EPIGENETIC MINERAL DEPOSITS OF THE KETZA-SEAGULL DISTRICT, YUKON

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INTRODUCTION

Most epigenetic occurrences of gold and silver in the Pelly Mountains of central Yukon form two adjacent clusters at the headwaters of the Ketza River and Seagull Creek, which together, occupy a region about 45 km long and 15 km wide, that is here named the Ketza-Seagull district. The origin of these deposits has never been clear because they have been scarcely studied. Many are in Mississippian volcanic and intrusive rocks to which some have been attributed, and none are clearly associated with Mesozoic intrusions. This paper summarizes the characteristics of those deposits (Table 1) which are certainly, or probably, epigenetic, and presents evidence that they are related to a domal uplift here named the Ketza-Seagull Arch (Figure 1), and to one or more buried Cretaceous intrusions.

The writer spent about six weeks in the district in 1985. Descriptions in Table 1 also include information from assessment reports summarized in D.I.A.N.D. publications; Yukon Exploration and Geology or the Mineral Industry Report - Yukon Territory, from Geological Survey of Canada papers entitled The Mineral Industry of Yukon Territory and Southwestern District of Mackenzie, or from the National Mineral Inventory. Archer, Cathro and Associates kindly provided some information from the Northern Cordillera Mineral Inventory. Only the latter source, which is not readily available to the public, is referenced.

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REGIONAL GEOLOGY

The Ketza-Seagull District and surrounding area (Fig. 1) is underlain by Late Proterozoic to Triassic, miogeoclinal clastic, volcanic, and carbonate rocks that were deformed during Mesozoic arc-continent collision, and by mid-Cretaceous intrusions of intermediate composition (Tempelman-Kluit, 1977, 1979). The map units used in this paper are those of Tempelman-Kluit (1977, 1979, in press), and are not described here.

The structural framework is dominated by a few large thrust faults, mainly the McConnell, Porcupine-Seagull-Pass Peak, Cloutier, and St. Cyr, (Tempelman-Kluit, in press) and by the Ketza-Seagull Arch (Fig. 1). The Cloutier thrust sheet is bounded below by the St. Cyr thrust sheet, and above by the Porcupine-Seagull thrust sheet. The Ketza-Seagull Arch is a broad window in which strata in the Cloutier Thrust sheet are exposed beneath the Porcupine-Seagull Thrust. The Ketza Uplift and Seagull Uplift are two parts of the Ketza-Seagull Arch. Shortening on the Porcupine-Seagull-Pass Peak Thrust alone must be at least 30 km. Displacement on the others is probably less, but in the same order of magnitude. Right lateral, Late Cretaceous and Early Tertiary movement on the Tintina Fault is at least 450 km (Gabrielse, 1985).

KETZA-SEAGULL ARCH

Ketza-Seagull Arch is introduced here as a revision of Ketza Uplift, a term used by Tempelman-Kluit (in press) for a small domal structure centered about the headwaters of the Ketza River. The writer interprets the Ketza-Seagull Arch to include a second dome, called the Seagull Uplift, which together with the Ketza Uplift, forms a window in the Porcupine-Seagull Thrust. The origin of that window is not certain, but is probably, wholly, or in part, related to uplift about one or more buried Cretaceous intrusions. The basis for this revision is some detailed mapping by the writer between Seagull and Groundhog Creeks (Fig. 2) and relatively insignificant reinterpretations of Tempelman-Kluit's (1977, in press) mapping near Ketza River (Fig. 1).

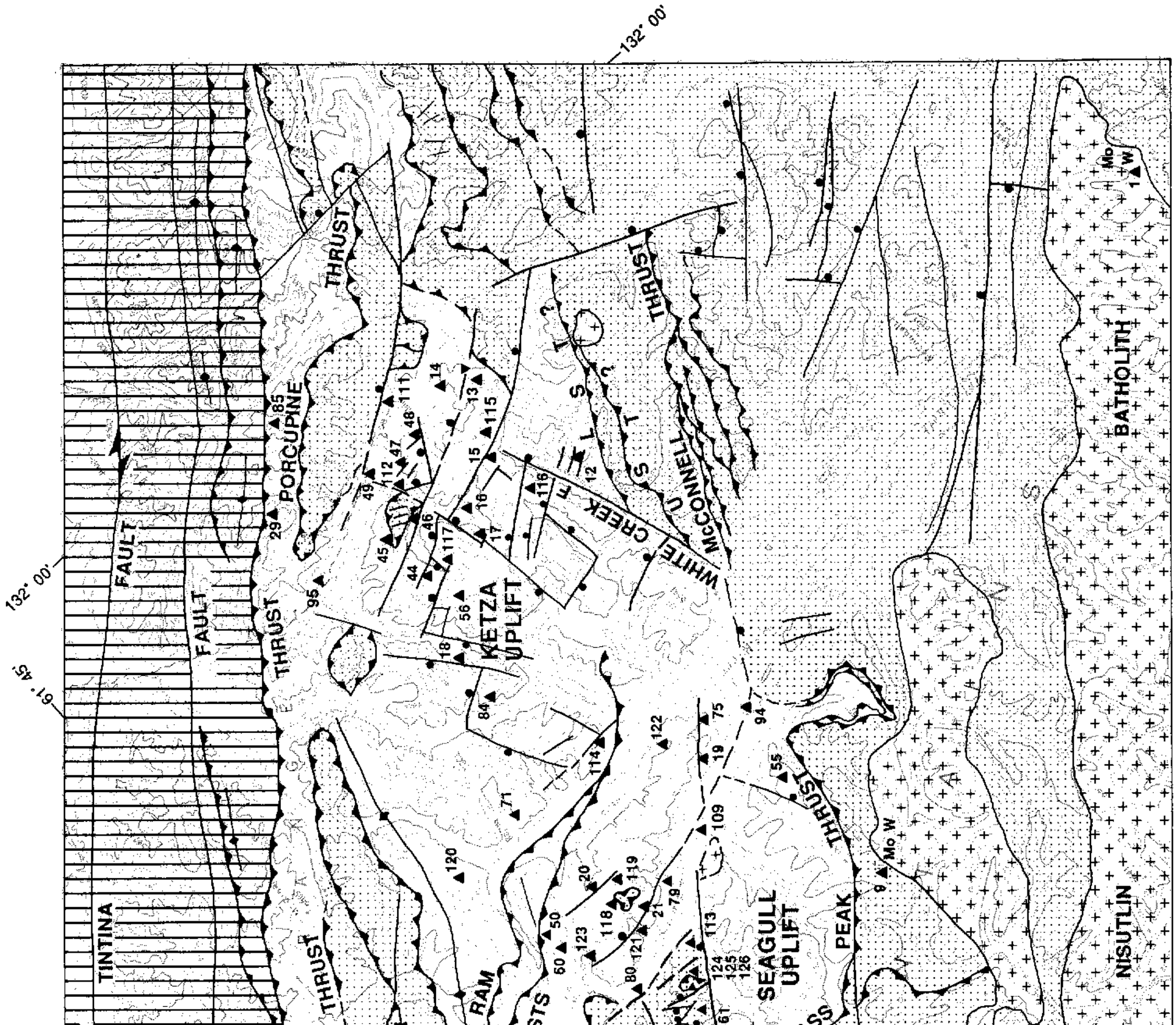
Difference between the Ketza Uplift of Tempelman-Kluit and Ketza-Seagull Arch reflect differences in the way the Seagull Thrust is mapped and correlated. Tempelman-Kluit (1977, in press) interprets the Upper and Lower Seagull Thrusts to extend eastward along Seagull Creek to the White Creek Fault, where they are offset to the east. In this interpretation, the Pass Peak and McConnell Thrusts are equivalent to one another, but separate from and structurally higher than the Seagull Thrusts. The writer (Fig. 1) interprets the Seagull Thrusts to be equivalent to the Pass Peak Thrust, with only the McConnell Thrust separate from, and structurally higher than the Seagull Thrusts.

New mapping, west of Seagull Creek, (Fig. 2) reveals how the Seagull Thrusts and the Pass Peak Thrust may be the equivalent, and form the northern and southern flanks of a complexly faulted arch, the Seagull Uplift. This interpretation assumes that the Lower Seagull Thrust places Siluro-Devonian carbonate onto Devono-Mississippian shale and volcanics, and that the Upper Seagull Thrust places Cambro-Ordovician phyllite onto Devono-Mississippian shale. The two splays may merge in the northwest part of the area, where only the Upper Seagull Thrust has been recognized. Many normal faults with a variety of orientations are superimposed on the Upper and Lower Seagull Thrusts. In most fault-bounded blocks, strata can only be assigned with confidence to one of the three possible structural levels defined by the thrusts, if a thrust is exposed in that block.

Although it is open to interpretation, Figures 1 and 2 show that it is difficult to run the Seagull Thrusts the full length of Seagull Creek because their trailings edges are brought to surface far to the west. In another interpretation, the fragments of thrust faults seen west of Seagull Lakes might belong to the Pass Peak Thrust, and be separate from the Seagull Thrust. However, if the Seagull Thrusts are not equivalent to the Pass Peak Thrust, then the latter terminates abruptly to the northwest, with no explanation.

The pattern of faulting and uplift documented in Figure 2 resembles that seen in the Ketza Uplift (Fig. 1) where fault orientations and overall sense of movement indicates local doming centered a short distance west of the KETZA RIVER deposit (17).

Figure 1. Structural setting of epigenetic mineral occurrences in the central Pelly Mountains. Most occurrences are associated with two domal structures, the Ketza and Seagull Uplifts, which together form Ketza-Seagull Arch. Ketza-Seagull Arch is a window through the Seagull-Porcupine-Pass Peak Thrust, and includes the unpatterned area southwest of the Porcupine Thrust, and southeast of the Porcupine Anticline. The Arch and Uplifts are defined by the window, by the pattern of normal faults in it, and by the distribution of map units, which are not shown here (see Tempelman-Kluit, 1977). Abbreviations include Lower Seagull Thrust (LST), Upper Seagull Thrust (UST), Porcupine Thrust (PT). See Figure 2 for explanation of other symbols and Table 1 for deposit descriptions.



132° 00'
61° 45'
TINTINA
FAULT
ST. CYR
FAULT
CLOUTIER
THRUST
LOWER
PORCUPINE
THRUST
UPPER
PORCUPINE
RAM
THRUSTS
ANTICLINE
LOWER
SEAGULL
THRUST
UPPER
KETZA
UPLIFT
SEAGULL
UPLIFT
PEAK
PASS
THRUST
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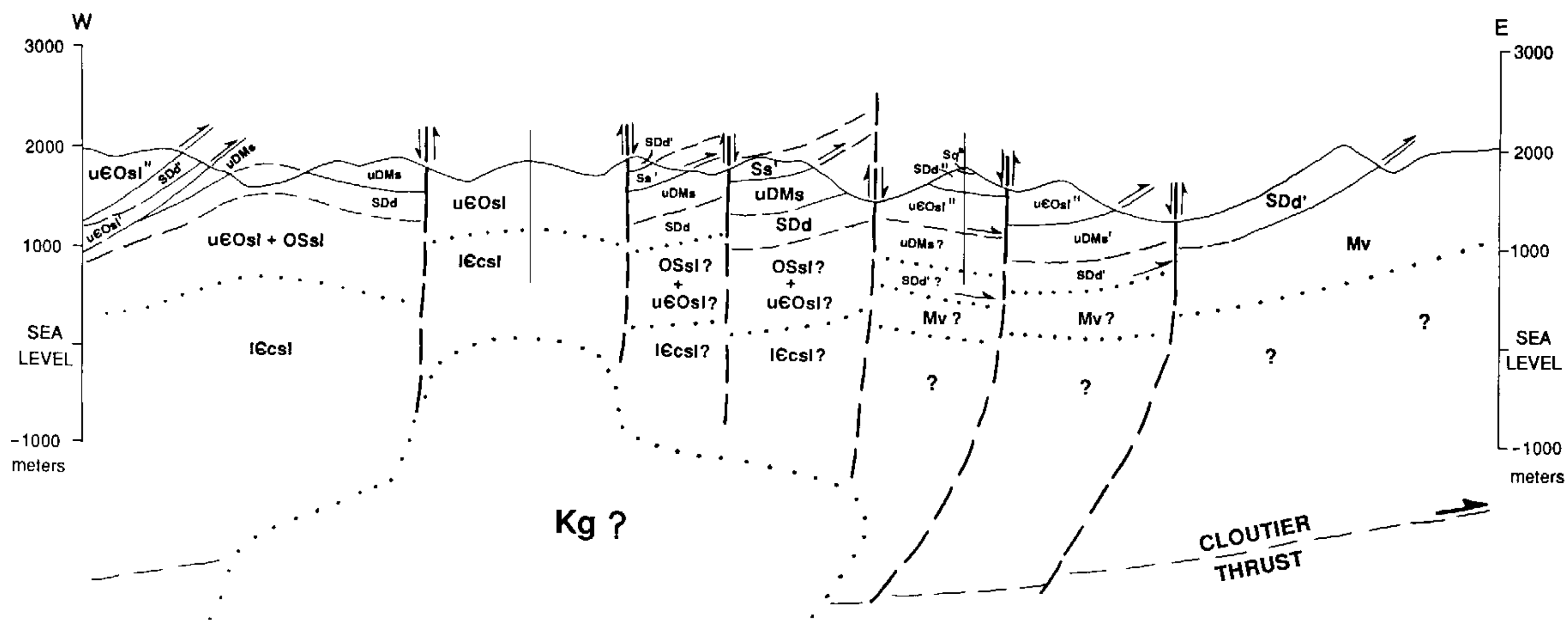

EXPLANATION
(Figures 1 & 2)

CRETACEOUS AND (?)EARLY TERTIARY

KTqfp Dark green, fine grained biotite-bearing mafic dikes. Minor quartz feldspar porphyry.

Kg Homogenous, medium grained, biotite quartz monzonite.

LATE DEVONIAN AND MISSISSIPPIAN

Mv Undifferentiated felsic and mafic volcanics, hornblende syenite, and black shale.

uDMs Black shale, chert grit, and chert conglomerate.

SILURIAN, EARLY AND MIDDLE DEVONIAN

SDd Buff, grey, and red weathering dolomite, with lenses of massive quartz arenite.

Ss Grey weathering platey, thinly laminated dolomitic siltstone.

Sq Massive grey weathering quartz arenite.

ORDOVICIAN AND SILURIAN

OSsl Black, graptolitic shale, minor chert.

LATE CAMBRIAN AND EARLY ORDOVICIAN

uЄOslv Grey-buff weathering thinly laminated calcareous phyllite, tuffaceous phyllite, with some mafic tuffs, and flows.

uЄOb Resistant dark green mafic flow or sill.

EARLY CAMBRIAN

lЄcsl Grey weathering calcareous mica schist and marble.

Footwall of the Cloutier Thrust Sheet

Hangingwall of the Cloutier Thrust Sheet

Strata above the Upper Seagull Thrust.................................. "

Strata between the Upper and Lower Seagull Thrusts......... '

Geological contact; defined, approx., assumed .....

Bedding; inclined, vertical..

Foliation; phase 2, phase 1, inclined, vertical...............

Steep dipping fault; sense of movement unknown..................

Normal fault...

Thrust fault...

Epigenetic mineral occurence or deposit................................ 20 ▲

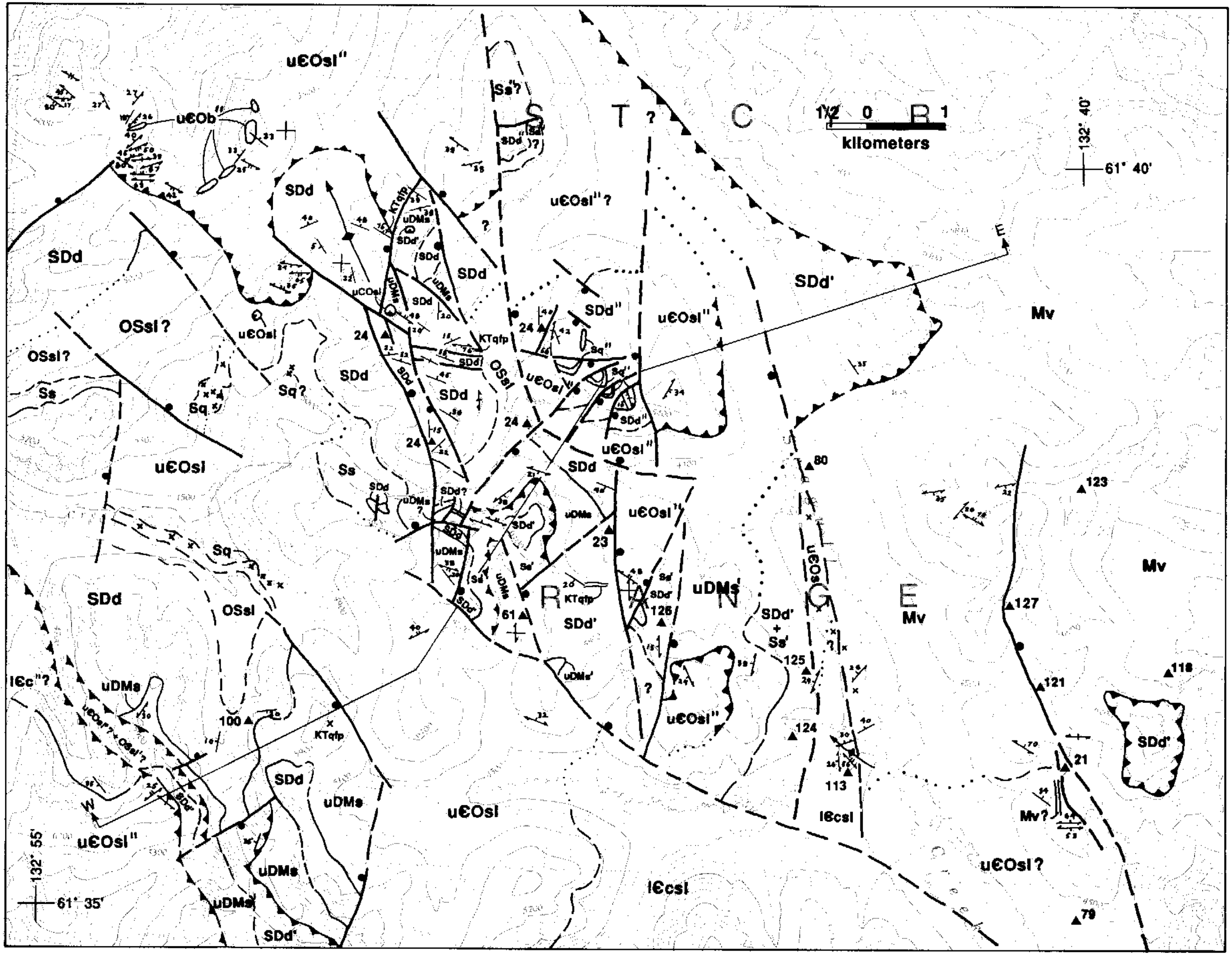

Figure 2. Geological map of the Seagull Uplift at the western end of Ketza-Seagull Arch. This map and cross-section show the evidence that the Pass Peak and Seagull Thrusts are equivalent, and probably domed about a buried intrusion.

Strata in the cores of both uplifts are Lower Cambrian, but are as young as Mississippian in between (Tempelman-Kluit, 1977), where there is less uplift. There are also few normal faults in the central part of the Ketza-Seagull Arch, but the White Creek Fault, along the southern margin could account for most of the uplift.

Other structures possibly related to the Ketza-Seagull Arch include the Ram Thrusts and the Porcupine Thrust sheet, probably as a splay of the underlying Cloutier Thrust. They were not examined by the writer, but appear to be relatively small, with little bearing on the configuration of Ketza-Seagull Arch. The Porcupine Anticline merges with the northwest end of the Ketza-Seagull Arch, may continue east along the Cloutier Thrust (Fig. 3), and may be a passive fold that developed above a step in the Cloutier Thrust. The relationship, if any, to the Ketza-Seagull Arch is unknown.

A small undated stock is near the core of the Seagull Uplift (Fig. 1). The metamorphic grade of adjacent Lower Cambrian schist and marble is noticeably higher than that seen elsewhere, and drill core at mineral locality 109 is reported to contain skarn. An intrusion such as the one shown hypothetically in Figure 2 may therefore underlie much of the area. In the core of the Ketza Uplift, just east of the Ketza River deposits, a small hornfels suggests the presence of an intrusion at depth. Mafic dykes are widespread and fairly common, but it is not known if they are confined to the Ketza-Seagull Arch. A radiometeric age of 112 Ma has been obtained from one of these dykes (Tempelman-Kluit, in press).

MINERAL DEPOSITS

Figure 1 shows, and Table 1 describes all known and suspected epigenetic mineral occurrences both in and around the Ketza-Seagull Arch. These demonstrate the empirical, and presumed genetic relationship between the two. Suspected volcanogenic occurrences are excluded, and only epigenetic occurrences in the Ketza-Seagull Arch are discussed here.

Most mineral occurrences are veins of galena, sphalerite, quartz, and siderite, ± pyrite, pyrrhotite, arsenopyrite, chalcopyrite, and tetrahedrite. Mantos consisting of pyrrhotite, pyrite, ± arsenopyrite, siderite, galena, and sphalerite are found only on the KETZA RIVER (17) (Canamax), SONNY (12), and OXO (15) properties. Precious metal content varies widely. Most deposits contain silver in association with galena and tetrahedrite. Silver content reaches 7714 g/t in the SOUTH FAULT Zone (111), but generally ranges from 300 to 700 g/t, with ratios of about 340 g/t Ag to 1%Pb. Some, but not all deposits rich in arsenopyrite, pyrite, and pyrrhotite contain gold. Only the GRAYLING (20), KETZA RIVER (17), LP (109), and HOEY (47) are significant. Grab samples from the GRAYLING occurrence has reached 155.3 g/t Au, but the average grade of 12.36 g/t Au in the PEEL and RIDGE Zone of Canamax's Ketza River property is more typical.

Most veins are pods or lenses along strong, well-defined faults with apparent displacements that are small. In many places, vein materials are crushed and brecciated, or cut by slickensided faults, as if faulting was intermittently active during mineralization. Few veins exceed a meter in width, and the largest reserves are on the STUMP Vein (A1) (48) where 36,280 tonnes of proven reserves grade 353 g/t Ag and 8.4% Pb.

Mantos are near faults, and form tubelike lenses along the contact between Lower Cambrian limestone and overlying shale. The PEEL and RIDGE Zones on Canamax's Ketza River property, with estimated reserves of 861,840 tonnes grading 12.36 g/t Au, demonstrate that although mantos are rare, they are attractive exploration targets. Siluro-Devonian dolomite and limestone underlies much of the Seagull Area, and may also contain mantos, although none have yet been recognized in those rocks.

Mineral occurrences form two clusters, the Ketza and Seagull areas, which are spacially associated with Ketza and Seagull Uplifts. In the Ketza area, deposits are zoned about the center of the Ketza Uplift. Gold-bearing, pyrrhotite- and arsenopyrite-rich mantos, chimneys and secondary oxides are in the core (KETZA RIVER DEPOSITS, 17, OXO), silver- and galena-rich veins are in the eastern and northern flanks, and barren pyrrhotite and siderite-rich mantos (SONNY 12) are on the southeast margin. In the Seagull area, occurrences on the west, north, and east peripheries (BOX 19, GROUNDHOG 24, TAKU 60, FOX 71, GULL 75, LORNE 100, ROWE 114, FALCON 120, GOAT 122) tend to be sphalerite- and galena-rich, while most of the others contain more pyrrhotite, pyrite, and arsenopyrite. In the south-center, the LP (109) occurrence comprises gold-bearing pyrite and pyrrhotite in association with skarn. With more work, an accurate zonation related to the Seagull Uplift may be established.

During the mid 1970's, many geologists were in the district exploring for massive sulphide deposits in Mississippian volcanic rocks. Some interpreted the above deposits to be either volcanogenic, or veins related to Mississippian intrusions (Morin, 1977, 1981). Some may be, but most of those examined by the writer are in faults that cut sharply across Mesozoic metamorphic fabrics, none are foliated, and their mineral ratios and general character resemble those of Mesozoic veins in other parts of the northern Cordillera. Near Seagull Creek (Fig. 2), veins are in different Mesozoic thrust sheets, along normal faults that cut those thrusts. If the thrusts, with many kilometers of displacement, are younger than the veins, the present juxtaposition of veins is more than fortuitous. Descriptions of most deposits not visited by the writer resemble those that were seen. In the writer's opinion, only the GUANO (59), NOKLUIT (58), MM (10), BNOB (96), CHZERPNOUGH (77), and CPA (11) occurrences (not shown on Fig. 1) might be volcanogenic.

ORIGIN OF THE KETZA-SEAGULL ARCH

The spacial association of epigenetic mineral deposits to the Ketza-Seagull Arch suggests that the two are genetically related. Mineral zoning appears to coincide with the smaller Ketza and Seagull Uplifts, which respectively contain hornfels and schist in their cores. The Ketza-Seagull Arch may therefore reflect doming and uplift about a buried Cretaceous intrusion, with apophyces beneath the Ketza and Seagull Uplifts.

The only obvious alternative is the possibility that the Ketza-Seagull Arch wholly or partially reflects a step in an underlying thrust fault (Fig. 3c). The miogeoclinal assemblage that underlies the Ketza-Seagull District was detached from basement and compressed and transported eastward or northeastward during deformation that probably lasted from late Jurassic to Early Tertiary time (Tempelman-Kluit, 1979). Generally, deformation migrated eastward and deeper with time, such that movement probably occurred first on the McConnell Thrust, then the Pass Peak-Seagull-Porcupine Thrust, then the Cloutier Thrust, and finally the St. Cyr Thrust before changing to dextral strike-slip on the Tintina Fault. If a thrust cut abruptly upward across strata, then as it continued to move, the thicker strata in the hangingwall would passively form an arch or anticline (Boyer and Elliott, 1982; Dahlstrom, 1969). The Porcupine Anticline along the northern margin of Ketza-Seagull Arch may be such a feature (F.g 3a). The presence of abnormally thick Mississippian volcanic rocks in the Ketza-Seagull Arch and the probability that they are associated with complex Paleozoic faults at depth suggests that Mesozoic thrust faults in this region developed irregularities or steps. Perhaps the Porcupine Anticline is part of a larger step that encompasses all of the Ketza-Seagull Arch. However, if the Ketza-Seagull Arch is solely related to passive folding, the empirical association with epigenetic veins is difficult to explain. There could only be a connection if the thickness of strata carried above the step is so much greater than elsewhere that tectonic thickening resulted in high heat flow, and (?) the generation of some small intrusions by partial melting. The mechanism has been used by Tempelman-Kluit (1979) to explain the origin of mid-Cretaceous intrusions in the region. He argued that tectonic thickening of the Cordilleran thrust and fold belt as a whole resulted in anatectic melting at the base of the continental crust. No correlation between single intrusions and areas of unusual tectonic thickening has been demonstrated.

Perhaps the Ketza-Seagull Arch is a composite feature that reflects both doming about an intrusion, and arching above a step. In this interpretation, a step may define the configuration of the whole arch, and two relatively small intrusions, the Ketza and Seagull Uplifts. It is possible but unlikely that such a step is younger than mid-Cretaceous (Fig. 3b). Late Cretaceous and (?) Early Tertiary strata at the leading edge of the Rocky Mountain Thrust and Fold Belt, far to the east of the Ketza-Seagull District (Stott, D.F., 1982), are deformed, and therefore detached from basement. The basal detachment must continue west beneath the Ketza-Seagull District, to the suture zone. This step would have to be in the basal detachment somewhere beneath the Cloutier Thrust (Tempelman-

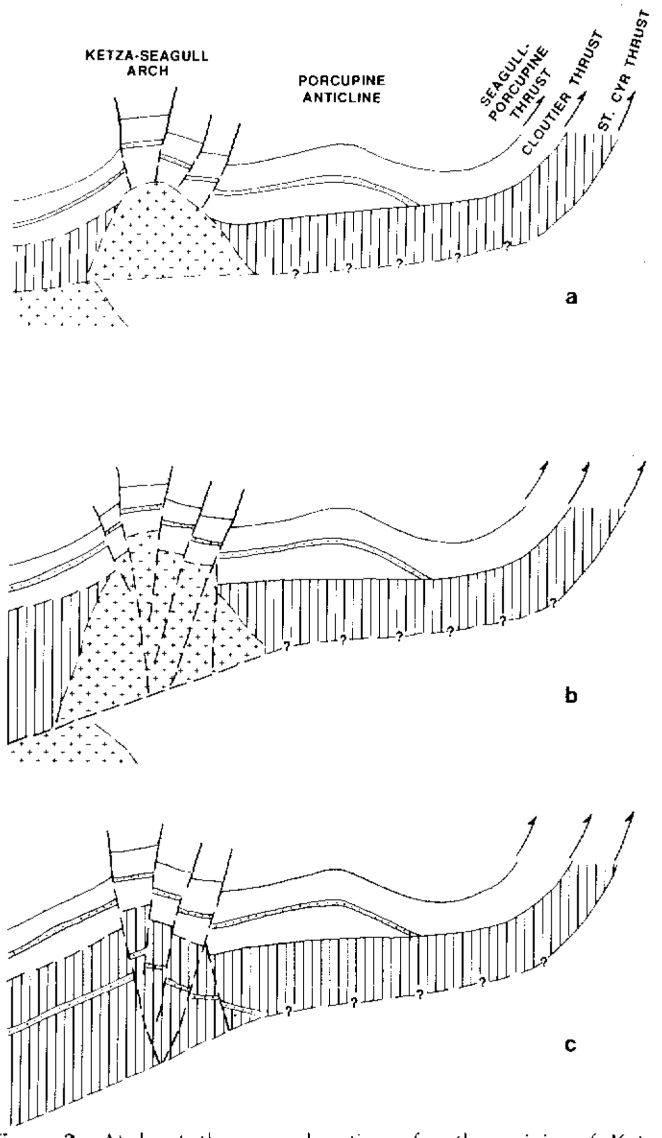

Figure 3. At least three explanations for the origin of Ketza-Seagull Arch are possible, the first (a) is most likely. (a) Doming about an intrusion, which may be truncated by a younger thrust. (b) Combination of doming about an intrusion, and uplift above a step in a younger (or older) thrust fault. (c) Anomalous heating as a result of tectonic thickening above a step, with no large intrusion. A step is the abrupt change in stratigraphic level of a thrust fault which results in a change in thickness and arching or passive folding of the overlying thrust sheet. The Porcupine Thrust may be such a feature.

Kluit, in press).

The above discussion shows that any explanation of the setting of epigenetic mineral deposits in the Ketza-Seagull District must not only consider their relationship to intrusions, but also to their regional tectonic setting. Mineralization occurred during the waning stages of deformation and transportation of supracrustal rocks above a passive basement, and faults associated with the Ketza-Seagull Arch may reflect a long and complex history. Normal faults may be related to buried intrusions, to the Porcupine-Seagull-Pass Peak Thrust, or to younger and deeper thrust faults that were active before and after (?) emplacement of mid-Cretaceous intrusions. Normal faults containing veins are younger than the Porcupine-Seagull-Pass Peak Thrust, and most likely reflect uplift about one or more buried intrusions.

COMPARISONS WITH THE SETTINGS OF VEINS IN OTHER AREAS

Many silver- and gold-bearing veins and mantos in central Yukon resemble those in the Ketza-Seagull District, but the local tectonic setting of some is different. This brief summary of the more important districts emphasizes that no consistent pattern of faulting has yet been identified with this type of deposit, and no area should be excluded from exploration on that basis. However, the deposits are all confined to that part of the Yukon underlain by deformed migeoclinal strata, and mid-Cretaceous to Early Tertiary intrusions. They are in or near late faults that cut regional folds and thrusts, and penetrative fabrics, and are mid-Cretaceous to Early Tertiary in age, but are commonly not near an intrusion. The Mt. Hundere deposits, north of Watson Lake, replace lower Cambrian limestone in the core of a small domal uplift over a buried intrusion (Abbott, 1977, 1981). Veins in the Plata Camp (Abbott, this volume) are fault controlled, a small undated porphyry dyke is near some veins, but not others, and there is no evidence of doming. The veins cut earliest (?) Cambrian limestone, but show no tendency to form mantos. The McMillan (Quartz Lake) deposit, located east of Watson Lake, was briefly visited by the writer who agrees with Morin's (1981) interpretation that it is a manto in (?) Earliest Cambrian limestone. The deposit and other small zones of veining and hydrothermal alteration underlie an area about 5 km x 5 km, but there is no exposed intrusion, or doming, although outcrop is scarce. The Keno Hill District is a belt about 25 km long, on the southern flank of the McQuesten Anticline (Boyle 1965). Most veins are along NE-trending faults with sinistral movement that are cut by NW-trending-faults with dextral movement. Displacements are in the order of 100 m or less (Lynch, this volume). Small Cretaceous intrusions are nearby, but no consistent relationship has been demonstrated to them. The McQuesten Anticline plunges southwest to form a partial window through the Robert Service Thrust that is about the same size as the Ketza-Seagull Arch. Aho (1963, 1964) proposed that vein and faults in the Keno Hill district are related to the development of the McQuesten Anticline, and indirectly to the nearby intrusions.

In the Rancheria District (Abbott, 1985), deposits are associated with many widespread Late Cretaceous and Early Tertiary dykes and small intrusions. Veins are along faults that display a systematic pattern indicative of a regional tectonic control that probably results from movement on large strike-slip faults such as the Tintina. The exact nature of this relationship is not yet clear. The small secondary faults could be riedel shears as suggested by Abbott (1985), although the writer now favours a broad zone of crustal extension that would have resulted in abnormally high heat flow, and partial crustal melting.

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TABLE 1

NAME (YEX Ref. No. (105 F))	TYPE	HOST ROCK	ASSOCIATED INTRUSIONS	DESCRIPTION
MOLLY (1)	Skarn Mo, W	Siluro-Devonian dolomite	Cretaceous Nisutlin Batholith	Diopside-garnet and wollastonite-garnet skarn contains molybdenite, pyrrhotite, chalcopyrite, and flourite over a strike length of about 200 m and narrow widths. The best drill intersection assayed 1.08% MoS_2 across 4 m. Endoskarn about 1 km to the north contains powellite.
STORMY (9)	Skarn Mo, W	Lower Cambrian limestone	Cretaceous Nisutlin Batholith	Molybdenite and minor scheelite occur in skarn and in granodiorite at the contact between the Nisutlin Batholith and Lower Cambrian limestone. Probable reserves are 17,000 tons grading 1.05% MoS_2.
★ SONNY (12)	Manto	Lower Cambrian limestone	Cretaceous Mafic dyke	Three mantos, comprised mainly of siderite and pyrrhotite and some pyrite and quartz, are exposed over a strike-length of about a kilometer. The largest and westernmost of the three is exposed for a length of about 75 m and a width of 2 or 3 m. The deposits are probably tubelike, but their orientation is unknown.
KAY (13)	Vein	Siluro-Devonian dolomite, limestone	?	Galena, sphalerite, chalcopyrite, and tetrahedrite, with lesser amounts of pyrite, pyrrhotite, and manganiferous siderite and minor quartz and barite form veins and breccias along fractures and faults or replace limestone (NCMI).
SHARON (14)	Vein	Cambro-Ordovician phyllite	?	Two north-trending, weakly mineralized quartz veins, about 450 m apart, assayed as high as 476.6 g/t Ag and 20% Pb across 1.75 m.
★ OXO (15)	Manto	Lower Cambrian	—	A lens of pyrrhotite, galena, sphalerite, and pyrite is exposed over 15 m x 30 m at the contact between Lower Cambrian limestone and overlying black shale. A 4 m chip sample assayed 349.7 g/t Au, 12.7% Pb, 0.03% Cu, 0.4% Zn, and 0.68 g/t Au. Next to the massive sulphides, in the same position, a quartz vein up to 2 m wide and 50 m long contains some chalcopyrite and pyrite.
KOPINEC (16)	Vein	Lower Cambrian phyllite	?	A vein of massive pyrrhotite, pyrite, and chalcopyrite assayed as high as 0.15% Cu over an undisclosed width (NCMI). Recent exploration has failed to find this occurrence.
★ KETZA RIVER (17) (WOODCOCK, BOOM, KON)	Mantos, chimneys	Lower Cambrian limestone	Cretaceous hornfels	The TARN, PEEL, RIDGE, PENGUIN, CREEK, and FLINT Zones are all localized along a steep east-trending fault known as the 080 fault. The RIDGE Zone is a chimney; the rest are mantos. The first three contain gold and are rich in arsenopyrite as well as pyrrhotite and pyrite. The PEEL and RIDGE Zones contain an estimated 861,840 tonnes grading 12.36 g/t Au. Most of these reserves are oxides. The other zones are barren and consist mainly of ankerite and pyrite.
★ BOX (JD) (19)	Vein	Mississippian volcanics, shale	—	A southeast-trending, southwest-dipping fault contains massive galena, pyrite, arsenopyrite, and crushed vein quartz, in a lens about 50 m long and up to 1 m wide. Grab samples have assayed as high as 1584.6 g/t Ag, 21% Pb, 1.03 g/t Au, and 0.25% Zn.
★ GRAYLING (20)	Vein	Mississippian volcanics	—	Two lenses of massive sulphides at least 2 m thick and of unknown length replace very coarse calcite along a steep north-trending fault. Pyrrhotite, pyrite, black sphalerite, galena, and minor chalcopyrite and arsenopyrite are the main sulphides. Talus fragments of manganiferous siderite, calcite, and quartz are associated with the sulphides. A chip sample across the Upper Zone averaged 21.28% Pb, 1.69% Zn, 522.5 g/t Ag, and 6.0 g/t Au across 6.2 m. A chip sample across the Lower Zone assayed 27.25% Pb, 2.23% Zn, 620 g/t Ag, across 1.6 m.
★ COXALL (SUN) (21)	Vein?	Mississippian volcanics	—	Only one small siderite veinlet with a small amount of sphalerite was seen by the writer.
★ TYRO (22)	Vein?	Mississippian volcanics	Mississippian syenite	Small faults contain quartz, carbonate, ± pyrite veins up to 30 cm across. In felsic volcanics, near lineaments that may reflect young faults, rusty irregular zones up to a meter or two wide contain disseminated pyrite and pyrrhotite.
★ HAYDN (23)	Vein	Siluro-Devonian dolomite	Cretaceous mafic dykes	Partially oxidized float boulders up to 1 m across contain pyrite, galena, and minor chalcopyrite, sphalerite, and tetrahedrite in a siderite and quartz matrix.

TABLE 1 (cont.)

NAME (YEX Ref. No. (105 F))	TYPE	HOST ROCK	ASSOCIATED INTRUSIONS	DESCRIPTION
★ GROUNDHOG (24)	Vein	Siluro-Devonian dolomite	Cretaceous mafic dykes	Four sets of veins consisting of galena and variable amounts of tetrahedrite in massive white quartz and lesser siderite are scattered over an area 1 km x 1 km. Reserves of 2558 tonnes grading 695 g/t Ag, and 42.5% Pb were established in 1969 on the largest vein (NCMI).
★ PONY (26)	Vein	Cambro-Ordovician phyllite	—	A vein containing a little galena, jamesonite, and arsenopyrite assayed 0.17 g/t Au, 52.8 g/t Ag, and 3.82% Pb.
★ HAM (27)	Skarn	Lower Cambrian schist and limestone	Cretaceous batholith	Scheelite (?) has been traced over a strike length of 300 m and widths of 3 to 4 m. Assays of grab samples ranged from 0.71% to 4.06% WO_3.
AMBROSE (29)	Vein	Siluro-Devonian dolomite	?	A quartz vein up to 2.5 m wide and more than 1 km long contains pyrite and lesser amounts of chalcopyrite (NCMI).
BARITE MOUNTAIN (32)	Vein	Siluro-Devonian dolomite	Cretaceous (?) mafic dykes	Several northeast striking faults contain barren veins, 0.6 - 3.5 m wide.
McNEE (33)	Vein	Siluro-Devonian dolomite	—	A few, small barite veins contain a little galena, pyrite, and copper stain.
CANUSA (34)	Vein	Siluro-Devonian dolomite	—	A northwest-trending fault contains a quartz, pyrite, and galena vein up to 1 meter wide. A chip sample across the vein assayed 0.34 g/t Au, 45.94 g/t Ag and 5.19% Pb.
LAPIE (37)	Vein	Ordovician-Silurian phyllite	—	A quartz vein contains some pyrite and galena.
DANGER (39)	Disseminated(?) stratabound(?)	Devonian sooty limestone	— —	Five scattered exposures, containing no visible sulphides, assayed as high as 6% zinc.
MT. MISERY (44)	Vein	Siluro-Devonian dolomite	?	A northeast-trending, brecciated fault zone contains lenses of galena and siderite that assayed up to 332.6 g/t Ag, 18.2% Pb, and 0.68 g/t Au across 5 m (NCMI).
★ KEY 3 (45)	Vein	Devono-Mississippian shale	—	A vein up to 1 m wide, in a steep north-trending fault, contains quartz, siderite, galena, and minor sphalerite, tetrahedrite, and pyrite. A bulk sample averaged 1114.3 g/t Ag, 4.8% Pb, and 0.35% Cu.
★ LAP 10 (46)	Vein	Devono-Mississippian shale	—	A northeast-trending fault zone about 1.5 m wide contains several pods of massive galena up to 30 cm across as well as smaller lenses and stringers of galena and quartz. Channel samples indicated a grade of 1200 g/t Ag, and 38.5% Pb over a width of 1 m and a strike length of 137 m (NCMI).
★ HOEY (F2, F3) (47)	Vein	Silurian quartzite	—	Several veins include two that are important. The eastern (F3) vein is in a northwest-trending fault that juxtaposes Ordovician-Silurian black shale against Siluro-Devonian dolomite, and consists of siderite, galena, sphalerite and pyrite. Nearby, galena also occurs in veinlets and replaces dolomite. The western (F2) vein is in a steep north-trending fault zone. The vein is about 2 m wide, and contains mainly quartz, with some pyrite, siderite, and a little galena. Surface exposures contain silver, but underground workings intersected a zone that assayed 23.3 g/t Au, but no Ag across 0.73 m, and a length of 9.1 m (NCMI).
★ STUMP (A1) (48)	Vein	Cambro-Ordovician phyllite	—	A steep, north-trending vein more than 200 m long and up to 1 m wide consists mainly of variable amounts of siderite, quartz, galena, and pyrite. Proven reserves in 1975 were 36,280 tonnes grading 8.4% Pb, and 353 g/t Ag (NCMI).
★ KETZA KEY (49) (K18-b)	Vein	Cambro-Ordovician phyllite	—	Galena and pyrite with minor tetrahedrite and sphalerite in a gangue of quartz and siderite form a north-trending pod about 1.5 m wide and 32 m long that cuts across foliation at a shallow angle. Proven and possible reserves in 1975 were 10,702 tonnes grading 545.1 g/t Ag and 12.15% Pb (NCMI).
GYR (50)	Replacement	Siluro-Devonian dolomite	?	Irregular masses of sphalerite replace dolomite. A grab sample assayed 29.64% Zn and 33.94 g/t Ag.
CONNELL (55)	?	Siluro-Devonian dolomite	?	Tetrahedrite occurs in veinlets (NCMI).

TABLE 1 (cont.)

NAME (YEX Ref. No. (105 F))	TYPE	HOST ROCK	ASSOCIATED INTRUSIONS	DESCRIPTION
FURY (56)	Vein	Lower Cambrian carbonate	?	Quartz veins containing chalcopyrite and tetrahedrite are 0.1 to 1.4 m wide and at least 100 m long. The best chip sample assayed 3.2% Cu and 10.3 g/t Ag across 1.4 m. A selected specimen assayed 7.8% Cu, 1559.9 g/t Ag, and 15.1 g/t Au (NCMI).
TAKU (60)	Vein	Mississippian volcanics, shale	?	Veinlets of galena and sphalerite are reflected in a local geochemical anomaly.
★ H(PEAK)(61)	Vein	Siluro-Devonian carbonates	Cretaceous mafic dykes	Boulders of arsenopyrite, pyrite, quartz, and pyrrhotite, up to 30 cm across, are exposed for 30 m along a creek bank.
★ FOX (71)	Vein	Siluro-Devonian dolomite	Cretaceous mafic dykes	Brown carbonate, black sphalerite, and minor galena form diffuse veinlets.
★ GULL (75)	Vein	Mississippian volcanics	—	Several narrow veins of massive white quartz, 6-10 cm across, contain small amounts of galena and sphalerite and are associated with an intermittent zone of clay alteration and chalcedonic veining.
★ ANISE (80)	Float	—	—	Glacial till in the valley of Seagull Creek contains fragments, up to 30 cm across, of vein quartz, pyrite, and arsenopyrite. Other fragments consist of massive arsenopyrite, with calcite and galena.
DROC (84)	?	Cambro-Ordovician phyllite	?	Chalcopyrite with traces of galena and sphalerite occur in a zone rich in quartz, pyrite and siderite (NCMI).
★ HOWRU (85)	Diagenetic? Disseminated	Siluro-Devonian quartzite	—	Ovoid disseminations of galena, 1 mm to 1 cm across, are scattered through thick beds of quartzite over a stratigraphic thickness of about 100 m and an unknown strike length.
★ LAP (89)	Skarn Vein	Lower Cambrian schist, limestone	Cretaceous porphyritic granodiorite	Chalcopyrite-bearing pods of massive pyrrhotite, and scheelite, are sporadically distributed in quartz-chlorite-actinolite skarn, and quartz-pyroxene-pyrrhotite skarn, respectively. Narrow quartz veins contain pyrite, galena, ± boulangerite, ± sphalerite, ± calcite.
★ ANGIE (92)	Diagenetic? Disseminated	Devonian sooty limestone	—	Sphalerite, smithsonite, and native silver form pelletoidal disseminations that are concentrated in bands parallel to bedding and as secondary replacement and vein fillings. The largest zone is 280 m long, lenticular, and erratic. Higher grade portions assayed 5.8% Zn and 122.5 g/t Ag across 3.2 m.
GRAY (94)	Float	Overburden	?	Float boulders along the south side of Grayling Lake contain minor pyrrhotite, pyrite, chalcopyrite, and galena.
IGLE (95)	Diagenetic? galena Disseminated?	Siluro-Devonian quartzite	?	Galena and sphalerite are disseminated(?) in quartzite, much like the HOWRU occurrence.
★ LORNE (100)	Vein	Siluro-Devonian dolomite	Cretaceous mafic dykes	Galena occurs in boulders of massive sulphide float up to 30 cm across, in narrow fracture fillings, and as blebs up to 3 cm across in dolomite.
★ LP (109)	Float	Lower Cambrian schist, limestone	Cretaceous granite	Boulders of quartz, pyrrhotite, and pyrite bearing schist found along the Seagull Creek road have returned assays between 2 and 27 g/t Au. Five drill holes intersected similar material. Most were low grade, but one returned an intersection containing 2.8 g/t Au across 4.5 m. Garnet skarn, and granitic sills or dykes are associated with the sulphides.
SOUTH FAULT (111) (F4, F6)	Vein	Cambro-Ordovician phyllite	?	The F-4 occurrence consists of small lenses and pods of galena with lesser amounts of sphalerite and traces of tetrahedrite along a steep east-trending fault. Selected specimens ranged from 2228.5 to 7714.1 g/t Ag. The F-6 occurrence, located 1 km farther south consists of galena float assaying 4967.9 g/t Ag, 71.4% Pb, and 0.17 g/t Au (NCMI).
★ K33 (112)	Vein	Cambro-Ordovician phyllite	—	A steeply dipping south southeast-trending vein up to 1.5 m wide and of unknown length contains siderite, quartz, pyrite, arsenopyrite and galena.
★ TROUT (113)	Vein	Lower Cambrian? phyllite	—	A steeply dipping north-trending quartz vein about 1.5 m across and an unknown length contains variable amounts of pyrite and arsenopyrite. A grab sample assayed 35 g/t Ag, 0.07 g/t Au, 0.15% Pb, and 0.07% Zn.

TABLE 1 (cont.)

NAME (YEX Ref. No. (105 F))	TYPE	HOST ROCK	ASSOCIATED INTRUSIONS	DESCRIPTION
★ ROWE (114)	Vein, Replacement	Siluro-Devonian carbonate	Cretaceous mafic dykes	A gossan about 50 m x 75 m contains clots and lumps of zinc and iron oxides in vuggy dolomite. Galena veins up to 4 cm across occur nearby. Chip samples assayed as high as 5.35% Zn across 22 m.
CARL (115)	Vein	Lower Cambrian limestone Siluro-Devonian dolomite	?	A 30 m wide zone of narrow quartz veins contains galena and sphalerite. A selected sample assayed 16.0% Pb, 506.4 g/t Ag, 7.73% Zn, and 0.1% Cu. About 1.5 km to the northwest, coarse-grained galena and black sphalerite occur in rubble below cliffs of Lower Cambrian carbonate. A selected grab sample assayed 42.8% Pb, 1230.1 g/t Ag, and 4.76% Zn.
WHITE (116)	Vein	Lower Cambrian carbonate, phyllite	?	A lens of massive pyrrhotite and arsenopyrite about 7 m long and up to 0.5 m wide, and a sheared east-northeast trending quartz vein about 0.5 to 0.77 m wide, are along a phyllite-carbonate contact. A selected sample of the sulphides assayed 15.4 g/t Ag, 0.03 g/t Au, 0.48% Pb, and 0.12% Cu.
QUILL (117)	Vein? Replacement? float	Lower Cambrian quartzite, phyllite	?	Boulders of massive pyrrhotite with variable amounts of arsenopyrite and minor pyrite returned assays as high as 2.8 g/t Au, 2.3 g/t Ag, and 32.83% As. The sulphides are associated with a stockwork of narrow, vuggy quartz veins containing pyrite and arsenopyrite.
PIKA (118)	Vein float	Mississippian volcanics	Mississippian syenite	Several closely spaced float occurrences of vein material contain semi-massive galena, sphalerite, pyrite, ± chalcopyrite, ± arsenopyrite. A typical grab sample assayed 242.4 g/t Ag, 0.14 g/t Au, 8.00% Pb, and 4.25% Zn.
LOON (119)	Vein	Mississippian volcanics	?	Several small, widely spaced veins with low silver, gold, zinc and lead contents include one containing arsenopyrite, pyrrhotite, pyrite, and chalcopyrite, and several others containing galena, barite, and tetrahedrite in quartz-carbonate gangue.
FALCON (120)	Vein float	Mississippian volcanics	?	Boulders of massive barite ± galena assayed as high as 63.5% Pb, 605.8 g/t Ag, 0.07 g/t Au.
BEAR (121	Vein	Mississippian volcanics	Cretaceous ? mafic dykes Mississippian syenite	Grab samples from small veins containing disseminated arsenopyrite and pyrite, assayed as high as 125.8 g/t Ag and 1.6 g/t Au.
GOAT (122)	Vein	Mississippian syenite	?	Sparse float of coarse grained galena, and quartz-carbonate containing disseminations and blebs of sphalerite assayed 1136.9 g/t Ag and 0.068 g/t Au.
LEAPER (123)	Vein	Mississippian syenite	?	Galena, quartz, and calcite veins, and massive galena veins include one as wide as 0.45 m and one that assayed as high as 360.7 g/t Ag, 0.34 g/t Au, and 80.5% Pb.
RAVEN (124)	Vein, replacement suboutcrop	Siluro-Devonian dolomite	?	Small veins and replacement zones of disseminated galena and iron oxides are associated with a large, north-trending geochemical soil anomaly. A selected grab sample assayed 782.0 g/t Ag, 4.8 g/t Au, and 22.4% Pb.
VOLE (125	Vein, replacement suboutcrop	Siluro-Devonian dolomite, sandstone	?	Small amounts of galena and pyrite occur in oxidized carbonate veins, and replace dolomite.
LYNX (126)	Vein	Devono-Mississippian shale; Cambro-Ord. phyllite	?	Two closely spaced float occurrences consist of sphalerite, galena, and pyrite in a fine grained quartz, barite matrix; and iron oxides with quartz veins and breccia containing galena. A grab sample from the latter occurrence assayed 1024.1 g/t Ag, 20.9 g/t Au, and 54.6% Pb.
BID (127)	Vein	Mississippian volcanics	—	A few fragments of float in a creek bed consist of either massive galena with a little chalcopyrite or massive milled pyrite and quartz with angular pieces of arsenopyrite and pyrite and quartz.

★ Visited by writer