GOLD AND SILVER, LEAD DEPOSITS OF THE KETZA RIVER DISTRICT, YUKON: PRELIMINARY RESULTS OF FIELD WORK

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CATHRO, M.S., 1988. Gold and silver, lead deposits of the Ketza River District, Yukon: Preliminary results of field work; in Yukon Geology, Vol. 2; Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 8 - 25.

ABSTRACT

The Ketza River gold deposits, in central Yukon, are gold-bearing, massive sulphide mantos and chimneys in Lower Cambrian limestone. Mining is presently confined to oxidized portions of the deposits. The deposits are bounded on three sides by silver-rich veins. Metal zoning corresponds to a pronounced domal uplift that is thought to be related to a buried Cretaceous intrusion. The zoning may partly reflect stratigraphic control, but distance from the buried intrusion is considered the prime control.

RÉSUMÉ

Les gîtes aurifères de Ketza River, dans le centre du Yukon, sont des mantos et cheminées de minerai sulfuré massif aurifère, à l'intérieur de calcaires du Cambrien inférieur. Actuellement, l'exploitation minière se limite aux portions oxydées des gîtes. Ces gîtes sont limités sur trois faces par des filons argentifères. La zonation des métaux correspond à un soulèvement prononcé en forme de dôme, qui à notre avis est lié à la présence d'une intrusion crétacée située en profondeur. Il est possible que la zonation reflète partiellement le contrôle stratigraphique, mais on considère la distance de l'intrusion enfouie comme le principal élément de contrôle stratigraphique.

INTRODUCTION

The Ketza River gold deposit, jointly owned by Canamax Resources Inc. and Pacific Trans-Ocean Resources Ltd. is the largest lode gold deposit discovered in Yukon to date, and is the Yukon's next gold mine. The Ketza River deposit is bounded on three sides by numerous silver-lead veins informally known as the "Iona Silver Property". Together, these deposits comprise the Ketza River District.

Two aspects of the geology are of particular interest. Firstly, the style of gold mineralization is new to Yukon. Auriferous epigenetic massive iron, arsenic and copper sulphides or supergene, iron oxides occur mainly as stratabound "mantos" (or blankets) in thickly bedded Lower Cambrian limestone. Lead and zinc minerals are rare and silver values low. The mantos comprise a previously unrecognized type of gold deposit in the northern Cordillera, and perhaps present a gold-rich analogue of the silver-rich replacement deposits at Midway, British Columbia; Leadville, Colorado; Bingham and Tintic, Utah; and Santa Eulalia, Mexico.

Secondly, the district exhibits an obvious concentric zoning pattern of metals and style of mineralization, with gold occurring near the centre of a conspicuous, domal uplift, and silver-lead mineralization occurring more distally. The zoning may be partly the result of stratigraphic control of mineralization. The uplift is probably underlain by a middle Cretaceous stock although no intrusive rocks have been located. Mineralization in the Ketza River District is thought to be genetically related to this stock.

This report presents the preliminary results of field work which will form the basis of a Master of Science thesis at the Colorado School of Mines. It is based on outcrop, drill-core and underground examinations of the Ketza River gold deposits during the 1984 and 1986 field seasons. Study of the surrounding silver-lead occurrences during 1986 was confined to examination of surface exposure and dump material because most of the workings are inaccessible and drill-core is not available.

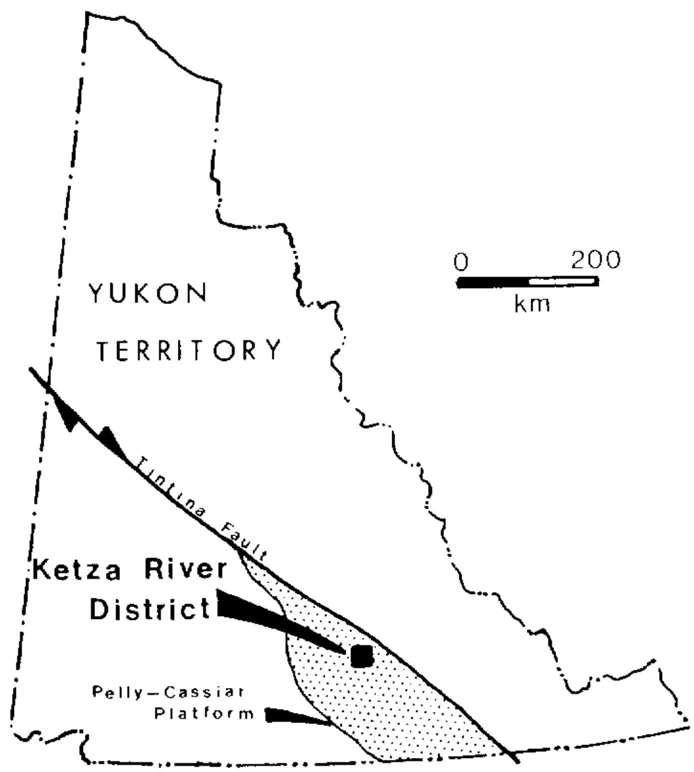

Figure 1. Location map of the Ketza River District, Yukon.

LOCATION AND HISTORY

The Ketza River District (Fig. 1) covers an area roughly 10 km by 10 km. It is centered 50 km south of the town of Ross River in the rugged St. Cyr Range of the Pelly Mountains (N.T.S. 105 F 09, 61°32'N, 132°15'W). A 45 km gravel road connects the Canamax camp with the Robert Campbell Highway at a point 23 km southeast of Ross River.

The first discovery in the district was a silver-lead vein found in 1947 by Hudson Bay Mining and Smelting Co. Ltd. The Ketza River gold deposit (formerly known as the BOOM or WOODCOCK showing) and many of the larger silver-lead occurrences, were discovered by Conwest Exploration Co. Ltd. and others in 1954 and 1955. The silver-lead veins have been intermittently explored with trenching, drilling, and underground work (12 short adits) by various interests until the present with only limited success. Only very minor production of hand cobbed ore has taken place. The STUMP (or 1) vein, discovered in 1966, is the best explored and by far the largest of the veins with probable reserves of 49,800 tonnes grading 20.0% Pb and 719.9g/t Ag (Orssich et al., 1985).

Conwest explored the Ketza River gold deposit with trenching and 59 drill holes from 1955 until 1960, and outlined sulphide reserves of 68,000 tonnes grading 12 g/t Au (Rotherham, 1958). The property then lay dormant until 1984 when Pacific Trans-Ocean Resources Ltd optioned the property from Conwest and entered into a joint venture agreement with Canamax Resources Ltd. Aggressive drilling and underground development to the end of 1986 had delineated reserves of 1.0 million tonnes averaging 13.7 g/t Au (Northern Miner, February 9, 1987).

Two factors have been primarily responsible for the greatly increased tonnage and economic viability of the Ketza River gold deposit: 1) appreciation by Canamax geologists of the geometry and ore controls of similar deposits in the U.S. and 2) recognition of the potential for large tonnages of metallurgically superior oxide mineralization in structurally prepared zones.

REGIONAL GEOLOGY

This summary of the regional geology is based on published descriptions of the geology of the Pelly Mountains and Ketza River District, including Wheeler et al. (1960), Tempelman-Kluit (1977a, 1977b, 1979, in prep.), Tempelman-Kluit et al. (1975, 1976), Read (1980), and Abbott (1986). The Ketza River district is underlain by moderately folded and faulted Paleozoic miogeoclinal strata of the Pelly-Cassiar Platform (Fig. 1), which are interpreted as autochthonous and parautochthonous to the North American craton by Tempelman-Kluit (1977a).

Four significant thrust faults, the McConnell, Porcupine-Seagull, Cloutier, and St. Cyr Thrusts, run parallel to the Tintina Fault and dip generally southwest (Abbott, 1986). Most rocks in the Ketza River District are part of the Cloutier Thrust Sheet although two small klippen belong to the overlying Porcupine-Seagull Thrust Sheet. Thrusting probably occured during the Late jurassic and Early Cretaceous (Tempelman-Kluit, 1979). The northwest-trending Tintina Fault located 15 km northeast of the District, (Fig. 1), has experienced at least 450 km of dextral, transcurrent offset since the middle Cretaceous (Gabrielse, 1985).

The most prominant structural feature in the Pelly Mountains is the Ketza-Seagull Arch (Abbott, 1986), an elongate, northwest-trending window through the Porcupine-Seagull Thrust that is probably underlain by, and related to buried Cretaceous intrusions. Abbott considered the Arch to be made up of two smaller domal structures, the Seagull Upleft and Ketza Uplift. Structure in the window is characterized by steeply dipping normal faults.

The Ketza Uplift, situated in the center of the Ketza River District (Fig. 3, was first postualted to be underlain by an intrusion by Parry et al. (1984). This theory is supported by the presence of a magnetic anomaly, hornfelsing, and hydrothermal alteration immediately north of the Ketza River gold deposit. The hornfels has been dated by whole-rock K-Ar as Middle Cretaceous (101 ±4 Ma; K.M. Dawson, .S.C., 1986, pers. comm. to S.E. Parry).

LOCAL GEOLOGY

The Ketza River District is underlian by five main units that range in age from Lower Cambrian to Missisippian. These are shown in

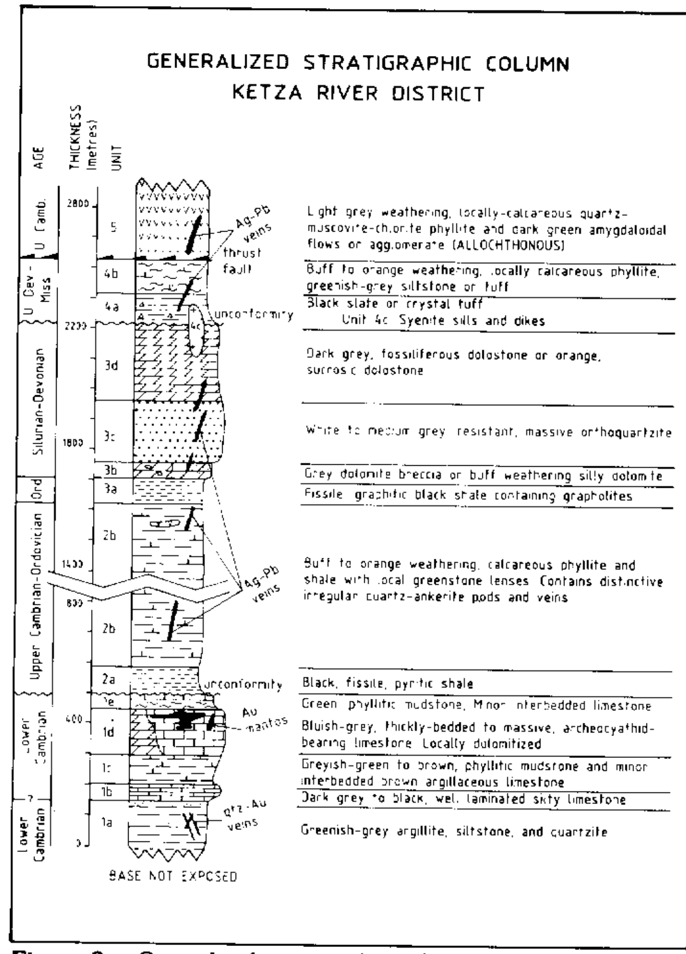

Figure 2. Generalized stratigraphic column for the Ketza River District including the relative positions of important mineral deposit types (modified after Tempelman-Kluit, 1977a; Read, 1980; and unpublished Canamax Resources reports).

Figures 2 (generalized stratigraphic column) and 3 (simplified geology map). Cambrian through Mississippian strata of units 1 to 4 belong to the Clouteir Thrust Sheet and strata of unit 5 belong to the structurally overlying Porcupine-Seagull Thrust Sheet.

An excellent description of the Lower Cambrian sedimentary rocks (Unit 1) near the Ketza River gold deposit has been presented by Read (1980). His terminology of subunits within Unit 1 is adopted here with minor modifications. The other units are mainly modified after Templeman-Kluit (1977a) and unpublished company maps.

Unit 1: Lower Cambrian

The Lower Cambrian succession has been split into five lithostratigraphic subunits (1a through 1e) with an aggregate thickness greater thatn 500 m. The lower contact is not exposed and the upper contact is an uncomformity of probable Upper Cambrian age.

Unit 1a contains the oldest rock exposed and comprises green argillite, siltstone, and quartzite. The unit contains a strong hornfels on the north side of the ridge that hosts the Ketza River gold deposits.

Unit 1b, a narrow bed (25 to 60 m thick) of resistant, dark grey to black, well laminated, silty limestone conformably overlies Unit 1a. Contacts are sharp and the unit is an excellent marker.

Unit 1c consists Early Cambrian fossils and is composed of greyish green to brown, recesive-weathering, calcareous, phyllitic mudstone with minor interbedded argillaceous limestone. Large pyrite cubes may be present. This unit may be as much as 100 m thick. The upper contact with Unit 1d is gradational and arbitrary since it is defined as the point where carbonate makes up to more than half of the rock (Read, 1980).

Unit 1d, the main host for gold mineralization, is distinctive grey-blue, thickly bedded to massive, archeocyathid-bearing, cliff-forming limestone (Fig. 4). The unit is 120 to 180 m thick and made up

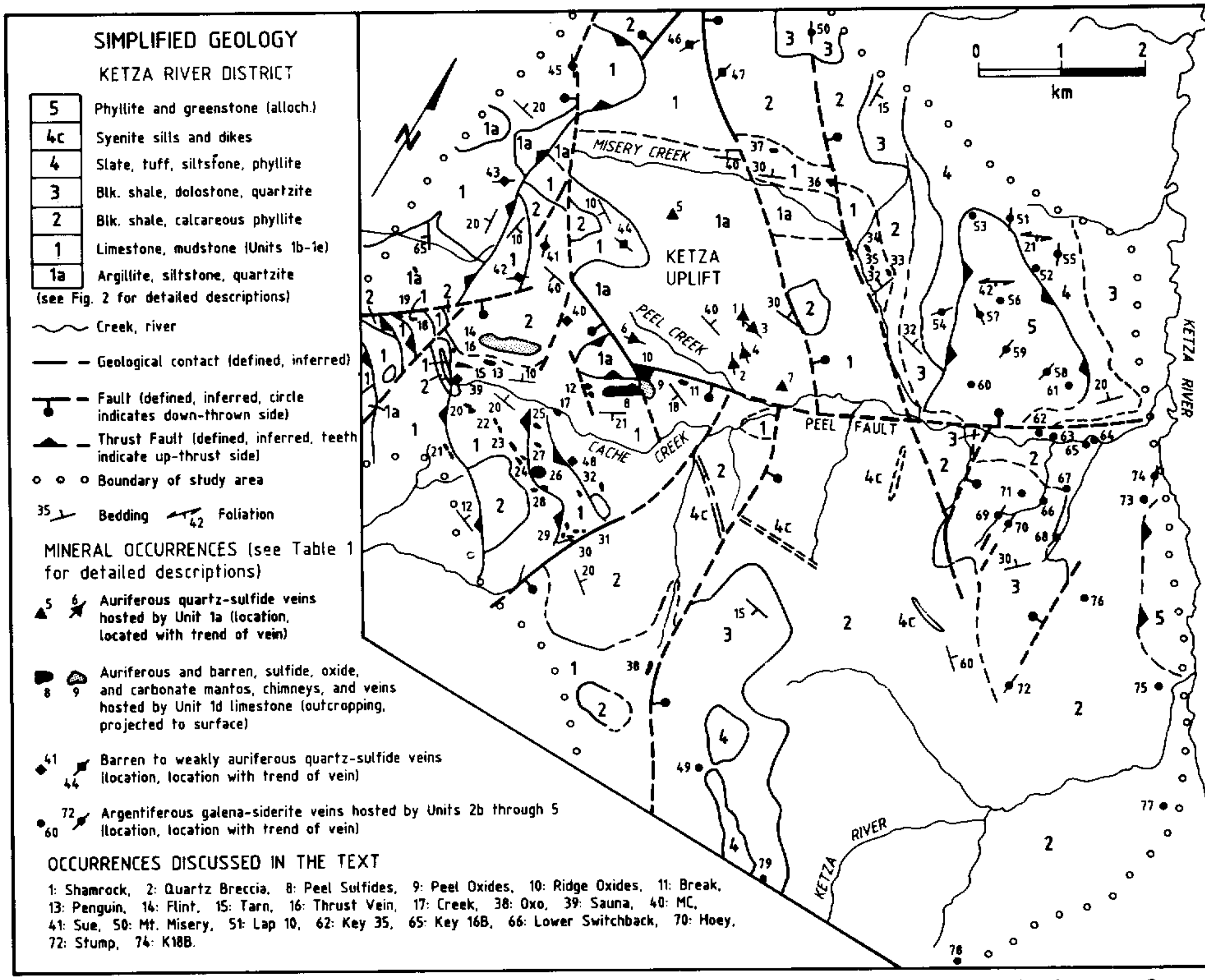

Figure 3. Simplified geology map of the Ketza River District including the locations of mineral occurrences discussed in this paper. Summary descriptions of all occurrences are given in Table 1. (Geology modified after Tempelman-Kluit, 1977a; 1980; and unpublished Canamax Resources maps).

predominantly lime mudstones with argillaceous interbeds near its base. Large archeocyathid buildups (archeocyathid bindstone and skeletal sand) are reported near the bottom of Unit 1d along the southern edge of the district (Read, 1980). Bedding attitudes are generally difficult to determine because the rocks are strongly bioturbated. To the west and north of the main Ketza River gold deposit, the limestones are strongly dolomitized and are blocky and orange weathering.

Unit 1e, a narrow (0 to 50 m thick) marker bed of non-calcareous, phyllitic green mudstone is interbedded with limestone within 10 m of the top of Unit 1d. In places, the upper limestone and green mudstone are completely missing, suggesting that the upper contact is an unconformity.

Unit 2: Upper Cambrian-Ordovician

Cambro-Ordovician rocks in the Ketza River District comprise a lower unit of black shale (Unit 2a) and a thick, upper unit of buff weathering, calcareous phyllite or shale (Unit 2b). Both weather recessively, making thicknesses and contact relations difficult to determine.

Drilling has shown Unit 2a to be at least 30 to 100 m thick. Unit 2b is at least 1000 m thick. A major unconformity probably exists beneath the black shale (Unit 2a). This unit was not described by Tempelman-Kluit (1977a), or Read (1980). It's age, though uncertain, is probably Upper Cambrian. In this study, it is grouped with Unit 2b. Unit 2b is strongly deformed and contains small, distinctive, irregular quartz-ankerite veins. Near large quartz veins, the calcareous phyllite is altered to blocky weathering, sucrosic dolomite. Large galena-siderite veins are hosted by Unit 2b.

Unit 3: Ordovician-Silurian-Devonian

Unit 3 includes four distinctive subunits that range in age from Ordovician to Devonian. Most host galena-siderite veins.

Unit 3a, the lowermost member, is recessive, fissile, graphitic, black graptolitic shale with minor interbedded calcareous, silty, and muddy beds. It is 50 to 100 m thick and Ordovician to Silurian in age.

Unit 3b, overlying the black shale, is a thin discontinuous interval of buff weathering, grey, silty dolomite and well indurated dolomite breccia with a dark grey dolomite matrix. Large coral fragments have been found at one location. This unit hosts weakly disseminated and vein-type Ag-Pb mineralization at the LOWER SWITCHBACK showing.

Unit 3c is distinctive white to medium grey, massive, resistant orthoquartzite. In many places it lies directly on Unit 3a black shale.

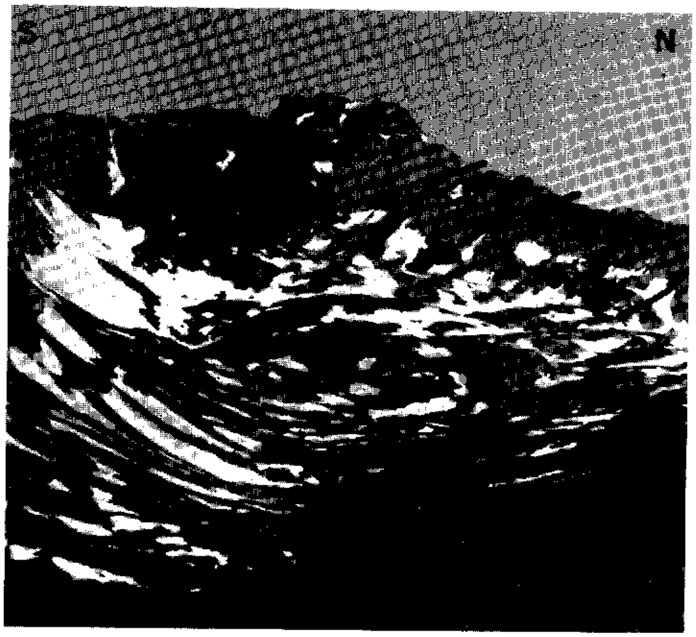

Figure 4. Thrust imbrication of Unit 1d limestone at the head of Cache Creek (looking west). Unit 1d hosts gold-rich sulfide/oxide mantos and chimneys in the district.

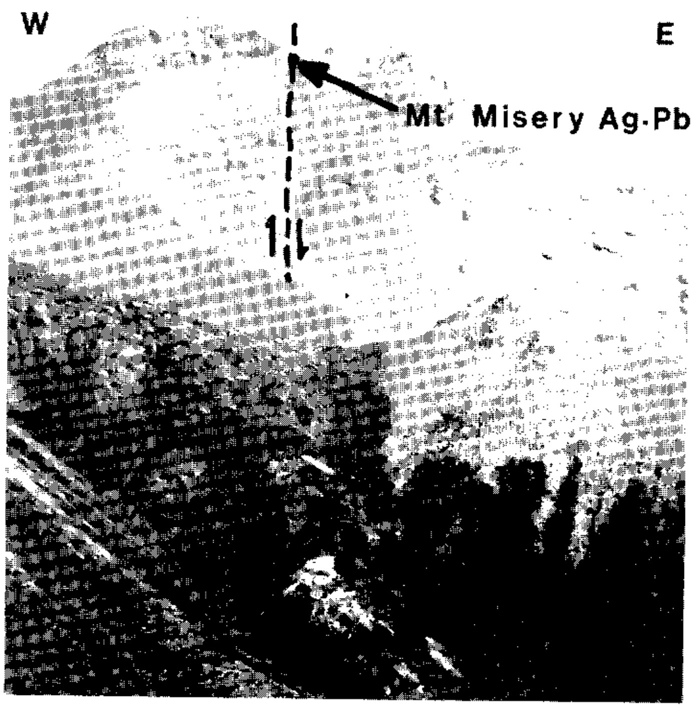

Figure 5. North-trending, steeply dipping fault in saddle on Mt. Misery. The east side of the fault has moved down approximately 100 m. Galena-siderite vein mineralization occurs in the fault (Occurrence #50).

It is at least 150 m thick and is Silurian. It hosts galena-siderite and quartz-pyrite-gold mineralization at the MT MISERY and HOEY showings.

Unit 3d is predominantly well-bedded, dark grey fossiliferous dolostone of Devonian age. On Mt. Misery, fine to medium-grained sucrosic, orange weathering dolomite overlying the quartzite (Unit 3c) is probably equivalent to Unit 3d.

Unit 4: Devonian-Mississippian

These rocks are equivalent to the Earn Group of Gordey et al. (1985) and consist of a lower member (Unit 4a) of black slate and dark grey to black, cherty siltstone or crystal tuff with minor interbedded chert, sandstone, chert pebble conglomerate and green tuff. The lower contact with carbonate is usually unconformable (Gordey et al., 1985).

Unit 4b overlies the black slate and includes buff-orange weathering, locally calcareous phyllite, and greenish-grey siltstone or tuff of unknown thickness.

Mississippian intrusive rocks (Unit 4c), consist of rare syenitic sills and dykes. A small diorite plug near the KEY 3 showing is surrounded by a pyrite aurole and alteration in overlying Mississippian volcanic rocks.

Unit 5: Upper Cambrian and Ordovician

Two klippen of volcanic rocks belonging to the Porcupine-Seagull Thrust Sheet occur near the junction of Cache Creek and The Ketza River. They are predominantly recessive, light grey weathering, locally calcareous, quartz-muscovite-chlorite phyllite, and green, moderately foliated, amygdaloidal volcanic flows and agglomerate, Minor chert and dark green diorite has also been reported (Orssich et al., 1985). The larger of the two lkoppen occurs north of Cache Creek, dips gently to the south, and is in contact with all rocks types from the Upper Cambrian phyllite to Mississippian volcanic rocks. The unit exceeds 200 m in thickness.

STRUCTURE

As stated above, the Ketza Uplift dominates the Ketza River District. The most obvious structures are southwest-dipping thrust faults with relatively small displacements, and steeply dipping, east, north and northwest trending normal faults. Most strata are gently folded and moderately dipping except near thrust, where drag folding has occurred.

Northeast-directed thrusts other than the Porcupine-Seagull Thrust are only documented in the well studied Lower Cambrian rocks (Fig.4). The highly contorted nature of the Cambro-Ordovician calcareous phyllite (Unit 2b) suggests that this unit may also have been inbricated by thrusting. Thrust-related folds have gently dipping axial planes and upright to overturned forelimbs (Fig. 4).

At least three sets of steeply dipping faults cut the thrust faults. These faults form the eastern, western and southern margins of the Ketza Uplift and are thought to reflect intrusion-related doming.

The Peel Fault is an east-trending, steeply north-dipping reverse fault located immediately north of the Ketza River gold deposit. The fault extends down Cache Creek and responsible for the 200 to 300 m of offset of strata on either side of the Cache Creek valley.

Northwest-trending faults are nearly vertical. The fault east of the SHAMROCK zone with at least 400 m offset is one of the largest and may be the offset extension of the fault east of the OXO showing. Most of the silver-lead occurrences occur near vertical north-trending faults of relatively small displacement (Fig. 5).

Faults near the Ketza River gold deposit are complex and are an important control on mineralization. The strong northwest-trending fault set crosscuts the east-trending Peel Fault and thrust faults.

MINERALIZATION

Over a hundred mineral showings occur in the Ketza River District. These can be broadly classified into four main types as follows:

1. auriferous quartz-arsenopyrite + pyrite veins cutting Lower Cambrian argillite/quartzite (Unit 1a),

2. auriferous and barren sulphide, carbonate and oxide mantos, chimneys and veins hosted in Lower Cambrian limestone (Unit 1D),

3. barren to weakly auriferous quartz + arsenopyrite veins and stockworks cutting Lower Cambrian limestone (Unit 1d) and Cambrian-Ordovician calcareous phyllite (Unit 2b),

4. argentiferous galena-siderite veins cutting Upper Cambrian through Mississippian strata (Unit 2b to Unit 5).

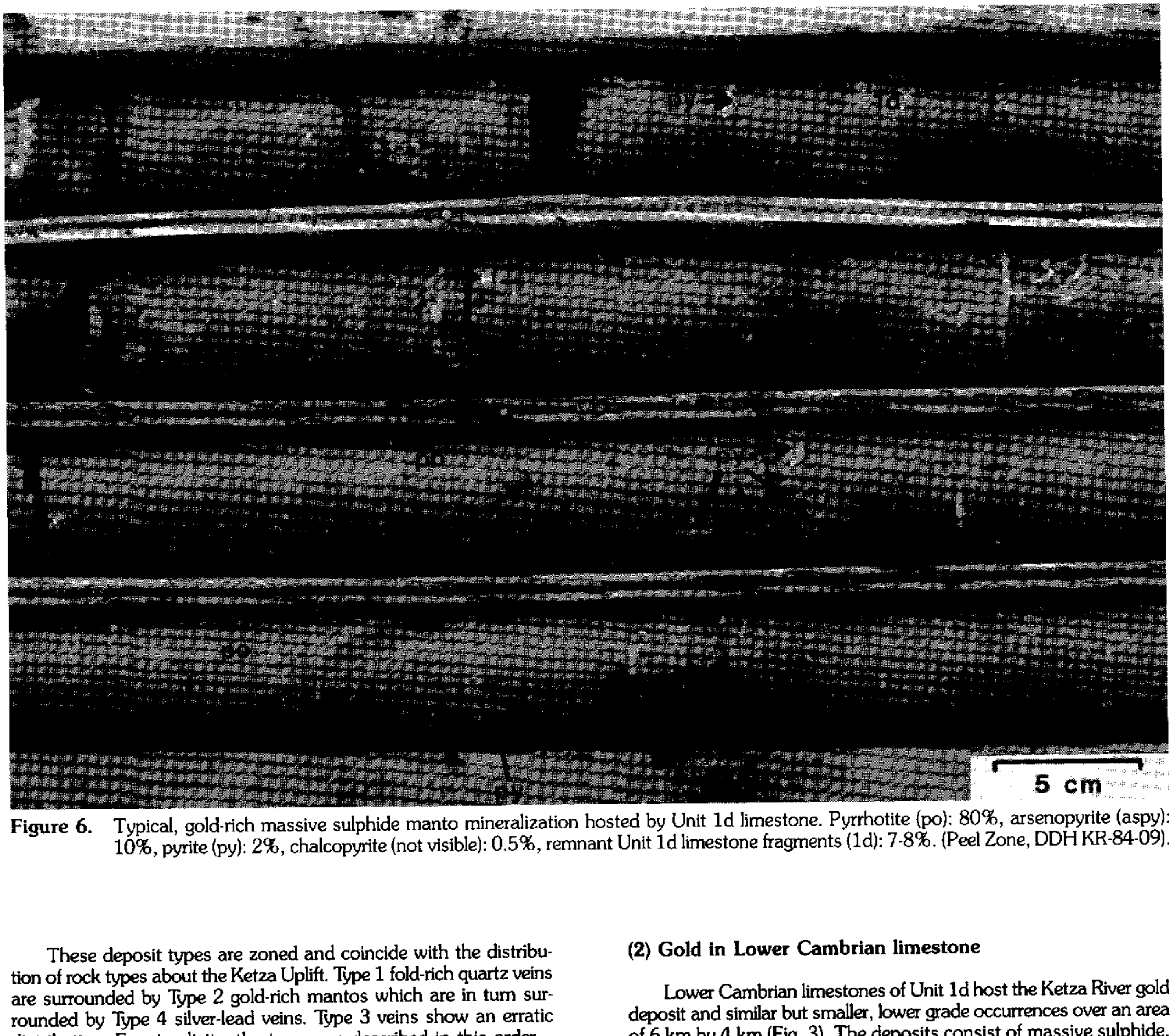

Figure 6. Typical, gold-rich massive sulphide manto mineralization hosted by Unit 1d limestone. Pyrrhotite (po): 80%, arsenopyrite (aspy): 10%, pyrite (py): 2%, chalcopyrite (not visible): 0.5%, remnant Unit 1d limestone fragments (1d): 7-8%. (Peel Zone, DDH KR-84-09).

These deposit types are zoned and coincide with the distribution of rock types about the Ketza Uplift. Type 1 fold-rich quartz veins are surrounded by Type 2 gold-rich mantos which are in turn surrounded by Type 4 silver-lead veins. Type 3 veins show an erratic distribution. For simplicity, the types are described in this order.

Locations of the showings are shown on Figure 3 and some of the important features (mineralogy, attitude, host rock, etc.) are given Table 1.

(1) Gold in Proterozoic argillite

Important gold-bearing quartz-arsenopyrite veins at the SHAMROCK and QUARTZ BRECCIA zones (Fig. 3) occur in argillically altered argillite and quartzite of Unit 1a near the approximate centre of the Ketza Uplift. The QUARTZ BRECCIA zone is a vein zone 200 m long by 24 m wide that strikes 300° and dips moderately east just north of Peel Creek. At surface, veins are composed of coarse, granular quartz, scorodite, and minor arsenopyrite. In the SHAMROCK zone 700 m farther north, similar veins also trend northwesterly. Surface samples containing mostly scorodite have returned assays up to 1000 g/t au (Northern Miner Magazine, March, 1987, p. 35).

FRED'S VEIN occurs approximately 500 m north of the Ketza River gold deposit in hornfelsed argillite of Unit 1a. It trends east-northeast, dips steeply and has a higher sulphide content than the Shamrock-type veins. Locally, this vein contains massive pyrrhotite-arsenopyrite not unlike the sulphide mantos and veins in Lower Cambrian limestone.

(2) Gold in Lower Cambrian limestone

Lower Cambrian limestones of Unit 1d host the Ketza River gold deposit and similar but smaller, lower grade occurrences over an area of 6 km by 4 km (Fig. 3). The deposits consist of massive sulphide, carbonate, or oxide mantos, chimneys, and veins. The largest deposits (the TARN, PENGUIN, FLINT, BREAK and PEEL zones (occurrences 8 to 15) fall along a 2 km lineament trending 080° (Fig. 3) suggesting structural control. All deposits occur in the upper 100 m of the Lower Cambrian limestone, indicating that stratigraphy is also an important ore control.

The deposits are either sulphide-rich or oxide-rich. The latter appear to be in situ supergene replacements of the sulphides. Their superior metallurgical properties and grade (average 18 g/t versus 9 g/t for sulphides), make the oxides the most economically important. The sulphides are more common and better exposed.

Sulphide mineralogy

The mineralogy of the sulphide bodies is simple, consisting mainly of semi-massive to massive pyrrhotite, with variable quantities of arsenopyrite, pyrite and minor chalcopyrite (Fig. 6). Some deposits south of Cache Creek contain significant siderite.

Arsenopyrite averages 5 to 10% by volume and forms large (2 to 5 mm) euhedral grains disseminated throughout the pyrrhotite. Arsenopyrite also locally forms narrow (5 mm) bands around remnant limestone clasts enclosed in pyrrhotite (Fig. 6). In some places massive pyrrhotite contains small (3 m by 20 m) discrete lenses of massive (90%) arsenopyrite.

Figure 7. Underground exposure of oxide mineralization consisting of earthy limonite (near hammer) and dark brown "hisingerite" (h). Gold values are often associated with "hisingerite". (1450 level, Peel Zone oxides).

Pyrite is common as large (to 5 cm) subhedral masses but rarely makes up more than 50% of the total sulphides. Chalcopyrite is common as a fine network between other sulphide grains and makes up 0.5 to 1% of the sulphides by volume.

Gold is irregularly distributed but correlates best with arsenopyrite and total sulphide content. Only in the PEEL zone are sulphides consistently auriferous. Only erratic high values have been encountered in showings distal from the PEEL zone. Tooney (1985) determined that gold generally occurs as 0.5 to 25 micron grains associated with native bismuth and chalcopyrite which fill fractures in other sulphides. Spheroidal gold inclusions in pyrrhotite and pyrite were also noted.

Galena and sphalerite are extremely rare in most sulphide deposits, with small amounts noted in the PEEL zone and the CREEK showing and significant quantities in the OXO showing (Fig. 9).

Oxide mineralogy

Gold-bearing oxide material is composed of limonite, hematite, other unidentified hydrous iron oxide minerals and quartz. Gold grades are often highest where an unusual yellow, orange, red or brownish black, conchoidally-fracturing amorphous mineral is present (Fig. 7). Conwest geologists referred to this as "hisingerite" which is actually a mineraloid. This material resembles yukonite in appearance.

Shape and size of ore bodies

The auriferous bodies vary in shape and size. All crosscut the enclosing limestone and are clearly epigenetic. The largest and most continuous of the sulphide bodies are conformable, nearly flat-lying blankets or "mantos". The deposits occur near the top of the massive Lower Cambrian limestone (Fig. 8), from 0 to 100 m beneath the green mudstone (Unit 1e). The thickness of the mantos varies greatly, from less than 10 cm to greater than 30 m. Vertical stacking of parallel lenses (Fig. 8) is common. The maximum drilled dimensions of the PEEL zone (sulphides plus oxides) are approximately 500 m by 300 m. The FLINT zone may be larger, with a drilled thickness of over 30 m (Fig. 9) and a possible strike length of over 1500 m based on geophysical data.

Mantos are extremely irregular in detail despite their strong overall stratigraphic control. Massive sulphides pinch and swell and interfinger with barren limestone (Fig. 10) or weakly sulphide-veined limestone. Locally, mantos become calcite and quartz-rich at their margins.

Sulphides consistently crosscut earlier-formed irregular calcite veins (5 - 20% of host limestone) proving that the deposits are epigenetic (Fig. 11).

Contacts between sulphides and limestone are invariably sharp (Fig. 12); only faint bleaching of limestone is occasionally visible. In some places, irregular sulphide veins form a strong crackle breccia. As sulphide content approaches 30 to 40%, incipient brecciation is evident, with no appreciable rotation of limestone clasts (Fig. 13). The clasts have irregular, rounded outlines (Fig. 14). These textures suggest gradual replacement of limestone by sulphides.

Crosscutting chimneys and irregular sulphide veins (Fig. 15) are common and have a variety of orientations. The THRUST vein and a number of unnamed crosscutting bodies south of Cache Creek are the best exposed. The BLUFF zone may be a vein occurrence.

The THRUST VEIN (Fig. 16) is a 2 m wide vein of pyrrhotite-pyrite-quartz- calcite striking northwest and dipping moderately south. It is in a thrust fault which juxtaposes Unit 1d (limestone) against Unit 2a (black shale) and has a strike length of over 100 m. At its west end, the THRUST VEIN changes to quartz and calcite with no sulphides. Similar veins occupy thrust faults in the cliffs south of Cache Creek, roughly 1 km south of the PEEL zone.

Auriferous iron oxide deposits (RIDGE, BREAK and PEEL OXIDE zones) can have the same general shape as sulphide bodies although they show a greater affinity for structurally disrupted sites.

The PEEL OXIDE zone is a flat-lying manto contiguous with the PEEL SULPHIDE zone but generally lies east of the major NW Fault. In some places, unoxidized sulphides are above the oxides suggesting that groundwater flow patterns the position of oxide mineralization.

The RIDGE zone (Fig. 3) is an irregular, northwest-plunging, pipe-shaped oxide body up to 30 m by 100 m across and at least 100 m below surface. It appears to occupy the junction between the PEEL Fault and the NW Fault. The RIDGE zone is mainly in limestone (Unit 1d) and merges with the PEEL OXIDES.

The BREAK zone, discovered in 1986, is 500 m east of the RIDGE zone in a similar structure and appears to be oriented in an easterly direction. The mineralogy and grade are similar to the RIDGE zone.

In summary, pyrrhotite, arsenopyrite, siderite and iron oxide mantos, veins and chimneys are in Lower Cambrian limestone (Unit 1d) beneath a layer of green mudstone (Unit 1e). The deposits are gold-rich only near the junction between the PEEL fault and the NW fault. Oxide deposits are developed in zones of structural complexity which apparantly controlled groundwater flow and in situ oxidation of sulphides. The sulphide deposits, although stratabound, are clearly epigenetic.

(3) Quartz-sulphide veins

Barren to weakly auriferous quartz-sulfide veins and stockworks (Fig. 17) are common. They are economically unimportant, and have not received much attention but may indicate a large intrusion-centered hydrothermal system. The SAUNA, MC and SUE show-

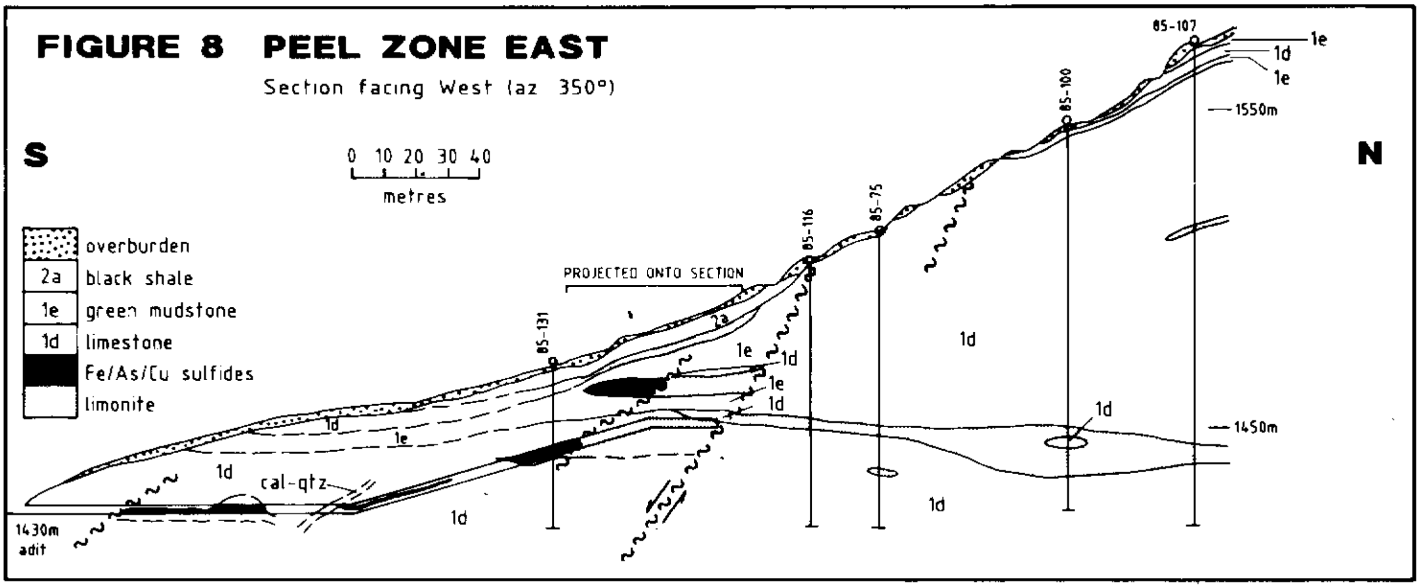

Figure 8. Cross section facing west through the Peel gold zone.

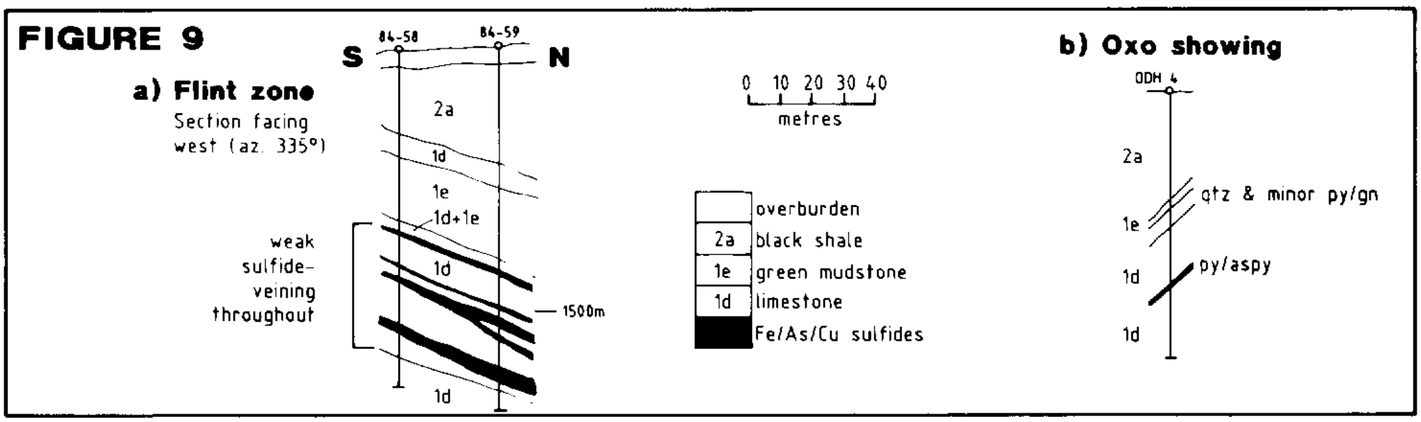

Figure 9. (a) Cross section facing west through the Flint zone. (b) DDH #4, OXO showing.

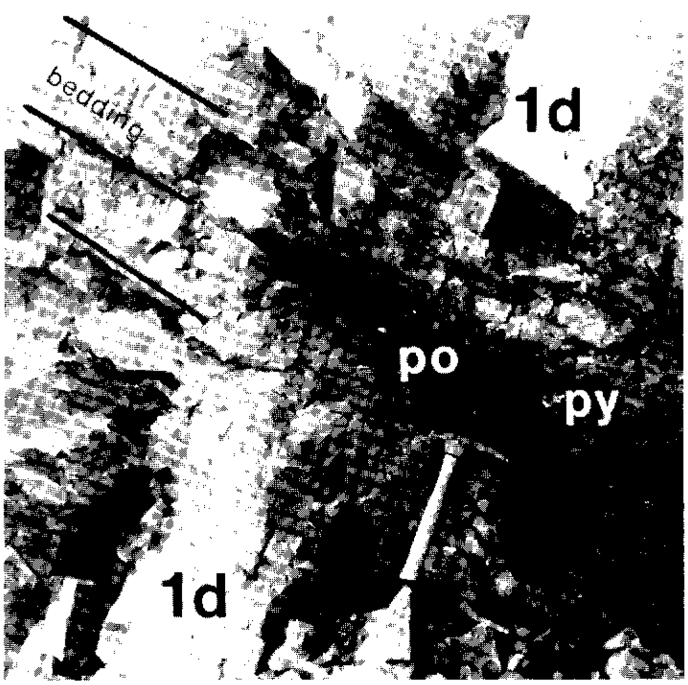

Figure 10. Bedding and fracture controlled replacement of Unit 1d limestone (1d) by massive pyrrhotite (po) and minor pyrite (py). (Occurrence #23).

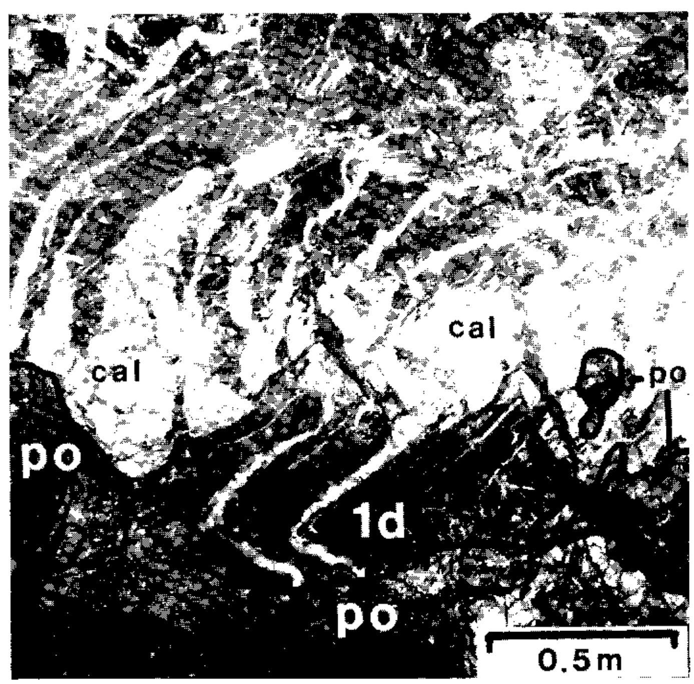

Figure 11. Underground photograph showing definitive epigenetic relation- ship between sulphides and host rock. Massive pyrrhotite (po) crosscuts calcite-veined (cal) Unit 1d limestone (1d). (1430 level, Peel Zone).

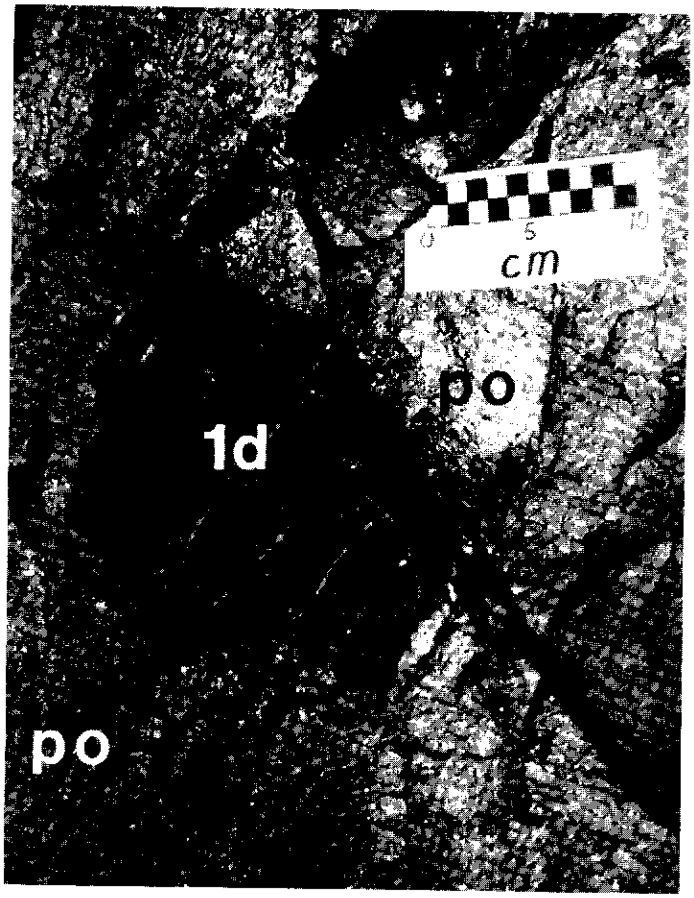

Figure 12. Close-up of a typical razor-sharp contact between an unaltered fragment of Unit 1d limestone (1d) and massive, engulfing pyrrhotite (po). (1430 level, Peel Zone).

ings are the best example. Similar but unnamed showings occur south and west of the MT MISERY showing and north and west of the OXO showing (Fig. 3).

The veins are randomly oriented and are predominantly quartz with subordinate (less than 2%), chalcopyrite or arsenopyrite, accessory pyrrhotite, pyrite, galena or tetrahedrite. Strong dolomitization of host carbonate rocks is ubiquitous near the veins. At the MC zone where a stockwork of small quartz veins is developed in Lower Cambrian limestone, chalcopyrite is the predominant sulphide. The SUE showing is a large (up to 3 m wide) quartz vein, with very minor disseminated chalcopyrite, in Upper Cambrian calcareous phyllite.

The relationship of the veins to pyrrhotite-arsenopyrite mantos and the auriferous quartz sulphide veins is not well understood. They may simply represent quartz-rich examples of the former, or gold-poor examples of the latter.

(4) Silver-lead veins in Upper Cambrian and younger rocks

At least thirty silver-lead-bearing veins have been discovered in the Ketza River District. Most are shown on Figure 3. All occur in Upper Cambrian to Mississippian strata. Fissure vein fillngs predominate although wall rock adjacent to the veins contains weak disseminations and stringers. The gangue is mainly siderite (some may be ankerite) with lesser, but locally abundant quartz, calcite and fragments of wallrock. Coarsely disseminated galena and pyrite form shoots in the siderite veins or massive veins up to 50 cm wide. Chalcopyrite, tetrahedrite, arsenopyrite, sphalerite and pyrrhotite are accessory. Silver grades up to 17,000 g/t have been reported from tetrahedrite-rich material (Woodcock, 1955) but hand-picked, massive galena typically assays between 1000 to 4000 g/t Ag. When sampled over the entire width, siderite-galena veins generally grade 10 to 25% Pb, 300 to 800 g/t Ag, and trace to 2 g/t Au (Green, 1966; Findlay, 1967, 1968, 1969; Orssich et al., 1985).

Several veins contain significant gold. The HOEY showing (Fig.

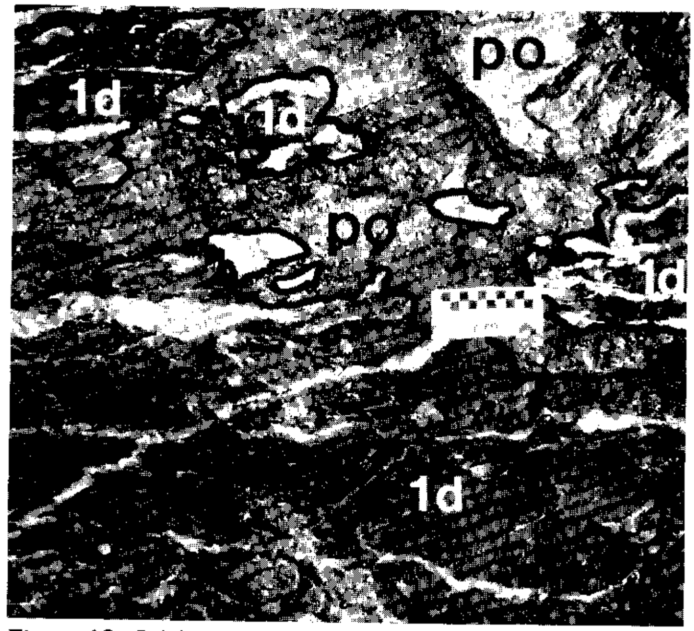

Figure 13. Sulphide breccia with clasts of Unit 1d limestone (1d). Note that a calcite vein can be traced between adjacent 1d clasts in the extreme upper left corner - showing that there has been no appreciable rotation of breccia clasts.

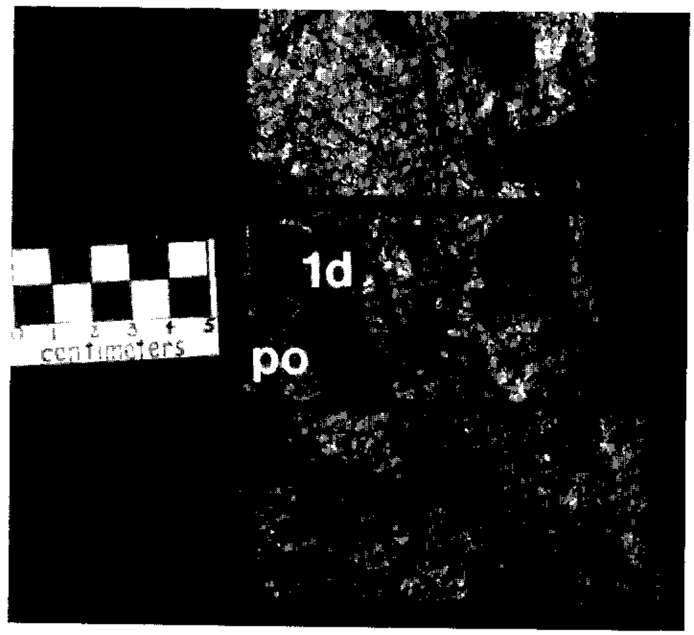

Figure 14. Remnant clasts of Unit 1d limestone (1d) engulfed by massive pyrrhotite (po). Note the irregular, rounded outlines of the clasts. (Flint Zone, DDH KR-84-58), 73.0 m).

18) consists of galena and siderite on surface but drilling and underground development have intersected a gold-bearing quartz-pyrite vein (21.6 g/t Au over 0.70 m for a length of 9.15 m) (Findlay, 1969; Orssich et al., 1985). Silurian quartzite encloses the vein at depth. Moderate gold values in a lens of pyrite and arsenopyrite have also been reported from the K16B zone (Orssich et al., 1985).

Vein-faults generally strike within 20° of north and dip steeply, either east or west. The orientations of most veins are given in Table 1. A few veins have slightly different attitudes. At the KEY 3 showing, a siderite- quartz-galena-tetrahedrite vein has an attitude of 010/30W, the LAP 10 vein is oriented between 030/15W and 010/45W, and a pyritic fault zone at the KEY 35 showing is oriented at 057/68N (Orssich et al., 1985). Dolomite breccia (Unit 3a) nearby contains narrow galena veins trending 350°.

The amount and direction of movement on the vein-faults is dif-

Figure 15. Irregular, vertically oriented vein-type pyrrhotite body (po). Bedding of host Unit 1d limestone (1d) is roughly horizontal. (Occurrence #23).

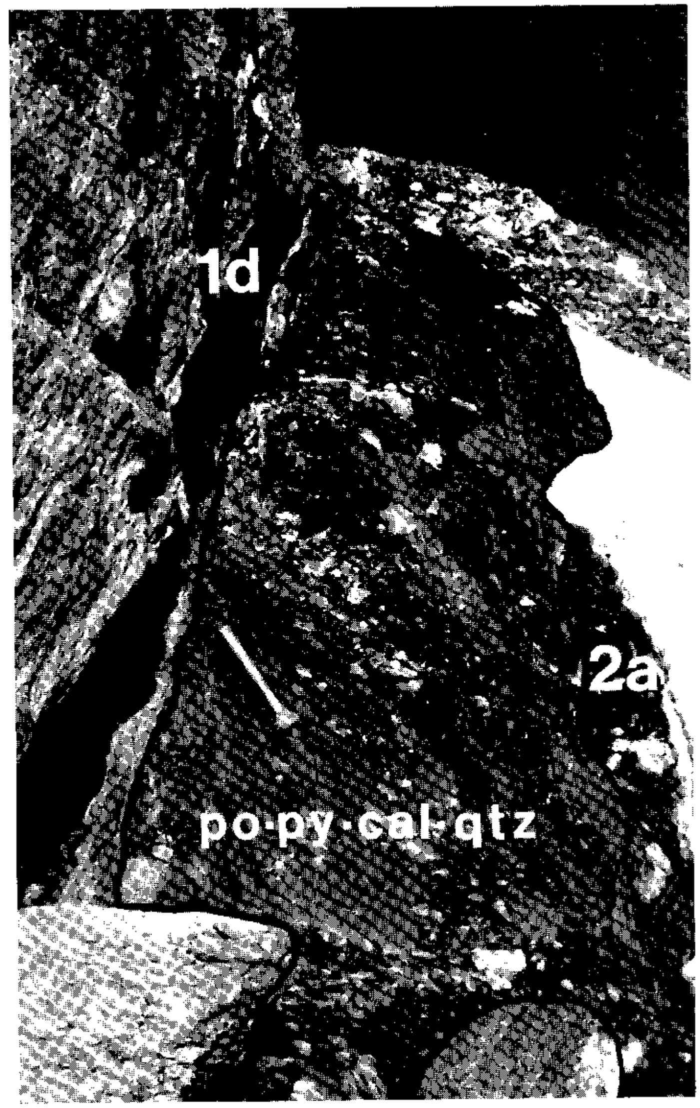

Figure 16. Thrust vein (Occurrence #16). Pyrrhotite-pyrite-calcite-quartz (low Au) are localized in a fault bringing Unit 1d limestone (1d) over Unit 2a black shale (2a). Both bedding and the fault dip to the southwest (left side of photo).

ficult to estimate but most displacement is probably vertical. The fault at the MT MISERY vein moved east side down by as much as 100 m. The HOEY vein is in a steep, east-dipping, reverse fault with an offset of at least 20 m. Offset on many of the other vein-faults is probably minimal. Some veins show good continuity. The STUMP vein can be traced on surface for 250 m while the HOEY and LAP 10 veins have been traced for 275 m and 140 m respectively. The MT. MISERY vein can be traced for 60 m and is covered by scree at both ends.

The veins vary in width from a few cm to more than 5 m but average 2 m, of which 15 to 60 cm may be galena. The galena tends to split into parallel bands, 10 to 20 cm wide. The only veins with defined tonnages are the STUMP vein (49 800 tonnes grading 20% Pb and 719 g/t Ag) and the KIBB vein (8065 tonnes grading 14.4% Pb and 873 g/t) (Orssich et al., 1985).

Galena-siderite veins cut nearly all rock types from Unit 2b (Upper Cambrian-Ordovician) to Unit 4 (Mississippian) as well as Unit 5 Upper Cambrian. Clearly the veins were emplaced after thrusting (Mesozoic) since they show no change in orientation or mineralogy across the thrust fault. Mineralization must also postdate formation of the north-trending fault set. It is not known whether these north-trending faults are related to the formation of the Ketza Uplift.

DISCUSSION AND CONCLUSIONS

Ore controls and mode of formation

Stratigraphy, thrust faults and steep faults control the pyrrhotite-arsenopyrite + siderite manto and vein showings. Gold-rich deposits of this class are confined to the area adjacent to the PEEL fault, particularly where this structure intersects northwest-trending cross-faults. Detailed mapping has shown that the sulphide deposits are clearly discordant and therefore epigenetic. Sulphide textures include vein stockworks, incipient breccia, and massive sulphide lenses suggesting variable replacement of limestone along bedding and fractures. Open-space textures, such as colloform banding are poorly developed and rubble breccias and laminated silt are absent. For these reasons, karst solution channels are not thought to have played an important role in controlling ore deposition. The author believes that pyrrhotite- arsenopyrite + siderite were deposited from hydrothermal solutions that gained access to the Lower Cambrian limestone along steep faults (i.e. the PEEL fault and cross-faults). These structures are thought to have formed in response to Middle Cretaceous intrusion and doming which has resulted in the Ketza Uplift. The hydrothermal solutions were confined beneath a thick sequence of impermeable shales (Units 1e, 2a, 2b) and therefore travelled laterally away from the faults. The gold-poor and siderite-rich mantos located far from the PEEL Fault may reflect the expected drop in temperature

Figure 17. Quartz-sulphide vein stockwork in dolomitized Unit 1d limestone. Sulphides make up 5 to 20% of veins and are predominantly pyrite and chalcopyrite in this case (Occurrence #39).

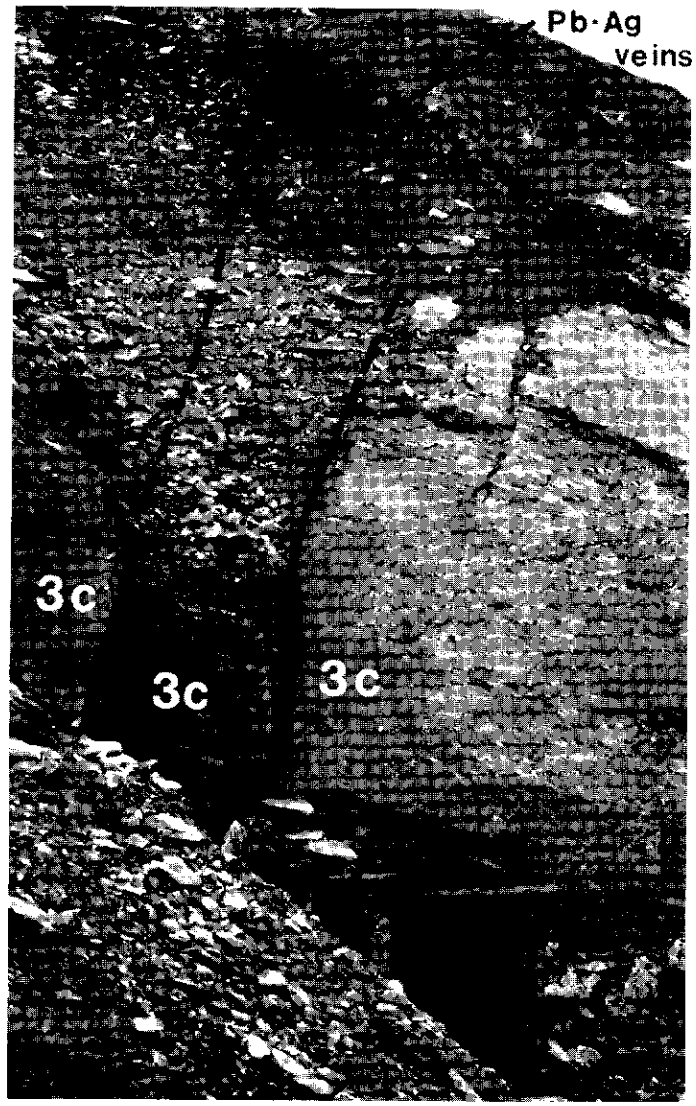

Figure 18. Hoey (F2) vein (looking south) (Occurrence #70). Two parallel, north-trending faults cut Unit 3c quartzite (3c) and are mineralized near the top of the photo. Drifting on the faults encountered a quartz vein with 5% disseminated pyrite which graded 21.6 g/t Au over 0.70 m for a length of 9.14 m.

and pressure of fluids moving away from the intrusion.

The important gold-rich, iron oxide deposits of the RIDGE, BREAK, and PEEL OXIDE zones occur in strong fault zones. These deposits are believed to have formed by the in situ, supergene oxidation of primary sulphide mantos and veins in zones of high groundwater flow.

Silver-bearing galena-siderite veins follow north-trending, steeply dipping faults in Upper Cambrian (Unit 2b) and younger rocks. The faults may also be middle Cretaceous in age. No regional zoning of galena-siderite vein mineralogy has been recognized.

Quartz-sulfide mineralization occurs in Proterozoic to Upper Cambrian strata but is only gold-rich in the Proterozoic rocks. These auriferous veins generally strike northwest and dip moderately east. Barren and weakly auriferous quartz-sulfide veins and stockworks in Cambrian limestone and calcareous phyllite (Units 1d and 2b) are randomly oriented.

Metal zoning and relative timing

Metals and occurrence types are zoned about the center of the Ketza Uplift from: quartz-arsenopyrite-gold veins; to auriferous pyrrhotite-arsenopyrite mantos and veins; to barren pyrrhotite-siderite mantos and veins; and finally, to galena-siderite veins on the perimeter. The zonation can be partly explained by strong stratigraphic control. This control can be summarized as follows:

1. quartz-arsenopyrite gold veins, mainly in Proterozoic argillite-quartzite (Unit 1a)
2. gold-rich pyrrhotite-arsenopyrite mantos and veins (or their oxidized equivalents), mainly in Lower Cambrian limestone (Unit 1d)
3. barren pyrrhotite-pyrite-siderite mantos and veins in Lower Cambrian limestone (Unit 1d)
4. silver-rich galena-siderite veins, mainly in Upper Cambrian and younger strata (Unit 2b through Unit 5).

An alternate exploration for the observed concentric zonation proposes that the different types of mineralization may all be part of a large, district-scale hydrothermal system. The change from gold and arsenic-rich, to silver and lead-rich deposits may be a direct result of a decrease in fluid temperature and pressure of the hydrothermal fluids as they migrated away from the heat source. In this case the heat source is a Middle Cretaceous stock, postulated to underlie the Ketza Uplift. The relative ages of the deposit types are unclear because they occur in different rock units and no cross- cutting relationships are seen. Isotopic studies and geothermomentry may help sort out these problems.

Implications for exploration

The suggestion that the various deposit types in the Ketza River District are related to a common source has important implications for exploration in the district and elsewhere. If silver-lead veins can be proven to be distal to a large intrusion-centred hydrothermal system with gold mineralization near the centre, then silver veins are a useful exploration guide for quartz-sulfide vein or sulphide manto deposits. Other silver camps in the Cordillera such as Keno Hill, Plata, Tintina, Quartz Lake and Midway should be re-evaluated with the Ketza zoning model in mind, especially if carbonate rocks are present.

ACKNOWLEDGEMENTS

Financial support for this study has been provided by the Exploration and Geological Services Division of Indian and Northern Affairs Canada. I am grateful to Grant Abbott and Jim Morin of INAC for advice and encouragement. Thanks are also extended to the management of Canamax Resources Inc. for accommodation in field, access to drill core, underground workings, and confidential exploration data, and for permission to publish. Special thanks must go to Canamax geologists Steve Parry, Jeff Toohey, Fred Harris, and Cyrril Orssich for inspiring and critical discussion. Kate Rodd and Karen Smith helped with proof-reading, typing and drafting and their assistance is greatly appreciated.

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TABLE 1: Summary of mineral occurrences in the Ketza River District

Occurrence Number	Name of Occurrence	Mineralogy (see key)	Host Unit (see Fig. 2)	Attitude	Dimensions	Type of Occurrence	Comments/Reference
Gold-bearing quartz-arsenopyrite veins and other occurrences hosted by Unit 1a (Proterozoic quartzite, argillite, siltstone).							
1*	Shamrock (MMM)	qtz, aspy, scor	1a	trends 330	est. 50 cm wide	vein	Up to 1000 g/t Au reported from surface samples (Northern Miner Magazine, March, 1987, p. 35).
2*	Quartz Breccia (QB)	qtz, aspy, scor	1a	averages 320/50E	3 parallel veins to 20 m wide	vein	
3*	-	qtz, aspy, scor	1a	290/80N	15-30 cm wide	vein	
4*	-	qtz, aspy, scor	1a	trends 330	1 m wide	vein	
5	Quill	po, aspy, py	1a	? (float only)	?	vein ?	Up to 2.8 g/t Au, 2.3 g/t Ag and 32.83% As. Sulphide boulders are associated a stockwork of narrow, qtz veins containing py aspy (Abbott, 1986).
6*	Fred's Vein (Peel 4, Peel 6)	qtz, po, py, aspy, cpy	1a	trends 070	1-2 m wide over 500 m	vein fault	Channel samples up to 7.2 g/t Au over 1.5 M (Northern Miner Magazine, March, 1987, p. 35).
7*	Peg-Fury Limonite (Fury 26, Peg 13)	limonite-cemented soil and scree	1a	-	500 x 200 m	gossan	Appears to be a transported (exogenous) gossan
Auriferous and barren, sulfide, oxide and carbonate mantos, chimneys and veins hosted by Unit 1d (Lower Cambrian Limestone).							
8*	Peel Sulfides (Boom, Woodcock, Peel 3a, 3b, 5a, Fury 30b)	po, aspy, py, cpy, qtz	1d	flat	400 x 300 x 5 m	manto	499,000 tonnes of 8.9 g/t Au (Northern Miner, Feb. 9, 1987
9*	Peel Oxides	lim, his, qtz	1d	flat	250 x 100 x 5 m	oxidized manto	499,000 tonnes of 18.2 g/t Au (Northern Miner, Feb. 1987).
10*	Ridge Oxides (Peel 3c)	lim, his, qtz	1d/1a	NW plunging pipe	100 x 30 m to at least 100 m depth	pipe/ chimney	
11*	Break Oxides	lime, his, qtz	1d	120/45S	30 x 60 x 5 m	pipe or vein	41,730 tonnes of 16.8 g/t Au to 60 m drill depth (Northern Miner March, 1987).
12*	Bluff (Fury 30a)	qtz, po, py, aspy, cpy	1d	?	100 x 2 m	manto or vein	Occurs on north-trending fault structure
13*	Penguin (Penguin 6)	po, py, aspy, cpy, qtz	1d	flat	100 x 30 x 5 m	manto	Generally low Au
14*	Flint	po, py, aspy, cpy, qtz	1d	dips 15 N	30 m thick	manto	Estimated strike length of 1500 m based on geophysics, width not known. Does not outcrop. Intersected in drill holes. Low Au.
15*	Tarn	po, py, aspy, cpy, qtz	1d	flat	125 x 75 x 5 m	manto	Generally low Au

16*	Thrust Vein	po, py, qtz, cal, minor aspy, cpy	1d/2a	300/45 S	125 x 2 m	vein	Low Au. Vein occurs in a fault bring Unit 1d over Unit 2a.
17*	Creek (Penguin 4)	po, py, aspy, cpy	1d (dol)	flat	50 x 25 m	manto ?	Galena reported in Conwest drill hole from 1950's.
18*	-	aspy, po, py	1d	flat	small	manto/ vein	Low Au
19*	-	aspy, po, py	1d	flat	small	manto/ vein	Low Au
20*	-	po, py, aspy	1d	flat	100 x 10 x 1 m	manto	Low Au
21*	- (2 showings)	1) po, cpy and 2) mag, aspy	1d	flat	5 x 2 m	manto	Low Au
22*	-	qtz, cal and po, aspy	1d	flat	100 x 2 m	manto	Low Au
23*	- (2 showings)	po, aspy, py	1d	1) 140/30 S 2) steep dip	40 x 0.5 m 1 x 5 m	manto pipe/ vein	High Au in grab sample. Manto changes to cal/qtz along strike.
24*	- (2 showings)	1) po, py, cal 2) po, py	1d	1) vertical 2) 080/60 S	20 x 10 x 20 m 30 x 4 m	pipe/ vein vein/manto?	Low Au
25*	-	po, py, cpy	1d	flat	2 x 5 m	manto	
26*	- (8 showings)	py, po, aspy	1d	flat	30 x 30 x 2 m (maximum)	mantos	Low Au
27*	-	sid, py, po	1d	flat	2 x 10 m	manto	Low Au
28*	- (3 showings)	sid, po, py	1d (dol)	flat	50 x 30 m (maximum)	mantos	Low Au. Adjacent to thrust fault
29*	- (4 showings)	sid, po, py	1d (dol)	flat	100 x 40 m (maximum)	mantos	Low Au. Adjacent to thrust fault
30*	- (2 showings)	py, sid	1d (dol)	trends 060 steep dip	30 x 5 m	manto/ vein	Low Au. On thrust fault.
31*	-	po	1d (dol)	340/80 W	very small	vein	Low Au.
32*	- (3 showings)	sid, py, po	1d (dol)	flat	50 x 10 x 1 m (maximum)	manto	Low Au. Adjacent to thrust fault.
33*	-	py, po, aspy	1d	float only	small	manto/ vein?	
34*	-	po, aspy, py	1d	float only	50 x 50 m area	?	
35*	-	py, po	1d	flat	30 cm pods	manto	
36*	-	po, py	1d	float only	20 x 20 m	?	
37*	-	po, py	1d	float only	20 x 20 m	?	

Table 1: Summary of mineral occurences in the Ketza River District Continued

Occurrence Number	Name of Occurrence	Mineralogy (see key)	Host Unit (see Fig. 2)	Attitude	Dimensions	Type of Occurrence	Comments/Reference
38*	Oxo	py, gn, sph, po, qtz, cpy	1d/2a/3a	flat	5 x 5 x 30 m	manto	Changes to qtz/cpy vein (trending 320) along strike to S. Drilled 1524 m in 21 holes in 1969 with disappointing results (Green, 1969).
Barren to weakly auriferous quartz-sulphide veins							
39*	Sauna	qtz, aspy, po	1d (dol)	-	300 x 150 m zone	vein of 2-5 cm veins	Low Au. stockwork
40*	MC	qtz, cpy	1d	-	10 x 20 m area	vein stockwork	Low Au.
41*	Sue	qtz, cpy, mal	2b (dol)	340/70	1 to 2 m wide	vein	
42*	-	qtz, mal	1d	trends 045	to 1 m wide	vein	
43*	-	qtz, cal, cpy	1d (dol)	trends 045	to 1 m wide	vein	
44*	-	qtz, cal, cpy	1d (dol)	trends 280	to 1 m wide	vein swarm	
45*	Fury	qtz, cpy, tet	1d	trends NW?	15 cm to 1.4 m wide	veins for 100 m	Abbott, 1986
46*	-	qtz, cpy, aspy	1d	020/70 E	narrow	veins	
47*	-	qtz, aspy, scor	1d (dol)/ 2a	010/70E	to 0.5 m wide	veins	Veins occur at faulted contact between Unit 1d and Unit 2a.
48*	-	qtz, cal, py	1d/1c	trends 300	?	vein ?	In thrust fault.
Argentiferous galena-siderite veins in Upper Cambrian through Mississippian rocks.							
49*	Carl 2	gn, sph	1d/3b or 3d?	float only	?	vein ?	Abbott, 1986.
50*	Mt. Misery (Tom 3a)	gn, py, sid, qtz	3c/3d	trends N, steep dip	est. 1 to 2 m wide by 70 m long	vein fault	A single boulder of py/aspy/ sid/qtz was found on the dump in front of the adit. Estimated 100 m displacment on fault (east side down).

51*	Key 3 (Ketzakey)	gn, tet, py, sid, qtz, cal	4a/4b	360/20 W	discontinuous 1 to 5 m wide vein at least 100 m long	vein fault	Sulfides occur as clots and veinlets within the siderite-quartz gangue. Grades up to 17,000 g/t Ag were reported by Woodcock (1955). Three short adits and an open cut were driven in the 1950's although all are now caved. Woodcock reported that adit #2 encountered a 1 x 8 m 30 W dipping vein fault with buff weathering slate and argillite in the hanging wall and cherty quartzite in the footwall. This vein is apparently a splay off a larger fault oriented at 155/48 W. The vein in adit #1 was poorly exposed but apparently had a similar orientation to the vein in adit #2.
52	Zinc	sph	?	float only	?	vein ?	Approx. location from old Iona Silver Mines report.
53	Key 1a	gn	4b?	?	?	vein	Description and location from Woodcock, 1955.
54*	Lap 10 (Laprarie, Strike 8a)	gn, sid	4b	variable 035/15 W to 010/45 W	1 x 140 m	vein	Steely or coarse grained galena forms a massive vein 20 to 45 cm wide within siderite gangue. An adit and raise driven beneath the vein failed to intersect mineralization.
55*	Key 6a	gn, sid, mal	4b	340/80W	5 cm x 5 m	vein	25 cm x 1.3 lens of galena located by Woodcock (1955).
56	Key 7a (Trench, Smitheringale 2)	aspy, sid, py, sph	5	float only	4.5 m wide zone	?	Aspy boulders occur on W side of a dike-like body of greenstone cutting phyllite (Woodcock, 1955; Orssich et al., 1985).
57*	Key 9a (Knoll)	sid, gn, aspy (phyllite)	5	320/40 W	10 cm wide fault	vein	
58*	Key 11a (Blazed Tree)	gn, sid, lim, cal (grnstone)	5	350/70 W by 10 m long	10 - 20 cm wide	vein	Float fragments to 20 x 40 cm of steely and coarse-grained galena.
59	-	sid, gn	5	360/80 W	1 x 15 m	vein	Orssich et al., 1985.
60	Strike 4a (OK)	?	5 (grnstone)	310/10 SW	10 cm wide	vein fault	Woodcock, 1955.
61	Dip	sid, gn	5	?	?	vein	Orssich et al., 1985.
62*	Key 35 (Cache Creek 1) (2 types of mineralization)	1) qtz, py, gn, dol, lim 2) lim, gn, sid	3a 3b	57/68 N 170/90	7 m wide by 8 m long to 3 cm wide	veins diss. veinlets	Pyrite occurs disseminated and along foliation planes in black shale while gn/sid veinlets occur in a nearby, small block of dolomite breccia (Unit 3b). (Orssich et al., 1985).

63*	Key 13a (Cache Creek 2, Smitheringale 4)	sid, py, gn, qtz, cpy	2b	trends N, steep dip	1.5 m wide by 40 m long	vein fault	1985 drill hole intersected 1.6 m of massive py/aspy (Orssich et al., 1985). Woodcock (1955) reported that a short adit encountered two diverging faults (oriented at 128/80 NE and 155/90) and the sedimentary rock between them is completely replaced by pyrite and ankerite. Near the intersection of the faults is a small lens containing galena and sphalerite.
64*	Key 16a (Smitheringale 5)	sid, qtz, aspy py, gn	2b	010/90	30 to 60 cm wide	vein fault	
65*	Key 16b	aspy, py, qtz, sid	2b	irregular, partly conformable	10 x 5 m	irr. vein or manto	Adjacent to fault trending N, dipping 68 W.
66*	Lower Switchback (F 1?)	sid, gn, py	3b (dol bxa)	015/90	1 to 2 cm wide veinlets over 10 x 20 m area	veinlets	Narrow siderite veinlets with minor galena.
67*	Upper Switchback	gn	3b	float only	5 x 15 m area	disseminated or vein ?	Orssich et al., 1985
68*	F3 (Hoey "J")	lim, sid, gn, qtz	3a/3b/3c	350/65W	1 to 2 m wide intermittently over 100 m	vein	Vein mainly occurs in Unit 3b dolomite breccia at contact with Unit 3a black shale.
69*	Canyon (F7, Gopher Copter)	gn, py, sid, qtz	3b/3c	015/70 W	1 x 60 m	vein fault	
70*	Hoey (F2, Hoey "H", Galena vein)	sid, gn, py, qtz	3c	010/70E	1 to 5 m wide intermittently over 300 m. Locally to 10 m wide	vein fault	Parallel bands of gn/py up to 30 cm wide occur on surface 30 m S of the adit portal. A quartz vein with minor pyrite (no siderite or galena) is present between two parallel faults in the adit. 32 m S of the portal this vein assays 21.6 g/t Au over a width of 0.7 m for 9.14 m of the drift (Orssich et al., 1985).
71	Gem	gn	3c	360/62 W	2 to 10 cm wide by 3 m long	vein	Discovered in 1977; description from Iona Silver report. Location not precisely known.
72*	Stump (A1 and A2)	sid, gn, py, cpy, qtz	2b	350/60 W	up to 1.2 m wide over 315 m long	vein fault	Discovered by soil geochmistry in 1966. Mineralized structure exposed on surface for over 315 m. Drifting on two levels has defined probable reserves of 49,000 tonnes grading 20% Pb and 719 g/t Ag (Orssich et al., 1985).
73	K18A	gn, sid	2b?	?	float over 70 m	vein ?	Findlay, 1969 length

Table 1: Summary of mineral occurences in the Ketza River District Continued

Occurrence Number	Name of Occurence	Mineralogy (see key)	Host Unit (see Fig. 2)	Attitude	Dimensions	Type of Occurrence	Comments/Reference
74*	K188 (Key 188, Ketzakey)	gn, py, sid, qtz, cal, tet	2b	010/70 W	1.7 x 32 m	vein fault	Discovered by soil geochemistry in 1968. Development on two levels has defined probable reserves of 8065 tonnes grading 14.4% Pb and 873 g/t Ag (Orssich et al., 1985).
75	F4 (South Fault)	gn, sph, tet	3a/3b/2b	?	very small pods	vein ?	Green, 1966; Orssich et al., 1985.
76	F5	gn, sid	?	?	?	vein ?	Location from Silver Key Mines, information for shareholders, March, 1967.
77*	F6 (Regehr, South showing)	gn, py, sph, lim (minor 2b, 5)	3b	float only	?	?	
78*	Sharon	gn, py, cpy, sid, cal, qtz	2b	005/70 E & 110/70 N	max. 1.8 m wide by 21 m long	vein fault	Two mineralized veins approx. 400 m apart.
79	Carl 1	qtz, gn, sph	3d?	?	30 m wide zone of narrow qtz veins	veins	Selected sample assayed 16.0% Pb, 7.73% Zn, 0.1% Cu, 506.4 g/t Ag (Abbott, 1986).

* Occurrence visited by author

KEY TO ABBREVIATIONS:

po: pyrrhotite / aspy: arsenopyrite / py: pyrite/ cpy: chalcopyrite / gn: galena / sph: sphalerite / tet: tetrahedrite / lim: limonite / his: hisingerite / mal: malachite / scor: scorodite / sid: siderite / qtz: quartz / cal: calcite / bxa: breccia / diss: disseminated / dol: dolomitized / dolo: dolomite or dolostone.