Remote Sensing Analysis of Golden Stranger Claims, Toodoggone Map-area, Omineca Mining Division B.C. Using Synthetic Aperture Radar and Thematic Mapper Satellite Data

Consisting of Golden Stranger, Golden Stranger 2 to 5, GST 1 to 3, GL 3 to 6, and Golden Lady 1 and 3 claims.

Omineca Mining Division
Latitude 57 degrees, 21 minutes N
Longitude 127 degrees, 20 min W
NTS 94E/6E

OWNER

WESTERN HORIZONS RESOURCES LTD.
985 Gatensbury Street
Coquitlam, B.C.
V3J 5J6

AND

SUTTON RESOURCES/REDFERN RESOURCES LTD.
Richmond, B.C.

Written By

K.E. Northcote and Associates Ltd.
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985 Gatensbury Street
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V3J 5J6

November 15, 1994

K.E. Northcote S.C. Gower

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PROJECT OVERVIEW/ INTRODUCTION

TERMS OF REFERENCE

K.E. Northcote, with assistance of Pratap Udumala, both associated with Minesat Explorations Ltd., and S.C. Gower of Gower, Thompson and Associates Ltd. was contracted by Western Horizons Resources Ltd., to carry out a detailed remote sensing study of the Golden Stranger claims area, Toodoggone, B.C., (Figure 1), using ERS-1 SAR and Landsat 5 thematic imagery. Field checking of Satellite imagery was done on the Golden Stranger property and surrounding area by S.C. Gower and Elaine Thompson in the period August 10 to 27, 1994.

LOCATION

The Golden Stranger satellite imagery window, (Figure 7), boundaries measure 12 km east-west and north-south with UTM coordinates 598000 - 610000 EW and 6351000 - 63630000 NS.

The Golden Stranger claims are located 24 km northwest of Sturdee River airstrip. The property lies between the headwaters of the Toodoggne and Chappelle rivers. It is situated on the west side of Lawyer's Creek at latitude 57 degrees 22 minutes N, longitude 127 degrees 20 minutes west in the Omineca Mining Division, (Figures 2 and 3). The property is at approximately 1500 meters elevation. The claims are accessible by helicopter from Sturdee airstrip or on foot, approximately 5 km from the Cheni mine road.

CLAIM STATUS

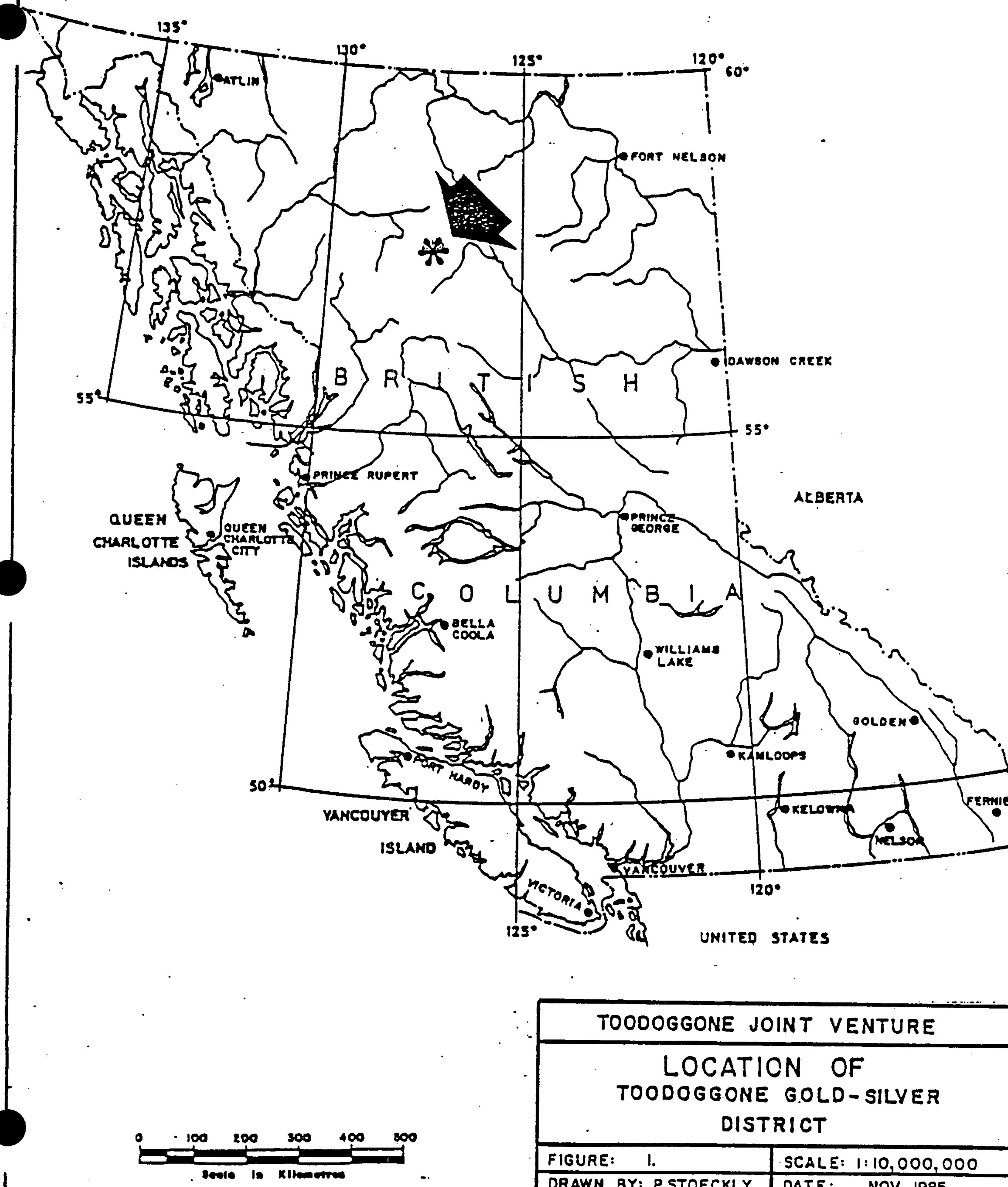
The following claims comprise the Golden Stranger property:

Claim	Units	Tenure	Expiry	Ownership
Golden Stranger	9		Nov 3/98	Sutton/Redfern/Western
Golden Stranger 2	3		Aug 24/98	Sutton/Redfern/Western
Golden Stranger 3	9		May 21/98	Sutton/Redfern/Western
Golden Stranger 4	4		May 21/98	Sutton/Redfern/Western
Golden Stranger 5	4		May 21/98	Sutton/Redfern/Western
GST 1	1		May 21/98	Sutton/Redfern/Western
GST 2	1		May 21/98	Sutton/Redfern/Western
GST 3	1		May 21/98	Sutton/Redfern/Western
Golden Lady 1	9	242645	Aug 30/96*	Western Horizons
Golden Lady 3	9	242647	Aug 30/96*	Western Horizons
GL 3	1	242651	Aug 30/96*	Western Horizons
GL 4	1	242652	Aug 30/96*	Western Horizons
GL 5	1	242653	Aug 30/96*	Western Horizons
GL 6	1	242654	Aug 30/96*	Western Horizons

* Pending approval of report

MINING HISTORY

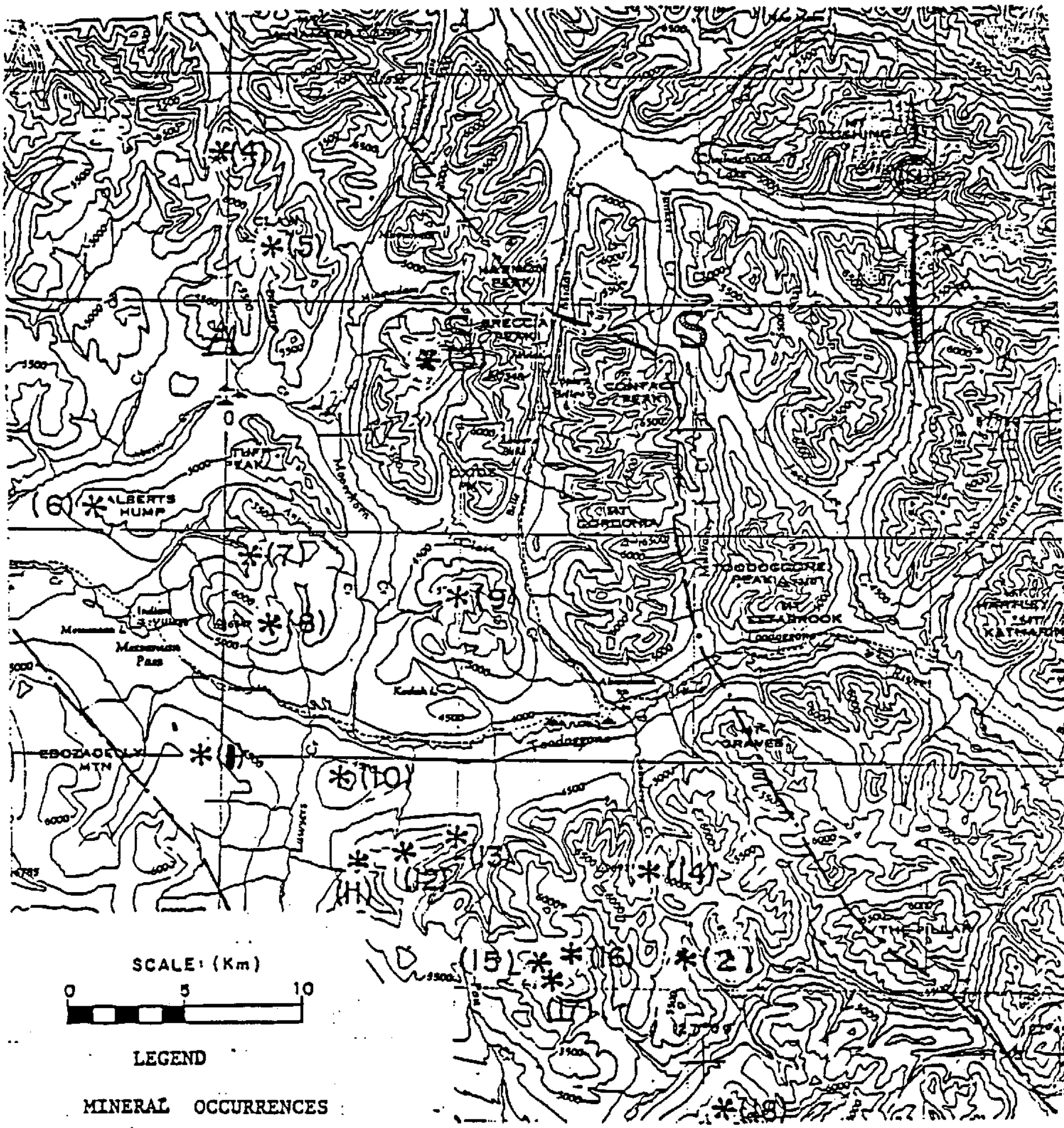
Prospecting began in the Toodoggone District with the discovery of placer gold in the early 1930's. No significant discoveries were made in the region until Chappelle (Baker Mine) was discovered in 1968 by Kennco Explorations (Western) Ltd. under the direction of R.W. Stevenson. The subsequent search for epithermal gold deposits and copper-gold porphyries over the next 25 years resulted in the discovery of



TOODOGGONE JOINT VENTURE

LOCATION OF
TOODOGGONE GOLD-SILVER
DISTRICT

FIGURE: 1.	SCALE: 1:10,000,000
DRAWN BY: P.STOECKLY	DATE: NOV 1985

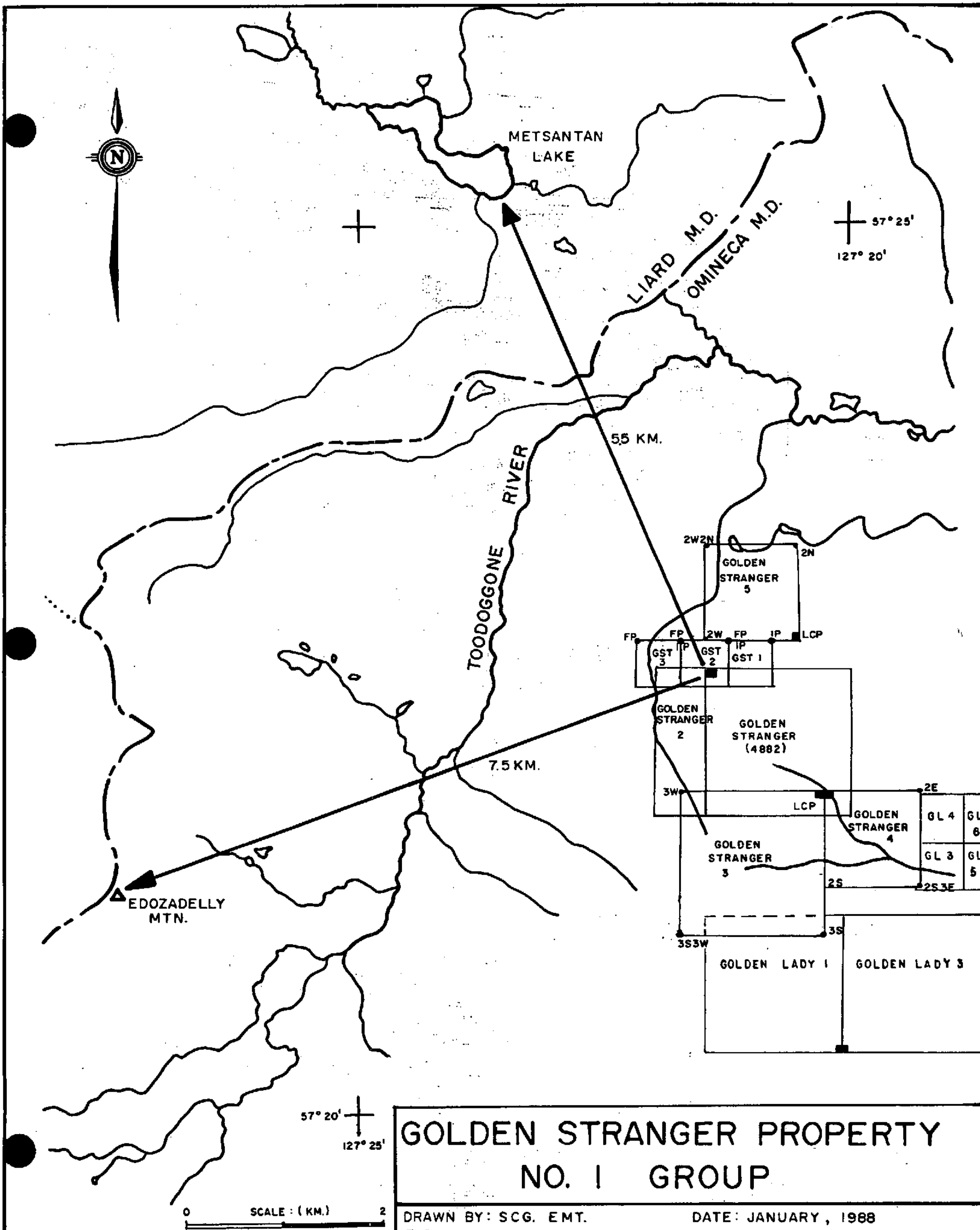


LEGEND

MINERAL OCCURRENCES

#1 GOLDEN STRANGER
2 DAVE PRICE
3 GORD DAVIES
4 COPPER KING
5 CLAW MTN.
6 ALBERTS
7 NORTH METSANTAN
8 METSANTAN
9 J.D.
#10 KODAH
11 SILVER POND
12 LAWYERS
13 LAWYERS
14 GOLDEN NEIGHBOUR
15 BAKER
16 BAKER
17 BAKER
18 SHA

TOODOGGONE JOINT VENTURE	
LOCATION OF TOODOGGONE GOLD-SILVER DISTRICT MINERAL OCCURRENCES	
FIGURE: 2.	SCALE: 1:250,000
DRAWN BY: P. STOECKLY	DATE: Oct. 83



OMINECA M.D.
TOODOGGONE AREA
94E 6/W

GOLDEN STRANGER PROPERTY
NO. 1 GROUP

DRAWN BY: SCG. EMT.
FIG. 3

DATE: JANUARY, 1988
SCALE: 1:50,000

GOWER THOMPSON & ASSOCIATES LTD.

significant deposits at the Cheni Mine, Albert's Hump, Metsantan Mtn., J.D. Property, Shasta-Black Lake, Jock Creek, Pine-Finlay River, and at Kemess-Duncan Lake.

The Baker Mine was in production until 1984 with initial reserves of 120,000 tons grading 0.8 ounces of gold, and 15 ounces of silver per ton. A total of 70,000 tons was reported mined during the production period. The Cheni Mine operated until 1992 when low gold prices and tailings pond problems caused them to shut down. Reserves still exist at the Phoenix zone, Metsantan Mtn. and Alberts Hump which could be mined with higher gold prices. All of the infrastructure is still on site at the Cheni Mine.

SUMMARY OF GEOLOGY

STRUCTURAL SETTING

The geological framework of the Toodoggone area is a result of comagmatic plutonic-volcanic-hydrothermal activity occurring along deep seated northerly trending structural breaks. Volcanism resulted in deposition of a thick succession of Toodoggone volcanic rocks on a "basement" of older Takla volcanics. Hydrothermal systems invaded the volcanics along reactivation zones. Linear zones of hydrothermal alteration and mineralization associated with emplacement of plutons were formed at different structural levels in Toodoggone and older rocks. Subsequently the Toodoggone and earlier rocks were subjected to repeated normal block faulting from Jurassic to Tertiary time. Sustut Group sedimentary rocks unconformably overlie these earlier rocks and have relatively flat dips with fewer structural disruptions.

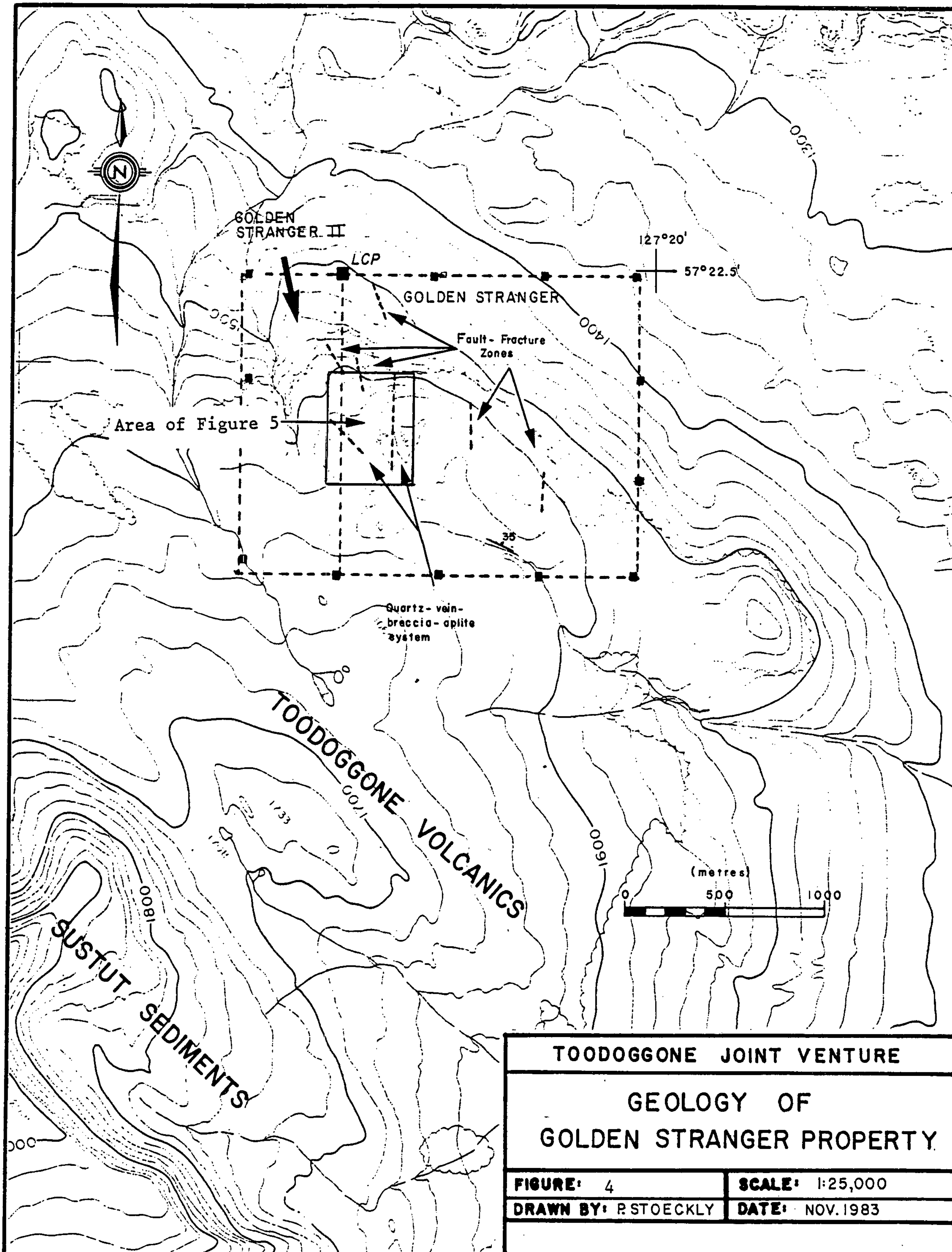
GEOLOGY OF GOLDEN STRANGER CLAIMS AND SURROUNDING AREA

Geological mapping and satellite imagery shows the Golden Stranger area to be underlain by a strong northerly trending radial structural fabric, cut by a series of eastwest arcuate structures, concave north. These are in turn cut by more intricate sets of subparallel northwesterly and northeasterly trending lineaments. On the Golden Stranger property a fan-like series of northwesterly trending structures occur between the "west" and "main" structures. In addition, three strong northeasterly trending structures noted on satellite imagery were confirmed by ground checking.

The Golden Stranger claims are underlain by massive Toodoggone volcanics consisting primarily of crystal lithic tuff breccia, and porphyritic trachyandesite flows and flow breccia. All of these lithologic units have a similar appearance because of intense propylitic alteration in the vicinity of aplitic complexes and hydrothermal alteration along the main Golden Stranger structure. Some of these volcanics have a hematitic matrix and/or hematitic lithic fragments. They range from unaltered grey to purplish red porphyritic/fragmental to secondary weathered hematitic which has resulted in pinkish colouration of plagioclase phenocrysts and groundmass in more intensely weathered zones. The Toodoggone volcanics underlying the claims correspond to Unit 6B of MEMPR Preliminary Map #61, by Diakow , Panteleyev, and Schroeter, 1985. The Toodoggone volcanics are unconformably overlain by Sustut sediments to the southwest (Figure 4).

The Toodoggone volcanics have superimposed northerly trending zones of hydrothermal alteration of varied intensity; most of which are associated with northerly trending fracture and shear-fault systems. These systems served as deep seated channelways for hydrothermal solutions and magmatic differentiates and have undergone successive episodes of reactivation over a long period of time. Alteration in these zones ranges from weak to strong propylitic, with localized zones of argillic alteration and silicified breccias. Aplite dykes or irregular elongate bodies follow these northerly trending fracture-fault systems.

Quartz veining and silicified brecciation of varied intensity cut both altered porphyritic volcanics and aplite dykes in some of the fracture-fault systems. Quartz breccias and multistage quartz layering with amethystine quartz are common with chalcedonic quartz occurring along some vein margins. Some



TOODOGGONE JOINT VENTURE

GEOLOGY OF GOLDEN STRANGER PROPERTY

FIGURE: 4	**SCALE:** 1:25,000
DRAWN BY: P. STOECKLY	**DATE:** NOV. 1983

complex veins contain up to 10 or more successive layers with drusy quartz crystal lined vugs and locally open drusy amethystine centers.

Variations in intensity of pyritic and hydrothermal alteration and the presence of aplite dykes and quartz breccia vein systems probably represent related hydrothermal magmatic processes which reached different structural levels in the Toodoggne volcanic sequence.

Two diverging quartz breccia zones approximately 180 meters apart at their northernmost exposure comprise the "main" and "west" zones. These zones in Toodoggone volcanics follow, and are followed by, later northerly and northwesterly trending fractures and/or fault-shear systems.

The multistage "main zone" aplite-quartz-vein-breccia on the east strikes approximately northerly and at surface dips near vertically. Diamond drilling and resistivity surveys showed that, within 10 meters of the surface, this structure changes dip to easterly at about 40 degrees. Where the full width of the "main zone" is exposed it measures more than 30 meters wide and extends northerly for a length greater than 400 meters. There is some conflicting evidence regarding the relative age of aplite dykes and the quartz vein system. The dykes, however, show some brecciation and veining by multistage quartz.

GEOLOGICAL SEQUENCE OF EVENTS

1. Deposition of volcanic rhyodacite crystal tuff and crystal lithic tuff breccia with interbedded trachyandesite flows and flow breccia. Deposition of these rocks was controlled by deep seated structures.

2. Development of deep seated structures following earlier structures. These were the conduits for the aplitic bodies and the associated alteration and pyritization. Reaching various stratigraphic levels, the aplitic bodies were emplaced in a shallow environment on the Golden Stranger property and were accompanied by internal and local brecciation.

3. Subsequent episodes of fracturing, hydrothermal alteration, brecciation, several generations of silicification were accompanied by brecciation, argillic alteration and hydrothrmal surface venting. Some silicification was accompanied by sulphide with associated gold and silver mineralization.

4. Late shear-gouge zones following earlier structures locally intersected and incorporated portions of the veins, silicic breccias and pods of mineralization.

SURFICIAL GEOLOGY

Outcrop is sparse over most of the Golden Stranger property with the exception of siliceous portions of the "main" zone which forms a topographic high. The width of the altered zone can be seen on the cliffs which form a northwest trending ridge line across the north end of the property. The soil cover varies from less than one meter in depth over the higher elevations to probably several meters deep in the swampy areas. Most of the drill holes only required a single 3.3 meter section of casing to return core. The soil commonly contains fragments, erosional remnants, of Sustut sediments. The valleys are partially filled with glacial debris with associated circular features visible on satellite imagery.

VEGETATION

Vegetation in the claims area consist mainly of alpine tundra and scrub brush. The lower portions of the claims are covered with a thick forest of pine, hemlock, spruce and alder. Different vegetation types are conspicuous on most of the satellite images.

GEOPHYSICAL SIGNATURE

Geophysical surveys carried out on the property are induced polarization, ground magnetics and VLF-EM. The resistivity pseudosections from the induced polarization survey, when incorporated with the drill data provide the best image of the geometry of the Golden Stranger structure at depth. The resistivity survey differentiates between the aplitic bodies and feldspar porphyry units, and indicates structure through differences in resistivity. These pseudosections provide a geophysical framework of the property to a depth of approximately 150 meters below the surface. The gold and silver mineralization discovered to date is associated with an abrupt shift in resistivity from 800 up to 3,000 ohm-meters. Survey lines run to 5+00 south appear to trace this shift, and thus the zone, for 500 meters south of the most southerly drill intersection. Also of significance is a similar shift in values which rises easterly towards the surface, branching off the main zone, from a depth of several hundred meters.

The magnetometer survey revealed generally high values from the southwest half of the survey area where unaltered feldspar porphyry containing primary magnetite is anticipated. A trough of low values, approximately coincident with the east flank of the northerly trending line of aplite is present on the survey. This corresponds to an observed destruction of primary magnetite and the presence of secondary iron minerals.

The VLF-EM survey shows a persistent north-south trending line of cross-overs flanking the east side of the aplitic bodies in the north. This extends to the south along the east flank of the "main" zone. A second northwesterly trending line of persistent cross-overs coincides with the west margin of the "west" zone. A strong trough of negative values which occurs between the two is disrupted by less persistent cross-overs. These cross-overs are expected to coincide with structural and/or lithologic features. Contours of the numeric values demonstrates a strong northwest trending zone which splays at Golden Stranger pond. An indicated parallel zone to the west requires exploration.

SOIL GEOCHEMISTRY

Soil development on the property is poor and commonly consists mainly of material derived from breakdown of Sustut sediments. A total of 380 soil samples were taken from the "B" soil horizon by B. K. Northcote. Background values of gold in soil are less than 5 ppb. Weakly anomalous values range from 15 to 40 ppb. and anomalous values from 40 to a high of 2,300 ppb. The strongest gold in soil anomaly corresponds to the location of the highest gold values found at surface.

HISTORY OF THE PROPERTY

The Golden Stranger showings were discovered by Stephen Gower and Elaine Thompson, while employed by Western Horizons Resources Ltd. in the summer of 1983. Work in 1983 consisted of geological mapping and preliminary sampling of interesting outcrops. Only slightly anomalous concentrations of gold and silver were found during the initial examination. In 1985 the "main" zone was trenched at widely spaced intervals and the discovery showing was located near the north end of the aplite body. Geologic mapping, a ground magnetometer and VLF-EM survey, soil sampling and trenching were carried out in 1986. Trenching resulted in locating a significant gold zone on surface adjacent to the aplite dyke. This zone appears to have a strike length of at least 540 meters and is the surface expression of a high level hydrothermal system. The most northerly trench to cut the "main" zone returned a value of 0.24 ounces of gold per ton over a width of 6.9 meters. The most southerly trench which contained significant gold values was located 390 meters on strike and assayed 0.04 ounces of gold per ton over a width of 4 meters.

The diamond drill program carried out in 1987 and 1988 consisted of 3520 meters of BQ core. This program indicated that the gold mineralization extends down dip for at least 80 meters, and in the vicinity of the surface showings, is associated with the aplite-feldspar porphyry contact. The most significant discovery of the drilling was wide intercepts of quartz-chlorite altered feldspar porphyry containing anomalous concentrations of gold. These zones are significant because they are similar to the alteration over the "AGB" zone at Cheni. Further diamond drilling is required to explore the down dip extension of the quartz-chlorite zones.

MINERAL POTENTIAL

The Golden Stranger has the potential to host epithermal gold and silver deposits of similar tonnage and grade to the nearby Cheni gold-silver mine. The surveys carried out on the property to date indicate that the lithology, alteration, structural setting and geophysical signature are the same as at Cheni.

Based on wide-spaced drilling and surface sampling the Golden Stranger "main" zone has potential for reserves the order of 500,000 tons grading 0.08 ounces of gold per ton, which includes a higher grade zone of 200,000 tons grading 0.15 ounces of gold per ton.

OVERVIEW OF REMOTE SENSING BY SATELLITE SENSORS

Remote Sensing (RS) refers to methods of obtaining information about the earth's surface without making actual physical contact with it. RS using satellites has two facets:

(a) the sophisticated technology of acquiring digital satellite data to produce images and:
(b) analyzing and interpreting these images in conjunction with ground techniques, such as geology, geophysics, and geochemistry.

Minesat Explorations Ltd. is one of several companies and individuals actively pursuing research analyzing and interpreting remote sensing satellite data. The company is based at 8080 Glover Road in Fort Langley, B.C. and its principals include J. Spagnol, J. Vinnell, J. Payne, Pratap Udumala, and K.E. Northcote. The following section on Technical Background is taken from information that forms part of Minesat's satellite remote sensing reports.

TECHNICAL BACKGROUND (Minesat Resources Ltd.)

Presently, a vast amount of data about the earth's surface is being generated from remote-sensing (RS) platforms deployed on operational satellites. Some of these detectors measure reflected solar radiation in the visible and infrared part of the electromagnetic spectrum. Other more active instrument systems transmit radar signals and measure the amount of reflectance from earth's surface. Analysis and interpretation of these data through "state of the art" computer technology is becoming a powerful tool when applied at various stages of regional geological mapping and mineral exploration programs in conjunction with conventional ground and airborne techniques.

Despite the enormous amount of research in RS techniques and applications in the last decade, progress of direct application of satellite data in mineral exploration is slow. In Canada, this is due in part to the inexperience of industry and the non-ideal ground conditions caused by moderate to thick vegetation cover and widespread glacial drift. By interpreting RS with conventional data and by making a ground check on zones of interest indicated by the RS study, some of these difficulties can be minimized and significant geological information obtained.

In areas where no ground data are available, the interpretation of RS data provides an excellent first-phase tool to focus geological mapping and exploration for mineral deposits on targets of interest. For regions where geological information is available, it can be correlated with the RS data. Integration of RS data with more conventional, geological, geochemical, and geophysical studies is of significant benefit in both the short and long term to geological mapping and mineral exploration. Interpretation of these data sets provides a low-cost technique to assess large areas of ground quickly, and to focus on significant exploration target areas more rapidly than by use of conventional methods alone.

The future of the RS approach is one of increasing expectations. The next decade will see more operational satellites with improved instrumentation delivering data which is ever more useful for geological interpretation. Routine examination of satellite data is gaining much wider acceptance with many mineral resource companies for grass-roots and intermediate stages of exploration.

OVERVIEW OF THEMATIC (TM) DATA (Minesat Resources Ltd.)

Materials on the earth's surface reflect and absorb solar radiation differently depending on their atomic and crystallographic or molecular structures. Many minerals have characteristic absorption peaks of known wave lengths. These are caused by electronic transitions between atomic and molecular sites of different energy, and by vibrational frequencies of certain molecular bonds.

The Landsat Thematic Mapper measures reflected solar electromagnetic (EM) radiation from the earth's surface in the visible, near-infrared, mid-infrared and thermal infrared wave lengths of the EM spectrum. Digital TM data are measured in six spectral bands in the visible and near-infrared and in one in the thermal infrared (see Figure 5). The detector records the intensity of reflected radiation in each spectral band (called DN or data number) for every 30 m x 30 m area. Some of these bands are chosen because they have particular geological relevance. Interpretation of RS data allows differentiation among features and materials comprising the earth's surface which have different spectral signatures; certain signatures can be correlated with specific mineral groups. As well, textural patterns can be used to distinguish among certain geological units.

Blue Green Red		Near Infrared		Mid Infrared		Thermal Infrared
Band 1	Band 2	Band 3	Band4	Band 5	Band 7	Band 6
450-520 nm	520-600 nm	630-690 nm	760-900 nm	1550-1750 nm	2080-2350 nm	10,500-12,500 nm

FIGURE 5. Spectral Bands of Landsat TM Sensor.

LANDSAT THEMATIC MAPPER (TM) CHARACTERISTICS (Minesat Explorations Ltd.).

Because the Landsat TM sensor is continually receiving and transmitting data, the supplier can examine data obtained during any specific period and select those data which have minimum cloud cover and which were acquired at any specific time (e.g., before or after any recent ground disturbance due to mining activity, road building, etc.). Seasonal data can also be obtained in order to utilize variations in the sun's inclination, vegetation and snow cover. This gives TM data a distinct advantage over conventional air photographs. Overall, the quality of TM data is excellent as compared to conventional air photographs, but present spatial resolution is not as good.

Raw TM digital data were geographically coordinated with the Universal Transverse Mercator Projection (UTM) by Minesat Explorations Ltd. with a precision of less than 15 meters. Furthermore, the data were corrected for haze suppression and atmospheric effects. This procedure gives each data point (called pixel point) an apparent size of 25 x 25 metres. Each pixel point in an image or scene is represented by an integer digital number (DN) between 0 and 255. For any image, the object(s) with the lowest reflectivity is(are) assigned a DN of zero, and appear black on the monitor. Deep water has a very low reflectance, and, if present, is assigned the zero value. High DN values are assigned to objects which have high reflectivity, e.g., outcrops, grassy fields, clear-cuts, and unconsolidated glacial deposits.

EM SPECTRAL FEATURES OF GEOLOGICAL SIGNIFICANCE (Minesat Explorations Ltd.)

Visible and Near-Infrared Region (400 - 1000 nm)
Dominant spectral features are caused by electronic transitions in transition metals such as iron, manganese, copper, nickel, and chromium. These metals have a major electronic transition in this part of the EM spectrum, which is activated by EM radiation of this or higher energy (shorter wavelength) but which is not activated by radiation with lower energy (longer wavelength). This causes a strong absorption edge at the characteristic wavelength of the transition. Because of the geological abundance of iron, spectral signatures in the visible and near-infrared region are mainly due to iron. Iron absorption features occur in the region from 400 to 700 nm.

Short-Wave Infrared Region (1000 - 3000 nm)
This region is characterized by spectral signatures of many common anionic constituents of mineral groups such as hydroxyls, carbonates, and phosphates. Hydroxyl ions are most abundant in clays and in minerals containing water of crystallization. In clays and some hydrated silicates, hydroxyl ions occur in combination with aluminum and magnesium. The Al-O-H and Mg-O-H bonds have characteristic vibrational frequencies which cause absorption in the range 2100 to 24000 nm. The energy of Al-O-H and Mg-O-H bonds varies slightly from mineral to mineral; however, the spectral window on the TM sensor in this region, TM band 7, covers the whole range and makes distinction between these different mineral species impossible. Similarly, carbonate minerals have several characteristic vibrational bond energies in this region and, for the same reason, they too cannot be discriminated by mineral type.

Thermal Infrared Region (10500-12500 nm)
This region is covered by Band 6, (Figure 5), a very broad long wavelength band, which has presently received little attention for geological applications.

SYNTHETIC APERTURE RADAR (SAR) CHARACTERISTICS (Minesat Explorations Ltd.)

Radar is defined as Radio Detection and Ranging, which is an active remote sensing system. It generates its own scene illumination through a radar beam and records phase and polarization of reflected microwave energy. A radar beam is a fan-shaped beam of electromagnetic energy produced by the transmitter. In SAR System a synthetically long aperture is constructed by integrating multiple returns from the same ground point until the point passes through the site of illumination of the transmitter.

The sensor is independent of solar illumination and penetrates through clouds and rain. Partial penetration is achieved through moderate amounts of vegetation and dry, loose soil. The radar beam is sensitive to surface roughness, soil moisture content and di-electric properties of the surface.

The European Research Satellite (ERS-1) is an active SAR system which comprise C band with a frequency of 5.3 GHz, wavelength 5.7 cm. The sensor is operated with vertical receive, vertical transmit polarization. The "swath" of the system is 100 km with a pixel resolution of 30 meters. The incidence angle of the SAR system on ERS-1 is 23 degrees directed towards the right. The orbital altitude of the spacecraft is 785 km.

The most obvious geological applications of SAR imagery are for the interpretation of regional and local scale geological structure, revision of geologic maps, mapping of Quaternary surficial deposits, engineering and environmental geology, geohydrology, geologic hazard mapping etc.. SAR imagery can be used even in areas of thick overburden and vegetation cover and can provide unique information as compared to optical images and aerial photographs. The information provided by SAR images to discriminate among lithologies is limited. However, in areas of weak vegetation and little glacial cover some major lithologic boundaries can be derived from linear patterns and deduced from textural and tonal variations. SAR and TM imagery complement each other and should be used in combination because of their different structural and lithologic mapping applications.

SAR Data were geo-coded, in a manner similar to raw TM digital data, to the Universal Transverse Mercator Projection (UTM), with precision of less than 30 meters, by Minesat Explorations Ltd.. Windows with the same coordinates prepared from the two sets of geo-coded data from the two satellites were found to match perfectly when the boundary from one was superimposed on the second (Figure 6).

Figure 6 Image of TM Band 4 with superposition of Window outline from SAR image. (12 X 12 kms)

INTERPRETATION OF RS DATA

TM data were used in conjunction with SAR data to attempt to locate specific structural and lithological patterns and zones of hydrothermal alteration and iron-oxide enrichment. These are commonly associated with epithermal vein and copper-gold porphyry systems and other types of mineral deposits typical of this part of the Cordillera.

Mineralized zones in many epithermal vein and porphyry systems are associated with breccia centers, which commonly occur in clusters. Several hypotheses have been proposed to explain the origin of breccia centers including the following: 1) explosive vents or conduits; 2) subjacent to volcanic vents, and 3) sudden release of volatile components from a rapidly crystallizing porphyry magma. Breccia centers commonly are circular or ovoid in shape and range in diameter from a few tens of meters to few thousand meters. Detection of objects of this size is within the capacity of satellite sensors. Detailed investigation of these centers, in terms of their configuration, size and structural setting, as well as significant internal planar structures is important in the exploration for other mineralized breccia centers in the Toodoggone area.

GENERAL PROCEDURE

DETAILS OF RS ANALYTICAL METHOD

A computer window of digital RS data was established for an area 12 by 12 kms to cover the Golden Stranger area. The window extends from UTM 598000 to 610000 EW and 6351000 to 5363000 NS. Windows were prepared for the two sets of geo-coded TS and SAR images from the two satellites. The windows matched perfectly when the boundary from one was superimposed on the second.

DETAILS OF SYNTHETIC APERTURE RADAR (SAR) ANALYSIS

The European ERS-1 SAR data was analyzed to produce two types of images: contrast enhanced grey scale images, and filtered images showing structural configurations. In addition elarged images and larger scale images with suspected circular features can be supplied for exploration purposes. Lineament analysis of RM data done by eye is subjective. Each time the SAR image is viewed additional linears and extensions of linears are noted which can be added between and parallel to linear

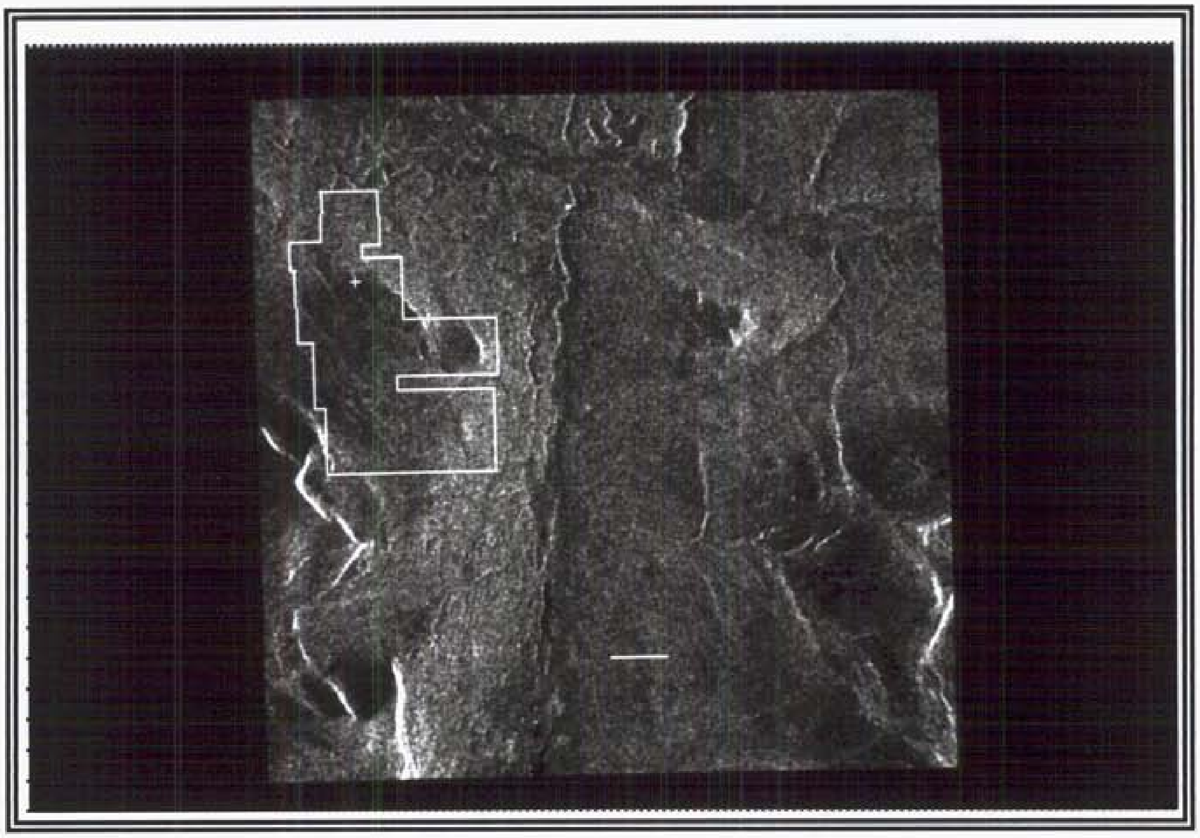


Figure 7. SAR image of Golden Stranger Claims area. (12 X 12 kms), showing claims outline.

sets shown. However in order to avoid masking the image the most conspicuous linears are shown with a sufficient number of less conspicuous linears to establish the structural framework. Linear analyses were completed using SAR in conjunction with TM images. Although there was not perfect linear for linear correlation, the major linears and the same linear patterns were observed on both images.

DETAILS OF THEMATIC MAPPER (TM) IMAGERY ANALYSIS

TM data were analyzed using a variety of techniques designed to enhance structural and textural patterns in the data. For the Golden Stranger project, four types of TM images were prepared: simulated natural gray scale images, color-infrared composites, color ratio composites, and principal component images.

Contrast enhanced images were created for visual observation. Because fifteen colour intensities is approximately the number that the human eye can distinguish and process, original raw TM data, provided in 256 grey tone intensity levels, is auto-scaled into 15 levels of colour intensity ranging from black to white (FIGURE 8). For example, a histogram of TM band 5 covering the Golden Stranger area, (FIGURE 9), shows that this band does not cover the entire range of 256 intensity levels and produces a skewed bell-shaped histogram. In order to further enhance grey tone differences between pixels, data for the major central portion of the histogram are stretched, grouped to 250 intensity levels and displayed (FIGURE 10). This affords the human eye a better opportunity to pick out subtle differences in intensity levels and provides flexibility in analysis which gives satellite digital data a distinct advantage over use of air photographs for geological interpretation.

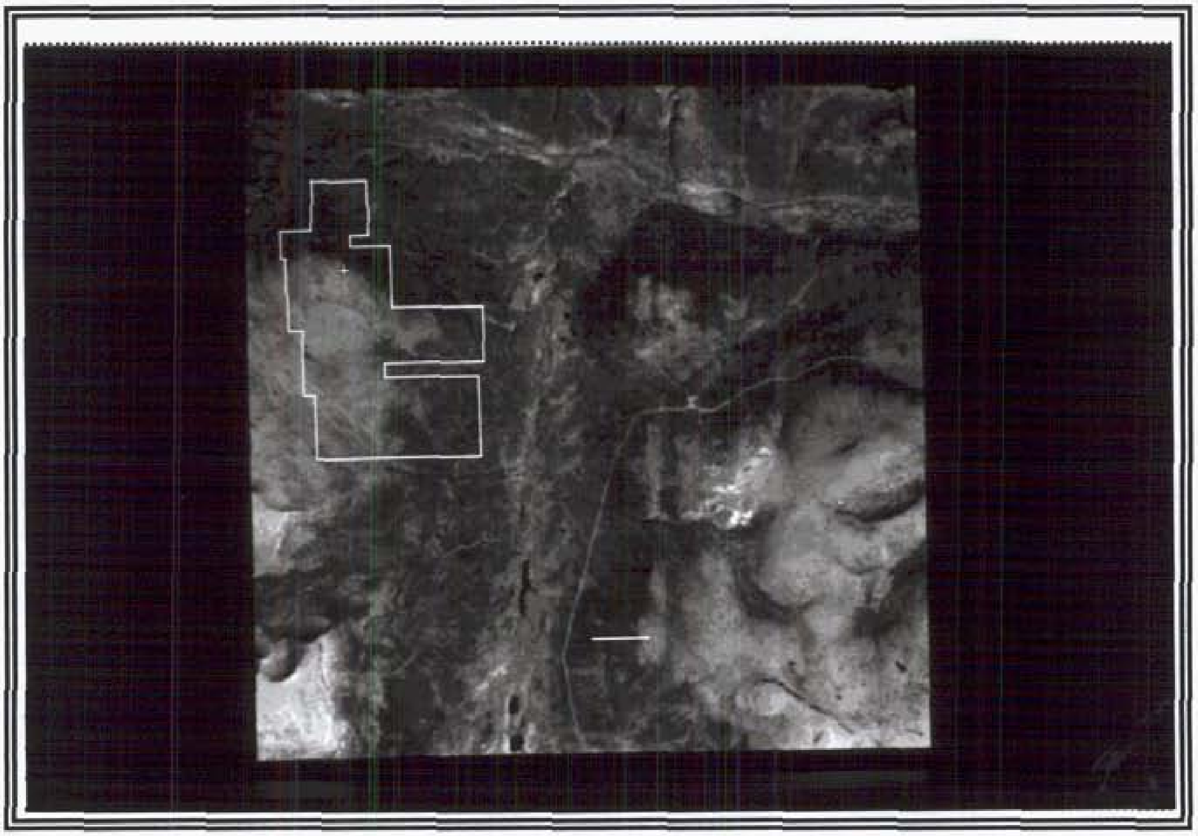


Figure 8 Unstretched TM image of Band 5, showing claim outline. (Scale 12 X 12 kms).

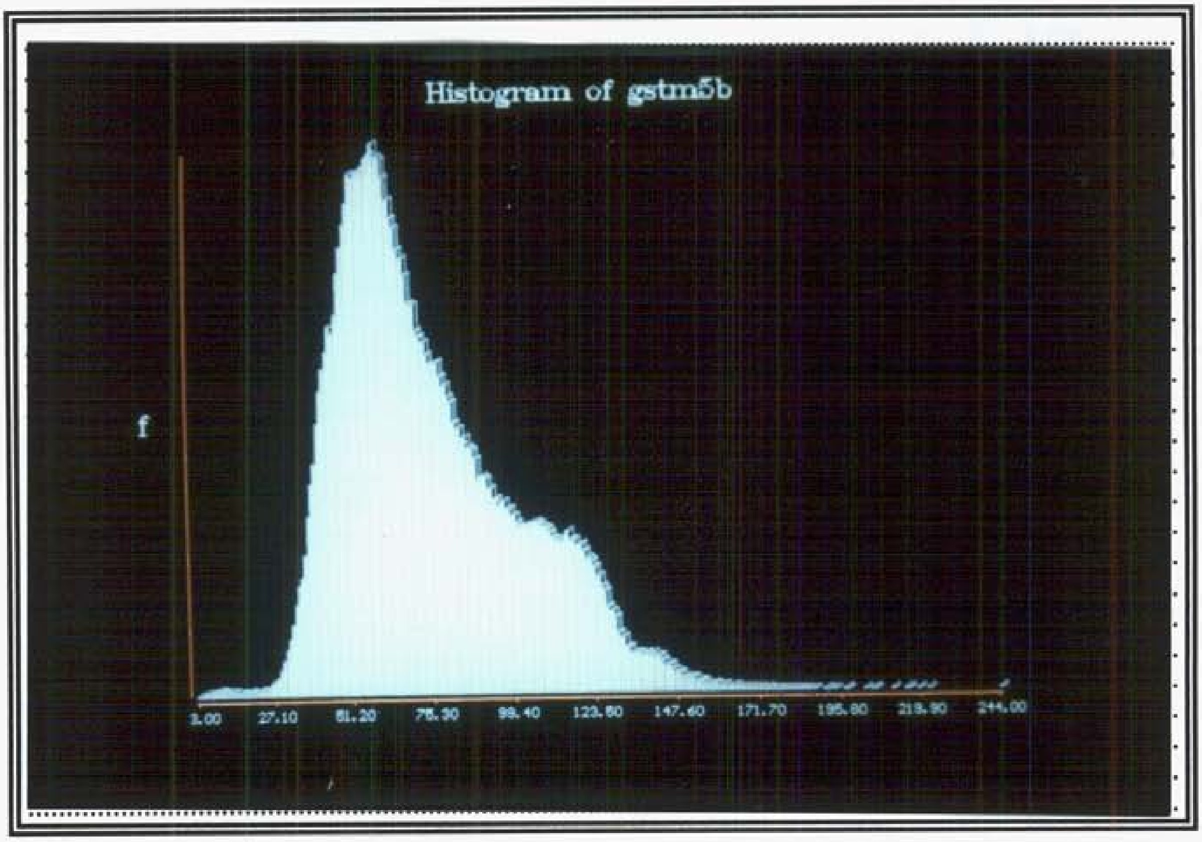


Figure 9. Histogram of TM band 5

Figure 10. Stretched image of TM Band 5.

COLOUR COMPOSITE IMAGES

A 2- or 3-band colour-composite image can be made from any combination of the original bands. At each pixel point, these plot the band with the highest reflectance level. Color-composites are useful in discriminating subtle differences in ground reflectance resulting from a combination of effects of vegetation, vegetation stress, moisture content, topography, angle of incidence, and different surficial and bedrock materials (FIGURE 11).

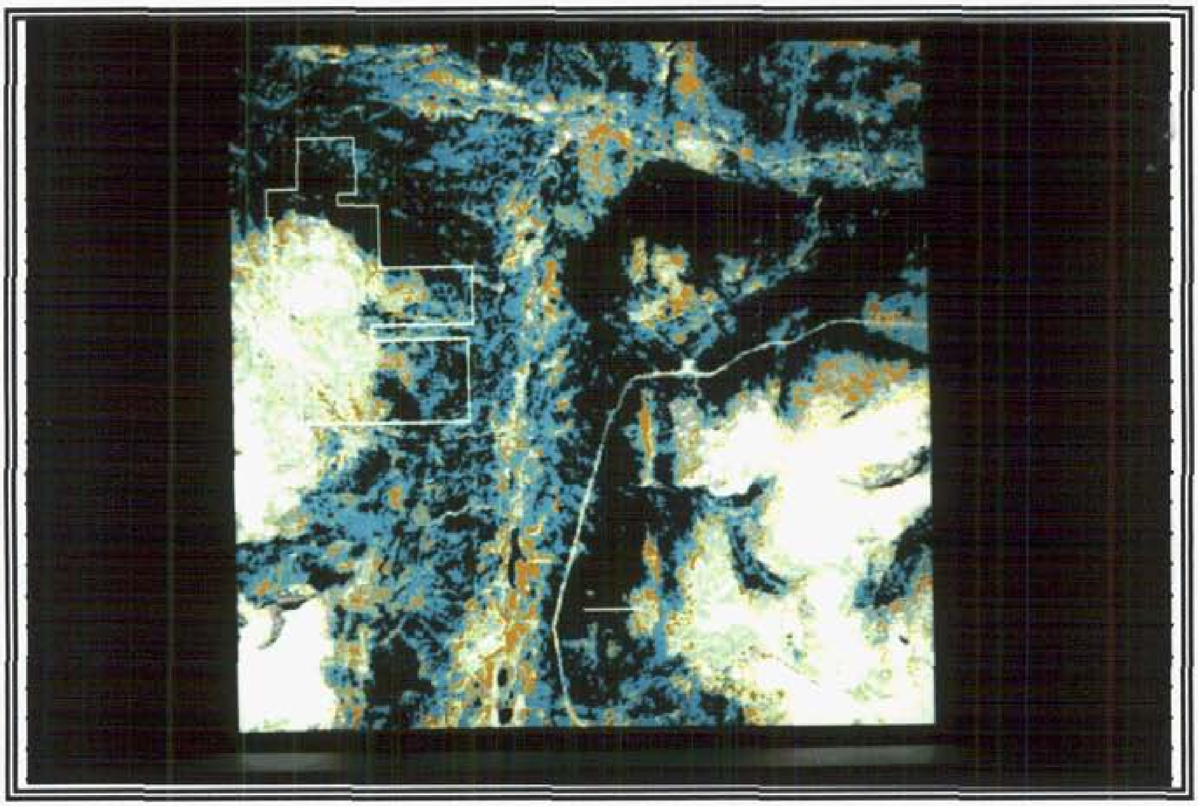


Figure 11 Colour Composite image TM Bands 4, 5, and 7.

BAND RATIO IMAGES

Band ratios (e.g., Band 1 vs. Band 3 or Band 7 vs. 5) also are useful in enhancing subtle differences in reflectance from different materials (FIGURE 12). Bands can be compared in a variety of ways, e.g., by addition, subtraction, multiplication, or by use of simple algorithms. These are used in order to delineate possible hydroxide and iron oxide zones.

PRINCIPAL COMPONENT IMAGES

Principal-component images can be used on two or more bands to extract arithmetic functions (components) which can explain most of the variation in pixel intensity in that set. These components are orthogonal, and explain progressively less of the variance in the original set of bands. The degree of correlation of these components with ground data may show wide variation.

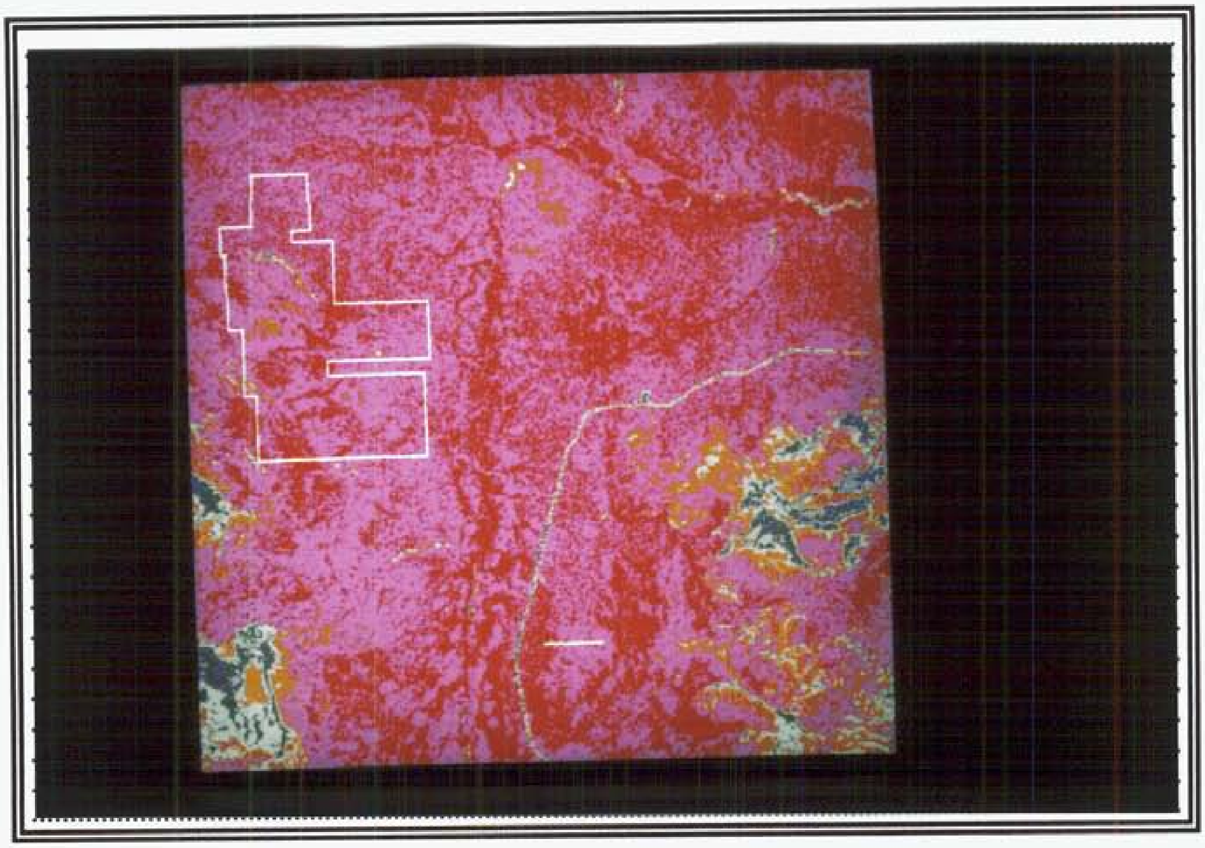


Figure 12. Band Ratio Image TM Bands 7/5 (12X12 kms)

Figure 13. Principal Component 2 TM Bands 1, 4, 5, and 7 (12X12 kms)

Component #1 shows common features depicted on a combination of bands 1, 4, 5, 7 and therefore is normally not used in the interpretation. Component 2, however, (FIGURE 13), depicts the variation between visible, (Band 1), and short wave mid-infrared bands (Bands 4, 5, and 7). These first two components commonly represent variation in surficial features with obvious differences in intensity levels, such as spruce or fir forest (low reflectivity) and meadow (high reflectivity). Component 3, (Figure 14, colour enhanced), shows the influence of bands 1 and 4 in variation of grey tones. Commonly, the important principal components useful for explaining variation in pixel intensity due to geological features are those which include only a small percentage of the total variance among bands. Component 4 is used to supplement Component 3.

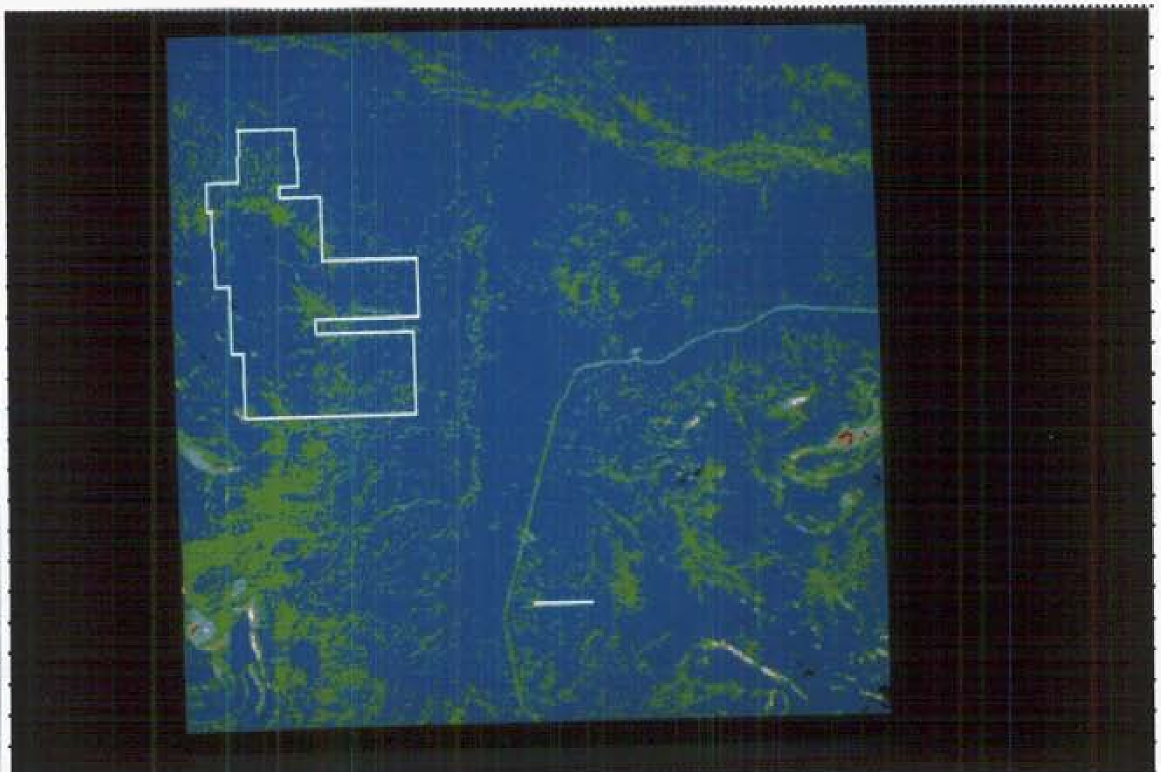


Figure 14 Principal Component 3, TM Bands 1, 4 , 5, and 7.

UNSUPERVISED CLASSIFICATION

Unsupervised-classification (Cluster analysis) images are produced by utilizing two or more bands in which the pixels are classified into a desired number of groups (clusters) such that the within-group variance is minimized and the between-groups variance is maximized. This procedure was not utilized because of extensive glacial drift and vegetation cover.

SUPERVISED CLASSIFICATION

Supervised-classification images were also not used because of extensive glacial drift and vegetation cover. Supervised-classification images are made by choosing small (25 to 100 pixel) "training sites" over areas of known or interpreted geology. As many groups are chosen as the geologist feels necessary for the interpretation, and a number of different combinations of training sites may be analyzed. The spectral signature of the training sites is calculated (using mean and variance for each of two or more bands) and then the remainder of the pixels in the image are classified into one of these groups according to minimizing certain mathematical parameters between the pixel and the group.

Parameters used in this type of analysis include "minimum distance" and "maximum likelihood". The "minimum distance" method classifies each pixel according to the minimum variance between the value of the pixel and the mean of each training site. The "maximum likelihood" method classifies pixels according to minimizing the probability density function associated with the training sites; pixels are assigned to the most likely class based on comparison of the probability that it belongs to each of the signatures being considered.

RESULTS

All types of SAR, TM and combinations of TM bands and methods of analysis, described in the above section, Details of Thematic Mapper (TM) Analysis, were utilized in RS analysis of the Golden Stranger area. For reasons of extensive vegetation and glacial drift cover, not all TM bands and analytical procedures are applicable such as Unsupervised and Supervised Classification discussed above. This report discusses in detail only those procedures utilized and their results.

The analyses and results are presented in six sections as described below:
Structural Lineament Analysis SAR and TM Imagery
Significance of Textural Differences in SAR Imagery.
Circular Features on SAR and TM Imagery
Thematic Mapper Imagery Analysis
Results of Ground Check.
Conclusions and Recommendations

STRUCTURAL LINEAMENT ANALYSIS OF SAR AND TM IMAGERY

Precision geocoordinated SAR imagery, supplemented by precision geocoordinated TM imagery, was used for structural lineament analysis. The coordinate precision between the two sets of data from different satellites was confirmed by applying the coordinate-positioned Golden Stranger window boundaries from SAR into TM imagery. The property outline corresponds perfectly on the two images.

Linear analysis of SAR and TM imagery has shown that the Golden Stranger claims area and, indeed, the general Toodoggone area is far more structurally complex than previously known. Four sets of diverging, curvilinear, and subparallel lineaments were identified; these can be used as a guideline for detailed structural mapping in the field Figures 15 and 16. The most significant sets of linears in order of probable importance are:

(a) Major northerly trending breaks through Lawyers property on the east; a second through the west side of Lawyer's ridge northerly across Toodoggone River and up Moosehom Creek. A third is followed by Lawyer's Creek and cuts the east side of Metsantan Mtn. These three structures converge to the north. The fourth major lineament passes through the west side of the Golden Stranger claims, and forms the approximate contact between Sustut sediments and Toodoggone volcanics in the southwest comer of the Golden Stranger "window". The major Lawyers and Toodoggne northerly trending systems were previously interpreted as a graben structure. It is noted that AGB mineralization lies on the west side of a similar major north-south structure, sort of a mirror image to Golden Stranger. At AGB the veins dip to the west; on the west the Golden Stranger vein system dips to the east.

(b) Associated with the above are a series of conspicuous east-west trending curvilinear lineaments concave to the north.

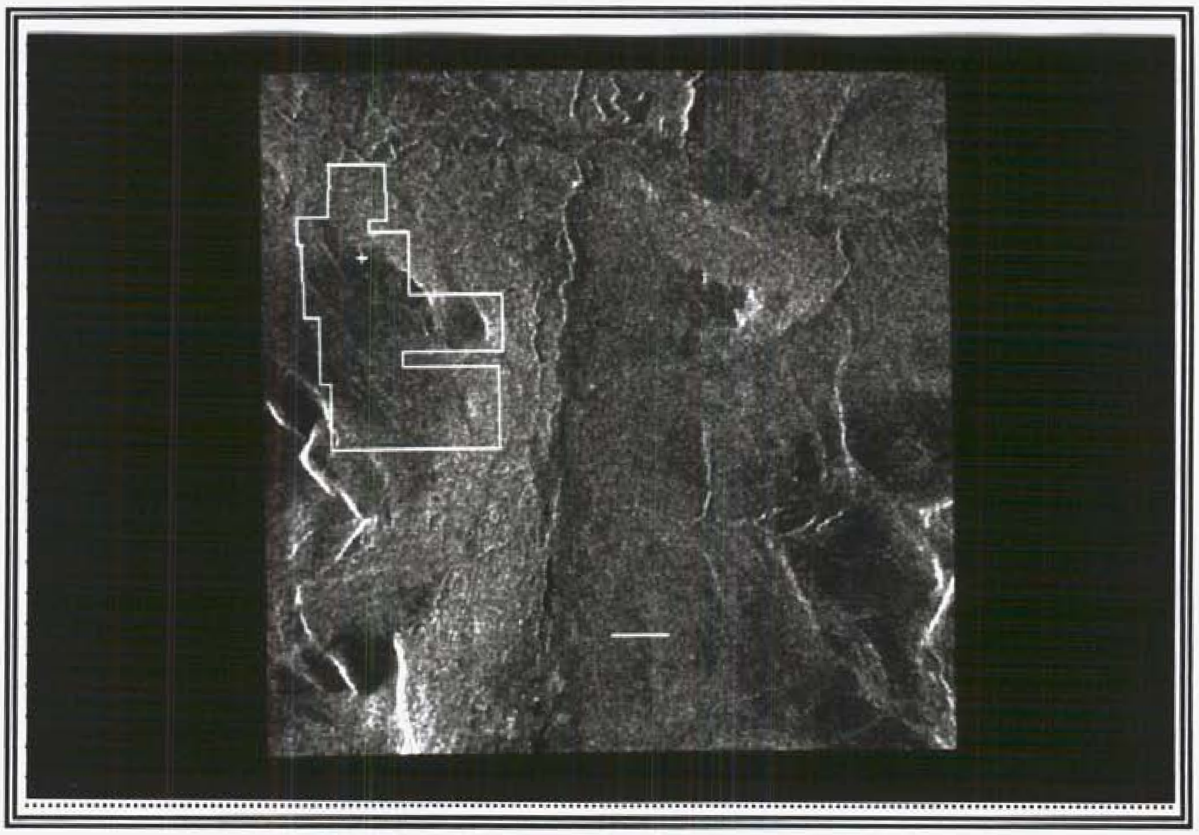


Figure 15 SAR image of Golden Stranger Claims area (12X12 kms) . Vein (+)

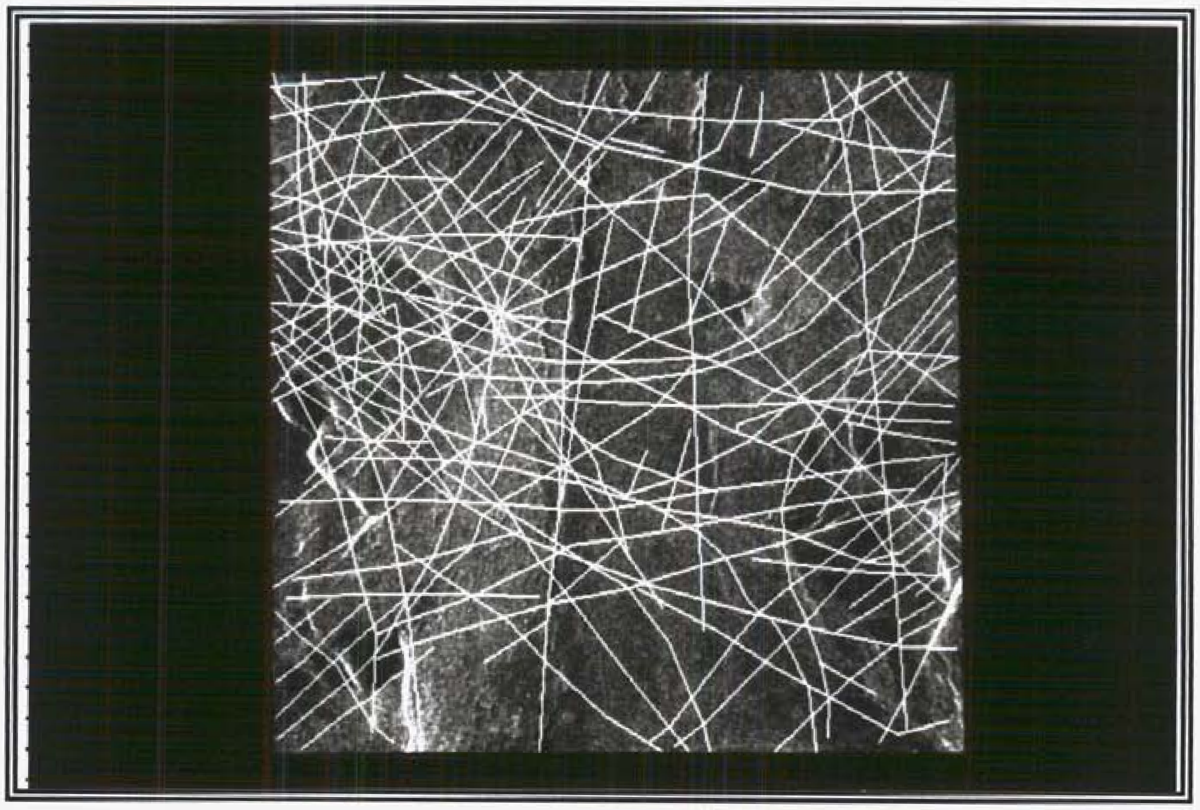


Figure 16. SAR image showing lineament pattern. (12X12 kms)

(c) Superimposed on these are a myriad of less conspicuous subparallel lineaments in two northeasterly and northwesterly trending sets. Some of these are continuous through the major structures, others are discontinuous resulting from offsets at intersections or burial by overburden. It is noted that these systems are more prevalent in areas of shallow overburden on the Golden Stranger property on the west and Lawyer's property on the east.

The major northerly trending converging lineaments with the east-west trending curvilinear concave north sets may be of regional economic significance with certain of the finer subparallel sets acting locally as ultimate ore controls. On the Golden Stranger claims the northerly trending mineralized structure is clearly visible on SAR and on a number of different TM images. In addition there are several subsidiary northerly, northeasterly and northwesterly lineaments which require field investigation.

A disturbing feature commonly noted during lineament analysis is that many lineaments appear to continue uninterrupted at intersections with major sets; some of which have known significant displacement. The explanation for this is unclear but could result from a number of factors:

(a) "Artifacts" resulting from SAR data collection and image processing appears unlikely because similar patterns appear on SAR and on TM images which utilize entirely different satellites, energy sources, data collection and image processing techniques.

(b) Most of the linears may represent shatter zones with little apparent horizontal displacement. This may be true for many linears but some pass through faults with significant offset.

(c) Where numerous parallel linears occur it is probable that different but parallel linears within the same set are projected as one through covered areas and across major intersecting linears.

Field mapping and integration of data from other sources will help resolve this and other problems.

SIGNIFICANCE OF TEXTURAL DIFFERENCES IN SAR IMAGERY

There are conspicuous textural variations on the SAR image which may be a result of a combination of effects of vegetation, moisture content, surficial materials and underlying bedrock. These textural variations in the Golden Stranger claims appear to reflect most closely differences in type and density of vegetation cover. Lithology cannot be mapped with any confidence solely on the basis of SAR imagery textures.

CIRCULAR FEATURES ON SAR AND TM IMAGERY

A total of 42 circular features were noted on SAR and TM imagery. They range in size from about 150 to 550 meters in diameter and have varied appearance; some are simple circles, others appear as smaller circles within larger ones, a few appear to have radiating spokes within them and still others occur in clusters of two or more. The majority of these circular features fall along structures and 10 are on, or adjacent to, the Golden Stranger claims. In addition there are a number of randomly scattered circular features. The coordinates of these circular features are given in Appendix A and are shown in Figure 17.

The circular features may be a result of erosional topography, cultural activity (mining), vegetation patterns, or glacial patterns; but, in this locality, should be investigated for the possibility being volcanic or intrusive related hydrothermal centers which could be significant for localization of gold-silver mineralization in the claims area, or porphyry copper-gold systems in this geological environment. It is noted that mineralization at Cheni, Silver Pond and the "main" vein at Golden Stranger are all associated with diatremes/breccia pipes which appear to coincide with circular features on SAR and TM imagery.

Figure 17 SAR Image of Golden Stranger area showing Circular Features (+). Scale 12 X 12 kms)

It is probable that most of the 42 (+) circular features, when checked in the field, will prove to be of no geological interest but a few could be of economic significance. Field checks integrated with geophysical, geochemical surveys and geological mapping are a vital additional component of this RS analysis.

The circular features are prioritized as follows:

(1) Underlain by Toodoggone volcanic rocks with little or no glacial drift cover, with further priority given to those associated with lineaments.
(b) Occurring in areas believed to be underlain by only a thin veneer of Sustut on Toodoggone volcanics, at Sustut-Toodoggone contacts, or possible Toodoggne windows in Sustut sediments.
(c) Features thought to represent topographic highs. These may be accompanied by silicification etc.
(d) Circular features attributed to glacial drift.

Visual delineation of circular features, as for linears, is very subjective and subtle features may be overlooked. This reinforces the recommended procedure that SAR images be viewed and reinterpreted during the course of ongoing exploration.

THEMATIC BAND IMAGE ANALYSIS

The TM digital data has been processed using several in-house software programs. For TM data analysis, five types of images were produced: 1) Grey scale images, 2) Multiband-band colour-composite images, 3) Principal component analysis, 4) Several types of Color-ratio and Overlay images.

A number of factors affect reflectance measured by a TM sensor and these should be borne in mind while interpreting TM data for geological purposes. A TM sensor measures reflectance of only the top few millimeters of the surface. Direct measurement of lithology is predicated by the amount and size of clean bedrock that is exposed. Bedrock values are unattainable through overburden and vegetation but indirect determination of bedrock lithology may be possible by interpretation of the effects of bedrock on topography, vegetation and overburden and the interplay of all these factors. Vegetation, in particular, is affected by underlying bedrock and overburden in terms of presence or absence of nutrients, metals resulting in stress, moisture content, etc. Such interpretation requires sophisticated data processing and field studies that are far beyond the scope of this report. However, anomalous areas can be delineated for field checks or targets for conventional exploration.

Images for all seven TM bands, unstretched and stretched, were examined for RS study of the Golden Stranger claims. Although many of the same features are visible on a number of the TM images, and on SAR, each band contributed unique bits of information. Because of varied vegetation and near complete overburden cover, delineation of lithologies by TM analyses was not possible.

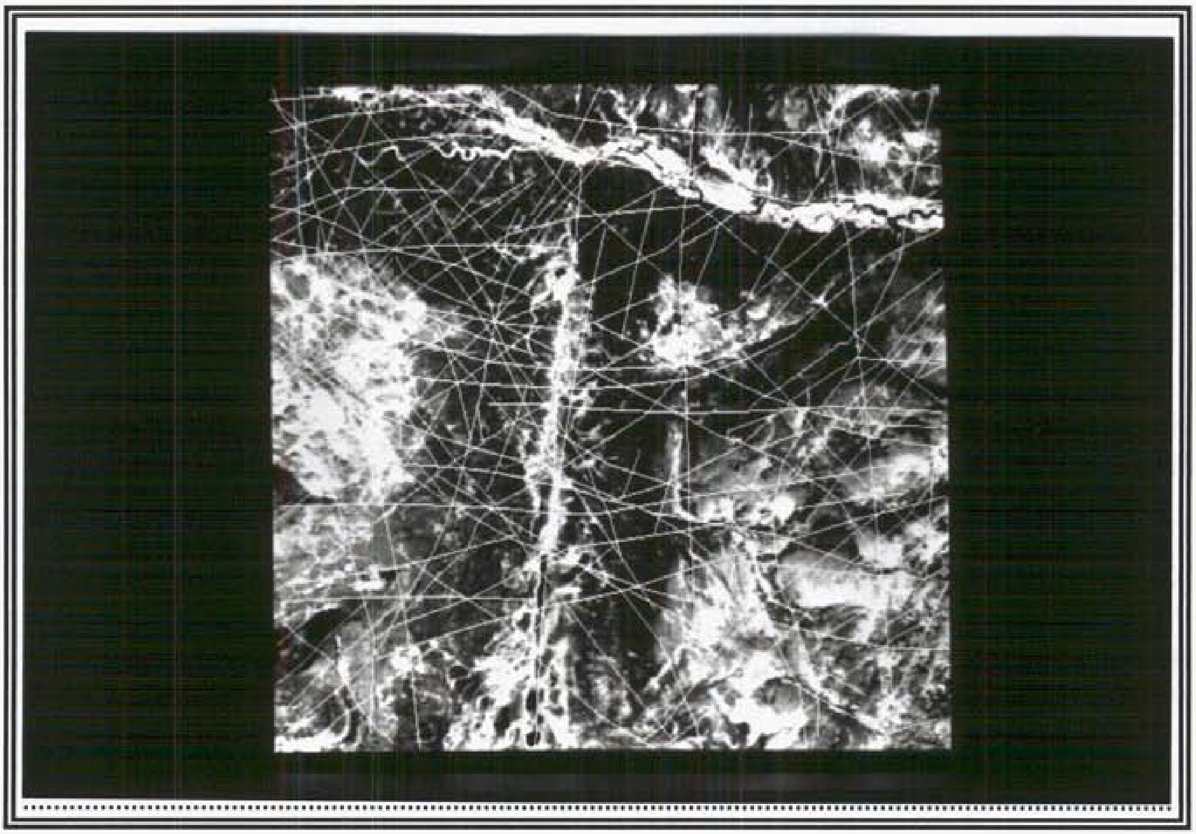


Figure 18 Stretched image TM Band 4 showing linears from SAR, (Scale 12 X 12 kms)

Shorter wave lengths in the visible range, TM Band 1, produces an image much like a photograph. Ground disturbance, roads, are very conspicuous, Sustut bluffs are outlined, and some structure is visible. Slightly longer wave lengths of Band 2 enhances glacial features. Lineaments in drift, thought to reflect structures in underlying bedrock, are also visible . Band 3 shows greater vegetation contrast. Structural lineaments are enhanced with some lineaments visible on this band used to supplement SAR data.

Band 4 stretched, (Figure 18), enhances vegetation contrast. Structure shows up very well but is obscured in areas of darker vegetation. This band gives conspicuous tonal contrast in the Sustut sediments where flat lying bedding is noted. The major northerly converging lineaments and large arcuate features concave to the north are visible on this image and correspond to those conspicuous on SAR. The AGB and Cliff Creek siliceous zones, and a silicified breccia zone and gossan to the west, appear to be within a large (3 kms) circular structure. This large ovoid feature may be of geological significance. A second large oviod feature is noted at South Lawyers in the southeast part of the image on the Golden Stranger claims at the erosional unconformity at top of Toodoggone volcanics under Sustut sedimentary remnants. A third, similar, but egg-shaped feature, 2.5 kms, containing at least 4 concentric rings, underlies the Golden Stranger claims with about 40% of it in the treed valley north of the known Golden Stranger showings. Finally, a fourth, less conspicuous ovoid feature, about 2.5 km, is located at the NE end of the south Sustut lobe, on the east side of Metsantan- Golden Stranger Fault. It lies mainly within Toodoggone volcanics but is partly covered by Sustut.

Figure 19 Stretched image ofTM Band 5 (Scale 12 X 12 kms).

The stretched image of TM band 5 is normally used for distinguishing surficial features such as land, water and vegetation. The lakes and ponds in this area appear dark because of absorption of electromagnetic energy. The land surface appears as various shades of grey depending upon types of material and their reflectance. Vegetated areas appear as moderate to dark grey tones depending upon abundance and vegetation type. Brighter areas indicate sparse vegetation, tundra, roads and other disturbed areas. The image shows many strong lineaments which correspond to those depicted on Band 5 and SAR data. Additional strong lineaments visible on this image, not noted previously, were added to the lineament file. For example a distinct strong wide linear, running parallel to and about 2 km east of Lawyers Creek Fault, passes from the south boundary of this image, through the west end of Lawyer ridge, northerly through Kodah and up into Moosehorn Creek. The main Lawyers Creek Fault, with a number of east-west spur linears projecting to the east, is particularly conspicuous on this image. In addition some of the ovoid and circular features are conspicuous on this band. The stretched image of Band 5 is useful for supplementing SAR lineaments, circular features and ovoids (Figure 19).

The stretched image of Band 6, utilizing long wavelengths in a very broad portion of the thermal infrared range, produces a fuzzy image which has received little attention in TM analysis to date. It, however, clearly shows the West Lawyers-Kodah- Moosehorn Creek structure noted in Band 5. There is also a suggestion of a slightly diverging NE linear still farther to the east. The spur linears off the east side of the Lawyers Creek linear are also conspicuous.

The stretched image of Band 7 is similar in appearance to stretched Band 5. The large ovoid feature butting against the southernmost spur of Sustut is more conspicuous in this image. It measures about 2.5 km oriented north-northeasterly and is coincident with a heavy media anomaly.

COLOUR COMPOSITE IMAGES

A color-composite was made using one short-wave (Band 1) and two mid-infrared bands, (Band 4 and Band 7), to enhance subtle variations in the ground reflectance data. In this image we see the dominating influence of band 4 shown as green in the image. Red shows the influence of Band 7 and blue, Band 1. Colour composites will only show the influence of relative strength of the various bands and cannot discriminate among lithologies. The importance of Band 7 here is its capability of delineating large hydroxyl enriched zones, the sites of major alteration. A VGA composite was prepared to show the relative intensity of reflected energy for each band (Figure 20). The VGA image provided no new information and any indication of hydroxyl enriched zones is masked by high reflectivity of disturbed areas and sparse vegetation. It is necessary, therefore, to utilize different combinations of Band Ratios to achieve the desired result for hydroxyl zones.

BAND RATIO IMAGES

Search for hydroxyl zones

Band Ratio images utilized TM Bands 5 and 7 and Bands 1 and 3, respectively, in a search for hydroxyl zones and iron oxide zones. Several different types of analysis were carried out and resulted in varied measures of success.

Band Ratio image (Band 7/5), shows a significant increase in pixel values over background in the general Lawyers area with the highest values noted in single or clusters of a few pixels. A few similar values were obtained in known disturbed areas, a few less conspicuous values on Golden Stranger claims, and scattered pixels with highest were values noted on barren Sustut sediments. This image cannot be used with any confidence to delineate hydroxyl zones (Figure 21).

Figure 20. Colour Composite image TM Bands 1, 4, and 7 with VGA palette (12X12 kms)

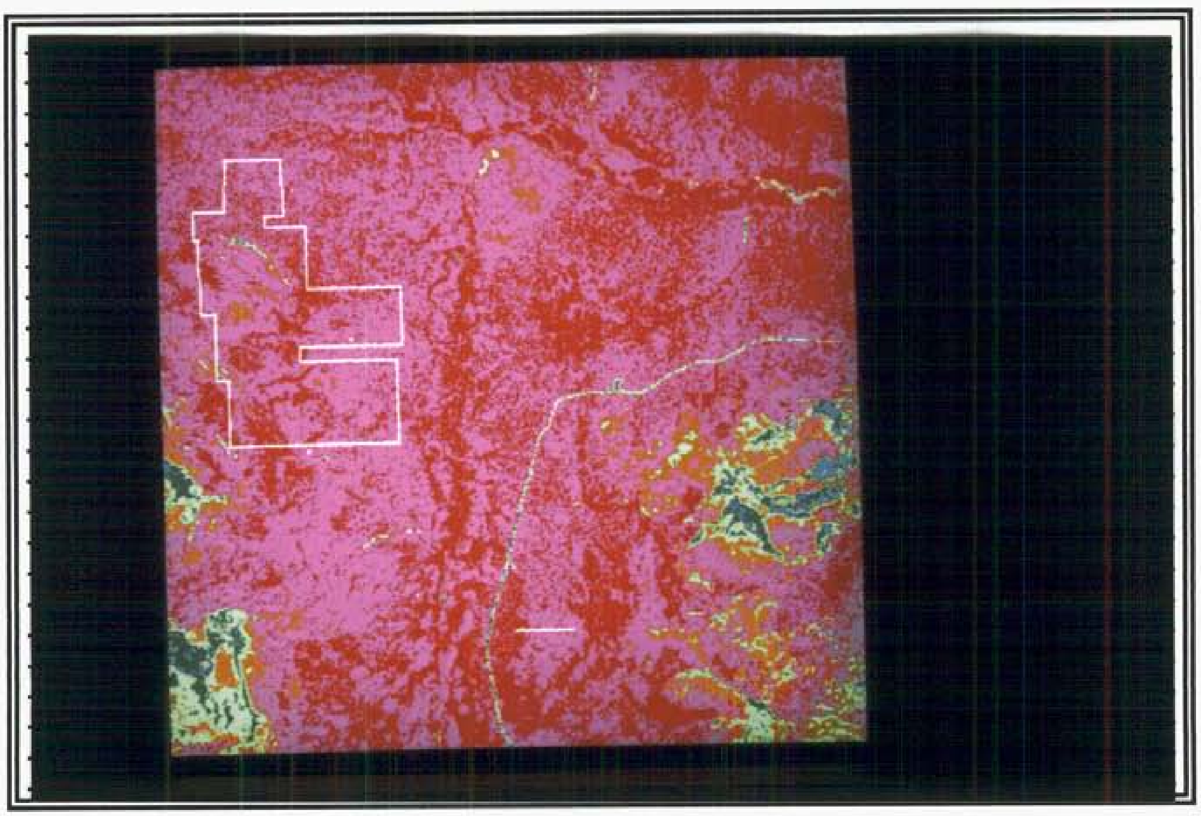


Figure 21. Band Ratio image TM Bands 7/5 (12X12 kms)

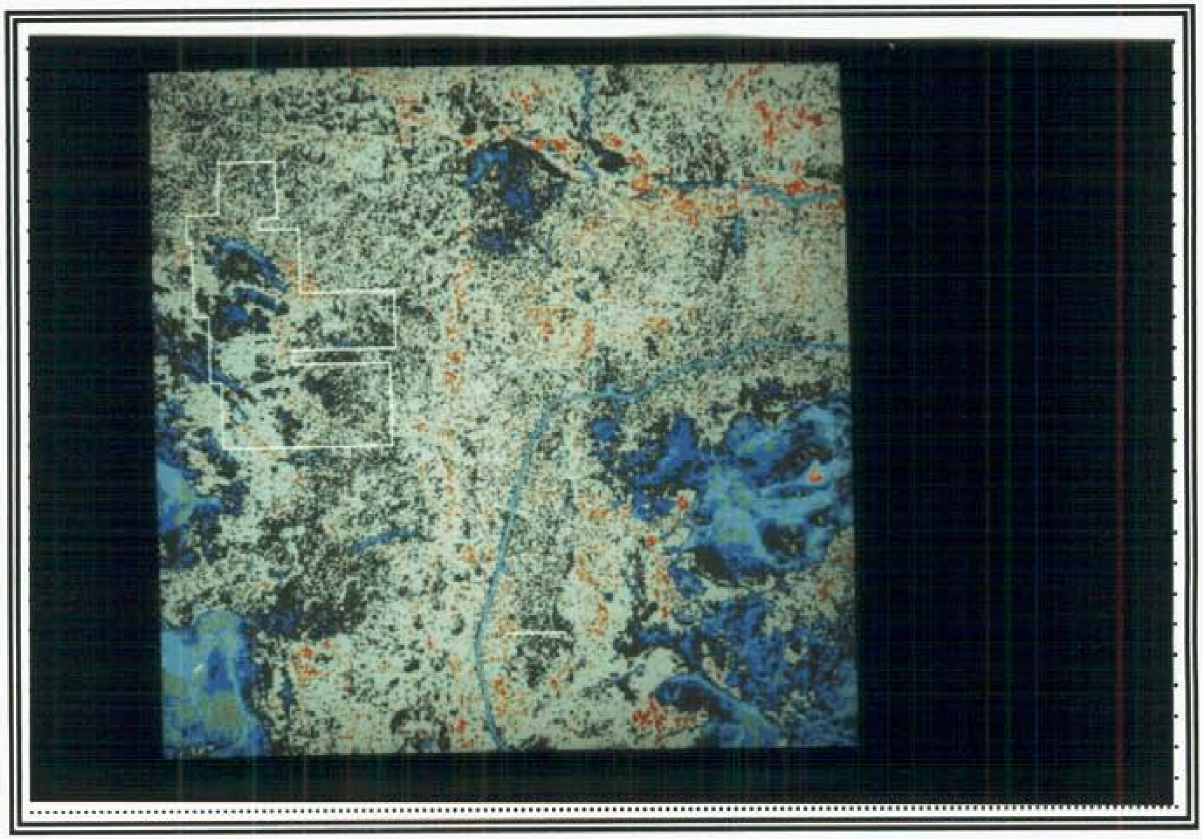


Figure 22. Normalized Band Ratio TM Bands 7 and 5 (12X12 kms)

Figure 23. Band Subtraction image TM Bands 5-7 with possible OH zones circled.

Normalized Band Ratio image, using TM bands 7 and 5, shows higher but still (-) values as compared to background over the general Lawyers area, with the highest values occurring as single and clusters of a few pixels. Similarly high values occur in a line marking the north flank of Golden Stranger ridge. Still higher values, a few (+) pixels, occur on the barren Sustut outcrops (Figure 22). High values on barren Sustut suggests that this image cannot be used with any confidence for delineation of hydroxyl zones. Normalized band Ratio image using TM bands 5/7 produces positive values throughout with lower value patterns similar to corresponding higher values of Figure 22.

Band Subtraction image, using subtraction of TM bands 7-5, shows higher but still (-) values rimming the general Lawyers zone, nothing anomalous over known AGB showings, or at Golden Stranger claims. This image also shows higher (-) values in the cirque on the north side of Sustut ridge which probably *represent snow remnants. In any case, this image cannot be used in this area to delineate hydoxyl* zones. Using subtraction of TM bands 5-7, however, delineates several anomalous high single and clusters of pixel values in the general Lawyers area (Figures 23 and 24). None of these, however, relate directly to AGB showings; no anomalous values were observed at Golden Stranger and only one cluster of 5 slightly anomalous pixels occurs in barren bedded Sustut. The less anomalous values in Sustut suggests that the 5-7 image might be of some assistance in delineating hydroxyl zones. It also suggests that Principal Component images using bands 5 and 7 might supplement Band Subtraction image 5-7 in delineation of hydroxide zones.

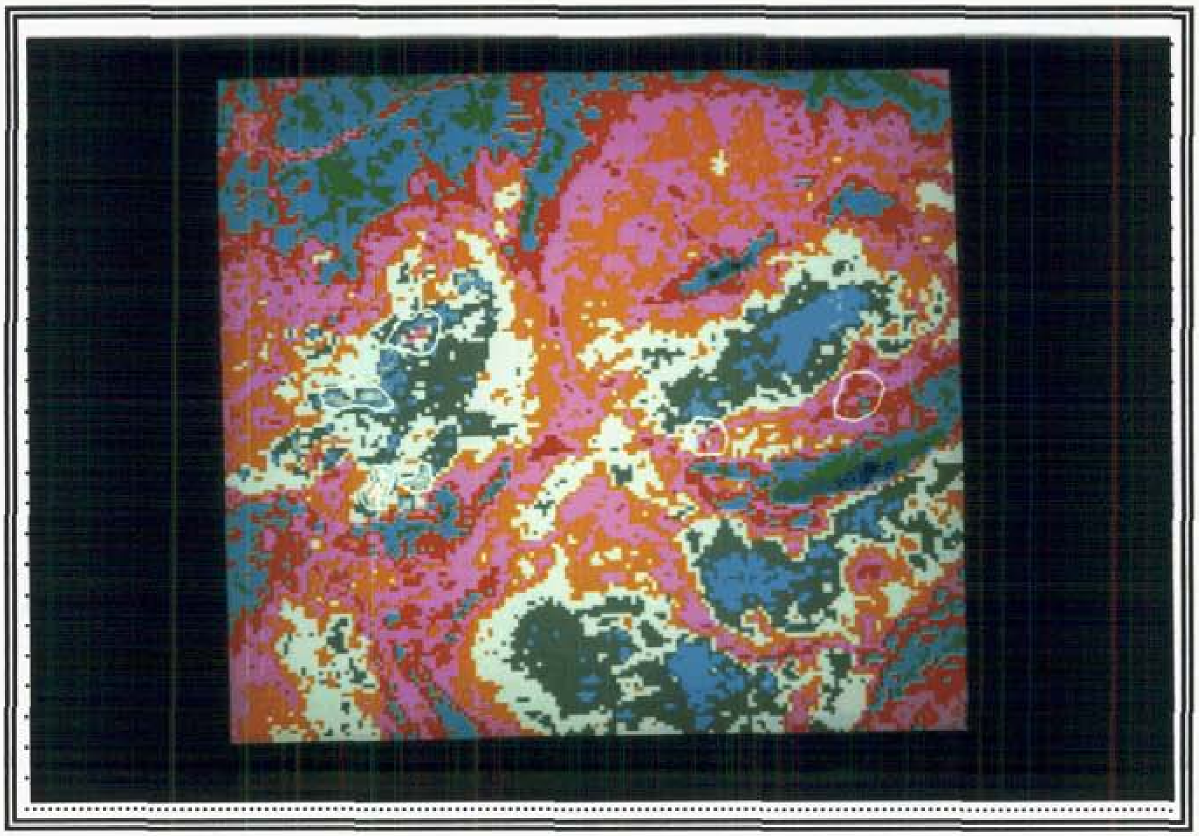


Figure 24 Band Subtraction image, TM Bands 5-7, showing Lawyers area at an enlarged scale. Suspected hydroxyl areas are outlined.

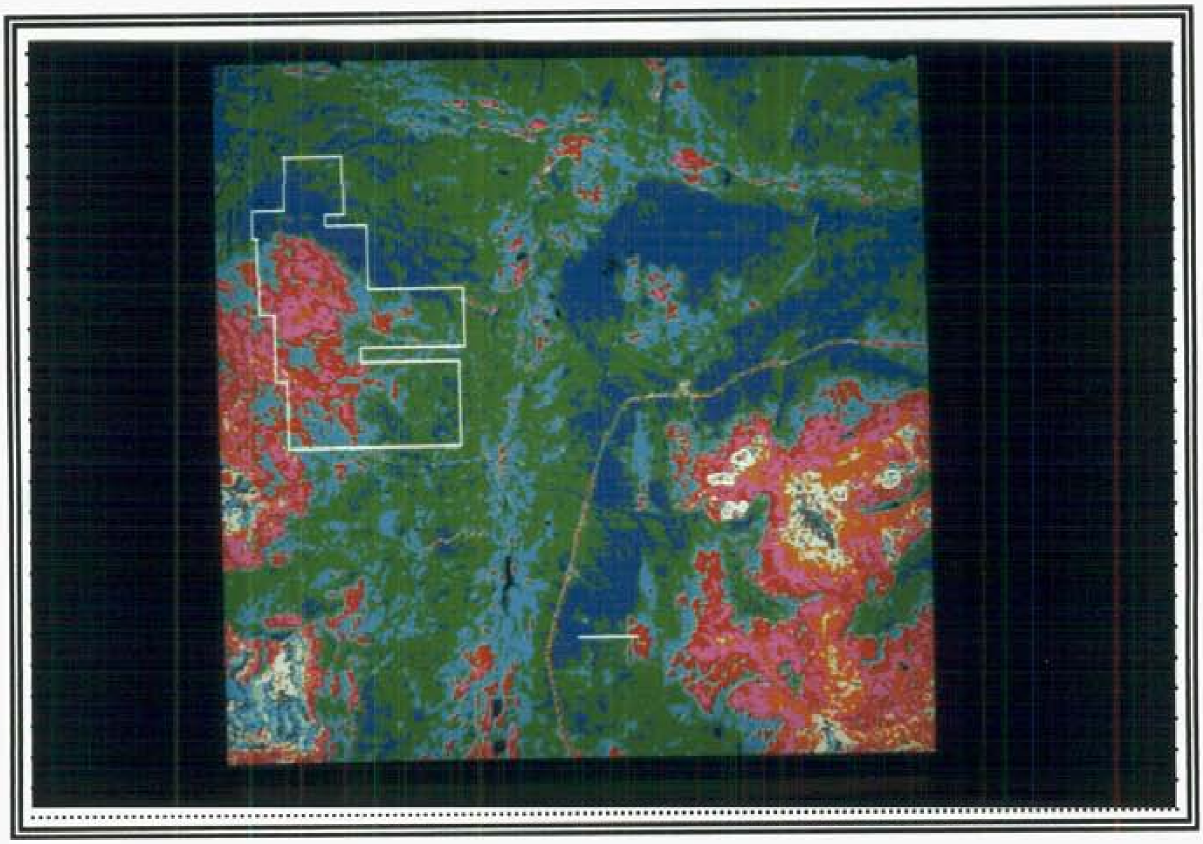


Figure 25. Band Masking image TM Band 7 covers 5. (12X12 kms)

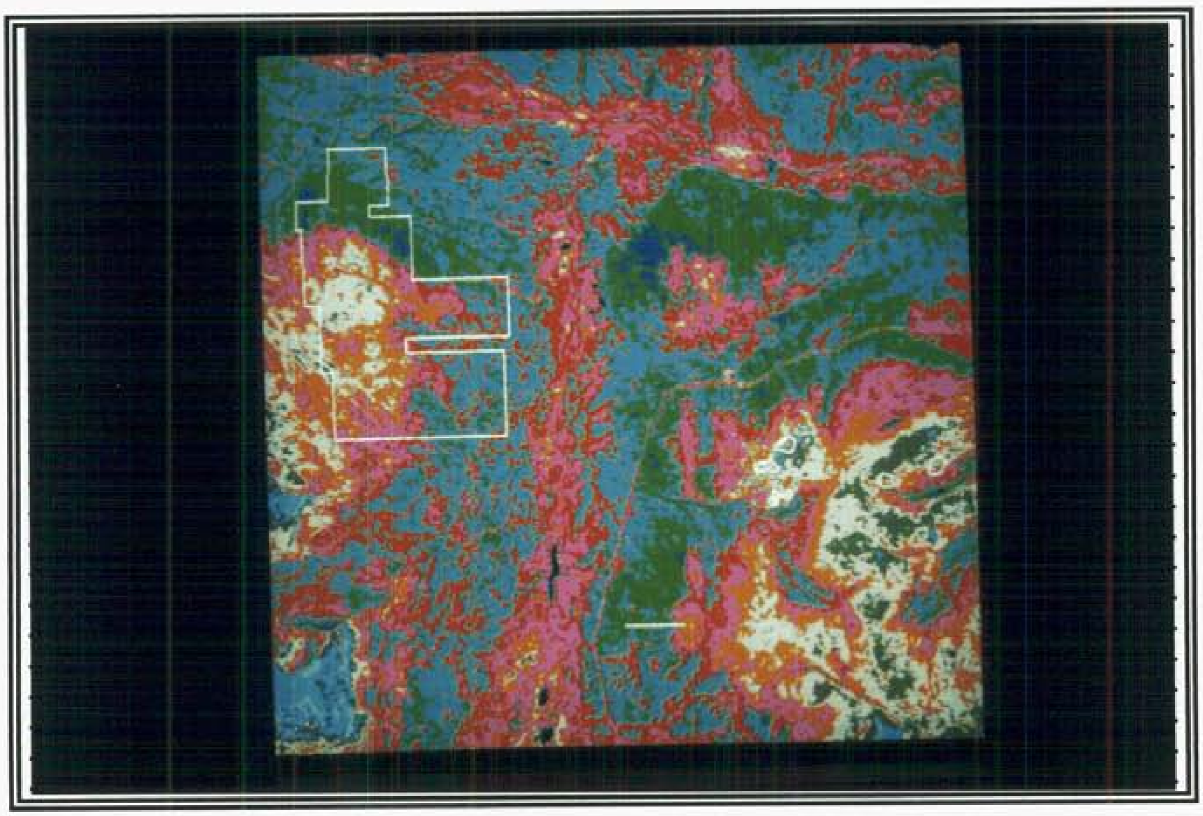


Figure 26. Band Masking image TM Band 5 covers 7. (12X12kms)

Band Masking images using TM bands 7 and 5 (band 7 covers 5), shows small clusters of anomalous high (+) values in general Lawyers area (Figure 25). These correspond well with anomalous values on Figure 23 but there are also clusters of slightly weaker anomalous values over barren Sustut which indicates this Band Masking image (band 7 covers 5) cannot be used with confidence to delineate hydroxyl zones. The image using TM bands 5 and 7 (band 5 covers 7) shows a similar pattern of clusters of high values in the general Lawyers area, and less pronounced but still weakly anomalous values in the Sustut area (Figure 26). It is noted that although the patterns are similar in the Lawyers area the highest values occur in different clusters. No anomalous values were noted in the Golden Stranger area.

Search for Iron Oxide Zones

Band Ratio image using TM Bands 3/1 shows 9 anomalous zones in Lawyers area as outlined in Figure 27, which corresponds well with the 6 anomalous hydroxide zones. In addition there are conspicuous broader northwesterly trending anomalous zones in the central Lawyers area which may be a result of a combination of sparse vegetation cover and iron oxides. The Golden Stranger area shows no significant anomalous values attributable to iron oxide, and the Sustut has a few small patches of slightly anomalous values which may be attributed to sparsely vegetated zones. Band Ratio image using TM Bands 1/3 shows nothing new and has less conspicuous and lower values in areas corresponding to "iron oxide" zones in the Lawyers area, and scattered similar values over Sustut.

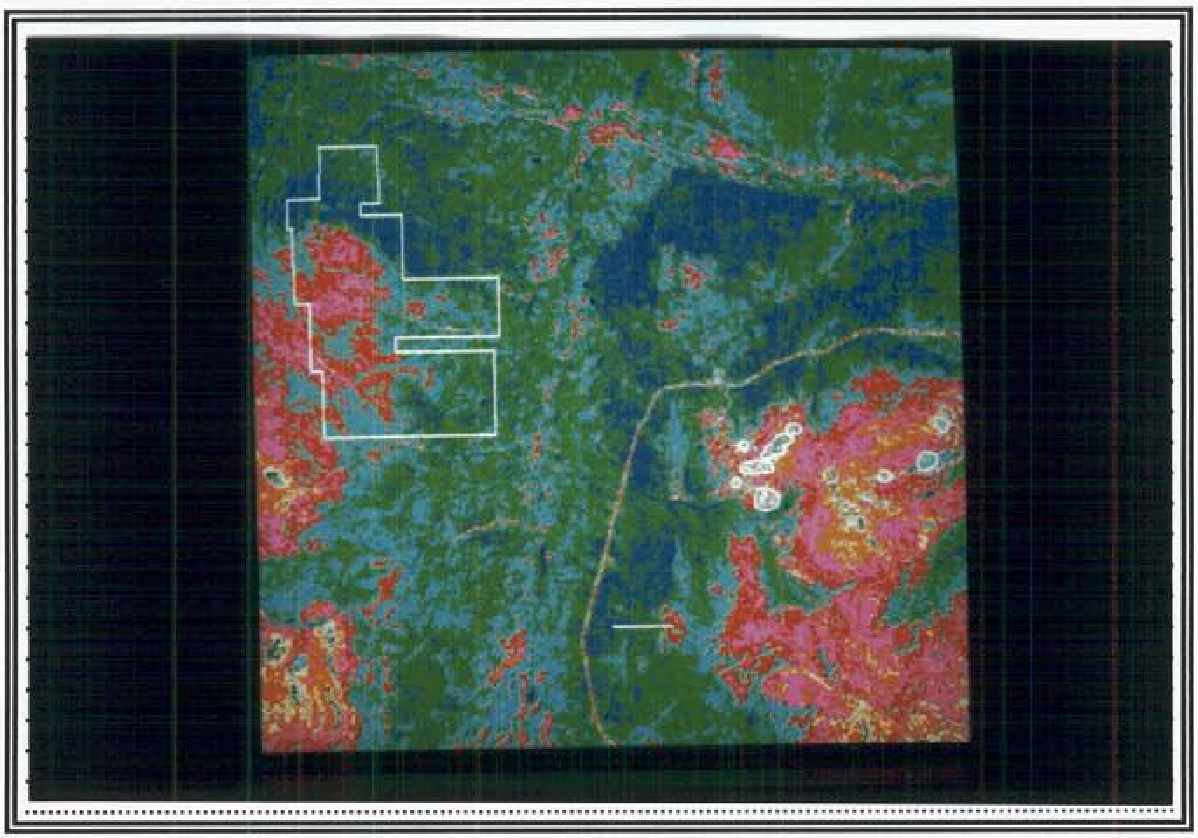


Figure 27 Band Ratio image TM Bands 3 / 1 (Scale 12 X 12 kms).

Normalized Band Ratio images using TM Bands 3 and 1 shows higher pixel values in the Lawyers area, ranging from small negative values to small positive values , and which correlate perfectly with areas delineated on Band Ratio image TM Bands 3/1. In addition, the known staining at a staging area on the access road also appears anomalous relative to the general road surface. The Sustut shows scattered slightly anomalous pixels not nearly as conspicuous as in the Lawyers area. Bedding is conspicuous in pixel patterns. No anomalies were noted on the Golden Stranger claims, and no significant iron oxide zones are known there, (Figure 28). It appears therefore that this image would be useful for delineation of iron oxides elsewhere in the Toodoggone region. Normalized Ratio image using TM Bands 1 and 3 gives lower pixel values ranging from very low (+) to very low (-). These correlate well with "iron oxide" zones delineated previously on Band Ratio image 3/1. Background values are higher positive. No anomalous values were obvious on the Golden Stranger claim area or in the areas underlain by Sustut where flat lying bedding is conspicuous in pixel patterns.

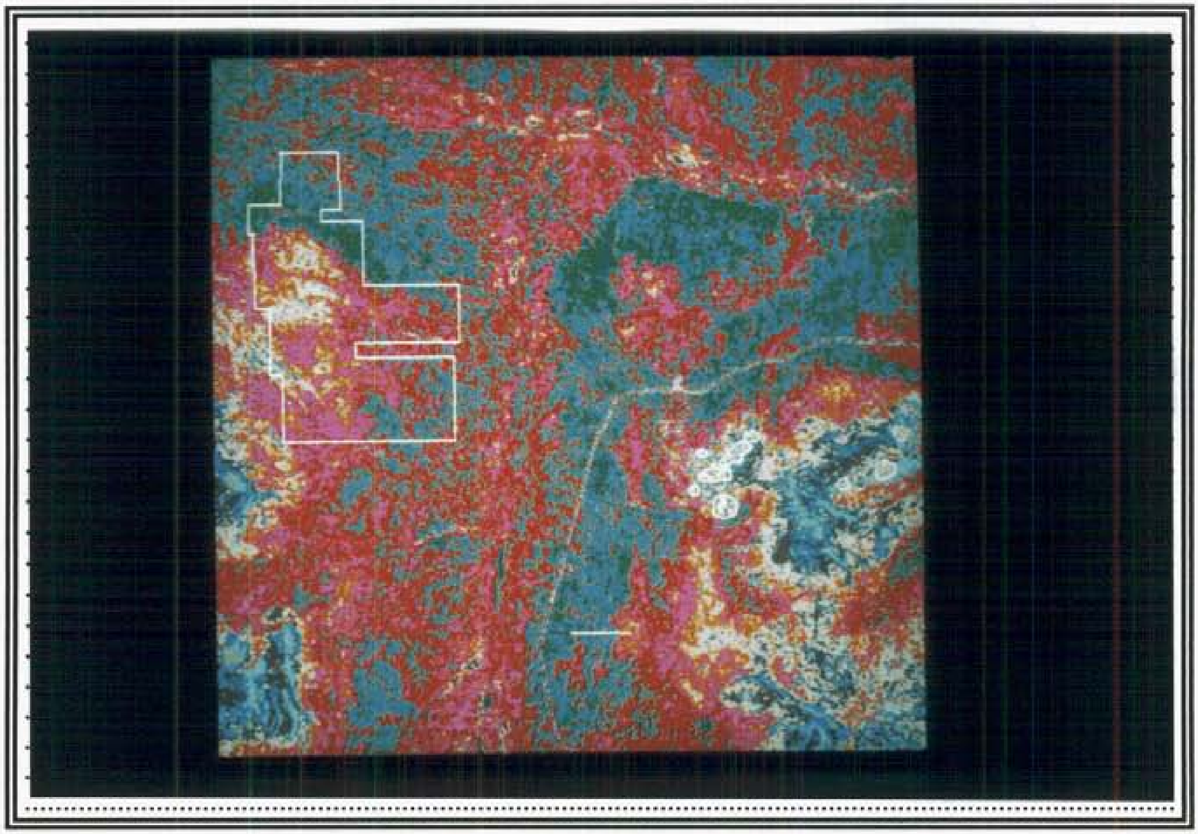


Figure 28 Normalized Band Ratio image using TM Bands 3 and 1, (Scale 12 X 12 kms).

Band Subtraction image using TM Bands 3 -1 delineates areas previously outlined as "iron oxide" fairly well. in the Lawyers area (Figure 30). Anomalous values range from low (-) to low (+). Background values are much lower (-). No anomalous values were noted in the Golden Stranger area. Although there are scattered anomalous colours over the Sustut sediments they give deep negative values as compared to Lawyers (Figure 29). This is, therefore a useful image for delineation of possible iron oxide zones. A field check is required to confirm presence of iron oxides where indicated in Figure 30. Band Subtraction image 1-3, with similar patterns as Figure 29, gives two sets of anomalous colours. The first set have values lower than background and may be indicative of iron oxide. The second set are higher than background and indicate very low vegetation and appear to delineate bedding in Sustut.

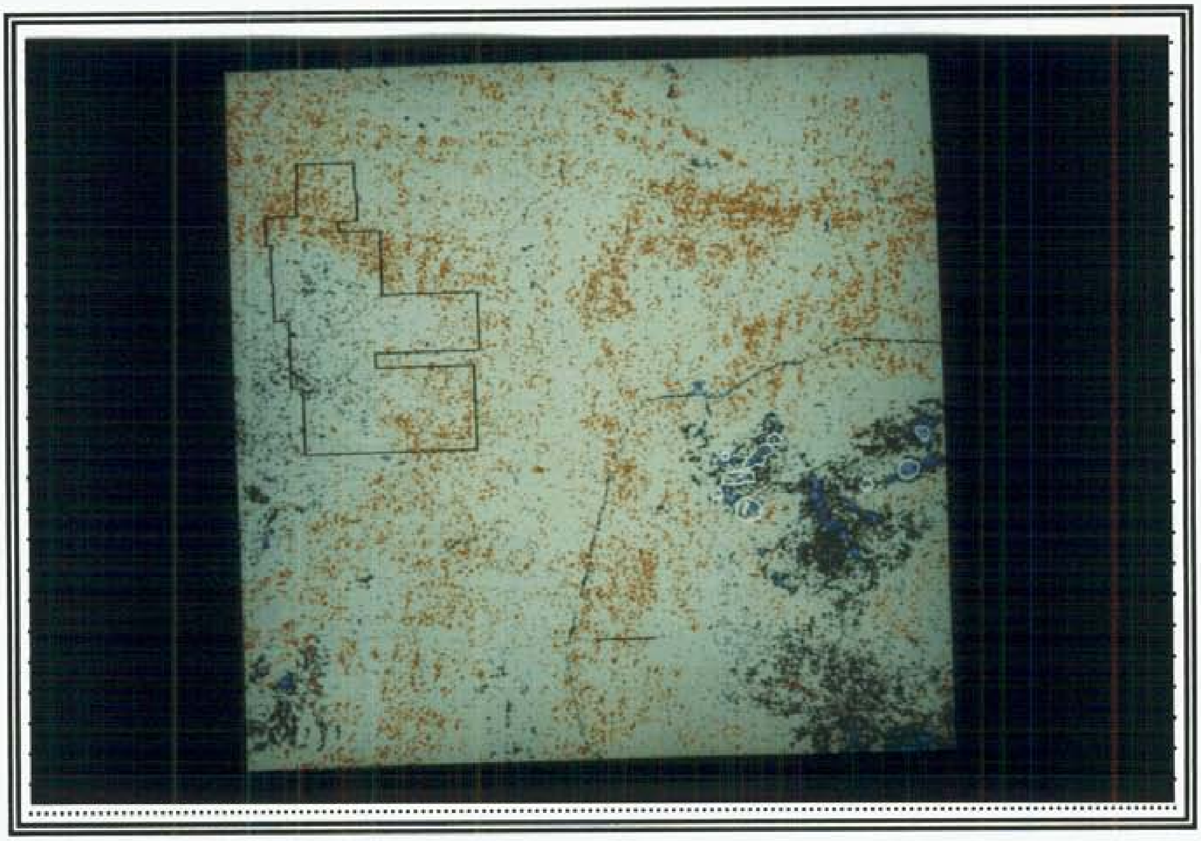


Figure 29. Band Subtraction image TM Bands 3 - 1 (12X12 kms)

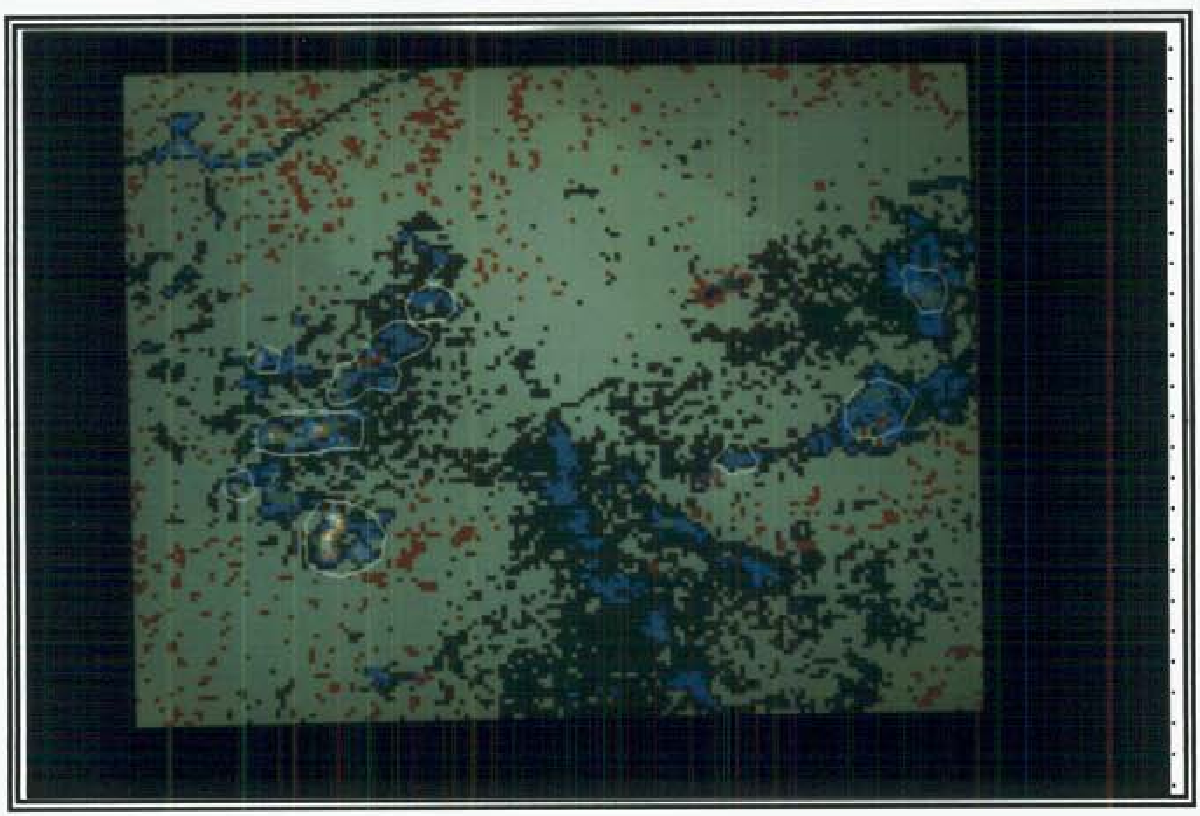


Figure 30. Band Subtraction image TM Bands 3-1 Enlarged Lawyers area.

Band Masking images using TM Bands 3 over 1, and 1 over 3 show widespread similar anomalous values, higher than background in the general Lawyers area, in the southeast corner of the area, and on Sustut sediments. No delineation of iron oxide zones seems possible.

UNSUPERVISED AND SUPERVISED CLASSIFICATION

Minimum Distance and Maximum Likelihood classifications are used for geological purposes in areas of extensive outcrop and little vegetation cover. This type of imagery analysis is not applicable to the Golden Stranger area. The method involves choosing a number of training sites of known lithology. Several classifications are made taking signatures of selected areas at different locations. Training sites determine spectral signatures of those selected areas and classifies the rest of the data on the basis of those signatures. The patterns that emerge ideally should delineate lithologies of similar reflectance but in practice are a function of a combination of effects of vegetation, vegetation stress, moisture content, topography, angle of incidence, and different surficial and bedrock materials. Field checks are required to determine the significance of these patterns.

PRINCIPAL COMPONENT ANALYSIS

Principal Component Analysis (PCA) was performed to detect subtle variations in the ground reflectance which might indicate presence of iron-oxide rich zones and possible alteration (hydroxide-rich) patterns. To produce four components, four bands, 1,4,5, and 7, were used; two from short-wave length region to detect iron-rich zones, and two from mid-infrared region to delineate possible hydroxide-rich zones. Four images were produced.

The first component utilizes maximum reflection of each of the four bands (albedo). Subtle variations are shown in the remaining three components which are mainly used for geological interpretation including delineation of outcrop areas, and lithology. Principal Component 1, using grey palette, is useful for supplementing previous images for major structural features, vegetation types and density. Colour enhanced images add little definitive data but assist in delineating pixels for intensity measurements.

The second component shows differences in ground reflectance contributed by visible and mid-infrared bands. The resulting spectral patterns outlined correspond to those of SAR and to lesser extent classified TM images. However, the differences in tone and texture are greatly affected by vegetation so can only be used as a guide for delineation of lithologies. Glacial features are conspicuous in this image. Colour enhancement indicates strong influence by presence or absence of vegetation.

The third component shows bright anomalous spectral signatures, with grey palette, which are contributed by band 7 as indicated by positive vector loadings of principle component analysis. These patterns, when present, are useful in delineation of hydroxyl-rich zones but may be a result of other factors. Anomalously high spectral values are noted in the Lawyers area on grey and colour enhanced images, (Figure 31). Some of these correlate with possible hydroxyl zones delineated from other images. It is noted that anomalous values appear in clusters elsewhere, particularly in the southeast corner, and in association with Sustut rocks, where hydroxyls are not anticipated, in the southwest corner of the image. These values cannot be attributed solely to barren exposures of soil or rock. Some also are associated with extremely low values. A field check is required of all these areas to resolve these problems.

The fourth component looks like a positive print of CMP3 with a similar pattern, but low (-) values instead of high (+) and shows all of the exploration areas in the window; AGB, Silver Pond and Golden Stranger. Ovoid structures are conspicuous; one 3 km across at Golden Stranger, a smaller one of 2 km at Lawyers, and faint outlines of two overlapping, 2 km and 2.5 km, off NE end of lower lobe of Sustut. This component does a very fine job of pinpointing mineralization on Lawyers, (Figure 32).

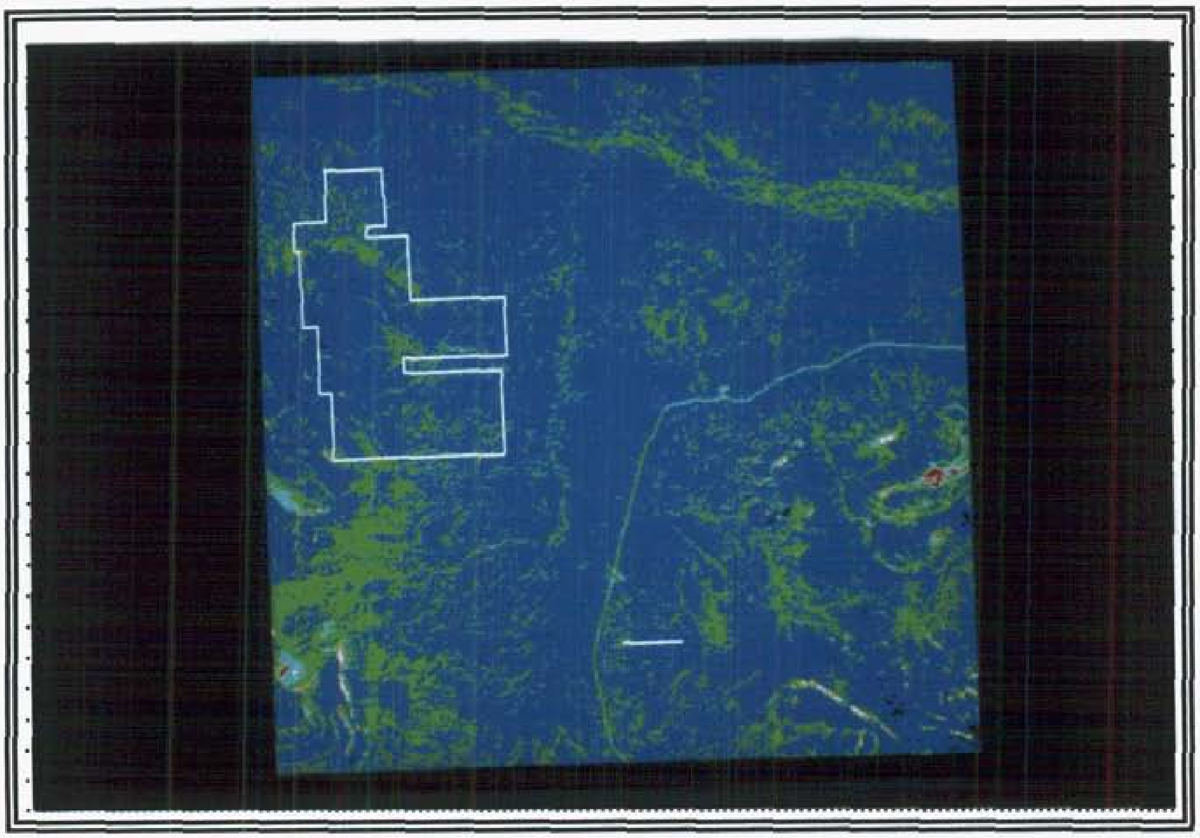


Figure 31. Principal Component 3 TM Bands 1, 4, 5, and 7 (12X12 kms)

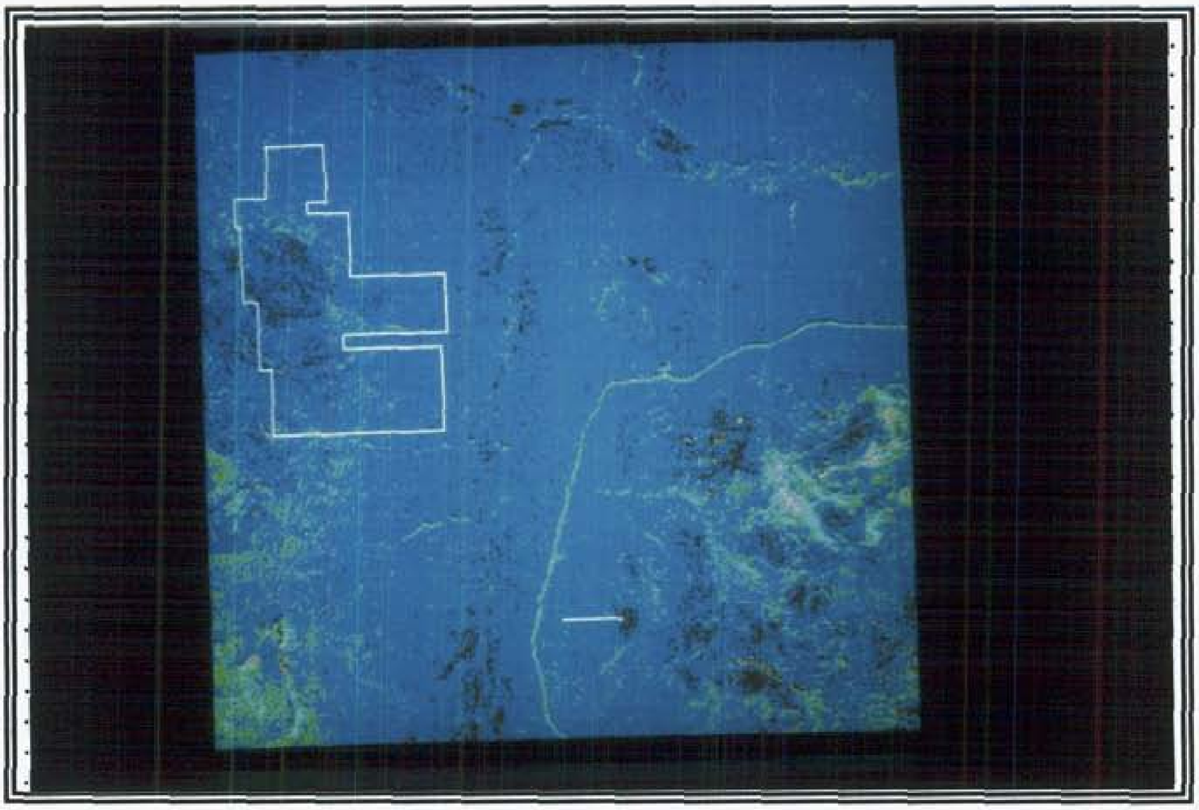


Figure 32. Principal Component 4 TM Bands 1, 4, 5, and 7 (12X12 kms)

Figure 33. Principal Component 1 TM Bands 5 and 7 (12X12 kms)

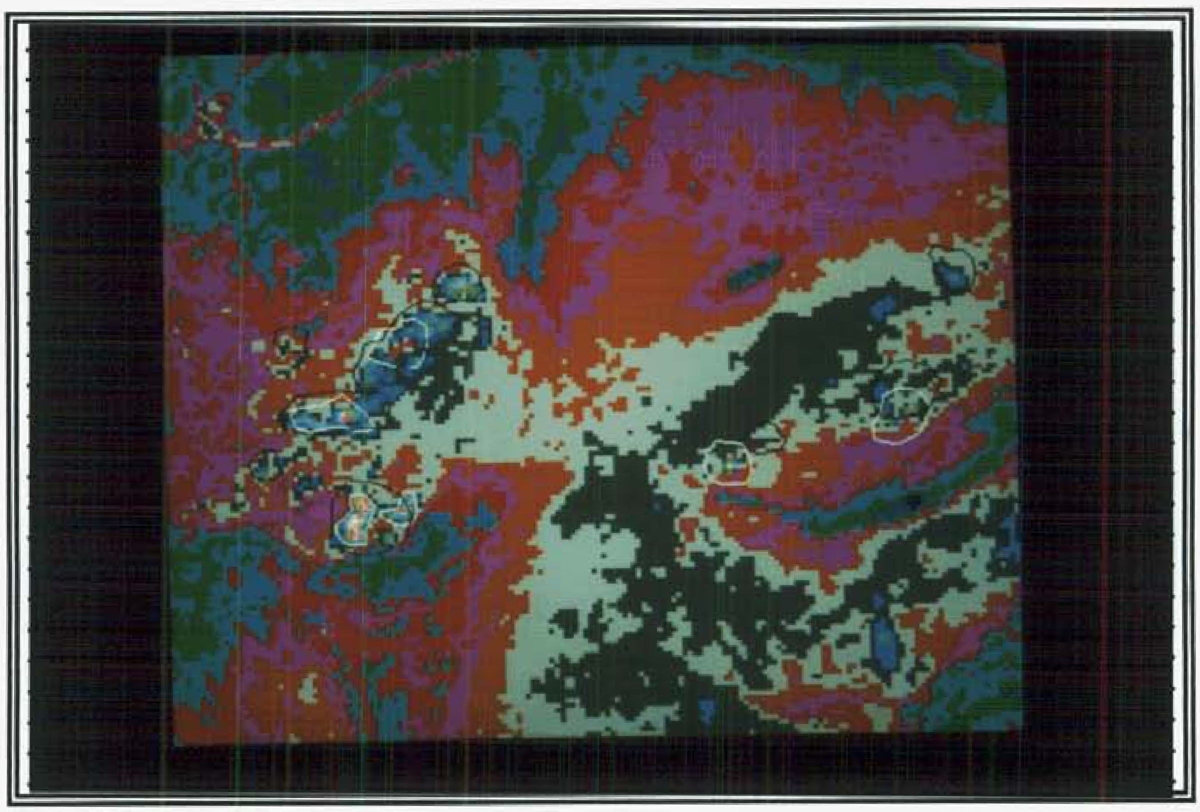


Figure 34. Principal Component 1 TM Bands 5 and 7 Enlarged Lawyers area.

Bands 5 and 7 were used to produce Principal Component images in an attempt to delineate possible hydroxyl zones using a strong contribution from band 5. This image produces strong (+) values in possible hydroxyl zones with much lower background values, (Figure 33, and 34 Lawyers area). The Sustut rocks in the southwest corner of the window also appear anomalous but produce generally lower values than the Lawyers area. Component 2 is not useful for delineation of hydoxyls.

GROUND CHECKING OF SATELLITE IMAGERY

Ground checking of radar images was carried out by Elaine Thompson and Stephen Gower during portions of the period August 16 to August 27, 1994. This work was done in conjunction with walking the property to perform reclamation work. To facilitate identification of satellite imagery with ground structures the data were transposed onto a 1:50,000 scale topographic map. Accuracy of plotting was later verified with the computer.

It was apparent during the ground checking that the radar imagery was doing an excellent job of identifying the major structures cutting through the property. What the satellite was showing as a linear was generally relative negative relief which would form a trough. The trough commonly contained swampy patches and braided stream drainages. In some areas flat patches of stones formed plate like caps on marshy ponds. In other areas fine pebbles of volcanic rubble formed airstrip like zones which could be traced for hundreds of meters along strike.

DETAILS OF GROUND CHECKING ARE AS FOLLOWS:

1] The "Main" Golden Stranger zone forms a strong north to northwest trending lineament on the radar image. Ground checking confirmed the truth of the satellite tracking of the zone over more than a kilometer and provided information for the location of the structure to the north and south of the central area. Of more importance the radar images identify three east trending linears to the east of the "Main" zone which are coincident with a resisitivity anomaly from the 1988 IP survey. The radar image indicates that the "Main" zone is offset by an East West trending fault about 250 meters south of camp creek. This corresponds in ground checking to the last outcrop of aplite that occurs along the "Main" zone. There are a series of strong south-east trending linears that could be the extension of the "Main" zone. The radar imagery identified the east west trending fault which cuts off the "Main" zone to the north in DDH 26. It appears on the radar image that the "Main" zone should extend north of this fault and trend northwesterly into the Toodoggone Valley. A resistivity survey will be required to check for this extension.

2] The "West" zone does not have as a strong radar signature, however a strong parallel linear does exist 200 meters to the west which is also coincident to VLF-EM conductor.

3] The easternmost of the three NE trending linears referred to in 1 has a strong ground expression which consists of an 050 degree striking series of local depressions, swampy patches, braided creeks and patches of clay fault gouge. This occurs north of camp creek for a distance of at least 500 meters until the zone is obscured by heavy forest cover.

4] A intersection of north-west, north-east and east-west trending linears centered near the LCP for GST 5 and 6 has a most remarkable surface expression. It consists of zones of local negative topographic relief carpeted in part with crushed Toodoggone volcanics. These form pseudo roads which traverse across the hill at the intersection of the structures. Local areas of silicification and pyritization are associated with these structures. This is the area referred to as Area B in the 1990 prospecting report. Samples were taken for petrographic study.

5] The major north trending radar linear situated along the east side of the Sustut Bluffs is interpreted to be the west side of a graben structure. Ground checking along this structure revealed a broad area of negative relief along the northern 4 km of structure until it was obscured by thick forest along the Toodoggone Valley. Local areas of clay gouge were observed along the creek banks to the west of the "West" zone.

6] The anomalous area referred as Area A in the 1990 prospecting report was checked and samples taken for petrographic study. This area is cut by a strong east west trending radar linear. This structure was confirmed by the presence of the "road" referred to in note 4 above.

7] The area referred to as Area C in the prospecting report, situated on the north side of Camp creek about 3 km east of the drill camp, was found to be coincident with a strong north west trending radar linear.

8] The area referred to as Area D in the prospecting report, situated about 150 meters north east of the LCP for the Golden Lady 3 claim, is coincident with a strong north northwest trending radar linear. This may be the offset portion of the "Main" zone situated about 2 km to the west, or a similar aplitic body on a parallel fault system. This area warrants detailed follow-up consisting of geophysics, geochemistry and trenching.

9] Ground checking and radar linears of the Lawyers, Kodah, Golden Rule and Alberts Hump structure and alteration patterns revealed some evidence for a common north west trending localizing structure linking the deposits. It is suspected that further study of the satellite data will reveal that some combination of the north west trending structures in association with radial and crosscutting structures forms the ore controls for the deposits.

General Conclusions and Recommendations

A major problem inherent with visual analysis of SAR and TM satellite imagery that it is highly subjective. Different investigators identify similar but different features, and some features included by one analyst are not included by another. In order to overcome this problem several cycles of careful analysis, followed by field checks, are required.

SAR DATA

Lineaments
Linear analysis of SAR and TM imagery has shown that the Golden Stranger claims area and, indeed, the general Toodoggone area is far more structurally complex than previously known. Four sets of subparallel, diverging linears and curvilinear features were identified; these can be used as a guideline for detailed structural mapping in the field. The most significant sets of linears in order of probable importance are:

(a) Major northerly trending breaks.
(b) East-west trending curvilinear lineaments, concave to the north.
(c) Two sets of subparallel close spaced lineaments with northeasterly and northwesterly trends. These systems are more prevalent in areas of shallow overburden on the Golden Stranger property on the west and Lawyers area on the east.

The major northerly trending converging lineaments with the east-west trending curvilinear convex north sets may be of regional economic significance with certain of the finer subparallel sets acting locally as ultimate ore controls. On the Golden Stranger claims the northerly trending mineralized structure is clearly visible on SAR and on a number of different TM images. In addition there are several subsidiary northerly, northeasterly and northwesterly lineaments. Field checks on the Golden Stranger claim have resulted in discovery of previously undetected faults of this nature which require exploration by more conventional means.

Radar Textures
Textural variations on the SAR image of the Golden Stranger area produces distinct patterns. The Sustut sedimentary bluffs are outlined quite well but textures appear to reflect most closely differences in type and density of vegetation cover. When these patterns are compared to known geology the correlation is poor and are not sufficiently diagnostic to permit delineation of lithologic contacts with any degree of confidence.

Circular Features
It was noted that mineralization at Cheni, Golden Stranger and Silver Pond deposits approximately coincides with circular features on SAR image. A total of 42 circular features, ranging in size from 150 to 550 meters, were delineated. Some appear as simple circles, others have a concentric arrangement, a few appear to have radiating spokes within them, and still others occur in clusters of two or more. Many of the same circular features noted on the SAR image were observed on TM images, and some of these coincide with suspected "iron oxide" and hydroxyl patterns. The majority of these circular features fall along structures and 10 are on, or adjacent to, the Golden Stranger claims. In addition there are a number of randomly scattered circular features.

The circular features may occur for a number of reasons as outlined in the Results section above. Most will undoubtedly prove to be of no geologic or economic interest. However, in view of the known association of circular features with diatremes/breccia pipes, and copper-molybdenum-gold porphyry deposits in other areas, it is essential that their significance be determined in the Golden Stranger-Lawyers area where some circular features appearing on RS imagery could be of economic significance. The circular features have been prioritized in order of probable importance as follows:

(a) Underlain by Toodoggone volcanic rocks with little or no glacial drift cover, with further priority given to those associated with lineaments.
(b) Those occurring in areas believed to be underlain by only a thin veneer of Sustut on Toodoggone volcanics, at Sustut-Toodoggone contacts or possible Toodoggone windows in Sustut sediments.
(c) Features thought to represent topographic highs. These may be accompanied by silicification etc.
(d) Circular features attributed to glacial drift.

Visual delineation of circular features, as for linears, is very subjective and subtle features may be overlooked. This reinforces the recommended procedure that SAR images be viewed and reinterpreted during the course of ongoing exploration. Field checks integrated with geophysical, geochemical surveys and geological mapping are a vital additional component of this RS analysis.

TM DATA

As anticipated, in this area, TM data are affected by heavy drift and vegetation cover and have limited value for delineating lithologies. It is possible, however, to tentatively outline broad areas of volcanic vs. sedimentary rocks on the basis of tone and texture. Areas underlain by younger flat lying sedimentary rocks tend to form bluffs and appear smoother and show bedding patterns. Older volcanic rocks appear "grainy" as a result of greater structural complexity projected through thin overburden. Colour composites of TM images show similar patterns suggesting some lithologic differences but are also affected mainly by variations in amount and type of vegetation and depth of overburden.

Most TM images gave useful structural information which supplemented SAR imagery, particularly in areas of high relief where shadow effect and layering adversely affect SAR images. The two types of imagery should be used together.

Possible iron oxides, and less successfully, hyroxyl enriched areas were delineated by Principal Component Analysis, Band Ratio and Band Masking Images. Use of Bands 3 and 1 in combination gave varied degrees of success in delineating areas of known and suspected iron oxides in the Lawyers area. Field checking of this pattern is required. No strong iron oxide zones are known in the Golden Stranger claims and no anomalous zones were delineated there. Some of these images give similar pixel intensity values over "iron oxide" zones as for barren Sustut sediments. Others, which appear similar, have quite different pixel values, so it is essential to measure pixel values carefully in each area, and to analyze a combination of images using these bands. Some measure of success was obtained in delineation of suspected "hydroxyl-rich" zones using Bands 7 and 5 with combinations of Principal Component Analysis, Band Ratio and Band Masking images. As for "iron oxides", anomalous appearing pixel values must be carefully measured.

Interpretation of integrated remote-sensing data and field data from more conventional geological, geochemical, and geophysical studies is of significant benefit in both the short and long term to geological mapping and mineral exploration. SAR and TM analysis assists and complements conventional exploration techniques. The full potential of SAR and TM data occurs where they are used in conjunction with other data sets.

On a regional scale, a RS study of known rock types and major alteration patterns provides the basis for a catalogue of signatures of typical rock types and their associated alteration zones. The remote-sensing signatures produced by these types can be used as a guide in the exploration of other areas for which surface data are minimal.

APPENDIX A

CIRCULAR FEATURES

	X axis	Y axis	Diam	Place	Priority
1]	605420	6362940	550	MH CK	1 Oxide, Au.
2]	608340	6362570	450	KODA LK	1 Linear
3]	598200	6361260	350	TGDNE R	3 Glacial ex Au
4]	601610	6360630	300	TGDNE R	4 Glacial
5]	601980	6360650	400	TGDNE R	4 Glacial
6]	605400	6360290	350	TGDNE R	4 Glacial
7]	599070	6359970	550	GSTR	1 Linears
8]	601400	6359790	400	TGDNE R	2 Glacial ?
9]	599620	6359550	450	GSTR	1 Au zone
10]	600010	6359470	400	GSTR	1 Au zone IP
11]	602300	6359550	400	LAW CK	4 Glacial
12]	601800	6359100	250	GSTR	1 Siliceous
13]	602400	6358970	300	LAW CK	4 Glacial
14]	605400	6359180	300	KODA PK	3 Topography
15]	605530	6358710	350	KODA PK	2 Volc center?
16]	609260	6358870	450	TGDNE R	4 Glacial
17]	601900	6358340	150	LAW CK	3 Glacial
18]	602140	6358340	400	LAW CK	4 Glacial
19]	605000	6358240	550	LAW CK	3 Glacial Ag
20]	599640	6357790	450	SUSTUT	2 Sus veneer
21]	608250	6357760	300	MINE RD	3 Glacial Can wall
22]	601770	6357270	350	LAW CK	4 Glacial
23]	606450	6357240	500	CREEK	4 Glacial
24]	609830	6357060	300	N. AGB	1 Min zone
25]	600040	6356610	250	SUSTUT	3 Deep Sus
26]	608630	6356450	250	SIL PD	1 Gossan
27]	609650	6356500	250	AGB	1 Min zone
28]	603980	6355820	450	LAW CK	4 Glacial
29]	607390	6356030	250	SIL PD	1 Gossan
30]	609390	6355610	500	S. AGB	2 Cirque
31]	605580	6355400	250	RIDGE	3 Topography
32]	603770	6354880	300	LAW CK	4 Glacial
33]	598460	6353960	300	SUSTUT	4 Deep Sus
34]	599330	6352800	500	SUSTUT	2 Sus window, TM
35]	606030	6352510	350	LAW CK	4 Glacial
36]	604950	6352350	450	LAW CK	4 Glacial
37]	598440	6352700	200	SUSTUT	4 Deep Sus
38]	599590	6352010	500	SUSTUT	4 Deep Sus
39]	601750	6351850	350	LAW CK	4 Glacial
40]	603080	6351590	300	LAW LK	4 Glacial
41]	601670	6351430	350	LAW CK	4 Glacial
42]	607710	6351250	350	LAW PAS	4 Glac-Top

OVOID STRUCTURES

1]	599460	6359520	2.4 km	Golden Stranger
2]	601220	6354510	2.5 km	Lawyers West
3]	608780	6356690	2.3 km	AGB Mine
4]	607450	6352460	2.6 km	AGB South

STATEMENT OF COSTS

Radar & Thematic Satellite Data - Purchase From Gower Thompson	$ 2,000
Mobilization & Demobilization -Van -Golden Stranger property-Return	$ 2,000
Food & Accomodation 6 man days - Ground checking	$ 420
Wages -Gower Thompson, 8 days @ $300	$ 2,400
Wages- K.E. Northcote 10 days @ 400 (Includes computer time)	$ 4,000
Report Preparation	$ 1,500
	Total Costs $ 12,320

Amount claimed for assessment purposes. **$ 7,100**

CERTIFICATE

I, Kenneth E. Northcote of 2346 Ashton Road, R.R. #1 Agassiz, B.C. do hereby certify that:

1] I have been practising as a professional geologist for a period of approximately 40 years for petroleum exploration, mining exploration and consulting companies, federal and provincial agencies.

2] I have been actively engaged in interpretation of Remote Sensing Imagery since 1992.

3] I obtained a Ph.D. in geology from U.B.C. in 1968 and qualified for registration with the Association of Professional Engineers of B.C. in 1967.

4] This report is the result of work done personally on the Remote Sensing Imagery of the Golden Stranger Claim area, with the report manuscript written after field checking the satellite data was completed in August 1994.

5] I have a one third interest in Western Horizons Resources Ltd. which, for those who know me, does not influence the contents of this report.

7] This report is for assessment purposes only and is not to be used in, or in connection with, a prospectus relating to the raising of funds.

Dated at Agassiz B.C. this 27th day of June, 1994.

K.E. Northcote Ph.D., P.Eng.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K.E. NORTHCOTE

Certificate

Stephen C. Gower of 985 Gatensbury Street, Coquitlam, B.C., do hereby certify that:

1. I have been practicing as a professional geologist for a period of approximately 24 years for mining exploration and consulting companies.

2. I obtained a B.Sc. in Geology from the University of British Columbia in 1970 and have completed Master's courses in Property Evaluation and Exploration. I qualified for registration with the Association of Professional Engineers and Geoscientists in the Province of B.C., in 1993.

3. The portions of this report written by me are based on work carried out during the period August 16 to August 27, 1994.

4. I am a Fellow in the Geological Association of Canada.

5. I assisted in the report preparation of the Remote Sensing Imagery of the Golden Stranger Area during periods in Sept. and Oct. 1994.

6. I am a director and an Officer in Western Horizons Resources Ltd. which holds an interest in the Golden Stranger property.

7. I consent to the use of this report in or in connection with a prospectus relating to the raising of funds.

Dated at Coquitlam B.C., this 23 day of October, 1994

Stephen C. Gower, B.Sc., Professional Geoscientist

PROFESSIONAL PROVINCE OF S. C. GOWER BRITISH COLUMBIA GEOSCIENTIST