GEOLOGY, MINERALOGY AND GEOCHEMISTRY OF TIN AND TUNGSTEN VEINS, BRECCIAS AND SKARNS, MCQUESTEN RIVER REGION (115 P (NORTH) AND 105 M 13), YUKON

Diane Emond
Exploration and Geological Services Division
Indian and Northern Affairs Canada
200 Range Road
Whitehorse, Yukon
Y1A 3V1

Teresa Lynch (née Potter)
2961 de Vincennes
Ste-Foy, P.Q.
G1W 2E5

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ABSTRACT

Tin and tungsten-bearing veins, breccias and skarns occur in a 60 km long belt trending west from Keno Hill to the Tintina Fault. They are hosted by mid-Cretaceous felsic intrusions, or adjacent metasedimentary rocks of Upper Precambrian to Mississippian age. Tin occurrences are mainly associated with two-mica granites in the southern part of the belt, while the tungsten lodes are more commonly associated with biotite-hornblende granitoids. Tin- and silver-bearing veins are associated with the central granite phase of a zoned intrusion in the northwest part of the belt (the Syenite Range). The zoned intrusion ranges in composition from tourmaline orbicular granite to granite to quartz monzonite to syenite.

Most skarns are tungsten-dominant, whereas most breccias and veins are tin-bearing. The skarns are calcic and reduced. Three stages of skarn mineral formation and associated minerals are recognized: (1) isochemical contact metamophism, including diopside, grossular, wollastonite, and tremolite; (2) metasomatic skarn formation including andradite, idocrase, hedenbergite, axinite, and some sulphide minerals; and (3) retrograde alteration including actinolite, chlorite, clinozoisite, epidote, calcite, biotite, scheelite, cassiterite and sulphide minerals. Sulphide minerals are mostly minor, with pyrrhotite and pyrite predominant.

Breccias, veins and sheeted veins of tin and tungsten occur in steeply dipping tabular bodies close to felsic intrusions. The veins consist of quartz, tourmaline or chlorite. Tin-bearing veins and breccias contain all three gangue minerals plus pyrrhotite, pyrite, sphalerite, chalcopyrite, arsenopyrite and galena. Tungsten is only found in quartz (-orthoclase) veins which contain minor pyrite and molybdenite.

Sheeted vein systems consist of three mineral assemblages: (1) quartz-orthoclase-scheelite, (2) quartz-orthoclase-cassiterite, and (3) tourmaline-cassiterite. The first assemblage is present both in the endo- and exocontact of felsic intrusions, whereas the second and third occur further away from the granite in metasedimentary rocks which generally lie outside the thermal aureole of the intrusion.

Breccia clasts consist of quartzite, schist, and/or vein fragments (quartz, tourmaline, or chlorite). The breccias are either clast-supported with a matrix of rock flour, or matrix-supported with a matrix (groundmass) of crystalline quartz, tourmaline or chlorite similar to vein material.

Geochemical studies of the McQuesten River occurrences indicate that: (1) Some properties are exclusively tin or tungsten properties, but others contain both metals. There is a positive correlation between tungsten and tin in some tin-bearing rocks. (2) Silver is common in veins and skarns which contain over 50 ppm Sn. (3) Gold occurs in significant quantities in most skarns and in several veins. (4) There is a positive correlation between gold and bismuth in the skarns. Bismuth can be used as a pathfinder for gold in these skarns.

RÉSUMÉ

On trouve des veines, des brèches et des skarns renfermant de l'étain et du tungstène dans une zone d'une longueur de 60 km s'allongeant vers l'ouest depuis la colline Keno jusqu'à la faille de Tintina. Ils se situent à l'intérieur d'intrusions felsiques du Crétacé moyen ou dans les roches sédiementaires métamorphisées adjacentes datant du Précambrien supérieur au Mississippien. Les indices minéralisés en étain sont principalement associés aux granites à deux micas de la partie méridionale de la zone alors que les filons de tungstène sont plus couramment associés aux granitoïdes à biotite et hornblende. Les veines renfermant de l'étain et de l'argent sont associées à la phase granitique centrale d'une intrusion zonée dans la partie occidentale de la zone (la chaîne Syenite). La composition de l'intrusion zonée passe du granite orbiculaire à tourmaline au granite à la monzonite quartzique à la syénite.

La plupart des skarns renferment principalement du tungstène alors que la plupart des brèches et des veines renferment de l'étain. Les skarns sont calciques et réduites. Trois stades de formation de minéraux et de minéraux associés dans les skarns ont été reconnus : 1) métamorphisme topochimique de contact (incluant diopside, grenat grossulaire, wollastonite et trémolite), 2) formation de skarn métasomatique (incluant andratite, idocrase, hédenbergite, axinite et certains minéraux sulfurés) et 3) altération rétrograde (incluant actinolite, chlorite, zoïsite monoclinite, épidotite, calcite, biotite, scheelite, cassitérite et minéraux sulfurés). Les minéraux sulfurés sont principalement présents en quantités mineures, la pyrrhotine et la pyrite étant les principaux.On trouve des brèches, des veines et des groupes de filons séparés de stériles renfermant de l'étain et du tungstène dans des masses tabulaires d'un fort pendage à proximité des intrusions felsiques. Les veines se composent de quartz, de tourmaline ou de chlorite. Les veines stannifères et tungstènifères renferment toutes trois minéraux de gangue en plus de pyrrhotine, de pyrite, de sphalérite, de chalcopyrite, d'arsénopyrite et de galène. Le tungstène n'est présent que dans les veines de quartz (-orthoclase) qui renferment des quantités mineures de pyrite et de molybdénite.

Les réseaux de filons séparés de stériles consistent en trois assemblages de minéraux : 1) quartz-orthoclase-scheelite, 2) quartz-orthoclase cassitérite et 3) tourmaline-cassitérite. Le premier de ces assemblages est présent dans les intrusions felsiques des côtés intérieur et extérieur du contact alors que les deuxième et troisième se retrouvent plus loin du granite dans les roches sédimentaires métamorphisées qui se trouvent généralement à l'extérieur de l'auréole thermique de l'intrusion.

Les fragments des brèches consistent en quartzite, en schiste et/ou en fragments de veines (quartz, tourmaline ou chlorite). Les brèches sont soit à base de fragments avec une matrice de poussière de roche, soit à base de matrice avec une matrice (pâte) de quartz cristallin, de tourmaline ou de chlorite similaires aux matériaux des veines.

Les études géochimiques des indices minéralisés de la rivière McQuesten indiquent 1) qu'il existe une corrélation positive entre la présence du tungstène et de l'étain dans certaines roches stannifères. Certaines propriétés sont exclusivement stannifères ou exclusivement tungstènifères, mais dans d'autres l'on trouve les deux métaux. 2) L'argent est commun dans les veines et dans les skarns renfermant plus de 50 ppm de Sn. 3) Il y a des quantités importantes d'or dans la plupart des skarns et dans plusieurs veines. 4) Il existe une corrélation positive entre la présence de l'or et du bismuth dans les skarns. Le bismuth peut être utilisé comme élément indiquant la présence d'or dans ces skarns.

INTRODUCTION

The McQuesten River - Mayo region is one of the most intensely mineralized in the northern Cordillera. Placer gold has been mined since the turn of the century mainly from Haggart, Highet, Johnson, Clear, Duncan and Swede Creeks. Silver-lead veins (MINFILE 105M 001 etc.) have been mined in the Keno and Galena Hill district since 1913, producing over 6.4 billion grams of silver (Watson 1986). Tin and tungsten lodes occur in a west-trending belt extending from the western edge of the Keno-Galena Hill district to the Tintina Fault (Figs. 1 and 2), and represent a different component of the same metallogenic event (i.e., deposits related to Cretaceous intrusions). The most notable deposit is the RAY GULCH tungsten skarn (MINFILE 106D 027) with probable and possible reserves of 5.4 million tonnes of 0.82% WO_3 (Lennan 1986).

Following a study of the Oliver Creek tin-silver breccias (MINFILE 115P 030)(Emond, 1985), the authors visited most of the tin and tungsten occurrences in 1985 (Emond 1986, INAC 1989). Lynch completed a B.Sc. research paper on the petrography of these occurrences (Potter 1987). This paper summarizes the detailed mineralogy, geochemistry and distribution of metals in the mineral occurrences. The McQuesten occurrences have been previously explored mainly for tin and tungsten, but this new geochemical data indicates local enrichment in gold.

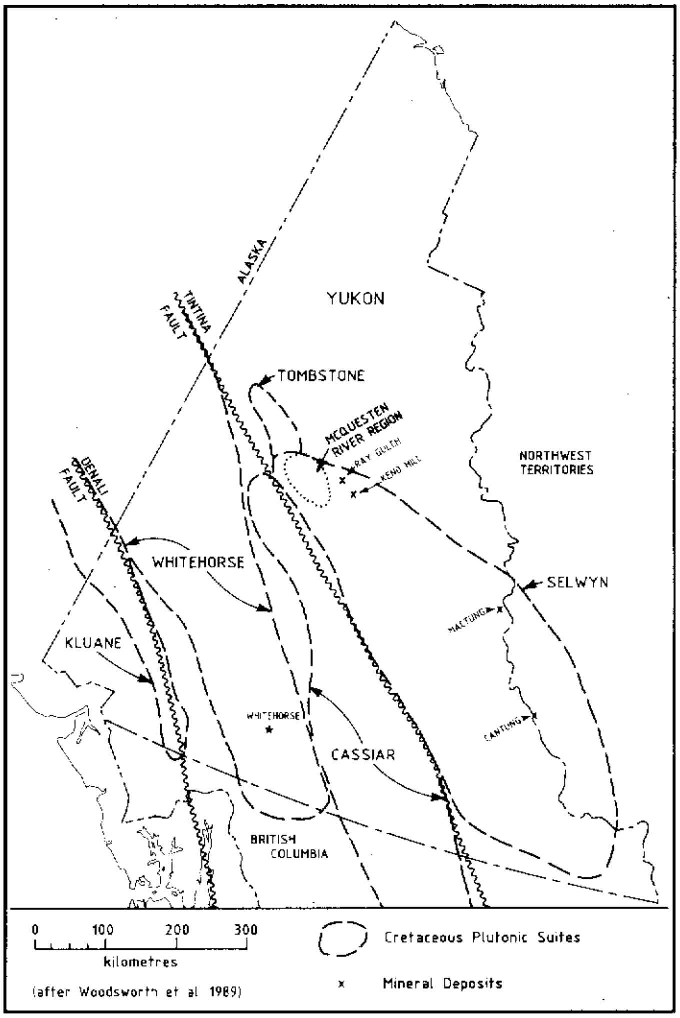

Figure 1. Location of the McQuesten River region in Yukon. Also outlines mid-Cretaceous felsic plutonic suites (after Woodsworth et al. 1989).

GEOLOGICAL SETTING

Tin- and tungsten-bearing veins, breccias and skarns occur in a 30 x 60 km belt that trends east from the Tintina Fault in the McQuesten River region (Fig. 1). They are closely associated with mid-Cretaceous plutons along the same trend, and occur in both the plutonic rocks and in Late Proterozoic to Mississippian metasedimentary rocks of the Late Precambrian to Early Cambrian Hyland Group ("Grit Unit"), the Ordovician-Silurian Road River Formation, and the Mississippian Keno Hill Quartzite (Bostock 1946 and 1964, etc). The only prominent large scale structure is the ENE-trending McQuesten Anticline. A strong foliation which strikes east-northeast cuts the metasedimentary rocks (Boyle 1965, Fig. 2).

The mid-Cretaceous plutons (83 to 108 Ma: biotite - K/Ar, Stevens et al. 1982) are small epizonal felsic intrusions with associated coeval lavas (85 Ma, whole rock, K/Ar, Hunt and Roddick 1987, Fig. 2). The felsic intrusive rocks (Emond 1992) belong to the post- to syn- collisional bimodal Selwyn Plutonic Suite, and are bounded by and may grade into the more alkaline Tombstone Plutonic Suite to the northwest (Fig. 1; Woodsworth et al. 1989). The lavas are most likely the northwesternmost exposure of the South Fork Volcanics (Gordey 1988).

The plutonic rocks are generally bimodal, "S" type, reduced granitoids, with biotite-muscovite (two-mica) granites mainly confined to the southern part of the belt, and biotite-hornblende granite, quartz monzonite, and granodiorite further north. At the north end of this belt, the rocks are more alkaline: a large stock zoned from hornblende-biotite syenite to quartz monzonite to granite towards the core has fractionally crystallized in situ (Abercrombie 1990, Emond 1992). Contact aureoles of biotite hornfels, andalusite porphyroblast hornfels, calc-silicate rocks and tourmalinite are common where pelitic metasedimentary rocks were intruded.

Each mineral occurrence is related to a particular type of granitoid (Fig. 2). Tin (-silver) occurrences are associated with evolved two-mica granites in the southern and northwestern part of the belt, while tungsten (-gold) occurrences are associated with less evolved biotite-hornblende granite, quartz monzonite and granodiorite throughout the belt (Emond 1992). In the southern part of the belt, where tungsten skarns are associated with biotite-hornblende granite, they are commonly polymetallic. The mineral associations in the McQuesten Plutonic Suite differ from those in the Selwyn Plutonic Suite. Tin-rich occurrences are more common in the McQuesten area, where they are associated with two-mica granites. Tungsten occurrences in the McQuesten area are associated with biotite-hornblende granitoids, but larger and more numerous tungsten deposits occur in the Selwyn Mountains where they are associated with two-mica granites (Anderson, 1988).

STYLES OF MINERALIZATION AND MINERALOGY

There are two main styles of tin and tungsten mineralization: (1) skarns, and (2) veins and/or breccias (Emond 1986). Detailed descriptions of individual properties mentioned here are published in Yukon Exploration 1988. Petrography of the mineral occurrences is discussed separately below.

1. Skarns

Both the Hyland Group and the Road River Formation contain thin layers of marble and dolomite which pinch and swell along strike. These units form calcic skarns on the margins of intrusions. At the OLIVER CREEK (MINFILE 115P 030) tin occurrence, calcareous diorite intercalated with Hyland Group rocks is also skarnified. Tin skarn occurs at OLIVER CREEK (MINFILE 115P 030) and BOULDER CREEK (115P 048). Tungsten skarn occurs at SCHEELITE DOME (MINFILE 115P 004), LUGDUSH (MINFILE 115P

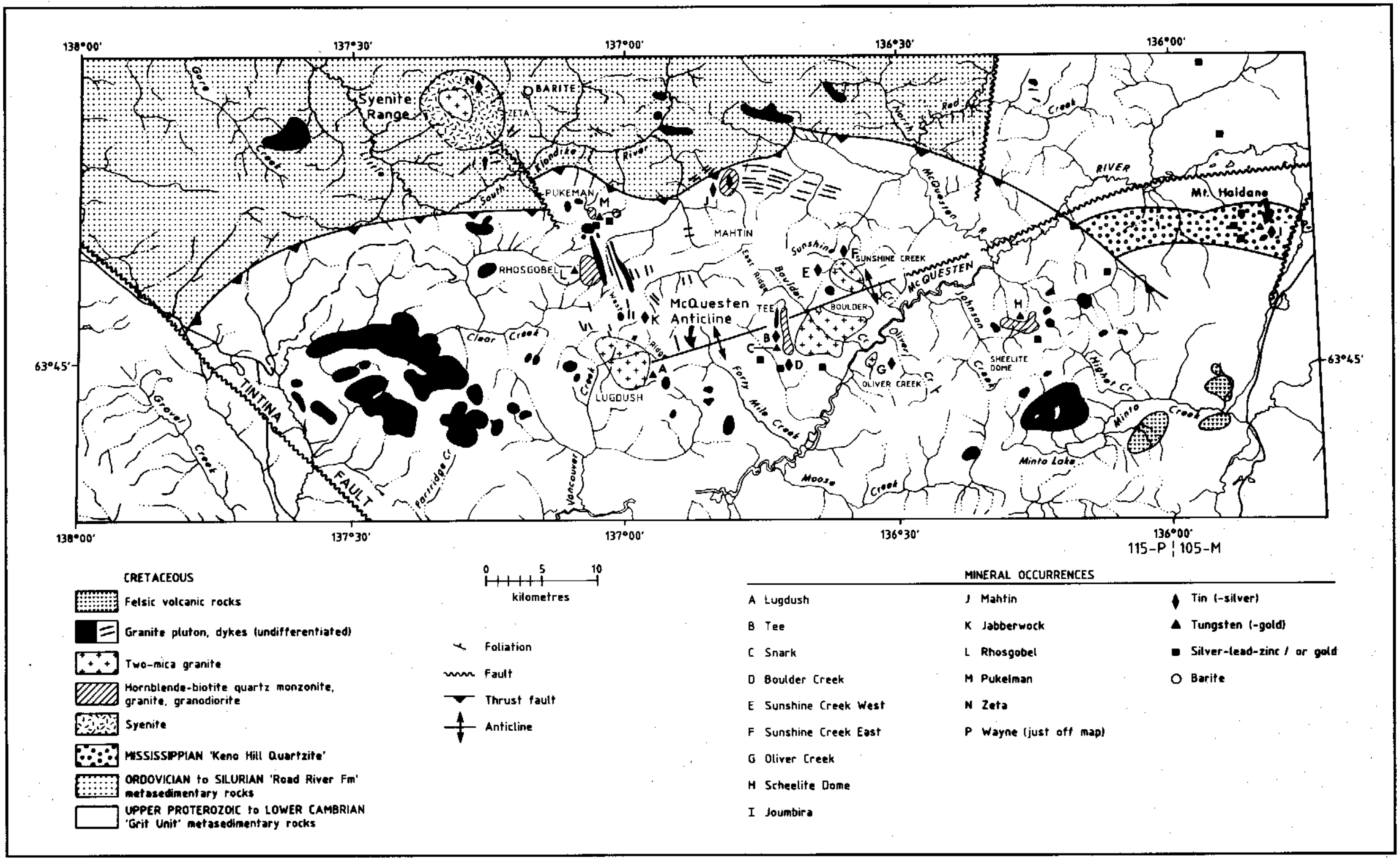

Figure 2. Geology and mineral occurrences, McQuesten River region. Plutonic phases are also distinguished where known.

009), RHOSGOBEL (MINFILE 115P 012) and RAY GULCH (MINFILE 106D 027)(Lennan 1986). Tin-tungsten skarn occurs at SNARK (MINFILE 115P 008b)(Fig. 2). These mineral occurences are documented in Table 1 in terms of host rock, associated intrusion, skarn mineral assemblage, size and geochemistry.

The best assays from the tungsten skarns came from SCHEELITE DOME (MINFILE 115P 004), where a 4 m chip sample of drill core contained 3620 ppm W and 2080 ppb Au. The best assays from tin skarns came from the OLIVER CREEK showing (MINFILE 115 P 030), where a 1.7 m drill intersection contained 0.9% Sn and 4 ppm Ag.

The skarns show a typical three-stage evolutionary pattern: (1) isochemical contact metamorphism accompanying crystallization of the magma; (2) metasomatic skarn formation accompanying crystallization of the magma and evolution of the ore fluid; and (3) retrograde alteration and continued ore deposition with the final cooling of the system (Einaudi et al. 1981). Table 2 places the skarn minerals in their respective evolutionary stages and summarizes the petrographic characteristics of the McQuesten River occurrences, such as mineral abundance, colour, grain size, form and alteration.

Stage 1. Isochemical Contact Metamorphism

In this prograde stage, metamorphic reactions involve changes in the amount of volatile components only, such as oxygen, carbon dioxide and water. Otherwise, on the scale of an outcrop, the system remains isochemical. Minerals from this stage in McQuesten area skarns consist mainly of diopside, grossular, wollastonite, and tremolite. Diopside is the most common mineral, occurring in both the tin and tungsten skarns. Grossularite occurs mostly in the tin skarns, while wollastonite is mainly restricted to the tungsten skarns. These iron-poor calcium-magnesium-aluminum silicates reflect the original limestone and dolomite host rocks. Though this stage was not a mineralizing event, the porosity increase resulting from the fracturing and volatile loss during intrusion probably controlled the later emplacement of the economic minerals (Einaudi et al. 1981).

Stage 2. Metasomatic Skarn Formation

The metasomatic minerals are formed by magmato-hydrothermal processes which, unlike the previous metamorphic ones, produce changes in the amounts of non-volatile components, such as calcium, iron, silica and boron (Einaudi et al. 1981). Minerals from this stage in McQuesten skarns include andradite, idocrase, hedenbergite and axinite. Complex skarns result from the overprinting of stage 2 on stage 1 assemblages. Minerals show iron enrichment trends (Emond 1985) due to infiltration of iron, silica and boron-rich magmatic fluids into the fractured host rock. Minor amounts of sulphides (pyrite, pyrrhotite, chalcopyrite, sphalerite and galena) were also deposited during this stage. Tin in the BOULDER CREEK (MINFILE 115P 012) tin skarn is inferred to be locked up in the andradite or axinite as no cassiterite was observed.

Stage 3. Retrograde Alteration

Retrograde minerals are formed by the final cooling of the system and the incursion of meteoric water, and typically reflect the composition of original skarn silicates, but modified by leaching of Ca, and the introduction of volatiles (Einaudi et al. 1981). Hydrous phases are typically formed. Minerals from this stage in McQuesten area skarns include actinolite, chlorite, clinozoisite, epidote, calcite and biotite. Scheelite precipitates at this stage, and calcium is released in solution (Figs. 3a and 3b). Cassiterite also precipitates at this stage as tin is released from calc-silicate minerals. Sulphide minerals continue to precipitate and reach a peak during retrograde alteration. The retrograde chlorite-actinolite-pyrrhotite-pyrite-cassiterite skarn (Fig. 3c) associated with chlorite-cassiterite breccias at OLIVER CREEK (MINFILE 115P 030) is an example of the importance of the retrograde stage in producing an economically viable tin prospect. At the PUKELMAN (MINFILE 115P 013) sheeted quartz-scheelite vein occurrence, scheelite occurs with retrograde biotite in hornfels, particularly in less calcic, more pelitic layers in the host rock.

Petrographic studies show clinozoisite and actinolite replacing diopside, and epidote and calcite replacing garnet. Actinolite also replaces idocrase and axinite. Fluorite is not abundant in the McQuesten area skarns, although some occurs locally in biotite hornfels.

Fluorite with abundant muscovite signals the onset of greisenization, an important retrograde alteration which improves the economic viability of tin deposits. In this area, only the OLIVER CREEK (MINFILE 115P 030) occurrence shows minor fluorite-sericite-chlorite alteration. Most of the skarns in the McQuesten region have not reached this stage.

Textures

Many of the tin and tungsten skarns are banded, with alternating 1-2 mm wide layers composed of quartz-orthoclase and diopside-clinozoisite (± wollastonite or tremolite; Fig. 3d). This banding reflects the early regional metamorphic fabric. The foliation is believed to have exerted physical and chemical controls on the skarn mineralogy and textures (Fig. 3d). Only the coarse grained garnet-axinite-idocrase tin skarn at BOULDER CREEK (MINFILE 115P 048) is unfoliated.

Hornfels

Hornfels is defined as fine-grained, non-foliated rock composed of a mosaic of equidimensional grains with no preferred direction (Turner 1968). In the McQuesten River region, hornfelsed rocks occur within the contact aureole of the granitoid intrusions. They are composed of quartz, biotite, muscovite and actinolite, and are weakly foliated. Hornfels at the RHOSGOBEL property (MINFILE 115P 012) contains scheelite, and is intercalated with diopside-tremolite-biotite-scheelite skarn. The skarn-hornfels contact is sharp, and scheelite and sulphides are preferentially concentrated in the hornfels. Scheelite crystals occur in lens-shaped clusters associated with biotite. Scheelite concentrations run as high as 5% in hornfels, and 1-2% in skarn.

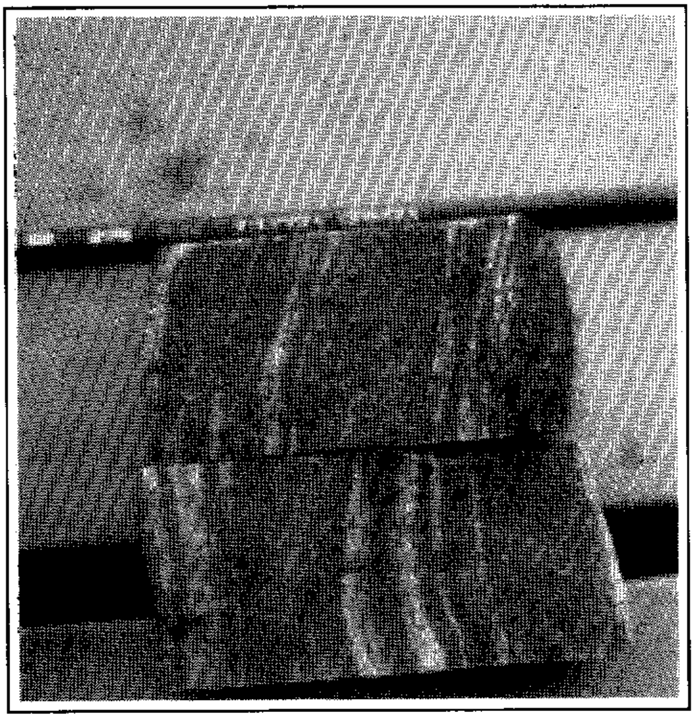

Figure 3a. Actinolite (dark)-quartz (light)-scheelite skarn from SCHEELITE DOME (MINFILE 115P 004).

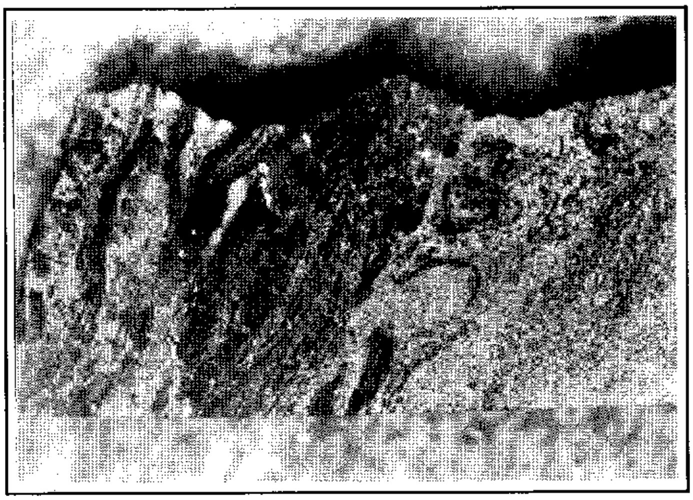

Figure 3c. Actinolite (dark), pyrrhotite (light-reflective), and cassiterite (microscopic) in skarn from OLIVER CREEK (MINFILE 115P 030).

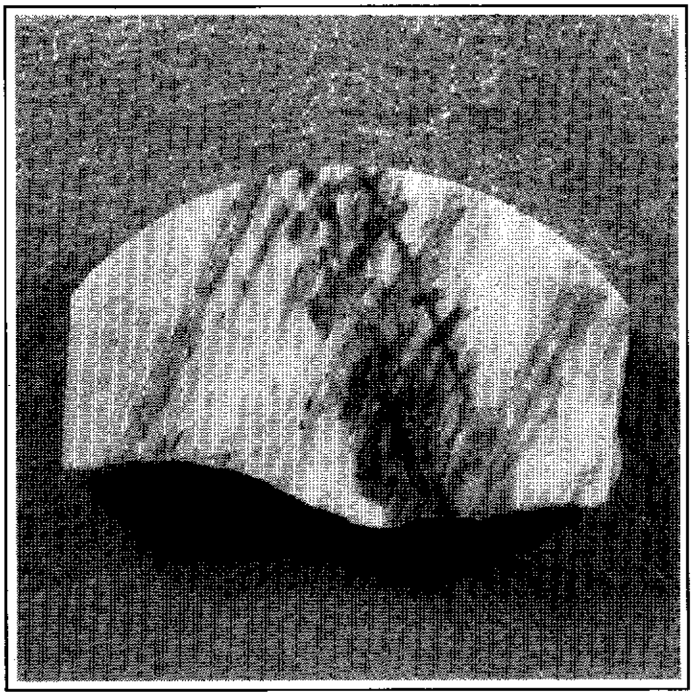

Figure 3b. Quartz-orthoclase-wollastonite (white) skarn cut by quartz-actinolite-scheelite (dark) vein and envelope, SCHEELITE DOME (MINFILE 115P 004).

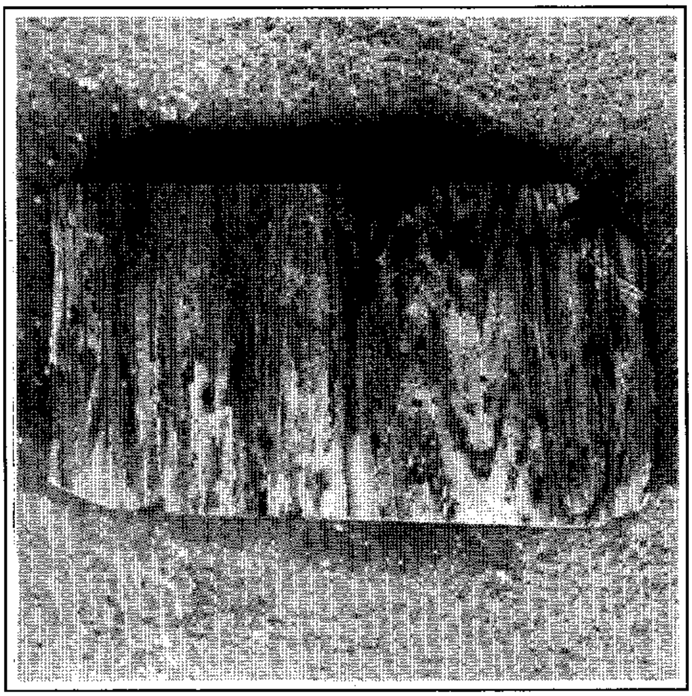

Figure 3d. Banded quartz-orthoclase (white) assemblage alternating with diopside (grey)-rich assemblage, SCHEELITE DOME (MINFILE 115P 004).

Tourmalinite

Tourmalinite also occurs in the contact aureoles of intrusions, and is most common near tin and tungsten showings. Pervasive tourmaline alteration occurs in mica-quartz schist, where the mica is altered to tourmaline, leaving alternating quartz and tourmaline layers on a millimetre to centimetre scale. Sphene crystals approximately 0.1 mm long form 2-3% of the rock, and up to 2% topaz occurs locally.

Summary of Skarns

Petrographic analysis shows that skarns of the McQuesten River region incorporate features of both reduced and oxidized skarns as defined by Einaudi et al. (1981). Due to the predominance of pyrrhotite over pyrite and pyroxene over garnet, and the presence of some biotite and hornblende as retrograde minerals, they are appear to resemble Einaudi's reduced skarns. However, retrograde minerals common in oxidized skarns are also present, suggesting the onset of retrograde alteration was accompanied by an increase in oxidation state.

Temperatures typical of early skarn formation range from 500-600°C, and retrograde skarns form at 300-450°C (Einaudi et al. 1981). Newberry (1980) suggested that calcium released during breakdown of pyroxene and garnet during retrograde alteration contributes to tungsten precipitation. This is supported by the observation that biotite and sphene are closely associated in McQuesten River skarns. Calc-silicate gangue predominates over opaque minerals, in contrast to the sulphide or iron oxide replacement skarns which contain only minor amounts of low temperature calc-silicate minerals. Only the tin skarn at OLIVER CREEK and the tungsten skarn at SCHEELITE DOME contain massive sulphides, and these consist mainly of pyrrhotite, a low sulphur species (Fig. 3c).

The following three major evolutionary stages were involved in formation of the McQuesten River skarns: (1) Formation of a metamorphic aureole and local reaction skarns accompanying magma intrusion and expulsion of connate and ground water. (2) Melt crystallization and exchanges of components between the magmatic fluid and carbonate host rocks. Later stages of prograde skarn formation show an iron enrichment trend in the silicates which is reflected by the development of hedenbergite and axinite. (3) Cooling of the system and influx of meteoric water, leading to retrograde alteration of the skarn and hornfels. This is a very important stage in metal deposition.

(2) Breccias and Veins

Breccias, veins and sheeted veins containing tin and tungsten occur near the contacts of dykes and plutons with the metasedimentary rocks. They are especially common in the cupola region of the pluton. Sheeted veins in some cases extend from the pluton several hundred metres into the country rock. Breccias commonly grade into stockwork or veins, and have many of the characteristics of veins (Emond 1985). Most veins and breccias dip steeply and are fault or joint controlled (Fig. 4a).

The breccias form two main types: (1) rock flour breccias, consisting of quartzite or schist fragments in a matrix of finely ground quartzite (Fig. 5a); and (2) crystalline matrix breccias, consisting of a combination of quartzite (or schist) and/or vein material fragments in a matrix of vein minerals (Figs. 5b-d). The crystalline matrix breccias include three general types based on the dominant matrix mineral, which can be either quartz, tourmaline or chlorite.

Vein types are also defined by the same three dominant minerals. The three vein assemblages in order of paragenesis are: (a) quartz (± tourmaline, orthoclase, cassiterite, scheelite, topaz; (Fig. 5b)); (b) tourmaline (± sulphides, cassiterite; (Fig. 5c)); and (c) chlorite (± cassiterite, sulphides, biotite, muscovite; (Fig. 5d)). Calcite also forms crosscutting veins and breccias (Fig. 5a), but these are generally unmineralized.

Table 3 summarizes the tin and tungsten breccia/vein occurrences, including associated pluton, host rock, matrix or gangue, fragments, and geochemistry. The highest grade tin-silver breccia/vein occurrence is the OLIVER CREEK showing (MINFILE 115P 030), where a 1.7 m drill intersection assayed 0.9% Sn and 4 ppm Ag. The highest grade tungsten-gold sheeted vein occurrence is the PUKELMAN showing (MINFILE 115P 013) where a 4 m chip sample of drill core contained 3620 ppm W and 2080 ppb Au.

Rock Flour Breccias

Rock flour breccias consist of 70-95% angular to subrounded quartzite, schist, and/or tourmalinite fragments (<5 cm) in a finely comminuted matrix of quartz, tourmaline, muscovite, chlorite and occasional biotite (silt to sand size). Up to 5% cassiterite occurs in the matrix, and minor euhedral pyrite cubes occur locally. Other sulphide minerals are uncommon, except where chlorite or tourmaline veins are present. Topaz occurs with tourmaline, quartz and cassiterite in biotitized rock flour breccia, and limonite staining is common.

These breccias are common in fault zones and are not always mineralized. However, many are tin-bearing where crystalline-matrix breccias and/or veins are also present and on close examination, many of these accompanying breccias and veins also prove to contain rock flour (Table 3).

Rock flour breccia zones are closely associated with chlorite breccias at OLIVER CREEK (MINFILE 115P 030). These zones vary from a few centimetres to 15 m wide and were probably originally tectonic but were rebrecciated by pneumatolytic-hydrothermal processes accompanying the deposition of cassiterite (Emond 1985).

Crystalline Matrix Breccias and Veins

Crystalline matrix breccias are commonly vein-like in form, with similar mineralogy and texture to the veins. They consist of 30 to 70% angular to subrounded fragments (<5 cm) of quartzite, schist, tourmalinite and vein material (Figs. 5b-d). The breccias are matrix-supported with an average of 60% matrix, (mostly quartz, tourmaline and chlorite as separate phases). Veins associated with tin or tungsten showings usually occur in steeply-dipping to vertical sheeted sets, and are mainly confined to joints in the quartzite or the associated intrusion. Textures in matrix or vein material include comb-textured quartz and orthoclase. Tourmaline and

Figure 4a. Steeply dipping quartz-orthoclase-scheelite sheeted veins cutting hornfelsed, jointed metasedimentary rocks adjacent to the Pukelman quartz monzonite stock.

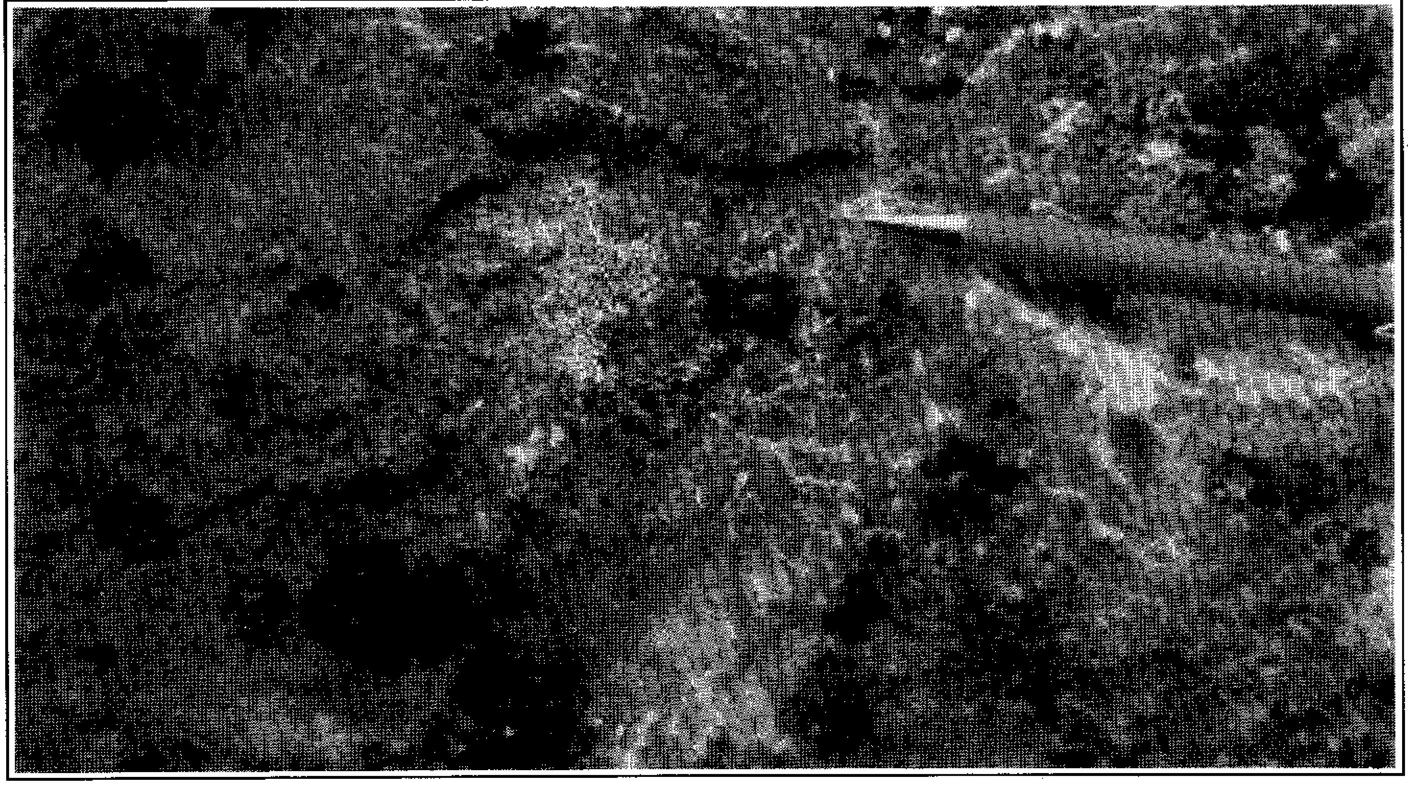

Figure 4b. Cassiterite crystals (small dark grey patches, at tip of pencil <2 mm) on joint surface of grey quartzite, JABBERWOCK (MINFILE 115P 051).

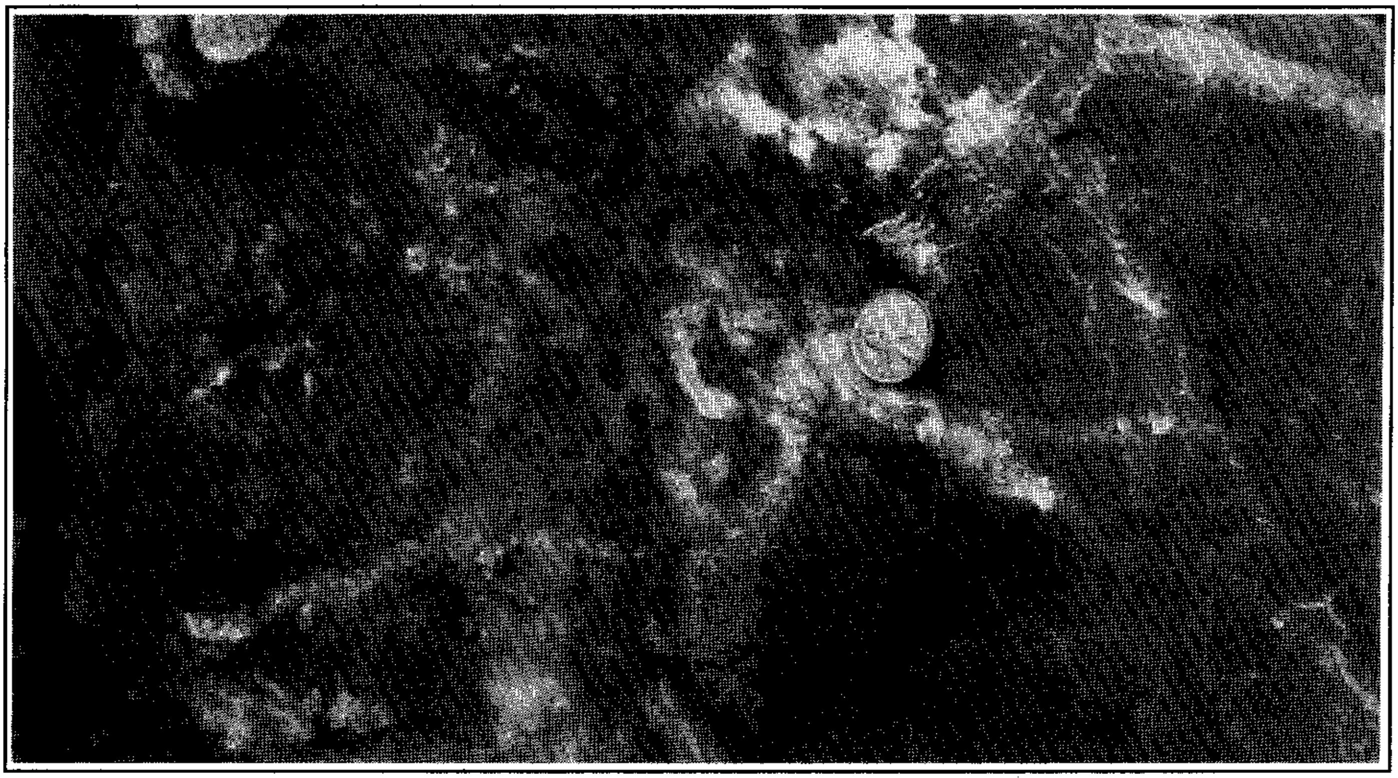

Figure 4c. Radiating tourmaline needle aggregates (black clots) with microscopic cassiterite on joint surfaces of Keno Hill quartzite with quartz veins, JOUMBIRA(MINFILE 105M 031).

chlorite occur locally in radiating aggregates in veins. Veins at OLIVER CREEK (MINFILE 115P 030) are zoned, with chlorite-cassiterite-sulphide cores and quartz margins. Oxidation of iron and manganese, and kaolinization of matrix and vein material occurs near surface.

The crystalline matrix breccias are locally heavily stained with limonite. Cassiterite crystals, crystal aggregates and fragmented crystals occur disseminated in the matrix or in vugs, forming up to 10% of the breccia. The crystals are anhedral to euhedral, display elbow twinning, and form aggregates up to 1 cm wide. Sulphides are rare, except at OLIVER CREEK (115P 030), MAHTIN (MINFILE 115P 007), and ZETA (MINFILE 115P 047).

Quartz crystalline-matrix breccias and quartz veins

Quartz crystalline matrix breccias are predominantly tin- and silver-bearing, and occur mainly at SUNSHINE CREEK WEST and EAST (MINFILE 115P 031a,b), and TEE (MINFILE 115P 008a)(Fig. 5b). They can be extensive; the SUNSHINE CREEK WEST breccia (MINFILE 115P 031a) is exposed over 200 m, and varies from 1 to 10 m wide. Up to 15% of the rock consists of open space. Tourmaline is common as an accessory phase, as an alteration of adjacent wallrocks (tourmalinite), and as fragments in breccias.

Sheeted quartz veins containing scheelite and gold occur mainly at PUKELMAN (MINFILE 115P 013)(Fig. 4a), within and on the margins of the Pukelman Stock. Most veins are 0.5 to 1.5 cm thick, but some reach 7 cm, and contain up to 10% scheelite. Molybdenite and pyrite are accessory minerals. Minor quartz stockwork containing molybdo-scheelite and scheelite cut metasedimentary rocks at SCHEELITE DOME (MINFILE 115P 004).

Relatively "dry" sheeted veins at JABBERWOCK (MINFILE 115P 051) contain cassiterite with only minor orthoclase (Fig. 4b). Orthoclase is a common accessory mineral in breccias (SUNSHINE CREEK (MINFILE 115P 031), TEE (MINFILE 115P 008a), MAHTIN (MINFILE 115P 007) and sheeted veins (both cassiterite-bearing at JABBERWOCK (MINFILE 115P 051), and scheelite-bearing at PUKELMAN (MINFILE 115P 013).

Tourmaline-dominant crystalline-matrix breccias and veins

Tourmaline-dominant breccias occur at OLIVER CREEK (MINFILE 115P 030)(Fig. 5c) and JABBERWOCK (MINFILE 115P 051), and veins occur at ZETA (MINFILE 115P 047). Pyrrhotite, pyrite, chalcopyrite and cassiterite are commonly associated with the tourmaline, along with stibnite, stannite, arsenopyrite, jamesonite and boulangerite at ZETA (Abercrombie 1990). Tourmaline also occurs as a common accessory in the granitoid rocks. At ZETA, the granite core of the zoned syenite stock contains fist-sized, tourmaline-rich orbicules. At OLIVER CREEK, intergranular granite- and aplite-hosted tourmaline is of similar composition to that from early tourmaline breccias, indicating their genesis from magmatic solutions derived from the associated granite plug (Emond 1985).

Figure 5a. Rock flour breccia with some calcite (white) stockwork (and breccia), OLIVER CREEK. Fragments are mostly quartzite.

Tourmaline also occurs in sheeted veins in the Keno Hill Quartzite and in crosscutting rhyodacite dykes at JOUMBIRA (MINFILE 105M 031) on Mt. Haldane. On the "FED showing" needle aggregates of tourmaline occur in relatively "dry" joints of the quartzite (Fig. 4c). Nearby, on the "PRO" showing, thin tourmaline veins cut a heavily sericitized and locally tourmalinized dyke. Cassiterite and fluorite occur within the tourmaline veinlets, mostly along and parallel to the margin of the 2 m wide dyke. At OLIVER CREEK, tourmaline forms steeply-dipping, millimetre size veinlets in quartzite. The veinlets are spaced several centimetres apart.

Chlorite breccias and veins

Chlorite breccias and veins are confined to the OLIVER CREEK occurrence (Fig. 5d). The chlorite matrix locally contains sphalerite, chalcopyrite, pyrite, pyrrhotite and rare galena. Cassiterite and silver are common. Due to the fine grain size, the silver mineralogy is unknown. The chlorite is a dark green, iron-rich variety and occurs in both radiating aggregates and in equant habits. Accesssory minerals are up to 5 mm in diameter. Several periods of brecciation and chlorite and cassiterite crystallization are generally evident.

Summary of Petrography

Tin and tungsten occurrences in the McQuesten River region are subdivided into (1) skarns and (2) breccias and/or veins. Most skarns are tungsten-dominated, whereas most breccias and veins are tin-bearing.

The skarns are calcic and reduced, and show evidence of a three stage evolution: (1) isochemical contact metamorphism of limestone to form diopside, wollastonite, tremolite and grossular garnet; (2) metasomatic formation of hedenbergite, andradite, axinite and sulphides; and (3) retrograde hydrolysis and formation of actinolite, clinozoisite, epidote, chlorite, sulphides and calcite. Scheelite, cassiterite and most sulphides are associated with the retrograde stage.

Early rock flour breccias were followed by crystalline-matrix breccias and veins with the following mineral paragenesis: (1) quartz (± orthoclase, cassiterite or scheelite); (2) tourmaline (± cassiterite and iron-sulphides); (3) chlorite (± cassiterite, sulphides, epidote, muscovite, biotite); (4) calcite, topaz, fluorite; (5) limonite, manganese oxide, kaolinite. Stages 2 and 3 are similar to the second and third stages of skarn mineral formation and indicate a similar genesis.

GEOCHEMISTRY

During property investigations, representative rock samples including grab and chip samples were collected from mineral showings. Samples include mineralized wallrock, wallrock adjacent to veins, barren skarn and mineralized skarn. Bondar-Clegg & Co. Ltd of Vancouver carried out 33 element ICP analysis of more than 110 samples. Elements analysed include Au, Sb, As, Ba, Cd, Cs, Cr, Co, Eu, Hf, Ir, Fe, La, Mo, Ni, Rb, Sc, Se, Ag, Ta, Th, W, U, Yb, Zn, Cu, Pb, F, Bi, Li, Sn and Nb. Appendix 1 lists analyses for Sn, W, Ag, Au, Pb, Zn, Cu, As, Sb, Bi, and F only.

The main problems addressed by this study are: (1) What are the relationships between tin and tungsten? (2) What are the relationships between tin/tungsten and precious metals? (3) Is bismuth a pathfinder element for gold?

The following discussion considers veins and breccias separately from skarns, and examines variations in the elements tin, tungsten, gold, silver and bismuth. Geochemical variations are displayed on two types of diagrams: (1) two metal plots (XY plots) where all samples are plotted to see if there is a correlation between the two metals; and (2) frequency diagrams (histograms) where all samples are plotted to study the variation in content of one metal.

Tin-Tungsten Relationship

Figure 6 is a plot of tungsten versus tin. It shows that some rocks are exclusively tin-rich, while other rocks are exclusively tungsten-rich. A third group of tin-rich samples (enclosed by dashed line) shows a general increase in tungsten with increasing tin content, although most samples with significant amounts of tungsten contain no tin.

Figure 7 is a frequency diagram which shows tungsten variation in samples from tin exploration targets. The figure shows that over 80% of these samples contain less than 50 ppm W. However, significant tungsten occurs in veins at JOUMBIRA (MINFILE 105M 031) and ZETA (MINFILE 115P 047)(up to 3600 ppm), and in skarn at SNARK (MINFILE 115P 008b)(up to 3270 ppm).

Figure 8 is a frequency diagram which shows tin variation in samples from tungsten exploration targets. It shows that over 80% of these samples have less than 25 ppm Sn. Significant tin occurs in skarn at SCHEELITE DOME (MINFILE 115P 004)(920 ppm) and LUGDUSH (MINFILE 115P 009).

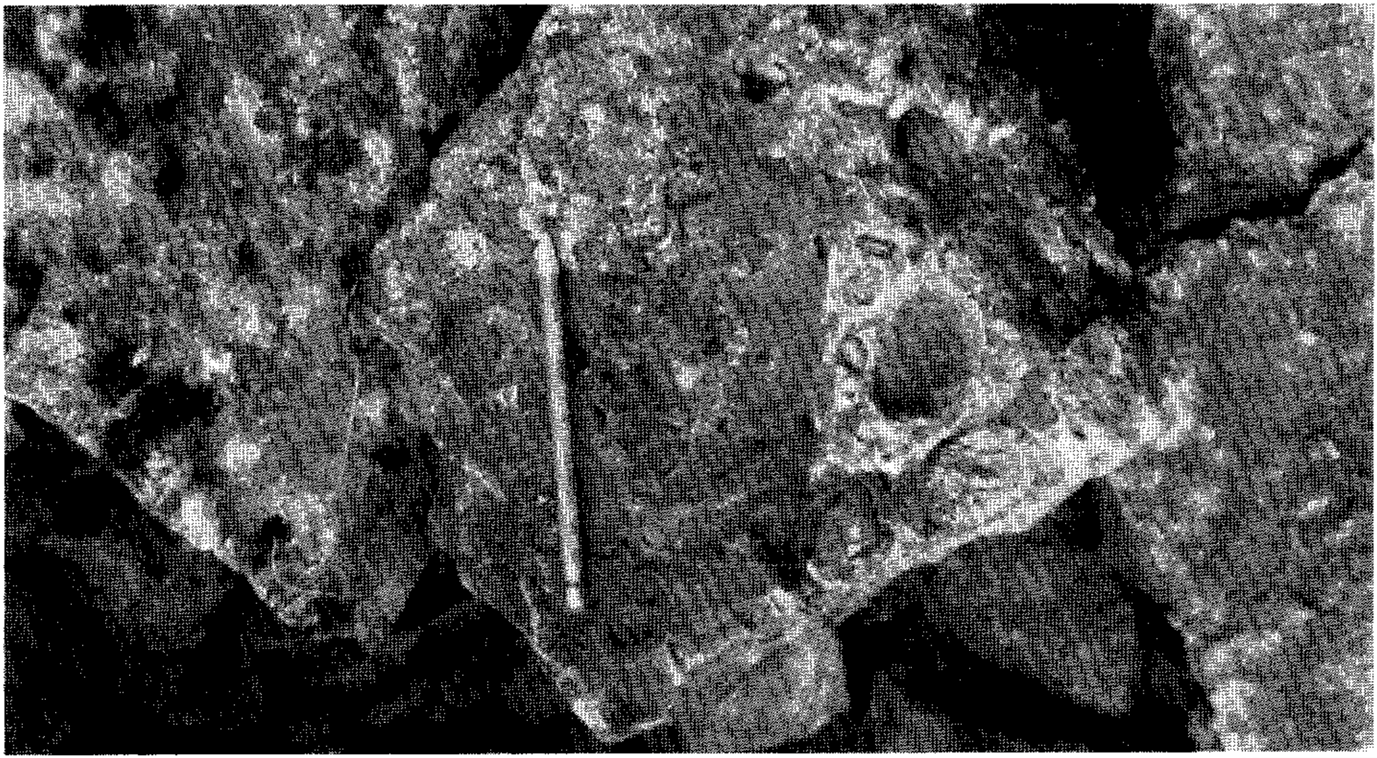

Figure 5b. Quartz-matrix breccia, SUNSHINE CREEK WEST (MINFILE 115P 031). Rounded mica schist fragments with comb-textured quartz matrix.

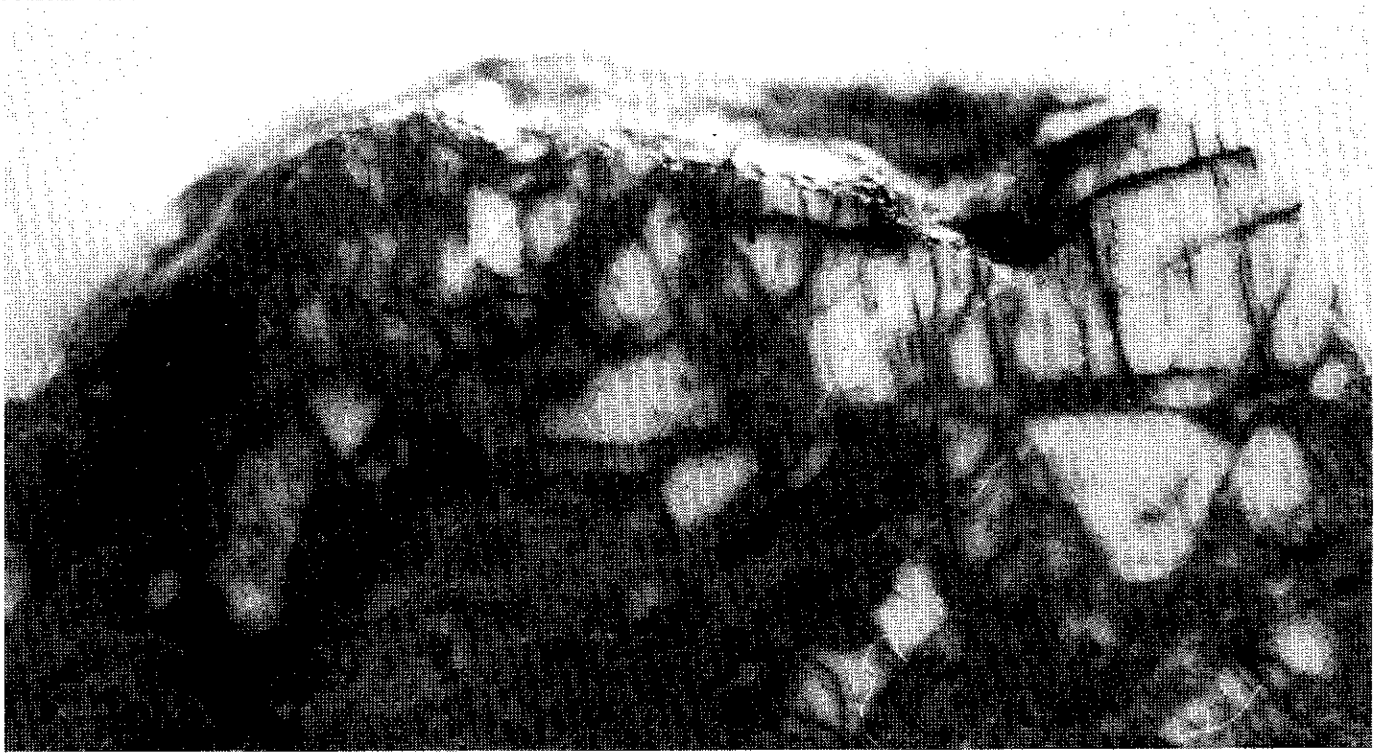

Figure 5c. Tourmaline-matrix breccia with quartz vein (white) and tourmaline vein (black) fragments, OLIVER CREEK (MINFILE 115P 030).

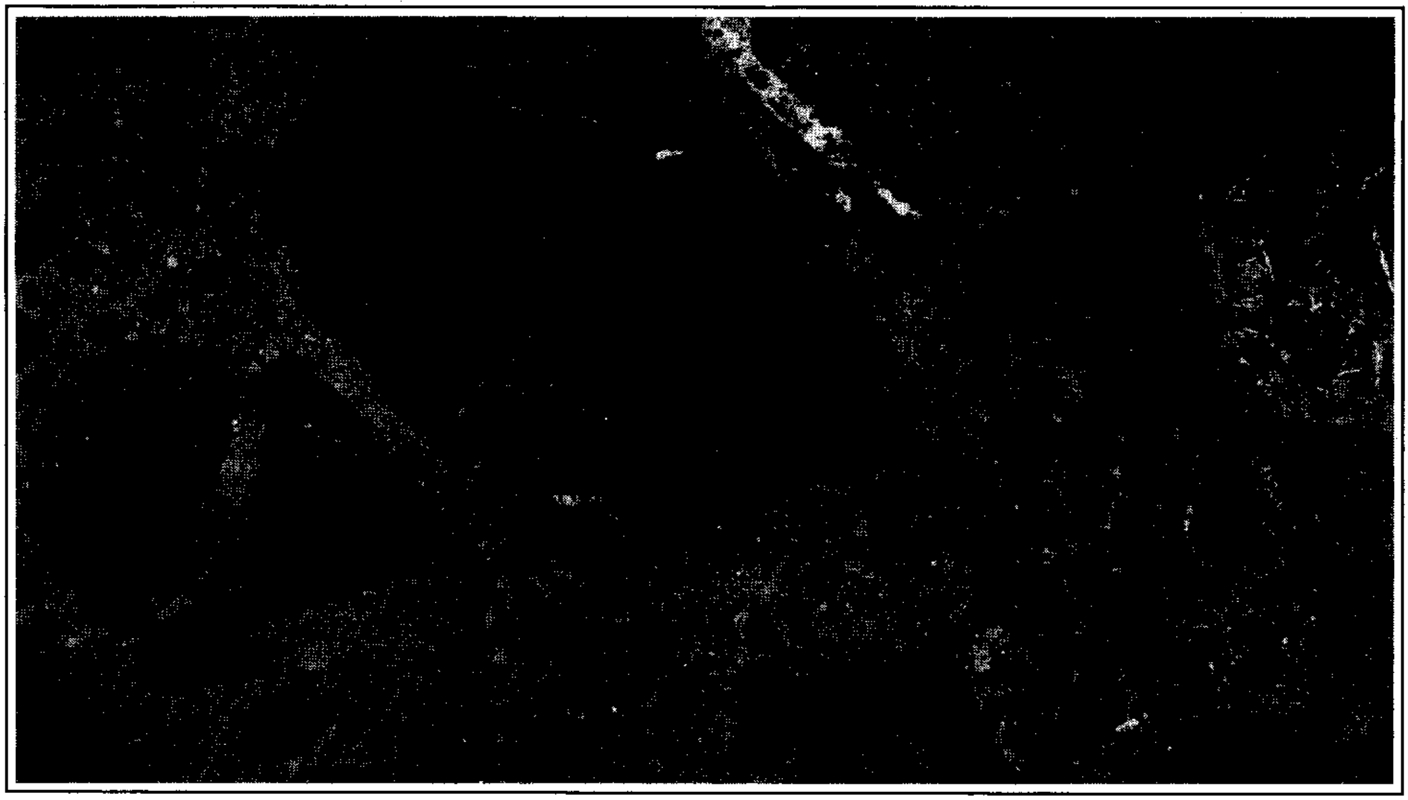

Figure 5d. Full view of thin section of chlorite-matrix breccia with quartzite (black) and chlorite vein (grey) fragments, OLIVER CREEK (MINFILE 115P 030).

Tin and Tungsten versus Precious Metals

a) Tin versus Silver

A plot of tin versus silver (Fig. 9) shows that most skarns contain no silver. A substantial group of number of mostly vein samples contain significant silver, but no correlation between tin and silver is evident. A gap in this random distribution exists: samples with less than 50 ppm tin contain little to no silver. Rocks containing over 50 ppm tin are more likely to contain some silver.

Figure 10 is a frequency diagram showing silver variation. Two groupings are evident in the data and represent: (i) tin exploration targets, and (ii) tungsten exploration targets. Almost 80% of the samples contain less than 5 ppm Ag. Also, almost all samples containing appreciable silver are from tin exploration targets. Samples from tungsten properties contain no silver. Properties containing significant silver include tin veins at ZETA (MINFILE 115P 047) up to 1060 ppm), TEE (MINFILE 115P 008a)(500 ppm), SUNSHINE CREEK (MINFILE 115P 031) and OLIVER CREEK (MINFILE 115P 030)(30 ppm); and some silver is contained in the tin skarn at SNARK (MINFILE 115P 008b).

b) Tin versus Gold

The plot of tin versus gold (Fig. 11) shows that most skarns contain gold. However, there is no direct relationship between the amount of tin and the amount of gold. Some tin-mineralized rock is gold-bearing and some is not.

c) Tungsten versus Gold

The plot of tungsten and gold (Fig. 12) also shows that most skarns contain gold. Many of the veins (mostly the tin-bearing type) contain no gold. The diagram shows a random distribution indicating that tungsten has no direct correlation with gold.

d) Gold Variation

The gold frequency diagram (Fig. 13) divides samples into: (1) tin exploration targets, and (2) tungsten exploration targets. More than 35% of the samples contain significant gold (>25 ppb). Gold is important in the WAYNE gold-tungsten occurrence (MINFILE 105M 029)(up to 22 700 ppb), the SCHEELITE DOME (MINFILE 115P 004) and TEE (115P 008a) tungsten skarns (2080 ppb), and in the PUKELMAN (MINFILE 115P 013) tungsten sheeted veins (7630 ppb). Gold is also important and was previously unrecognized in tin (-tungsten) skarn at SNARK (115P 008b)(3670 ppb), TEE, and MAHTIN (MINFILE 115P 007); and in tin-bearing veins at TEE (940 ppb). To stress the significance of these gold values: three 5m chip samples (15 m total width) across the SNARK tin-tungsten skarn assayed 2227 ppb Au (0.065 oz/t) along with 1210 ppm W and 951 pp Sn.

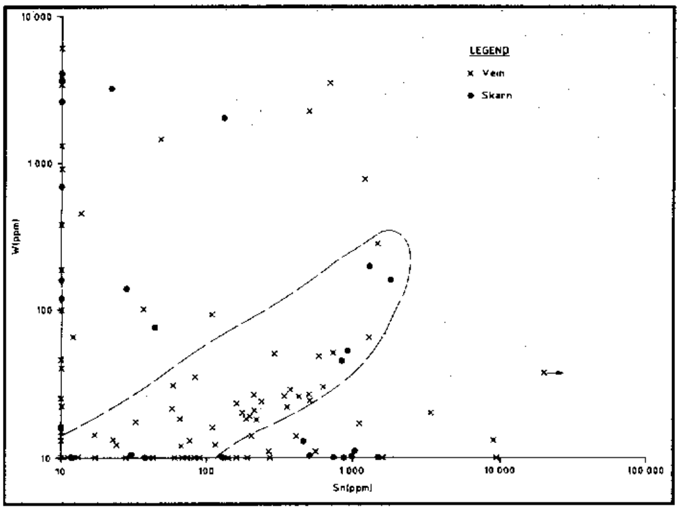

Figure 6. Graph of tungsten against tin.

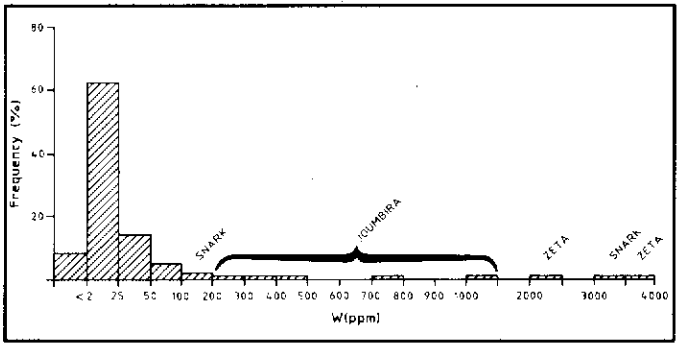

Figure 7. Frequency diagram of tungsten variation in samples from tin exploration targets.

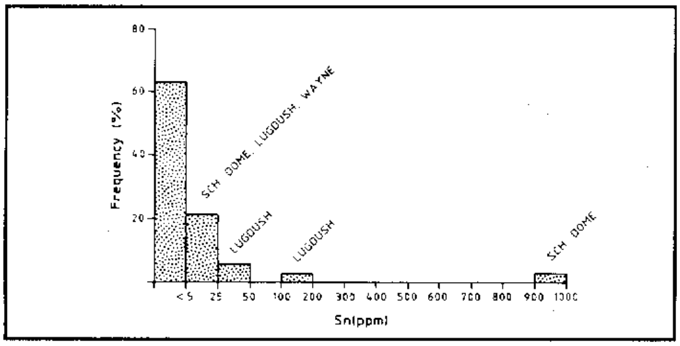

Figure 8. Frequency diagram of tin variation in samples from tungsten exploration targets.

e) Gold versus Bismuth

The plot of gold versus bismuth (Fig. 14) demonstrates that most gold-bearing skarns contain bismuth, and that there is a strong positive correlation between gold and bismuth. Many veins also contain bismuth, but no positive correlation between gold and bismuth is evident.

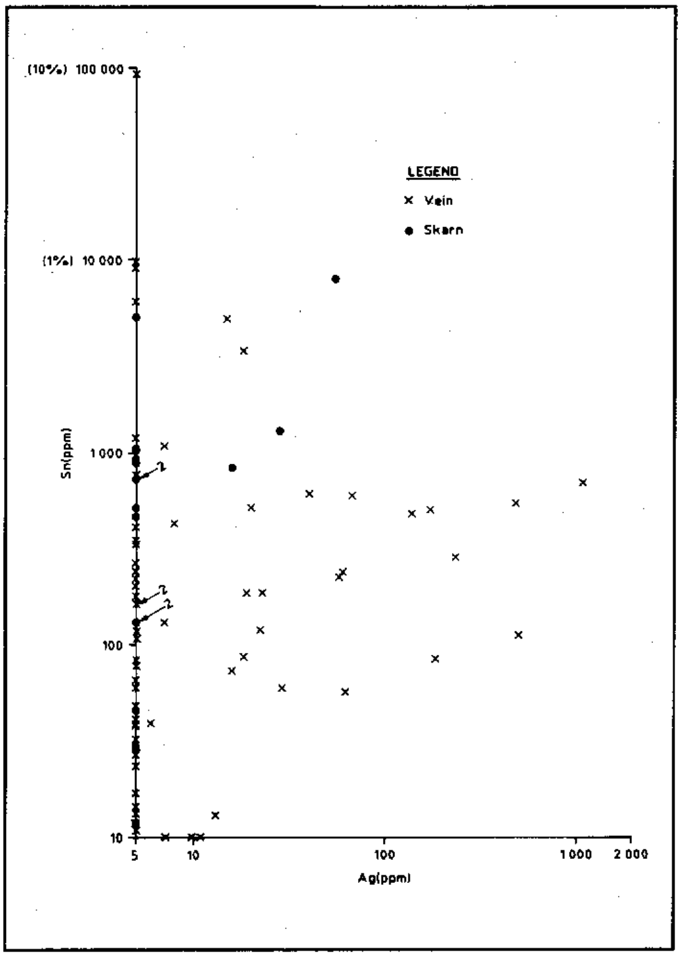

Figure 9. Graph of tin versus silver.

The frequency diagram for bismuth (Fig. 15) shows that over 70% of the samples contain less than 10 ppm Bi, and over 25% contain anomalous bismuth (up to 450 ppm at WAYNE (MINFILE 105M 029), and 264 ppm at SUNSHINE CREEK (MINFILE 115P 031)). The strong correlation indicated by the gold-bismuth plot (Fig. 14) suggests that skarns containing anomalous bismuth have a good gold potential. Most of the skarns contain high gold, except LUGDUSH (MINFILE 115P 009)(208 ppm Bi) which had only slightly anomalous values. The bismuth values at LUGDUSH suggest that the gold potential of this property should be re-evaluated.

Summary of Geochemical Results

(1) There is a positive correlation between tungsten and tin in some tin-bearing samples. Tungsten is evident in the ZETA (MINFILE 115P 047) and JOUMBIRA (MINFILE 105M 031) tin veins, and at the SNARK (MINFILE 115P 008b) tin (-tungsten) skarn properties. There is some tin at the SCHEELITE DOME (MINFILE 115P 004) and LUGDUSH (MINFILE 115P 009) tungsten skarn properties.

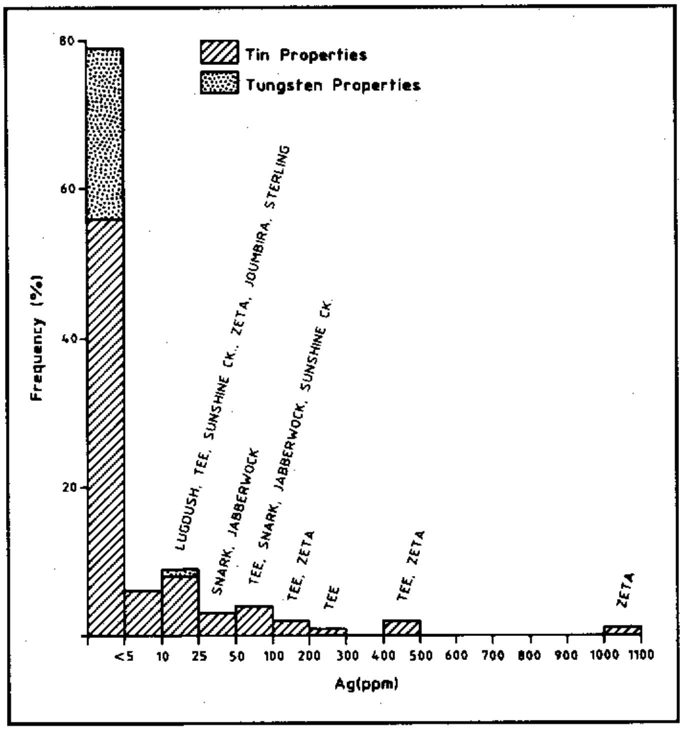

Figure 10. Frequency diagram of silver variation in samples from tin exploration targets and tungsten exploration targets.

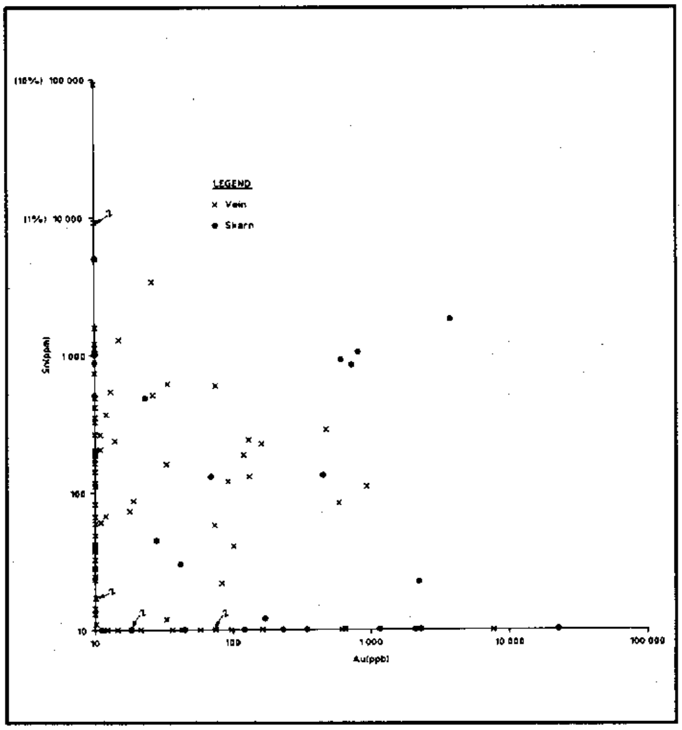

Figure 11. Graph of tin versus gold.

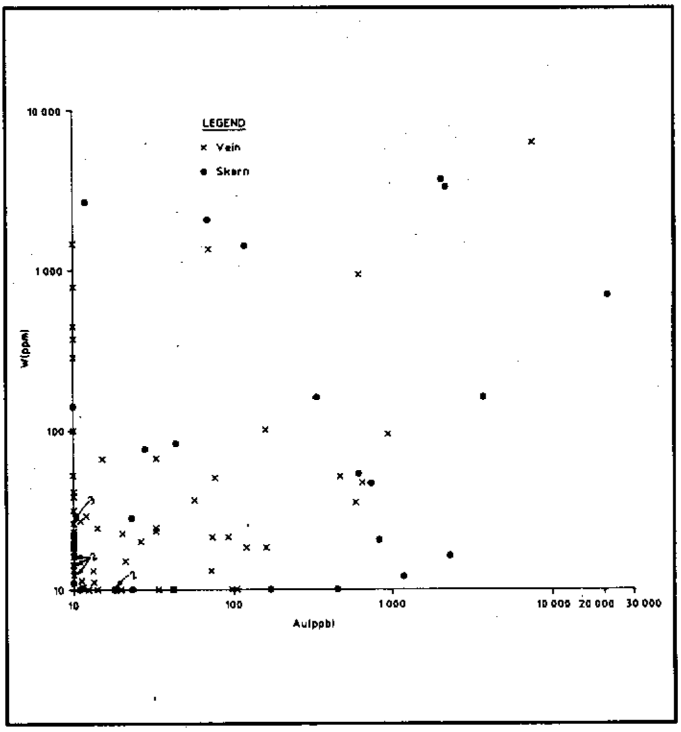

Figure 12. Graph of tungsten versus gold.

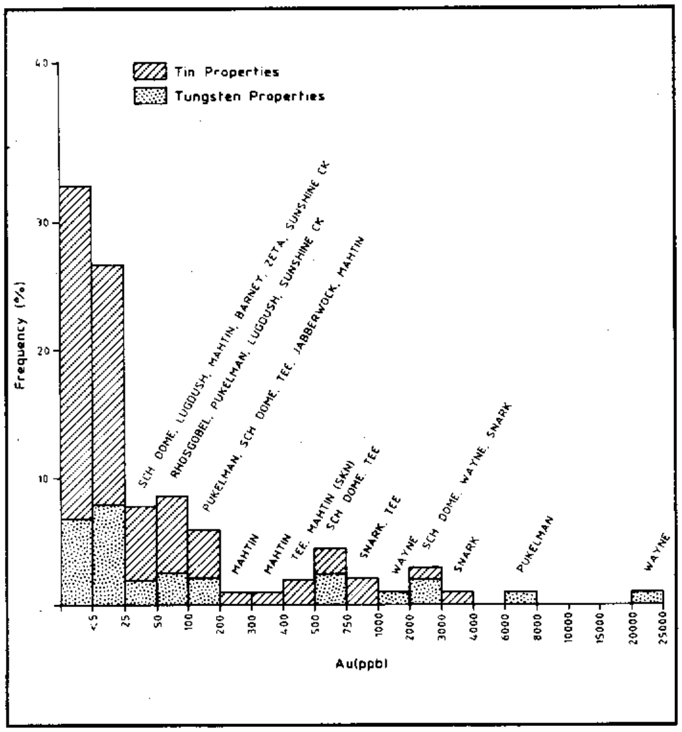

Figure 13. Frequency diagram of gold variation in samples from tin exploration targets and tungsten exploration targets.

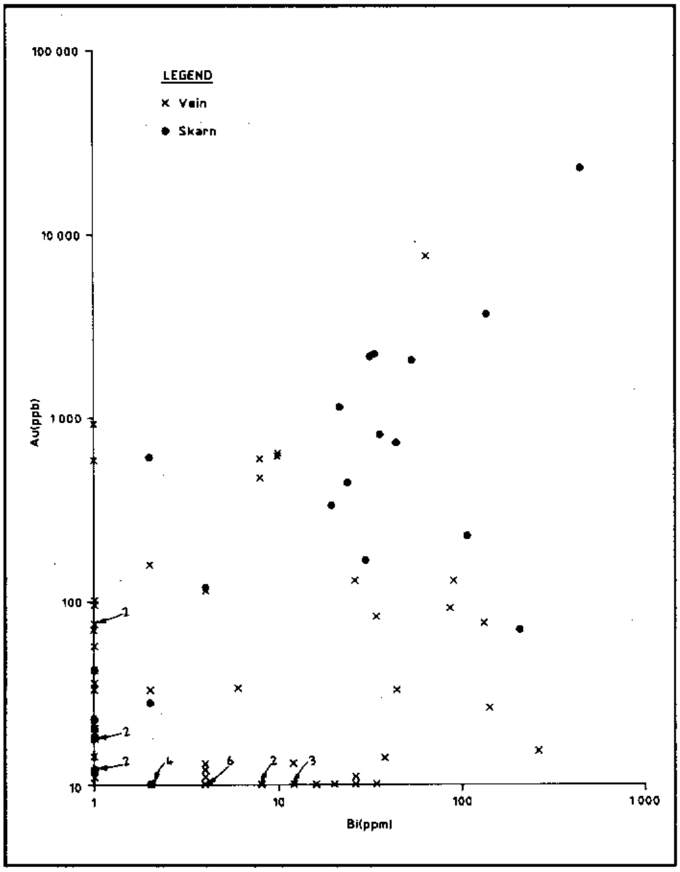

Figure 14. Graph of bismuth versus gold.

(2) Silver correlates with tin in veins containing more than 50 ppm Sn. Silver is important in the ZETA (MINFILE 115P 047), TEE (MINFILE 115P 008a), OLIVER CREEK (MINFILE 115P 030) and SUNSHINE CREEK (MINFILE 115P 031) tin veins and breccias, and in the SNARK (MINFILE 115P 008b) and OLIVER CREEK tin skarns. Other known tin showings probably also have silver potential, and in fact a silver-lead vein (the QUEST showing) was recently discovered by Silverquest Resources Ltd near the SNARK, BOULDER CREEK (MINFILE 115P 048) and TEE occurrences following the release of assessment reports on these properties.

(3) This study demonstrates that the McQuesten River area has gold as well as tin-tungsten potential. Most skarns and several veins contain appreciable gold, although no direct correlation exists between gold and either tin or tungsten. Significant gold values were previously known at the SCHEELITE DOME (MINFILE 115P 004) and WAYNE (MINFILE 105M 029) tungsten skarns. Gold also occurs in significant quantities in the SNARK (MINFILE 115P 008b), TEE (MINFILE 115P 008a) and MAHTIN (MINFILE 115P 007) skarns and in the TEE and PUKELMAN (MINFILE 115P 013) veins where it was previously unknown. Further discoveries may be expected. Recently a new gold-bearing vein, the RUM showing, was found by Goldrite Mining Corp. on the JOSEPHINE (MINFILE 115P 011) property, presently under option to Noranda Exploration Co. Ltd.

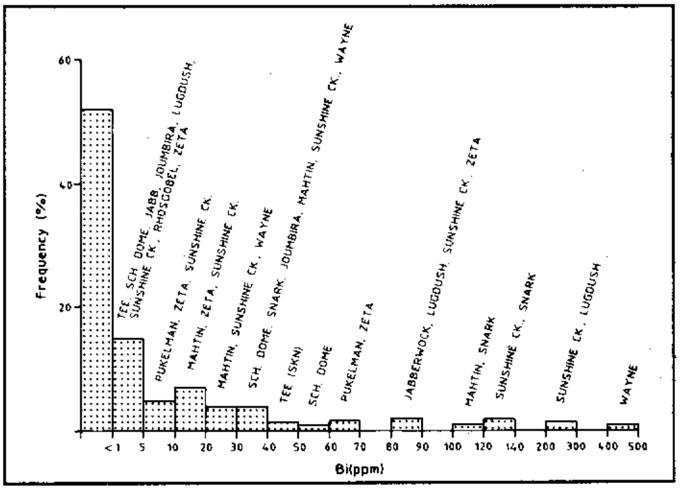

Figure 15. Frequency diagram of bismuth variation in all samples.

(4) Skarns show a strong positive correlation between gold and bismuth, demonstrating that bismuth can be used as a gold pathfinder. The LUGDUSH tungsten skarn (MINFILE 115P 009) contains significant bismuth and should be reexamined for gold.

CONCLUSIONS

Skarns, breccias, veins and sheeted vein systems of similar chemical composition form elongated belts in many tin-tungsten districts. Kwak (1987) explained: "Where carbonate is absent, other styles of similar mineralization such as vein systems may be interspersed between skarn deposits." The associated granitoids show a similar specialization pattern worldwide: W (-Mo-Cu) skarns containing little or no tin are commonly related to calcic magnetite-bearing granitic plutons (similar to RHOSGOBEL, (MINFILE 115P 012)), while Sn (W-F-Be-Li) skarns are typically related to low Ca, high Si & K, ilmenite-bearing plutons (LUGDUSH (MINFILE 115P 009), SCHEELITE DOME (115P 048), SNARK (MINFILE 115P 008B), BOULDER CREEK (MINFILE 115P 048), OLIVER CREEK (MINFILE 115P 030)(Kwak 1987).

Several conclusions from this study have implications for mineral exploration: (a) several tin and tungsten showings are open for staking; (b) several tin properties should be re-evaluated for tungsten potential and vice versa; (c) silver is expected in tin-bearing veins and skarn; (d) gold is important in most skarns and some veins, and was previously unrecognized at some of these properties; and (e) bismuth can be used as a pathfinder for gold in skarn and has defined several gold targets which were previously recognized only for tungsten, and (f) granitoid specialization defines the expected deposit type.

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ABBREVIATIONS USED IN TABLES

GRAN	granite
GRDI	granodiorite
QZIT	quartzite
QZMZ	quartz monzonite
PP	porphyry
RHY	rhyolite
RYOD	rhyodacite
SYEN	syenite
VN	vein
VNQZ	vein quartz
AC	actinolite
ASP	arsenopyrite
AX	axinite
BI	biotite
BOUL	boulangerite
CB	carbonate
CC	calcite
CL	chlorite
CO,COR	corundum
CP	chalcopyrite
CT	cassiterite
DI	diopside
EP	epidote
FL	fluorite
FS	feldspar
GL	galena
GOE	goethite
GT	garnet
HB	hornblende
ID	idocrase
JAM	jamesonite
LI	limonite
KA	kaolinite
KSP	K feldspar
MN	manganese oxide
MO	molybdenite
MO-SCH	molybdoscheelite
MU	muscovite
OR	orthoclase
PH	phlogopite
PL	plagioclase
PR	pyrrhotite
PY	pyrite
QZ	quartz
RKFL	rock flour
SCH	scheelite
SER	sericite
SL	sphalerite
STAN	stannite
SX	sulphide minerals
TO	tourmaline
TOP	topaz
TR	tremolite
WO	wollastonite

Table 1. Skarn occurrences, including skarn from vein properties (location map in Fig. 1).

Property Name **Minfile No.** **Location**	**Host Rock**	**Associated Pluton**	**Mineral Assemblages (stages)**	**Best Assay This Study (earlier)**
Tungsten Skarns:				
LUGDUSH **115P 009** **A**	Hyland Gp (Grit Unit)	BI-MU GRAN Stock (megacrystic PP)	DI-PL-OR-CO-QZ-CC-HB-PR-HB-SC	Best grab: 2050 ppm W, 8000 ppm Zn (800 X 150-200 m area, 0.1% WO_3; highest grab 2.18% WO_3)
SCHEELITE DOME **115P 004** **H**	Hyland Gp	HB-BI GRAN stock (PP)	WO-DI-CC-QZ-OR-PL(+/-GT) DI-AC-TR-QZ-CC-OR-BI-SC	4m Chip: 3620 ppm W, 2080 ppb Au (6.67 g/t Au over 3 m; 4800 ppm W over 1.5 m)
RHOSGOBEL **115P 012** **L**	Hyland Gp	BI-HB QZMZ Stock (PP)	QZ-DI-AC-PL-BI-SC QZ-DI-OR-WO-BI-SC	Best grab: 2630 ppm W
WAYNE **105M 029** **(5 km E of Mt Haldane)** **P**	Keno Hill Quartzite	MU-BI RHY? Dyke (PP)	DI-AC-CC-QZ-SC TR-CC-QZ-DI	Drill core: 22 700 ppb Au 696 ppm W 450 ppm Bi
Tin Skarns:				
TEE **115P 008a** **B**	Hyland Gp	HB-BI GRDI Stock	AC-QZ-PR-CP-PY-AX	Grab: 845 ppm Sn 740 ppb Au 2.38% Zn 0.22% Cu 16 ppm Ag
SNARK **115P 008b** **C**	Hyland Gp	MU-BI RYOD Dyke	AC-QZ-EP-AX-GL-PR-CP-SL-PY-SCH	Avg 3 grab over 15 m: 2227 ppb Au 28 ppm Ag 1210 ppm W 951 ppm Sn 5553 ppm Cu 3740 ppm Zn
BOULDER CREEK **115P 048** **D**	Hyland Gp	BI-MU GRAN Stock	AX-CC-AC-ID-GT-PL-EP-QZ	Avg 5 chip over 25 m exposure, 10-15 m thick: 1036 ppm Sn
OLIVER CREEK **115P 030** **G**	Hyland Gp	BI-MU GRAN	AC-CL-CC-DI-QZ-EP-PR-PY-SCH-CT	Drill core: 0.9% Sn, 4 ppm Ag over 1.7 m

Skarn from Vein Properties

MAHTIN **115P 007** **J**	Hyland Gp	BI-HB QZMZ Stock	DI-CC-GT-QZ	Grab from 10 X 4 m unit: 450 ppb Au 130 ppm Sn
			DI-TR-QZ-CC--AS-PR-CP	Grab of float: 340 ppb Au 160 ppm W 870 ppm Cu 531 ppm As
SUNSHINE CREEK EAST **115P 031a** **F**	Hyland Gp	BI-MU GRAN	DI-TR-BI-QZ-OR-SCAP	low metal values

Table 2. Mineralogy of tin and tungsten skarns, McQuesten River region.

Mineral	Abundance	Size (mm)	Color	Habit	Diagnostic	Association	Other
ISOCHEMICAL STAGE							
Diopside	25-40%	0.1-2	Pale brown to green	Anhedral aggregates	Cleavages at 90°, moderate birefringence	Replaced by clinozoisite and actinolite	Most common isochemical mineral in both Sn & W skarns
Grossularite	10-60%	0.5-2	Light brown	Dodecahedral, often subhedral	Isotropic or anomalous isotropic extinction	Occurs with axinite, idocrase & diopside in Sn skarns. Replaced by calcite & epidote.	Often zoned
Wollastonite	30-60%	0.1-0.25	Colorless	Fibrous, radiating radiating	Fibrous habit, low birefringence	Occurs with quartz, fsp & diopside	More common in W skarns
Tremolite	20-30%	0.1-1.0	Colorless	Prismatic to anhedral	120° cleavages	Occurs with diopside	Found in W & Au-bearing skarns
Quartz	10-40%	0.1-1.5	Colorless	Anhedral, often strained	Low birefringence & relief	Forms interlocking mosaic with orthoclase	Found in almost all skarn assemblages; more where no metasomatic minerals have been introduced
Orthoclase	5-15%	0.1-0.5	Colorless	Anhedral	Lack of twinning, biaxial	Found with quartz	Common in Sn & W skarn assemblages
Calcite	5-20%	3.0 (approx.)	Colorless	Elongate prisms	Growth twinning, high interference colours	Occurs with axinite, garnet, idocrase	Occurs in Sn skarns in this stage.
Corundum	20-30%	0.1-0.3	Colorless	Granular	Low birefringence, uniaxial negative, sometimes biax., high relief	Associated with diopside, quartz & calcite in a W-bearing skarn	Rare. Only found in one thin section from Lugdush.
METASOMATIC STAGE							
Scapolite	5-15%	0.1-0.3	Colorless, with a mottled appearance	Anhedral aggregates	Low birefringence, uniaxial negative	Occurs with biotite and diopside	Rare. Found in only one section from Sunshine Creek
Axinite	30-40%	1-4	Colorless to light brown	Euhedral, wedge-shaped	"Axe-head" shape, low birefringence	Occurs with garnet & idocrase. Replaced by actinolite & epidote	Sn-skarns only
Idocrase	5-30%	1-2	Light brown	Equidimensional, sub-anhedral	Blue anomalous interference colours, high relief	Occurs with axinite & garnet in Sn skarns	Sometimes difficult to distinguish from garnet
Andradite	10-60%	0.5-2	Light brown	Dodecahedral, sub to anhedral	Isotropic or anomalous isotropic extinction	Occurs with axinite, idocrase, diopside in tin skarns	Commonly zoned; unable to distinguish from andradite, but assumed both the Al & Fe-rich varieties may exist
Pyrite	1-2%	0.5-4	Light yellow	Anhedral, disseminated flakes	Isotropic	Assoc. with clinozoisite, diopside, wollastonite, & other	Uncommon, minor in Sn & W skarns
Pyrrhotite	< 5%	0.5-1.5	Creamy brown	Anhedral disseminated	Strongly anisotropic	Assoc. with other sulphides	Most common sulphide mineral in skarns
Chalcopyrite	1-2%	0.5-1	Brassy yellow	Anhedral disseminated	Tarnish, weakly anisotropic	Assoc. with other sulphides	Not common
Sphalerite	< 3%	0.1-1	Gray	Anhedral aggregates	Isotropic	Assoc. with other sulphides	Not common
Galena	< 3%	1-3	White to light grey	Anhedral, diss. & veinlets	Isotropic	Assoc. with other sulphides	Not common

Mineral	Abundance	Size (mm)	Color	Habit	Diagnostic	Association	Other
RETROGRADE STAGE							
Actinolite	up to 65%	0.1-1	Light green	Acicular, fibrous aggregates	Green colour, habit, pleochroic	Replaces diopside, axinite	Very common in Sn & W skarns
Clinozoisite	5-20%	0.1-1	Colorless to light brown to light green	Anhedral masses	Anomalous blue interference colours	Replaces diopside, forms haloes around sulphides	Quite common, especially at at the Wayne occurrence
Epidote	5-40%	0.1-0.5	Pale green, moderately pleochroic	Anhedral aggregates, stubby prismatic	Green color, high relief, moderate birefringence	Replaces garnet & axinite, & associated with sulphides	Quite common
Calcite	5-10%	0.5-2	Colorless	Anhedral	High birefringence	Replaces garnet, wollastonite axinite, idocrase, diopside	Very common
Phlogopite	up to 30%	0.2-0.6	Colorless	Radiating bundles deformed	Very high birefringence gence	Occurs with calcite	Rare-seen in Sn skarn assemblage
Hornblende	2-5%	0.1-0.5	Pleochroic in shades of green	Anhedral-subhedral, prismatic	120° cleavage, green colour	Replaces diopside where actinolite is absent	Not common in Sn & W skarns
Biotite	5-35%	0.1-1	Pleochroic in shades of brown	Platy	Brown-green colour, perfect cleavages	Associated with sulphides & scheelite	Occurs in skarns in contact with biotite hornfels.
Scheelite	1-3%	0.2-2	Sugary-brown	Anhedral disseminated grains	Grainy appearance, high relief	Occurs with diopside/actinolite, sulphides & biotite	Found in W skarns

Table 3. Breccia and/or Vein Occurrences (for location map, see Fig. 2).

Property Name Minfile No. Location	Host Rock	Associated Pluton	Matrix-Gangue Minerals (% Matrix)	Fragments	Best Assay This Study (earlier)
Tin-Silver Breccias:					
TEE 115P 008a B	Hyland Gp	HB-BI GRDI Stock	QZ-OR (50-70%) 10% open sp. <3% CT	angular to subrounded, 1-5 mm QZIT, mod-poor sorting	0.1 to 1.5 m wide zone, over 150 m long, avg six grabs from six trenches 300 ppb Au, 139 ppm Ag, 1724 ppm Pb, 1485 ppm Zn, 105 ppm Sn, 167 ppm Cu
SUNSHINE CREEK WEST 115P 031a E	Hyland Gp	BI-MU GRAN Stock	QZ-OR-TO (50-70%) CT <15% open spaces	subangular to subrounded < 5 cm QZIT mod-poor sorting	1-10 m wide, 200 m long, avg 10 grabs at 20 m intervals along length: 308.5 ppm Sn, 877 ppm Pb, 263 ppm Cu, 1740 ppm As Other grab: 67 ppm Ag; Other grab:120 ppb Au, 600 ppm Sn, 900 ppm Pb; (Cominco drill int: 7.6 m 0.28% Sn)
SUNSHINE CREEK EAST 115P 031b F	Hyland Gp	Bi-MU GRAN Stock, RHYOD Dyke	QZ-TO-OR <1% CT (20-50%) No open space	angular to subangular <2 cm QZIT, TO, VNQZ mod-poor sorting	1 to 5 m wide, 10 m long, avg 2 grab sam: 2350 ppm Sn, 23 ppm Ag
OLIVER CREEK 115P 030 G	Hyland Gp	BI-MU GRAN	Rock Flour (10-30%); Crystalline: CL; TO; QZ; CC; MU; BI; KA (20-50%) <5% CT SL,CP,PY,PR,GL	angular to subrounded 1-4 cm QZIT, SCH, VN mat, mod-poor sorting	(Drill core: Over 3.7 m 0.94% Sn & 11.83 g/t Ag; Over 0.95 m 2.45% Sn & 2.1 g/t Ag - Billiton Canada)
MAHTIN 115P 007 J	QZMZ, Hyland Gp	HB-BI QZMZ	TO-ASP-PY; QZ-OR-SER-Rock Flour; QZ-CC-TO-SER-ASP-PY-STIB-CP veinlets	angular to subrounded, < 3 cm QZMZ, mod sorting	1 X 15 m zone: Best grab 7 ppm Ag, 1650 ppm Cu, 130 ppm Sn, 130 ppb Au, 299 ppm Sb; < 100 ppm Ag - (Best grab - < 100 ppm Ag: Billiton Metals Canada)

Table 3 (continued)

Property Name Minfile No. Location	Host Rock	Associated Pluton	Matrix-Gangue Minerals (% Matrix)	Fragments	Best Assay This Study (earlier)
Tin-Silver Veins, Sheeted Veins					
JOUMBIRA **115M 031** **I**	Keno Hill Quartzite	BI-QZ RYOD (PP), BI-MU GRAN	TO-CT-FL, QZ-MU, QZ-TO-MU-SL-PY-ASP	Sheeted veins in joints	PRO showing: Grab 1200 ppm Sn & 798 ppm W; FED showing: Grab 740 ppm Sn & 1460 ppm W;
			QZ-SL-PY-GL	Vein	Fortune Ck showing: Grab 10 000 ppm Zn, 1500 ppm Sn 283 ppm W, 15 ppm Ag
JABBERWOCK **115P 051** **K**	Hyland Gp	BI-HB RYOD (PP)	OR-QZ-CT	Sheeted veins in joints	Avg 2 grab samples 9450 ppm Sn
ZETA **115P 047** **N**	Syenite	HB-BI SYEN, QZMZ, GRAN	TO-MU-ASP-PY-JAM-BOUL-CT-STAN	Greisen vein	(<1 km long zone, 150 m str. length, 50 m depth, 2 m avg width; Shallow - 103-137 g/t Ag; Deeper - 686-1234 g/t Ag; Avg Sn throughout - 0.1% with up to 0.6% Sn locally (Noranda) Recent drill indicated silver reserves: 98 248 tonnes of 557.8 g/t Ag - Danra Resources)
Tungsten-gold Sheeted Veins					
PUKELMAN **115P 013** **M**	Hyland Gp, QZMZ	BI-HB QZMZ	QZ-OR-SCH	Sheeted veins in joints	Grab 7630 ppb Au, 6100 ppm W (200 x 200 m zone outlined) - 9 samples avg 0.05% WO_3 (Cathro);
			QZ-ASP-GL		Grab of QZ-SX vein in HNFLS 19.3 g/t Au, 227.6 g/t Ag, 4.48% Pb)(Bema)

Abbreviations: see Appendix 2

Appendix 1. Hand sample description and geochemical analyses of mineralized rock.

Sample No.	Sn	W	Ag	Au	Pb	Zn	Cu	As	Sb	Bi	F	Description
BOULDER CREEK (MINFILE 115P 048)												
E-85-01	1050	11	<5	8	69	510	7	5	1.6	<1	510	Ophicalcite: CC-PH-CL-OR (-AX-QZ) skarn
-02	746	<2	<5	<5	35	<200	3	5	1.7	<1	470	GT-CC-AC-AX-SCH skarn
-03	1500	5	<5	<5	18	320	2	6	3.3	<1	580	AX-GT-EP-CC (-QZ-AC-PL-SCH) skarn
-04	1000	3	<5	<5	20	290	2	5	5.5	<1	490	ID-GT-CC-EP-AC-QZ-AX skarn
-05	885	<2	<5	<5	26	440	2	6	1.3	<1	420	AX-CC-AC-ID-GT-PL skarn
-06	68	4	<5	12	39	<200	42	132	7.0	<1	970	QZ stockwork and breccia
-200	510	4	<5	<6	32	250	4	84	44.4	<1	400	Garnetite: 60% GT, 25% DI, 10% AX, CC, AC
TEE (MINFILE 115P 008a)												
E-85-07	845	46	16	740	32	23,800	2200	15	0.9	44	550	QZ-OR-AC-ID-CC-DI (-TOP-GL-PR-PY-SL-CP-AX)
-08	40	5	<5	100	1770	6700	89	962	29.7	<1	530	QZ breccia and stockwork
-09	285	50	230	470	2.50%	4600	390	2910	133.0	8	650	QZ breccia and stockwork cutting skarn
-10	10	3	11	8	680	3400	196	117	6.3	4	430	QZ breccia with SER
-11	485	13	<5	23	150	4300	300	97	2.3	<1	760	QZ-OR-EP-AC (-SL-PY) skarn
-12	220	18	57	160	3500	3000	490	6370	56.9	8	580	QZ-OR (-CT) breccia
-13	73	3	16	18	280	3100	145	325	10.0	<1	240	QZ-OR (-CT) breccia
-14	84	35	180	593	4600	1300	87	1740	89.5	<1	340	QZ-OR (-CT) breccia
-15	110	94	500	942	420	210	164	1760	55.3	<1	430	QZ-OR (-CT) breccia
-16	57	21	63	73	82	<200	22	296	11.0	<1	870	QZ-OR (-CT) breccia
-17	<5	<2	<5	9	78	<200	6	16	1.2	<1	130	QZ-OR-WOL-EP-SER(-SX) skarn
-18	86	6	18	19	1460	1100	92	145	20.2	<1	470	QZ-OR (-CT) breccia
SNARK (MINFILE 115P 008b)												
E-85-19	1800	160	55	3670	20	4000	6900	1130	8.9	136	350	AC-ID-QZ-EP (-SCH-PY-AX-GT-CC) skarn
-20	1030	200	28	821	14	7000	9200	6840	4.9	36	330	EP-AC-CC-QZ-ID (-SCH-PY-PR-CP-SL-AX) skarn
-21	22	3270	<5	2190	18	220	560	23	5.3	116	220	EP-CC-AC-GT (-SCH-AX) skarn
SCHEELITE DOME (MINFILE 115P 004)												
E-85-22	920	53	<5	613	10	5900	1680	836	2.4	32	340	DI-CC-QZ-OR-AC (-PR-SCH) skarn
-23	12	67	<5	33	30	<200	38	40	1.1	2	550	QZ-KSP-PR-TO-MU greisen vein
-24	9	3620	<5	2080	16	330	176	9	5.2	54	210	DI-CC-QZ-CL-AC-SCH-PR-CP-GL (-PY) skarn
-25	<5	81	<5	44	46	<200	16	50	5.0	<1	350	DI-WOL-QZ-CC (-PY) skarn
-26	<5	28	<5	22	72	220	49	52	1.2	<1	240	WOL-DI-QZ-OR-CC-PL (-PR-PY-SCH) skarn
-27	<5	22	<5	20	152	<200	22	74	11.0	<1	24	QZ-CC (-SCH) stockwork
E-85-28	<5	8	<5	11	114	<200	8	17	7.6	<1	370	WOL-DI-QZ-CC-CL-OR (-SCH) skarn
-29	8	1410	<5	120	240	400	126	11	5.7	4	240	DI-AC-QZ-CC-CL (-SCH-PR-SL-CP) skarn
JABBERWOCK (MINFILE 115P 051)												
E-85-30	160	10	<5	7	240	<200	12	2800	3.0	<1	340	QZ-MU-TO-PY rock flour breccia
31	140	31	6	<6	24	<200	11	328	4.0	<1	550	Tourmalinite: 65% TO, QZ, MU (PY)
32	<5	5	<5	<5	44	<200	15	69	1.6	<1	210	QZ vein & tourmalinite (dissem. PY)
33	60	<3	29	11	7300	11.81%	1510	254	10.0	<1	80	QZ (-SL-CP-GL-PY) vein
34	77	13	<5	<11	100	2800	34	11400	6.8	4	75	ASP pods & SCOR in QZ (-PY) vein
35	9500	2	<5	<5	45	600	42	96	1.4	4	180	CT on joints of musc. quartzite
36	9400	13	<5	13	32	<200	24	357	1.7	4	130	Tourmalinized (QZ-TO-CT) rock flour breccia
37	240	<12	60	130	9400	430	24	16900	26.0	90	510	QZ vein with GL, ASP in FS-BI porphyry
38	9.32%	38	<5	<7	84	<200	14	801	1.9	8	330	CT-OR in fractures of quartzite

Appendix 1 (continued)

Sample No.	Sn	W	Ag	Au	Pb	Zn	Cu	As	Sb	Bi	F	Description
STERLING (MINFILE 115P 010)												
E-85-39	1600	<2	<5	<5	260	240	8	36	2.4	<1	60	QZ (-TO) vein
40	185	9	23	<8	2600	1300	48	2510	34.2	<1	150	Limonitic rock flour (-TO) breccia
41	115	12	<5	<5	45	<200	4	113	1.3	<1	230	TO veinlets within QZ vein
42	40	4	6	<5	660	5700	54	169	3.8	<1	250	Rock flour breccia
43	83	<2	<5	<5	260	270	7	16	2.1	<1	140	QZ vein with CL pods & veinlets
JOUMBIRA (MINFILE 105M 031)(Fed Showing)												
E-85-45	175	20	<5	<5	32	<200	6	37	0.9	<1	100	QZ vein with TO in joints in quartzite
46	195	19	<5	<5	32	270	9	684	1.0	<1	110	QZ vein in quartzite
47	740	51	<5	<5	48	210	9	1140	1.5	<1	110	QZ vein in quartzite
48	48	1460	<5	<5	14	<200	5	303	0.9	<1	160	LI stained QZ-TO vein in quartzite
49	37	100	<5	<5	19	<200	6	348	1.0	<1	55	QZ vein in quartzite
50	355	22	<5	<7	9	<200	5	245	0.8	2	130	QZ vein with TO filled fractures
51	28	9	<5	<5	78	1200	7	13	1.7	<1	130	QZ-SL vein
52	410	14	<5	5	16	<200	4	118	0.8	<1	140	QZ vein with TO-SER along fractures
53	23	13	<5	<5	45	520	11	254	1.5	<1	85	Fractured, limonitized quartzite
55	14	453	<5	<7	13	220	5	748	1.1	<1	130	QZ-TO veins in quartzite
JOUMBIRA (MINFILE 105M 031)(Creek Showing)												
56	24	12	<5	<5	39	<200	14	349	1.4	<1	870	SER-FS veins in quartzite
E-85-57	<5	3	<5	<5	10	<200	4	53	0.5	<1	180	QZ (-BI-FS) vein
58	32	17	<5	<6	56	<200	14	2960	3.9	<1	1600	QZ-FS (-SER) veins in quarzite
59	<5	377	<5	<5	10	<200	29	52	1.0	<1	160	QZ-FS veins with greisen envelopes in quartzite
61	11	7	<5	<5	18	310	10	1210	1.4	<1	530	QZ vein with MU selvage
62	1500	283	15	<10	58	15000	37	8120	18.0	34	650	QZ-TO-MU-CT (-PY-ASP-SL) vnlts in porph dyke
63	<5	5	7	<5	68	<200	3	108	1.7	2	140	QZ-MU stockwork with FS veins
JOUMBIRA (South)												
64	<5	<2	5	18	10	340	134	60	0.7	<1	210	Amphibolite
65	<5	<2	<5	<5	10	<200	160	226	0.7	<1	110	QZ-CB veins
JOUMBIRA (Pro Showing)												
60	59	31	<5	<5	21	<200	6	193	1.2	<1	130	TO veinlets in quartzite
99	6	10	<5	<5	33	1200	12	411	0.6	4	370	QZ porphyry dyke
100	1100	17	7	<5	51	<200	5	1290	2.2	4	470	TO-CT veinlets in QZ porphyry dyke, QZ-MU filled vugs
101	1200	798	<5	<5	15	<200	5	1060	1.0	4	300	QZ-MU vein with TO in fractures
102	<5	3	<5	<5	12	<200	2	35	0.7	2	120	TO-MU greisen vein
MAHTIN (MINFILE 115P 007)												
E-85-66	130	<120	7	130	32	<200	1650	>30000	299.0	26	630	QZ-FS vein cut by TO (-ASP-PY-CT) veinlets and TO breccia
67	12	6	<5	170	59	<200	700	1550	5.8	30	420	DI-TR-QZ-CC (-PR-CP-ASP-PY) skarn
68	<5	<25	<5	230	42	260	220	>30000	42.9	108	800	AC-QZ (-ASP-PY) skarn
69	30	3	<5	42	26	270	44	119	2.9	<1	310	DI-CC-ID-AC (-QZ) skarn with PR veinlets
70	9	160	<5	340	20	<200	870	531	3.6	20	470	DI-TR-QZ-CC (-PR-CP) skarn
71	215	<13	<5	82	37	290	115	17700	114.0	34	1250	QZ-CC-FS (-PY-ASP-CP) vein
72	130	4	<5	450	38	280	122	86	17.0	24	680	DI-QZ-PL-HB-CC (-SPH) skarn

Sample No.	Sn	W	Ag	Au	Pb	Zn	Cu	As	Sb	Bi	F	Description
BARNEY (MINFILE 115P 055)												
E-85-73	<5	21	<5	<5	70	<200	30	169	10.0	<1	580	Greisenized quartzite
74	<5	13	<5	73	14	<200	14	529	25.9	<1	200	Brecciated quartzite
75	<5	3	<5	42	133	<200	13	296	42.8	<1	170	Brecciated quartzite
76	<5	4	<5	35	26	<200	18	258	32.8	<1	270	QZ breccia
77	<5	6	<5	98	20	<200	13	1050	187.0	<1	170	Brecciated quartzite
RHOSGOBEL (MINFILE 115P 012)												
E-85-78	<5	<2	<5	<5	26	<200	26	16	1.1	<1	1100	BI quartzite
79	<5	2	<5	7	14	<200	26	11	1.6	<1	780	BI schist with PY-QZ pod, minor SCH
80	<5	<2	<5	7	10	<200	4	14	1.9	<1	190	QZ-AC-DI-PL (-SL) skarn
81	<5	2630	<5	12	54	<200	6	7	1.9	<1	300	DI-QZ-AC-PL (-SCH) skarn
82	<5	40	<5	<5	30	<200	14	30	1.8	<1	680	BI quartzite with TO-QZ veins
83	<5	9	<5	<5	26	<200	5	8	2.0	2	290	QZ-DI-AC-PL-BI (-OR-SL) skarn
84	<5	1340	<5	71	21	<200	16	9	0.7	2	320	QZ-PL-PH-DI-CC-AC (-SCH) skarn cut by QZ-SCH vein
PUKELMAN (MINFILE 115P 013)												
E-85-85	17	14	<5	<5	10	<200	11	151	3.5	<1	900	TO-BI (-CT-TOP) rock flour breccia
86	<5	6	<5	<5	24	<200	14	986	1.4	<1	440	BI quartzite with QZ veinlets
87	<5	5	<5	14	5	<200	6	1790	1.3	<1	550	QZ breccia cutting BI hornfels
88	<5	100	<5	160	11	<200	8	341	4.1	2	950	QZ-FS veinlets in FS granite porphyry
89	<5	46	<5	647	19	<200	12	7580	8.2	10	970	QZ-MO-PY vein in quartz monzonite
90	<5	15	<5	21	15	<200	16	82	4.2	<1	710	QZ vein in BI quartzite
91	<5	924	<5	616	6	<200	16	232	2.4	10	1800	BI-QZ schist cut by QZ-FS(-SCH) veins
92	<5	6100	<5	7630	11	<200	28	89	3.0	64	1300	Sheeted QZ-FS-SCH veins in BI quartzite
93	<5	3560	<5	57	5	<200	14	26	0.8	<1	3600	BI hornfels and QZ-BI-AC-OR (-SCH) skarn
LUGDUSH (MINFILE 115P 009)												
E-85-94	130	2050	<5	70	10	330	6	17	1.3	208	8000	DI-PL-QZ-CC-HB (-SCH) skarn (float)
95	<5	60	<5	<5	64	460	43	11	0.4	84	3600	Tourmalinite: 80% TO, OR, QZ
96	45	76	<5	28	48	440	10	12	1.8	2	1050	DI-OR-QZ-CC-HB (-SCH) skarn
97	28	140	<5	<5	18	390	6	5	0.6	2	460	DI-COR(20%)-QZ-OR-CC-PL (-PR-SCH) skarn
98	13	7	13	<5	148	<200	6	6	1.0	20	100	QZ vein with minor MO-SCH
ZETA (MINFILE 115P 047)												
E-85-103	140	8	<5	<5	34	<200	52	996	20.7	<1	1250	Syenite with TO (-PY-CT) veins
104	610	<30	40	34	690	1100	340	16600	507.0	6	1800	QZ(-LI-TO-PY-ASP) vein
105	480	<2	2.99°/t	nd*	4700	85	210	3.2%	0.70%	18	830	Radiating tourmaline in pods in granite
106	500	2300	3.12°/t	nd	5200	57	1320	6.1%	0.92%	5	1100	LI-stained TO (-SX) vein
107	600	<2	8.10°/t	nd	>10000	121	320	3.34%	3.64%	12	950	TO-QZ (-SX) breccia
108	450	<2	7.19°/t	nd	>10000	86	260	2.01%	2.56%	18	900	Tourminilized qranite: 10-20% TO, CT, PR
109	550	<2	9.10°/t	nd	>10000	225	104	1.16%	1.09%	4	520	QZ-TO (-SX) vein
110	<5	<20	10	<22	500	<200	53	1160	693.0	<1	150	FS porphyritic syenite with TO
111	<5	25	<5	<13	260	<200	10	339	329.0	<1	1150	HB-QZ syenite with TO veinlets
112	510	24	20	33	310	3000	133	864	312.0	<1	2200	LI-SCOR stained QZ (-ASP-PY-TO) vein in quartz monzonite
113	<5	3	<5	<9	67	<200	20	97	110.0	<1	340	TO (-PY) veins in quartzite
120	17	7	<5	<7	164	<200	4	69	51.0	<1	770	TO-QZ-(-CT) veins in greywacke
121	<5	4	<5	<9	220	<200	57	178	87.5	<1	650	SER veinlets in joints of quartzite
152	2900	<2	30.74°/t	nd	1.42%	151	720	3.26%	2.45%	88	1600	TO (-QZ-MU-CT-SX) breccia
153	700	3600	26.77°/t	nd	2100	92	260	4.83%	0.51%	64	1150	TO (-QZ-SX) vein

Appendix 1 (continued)

Sample No.	Sn	W	Ag	Au	Pb	Zn	Cu	As	Sb	Bi	F	Description
ZETA (MINFILE 115P 047)(East Showing)												
114	5	2	<5	<7	84	320	27	134	111.0	<1	800	CT-SER-LI in joints of SER quartzite
115	<5	3	<5	<6	60	410	35	124	78.5	<1	680	CT-SER-LI in joints of SER quartzite
116	<5	6	<5	<9	57	250	52	137	177.0	<1	740	CT-SER-LI in joints of SER quartzite
117	<5	5	<5	<7	123	<200	32	69	51.8	<1	680	CT-SER-LI in joints of SER quartzite
118	10	3	<5	<9	80	<200	22	66	88.2	<1	740	CT-SER-LI in joints of SER quartzite
SUNSHINE CREEK WEST (MINFILE 115P 031a)												
E-85-122	120	21	22	93	1900	<200	101	2340	80.1	86	300	QZ-TO (-SL) breccia and stockwork (0-20 m from SSW end of trench)
123	600	49	67	76	900	<200	220	3460	55.5	130	720	QZ-TO (-SL) breccia (20-40 m)
124	265	11	<5	11	340	<200	145	1180	40.3	4	770	Tourmalinite: 55% TO, 40% QZ, iron oxides (40-60 m)
125	500	26	<5	8	600	<200	149	1140	33.3	8	610	QZ breccia with TO veinlets and tourmalinite (60-80 m)
126	425	26	8	6	910	<200	120	1760	27.4	26	290	QZ-TO breccia (at 75 m, grab)
127	265	10	<5	9	900	<200	380	2220	62.9	16	470	TO-CL-QZ (-EP) breccia (80-100 m)
128	205	27	5	11	760	<200	360	1810	63.9	26	670	QZ breccia & stockwork, TO alteration & veins (100-120 m)
129	235	24	<5	14	950	<200	290	1280	34.6	38	370	TO-QZ breccia (120-140 m)
130	185	18	19	120	280	<200	185	1600	32.7	4	670	LI-stained QZ breccia with tourmalinite (140-160 m)
131	160	23	<5	33	1810	<200	310	1940	103.0	44	560	QZ breccia (160-180 m)
132	550	11	<5	13	330	220	490	426	29.0	12	720	QZ breccia (180-200 m)
141	7	3	<5	12	14	720	250	14	2.5	<1	1200	LI-MN-stained quartzite & BI schist
142	375	29	<5	12	59	200	88	298	14.0	4	1500	CL-QZ schist with TO band
SUNSHINE CREEK EAST (MINFILE 115P 031b)												
E-85-133	340	26	<5	<6	86	<200	167	537	8.0	12	440	GOE veins in quartzite
134	3400	20	18	26	116	<200	110	741	21.4	140	740	QZ breccia with TO veins
135	1300	66	28	15	800	<200	330	2400	15.0	264	1000	QZ-TO (-CT-LI) breccia
136	200	14	<5	<5	30	<200	168	51	5.0	12	200	TO veinlets in quartzite
137	38	5	<5	<5	53	<200	22	60	13.0	2	330	AC (-CL-CT) veinlets in BI quartzite
138	110	16	<5	9	41	<200	290	55	15.0	12	1950	BI schist with TO veins
139	66	18	<5	<5	15	<200	450	18	4.9	10	1700	Tourmalinite: 85% TO, 10% QZ, 3% TOP, CC, PY, CP, SL
WAYNE (MINFILE 105M 029)												
E-85-143	<5	696	<5	22700	66	<200	410	50	22.8	450	220	QZ-DI-CZ-AC-CC (-SL-PY-SCH) skarn
144	10	120	<5	1150	92	<200	76	89	28.8	22	870	AC-TR-DI-QZ (-PY) skarn
145	9	16	<5	2250	101	<200	137	204	80.2	34	1650	QZ-DI-TR-BI (-PY-SCH) skarn
147	<5	5	<5	18	109	490	4	18	3.1	<1	190	skarn with QZ-SL-PY

nd: not detected (for Au - detection limit is 0.002 oz/ton)

o/t: ounces per ton