.00	0.0	70.00	700.00	1.50	0.0
78	C- 58	0.02*	10.00*	25.00*	40.00	3.00	0.70	0.07	0.15	300.00	0.0	10.00	200.00	15.00	0.0
79	BL- 3	0.10*	94.00	60.00	230.00	3.00	0.50	0.50	0.30	700.00	0.0	70.00	700.00	15.00	0.0
80	BC- 9	0.10*	21.00	25.00*	52.00	7.00	0.70	0.30	0.70	500.00	0.0	200.00	700.00	7.00	0.0
81	BC- 6	0.10*	10.00*	32.00	50.00	7.00	1.00	0.70	0.30	700.00	0.0	100.00	150.00	7.00	0.0
82	L- 44	0.0	0.0	0.0	0.0	0.07	0.20	0.20	0.05	150.00	0.0	100.00	300.00	3.00	0.0
83	L- 43	0.10*	13.00	25.00*	32.00	3.00	0.30	0.30	0.15	300.00	0.0	150.00	300.00	7.00	0.0
84	C- 54	0.02*	33.00	0.0	66.00	3.00	0.70	0.50	0.20	300.00	0.0	50.00	300.00	3.00	0.0
85	L- 37	0.02*	14.00	25.00*	58.00	5.00	1.50	1.50	0.50	500.00	0.0	200.00	700.00	1.50	0.0
86	L- 36	0.02*	17.00	25.00*	50.00	7.00	3.00	3.00	0.70	1000.00	0.0	500.00	700.00	7.00	0.0
87	L- 35	0.02*	34.00	25.00*	60.00	7.00	3.00	3.00	0.70	1000.00	0.0	200.00	700.00	100.00	0.0
88	L- 34	0.02*	55.00	25.00*	110.00	5.00	1.50	1.00	0.50	700.00	0.0	200.00	700.00	0.0	0.0
89	L- 38	0.0	10.00*	25.00*	0.0	3.00	1.50	2.00	0.30	700.00	0.0	100.00	150.00	0.0	0.0
90	L- 41	0.20*	65.00	25.00*	32.00	7.00	1.50	1.50	1.00	700.00	0.0	0.0	700.00	1.00	0.0
91	L- 39	0.20*	29.00	25.00*	48.00	10.00	3.00	3.00	1.00	1500.00	0.0	15.00	700.00	0.0	0.0
92	C-212	0.04*	10.00*	28.00	44.00	2.00	0.20	0.15	1.50	200.00	0.50	500.00	150.00	10.00	0.0
93	C-160	0.02*	22.00	90.00	120.00	5.00	0.30	0.07	0.15	700.00	0.70	700.00	100.00	20.00	15.00
94	C-213	0.02*	63.00	29.00	100.00	5.00	1.00	0.15	0.20	300.00	0.0	500.00	700.00	5.00	0.0
95	C-157	0.02*	13.00	32.00	100.00	5.00	3.00	0.30	0.20	500.00	0.0	30.00	300.00	10.00	0.0
96	C-158	0.20*	10.00*	56.00	44.00	5.00	1.50	0.15	0.10	1000.00	0.0	200.00	200.00	10.00	10.00
97	C-161	0.02*	13.00	30.00	56.00	3.00	0.70	0.50	0.20	200.00	0.0	100.00	500.00	7.00	0.0
98	L- 86	0.02*	60.00	25.00*	40.00	1.50	0.15	1.00	0.15	150.00	0.0	30.00	150.00	5.00	0.0
99	L- 87	0.02*	35.00	25.00*	82.00	3.00	0.70	0.70	0.30	200.00	0.0	30.00	300.00	3.00	0.0
100	L- 88	0.02*	10.00*	25.00*	44.00	1.50	0.30	0.30	0.15	150.00	0.0	30.00	150.00	5.00	0.0
100	L- 89	0.02*	10.00*	25.00*	28.00	3.00	0.30	0.30	0.15	200.00	0.0	30.00	150.00	5.00	0.0
101	L- 90	0.10*	10.00*	25.00*	25.00	0.07	0.07	0.30	0.03	150.00	0.0	100.00	150.00	7.00	0.0
102	L- 91	0.02*	10.00*	25.00*	30.00	2.00	0.15	0.30	0.15	300.00	0.0	30.00	150.00	3.00	0.0
103	L- 93	0.0	10.00*	25.00*	78.00	3.00	0.30	0.30	0.15	700.00	0.0	30.00	200.00	7.00	0.0
104	L- 92	0.10*	10.00*	25.00*	60.00	2.00	0.20	0.50	0.15	300.00	0.0	50.00	300.00	7.00	0.0
106	L- 95	0.02*	10.00*	25.00*	38.00	3.00	0.30	0.15	0.15	200.00	0.0	50.00	300.00	5.00	0.0
106	L- 94	0.20*	10.00*	25.00*	50.00	3.00	0.50	0.30	0.15	700.00	0.0	50.00	200.00	7.00	0.0
107	L- 96	0.04*	10.00*	25.00*	30.00	3.00	0.30	0.50	0.15	1000.00	0.0	15.00	150.00	15.00	0.0
108	L- 97	0.02*	24.00	26.00	120.00	3.00	0.70	0.70	0.50	700.00	0.0	20.00	300.00	15.00	0.0
109	L- 98	0.02*	10.00*	30.00	92.00	5.00	0.70	1.00	0.50	700.00	0.0	30.00	700.00	15.00	0.0
110	L- 99	0.02*	10.00*	30.00	54.00	10.00	1.00	0.70	0.70	1500.00	0.0	30.00	700.00	15.00	0.0
111	L-100	0.04*	24.00	40.00	72.00	5.00	0.70	0.20	0.30	700.00	0.0	50.00	150.00	7.00	0.0
112	L-101	0.10*	10.00*	25.00*	86.00	5.00	1.00	0.30	0.50	700.00	0.0	700.00	700.00	1.00	0.0
113	L-121	0.10*	25.00	25.00*	84.00	5.00	1.50	0.01	0.20	300.00	0.0	700.00	700.00	1.50	0.0
114	L-123	0.10*	26.00	25.00*	78.00	3.00	1.50	0.10	0.15	700.00	0.0	200.00	700.00	2.00	0.0
115	L-102	0.10*	23.00	25.00*	100.00	7.00	1.00	0.30	0.50	700.00	0.0	200.00	1000.00	3.00	0.0
116	L-103	0.02*	14.00	25.00*	66.00	7.00	1.50	1.00	0.70	300.00	0.0	150.00	700.00	1.00	0.0
117	L-138	0.02*	23.00	25.00*	72.00	5.00	3.00	0.20	0.20	150.00	0.0	50.00	500.00	1.00	0.0
118	L-137	0.02*	16.00	25.00*	68.00	3.00	2.00	0.20	0.20	300.00	0.70	200.00	700.00	3.00	0.0
119	L-136	0.02*	16.00	25.00*	86.00	3.00	2.00	0.30	0.20	500.00	0.0	30.00	300.00	5.00	0.0
120	L-135	0.02*	18.00	26.00*	84.00	3.00	2.00	0.20	0.30	700.00	0.0	200.00	500.00	5.00	0.0
121	L-134	0.04*	22.00	25.00*	110.00	3.00	3.00	0.30	0.30	700.00	0.0	100.00	500.00	5.00	0.0
122	L-133	0.02*	40.00	30.00	170.00	5.00	5.00	1.00	0.20	700.00	0.0	50.00	700.00	0.0	0.0
123	L-132	0.02*	16.00	25.00*	76.00	5.00	3.00	3.00	0.03	700.00	0.0	15.00	50.00	5.00	0.0
124	L-131	0.06	26.00	25.00*	78.00	5.00	3.00	1.00	0.15	700.00	0.0	30.00	700.00	1.00	0.0
125	L-130	0.02	50.00	26.00	110.00	3.00	3.00	0.70	0.20	1000.00	0.0	100.00	700.00	2.00	0.0
126	L-129	0.0	0.0	0.0	0.0	10.00	1.50	1 00	0.03	1000.00	0.0	30.00	50.00	7.00	0.0
127	L-128	0.02*	120.00	25.00*	68.00	5.00	3.00	1.00	0.15	700.00	0.0	30.00	500.00	1.50	0.0
	Limit of determination					0.05	0.02	0.05	0.001	20	0.5	10	20	1	10

Map No.	Field Test(c)	Sample Type(d)	Description of Bedrock, Soil, Etc.
57	6	D-2"	
58	4	C-1'	Float: granite, quartz mica schist, vein quartz 10%
59	2	C-1'	Dry creek granite, quartz mica schist, vein quartz
60	6	C-1'	Granite float
61	10	C-1'	Granite, schist, float
62	10	C-1	Dry creek, no float
63	7	C-2	Sample from bank, float granite, 5% schist
64	6	C-2'	Sample from bank, granite float
65	3	C-6'	
66	6	C-6"	Side channel
67	7	C-1	Meadow drainage
68	4	C-18"	Meadow drainage
69	2	C-3'	At lake level, behind bar
70	2	C-10'	Float: granite, schist 5%
70a	3	D-2"	Granite bedrock
71	5	C-3	Upper edge large swamp
72	4	C-18"	
73	2	C-2'	
74		C-4"	Red stained granite, sand, granite bedrock
75		D-2"	Moderate red stained granite soil, granite bedrock
76		C-4'	Quartzose schist bedrock
77	1	D-1	Soil patch in diabase rubble
78		C-1'	Bedrock: diabase(?), granite pea gravel float
79	5	C-3	Dry creek float, dark hornfels, schist, granite
80		C-3'	Float granite 60%, diabase 40%
81		D-2"	Rubble in place over quartz vein
82	2	C-3	Lake level behind sand bar
83	4	C-1 1/2'	Lake level behind sand bar
84		C-2'	Greenstone bedrock
85	4	C-4'	Lake level behind bar
86	3	C-3'	
87	4	C-2 1/2'	
88	5	C-2 1/2'	
89	3	C-2 1/2'	Lake level

ANALYSES OF GEOCHEMICAL SAMPLES FROM THE SITHYLEMENKAT LAKE AREA

Cobalt	Chromium	Copper	Lanthanum	Molybdenum	Niobium	Nickel	Lead	Scandium	Tin	Strontium	Vanadium	Yttrium	Zirconium	Map No.
70.00	500.00	15.00	50.00	0.0	15.00	200.00	15.00	15.00	0.0	160.00	200.00	30.00	500.00	57
10.00	70.00	15.00	50.00	0.0	10.00	30.00	50.00	10.00	0.0	0.0	100.00	50.00	100.00	53
10.00	30.00	10.00	150.00	0.0	10.00	30.00	50.00	10.00	0.0	0.0	100.00	30.00	100.00	59
10.00	50.00	0.0	100.00	0.0	20.00	20.00	50.00	7.00	0.0	0.0	70.00	50.00	300.00	60
10.00	70.00	5.00	100.00	0.0	20.00	20.00	70.00	15.00	0.0	150.00	100.00	50.00	300.00	61
7.00	50.00	5.00	50.00	0.0	15.00	30.00	50.00	10.00	0.0	0.0	100.00	50.00	300.00	62
10.00	50.00	10.00	150.00	0.0	20.00	20.00	70.00	15.00	0.0	100.00	70.00	50.00	500.00	63
10.00	30.00	0.0	100.00	0.0	20.00	20.00	30.00	15.00	0.0	100.00	50.00	50.00	1000.00	64
5.00	30.00	5.00	70.00	0.0	10.00	7.00	70.00	7.00	0.0	100.00	50.00	20.00	300.00	65
5.00	30.00	0.0	150.00	0.0	30.00	10.00	70.00	10.00	15.00	0.0	70.00	50.00	100.00	66
5.00	10.00	20.00	70.00	0.0	15.00	10.00	100.00	7.00	20.00	200.00	50.00	30.00	70.00	66
6.00	50.00	30.00	50.00	0.0	15.00	20.00	100.00	7.00	0.0	0.0	50.00	20.00	300.00	67
0.0	20.00	0.0	50.00	0.0	10.00	7.00	70.00	5.00	0.0	0.0	30.00	15.00	300.00	68
10.00	20.00	7.00	70.00	0.0	15.00	10.00	70.00	7.00	1000.00	0.0	100.00	20.00	150.00	69
7.00	30.00	10.00	70.00	0.0	15.00	7.00	100.00	15.00	50.00	100.00	30.00	30.00	200.00	70
5.00	70.00	70.00	150.00	0.0	10.00	20.00	70.00	10.00	10.00	0.0	100.00	70.00	300.00	70
0.0	20.00	0.0	200.00	0.0	0.0	7.00	150.00	0.0	0.0	100.00	30.00	30.00	200.00	71
0.0	20.00	15.00	200.00	0.0	30.00	7.00	200.00	5.00	20.00	0.0	30.00	200.00	1000.00	72
5.00	30.00	0.0	730.00	0.0	15.00	7.00	100.00	5.00	0.0	0.0	30.00	30.00	300.00	73
10.00	5.00	0.0	50.00	0.0	10.00	30.00	150.00	7.00	15.00	0.0	20.00	20.00	300.00	74
15.00	300.00	50.00	20.00	0.0	10.00	150.00	15.00	15.00	0.0	0.0	20.00	20.00	500.00	75
10.00	100.00	30.00	[illegible]	0.0	0.0	100.00	20.00	20.00	0.0	0.0	0.0	30.00	300.00	76
15.00	200.00	70.00	20.00	0.0	10.00	100.00	15.00	20.00	0.0	0.0	150.00	30.00	150.00	77
10.00	20.00	0.0	[illegible]	0.0	0.0	15.00	70.00	5.00	0.0	0.0	30.00	30.00	100.00	78
15.00	70.00	100.00	[illegible]	0.0	0.0	100.00	30.00	15.00	15.00	0.0	150.00	30.00	150.00	79
5.00	70.00	30.00	0.0	0.0	0.0	30.00	20.00	10.00	0.0	0.0	150.00	20.00	300.00	80
0.0	30.00	15.00	20.00	0.0	10.00	15.00	150.00	7.00	70.00	0.0	30.00	30.00	300.00	81
5.00	30.00	0.0	0.0	0.0	0.0	7.00	50.00	7.00	0.0	0.0	100.00	15.00	30.00	82
7.00	30.00	7.00	0.0	0.0	0.0	20.00	30.00	5.00	0.0	0.0	150.00	15.00	30.00	83
10.00	70.00	15.00	30.00	0.0	0.0	30.00	30.00	10.00	0.0	0.0	150.00	20.00	150.00	84
10.00	150.00	15.00	70.00	0.0	10.00	100.00	70.00	15.00	0.0	100.00	300.00	50.00	500.00	85
15.00	200.00	50.00	50.00	0.0	0.0	100.00	200.00	20.00	0.0	150.00	300.00	30.00	500.00	86
15.00	200.00	50.00	30.00	0.0	0.0	70.00	0.0	20.00	0.0	0.0	500.00	30.00	500.00	87
15.00	150.00	50.00	30.00	0.0	0.0	70.00	0.0	20.00	0.0	100.00	300.00	15.00	300.00	88
10.00	150.00	20.00	0.0	0.0	0.0	70.00	30.00	10.00	0.0	0.0	200.00	0.0	0.0	89
15.00	70.00	70.00	0.0	7.00	10.00	50.00	0.0	30.00	0.0	300.00	200.00	30.00	70.00	90
15.00	100.00	50.00	0.0	0.0	0.0	100.00	0.0	50.00	0.0	100.00	300.00	15.00	50.00	91
7.00	30.00	0.0	50.00	0.0	20.00	10.00	100.00	7.00	30.00	150.00	70.00	50.00	150.00	92
10.00	20.00	20.00	50.00	0.0	30.00	15.00	200.00	10.00	70.00	0.0	50.00	70.00	150.00	93
15.00	150.00	70.00	100.00	0.0	15.00	70.00	70.00	20.00	0.0	0.0	150.00	50.00	150.00	94
10.00	50.00	30.00	100.00	0.0	30.00	20.00	150.00	15.00	30.00	0.0	50.00	100.00	300.00	95
10.00	30.00	10.00	50.00	0.0	15.00	10.00	200.00	7.00	30.00	0.0	70.00	50.00	70.00	96
10.00	70.00	5.00	70.00	0.0	15.00	30.00	100.00	10.00	30.00	0.0	100.00	70.00	200.00	97
0.0	5.00	7.00	20.00	0.0	0.0	7.00	70.00	0.0	15.00	0.0	30.00	15.00	50.00	98
10.00	70.00	10.00	70.00	0.0	10.00	30.00	30.00	10.00	0.0	0.0	150.00	30.00	300.00	99
10.00	30.00	7.00	70.00	0.0	15.00	10.00	100.00	7.00	15.00	0.0	70.00	50.00	70.00	100
10.00	10.00	0.0	70.00	0.0	0.0	7.00	50.00	5.00	0.0	0.0	30.00	20.00	70.00	100
10.00	0.0	0.0	0.0	0.0	0.0	5.00	70.00	0.0	0.0	0.0	30.00	10.00	50.00	101
7.00	7.00	7.00	50.00	0.0	0.0	7.00	100.00	5.00	10.00	0.0	30.00	20.00	70.00	102
10.00	30.00	10.00	30.00	0.0	10.00	10.00	70.00	7.00	0.0	0.0	50.00	30.00	300.00	103
10.00	15.00	10.00	50.00	0.0	10.00	10.00	100.00	7.00	15.00	0.0	30.00	20.00	70.00	104
10.00	30.00	7.00	50.00	0.0	10.00	10.00	70.00	7.00	0.0	0.0	50.00	20.00	70.00	105
15.00	20.00	7.00	50.00	0.0	0.0	15.00	100.00	7.00	0.0	0.0	50.00	30.00	200.00	106
15.00	7.00	7.00	0.0	0.0	0.0	5.00	70.00	0.0	0.0	0.0	30.00	15.00	30.00	107
15.00	50.00	7.00	150.00	0.0	15.00	30.00	50.00	0.0	0.0	0.0	150.00	70.00	700.00	108
7.00	50.00	15.00	100.00	0.0	15.00	30.00	70.00	15.00	0.0	0.0	150.00	30.00	500.00	109
15.00	70.00	15.00	20.00	0.0	15.00	30.00	150.00	15.00	0.0	0.0	150.00	30.00	700.00	110
10.00	30.00	50.00	30.00	0.0	20.00	15.00	150.00	10.00	10.00	0.0	100.00	50.00	300.00	111
15.00	100.00	15.00	70.00	0.0	10.00	70.00	15.00	10.00	0.0	0.0	200.00	15.00	300.00	112
10.00	100.00	10.00	50.00	0.0	15.00	30.00	10.00	15.00	0.0	150.00	150.00	20.00	100.00	113
15.00	100.00	20.00	30.00	0.0	10.00	30.00	20.00	15.00	0.0	150.00	100.00	15.00	70.00	114
15.00	100.00	30.00	50.00	0.0	15.00	70.00	30.00	15.00	0.0	0.0	200.00	15.00	300.00	115
10.00	150.00	30.00	30.00	0.0	10.00	70.00	15.00	15.00	0.0	0.0	300.00	20.00	700.00	116
10.00	100.00	10.00	30.00	0.0	0.0	50.00	20.00	15.00	0.0	0.0	100.00	15.00	100.00	117
10.00	70.00	10.00	150.00	0.0	0.0	30.00	20.00	10.00	0.0	0.0	100.00	20.00	70.00	118
10.00	30.00	10.00	30.00	0.0	0.0	30.00	20.00	7.00	0.0	0.0	70.00	20.00	300.00	119
10.00	70.00	20.00	70.00	0.0	0.0	30.00	30.00	15.00	0.0	0.0	70.00	20.00	300.00	120
10.00	50.00	20.00	70.00	0.0	0.0	30.00	20.00	10.00	0.0	0.0	70.00	0.0	70.00	121
15.00	150.00	20.00	30.00	0.0	0.0	50.00	20.00	20.00	0.0	0.0	100.00	20.00	100.00	122
100.00	2000.00	10.00	0.0	0.0	0.0	5000.00	0.0	7.00	0.0	0.0	20.00	0.0	0.0	123
15.00	150.00	30.00	20.00	0.0	0.0	30.00	20.00	20.00	0.0	100.00	150.00	20.00	100.00	124
15.00	100.00	50.00	30.00	0.0	0.0	50.00	20.00	15.00	0.0	0.0	150.00	20.00	70.00	125
150.00	5000.00	0.0	0.0	0.0	0.0	5000.00	0.0	10.00	0.0	0.0	30.00	0.0	0.0	126
20.00	100.00	100.00	20.00	0.0	10.00	50.00	10.00	20.00	0.0	150.00	100.00	20.00	70.00	127
5	5	2	20	5	10	5	10	5	10	50	10	5	10	

Map No.	Field Test(c)	Sample Type(d)	Description of Bedrock, Soil, Etc.
90	2	D-1"	Dry creek
91	1	D-1"	Dry creek
92		D-4"	Tourmaline granite, vein quartz
93		D-2"	Granite w/1% vein quartz
94		D-2'	Barren schist
95		D-3"	Granite
96		D-3"	Granite
97		C-2'	Black mud from swampy creek
98	3	C-15'	Swampy
99	13	C-1'	Swampy creek
100	3	C-6"	Sub channel
100	2	C-2'	Main creek
101	2	C-8'	Granite float
102	2	C-8'	Granite float
103	2	C-4'	Granite float
104	2	C-2'	Granite float
105	2	C-3'	Granite float
106	2	C-3'	Granite float
107	2	C-10'	Granite float
108	6	C-2'	Granite float
109	4	C-2	Muskeg
110	2	C-2	Granite float
111	4	C-15'	Granite float
112	2	C-2'	Float: schist, granite, 10% diabase
113	3	C-1 1/2'	Schist float
114	8	C-1 1/2'	Schist float
115	2	C-15	Float: schist 85%, diabase 5%, quartz 5%, granite 5%
116	13	C-1'	Swampy
117	6	C-2	Swampy
118	4	C-8	Float: diabase, quartz, granite
119	4	C-17'	Float: diabase, quartz, schist, granite
120	7	C-1	Dry tributary creek. Float: schist, quartz, diabase
121	8	C-15'	Float: schist, diabase, quartz
122	7	C-3	Float: schist, 5% quartz
123	5	C-10'	Float diabse, 10% quartz
124	10	C-1	Float: diabase, quartz
125	7	C-1'	No float
126			Platy quartzite
127	6	D-3	Frost boil

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