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SILVER IN YUKON

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INTRODUCTION

Silver occurs in significant quantity in Yukon in three major geologic regions (a) the Coast Mountains - Dawson Range, (b) the Cassiar-Pelly Mountains - Klondike Area, and (c) the large region northeast of Tintina Trench (see Figure 1).

The regional, geochemical and geologic environment of Yukon is similar to that of southern British Columbia, with a volcanic-orogenic or eugeosynclinal environment predominating in the coastal regions with its associated gold and silver and a more miogeosynclinal environment farther inland with its associated silver and lead.

Within the three regions or broad metallogenic provinces, gold-silver veins, silver-lead-zinc veins, lead-zinc replacements with silver, and intermediate types, all characteristic of the Cordillera, occur in certain districts. The term "district" is used to include any set of areal geologic conditions, usually structural in this case, which localize interrelated mineral deposits within their boundaries. Within these districts the deposits are localized by local structural conditions, often characterized by intense overthrusting followed by northwest regional faulting, uplifts, or transverse folds or faults; but in many cases not enough is known to present any structural picture.

This paper will briefly outline the environment of silver in the three major regions of Yukon and suggest districts that warrant further exploration, with particular emphasis on the Mayo district.

MAJOR GEOLOGIC REGIONS

(A) COAST MOUNTAINS - DAWSON RANGE (Figure 1)

Gold-silver-lead-zinc-bearing veins occur in an intermittent metallogenic province paralleling the northeast margin of the Coast Mountains batholithic-metamorphic belt from Tulsequah through Atlin, B.C. to the Windy Arm and Wheaton districts. Gold-silver veins and silver-lead veins occur in the Dawson Range from the Mt. Nansen-Freegold district 80 miles or more to the Dip Creek district.

The Tulsequah lead-zinc-copper deposits which carry some gold and silver, lie on a northwesterly trending arch of Paleozoic rocks which are intruded by porphyry and andesite, cross-folded in a northeast direction, cut by steep regional northwest faults and local cross faults, and mineralized where brittle porphyry is intersected by faults.

The Atlin district is a transverse northeast zone of folding and serpentinite bodies, 40 miles long and 20 miles wide, with associated placer gold, gold-quartz veins, tungsten veins and replacements, and silver-lead-zinc veins principally on the Atlin Ruffner prospect. The Atlin Ruffner deposits consist of lenses in or next to lamprophyre dikes along fault zones striking N 30^{o} to 50^{o} E and dipping steeply northwest. No silver production has come from the Atlin district but further exploration for silver may be justified, since other silver prospects have been reported elsewhere in the district.

At the south end of Tagish Lake a few silver-lead-gold prospects occur, possibly in association with northwest faulting paralleling the batholithic contacts.

The Windy Arm district consists of a number of gold-silver-lead-zinc veins largely striking northwest and dipping 30° to 45° southwest. Although the veins were mined on a salvage basis up to the 1920's, no serious work has been done since and no overall district structure or ore controls have been worked out. This district certainly warrants careful geologic mapping for ore control and exploration in detail to test its possibilities.

The Wheaton district immediately to the northwest consists of a crude east-west reentrant or sag of volcanic and metamorphic rocks projecting westward 20 miles into the Coast batholith. A variety of gold, copper, and antimony prospects occur but the chief mineralization, as at Windy Arm, is in gold-silver-lead-zinc veins. The district warrants some closer exploration.

The Mt. Nansen-Freegold district, forming the southeastern terminus of the Dawson Range batholithic belt, is an area 12 miles by 30 miles in extent consisting of complex metamorphics and instrusives which have been injected with Tertiary quartz porphyry and rhyolite and partly mantled by the related Carmacks volcanics. Deposits of copper, gold, silver-lead, and gold-silver occur in this district, the most significant of which is an epithermal gold-silver prospect being explored by the Mt. Nansen Syndicate in 1962. This deposit consists of a N30°W zone, 1400 feet or more long, of several parallel or en echelon veins and stringers of cherty quartz with very fine-grained sulfides in which andorite has been identified as a silver mineral. Wall rocks consist of meta volcanics and sediments of the Yukon Group, intruded by a rhyolite porphyry plug which is believed to be related to the mineralization. Epithermal veins occur throughout the Coast Mountains - Dawson Range province with millerite southeast of Atlin, gold at Atlin and Tagish Lakes, minor tellurides and barren quartz in the Wheaton district, and now this type of deposit in the Dawson Range. The extent of epithermal mineralization in the Mt. Nansen area or the rest of the Dawson Range remains to be determined because of the masking residual overburden characteristic of this unglaciated area. Further exploration is well justified since this Mt. Nansen discovery could presage the development of important epithermal gold and silver deposits like those of the Western States. The presence of northwest Tertiary faulting, prophyry or rhyolitic intrusives, and related Carmacks group volcanics may be good regional guides to this type of deposit elsewhere in Yukon.

Northwest along the Dawson Range at Dip Creek, silver-lead veins occur in granitic rocks near a northeast lineament which cuts transversely across a bend or restriction in the batholithic belt.

(B) <u>CASSIAR-PELLY MOUNTAINS - KLONDIKE AREA</u> (Figure 1)

The Meso-Cordilleran metallogenic province extends up through Cassiar and Pelly Mountains into the Klondike district of Yukon and the Fairbanks district of Alaska, forming a structural backbone of recurrent belts of metamorphic, granitic, and Proterozoic rocks bounded and cut by major regional fault trenches such as the Rocky Mountain and Tintina trenches. Many of the major ore deposits of the Cordillera occur in and near this Meso-Cordilleran belt. Silver in this metallogenic province in Yukon occurs in: (a) silver-lead-zinc veins and lead-zinc replacements in the Cassiar-Mile 701 district northeast of the Cassiar batholith, (b) similar deposits southwest of the batholith, (c) silver-lead-zinc veins and replacements at the Tintina property, (d) similar deposits in the Ketza River district, (e) silver-lead veins at Boswell River, (f) silver-lead veins and replacements at Little Salmon Lake, (g) silver-lead veins in the Klondike district, and (h) silver-lead and antimony veins at Silver City.

Parallel to the northeast margin of the Cassiar batholith, from Cassiar, B.C. to beyond Mile 701 on the Alaska Highway, silver-lead-zinc veins and lead-zinc replacement deposits occur in intensely deformed Lower Cambrian limestone, phyllite, and quartzite. This district and a corresponding similar district on the southwest side of the Cassiar batholith certainly deserve further exploration.

The Tintina property, presently being explored by Conwest Exploration Company Limited, lies in a belt of intensely deformed Lower Cambrian phyllite and limestone which is intruded by a granitic stock. This forms a mineral district about 10 miles by 6 miles in extent which is cut by northwest fault zones subsidiary to the nearby Tintina Trench. Mineralization of galena, sphalerite, and tetrahedrite occurs in lenticular veins or replacements largely in the northwest-striking, southwest-dipping fault zones and apparently subsidiary to a northerly-trending cross fault.

The Ketza River district is a complex lenticular area 30 miles long by 15 miles wide which is bounded by faults and contains an anomalous faulted half-dome structure, 10 miles in diameter, whose northeast side is cut off by northwest faults subsidiary to the Tintina Trench. Intensely overthrust Lower Cambrian limestone, phyllite and quartzite form the half dome, while other Paleozoic rocks surround it. Mineralization is localized in and near steeply-dipping northwest faults which cut the half dome structure and the surrounding district. It consists of three types: galena-tetrahedrite-sphalerite veins with or without jamesonite; pyrite or pyrrhotite replacements with or without silver-lead and gold as in the new Pelly Minerals Syndicate discovery; and arsenopyrite veins with or without gold. This district certainly warrants closer exploration and geologic mapping.

Little is known of the silver-lead occurrences around Boswell River except that they are part of a mineralized district lying at the southeast end of a major fault system along the southwest front of the Pelly Mountains.

The Little Salmon Lake silver-lead deposits occur in limestone and chert where a north-south fault cuts across the east end of a larger anomalous east-west fold belt 20 miles long that lies along the lake. Major northwest faults cut this belt and reported silver-lead occurrences 20 miles to the southeast suggest that this district may extend to North Big Salmon River. In spite of rather extensive overburden in the rolling hills, this district should be prospected and explored more closely.

Between the Pelly Mountains and Klondike areas, much of the region is a low-lying portion of the Yukon Plateau or consists of rolling hills covered with extensive overburden and little is known of silver possibilities.

The Klondike, Yukon's foremost placer gold district, is an example of an anomalous cross-trend in foliation of the Klondike schists cut by major northwest faults subparallel to the nearby Tintina Trench. Along a 15-mile-long northwest belt the area is mineralized with gold-, copper-, or galena-bearing quartz veins which show most continuity when transverse to foliation of the schists. Several silver-lead occurrences are known, at least two of them under placer tailings. Exploration of this district is justified if quantity or continuity can be easily established, but prospecting is difficult due to extensive residual overburden characteristic of this unglaciated area.

The Silver City area carries silver-lead and antimony vein occurrences along Yukon River two miles southwest of Tintina Trench. Considerable shattering has occurred due to proximity to the Tintina fault trench and the main prospect occurs in a large landslide. Little or nothing is known of district structure or extent of mineralization due to the extensive residual overburden. This district may warrant closer examination.

In summary, silver in the Cassiar-Pelly Mountains-Klondike province is localized by northwest faults and by anomalous or transverse structures or uplifts, and tends to occur in intensely deformed rocks, chiefly of Lower Cambrian age in the Pelly Mountains. The Tintina Trench, Laramide or older to Late Tertiary in its fault movements, may exert some indirect regional control, with the main feeder channels for mineralization being subsidiary northwest faults parallel to, or branching obliquely off, the Tintina Trench.

(C) NORTHEAST OF TINTINA TRENCH

Regions northeast of Tintina Trench contain the largest silver potential in Yukon in two types of deposits: (a) lead-zinc replacement deposits of potential large size but low silver content which may, however, contain millions of ounces of silver, and (b) silver-lead-zinc or silver-lead-antimony vein deposits with modest or moderate size but high silver content which also contain millions of ounces of silver. Except for the productive Mayo district, little is known of the geologic environment or structural control of known or reported occurrences of silver in this vast region which is still partly unmapped and little prospected due to its relative remoteness and difficulty of access.

Lead-zinc replacement deposits with low silver content, ranging in size up to 10 million tons or more with 1 to 5 oz/ton silver, occur at four widely separated localities in this region: Vangorda Creek; McMillan Pass; Quartz Lake; and possibly Mt. Hundere, a new discovery made by the Frances River Syndicate in 1962. Other important discoveries of this type can be expected northeast of Tintina Trench, and may constitute the major mineral potential of Yukon.

Silver-lead vein occurrences with high silver content are known or reported in several widely separated localities within this wide arc of the Cordillera northeast of Tintina Trench, but little is known of their geologic environment except in the Twelvemile area 40 miles northeast of Dawson City, in the Mayo district, and in the Redstone district 200 miles northeast of Tintina Trench. Further regional mapping and reconnaissance exploration may reveal other important silver-bearing districts in this region.

The Twelvemile district contains small silver-lead veins in greenstone in a geologic environment of anomalous structure where quartzite formations, recently correlated with the Keno Hill quartzites, are twisted around syenitic intrusives. This area warrants closer exploration.

The Mayo district, part of a 100-mile-long and 60-mile-wide eastward-projecting transverse fold belt of Proterozoic rocks (McQuesten Mineral Belt), forms the largest single known geologic, structural, and metallogenic district northeast of Tintina Trench and will be discussed separately.

The Redstone district in the Northwest Territories consists of tetrahedrite-chalcopyrite, and galena-sphalerite mineralization along a major north-south fault breccia zone in Paleozoic limestones typical of the Mackenzie Mountains.

Known occurrences and regional geology indicate that the region northeast of Tintina Trench can be considered favourable for discovery of more silver deposits for a total length of 600 miles and a maximum breadth of the order of 200 miles.

McQUESTEN MINERAL BELT (See Figure 2)

A mineral belt, 80 to 100 miles long by 20 to 30 miles or more wide and stretching from Clear Creek on the west to include the well known Mayo district on the east, is being referred to by the writer as the McQuesten Mineral Belt. It consists of a major transverse N70°E belt of folding, granitic stocks, and related mineralization. Rocks in this belt consist chiefly of phyllites or schists and quartzites which have been intensely deformed by northward overthrusting and subsequent folding or arching. Intrusion of granitic stocks and quartz porphyry along, or parallel to, the fold direction has been accompanied by faulting and mineralization of tin, tungsten, and gold near the granitic stocks and of silver-lead-zinc veins and silver-lead-antimony veins. Tin, tungsten and gold occur around the granitic stocks at Clear, Arizona, Boulder, Haggart, Highet and Mayo Lake creeks. Silver-lead veins with or without antimony also occur throughout this mineral belt with high silver values (see Figure 2) reported from Boulder, Arizona and Rodin creeks and known at Haggart Creek, Chambers Hill, Mt. Haldane, and particularly Galena and Keno Hills which have contributed the $150 million production to date.

Marked similarity and relationships evident in rock types, intrusives, structure, and mineralization, particularly continuity of the N70^{o}E McQuesten anticline throughout most of the McQuesten mineral belt, lead to the conclusion that this is all one metallogenic district. It is possible that most of the silver-lead potential of this extensive district may lie in relatively low grade vein deposits west of the known high grade part of the district. However, little is known of the mineral potential or detailed structure of most of this district because of the extensive though thin residual overburden that mantles all but the easternmost part of it. Veins, especially if pyritic, may be deeply weathered; float is usually obscured by the soil and vegetation cover; and permafrost or north-facing slopes makes prospecting and preliminary exploration particularly slow and difficult. In spite of these difficulties prospecting with the aid of a gold pan, geochemistry, and a bulldozer can prove very rewarding. Much more intensive exploration of this entire mineral belt is warranted.

<u>MAYO DISTRICT</u> (See Figure 3)

Only the Mayo district part of the McQuesten mineral belt has been mapped in detail, and it also contains all the confirmed high silver values, therefore it will be discussed more fully. The entire McQuesten mineral belt has been mapped on a scale of 1 in. to 4 miles by H.S. Bostock (1943, 1946, 1948) and others, and the Mayo district has been mapped in more detail by E.D. Kindle (1955), L.H. Green (1956, 1958, 1962), R.W. Boyle (1957), K.C. McTaggart (1960), Dirk Templeman-Kluit (1962), and others. Numerous other reports and property records are available on the Mayo district.

<u>Stratigraphy</u>

Rock types in the Mayo district are predominantly phyllite and quartzite of several types and are so intensely deformed that stratigraphic relationships are uncertain.

The lowest formation (G.S.C. Unit 3), exposed in the northeast corner of the map area shown on Figure 3, is an assemblage of brown schist and quartzite with minor limestone and is considered to be Proterozoic or Lower Cambrian in age.

Above this formation, and probably overthrust onto it, is a section of predominantly graphitic phyllite with numerous lenses of greenstone and minor quartzite beds. True stratigraphic thickness is unknown due to probable repetition by folding or overthrusting, but apparent thickness is in the order of 20,000 feet. Fossils of Carboniferous or Permian age have been collected from the less deformed part of this formation.

Within this phyllite-greenstone formation is a section of 1200 feet of blue-grey Keno Hill type quartzite which was traced with remarkable stratigraphic continuity for 100 miles to the northwest by Operation Ogilvie of the Geological Survey of Canada in 1961. Fossils of Late Paleozoic or Mesozoic age were collected from this quartzite formation. Throughout most of its extent to the northwest, this quartzite is overlain by a major regional overthrust sheet of the Proterozoic or Lower Cambrian schists and quartzites (GSC Unit 3), the eastern extent of this thrust being shown on Figure 3.

Above the phyllite-greenstone formation, which is called the Lower Schist on Keno and Galena Hills, is another thickness of 2500 to 14,000 feet of Keno Hill type quartzite and associated greenstone lenses, known as the Central Quartzite. In the main ore-bearing section on Galena Hill this formation has a thickness of 2500 feet.

Overlying the Central Quartzite in turn is an assemblage of several thousands of feet of brown to grey phyllite with lesser quartzite members, called the Upper Schist, apparently identical to G.S.C. Unit 3. At Haggart Creek subdivisions of this assemblage consist of greenish thin-bedded quartzite and phyllite, and grey feldspathic quartzite.

Detailed mapping and further mapping to the west and south will be necessary to establish further relationships. Thicknesses of all the above formations vary considerably, probably due to repetition by isoclinal folding or overthrusting or both.

<u>Structure</u>

This part of the McQuesten mineral belt is characterized by extremely intense large scale deformation throughout the above described section. Northward overturned flat isoclinal drag folds parallel to bedding, with axes striking east-west, are common throughout the section. Gleitbrett structures showing much movement parallel to foliation or bedding are common. A large, complex recumbent fold overturned to the north occurs in the Davidson Range. Abrupt terminations and great changes in thickness suggest dismemberment and piling up of entire formations as in overthrust sheets. Small greenstone bodies are deformed until converted into lenses of chloritic schist, while large ones remain as knots in the fabric. These structures are quite apparently a result of very intense northward overthrusting involving the entire fabric of the district. At least one or two, and possibly several, superimposed overthrust sheets may occur. Even the detailed fabric shows much relative movement. This structural picture has been very ably presented by L.H. Green and K.C. McTaggart (1960), and subsequent work supports their concepts.

The above intense phase of deformation occurred under considerable cover as evidenced by great thicknesses (tens of thousands of feet) of apparently overlying, south-dipping formations exposed to the south, by accompanying metamorphism of the lower greenschist facies, and by the exceptional plasticity evidenced by isoclinal drag folding in the quartzites.

After some lapse of time and probable erosion of cover, renewed or continued deformation took place. This consisted of intrusion of granitic bodies along the pre-established east-west grain of the McQuesten mineral belt and the northwest regional grain east of Mayo Lake, and of anticlinal arching along these two directions, accompanied by fracturing and mineralization, particularly along the McQuesten anticline.

Along the McQuesten anticline, which extends most of the length of the McQuesten mineral belt, rock types, intrusives, and indications of mineralization are similar and form part of one large district. The pattern of faulting which controls mineralization is also part of this large district, and can be related very largely to the mechanics of doming or arching of the McQuesten anticline. The fracture pattern in the known part of the district is very similar to that of other Cordilleran districts that exhibit doming or anticlinal uplift as described by E.H. Wisser (1960).

On the south limb of the McQuesten anticline on Keno and Galena Hills, the fracture pattern consists essentially of (a) northeast-striking, steeply southeast-dipping vein-fault systems with essentially normal movement resulting in apparent left lateral displacement of the south-dipping formations; (b) north-to northwest-striking, southwest-dipping cross faults with apparent right lateral displacement of both formations and vein faults; and (c) some N 60-70°E, south-dipping longitudinal faults. Although there are other faults that do not fit this simplification, the entire pattern can be explained by tensional fracturing and faulting during rise of the McQuesten anticline.

On the north limb of the anticline across McQuesten Valley a similar pattern of tensional northeast, longitudinal, and probable cross faults dip in the opposite direction, corroborating this structural picture. This complementary north limb pattern appears to persist for 10 miles into the Haggart Creek area where the fracture pattern consists of (a) northeast-striking, steeply northwest-dipping vein-faults, (b) N 70-90°E mineralized shears or vein-faults (longitudinal), and (c) intramineral NW-WNW cross faults with apparent right lateral offset.

The entire fault pattern in the district appears contemporaneous and shows repeated movement before, during, and after mineralization, with mineralization occurring within each of the various types of fractures, but with ore being localized in certain ones largely because of intersections or interrelations between them. Although the complete fracture pattern is by no means completely understood, it is apparent that similar or complementary patterns of mineralized vein-faults and intramineral cross faults exist throughout the explored part of the Mayo district. This pattern can be related to mechanics of uplift of the McQuesten anticline. The apparent right lateral offsets on complementary cross faults on both north and south limbs can be explained as normal dip slip. The Haldane-Haggart fault with its antithetic movement is also typical of such anticlinal doming. (E.H. Wisser, 1960, p.56). Preliminary air photo interpretation strongly suggests that other northeast fractures exist westward along the McQuesten anticline.

To the west McQuesten anticline plunges gently westward so that the favourable Keno Hill or Central Quartzites disappear. However, a major NNW fault, the Haldane-Haggart fault, brings the quartzites up again on Mt. Haldane on the south limb and on the north side of McQuesten Valley on the north limb of the anticline. At Haggart Creek similar major displacement on this fault shows that the west side moved up. The height of Mt. Haldane and its quartzite section relative to the corresponding north limb also suggests displacement in Late Tertiary time along a major longitudinal fault up McQuesten Valley, lifting Mt. Haldane up like a wedge. West of the Haldane-Haggart fault, vein-faults on Mt. Haldane dip northwest as on the north limb, perhaps influenced locally by the fault or vice versa.

Mineralization

Mineralization in the district is controlled by (a) relative competence of rock types and (b) intersection and interrelations of fractures.

On the south limb of the McQuesten anticline on Keno and Galena Hills, the productive veins occur mainly in northeast-striking, south-east-dipping, tensional vein-fault systems in competent quartzites or greenstones of the south-dipping Central Quartzite formation. The ore tends to be localized in the more massive members of this formation, particularly in or near vein-fault intersections or branches, where vein-faults pass upward into less competent schist or thin-bedded quartzites, and often near NNW cross faults.

Mineralization of pyrite and arsenopyrite exists as early vein fillings, especially in the longitudinal fractures, while later silver-rich mineralization of galena, sphalerite, and tetrahedrite forms the ore in northeast fractures.

On the north limb of the McQuesten anticline, mineralization consists of galena and probably tetrahedrite but not enough work has been done to establish the nature of ore controls.

On Mt. Haldane the main vein system shows some similarity to the north limb in reversed dip and mineralogy but lies on the other side of the Haldane-Haggart fault and on the south limb so its mineralization and ore control may be different.

At Haggart Creek to the northwest, on the Peso property, tetrahedrite mineralization is localized in two vein systems: (a) Nos. 1, 2, 3, 4, 5 and 6 and (b) the Rex. The first consists of a major north-dipping east-west shear (no. 3 system) which branches and changes to a more southwesterly direction where it encounters a cross-fold, and crosses this fold at right angles to the foliation of the phyllite.

Mineralization consisting of abundant pyrite and arsenopyrite with jamesonite-tetrahedrite, and minor sphalerite and bismuthinite is localized in northeast-striking, steeply northwest-dipping vein segments between east-west intramineral cross-faults that dip moderately to flatly north. The Rex vein is a jamesonite-galena-tetrahedrite-sphalerite-bearing siderite vein zone which strikes N80°E and dips 55° north across a quartzitic section; its exact ore controls are not yet known.

The similarity or complementary nature of vein-fault patterns, mineralization and ore control, and the presence of high silver values in the Peso vein systems, at Haggart Creek, on intervening Chambers Hill and to the west, on Mt. Haldane, and on Galena and Keno Hills confirm that this entire area is a single geologic unit or district with strong suggestions that it may be still more extensive westward. Tetrahedrite, the chief silver mineral in this district, occurs over a larger, wider area than previously supposed.

There is also a suggestion of close genetic relationship between the mineralization and quartz-feldspar porphyry sills or dikes common to the district.

EXPLORATION

Since the first mining in 1913, exploration in the Mayo district has been confined almost completely to Keno and Galena Hills for several reasons: (a) in spite of difficult permafrost overburden, important high grade discoveries were made by hand methods from time to time, thus keeping interest centered on the two hills; (b) the few initial discoveries in adjoining areas were mostly low grade and much less work was done even though many discoveries on Keno and Galena Hill also contained low grade; (c) most of the area to the west consists of gentler hills mantled by residual overburden due to deep weathering and lack or lightness of glaciation; and (d) veins with abundant pyrite and arsenopyrite would be deeply weathered and silver is the most easily leached constituent, making surface showings of such veins very unimpressive. The scarcity of outcrop, cover of overburden, and difficulty of prospecting, compounded with the above factors, particularly the brilliance of discoveries on Keno and Galena Hills, has discouraged exploration of the outlying parts of the district until recently.

It is significant that every important ore body on Keno and Galena Hills was discovered in the past by individuals using hand methods in areas of fairly extensive but relatively shallow overburden, mostly on north facing permafrost slopes where the favourable competent quartzites are exposed.

Modern methods of detailed geologic mapping, using geophysics and in some cases geochemistry as guides, followed by bulldozer stripping or drilling is proving successful in discovery of new veins as in the recent discoveries around Haggart Creek and a new vein on the Duncan property on Keno Hill. Bulldozer work is particularly suited to non-permafrost areas in the relatively unglaciated western part of the district where miles of ground can be easily prospected for float by wild-cat stripping to shallow depth.

Geologic mapping of structure is the best guide to discovery of new veins, particularly once the fracture pattern and its control on ore localization is recognized.

Electrical resistivity surveys in the Galena Hill area appear to give the best structural picture of vein-faults under the cover of frozen till characteristic of this part of the district. Electromagnetic surveys also define vein-fault structures but empahsize their graphitic sections. Self potential surveys may prove very useful on south facing slopes or other areas where permafrost is absent.

Geochemistry is useful where overburden is light or of a residual nature as in the unglaciated terrain.

Valuable clues for the prospector include manganiferous siderite float, evidence of shearing, rusty-weathering alteration of greenstone wall rocks, and small topographic breaks indicating presence of probable vein-faults. Very close prospecting, with attention to all possible clues, is imperative, and digging is usually necessary.

Exploration in the Mayo district is difficult due to permafrost, overburden, vegetation cover, fractured nature of quartzite host rocks, short season, high costs, and other factors characteristic of the north, but the potential of the district definitely warrants much more extensive work. The favourable district is much more extensive than formerly recognized, so if enough work is done in the best and most efficient manner in the most favourable localities, including old and new prospects and areas west of those shown on Figure 3, it appears that more veins will be found and some of these should prove economic.

CONCLUSION

Although silver occurs in several widely different environments in Yukon, some useful generalizations can be formulated.

1. Since the silver-bearing deposits are all mesothermal to epithermal in character, the amount of erosion relative to depth of deposition is only moderate. Many of the deposits are probably Laramide to Tertiary in age and the uplift associated with some of the districts may still be reflected in slightly higher topography resulting from more resistant rocks within the uplift or from continued residual isostatic rise. Examples may be found in Mayo, Ketza River, Tintina, Mt. Nansen, and other districts.

2. Vein deposits high in silver in Yukon tend to favour distinct districts of anomalous structure and intense deformation followed by later uplift and accompanying fracturing; deposits low in silver have not been explored as fully but do not appear to show such a marked district association.

3. Close areal association of quartz porphyry or quartz-feldspar porphyry with silver-bearing districts and silver ore suggests a genetic relation, even if only in time and area of source.

4. Early Tertiary volcanism (Carmacks Group) is probably genetically related to the epithermal type of gold-silver deposit in the Mt. Nansen area and elsewhere in the Coast Mountains - Dawson Range metallogenic province.

5. Regional northwest faulting and subsidiary faulting exerts control on silver-bearing vein deposits within the districts in which they occur, as at Ketza River and Tintina.

6. Favourable host rocks in select areas include Lower Cambrian strata in the Mesocordilleran belt and Keno Hill type quartzites (probable Upper Paleozoic or Lower Mesozoic age) northeast of Tintina Trench.

7. Vein deposits rich in silver and sizeable lead-zinc replacement deposits low in silver are known in so many places in Yukon in spite of limited exploration, that further exploration may prove Yukon to be one of the world's largest silver-lead-zinc regions.

8. In Yukon the district of largest silver potential, indicated by its structure, geologic environment, and known mineralization, is the McQuesten mineral belt which includes the productive Mayo district. Considering its unexplored possibilities, this belt may rival the Coeur D'Alene district of Idaho or the Mexican silver province in overall potential.

REFERENCES

Bostock, H.S.

Geol. Surv. Canada (1943) Preliminary Map 43-9 Upper McQuesten River, Yukon Territory 1 in. to 2 miles.

Geol. Surv. Canada (1946) Map 890A - Mayo, Yukon Territory, 1 inch to 4 miles.

Geol. Surv. Canada (1948) Preliminary Map 48-25, McQuesten, Yukon Territory, 1 in. to 2 miles.

Boyle, R.W.

The Geology and Geochemistry of the Silver-Lead-Zinc Deposits of Galena Hill, Yukon Territory, Geol. Surv. Canada - Paper 57-1 (1957).

Green, L.H.

Geol. Surv. Canada Map 5-1956, Mayo Lake, Yukon Territory - 1 inch to 1 mile.
(1956)

Geol. Surv. Canada Paper 58-4 McQuesten Lake and Scougale Creek Map Areas, Yukon Territory.
(1958)

Green, L.H. and McTaggart, K.C.

Structural Studies in the Mayo District, Yukon, Proc. Geol. Assoc. Canada Vol. 12, P. 119-13A
(1960)

Green, L.H. and Roddick, J.A.

Dawson, Larsen Creek, and Nash Creek Map Areas, Yukon Territory, Geol. Surv. Canada Paper 62-7.
(1962)

Kindle, E.D.

Geol. Surv. Canada Preliminary Map 55-12, Keno Hill, Yukon Territory 1 inch to 1 mile.
(1955)

McTaggart, K.C.

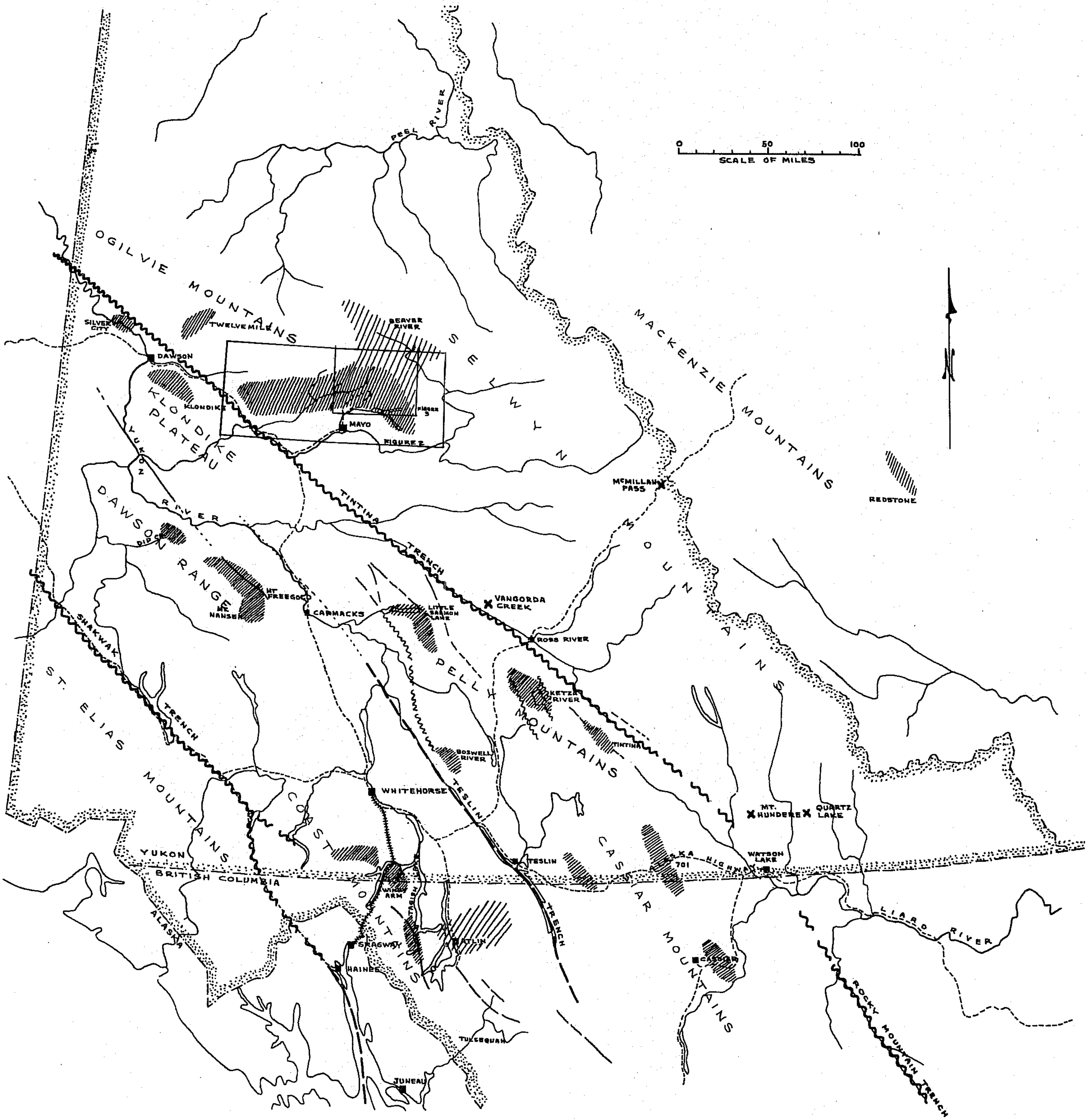
The Geology of Keno and Galena Hills, Yukon Territory, Geol. Surv. Canada Bulletin 58
(1960)

Templeman-Kluit, Dirk

Economic Geology of Secret Creek, Haggart Creek, and Dublin Gulch area. Private report for Peso Silver Mines.
(1962)

Wisser, E.H.

Relation of Ore Deposition to Doming in the North American Cordillera, Geol. Soc. America Memoir 77.
(1960)



SILVER-BEARING DISTRICTS IN YUKON

AND ADJACENT NORTHERN BRITISH COLUMBIA

A.E. AHO
OCT./62.

FIGURE 1

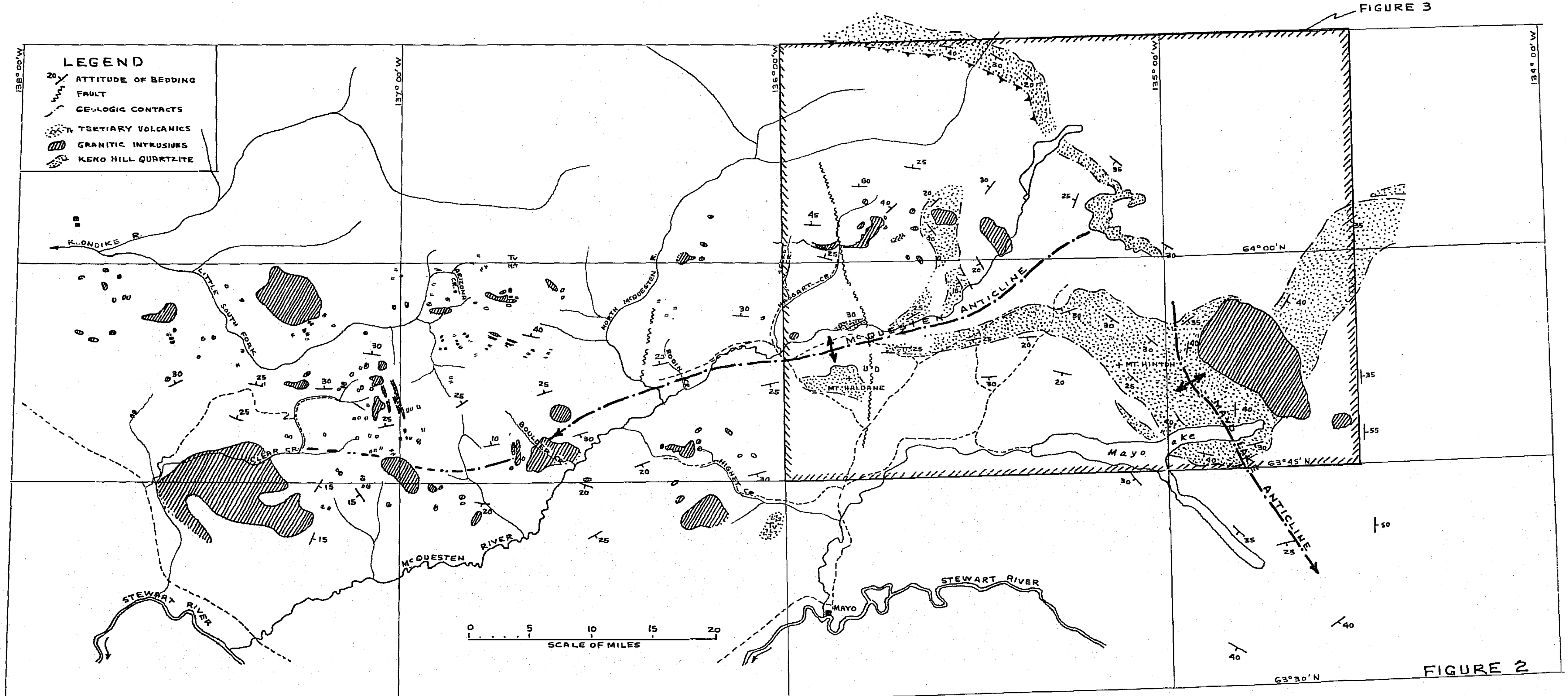


FIGURE 2

McQUESTEN MINERAL BELT

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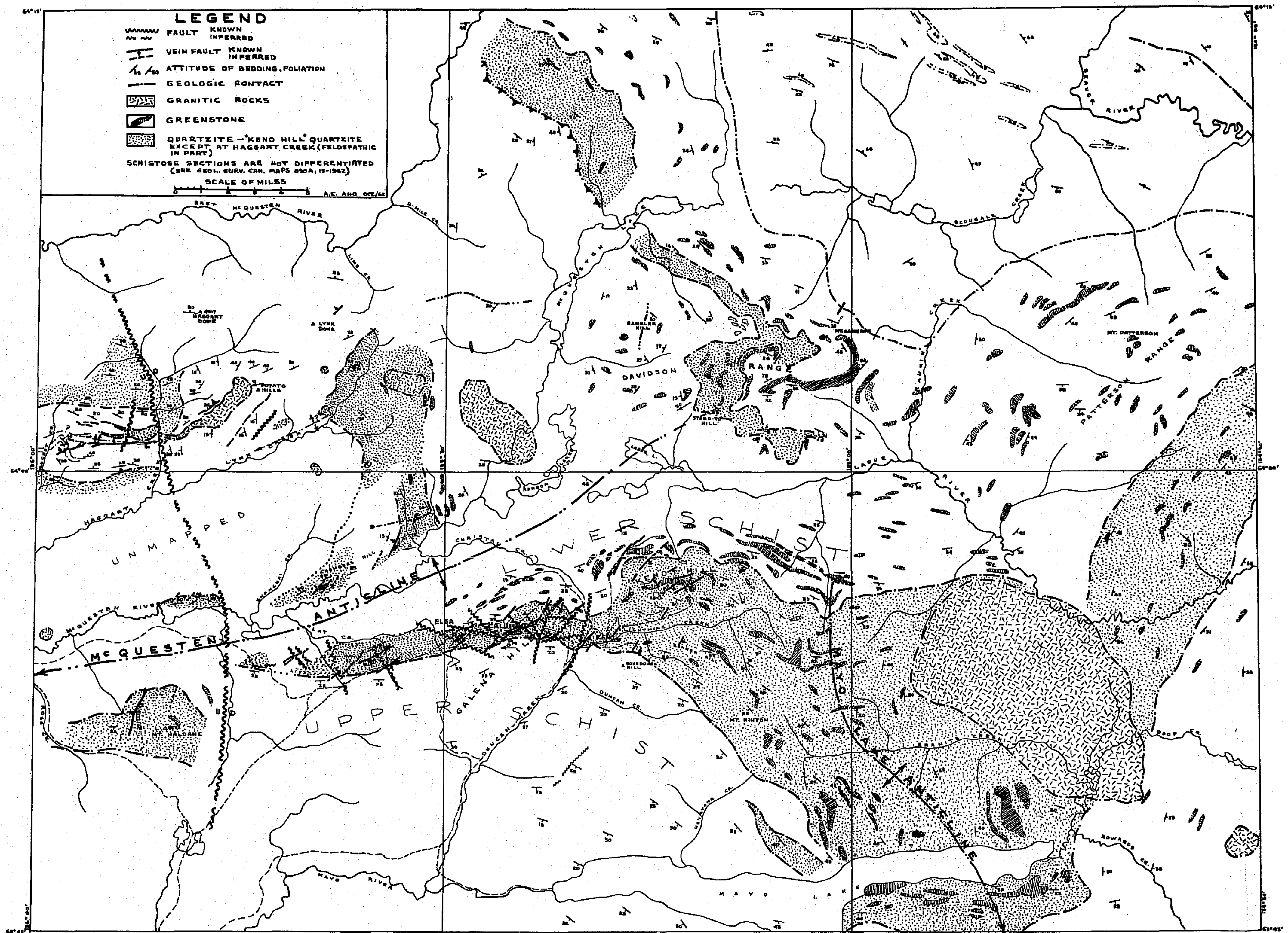

ELEMENTS OF STRUCTURE, MAYO DISTRICT, YUKON

FIGURE 3