GEOLOGY AND TECTONIC SETTING
OF TOOTSEE LAKE AREA,
CASSIAR MOUNTAINS, BRITISH COLUMBIA

BY

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ABSTRACT

The Tootsee Lake map-area lies in the southwest section of the Pelly-Cassiar Platform in northern British Columbia.

Stratified rocks in the map-area range in age from Cambrian to Upper Devonian and (?) Lower Mississippian, and represent marine, miogeoclinal sediments deposited on a slowly subsiding platform, overlain by a thick succession of eugeoclinal clastic sediments, representing the Sylvester Allochthon.

This thesis presents the tectonic setting of the map-area with respect to the northern Canadian Cordillera and describes the local lithology of the property, along with geochemical data obtained.

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INTRODUCTION

The TSEE claims, constituting the Tootsee Lake map-area, were staked in the spring of 1981 to cover areas thought to contain anomalous lead-zinc mineralization.

This thesis presents 1) a geological map of the area; (2) a discussion of the regional geological setting including the areas relation to tectonic elements of the northern Canadian Cordilleran; (3) detailed descriptions of the local rock types; and (4) a brief discussion on geochemical surveys and findings, including geochemical maps.

LOCATION AND PHYSIOGRAPHY

Tootsee Lake area (lat. 59°53'N,long. 130°26'W) lies approximately 45 kilometres southeast of Swift River, Yukon, near the Yukon-B.C. border, and about 24 kilometres south of mile 704 on the Alaska Highway (Figure 1a,b).

The map-area lies within the northeast section of the Cassiar Mountains in the Stikine Ranges physiographic region (Figure 1c). Topography is moderately rugged with maximum local relief ranging from 720 metres at Tootsee Lake to peaks of up to 1845 metres. Southerly facing slopes are generally smooth, moderately steep, talus covered, and dissected by shallow stream gullies; northerly facing slopes are locally rugged due to the presence of small cirques. Outcrop exposures above treeline are good except

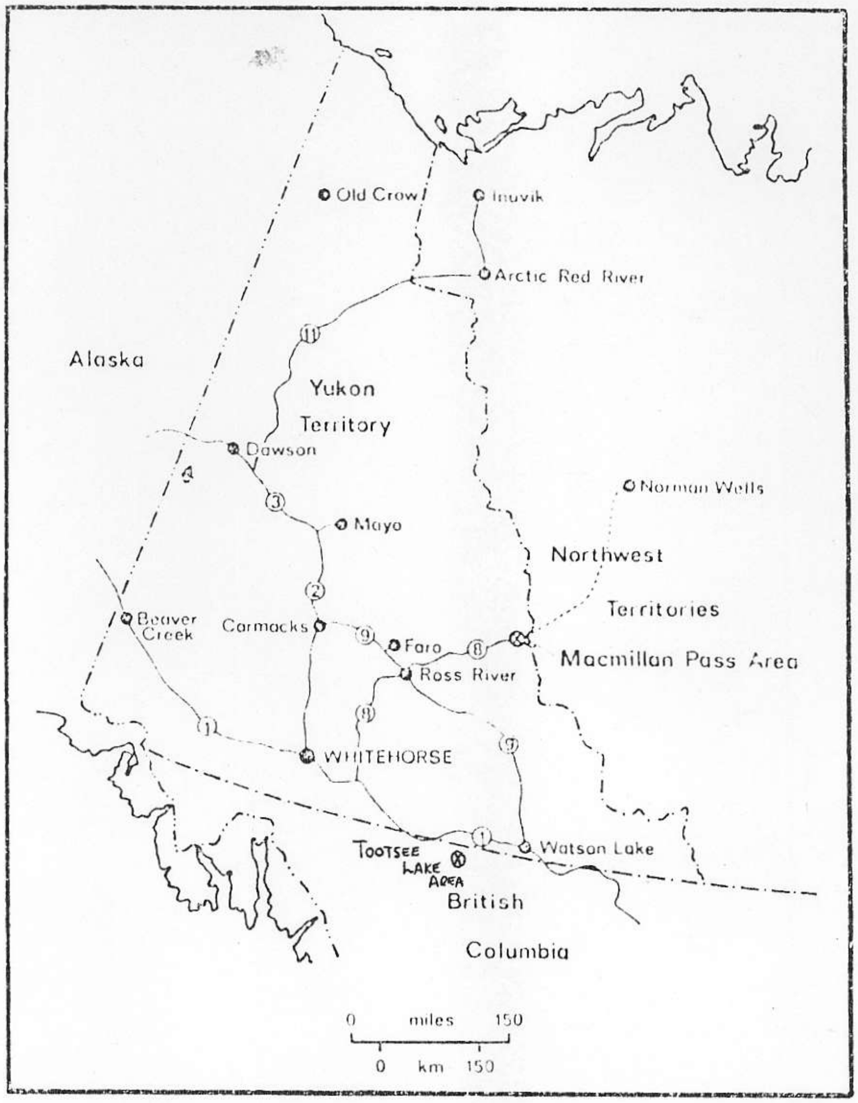
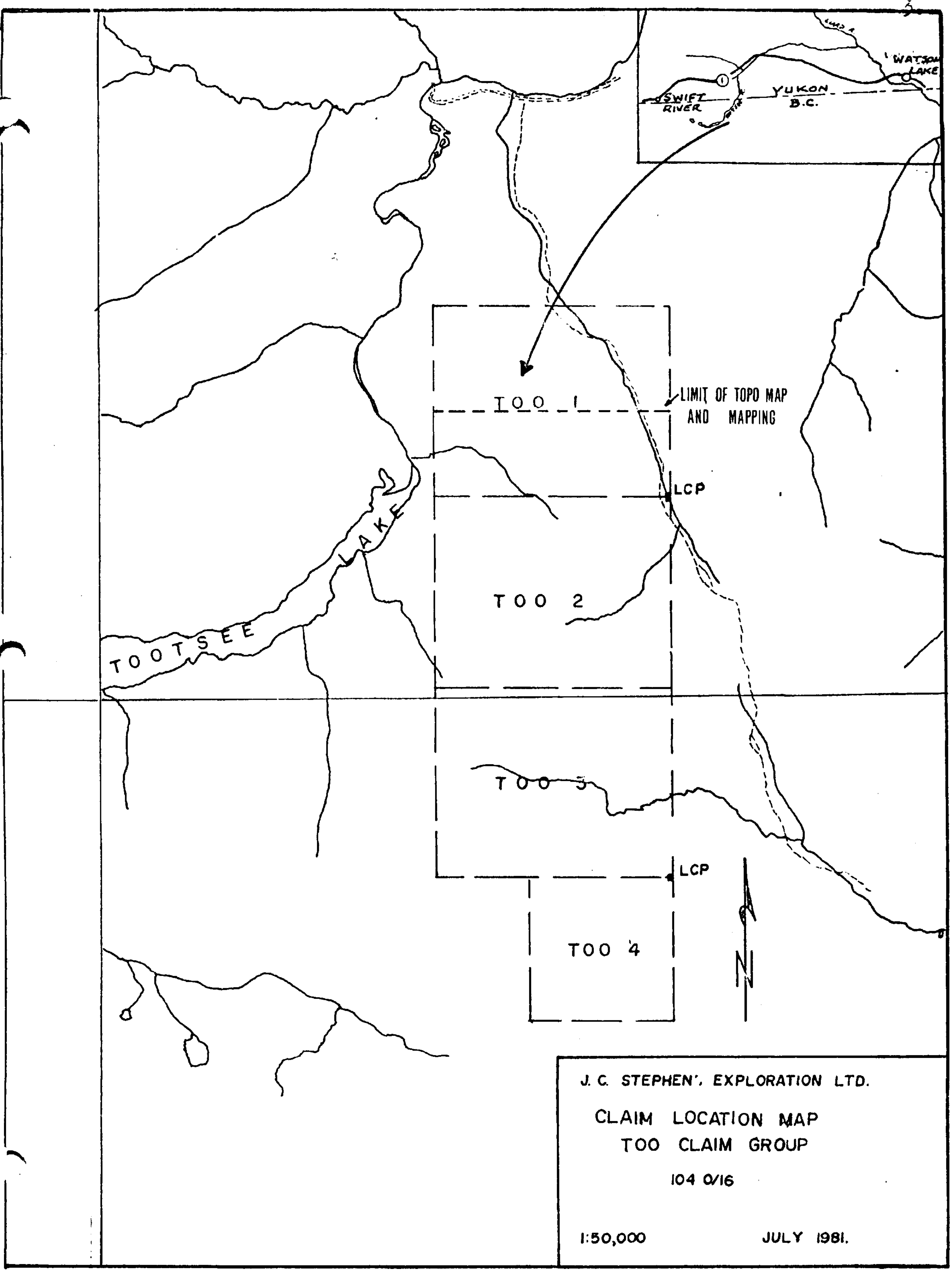


Figure 1a. Location of Tootsee Lake



J. C. STEPHEN'. EXPLORATION LTD.

CLAIM LOCATION MAP
TOO CLAIM GROUP

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Figure 1b

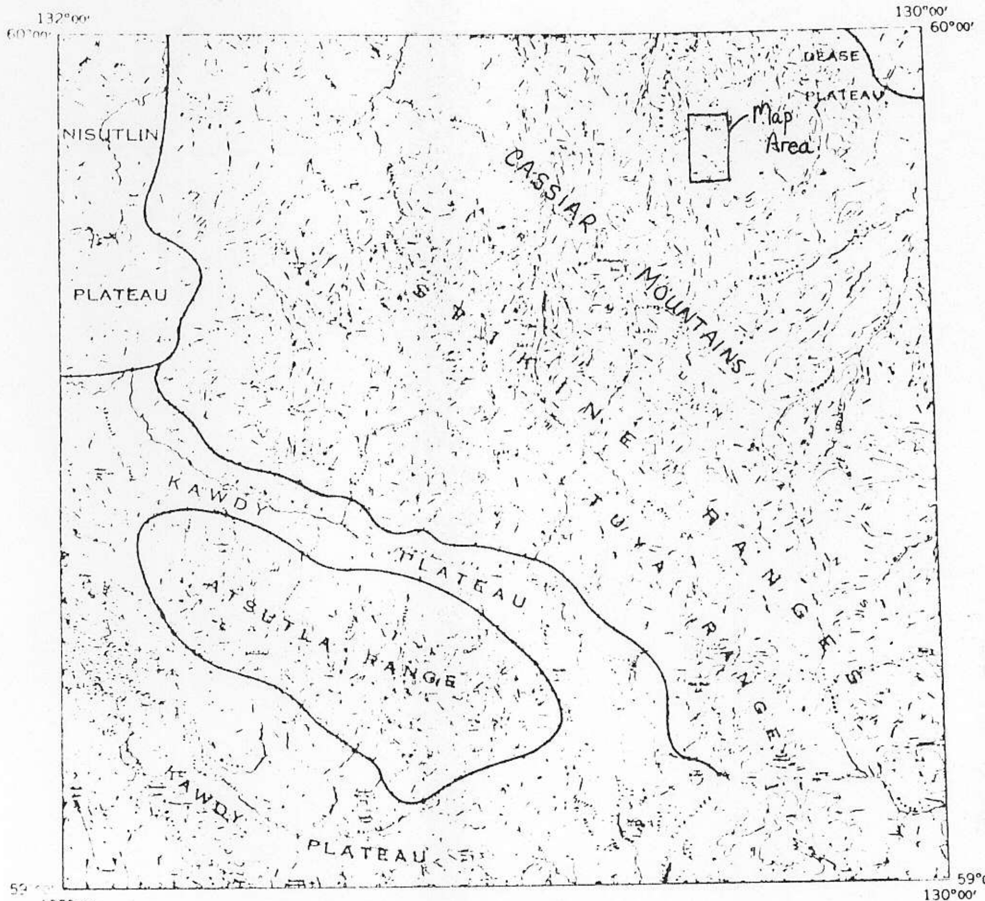


Figure 1c.Physiographic regions

Figure 1c. Physiographic Regions

where covered by extensive talus. Outcrops below timberline are rare except where exposed in steep stream cuts.

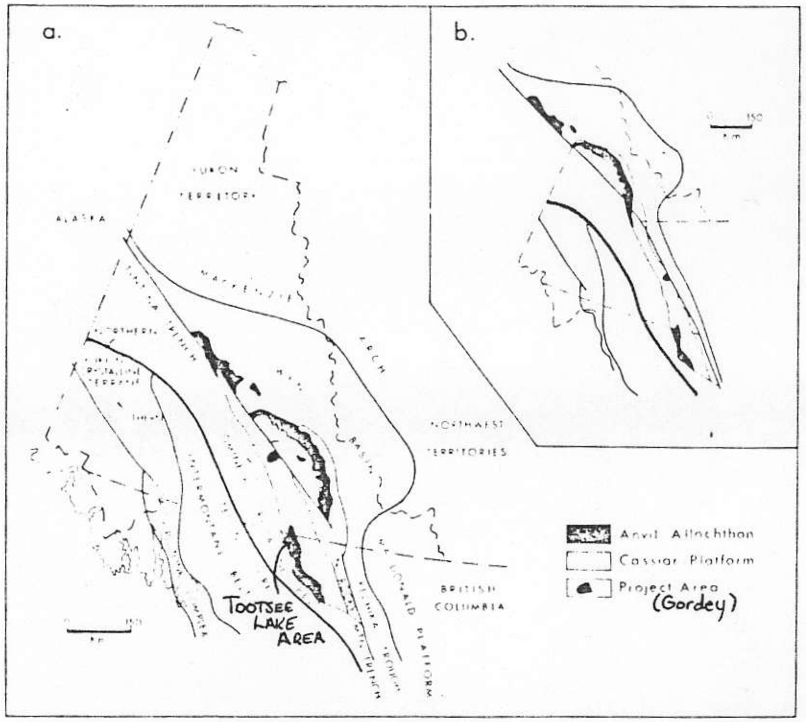
1. REGIONAL GEOLOGICAL SETTING

The location of the Tootsee Lake area with respect to regional tectonic elements is shown in Figure 2. The area lies in the southwest section of the Cassiar Platform in the Omineca Belt of the Canadian Cordillera, British Columbia (Tempelman-Kluit, 1979).

The regional tectonic framework of northern British Columbia and southern Yukon has been described in some detail by Gabrielse and Wheeler (1961), Gabrielse (1967a), Tempelman-Kluit et. al. (1976, 1977, 1979), and Gordey (1981).

The following description is taken from Gordey, 1981, which briefly summarizes previous works.

"In early and middle Paleozoic time the northwestern margin of North America was flanked by a belt of shallow water carbonate comprising Mackenzie Arch and MacDonald Platform which changed facies southwesterly to shale and chert in Selwyn Basin and Kechika Trough. Cassiar Platform, a peninsular centre of shallow water sedimentation outboard of the main carbonate belt, developed in Silurian and Devonian time above thick accumulations of Late Cambrian and younger volcanic and sedimentary rocks.



a Tectonic elements in their present relative positions.

b 450 km of dextral strike slip along Tintina and northern Rocky Mountain trenches restored.

Figure 3. Tectonic subdivisions of the northern Canadian Cordillera (modified after Tempelman-Kluit (1976, 1977, 1978) and Wheeler and Gabrielse (1972).

Figure 2. Tectonic Setting of the Tootsee Lake Area.

(after Gordey, 1981)

Carbonate of this platform changed facies to shale both to the northeast and southwest. During the late Devonian and Mississippian, shale, siliceous greywacke and chert pebble conglomerate derived from a western(?) source or from faultblocks within Selwyn Basin, spread over the platformal areas, Selwyn Basin, and Kechika Trough. The record of latest Paleozoic sedimentation is fragmentary, but where preserved indicates a return to normal clastic or carbonate shelf sedimentation. In Mesozoic time sediment largely derived from the Coast Plutonic Complex was shed eastward into a marine basin, the Intermontane Belt, which was floored by Paleozoic metamorphic rocks of southern Yukon Crystalline Terrane. This basin was possibly at the edge of North America but probably far removed from its present position. Early in the basin's history (Late Triassic) detritus was largely volcanic, but progressively became more granitic. By Late Jurassic or Early Cretaceous the Intermontane Belt was segmented into smaller successor basins accumulating nonmarine clastics and coal. Juxtaposition of the Intermontane and Omineca Crystalline belts occured along the Teslin Suture in mid- to Late Cretaceous time. The Anvil Allochthon, composed of ultramafic rock, basalt, chert, mylonite and plutonic rock was obducted in the Mesozoic. The Omineca Crystalline Belt consists of remnants of these Allochthons, metamorphosed shelf-edge equivalents of Cassiar Platform, and Mesozoic plutonic rocks. The

Coast Plutonic Complex and the Yukon Crystalline Terrane were also loci of widespread Mesozoic plutonism. Mid- to late Cretaceous dextral displacement along Tintina and northern Rocky Mountain trenches offset the earlier formed tectonic elements."[1]

1.1 REGIONAL TECTONIC FRAMEWORK OF 'EASTERN BELT' OF NORTHERN BRITISH COLUMBIA AND SOUTHERN YUKON.

The northern Cordilleran region embracing southern Yukon, northwestern British Columbia and southeastern Alaska can be divided into three northwesterly trending belts (Gabrielse and Wheeler,1961). The'eastern belt', which will be discussed here, embodies stratified and crystalline rocks of the Pelly, Cassiar and northern Rocky Mountains. Discussion of this belt will be limited to the shallow marine miogeoclinal assemblage which occurs in the map-area and extends some 600 kilometres northwest into the Pelly Mountains of south-central Yukon. This northwest trending belt of platform carbonates is referred to as the Cassiar Platform (Figure 3).

During the Paleozoic era, miogeosynclinal conditions existed in the eastern belt; non-volcanic sediments being deposited.

1. Gordey, S.P. Stratigraphy, Structure and Tectonic Evolution of Southern Pelly Mountains in the Indigo Lake Area, Yukon Territory. G.S.C. Bulletin 318, 1981

Figure 3 Sketch map of the distribution of eugeoclinal and miogeoclinal strata in the northern Omineca Crystalline Belt. Mesozoic intrusions are omitted. In the Pelly Mountains the eugeoclinal strata are thrust over the miogeoclinal sequence and a similar relationship modified in many places by younger phenomena is postulated on trend. The allochthonous eugeoclinal rocks are offset by mid-Cretaceous movement on the Tintina Fault a distance of about 450 km. Rocks in the Yukon Crystalline Terrane are the continuation of those in the allochthonous part of the Omineca Crystalline Belt.

Figure 3, (after Tempelman-Kluit,1977.)

In late Proterozoic and early Paleozoic time, great thicknesses of non-volcanic marine sediments were deposited. These were generally fine-grained and varied through out the eastern belt from calcareous to siliceous and argillaceous.

A relatively thick and widespread quartzite member was deposited as the basal beds of an easterly transgressing sea (Gabrielse and Wheeler, 1961). Early Cambrian shale and fossiliferous limestone (apparently deposited in shallow, well-aerated seas) commonly overlies the quartzite member.

Marked differences are noted in the remaining pre-Middle Silurian history between northern British Columbia and the Pelly Mountain area to the north.

Post-early Cambrian and pre-late Ordovician time in northern B.C. was marked by a deepening of the depositional basin west of the Rocky Mountain Trench. This deepening is suggested by the presence of thin-bedded argillaceous and calcareous Cambro-Ordovicia strata along with the presence of black, pyritic, graptolitic shales of early-mid Ordovician age.

In the Pelly Mountains area argillaceous sediments interbedded with volcanic breccias and tuffs were deposited in mid-upper Cambrian time, indicating some volcanic activity at this time. Black graptolitic slates of early Ordovician to middle Silurian age are widespread throughout the area. In late Lower-

Middle Silurian further volcanism took place with the extrusion of andesitic tuff and breccias.

In northern B.C. an unconformity is marked by a break in the faunal sequence between the Ordovician graptolitic shale and the overlying Silurian beds. This hiatus has recently been established in the Pelly Mountain region (Gordey,1981).

Silurian strata consists of coralline dolomites and sandy dolomites, deposited as a widespread, fairly uniform plate on a slowly subsiding platform. Local graptolitic siltstones and shales at this time may have accumulated in deep, isolated basins within the subsiding platform.

A widespread epeirogenic uplift occured in late Silurian and early Devonian time in northern British Columbia as evidenced by a regional unconformity beneath middle Devonian strata (Gabrielse and Wheeler,1961). These strata are generally highly fossiliferous, dolomitic rocks, similiar to the underlying strata in that they are also widespread and uniform and suggest accumulation in shallow, well-aerated seas on a slowly subsiding platform.

During late Devonian time the eastern belt underwent a marked change in tectonic activity. The area which had been relatively stable in late Proerozoic and early Paleozoic time, began to subside rapidly, and developed characteristics typical of eugeoclinal areas. Large amounts of upper Devonian and Mississippian volcanic and sedimentary material was deposited in a short time span. These deposits include fine-grained clastic sediments, chert-pebble conglomerates, greywacke and related volcanic rocks.

In Mesozoic time allochthonous blocks, including the Sylvester Allochthon, were obducted some 100+ kilometres from the area known as the Teslin Suture (Figure 3), due to tectonic subduction between ancient North America and the island-arc system far to the west (Tempelman-Kluit,1979). The north-west portion of the Sylvester Allochthon is located in the east-central portion of the Tootsee Lake map-area, where slightly sheared, fine-grained clastic rocks and chert-pebble conglomerates have been identified by the writer.

2. GEOLOGY OF THE TOOTSEE LAKE MAP-AREA.

Geological mapping of the Tootsee Lake area (TSEE Claims) was done during a three week period in the summer of 1981 (see accompanying geology map in pamphlet).

Within the map-area, stratified, marine, mio-geoclinal rocks of the Cassiar Platform, range in age from Cambrian to Middle Devonian, and alloch-thonous rocks of Upper Devono-Mississippian(?) age. Local stratigraphy is described in the McDame map-area (Gabrielse,1963), and the Jennings River map-area (Gabrielse,1969), in which Tootsee Lake occurs. Age correlations and unit names, where used, are based upon lithological identification of rocks as described by Gabrielse in this area.

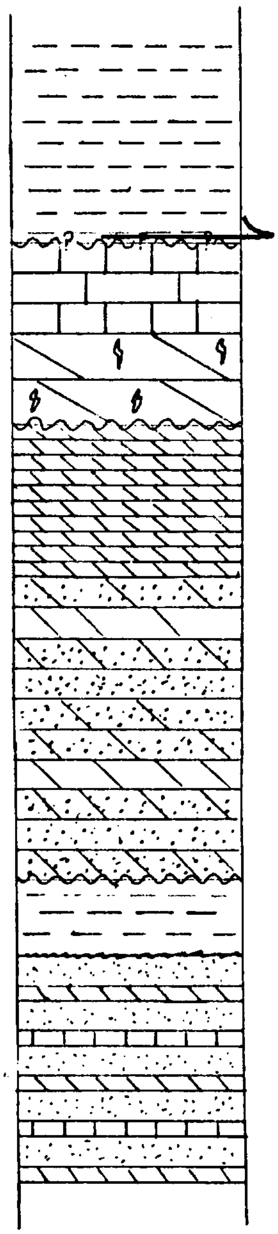
Figure 4 shows the stratigraphic section for the map-area, and shows two regional unconformities between Ordo-Silurian and Lower Devonian-Mid Devonian strata. Also shown is the inferred thrust fault between autochthonous carbonate rocks of the Cassiar Platform, and sheared clastic rocks of the Sylvester Allochthon. Figure 5 represents stratigraphic correlations across much of the Cassiar Platform. Note the lack of volcanics present McDame area,B.C. as compared to that of the Indigo Lake area, and also the correlation of the Ordovician-Silurian unconformity between British Columbia and the Yukon, as mentioned previously. Relative geographical locations are also shown on Figure 5. The Tootsee Lake map-area lies to the west of the McDame area.

2.1 LITHOLOGIC UNITS OF THE TOOTSEE LAKE MAP-AREA.

Cambrian - Atan(?) Formation (Unit 1)

Very little of the Atan Formation was observed in the area. Outcrops are located in the steep, northerly draining valley to the east of TOO-2 claim. Here the unit is represented by a variety of rock types including tightly folded, blue-grey phyllitic limestones, brown dolomites, and clean to impure sandstones and derived quartzites. Large amounts of disseminated pyrrhotite in the quartzites gives them a deep rust-red colour on weathered surfaces.

ESTIMATED UNIT THICKNESS (metres)



Mississippian — Lower Sylvester Formation: black, clastic unit, rarely found in outcrop, forms extensive talus, silver on weathered surface, includes siltstone, mudstone and gritstone.

U. Devonian — Platy, blue-grey limestone, fissile in places.

M. Devonian — MCDAME GROUP
Massive, dark grey dolomite, fetid, fossiliferous, referred to as spagetti-stone.

L. Devonian — Laminated dolomite, occurs in a black and white banded or blue-grey phase.

SANDPILE GROUP

Resistant unit includes sandy dolomite, siliceous dolomite and calcareous quartzite, thickly bedded to platy.

Silurian

Ordovician — KECHIKA GROUP.. black calcareous shale, occurs as slaty talus.

Cambrian — Atan Formation: dark quartzite, commonly interbedded with dolomite and limestone.

J.C. STEPHEN: EXPLORATION LTD.

TSEE PROJECT

TOO CLAIM GROUP

STRATIGRAPHIC COLUMN

VERTICAL SCALE 1:5000 JULY 1981.

FIGURE 4

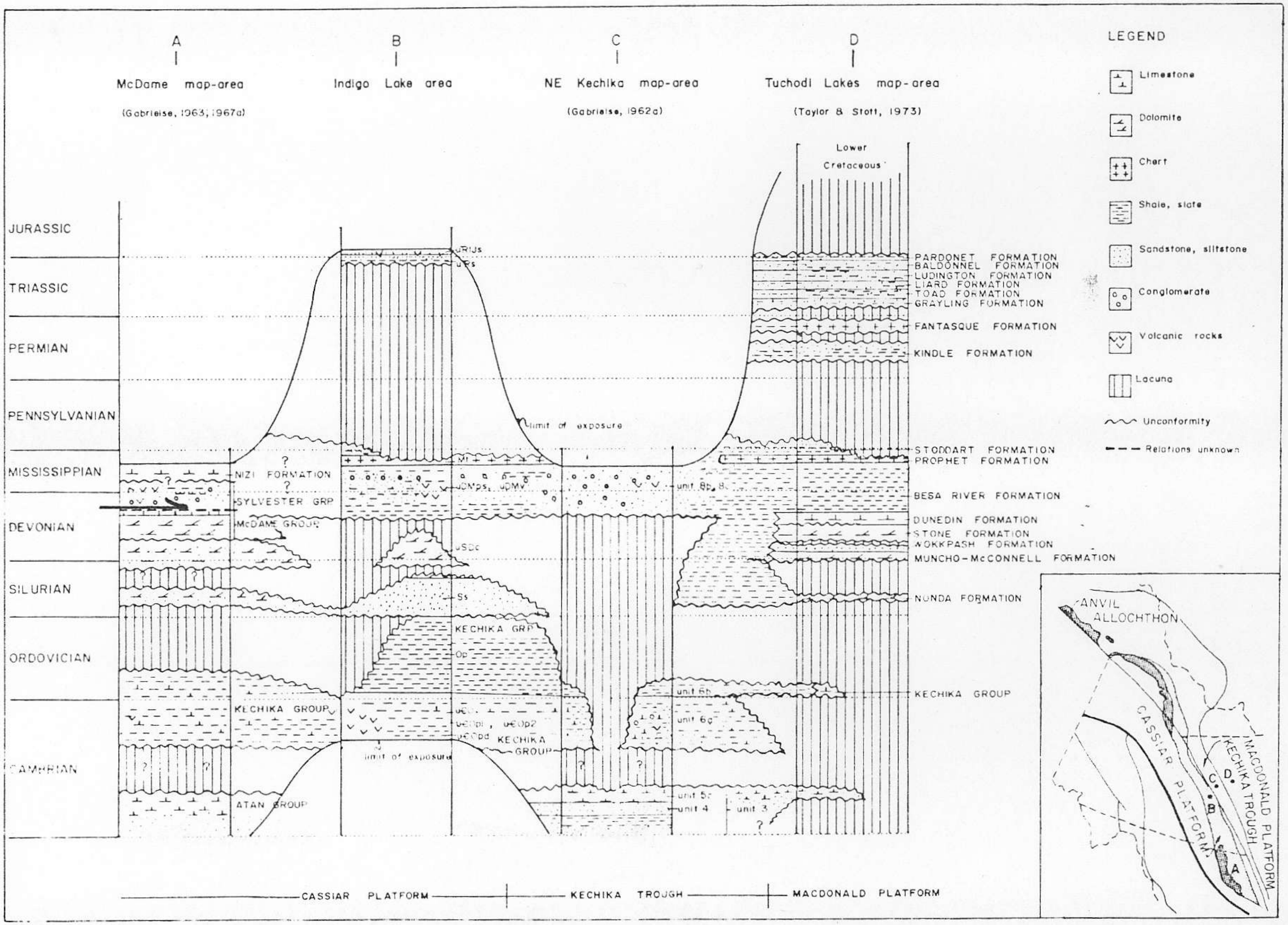


Figure 5 *Summary correlation chart for strata of the Indigo Lake areas with strata of McDame, northeastern Kechika, and Tuchodi Lakes map areas.* After Gordey, 1981.

This unit may also contain the lower portion of the Kechika Group (Unit 2 Gabrielse, 1968); Cambrian and Ordovician phyllites and argillaceous limestones.

Upper and lower contacts of the Atan Formation were not seen in the area, however Gabrielse 1968 reports that this unit is conformable with both underlying and overlying strata, and that the unit reaches 700$^+$ metres in thickness.

Rocks of this unit were apparently accumulated on a slowly subsiding platform in a fairly uniform environment.

A typical example of the Atan Formation consists of:

1. Quartz-50%: Occurs as subhedral-anhedral grains up to 1 mm., and as veinlets up to 1 cm in width.
2. Biotite-40%: Anhedral crystals up to 5mm and evenly distributed throughout sample.
3. Calcite-5%: Very fine-grained (<1mm) subhedral crystals and disseminated veinlets.
4. Sphene-4%: Anhedral crystals ranging in size from <1mm to 3mm, average 1mm and have moderately corroded grain boundaries.
5. Opaques-1%

Ordovician- Kechika (?) Group (Upper Division) (Unit2)

Black, calcareous, graptolitic shale outcrop in the southern section of the map area. These rocks are generally not well exposed, and outcrops are strongly cleaved making bedding difficult to distinguish. These black shales are predominantly argillaceous and vary somewhat from being calcareous to carbonaceous in places. Thin bedding, cleaving, recessive weathering and friability makes these rocks produce abundant fine talus.

Graptolites (identified by C.Stephen, 1982) were found in Unit 2 outcrops in the large creek draining the southwest portion of TOO-4.

Thin sections revealed extremely fine-grained, aphanitic quartz and carbonate grains surrounded by black argillaceous minerals.

Subunit 2a was not observed by the writer but occurs in the north-central portion of TOO-5 (staked 1982), and is described as a fine-grained, black quartzite interbedded with Unit 2 shales, and itself cut by numerous, barren white quartz veins (Cam Stephen, personal communication, 1982).

Contacts with underlying and overlying units were not seen, probably due to the recessiveness of this unit, however it is believed that these shales are overlain unconformably by the Sandpile Group of Silurian age.

The Kechika Group is believed to represent a relatively deep water facies, as suggested by the predominance of fine-grained argillaceous material and the overall scarcity of fossils within the unit.

Silurian and Devonian- Sandpile Group (Unit 3a)

Overlying the mainly recessive weathering rocks of Unit 2 is a distinctive sequence of alternating light and dark, white to black sandy dolomites, and dolomitic sandstones. These resistant, very well bedded rocks occur throughout the map-area and can be seen stretching far to the northeast of the property.

This unit is informally referred to as the 'tapioca-sandstone' a term making reference to the common occurrence of rounded, translucent quartz sand grains in a fine dolomitic matrix (Gabrielse, 1968). Bedding is conspicuous due to the varying amounts of sand in adjacent beds, and range from 10 centimetres to 1.5 metres in thickness.

Cross-bedding of less than 10 centimetres to 1 metre is characteristic of the sandy unit, and showed that these beds are right-side up throughout the map-area.

Unit thickness is estimated at 300^{+} metres and strata of the Sandpile Group are believed to be overlain unconformably by middle Devonian dolomites.

Evidently the Sandpile Group was deposited mainly in shallow, well-aerated seas on a slowly subsiding platform which was apparently unfavorable for marine organisms due to the total lacking of fossils in this unit (Gabrielse, 1963).

In thin section the quartz grains are moderately well sorted, and range up to 1-2mm in size. Many are strained, polycrystalline, have sutured grain boundaries and are poor to well-rounded. Most of these grains are 'floating' in a microcrystalline matrix of dolomite, however some are in point or tangential contact.

Gradationally above Unit 3a lies a platy, well laminated, muddy dolomite, Unit 3b. Outcrop of this unit were only located in the central portion of TOO-3 where they occur structurally below rocks of the Sandpile Group, and is approximately 30 metres thick.

This unit is light to dark grey with alternating colours distinguishing bedding. In hand specimen the beds themselves are seen to be finely laminated with laminations taking on a characteristic wavy appearance on the scale of a few millimetres. No fossils were found in this unit which is distinguished from the Sandpile Group by its muddy laminations and the absence of sand.

Middle Devonian- McDame Group (Unit3c)

Carbonate strata of the McDame Group are distributed in the central and northern portions of the property. Dark-grey to black, fetid dolomites forms an excellent marker bed in the area due to its distinctive lithology and fauna.

The dark-grey and black dolomite is finely crystalline and contains numerous veinlets and vugs filled with white, coarsely crystalline dolomite and minor calcite. Remains of rod-like organisms are very abundant and are also filled by coarsely crystalline, white dolomite. Hence the term 'spaghetti stone' has been applied to this unit, by members of the Geological Survey of Canada. Fossils reportedly identified in Unit 3c include: Amphipora sp, Coenites sp, Dendrostella sp, Spongophyllum sp and Stringocephalus sp, all of late middle Devonian age (Gabrielse,1968).

Bedding of Unit 3c is generally quite platy and averages 0.5 meters in thickness but becomes increasingly thinner towards the top of the unit. McDame Group is estimated to be 100+ metres thick in the map-area.

The McDame Group was apparently deposited on a slowly subsiding platform in relatively shallow, warm sea waters condusive to abundant marine organisms. According to Gabrielse 1968, this unit represents the uppermost beds of the Devonian carbonate sequence in the Cassiar Mountains.

Devonian - Unit 4.

Gradationally above Unit 3c lies a very narrow and discontinuous blue-white banded limestone, probably closely associated with Unit 3c.

Unit 4 is under5 metres thick and is extremely folded and faulted in the eastern portion of the property. Bedding ranges from a few millimetres to 10 centimetres, and thin sections show this unit to be comprised of non-fossiliferous, finely crystalline calcite.

This 'upper-portion' of the McDame Group may have been deposited in local, deepening basins, perhaps heralding the rapid subsidence of the fairly stable platform that was to follow in late Devonian and Mississippian time.

Upper Devonian and Mississippian(?)
Lower Sylvester Group (Unit 5).

Overlying the miogeclinal succession of carbonates, either unconformably or by means of a fault, is a typical eugeoclinal assemblage of clastic sedimentary rocks. This marks the point where the Cassiar Platform began rapid subsidence and took on typical eugeoclinal characteristics.

This is a moderately recessive weathering, black clastic unit which is often quite structureless. Outcrops tend to be fractured forming blocks and abundant fine talus, in the north-central and eastern portions of TOO-3.

Sedimentary rocks of the Lower Sylvester Group are comprised of argillite, slate, argillaceous quartzite and chert pebble-conglomerate, with grain sizes increasing from west to east on the property. Bedding varies from less than 0.5 metres in the west to 1-2 metres in the east, and unit thickness is reported to be $1{,}000^{+}$ metres (Gabrielse, 1968).

Thin sections taken from a sample at the western edge of the unit shows that this rock has undergone a minor degree of metamorphism, with a distinct foliation present, displayed by the parallel orientation of platy minerals. The rock consists of quartz 65%, muscovite 30%, and 5% unidentifiable black, argillaceous (?) minerals. The quartz occurs both as very fine-grained, anhedral groundmass and as large distinct clasts. The clasts range in size from 0.5mm-2mm and are angular to subrounded. Straining is visible in most and many are polycrystalline, thus making them similar to the quartz 'sands' of unit 3a, although it is not known whether they are derived from the same source as unit 3a, or if they are derived from erosional weathering of unit 3a itself.

Muscovite and the unidentified argillaceous (?) minerals show good preferred orientation and is generally concentrated in veinlets or along micro-bedding planes. Muscovite is frequently wrapped and bent around the quartz clasts, crystals are subhedral, less than 1mm. and are elongated parallel to foliation.

The thick accumulation of sedimentary and volcanic material (not found in the map-area) of the Sylvester Group reflects a marked change in the behavior of the area from that in earlier periods. The development of rocks that are typically migeosynclinal in the earlier periods gave way to the development of rocks that are typically eugeosynclinal. The clastic sedimentary rocks of the Sylvester Group were evidently derived from the eugeosynclinal rocks themselves, however some may have been derived from the earlier deposited miogeoclinal assemblages.

Since the initial classification of this unit, the writer, through personal communication with H. Helmstaedt, has decided that this slightly sheared unit represents a portion of the Sylvester Allochthon, and is similar to other allochthonous blocks in northern British Columbia and Yukon, see Figure 3, and Tempelman-Kluit, 1979.

Unit 6 - Age Unknown.

Dark green, very fine-grained, phaneritic intrusive greenstone dykes cut through Units 3c and 4 in the central portions of TOO-2, and through undifferentiated dolomites in the southwest portion of TOO-3. Outcrops of these dykes averaged 1-2 metres in width and 5-10 metres in length and were generally fractured and broken, resulting in loose, blocky fragments. These dykes may be associated with fault zones but no field evidence was found to substantiate this.

Microscopic analysis shows mineral composition to be as follows:

1. Quartz-20%: very fine grained subhedral-anhedral crystals ≤ 0.5mm.
2. Plagioclase-30%: very fine grained anhedral crystals associated with quartz in groundmass.
3. Chlorite-20%: very fine grained anhedral crystals.

4. Epidote-20%: characteristic grungy appearance, anhedral crystals up to 1mm.

5. Biotite-5%: anhedral crystals 1mm.

6. Magnetite-4%: very fine euhedral-anhedral crystals finely disseminated throughout (0.5mm.).

7. Apatite-1%: euhedral, prismatic crystals less than 0.5mm.

2.2 Tectonic Development of Tootsee Lake Area.

The geology of the Tootsee Lake area is of significance with respect to the tectonic development of the northern Canadian Cordillera, which was described previously. This area clearly reflects conditions existing on the Cassiar Platform in Pre-Devonian and earlier times.

According to Gabrielse, 1968, the character of Middle Devonian and older strata northeast of Cassiar Batholith reflects quiescent conditions of deposition on a slowly subsiding relatively stable shelf or platform, known as the Cassiar Platform. Temporary increased subsidence of the platform is indicated by the presence of Ordovician and Early Silurian graptolitic shale and siltstone. During the Late Devonian (?) the former platform subsided rapidly and received a thick sequence of mainly noncalcareous, clastic sedimentary rocks. The enormous volume of these clastic sediments in the northern Cordillera demands corresponding great uplift and erosion of extensive source areas, probably lying to the west (Gabrielse, 1968).

3. Stratabound Pb-Zn Mineralization of the Cassiar Platform.

The relative tectonic setting of the Tootsee Lake area with respect to the remainder of the northern Canadian Cordillera is an important factor for the recognition of favorable stratigraphy for stratabound Pb-Zn mineralization.

Lead-zinc deposits are essentially confined to the northeastern part of the Cordillera, that part which represents ancient North America. These deposits occur in essentially four stratigraphic association. Figure 6 shows the relation of stratabound Pb-Zn with regard to a)tectonic units and b) stratigraphy in the Yukon,

The stratigraphy and tectonic setting of the Tootsee Lake area is indicative of that associated with the Cassiar Platform, where Pb-Zn mineralization, in the Yukon, occurs in Cambro-Ordovician strata and in Devono-Mississippian strata (see figure 6b).

It should be noted that the common feature of these Yukon deposits is that almost all are ranged within, and around the margin of the Selaryn Basin.

Several minor lead-zinc-silver showings are known to occur east of Cassiar Batholith, near Tootsee River where an extensive gossan zone has been revealed at or near the contact of Middle Devonian McDame Group and overlying Upper Devonian-Mississippian (?) Sylvester Group (Gabrielse, 1969). Contact metamorphic

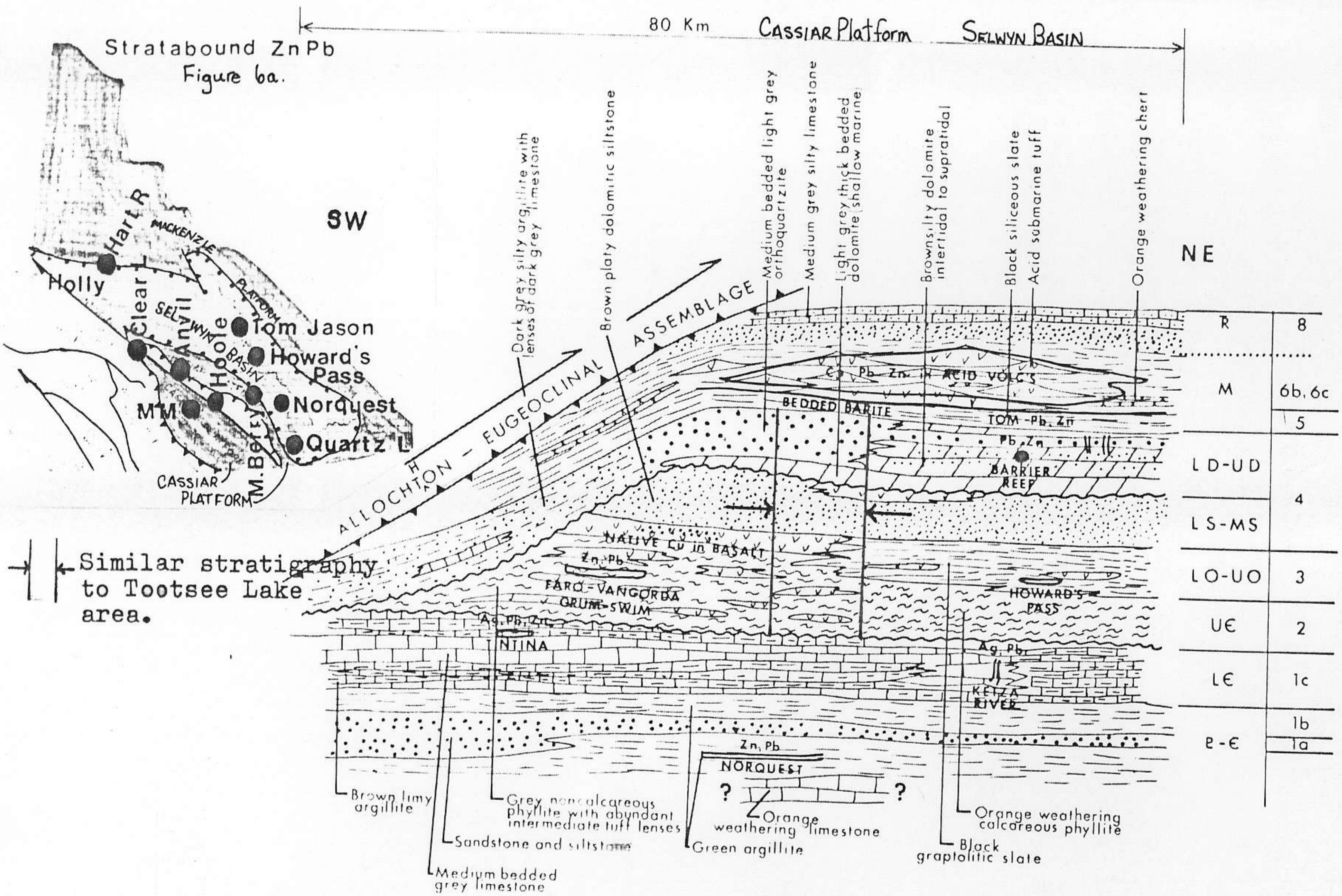


Figure 21.13. Mineral occurrences in southern Yukon that seem to have stratigraphic control are superposed on a schematic facies diagram of the Pelly Mountains to emphasize the presence of these stratigraphic targets for mineral exploration in this region.

FIGURE 6. RELATION OF Pb-Zn Occurrences to a) Tectonic Setting and b) Stratigraphy (AFTER Tempelman-Kluit, 1977, 1981)

Pb-Zn deposits are also known to be associated with the Cassiar Batholith in this area.

"The Cassiar Mountains in northern British Columbia, (directly adjacent to the Tootsee Lake area to the east) saw a flurry of activity in 1981 and 1982 due to significant lead-zinc-silver mineralization in the area."[2] This is reported to be a Paleozoic shale-hosted massive sulphide deposit, and regional geological maps show lithologies in that area to be of Upper Devonian-Lower Mississippian (?) Sylvester Group (Gabrielse, 1969). In addition to the base and precious metal showing a 13 metre thick barite occurrence in excess of 89% $BaSO_4$ was also located.

Thus, it appears that significant stratabound or stratiform lead-zinc mineralization does occurs south from the Yukon into northern British Columbia, in similar tectonic setting as the deposits to the north.

3.1 Geochemistry of the Tootsee Lake area (TSEE Project).

The TOO claims were staked in the spring of 1981 to cover areas thought to contain anomalous lead-zinc mineralization. During mapping of the area, no visible mineralization was noted, however a geochemical sampling survey was undertaken, including silts, soils and rock samples. See geochemical maps in pamphlet.

2. Morin,J., Grapes,K., Debicki,R., India and Northera affair's Canada. Precious Metals Tops in Yukon; Article in The Northern Miner, March 3, 1983.

REGIONAL GEOCHEMISTRY

During 1977, J.C. Stephen Explorations Ltd. conducted reconnaissance exploration in the Jennings River map sheet. Two significant tungsten anomalies and an extensive zinc anomaly with some lead indications were found in the Tootsee Lake area. The funding joint venture partner decided not to provide funds for follow up of these anomalies in 1978 or 1979 and the data was released to J.C. Stephen Explorations.

Further attempts to interest companies in the zinc anomaly in 1979 and early 1980 failed.

The GSC in conjunction with the BCDM carried out regional silt sampling in 1978 and data was published in 1979 and in revised form in 1980 as Open File 561. This published data shows silt values of 196 and 245 ppm in the north portion of the TOO claims and a value of 345 ppm in drainage to the southeast. Values from 96 ppm to 770 ppm occur in drainages to the east and northeast.

Cordilleran Engineering carried out exploration in 1980 and staked the CLIMAX claims which cover most of the favourable and anomalous geology. The anomaly located by J.C. Stephen Explorations in 1977 lies within the CLIMAX claims east of the TOO claims.

1981 GEOCHEMICAL PROGRAM

Three types of geochemical sampling were done on the TOO claims:

(a) In the southeast portion of the property creeks flow east and southeast into the area indicated to be anomalous in 1977. This portion of the drainage had not been sampled at that time and detailed silt sampling was conducted in this wide, relatively gentle valley during 1981.

Over the remainder of the property no silt samples were collected as the steep drainages, runoff conditions and generally wet weather made collection generally impractical.

(b) Along all major hillsides talus and soil samples were collected at about 100 metre intervals except in some areas where slopes were too steep for travel. These samples consisted of the finest material available at the site and were generally of the nature of soil samples although soil horizons, as such, were not developed.

(c) Rock geochemical samples were collected from several formations or occurrences of interest.

SILT SAMPLING

METHOD

Silt samples were collected at intervals of 100 to 150 metres on the creeks flowing easterly from the south portion of the TOO property.

These samples consisted of the finest available active stream sediments easily obtainable by hand and were collected in ordinary kraft wet strength paper sample bags.

Samples were dried at base camp and sifted through 35 mesh screen before shipment to Chemex Labs. Ltd.

Analysis was done by Chemex for lead, zinc and silver.

DATA AND RESULTS

The main stream below the creek junction in southeast claim TOO 3 (samples TS-X-101 to X-106) is recorded as 3 metres in width and 25 cm in depth with medium to fast flow. Material varied from gravel and sand to sand and silt with organics ranging from 10% to 45%. Lead values decrease gradually down stream from 66 ppm to 32 ppm; zinc values decrease somewhat more irregularly from 400 ppm to 200 ppm; while silver is consistantly 0.1 ppm.

Above the creek junction the stream from the northwest, (samples TS X-121 to X-130) returned lead values increasing from 10 to 18 ppm going down stream, zinc values range from 70 to 140 ppm but are generally in the 100 ppm range. Silver values remain at 0.1 ppm. The stream is described as being 1 to 2 metres wide, 25 to 50 cm deep, medium to slow flow with fine sand to silt material available. Organics range from 10% to 60%.

The central stream branch (samples TS X-114 to X-120) is described as 1 to 2 metres wide, 25 to 50 cm deep with varied flow from slow to fast. Material consisted mainly of fine sand and silt with 5% to 15% organics. Lead values range between 90 ppm and 68 ppm with a general downward trend downstream from 88 ppm to 73 ppm. Zinc values decrease from a high of 770 ppm downstream to 365 ppm. One sample returned 0.3 ppm silver.

The most southerly branch flows northeast. Samples (TS X-108 to X-113) are described as being taken from a stream 1 to 2 metres wide, 10 to 25 cm deep with medium to fast flow. Material consisted of fine sand and silt with 5% to 45% organics. Lead values decrease downstream from 120 ppm to 73 ppm. Zinc values decrease from 520 ppm to 360 ppm and all silver values are 0.1 ppm.

These stream values appear to confirm the 1977 lead and zinc values to the southeast. The central and southern tributary streams are anomalous and appear to derive their anomalous values from high ground near the southwest boundary of the claim group.

TALUS SAMPLING

METHOD

Soil and talus material was collected at 100 - 200 metre intervals along contours of the main ridges. Distances between samples were measured by hip chain but location of the samples on the map is generally only approximate.

The finest available material was collected at each sample site. In the southern portion of the property especially, this material may be best described as soil although soil horizons are not well developed.

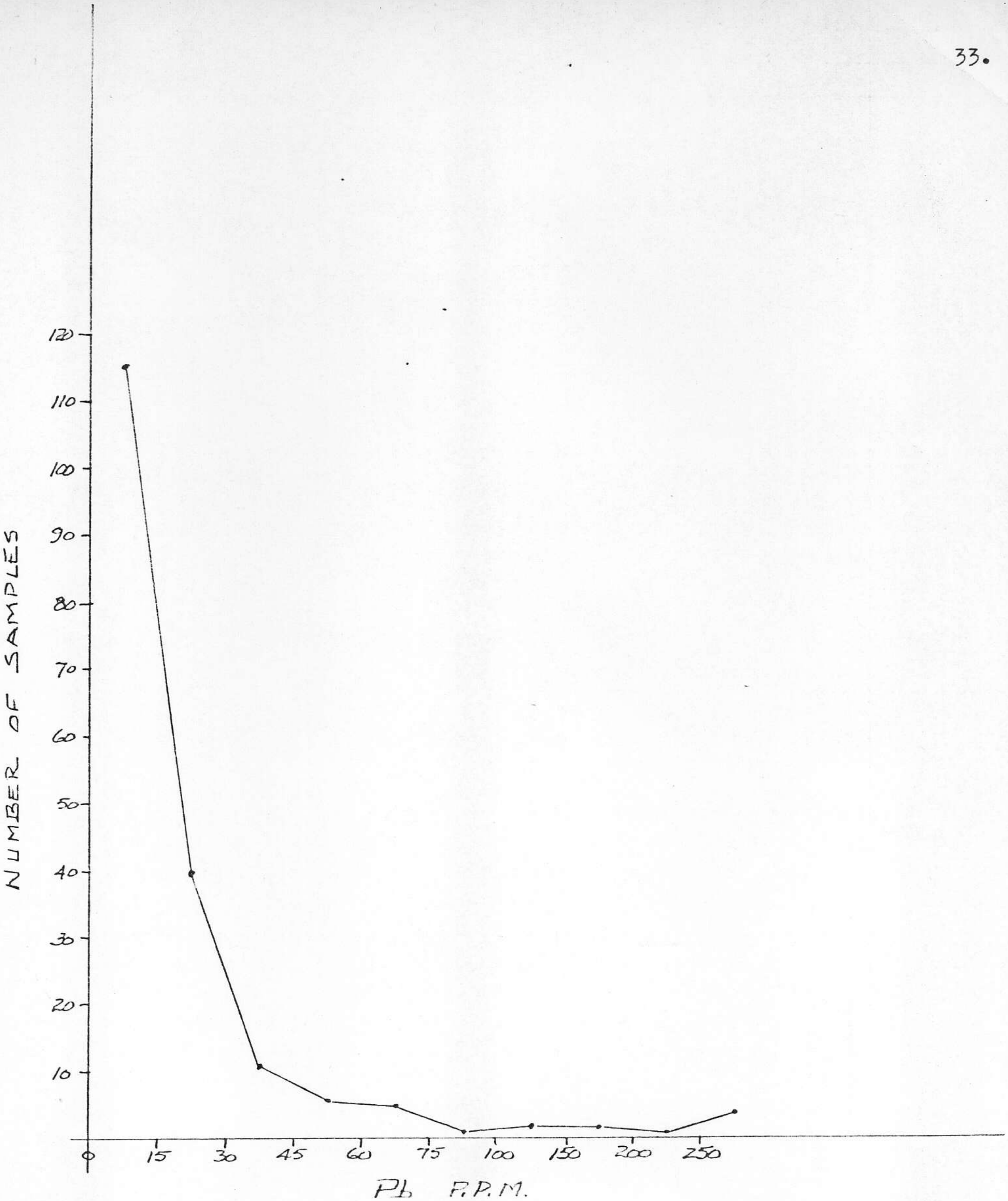
Material was collected in pleated kraft paper sample bags, shipped to base camp, dried and sifted to 35 mesh. In the case of samples with significant fresh coarse rock fragments (fine talus) the +35 mesh material was retained for possible future analysis.

The -35 mesh material was shipped to Chemex for determination of lead, zinc, silver and baruim content.

DATA AND RESULTS

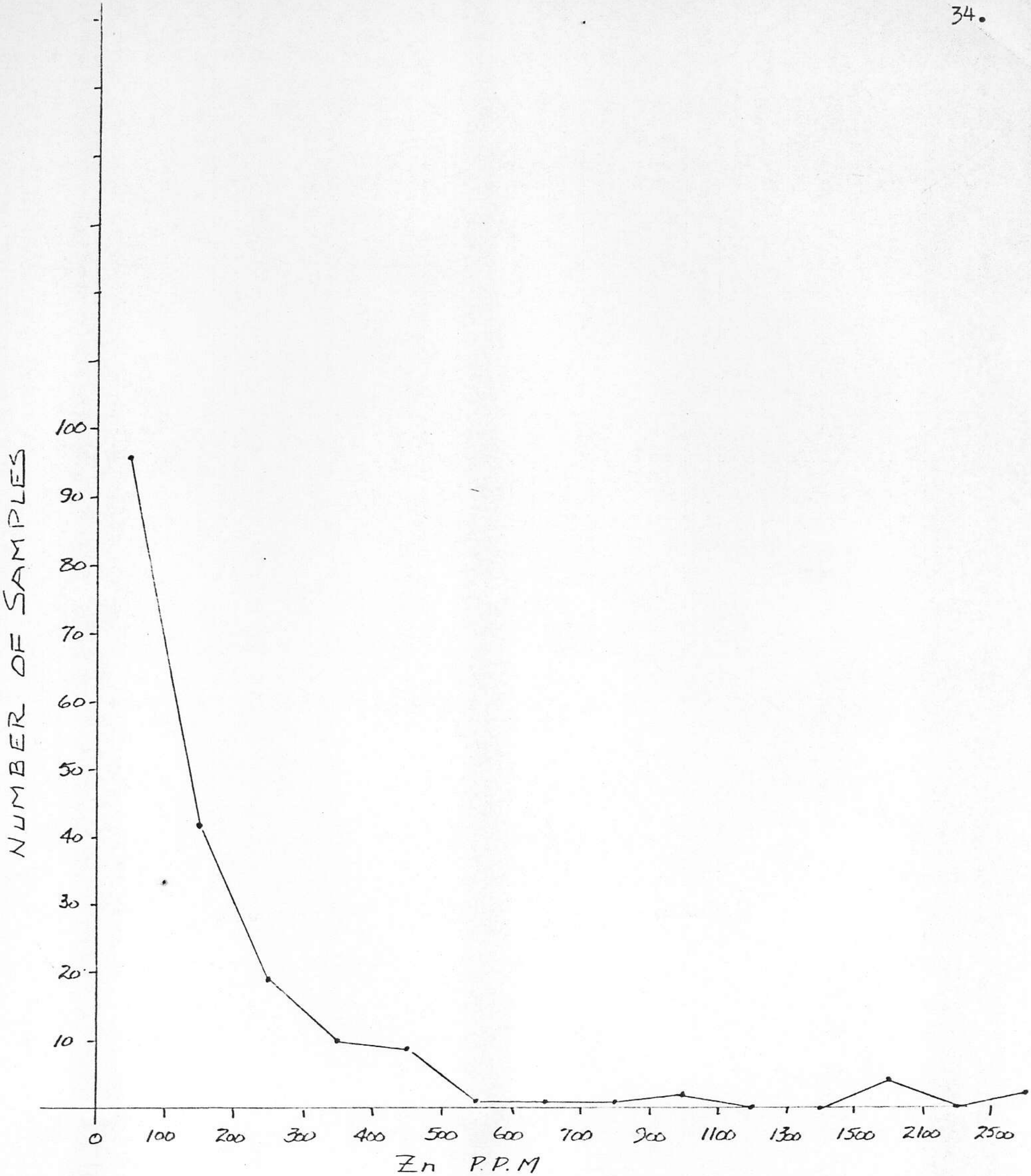
The only significantly anomalous values obtained occur in the northwest portion of claim TOO 4 and the southwest portion of claim TOO 3. Some values, and probable source areas, occur outside claim boundaries.

The talus sampling program indicates anomalous lead-zinc values near the common boundaries of TOO 3, 4 and 5. This anomalous area coincides with the lower black shale-dolomite contact (Units 2 and 3a) which also occurs in relatively low ground in south eastern TOO 3 and just north of TOO 5, west of TOO 3, in unstaked ground. These contact areas might warrant more detailed sampling although no anomalous values occur in the south west corner of TOO 3 where the same contact should be favourable.



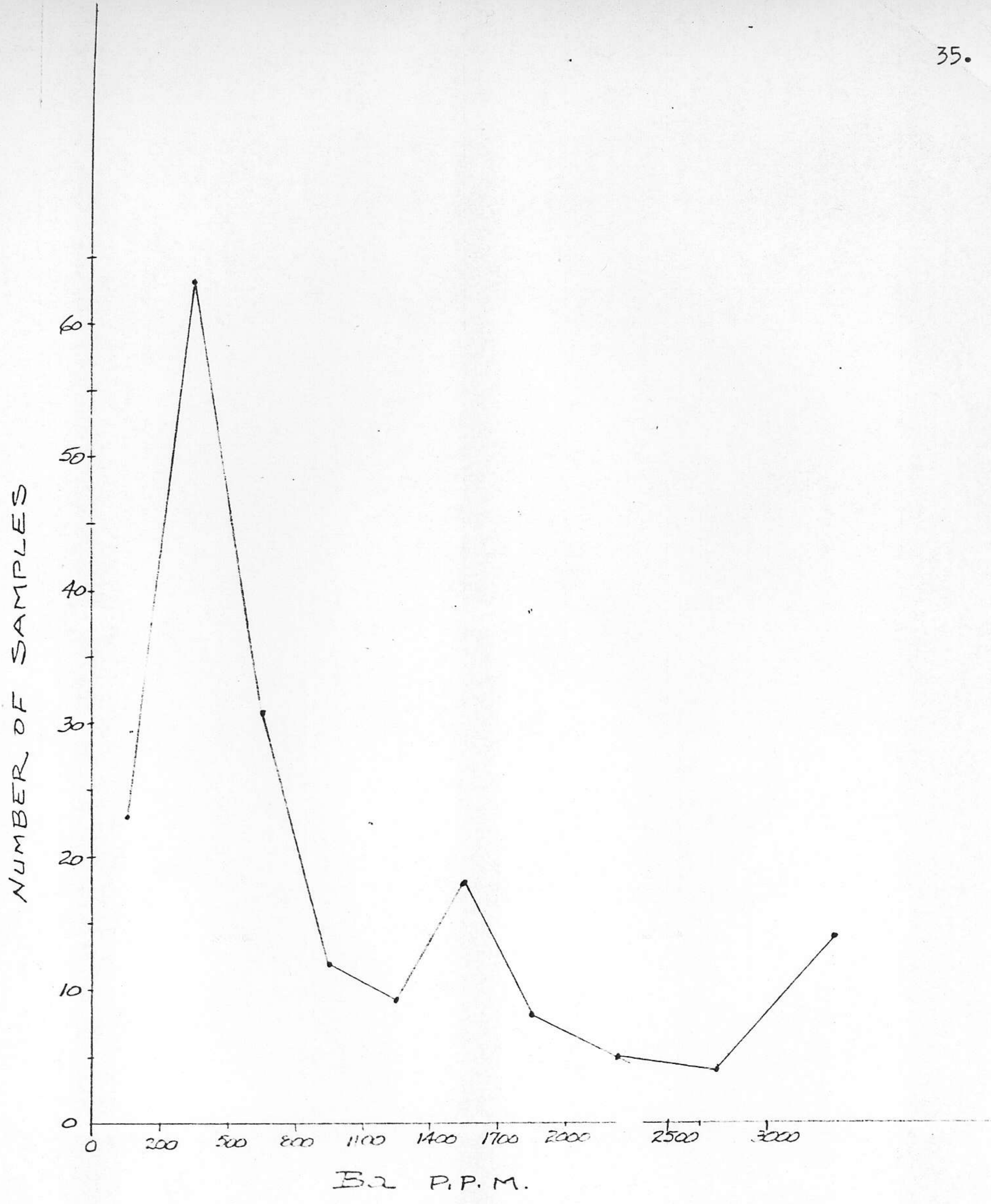
FREQUENCY DISTRIBUTION
LEAD IN TALUS

FIGURE 7



FREQUENCY DISTRIBUTION
ZINC IN TALUS

FIGURE 8



FREQUENCY DISTRIBUTION
BARIUM P.P.M. IN TALUS

FIGURE 9

ROCK SAMPLING

Specimens of mineralized rock were taken at several points for rock geochem analysis. Results are listed in Table 2.

Sample 27674C is located near the boundary between TOO 2 and TOO 3, and gave the highest lead (175 ppm) and zinc (610 ppm) values.

Six samples are from the small canyon just west of TOO 2 where sulphide mineralization is evident. No values of interest are indicated. Most of the mineralization consists of disseminated fine pyrrhotite in quartzites.

Four samples were taken some distance west of the property where massive pyrrhotite occurs in a cirque and where carbonate rocks came in contact with the Cassiar batholith. No values of significance are indicated.

J.C. STEPHEN EXPLORATIONS LTD.

GEOCHEMICAL DATA SHEET — ROCK GEOCHEM SAMPLING

NTS 104 O/16

LINE

AIR PHOTO No.

SAMPLER G. PRIOR, M. MASSON

PROJECT TSEE

DATE JUNE 25 - JULY 18 1981

	SAMPLE NUMBER	LOCATION	ROCK TYPE	ALTERATION	MINERALIZATION	STRIKE / DIP	ADDITIONAL REMARKS	APPARENT WIDTH		ASSAYS PPM. Zn	Pb	Ba	Ag	Au	Cu
(1)	27667 C		GREEN, MAROON QUARTZITE		PLENTIFUL PYRRHOTITE		H-4, ZONE 3' WIDE		Sn 1	47	70		0.1	<10	185
(2)	668		QUARTZITE	RUSTY WEATHERING	DISSEM. SULPHIDE					93	3		0.2	-	48
(3)	669		FLOAT DARK QUARTZITE		PLENTIFUL SULPHIDE					78	9		0.2		39
(4)	670		QUARTZ VEIN	IN STREAM	MASSIVE PYRRHOTITE				Sn 1	25	2		0.5	<10	130
(5)	671		BLACK TALUS QUARTZITE	GREEN FLUORESCENCE			BOTTOM OF SLOPE IN CANYON WEST OF CAMP 2		W 1	6	8		0.1		37
(6)	672				MASSIVE PYRRHOTITE TALUS, MODERATELY MAGNETIC		1/2 WAY UP SLOPE ON W. SIDE OF VALLEY	30 ELEMENT SPECTROGRAPHIC							
(7)	673		LIMESTONE IN CONTACT WITH QTZ MONZONITE		POSSIBLE SKARN ENVELOPE				W Mo 1 1						
(8)	674	TOP OF RIDGE TOO 2 / TOO 3	SILVERY WEATHERING SILTSTONE RUBBLE		Fe OXIDE					610	175	1400	0.4		
(9)	675 C		CARBONATE IN CONTACT WITH BATHOLITH		POSSIBLE SKARN		WEST END OF RIDGE SOUTH AND PARALLEL TO TOOTSEE		W Mo 1 1						
(10)	73670 B		DOLOMITE, SILIC ANHYDRITE NODULES, CHERT		SOME RUSTY WEATHERING NODULES ?					15	110			<10	
(11)	671 B		FINE GRAIN GREEN DYKE INTRUDING DOLOMITE				STRONGLY MAGNETIC			120	36		0.3	<10	
(12)	672 B		BLACK. VERY f.g CALC. PHYLLITE							20	2		0.1		
(13)	673 B		FINE GRAIN GREEN QUARTZITE	RUSTY GOSSAN	10-15 % SULPHIDE PYRRHOTITE ?		STRONGLY MAGNETIC		Ni 47	17	13		0.1		
(14)															
(15)															
(16)															
(17)															
(18)															
(19)															
(20)															

TABLE 2

<u>REFERENCES</u>

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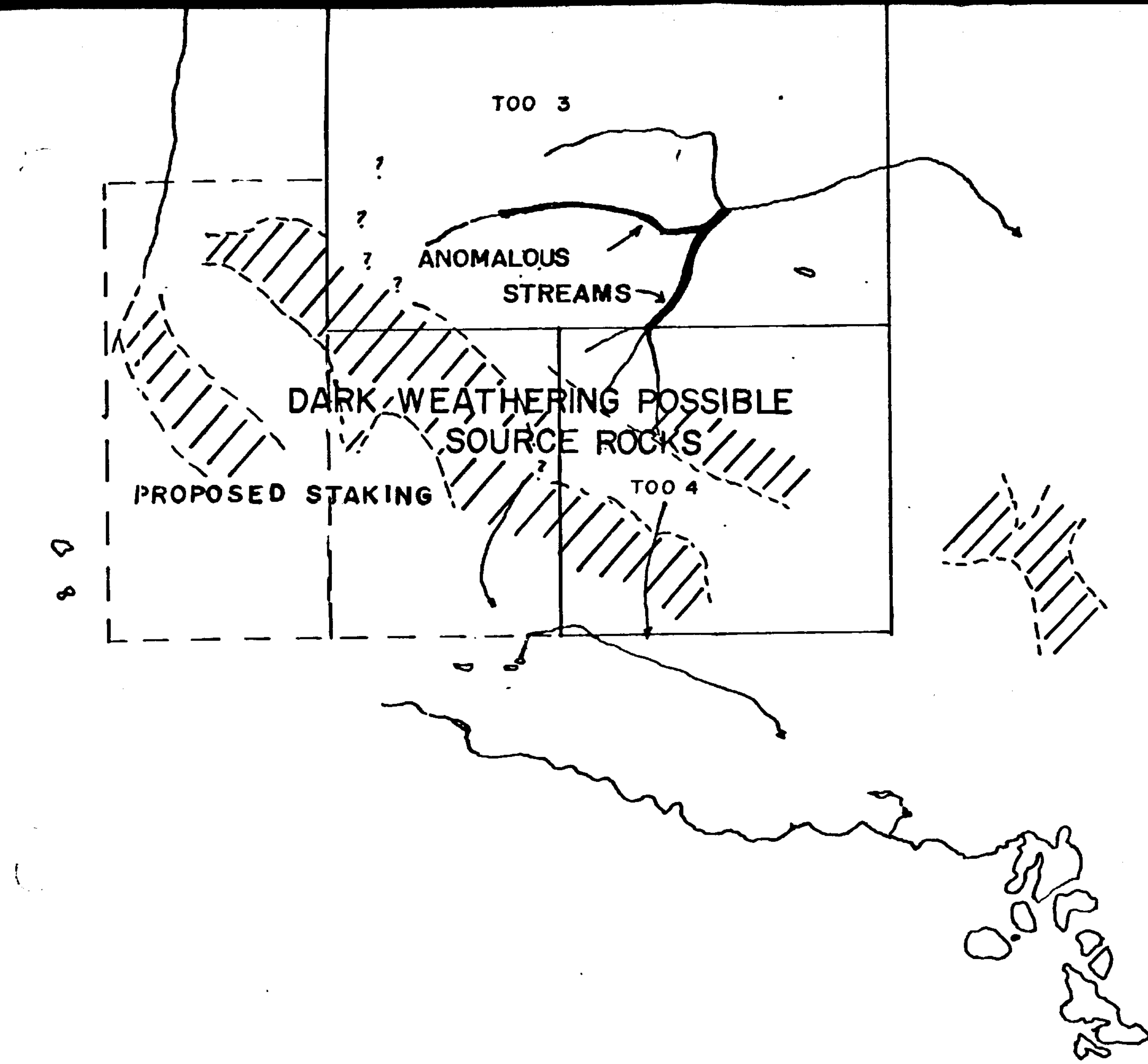
APPENDIX

After completing initial prospecting and mapping of TOO claims 1-4 in 1981, it was recommended that 12 additional units be staked to the southwest of the property (Figure 10) to follow up anomalous stream geochemistry. This staking was completed in 1982 and further geochemical surveys were done. The writer has been made aware of certain findings only in personal communications with C. Stephen of J.C. Stephen Exploration Ltd.

It is for this reason that mapping and discussions of this area have not been included in this thesis.



TSEE PROJECT

TOO CLAIM GROUP

ANOMALOUS AREA AND

PROPOSED STAKING

1" = 1/2 MILE   AUG. 1981

AIR PHOTO BC 5734-153

FIGURE 6

ANOMALOUS AREA AND
PROPOSED STAKING

1" = 1/2 MILE   AUG. 1981

FIGURE 10

J. C. Stephen Expl. Ltd.

MARK W MASSON
RR#2
PRESCOTT ONT
K0E 1T0 June 20/83

Cam: Here is a copy of my thesis from the Tsee Project. Sorry it's so late but the last year has been full of personnal and school problems, and I hope it didn't interfere with any work you did there. As you can see it turned out to be a tectonic-setting discussion.

You will find some chages on the geology map, from the copies you have, and you'll have to forgive the legend portion which they seemed to have troubles copying at school. Also I have not included geo-chem maps as I assume you already have copies.

I understand that the Climax claims to the east have shown good Pb-Zn-Ba values, and I think that the Devono-Mississippian contact is a good exploration target to the north and to the south, perhaps underlying Sylvester Allochthonous rocks?

You should also note that Unit 2 - Ordovician shales are now grouped within the Kechika Group and not the Road-River Form'n. which is limited to the Selwyn basin. They are however, probably facies equivalents from the basin to the platform.

Hope things are going all right with the company, times are tough, I myself have to see if I can get a job at this late date. Hope you enjoy the reading!

Sincerely,
[signature]

P.S. - H. Gabrielse over at the G.S.C. may be interested in this, I just missed him at school a few weeks ago.
- If you hear of any jobs I would appreciate it if you would let me know - either for the summer or winter. Thanx Can.


GEOLOGICAL MAP OF THE TOOTSEE LAKE AREA
N
TOOTSEE LAKE
TOO 1
TOO 2
TOO 3
TOO 4
TOO 5
LEGEND
CENOZOIC
QUATERNARY
PLEISTOCENE AND RECENT
7 Unconsolidated glacial, fluvioglacial, and alluvial deposits
PALEOZOIC
MISSISSIPPIAN AND DEVONIAN
LOWER MISSISSIPPIAN AND UPPER DEVONIAN
5 SYLVESTER GROUP (lower part): very fine grained black clastics, ranging from dirty siltstone to pebble conglomerate, characterized by shaley appearance and recessive weathering; mudstones often laminated and silver-grey on weathered surface.
DEVONIAN
4 Platy to massive, blue-grey limestone, prominant lineations, fissile character, grades into blue-white banded limestone.
MIDDLE AND LOWER DEVONIAN
3 Undifferentiated dolomites, form abundant talus; 3a, sandy and platy dolomites, white to brown to black, grades to silicious dolomites and calcareous quartzites, resistant, well bedded; 3b, finely laminated dolomite (rhythmite); 3c, massive fetid dolomite, dark grey to brown, fossiliferous (spaghetti stone).
ORDOVICIAN
2 KECHIKA GROUP: recessive, black, calcareous shale and siltstone.
2a: black, fine grained quartzite
CAMBRIAN
1 ATAN FORMATION: dark, clean siltstones and sandstones, metamorphosed equivalents include black quartzites, pyrrhotite bearing, grades upwards into interbedded limestone and dolomite.
AGE (?)
6 DYKE ROCK: green-black, fine grained, abundant mafics.
Geological boundary (observed, assumed, inferred)
Fault (known, uncertain, upthrown-downthrown)
Bedding, tops known (inclined, vertical)
Bedding, tops unkown (inclined)
Anticline (arrow indicates plunge)
Syncline (arrow indicates plunge)
Cleavage (known, unsure)
Lineation (trend, plunge)
[redacted]
SCALE 1:10,000
600 meters
DIAGRAMMATIC SECTION ALONG LINE A – B
meters
Drawn by: MARK W. MASSON
Revised by
Date
Traced by:
TSEE
TSEE PROJECT
LAT 59°52′N LONG 130°26′W
TOO CLAIMS 1–4
Scale: 1:10,000
Date: APRIL 1983
Plate:
104 O/16
FORM 210 0670