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Geological Fieldwork 1994

TATOGGA LAKE PROJECT, NORTHWESTERN BRITISH COLUMBIA (104H/11, 12)

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INTRODUCTION

The Tatogga Lake project is a geologic and metallogenic mapping program initiated in 1994. It will investigate the geologic setting of mineral deposits in late Paleozoic and early Mesozoic Stikine terrane arc-volcanic rocks along the northern margin of the Bowser Basin in northwestern British Columbia (Figure 1). The project area is located 80 kilometres south of Dease Lake, and is transected by the Stewart Cassiar Highway, south from the village of Iskut (Figure 2). It includes parts of NTS map sheets 104G/9 and 16, and 104H/12 and 13.

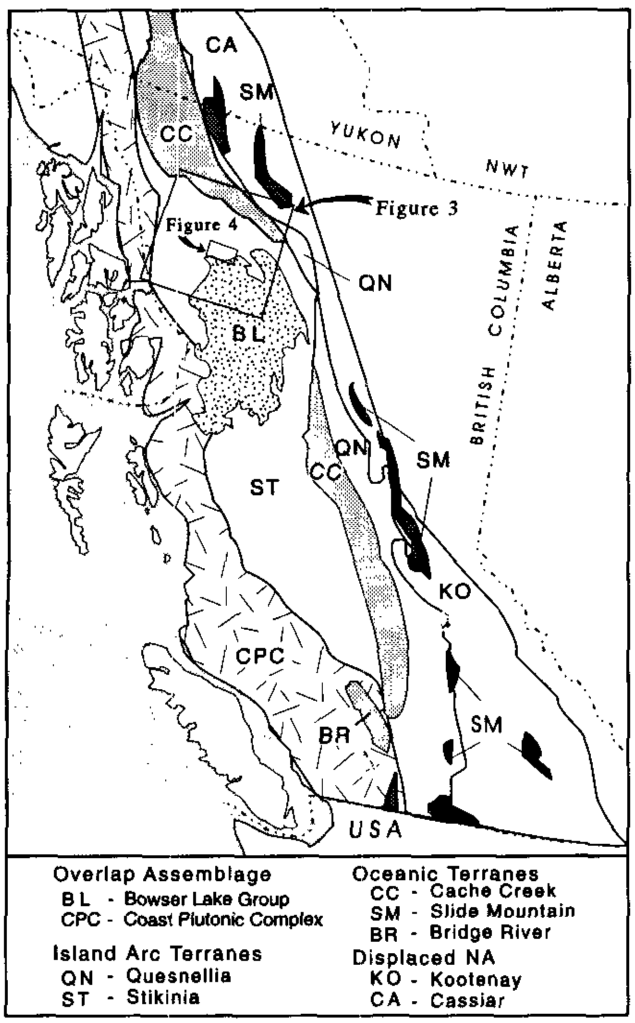
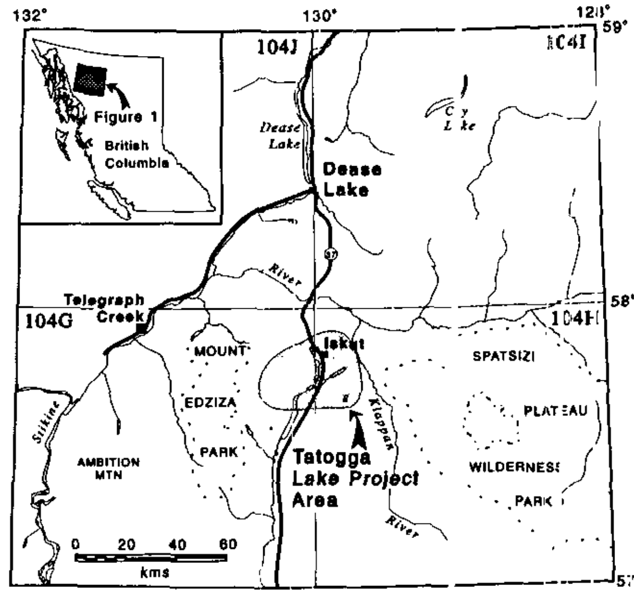


Figure 1. Regional geological setting of the Tatogga Lake map area.



Figue 2. Location of the Tatogga Lake map area.

Stikine Terrane arc rocks in the region host several copper-gold and copper-molybdenum occurrences (MINFILE 104 G and H). The volcanic stratigraphy hosting these deposits is, however, poorly constrained. The Tatogga Lake project will attempt to characterize individual deposits, describe their local and regional stratigraphic and structural settings, and determine the ages of magmatism and associated alteration.. The lithogeochemical character of the volcanic and associated plutonic rocks will be documented.

This report introduces the project area and discusses preliminary results obtained during fieldwork conducted from August 8th to September 26th which was restricted to the eastern half of the project area. Results of 1:20 000-scale mapping, will be released following mapping in the western sector which is planned for the 1995 field program.

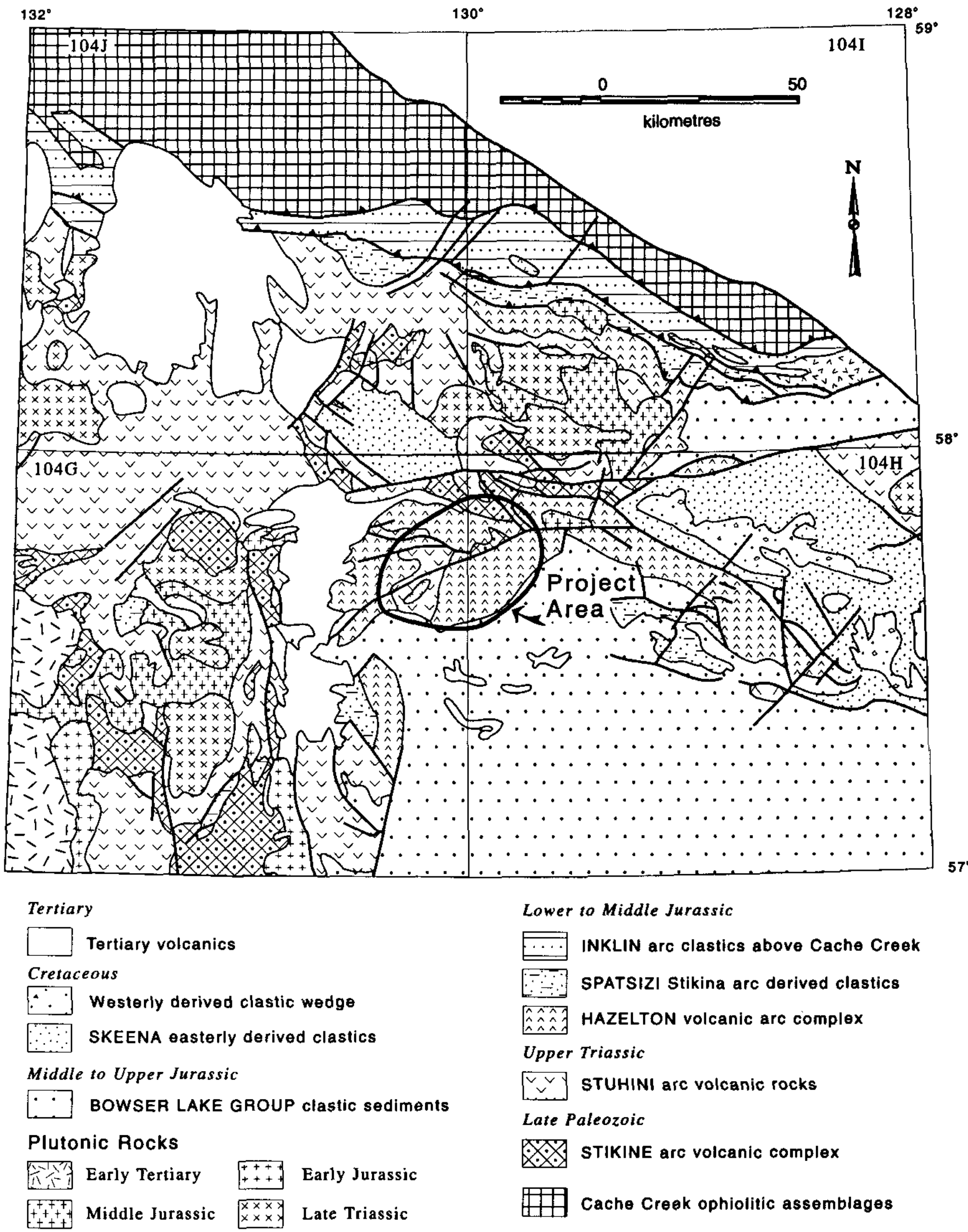


Figure 3. Geological setting of the Tatogga Lake Project area in northwestern British Columbia. Simplified after Wheeler and McFeely (1991).

The Red-Chris copper-gold deposit is the only active exploration project in the area. Extensively drilled by Texasgulf Inc. during the 1970s (Newell and Peatfield, in preparation), the deposit has recently been the focus of an aggressive deep drilling program by American Bullion Minerals Ltd.

PHYSIOGRAPHY

The study area covers the Klastine Plateau, part of the Stikine Plateau, along the northern margin of the Skeena Mountains. Locally the area is further dissected into a number of individual rolling plateaus at elevations between 1500 and 1800 metres that are bounded by steep-sided, U-shaped valleys with forested, flat valley bottoms below 950 metres. For the purpose of the following discussion we have assigned informal names to these plateaus.

Outcrops are generally absent in valley bottoms. Large areas of the individual plateaus are veneered by several metres of glacial till with vegetation limited to low shrubs (buckbrush), grass and moss. Outcrop is generally sparse, except in areas with abrupt changes in elevation. Best exposures are found on slopes between valleys and plateaus.

PREVIOUS WORK

Mapping by Souther (1972) of the Telegraph Creek sheet (104G) published at a scale of 1:250 000, and by Gabrielse and Tipper (1984) for the Spatsizi sheet (104H), published at a 1:125 000 scale, represent the regional geological database. Read (1984) and Read and Psutka (1990) produced 1:50 000 geological maps which include parts of the northeastern and eastern margins of the study area, respectively. Masters thesis research, including mapping, and deposit studies, was conducted in the area of the Red-Chris deposit by Schink (1977) and in the area of the Rose and Edon showings on the Eddon plateau by Cooper (1978). Leitch and Elliot (1976) also mapped the immediate area of the Red-Chris deposit. Templeton (1976) described the geology over most of the Todagin plateau as an honours B.Sc. thesis mapping project. The geological setting and history of Bowser Lake Group rocks along the southern margin of the study area have been documented as part of the multidisciplinary Bowser Basin project (Evenchick, 1991a, b, c; Evenchick and Green, 1990; Evenchick and Thorkelson, 1993; Green, 1991; Poulton *et al.*, 1991; Ricketts, 1990; Ricketts and Evenchick, 1991). Thorkelson (1992) recently conducted a study of Mesozoic Stikine Terrane arc rocks immediately east of the study area. Substantial contributions to the understanding of the Red-Chris deposit by J.R. Forsythe, and other Texasgulf geologists in the 1970s, are summarized in a soon to be published paper by Newell and Peatfield (in preparation).

REGIONAL GEOLOGICAL SETTING

The Tatogga Lake study area is within the Stikine Terrane in northwestern British Columbia (Figures 1 and 3). This terrane, which forms a broad northwest-trending belt through the centre of the province, includes mainly early Mesozoic and lesser late Paleozoic island-arc volcanic strata with related subvolcanic intrusions. Stikinia arc rocks are subdivided regionally into the upper Paleozoic Stikine assemblage, Upper Triassic Stuhini Group and Lower to Middle Jurassic Hazelton Group (Figure 3). Stuhini Group rocks are dominated by submarine, calcalkaline basaltic volcanic rocks which are commonly augite phyric (Souther, 1991). In contrast, the Hazelton Group is dominated by subaerial volcanics that range in composition from basalt to rhyolite.

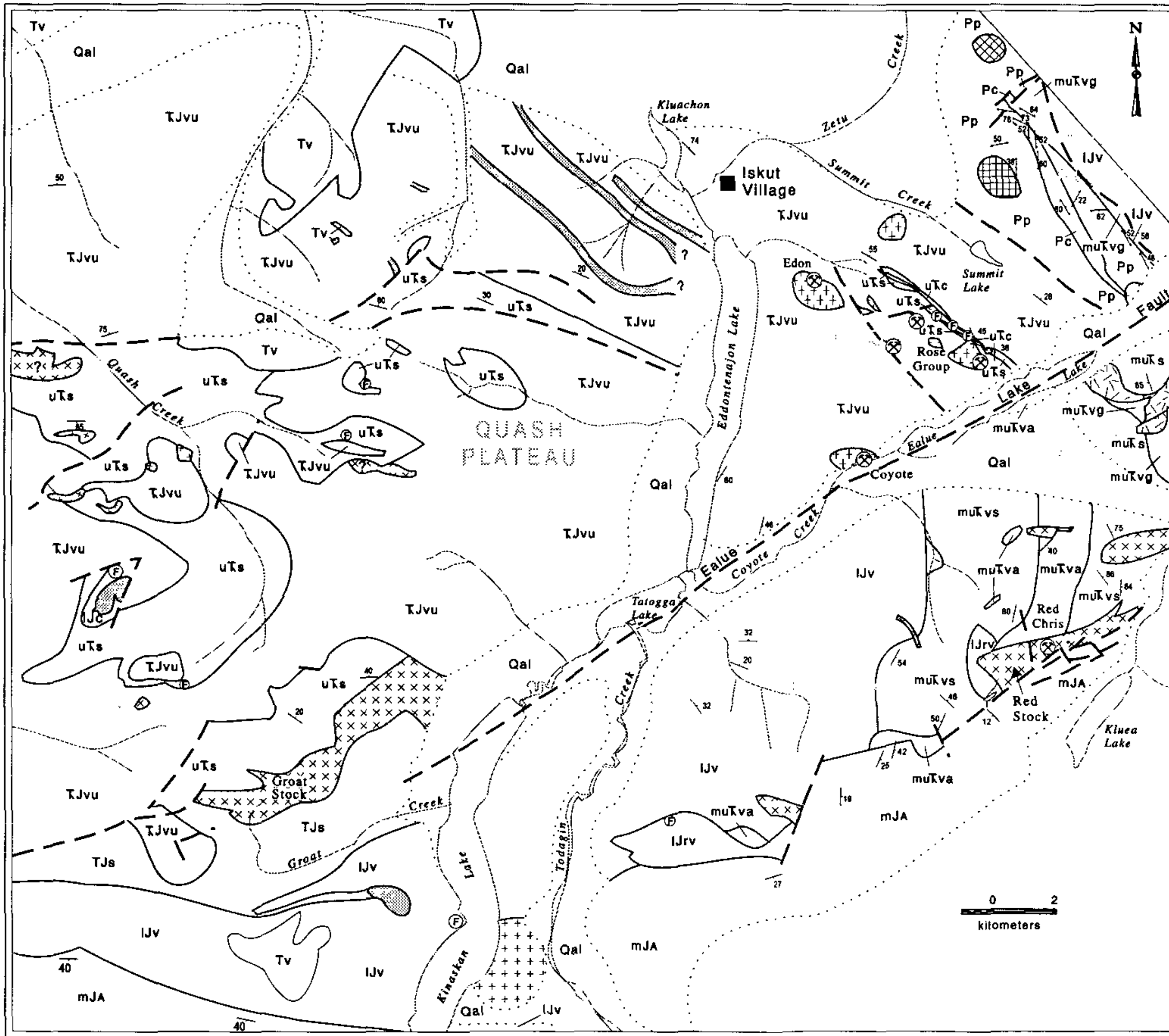
The Late Triassic and Early and Middle Jurassic oceanic island arcs that that comprise Stikinia, formed outboard of the ancient North American continental margin (Monger 1984; Gabrielse, 1991). Arcs evolved along the western margin of the intervening late Paleozoic Cache Creek ocean basin in response to its closure by westerly subduction. Early Middle Jurassic arc-continent collision, related to docking of Stikinia with ancestral North America, resulted in southwesterly tectonic emplacement of oceanic Cache Creek Terrane above the younger volcanic arcs. Vast quantities of flysch sediments were subsequently shed from the uplifted oceanic crust southwards into the newly developed Bowser Lake successor basin

Later Middle Cretaceous and Tertiary tectonism has disrupted the local stratigraphy, in large part by faulting. Lateral displacements of up to 800 kilometres have been suggested for this region of the province (Gabrielse, 1985). Foreland fold-and-thrust-belt styles of deformation affect Bowser Lake Group stratigraphy and record as much as 160 kilometres of northwest shortening (Evenchick, 1991c).

Quaternary to Recent Edziza olivine basalt flows overlie Stikinia rocks in the northwestern sector of the map area. Several small isolated volcanic necks are also present.

LOCAL STRATIGRAPHY

The map area is dominated by a largely undifferentiated sequence of early Mesozoic arc-volcanic, plutonic and derived sedimentary rocks (Figure 4). Older, late Paleozoic metavolcanic and metasedimentary rocks (Read, 1984; Gabrielse and



Layered Rocks

Tertiary to Recent

Tv - Edziza olivine basalt

Qal - glacial till, unconsolidated sediment

Middle Jurassic

mJA - Ashman Formation; marine clastic sediments

Lower to Middle Jurassic(?)

lJc - conglomerate, volcanoclastics

lJv - Andesite volcanic flows, breccias and conglomerate

lJrv - trachyte to rhyolite flow (may include areas in the SW shown as felsite)

Triassic-Jurassic undivided

TJvu - massive volcaniclastics, conglomerate and mudstone

TJs - siltstone, conglomerate

Upper Triassic

uTc - carbonate

uTs - volcanic wacke, siltstone

Middle-Upper Triassic(?)

muTs - siltstone, argillite, minor limestone and chert

muTvs - volcanic sandstone, siltstone

muTvg - aphyric green volcanics

muTva - augite phyric volcanics

Permian Stikine Assemblage

Pc - carbonate, recrystallized

Pp - Perman phyllite and greenstone

Plutonic Rocks

Early Jurassic(?)

Felsite

Syenite

Quartz monzonite

Quartz monzodiorite

Late Triassic(?)

Biotite-hornblende quartz diorite

Late Paleozoic(?)

Hornblende granodiorite

Diorite

Significant Mineral Occurrance

Fossil locality (from sources as discussed)

Figure 4.
Geology of the Tatogga Lake map area. Compiled largely from sources listed in previous work.

Tipper, 1984), form a northwest-trending penetratively deformed belt which is faulted against and possibly overlain by Mesozoic volcanic strata. To the south, Mesozoic rocks are overlain by and locally faulted against Middle Jurassic marine clastic stratigraphy of the Bowser Lake Group. Pre-Bowser Lake Group rocks are intruded by a range of mineralogically and texturally distinctive plutonic rocks.

Published geological maps that cover all or portions of the study area indicate general, though not unanimous agreement that Stikinia rocks are early to middle Mesozoic in age. Further subdivision of the local volcanic stratigraphy, however, into either Upper Triassic Stuhini or Lower Jurassic Hazelton assemblages shows consistent variability. Souther (1972) assigned volcanic rocks north of the Ealue Lake fault on the 104G sheet a Late Triassic age but suggested that those south of the fault are Middle Jurassic. On the adjoining 104H sheet, Gabrielse and Tipper (1984) assigned rocks underlying the Eddon plateau a Middle to Late Triassic age. A similar age was suggested for volcanics underlying the western half of the Todagin plateau, while those to the east were designated as Lower Jurassic. In contrast, Read (1984) grouped volcanic rocks underlying the Eddon plateau mainly as undivided Triassic-Jurassic strata. He interpreted one narrow northwest-trending belt of sediments as Upper Triassic and considered several other areas to be Early Jurassic.

Wheeler and McFeely (1991) assigned an Early to Middle Jurassic age to most of the volcanic rocks and considered isolated areas to be Late Triassic and late Paleozoic (Figure 3). More recently, Evenchick and Thorkelson (1993) combine all volcanic strata south of the Ealue Lake fault as 'undivided Triassic-Jurassic' but separate rocks north of the fault into both Permian and Early Jurassic volcanic arc assemblages.

Souther (1972) emphasized difficulties in differentiating Upper Triassic from Lower Jurassic volcanic stratigraphy along the eastern part of the Telegraph Creek sheet (104G). He wrote:

> "In the eastern part of the map area the distinction between Upper Triassic and Lower Jurassic rocks is not so clearly defined. Granitic clasts are sparse or absent and Lower Jurassic clastic sediments are similar to Triassic fragmental volcanics from which they are derived."

Recognition of original volcanic stratigraphy may be further complicated by regional folding and faulting. Mapping of volcanic rocks immediately to the east (Thorkelson, 1988) and west (Evenchick, 1991a) of the current study area found that contacts, previously interpreted as stratigraphic, are thrust faults.

UPPER PALEOZOIC STRATIGRAPHY

The oldest known rocks in the area are assigned to the upper Paleozoic, and possibly Lower Triassic, Stikine assemblage and include phyllitic greenstone, pale and dark grey banded limestone and brown phyllitic siltstone. Pale and dark grey, recrystallized, well banded limestone is exposed along a prominent northwest-trending ridge in the core of the belt. Banding is defined by thinly laminated, 3 to 8 millimetre, dark and light to buff-grey limestone. Locally buff to tan-brown marly limestone is banded on the 1 to 2-centimetre scale with light to dark grey varieties. Local minor folds with broken fold hinges are common. Broad open folds are also evident and, like the minor folding, are symmetrical and upright. Near its contact with phyllitic siltstone the laminated limestone contains folded bands of sheared phyllite that are parallel to the banding.

Outcrops of phyllitic and schistose rocks are less common because these units are generally friable and recessive. Individual exposures are commonly folded and locally crenulated. Foliation fabrics in these metamorphic rocks display a dominant northwest orientation with local deviations caused by folding. Folding is generally, open and upright with fold hinges plunging at shallow angles toward the northwest and southeast.

MESOZOIC STIKINIA ASSEMBLAGES

Lack of new fossil data at this early stage of the project precludes any attempt to refine previous interpretations of the volcanic stratigraphy. However, we have been able to subdivide volcanic rocks in the area mapped on the basis of distinctive lithological and textural characteristics. Conveniently, the geographic distribution of our subdivisions of volcanic rocks coincides with the individual plateaus (Figure 4).

EDDON PLATEAU

The Eddon plateau, and the area to the north surrounding the village of Iskut, is underlain by green and maroon volcaniclastic rocks that are intruded by more massive, texturally similar hypabyssal stocks and irregular bodies. Volcaniclastic rocks are dominated by tuff-breccias with lesser lapilli tuffs and rare flows. Individual outcrops may be entirely maroon, green or combinations of the two. There is, however, no notable textural or mineralogical change in the rock across colour boundaries. Colour contrasts appear to simply reflect differences in the oxidation state of the 3 to 5% of finely disseminated iron oxide phase present. Green volcanic rocks contain finely disseminated magnetite and are typically magnetic. In contrast, maroon volcanics contain hematite and are not magnetic.

Massive tuff-breccias, most likely lahars and debris flows are dominated by plagioclase±hornblende-porphyritic andesite. Clasts contain from 15 to 30%, 1 to 3-millimetre, tabular plagioclase phenocrysts and lesser hornblende phenocrysts of comparable size, in modal abundances of 3 to 10%. Subrounded to subangular volcanic clasts are usually from 2 to 6 centimetres across, but range from one to several tens of centimetres in size, in a fine to medium-grained fragmental groundmass. Breccias vary from matrix to clast supported and are dominated by clasts of porphyritic andesite. Individual clasts vary in both phenocryst size and abundance. Locally, breccias may be more heterolithic containing aphanitic green volcanic, limestone and distinctive red-brown, usually angular, mudstone clasts in addition to the dominant porphyritic clasts. The matrix of heterolithic breccias is much more poorly sorted and displays a wider grain size variation than in the other breccia type. The more heterolithic breccias are also typically dominated by maroon clasts in a predominantly maroon volcanic matrix.

Lapilli and sparse-lapilli tuffs are locally dominant in outcrops along the Stewart Cassiar Highway on the west side of the Eddon plateau. This unit is particularly well exposed in a quarried hillside east of Iskut village. Lapilli are dominated by cryptic fragments that vary from trace amounts to locally over 20%. Such fragments are not readily identifiable on fresh surfaces, and rarely on weathered surfaces, due to their colour and textural similarity to the matrix. Slabbed surfaces are particularly useful in detecting the fragmental character of this unit. Darker, very fine grained aphyric, angular fragments, from 0.5 to 2 centimetres in diameter, are much more obvious though less abundant, comprising less than 1% of the unit.

These volcanic breccias are predominantly massive, but occasionally bedding is well developed in laterally discontinuous lenses of laminated volcanic sandstone and red mudstone. Bedded zones are usually associated with the more heterolithic breccias. Relatively massive maroon mudstone, with 3 to 5%, 0.5 to 3-millimetre rounded to subangular volcanic fragments is exposed in outcrops spatially associated with the lapilli tuffs in the low-lying area west of the Eddon plateau. The mudstone unit is well bedded where it is associated with local sandstone and poorly sorted volcanic pebble conglomerate beds.

The most persistent sequence of sedimentary rocks in this area of the Eddon plateau includes a northwest-trending, southwest-dipping belt of siltstone, limestone and greywacke that is up to 300 metres thick. Cooper (1978) established a Late Triassic age for this sequence based on the presence of the pelecypod *Monotis*. He also concluded that the sediments were interlayered with and overlain by the andesitic volcaniclastic rocks. Interestingly, Read (1984) reported Early Permian conodonts from limestone recovered from the same stratigraphic sequence. To account for these conflicting paleontological data he suggested the limestone was most likely a Late Triassic olistostrome containing Early Permian limestone blocks.

To the west, Souther (1972) described volcanic rocks underlying the Quash plateau as being dominated by massive purple and green volcaniclastic rocks with minor related sediments. We tentatively correlate these rocks with volcanic rocks on the Eddon plateau. Souther (1972) also collected *Monotis* fauna from sediments lithologically comparable to those reported from the Eddon plateau by Cooper (1978). Souther established that these sediments are also conformably overlain by the volcaniclastic rocks. Bedding orientation in both these areas is consistently northwesterly (Figure 4).

Souther (1972) also identified sponge-like forms in limestone on the Quash plateau; although undiagnostic he considered them to be most likely Upper Triassic, due to the presence of similar macrofossils in Norian Sinwa limestone in both the Tulsequah and Dease Lake map areas.

EAST TODAGIN PLATEAU

A lithologically distinctive stratigraphic sequence, dominated by sediments with lesser and locally interbedded augite-porphyritic mafic volcanic rocks, is exposed on the eastern half of Todagin plateau.

Plagioclase-rich volcanic sandstone with interbeds of laminated siltstone and fine sandstone is the predominant unit exposed in this area. The volcanic sandstone weathers tan-brown to grey and is light grey on fresh surfaces. Tan-brown weathering exposures appears to be the result of carbonate alteration, which is common throughout this area. Volcanic sandstones are characteristically massive and lack obvious sedimentary features. Typically they are fine to medium grained and equigranular, except for sparse, dark grey to black, angular siltstone fragments from 3 to 15 millimetres in size. Abundance of siltstone fragments is usually from 1 to 2%, but ranges from areas where they are sparse, to zones, adjacent to siltstone interbeds, containing from 10 to 20% fragments, typically larger than those noted elsewhere. Massive coarse-grained, poorly sorted varieties of the sandstone with similar siltstone fragments are also common locally.

Dark grey to black siltstone interbeds that range from less than a metre to several tens of metres in thickness occur intermittently throughout the massive sandstone sequence. They may be interbedded with massive sandstone on a scale of several metres over distances of several tens of metres or consist predominantly of siltstone and silicious siltstone over similar distances. Siltstone beds are usually well bedded on a 5 to 15-millimetre scale. Siltstone units containing very fine grained volcanic sandstone interbeds display well developed sedimentary features such as graded bedding, scour marks and load structures. These features are useful in providing stratigraphic tops. Bedding within the unit typically strikes between northeast and southeast with steep to moderate dips to the north. Sedimentary structures usually indicate that bedding is right way up, and is locally overturned in some steeply dipping beds. Whether this is the result of folding or rotation by brittle faulting is not certain. Brittle gouge zones are common throughout the unit. Broad, open upright folding of some siltstone beds is also evident.

Samples of black siliceous siltstone from several areas were found to contain radiolarians. Unfortunately they are recrystallized and not diagonostic (Fabrice Cordey, personal communication, 1994).

Augite-phyric basalts are dark green with characteristic 5 to 15%, black, euhedral augite phenocrysts from 1 to 2 millimetres in size. Plagioclase as a phenocryst phase is usually absent, but may occur locally as 0.5 to 1-millimetre microphenocrysts where augite phenocrysts are locally more abundant. The unit is dominated by pillowed flows and flow breccias intercalated with siltstone and siliceous siltstone on a scale of metres to tens of metres. Locally, in the immediate area of the Red-Chris deposit, the unit is informally designated the Dynamite Hill volcanics (Schink, 1977). Amydgules from 2 to 5 millimetres in diameter commonly comprise from 5 to 15% of the rock. These are filled with an amorphous, pink material, which Schink identified as feldspar.

Augite-porphyritic basalt is also exposed discontinuously for 1.7 kilometres along the south-central shore of Ealue Lake. In this area the unit is dominated by tuff-breccia with intermittent massive and locally pillowed flows. Augite phenocrysts are more abundant and larger than those in the volcanics on Todagin plateau, comprising from 15 to 30% of the rock, and are from 2 to 6 millimetres in size. Volcanic breccias locally contain intervals of limy mudstone which is currently being evaluated for possible conodont fauna.

On the basis of augite as a phenocryst phase, Read and Pustka (1990) suggested that these rocks are probably equivalent to similar volcanic rocks at the top of the Middle Triassic Tsaybahe Group mapped to the east and northeast. In the Iskut map area to the southwest augite-phyric volcanic rocks characterize upper Triassic Stuhini volcanics (Anderson, 1989).

WEST TODAGIN PLATEAU

Rocks on the western side of the Todagin plateau are lithologically distinctive from those to the east. This area is dominated by grey-green to locally maroon-weathering, plagioclase-hornblende-porphyritic massive and pyroclastic flows, monomictic lapilli tuff-breccias and derived volcanic conglomerates. Texturally the unit is characterized by 10 to 20% plagioclase laths, 1 to 3-millimetres long and 5 to 10%, 2 to 6-millimetre euhedral black amphibole. Volcanic breccias, possibly debris flows, are heterolithic, matrix supported, with subangular to subrounded 2 to 6-centimetre clasts that include siltstone, feldspar-porphyritic and hornblende and feldspar-porphyritic clasts. Locally these contain centimetre-scale interbeds of red mudstone.

Lithologically and texturally, the unit is in many respects similar to rocks underlying the Eddon plateau. However, unlike the massive character of volcanics northeast of the Ealue Lake fault, these tend to be well stratified on a 2 to 5-metre scale.

Previously, the contact between the volcaniclastic rocks to the west and the sedimentary-volcanic sequence to the east has been interpreted as a fault (Gabrielse and Tipper, 1984). Where exposed in the bed of a creek flowing north from the east end of Todagin Mountain, the contact is clearly disrupted by brittle faulting, however, massive to brecciated hornblende-plagioclase-porphyritic volcanics near the contact contain 5 to 10-centimetre subrounded clasts of the underlying siltstone.

Pliensbachian ammonites have been collected from the upper part of these volcanic sequences on the west flank of Todagin Mountain (Newell and Peatfield, in preparation). Further, Evenchick and Green (1990) have delineated a thin interval of Middle Jurassic (Pliensbachian) Spatsizi Group sediments conformably below Bowser Lake Group strata. Volcanic rocks to the west of Kinaskan Lake, that are dominated by tuff, tuff-breccia and volcanic sandstone, are also known to contain Pliensbachian fossils near the top of the volcanic succession (Evenchick, 1991a)

EALUE PLATEAU

The Ealue plateau on the eastern margin of the map area is underlain by regionally distinctive sedimentary and volcanic rocks. Sediments are dominated by very fine grained siltstone, chert and argillite. Exposures are dark to medium brown and massive with no penetrative fabric, but are usually well fractured and blocky. Read and Psutka (1991) correlated these sediments with similar, dated rocks and suggested that they were most likely the Middle Triassic, Tsaybahe Group lithologies. Very silicious siltstone or dark grey chert, collected from this area, contains radiolarians which are unfortunately recrystallized, and not diagnostic (Fabrice Cordey, personal communication, 1994).

Volcanic rocks are less abundant and apparently restricted to the western part of the Ealue plateau. They are aphyric, green-grey to green, light grey-green weathering, commonly aphanitic and massive, but locally contain from 2 to 5%, 0.5-millimetre equant to tabular microphenocrysts of plagioclase. The unit is typically magnetic, very fresh, megascopically fractured and blocky. In addition to the contrasting fine-grained massive nature of these volcanics, the salmon-orange weathering colour that is locally developed on most other volcanic units is lacking.

Similar volcanics form a relatively continuous belt along the western contact of the Permian metasediments, are massive, grey-green weathering nondescript rocks mapped as greenstone.

BOWSER LAKE GROUP

In contrast to the stratigraphic uncertainty surrounding the volcanic arc rocks discussed above, the stratigraphic, sedimentalogical and structural character of the Bowser Lake Group to the south is well constrained. Middle Jurassic (Bathonian to early Oxfordian) marine clastic sedimentary rocks (Gabrielse and Tipper, 1984; Poulton *et al.*, 1991) of the Bowser Lake Group that crop out along the southern margin of the map area are assigned to the basal Ashman Formation and comprise siltstone, chert-pebble conglomerate and sandstone (Evenchick and Thorkelson, 1993). Sedimentalogical studies indicate that Bowser Lake rocks become progressively younger to the south and that deposition was from the north into the tectonically active northern margin of the Bowser Basin (Ricketts, 1990; Ricketts and Evenchick, 1991; Green, 1991).

Distinctive chert-pebble conglomerates crop out along the northeastern slope of Todagin Mountain. In this area the unit varies from massive to well bedded. It consists of subrounded 0.5 to 3-centimetre, generally light and dark grey or green chert pebbles in a tan-brown to grey sandstone matrix. Massive outcrops comprise 40 to 60% clasts with either clasts or matrix sandstone being locally dominant. Bedded exposures comprise layers defined by an upward reduction in both size and abundance of chert clasts, repeatedly over thicknesses of 5 to 15 centimetres.

PLUTONIC ROCKS

BIOTITE-HORNBLENDE QUARTZ DIORITE TO MONZODIORITE

Biotite±hornblende quartz diorite and lesser biotite monzodiorite characterize an apparent differentiated suite of plutonic rocks that underlies a large part of the Ealue plateau. The rock weathers light grey to buff-white to locally salmon pink and is dark grey on fresh surfaces. It is medium grained, equigranular and isotropic. Mafic mineral content and type are variable throughout the intrusion. Characteristic 25 to 30% mafics may increase locally to 60%. Biotite is usually the dominant mafic phase and shows rare, though conspicuous 1 to 2-centimetre oikocrysts, poikotically enclosing plagioclase. Hornblende is usually a minor mafic constituent but may be present in amounts equal or greater than biotite, or may be the only mafic mineral present. Quartz content varies from 10 to 15% and occurs as isolated 1 to 2-millimetre grains or as larger 5 to 10 millimetre oikocrysts. White, stubby, 1 to 3-millimetre subhedral feldspar, predominantly plagioclase, may also include some potassium feldspar. The rock contains several percent finely disseminated magnetite and is strongly magnetic.

The southwestern extension of the body is texturally distinctive and may represent a more differentiated phase of the intrusion. In this area the rock contains from 8 to 15%, pink-weathering, coarse to megacrystic potassium feldspar. Potassium feldspar is also present in the medium-grained groundmass consisting of 40%, 2 to 3-millimetre tabular plagioclase, 15 to 20% smoky grey quartz and 5 to 7% biotite.

Intense hornfelsing of fine-grained sediments and aphanitic, aphyric grey-green volcanic rocks, extending for several tens of metres from the intrusive contact, is well developed and was noted in a number of locations.

This body was included with the Railway Plutonic Suite by Read and Psutka (1990) which is dated elsewhere by U-Pb zircon methods, at 227±9 Ma.

HORNBLENDE-PLAGIOCLASE-PORPHYRITIC QUARTZ MONZODIORITE

Hornblende-plagioclase-porphyritic quartz monzodiorite comprises a suite of stocks and dikes exposed along the northern margin of the Bowser Basin. The rock weathers a buff white to light grey. Distinctive medium to coarse-grained hornblende and plagioclase phenocrysts are randomly oriented in an aphanitic grey groundmass. Plagioclase is the dominant phenocryst phase, occurring as 2 to 5-millimetre subhedral tabular grains comprising from 30 to 45 modal percent of the unit. Hornblende phenocrysts are less abundant, comprising from 6 to 12 modal percent, they are usually of similar grain size, but also locally form coarser tabular phenocrysts up to 1 centimetre long, that are a diagnostic feature of the unit. The groundmass mineralogy comprises microcrystaline, anhedral, granular quartz and feldspar, the later of indetermined composition.

We tentatively include the 'Red stock', an elongate east to northeast-trending intrusion which hosts the Red-Chris copper-gold deposit, with this plutonic suite. Its close proximity, comparable geometry and obvious textural similarity suggest that it is probably an altered equivalent. Previous detailed investigations of the Red stock have determined it to be monzonitic in composition (Schink, 1977; Leitch and Elliot, 1976) based on the identification of microscopic potash feldspar as a significant component of the groundmass mineralogy. In our opinion, it remains to be established whether the fine-grained, granular potash feldspar and quartz in the matrix of this pervasively altered rock is of primary or secondary origin, and characterization of the original composition of the Red stock remains equivocal.

The apparent age of the Red stock is presently constrained at latest Triassic. Schink (1977) reported a wholerock K-Ar isochron age of 210±7 Ma, suggesting at least a minimum age for the pervasive stage of phyllic alteration affecting the stock. A less altered northeast-trending stock of plagioclase-hornblende-porphyritic monzodiorite to the west of Kinaskan Lake, the 'Groat stock', was dated by hornblende K-Ar at 195±8 Ma and by wholerock K-Ar at 189±? Ma (Schmitt, 1977).

These ages are clearly consistent with a regionally significant Early Jurassic (200 Ma) episode of porphyry copper mineralization, well defined elsewhere throughout the province (J. Mortensen, personal communication, 1994). Samples of two separate stocks from the area, including one of the Red stock, are currently being processed for U-Pb, zircon analysis.

GRANODIORITE AND DIORITE

An isolated intrusive body of buff-white to pink weathering, medium-grained hornblende granodiorite outcrops along the east side of Summit plateau. It consists of 30 to 35%, white, stubby to tabular plagioclase feldspar from 2 to 3 millimetres long. Mafic minerals, weather a dark grey-green, and are completely replaced by chlorite and lesser epidote which combined comprise from 25 to 30 modal percent. Interstitial, fine-grained, anhedral, highly strained quartz forms the remainder of the rock. Internally the body is relatively homogeneous but displays a moderate foliation near its margins, defined by secondary chlorite. Contacts with the variably deformed and metamorphosed aphyric volcanic hostrocks were not observed.

Several kilometres to the north a small intrusion of medium to coarse-grained equigranular diorite was mapped in the aphyric grey-green Permian(?) volcanics. The unit is buff-white weathering and varies from medium to coarse grained equigranular with local grain size variation common. This small stock is characterized by equal to slightly varied abundances of mafic and felsic minerals that are completely replaced by secondary chlorite and sericite, respectively.

SYENITE-TRACHYTE

Two distinctive types of potassic intrusive rocks are present locally. One is melanocratic with coarse porphyritic to megacrystic potassium feldspar in a fine to medium-grained, melanocratic groundmass. The other type includes a number of dikes and small stocks of massive leucocratic syenite and quartz syenite.

A relatively large, though isolated, outcrop area of coarse feldspar-porphyritic to megacrystic syenite is exposed on the north side of the Ealue Lake road, roughly 1.5 kilometres northeast of the eastern end of Ealue Lake. Megacrystic rocks have 10 to 30%, 1 to 3-centimetre, elongate tabular, pink feldspars in a dark green, fine to medium-grained equigranular groundmass of potassium feldspar, amphibole and possibly quartz. Coarse-porphyritic varieties have 3 to 8-millimetre equant feldspars in a similar dark green groundmass. Compositional variability is recognized locally between potassium feldspar rich syenite and a finer grained, dark green melanocratic rocks; a feature which is emphasized by differential weathering of the two phases.

This unit is probably equivalent to plutonic rocks on the east-central shore of Kinaskan Lake which Souther (1972) included in a suite of syenite, orthoclase porphyry, monzonite and pyroxenite. He describes these as commonly porphyritic and very coarse grained with a high content of potash feldspar.

Syenite is buff-white, pink or smoky grey weathering. Where identified as dikes, it is usually aphyric and massive but may locally contain up to 5% irregular quartz phenocrysts. These dikes are usually less than a metre to several metres wide, dip steeply and strike between north and northwest. Several are well exposed along the north side of the Ealue Lake road, near the west end of Ealue Lake. In this area, a swarm of eight dikes, spaced from 5 to 50 metres appart, intrudes maroon, plagioclase-porphyritic flows and breccias along a 200 to 300-metre semicontinuous roadside outcrop. Epidote alteration, characterized by thin veinlets, patches and granular disseminations, is commonly developed in volcanic rocks intruded by these dikes. In larger dikes or small stocks the syenite or quartz syenite contains 5 to 10% anhedral quartz grains, 2 to 4-millimetres across. One to three-millimetre tabular, white plagioclase grains locally comprise from 3 to 7% of the rock.

Souther (1972) mapped a series of thin, laterally continuous dike-like bodies of white to light grey, fine-grained aplitic rock at the north end of the Quash Plateau (Figure 4). We tentatively correlate these rocks with the syenite-trachyte unit.

FAULTING

Brittle faulting is evident throughout the area on a variety of scales. The east-northeast-trending Ealue Lake fault, projected along the Coyote Creek - Ealue Lake valley, is the most prominent structural feature in the map area. To the east of the map area, where designated the McEwan Creek fault, this structure has been traced for an additional 30 kilometres by Read and Psutka (1990). They determined movement on the fault in this region to be south side down.

Though not exposed in the study area, the structure is well established by contrasting lithologies and styles of alteration on either side of the inferred contact. Zones of intense and pervasive carbonatization, with localized areas of ankerite flooding are prevalent in rocks to the south of the fault. These vary from several hundreds of metres to over a kilometre in width, and sometimes contain local concentrations of pyrite as stringers and disseminations. This particular style of alteration is absent both north of the Ealue Lake fault and also in overlying Middle Jurassic Bowser Basin Lake Group sediments. The origin and geological significance of these features are at present uncertain, but association with a currently undefined regional structural feature is considered most likely.

East to northeast oriented faults also define structural contacts locally along the northern edge of the Bowser Basin.

A number of less prominent, though locally significant northwest-trending faults are also prevalent throughout the area.

ECONOMIC GEOLOGY

Twenty mineral occurrences are recorded for the study area (MINFILE 104G and H). All appear to be related to high level, subvolcanic dikes and stocks which intrude volcanic and sedimentary rocks throughout the area. In almost all instances copper mineralization is dominant but is commonly associated with elevated concentrations of gold and silver. Chalcopyrite as fracture controlled veinlets or disseminations commonly associated with quartz stockwork is the dominant style of mineralization. Mineralization is commonly hosted by the intrusions but may also be developed in the stratified volcanic and sedimentary country rocks. The Red-Chris deposit is the only active exploration target.

RED-CHRIS DEPOSIT

The Red-Chris copper-gold deposit is hosted by the "Red stock", an east-northeast elongated intrusive body of pervasively quartz-sericite-ankerite-pyrite (phyllic) altered, plagioclase hornblende porphyry (Panteleyev, 1973, 1975; Leitch and Elliott, 1976; Schink, 1977; Figure 5). Chalcopyrite and localized concentrations of bornite are commonly associated with zones of quartz stockwork and sheeted quartz veining. The quartz stockwork forms a steeply dipping, high-grade core zone associated with intense and pervasive carbonatization that is surrounded by and gradational into barren to weakly mineralized, phyllic (quartz-sericite-ankerite-pyrite) altered host stock (Figure 6). Quartz stockwork zones dip steeply to the north and parallel the long axis of the Red stock.

Earlier drilling of this deposit by Texasgulf Inc. included 118 percussion and diamond drill-holes, totaling 16 476 metres. Drilling outlined two zones of copper-gold mineralization which were designated the Main and East zones (Forsythe, 1977; Newell and Peatfield, in preparation; Figure 5). Using a cutoff grade of 0.25% Cu, irrespective of gold, Texasgulf estimated an open-pit mining inventory of 34.4 million tonnes, grading 0.51% Cu and 0.27 g/t Au to a depth of 270 metres in the Main zone and 6.6 million tonnes grading 0.83% Cu and 0.72 g/t Au to a depth of 150 metres in the East zone.

Between late June and early November, 1994, American Bullion Minerals Ltd. drilled 21 417 metres of HQ and NQ core in 58 holes, to an average depth of 370 metres. Several holes exceeded 500 metres. Approximately 74 kilometres of cut grid line were established over the property. Induced polarization and ground magnetic geophysical surveys were conducted to help outline mineralization and identify potential new drill targets. The drilling program has successfully defined continuity of high grade copper-gold reserves along strike and to depth from previously outlined mineralization. It has established that the deposit becomes both wider and richer with depth. Drilling has more or less doubled its down dip extension, and it remains open at depth. Significant and continuous intersections of high-grade bornite mineralization have also been identified in the East zone.

Cross-sections through the East and Main zones (Figure 5, 7 and 8) were constructed by logging several holes and examining portions of others, supplemented by American Bullion drill logs. Sections indicate that most of the higher grade copper and gold is contained within quartz stockwork zones. Local intersections of laterally discontinuous intense quartz stockwork, with narrow zones of sheeted quartz material are flanked by moderate to strongly developed quartz stockwork which invades carbonate-sericite-pyrite altered plagioclase-hornblende porphyritic hostrocks.

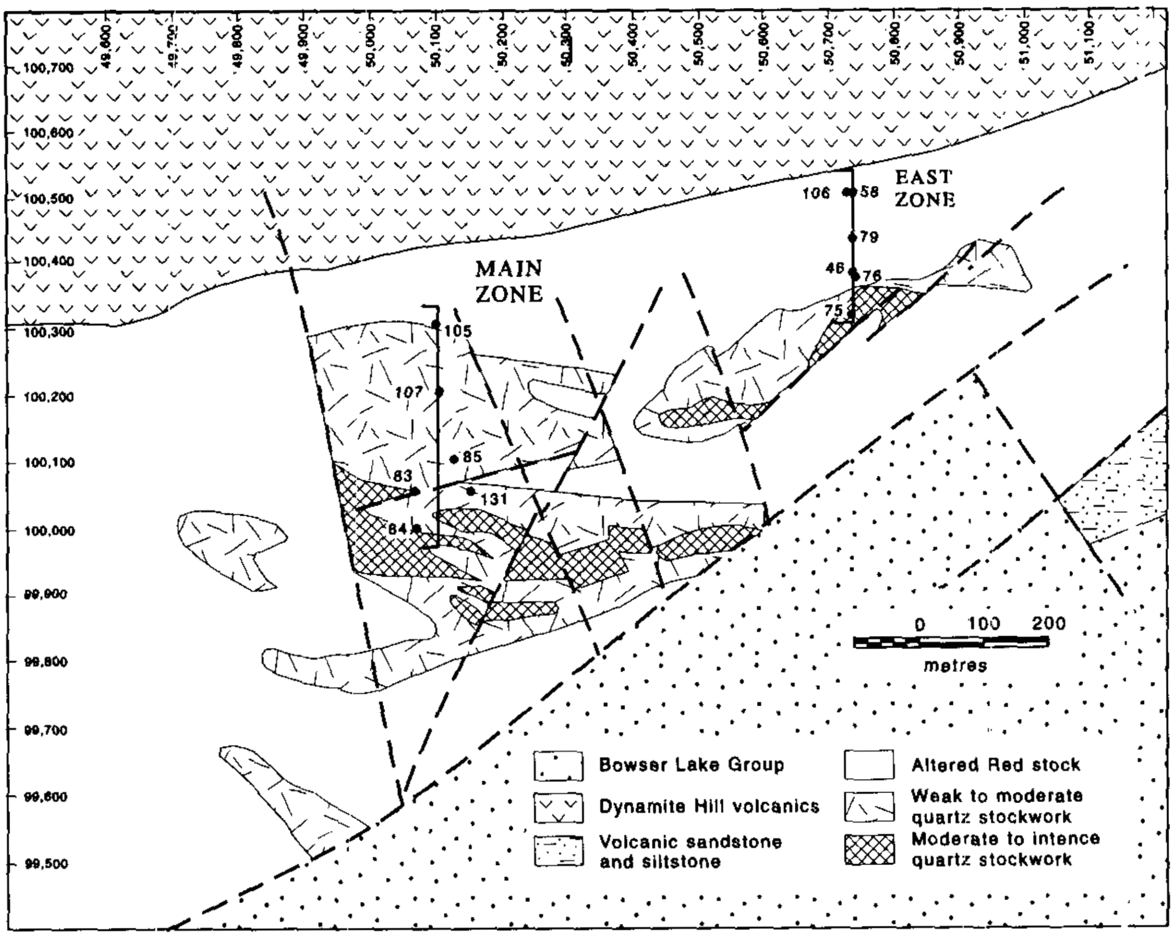


Figure 5. Setting of the East and Main zones of mineralization at the Red-Chris deposit (after Forsythe, 1977).

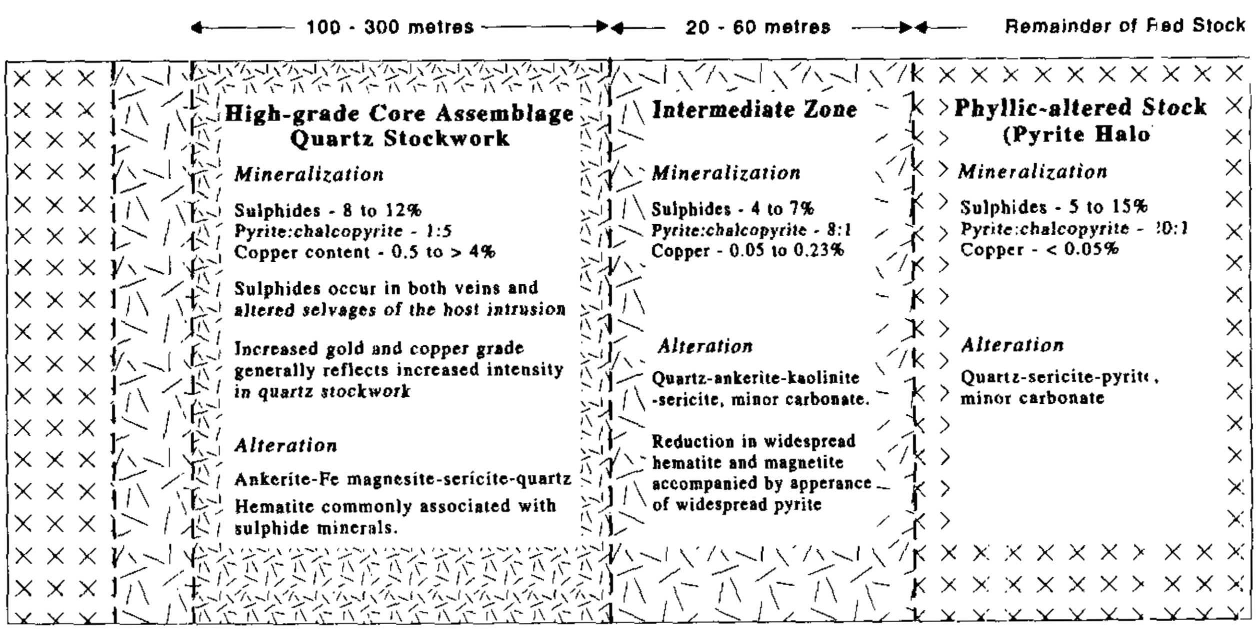


Figure 6. Generalized characteristics of mineralization and alteration at the Red-Chris deposit. Compiled largely from data by Leitch and Elliott (1976) and Schink (1977).

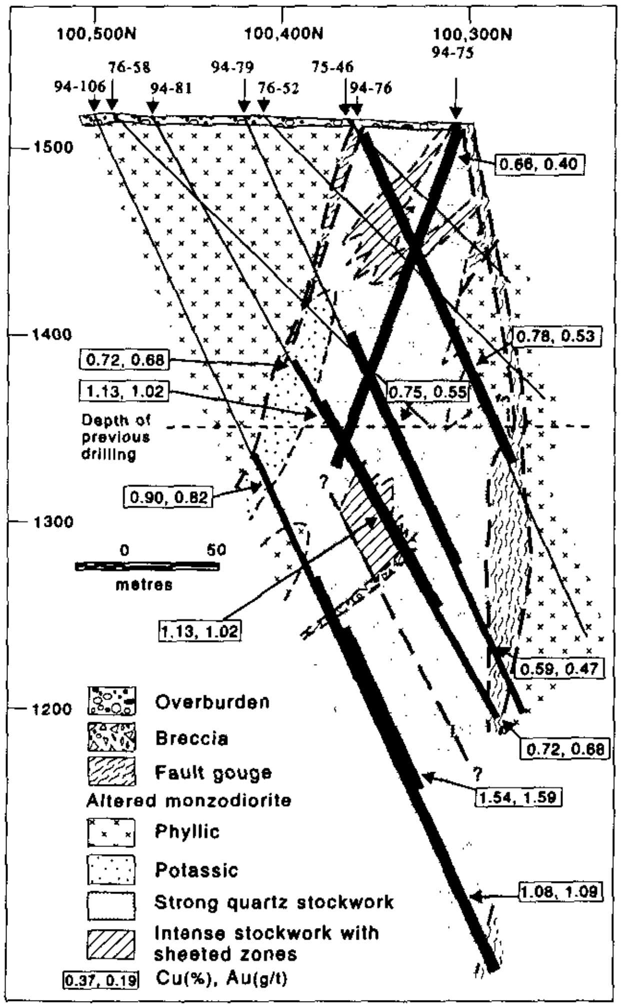


Figure 7. Generalized cross-section through the East zone along section 50 100 looking east. Abundant small-scale faults are not illustrated. Line of section shown on Figure 5.

Quartz stockwork consists of planar, grey quartz envelopes and vein-fill material characterized by sharp contacts with the host plagioclase hornblende porphyry. Veinlets are from 2 millimetres to 2 centimetres wide and form a randomly orientated network pattern with at least two generations of veining. To log the intensity of quartz stockwork on a consistent basis, American Bullion Minerals geologists have designated weak, moderate and strong stockwork by arbitrary values of less than 12, 12 to 30 and more than 30 veins per metre, respectively. Disseminated chalcopyrite, in addition to minor pyrite, hematite and bornite are commonly found as both disseminations and thin veinlets in both quartz veins and selvages of hostrock between the veins.

In the stockwork zones the host intrusion is affected by intense and pervasive carbonate alteration associated with lesser fine-grained quartz, sericite and sulphides. Mafic minerals are intensely altered to a probable combination of chlorite, sericite and ankerite. Plagioclase phenocrysts are locally kaolinized, but are more often strongly sericitized. Although difficult to detect in fresh drill core, orange-brown weathering of exposed core emphasizes the presence of abundant fine-grained iron carbonate. Preliminary scanning electron microprobe investigation indicates that hostrock selvages are dominated by roughly equal abundances of ankerite and iron-rich magnesite. These two minerals occur as a fine-grained, anhedral granular intergrowth with lesser pyrite and sericite.

Several zones of sheeted quartz-sulphide material associated with zones of intense silica flooding and quartz stockwork occur in the East zone. The fabric defined by the sheeted zone strikes between 070° and 090°. Discontinuity of sheeted zones in drill core is most likely a function of later faulting (Figure 7). Sheeted material consists of 2 to 4-millimetre alternating bands of light and dark grey microcrystalline quartz carrying chalcopyrite and pyrite, with minor bornite. Dark grey quartz bands contain skeletal hematite and remnants of hostrock that are intensely altered to sericite, hematite and clay. In drill core the upper transition from intensely developed quartz stockwork mineralization to sheeted material is gradational, whereas the lower contact is faulted. This is indicated by the abrupt truncation of sheeting and intense stockwork by carbonate breccia.

Hole 94-106 cut a significant intersection of bornite mineralization (Figure 7). Between 206 and 495 metres depth bornite comprises more than half of the copper bearing mineral and locally dominates. It occurs as disseminations and thin 1 to 3-millimetre, fracture-filling stringers with hematite within the altered stock and to a lesser degree in quartz veins were it is locally abundant.

In order to characterize the base and precious metal elemental character of the Red-Chris deposit, a total of 23 samples, including three or four representative of each of the individual styles of alteration and mineralization were collected from drill core. These samples were analysizd by both inductively coupled plasma emission spectroscopy (ICPES, 32 elements) and instrumental neutron activation analysis (INAA, Au + 34 other elements). Results for both precious and base metal elements are summarized in Table 1. These data demonstrate a correlation of high copper with elevated gold and silver. They also demonstrate that the highest concentrations of these elements are present in quartz-rich samples, either sheeted or stockwork.

Other base metal concentrations are typically low with zinc being weakly anomalous. These elements appear to show no correlation with copper and gold values.

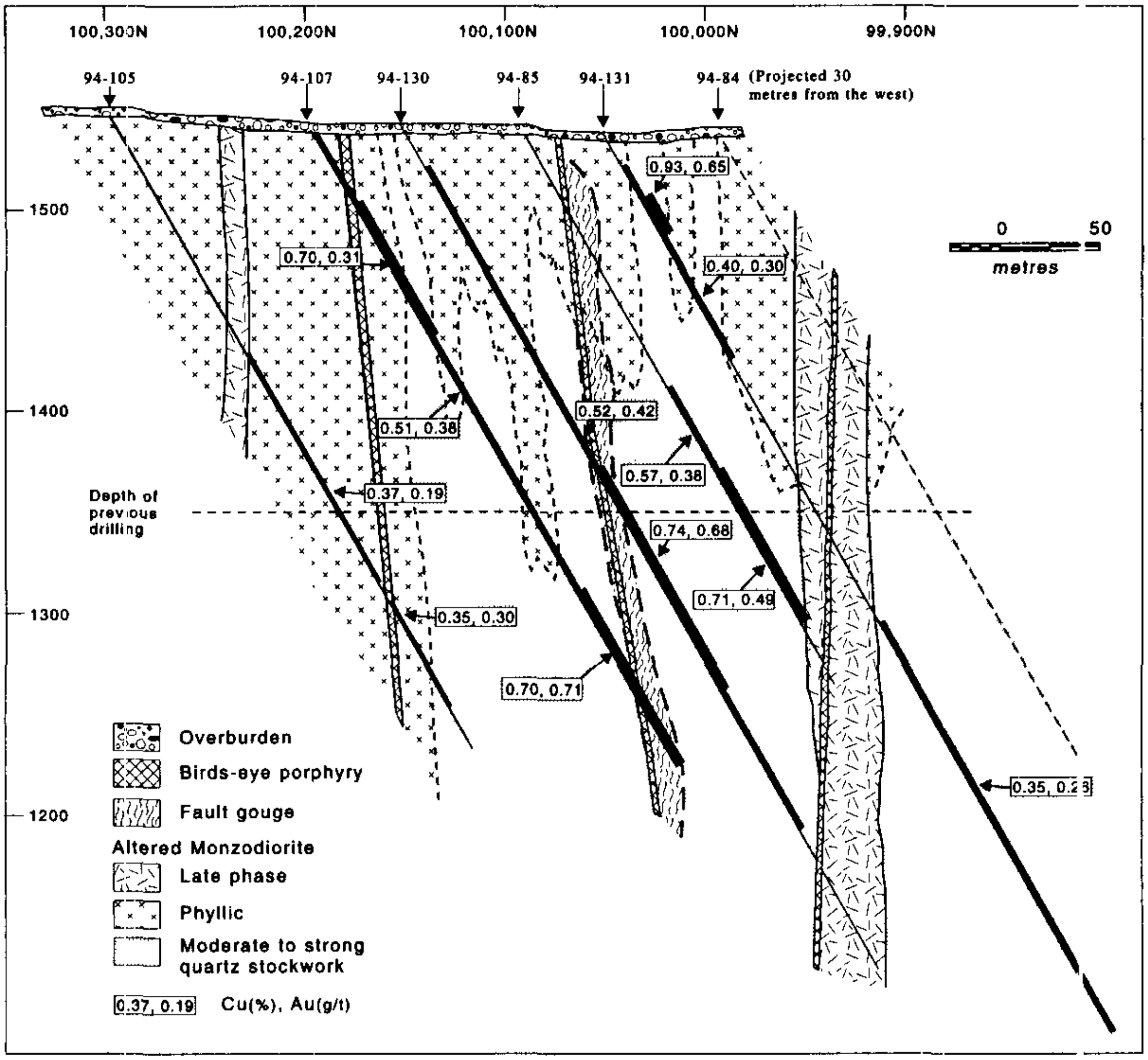


Figure 8. Generalized cross-section through the Main zone along section 50 740 looking east. Abundant small-scale faults are not illustrated. Line of section relative to locations of the individual drill holes is shown on Figure 5. Section does not include all previous drilling data.

Iridium was the only platinum group element assayed for. Abundances are below the detection limit of 5 ppb in all samples.

ALTERATION

Four main alteration types are evident at Red-Chris. The most prominent consists of phyllic (+carbonate) with interfingering mottled phyllic alteration and extends over an area of 2 to 3 square kilometres. Potassic alteration is sporadic and limited in both extent and intensity. Propylitic assemblages are prevalent in the mafic volcanics to the north of the Main and East zones and has been identified locally in late phase dikes.

Phyllic alteration is generally pervasive and is the most widespread alteration type. Generally the altered rock is pale grey and retains some primary texture. Weak phyllic (to weak argillic) alteration of the Red stock has altered plagioclase to sericite and kaolinite. Locally plagioclase has a bleached appearance and typically hornblende is intensely altered to completely destroyed. In places, the groundmass appears to be silicified. However, the orange-brown colour of weathered drill core suggests the presence of significant amounts of carbonate. Preliminary review of thin sections and SEM investigations suggest that carbonate material is composed predominantly iron-magnesite and ankerite, with usually 10 to 20% replacement of the hostrock. Vein pyrite exceeds disseminated pyrite for a total content of 5 to 10%. Weak quartz-pyrite± chalcopyrite stringers are cut by late, white calcite veins.

Mottled phyllic alteration partially destroys primary porphyritic texture. It is characterized by distinctive, 3 to 7-millimetre spherical and irregular

TABLE 1
METAL ABUNDANCES OF DRILL CORE FROM THE RED-CHRIS DEPOSIT

DDH	Intersection	Rock Type	Au	*Ag	*Cu	*Mo	*Pb	*Zn	As	Hg	Sb	Co	*Ni	Cr
			ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
94-79	190-195 m	Potassic alteration, East Zone	448	1.1	5510	4	9	89	2.5	-1	2.1	40	3	12
84-81	150-154 m	Potassic alteration, East Zone	91	0.1	1176	1	12	142	2.1	-1	2.4	24	4	23
94-84	280-283 m	Potassic alteration, Main Zone	55	0.1	2203	1	6	64	7.8	-1	3.4	17	3	14
94-85	84-88 m	Potassic alteration, Main Zone	133	0.5	2067	3	14	127	7.5	-1	1.3	27	4	15
94-81	242-246 m	Sheeted qtz-sulphide, East Zone	2230	3.3	16947	1	7	55	23	2	23	70	4	-5
94-76	47-49 m	Sheeted qtz-sulphde, East Zone	2290	3.7	41160	2	13	79	19	4	11	63	3	6
94-76	80-85 m	Sheeted qtz-sulphide, East Zone	1870	3.1	21514	1	17	133	8.6	6	34	51	3	6
94-81	285-291 m	Moderate qtz stockwork, East Zone	376	0.1	2788	2	8	68	4.7	4	15	27	2	9
94-76	117-120 m	Moderate qtz stockwork, Main Zone	335	0.8	4614	3	12	83	20	-1	6.9	26	3	15
94-83	53-54 m	Moderate qtz stockwork, East Zone	116	0.5	5642	3	9	137	19	-1	58	24	2	7
94-81	29-40 m	Phyllic alteration, East Zone	31	0.1	118	2	3	25	13	-1	12	21	6	-5
94-106	86-90 m	Phyllic alteration, East Zone	61	0.1	754	12	6	95	6.8	-1	11	37	4	-5
94-84	193-204 m	Phyllic alteration, Main Zone	21	0.2	148	1	13	188	5.5	-1	1	19	7	20
94-107	65-72 m	Phyllic alteration, Main Zone	167	0.1	5792	2	2	21	8.9	2	6.9	49	3	-5
94-81	92-97 m	Mottled phyllic alteration, East Zone	126	0.2	1474	16	12	20	13	-1	3.9	23	5	8
94-106	23-26 m	Mottled phyllic alteration, East Zone	23	0.1	84	3	2	21	28	-1	3.6	46	99	180
94-106	161-162 m	Mottled phyllic alteration, East Zone	116	0.1	985	35	3	24	4.4	-1	3.1	27	11	-5
94-76	140-145 m	Strong qtz stockwork, East Zone	263	1	4263	3	4	89	38	6	68	22	7	50
94-106	308-313 m	Strong qtz stockwork, East Zone	2840	12.3	25859	6	3	69	0.9	2	3.4	79	2	8
94-84	99-103 m	Strong qtz stockwork, Main Zone	1330	2.1	12943	3	7	102	13	-1	2.3	61	2	6
94-81	312-315 m	Weak qtz stockwork, East Zone	255	0.4	2322	2	2	86	20	3	22	16	3	9
94-105	342-345 m	Weak qtz stockwork, Main Zone	612	0.6	7470	2	8	18	9.6	2	14	39	5	11
94-85	88-92 m	Weak qtz stockwork, Main Zone	127	0.3	2031	3	14	135	30	1	3.9	32	8	12

* Analyses by instrumental neutron activation (INAA), elements without an asterisk analyzed by inductively coupled plasma emission spectroscopy.

pale grey patches of intense quartz-sericite alteration that comprise from 10 to 15% of the rock. Typically fine-grained to blebby pyrite occurs near the centre of these patches. Altered groundmass is beige, probably indicating significant ankerite replacement. Pyrite veins are common and have well developed sericite-quartz envelopes. Total pyrite content varies from 5 to 10%.

On the whole, areas of potassic alteration are minor, representing roughly 5 to 10% of the total alteration zones. Potassic zones are generally only a few metres wide and are discontinuous, with gradational to sharp contacts with the phyllic-altered host and quartz stockwork. Although locally the porphyritic texture is preserved, it is often totally destroyed and replaced by fine-grained potassium feldspar, giving the rock a light orange-brown to salmon colour. The potassic alteration assemblage includes 2 to 7% hematite after magnetite (martite) and finely disseminated magnetite and rare veins. Generally 2 to 4% disseminated pyrite is fine-grained to blebby, with few pyrite stringers. Narrow quartz stingers contain pyrite and chalcopyrite. Locally, hornblende is altered to fine-grained, felted brown biotite. Panteleyev (1975) commented on the fact that hematite and siderite impart a buff pink appearance to hand specimens that may be mistaken for potassium feldspar flooding.

Propylitic alteration, as discussed by Schink (1977), is poorly developed. It consists of 5% disseminated epidote and 2 to 5% finely disseminated pyrite and has only been identified in the augite porphyry (Dynamite Hill) volcanics immediately to the north of the main zones of stockwork mineralization. No epidote was noted in drill core during the 1994 drilling program.

A gypsum zone located west to south-west of the Main zone contains weak to strong gypsum veining but its extent is poorly defined. These veins appear to be late and cut mineralization (Schink, 1977). Drilling during the 1994 field season was concentrated within the East and Main zones with very little work done in this area.

Carbonate veins and alteration of groundmass minerals to ankerite and iron-rich magnesite are widespread throughout the Red stock. Surrounding volcanics and sediments are also locally intensely carbonatized. Generally the zones external to the stock are barren of sulphides, appear to be very late and may be unrelated to the main copper-gold mineralizing event, at least in part.

FAULTING

Prominent east-northeast-trending structures have controlled the orientation of the Red stock and the zone of mineralization. Faults active either before or during the mineralizing event are generally healed and associated with intense silicification. Schink (1977) and Leitch and Elliott (1976) defined the fault orientation as striking 060°-090° and dipping approximately 75° to the south. These are normal faults with dominantly dip-slip movement.

Fault gouge zones produced by reactivation of earlier structures vary from several centimetres to 50 metres in width and are a prominent feature throughout the drill core. The gouge material contains rounded centimetre-sized fragments of altered and mineralized (pyrite-chalcopyrite) Red stock in a matrix of clay, quartz and carbonate. As emphasized by Newell and Peatfield (in preparation), disruption of the mineralized zone by faulting is an important aspect of the deposit but difficult to characterize on sections due to uncertainity in correlating the many fault zones from drill hole to drill hole.

CLASSIFICATION OF THE RED-CHRIS DEPOSIT

The Red-Chris has been characterized, genetically as a porphyry copper-gold deposit (Panteleyev, 1973, 1975; Schink, 1977) or alkaline porphyry deposit (McMillan, 1991; Newell and Peatfield, in preparation). Both Schink (1977) and Newell and Peatfield (in preparation) have emphasize the apparent ambiguity of features that are indicative of both alkalic and calcalkalic deposit types (Table 2). The overall size and, in particular, the metal signature, with significant gold values associated with higher grade copper and a molybdenum deficiency are clearly indicative of alkaline porphyry deposits. The nature of the mineralization, however, as predominantly quartz stockwork zones associated with intense and pervasive carbonatization and phyllic alteration of the host intrusion is not. Classification of the Red Chris deposit as to the type of porphyry remains problematical. Reference to the deposit as strictly a copper-gold porphyry with no attempt to further refine the porphyry type is preferable at this stage.

TABLE 2. CHARACTERISTICS OF THE RED CHRIS DEPOSIT.

Alkalic Porphyry Deposits	***Calcalkalic Porphyry Deposits***
Exclusively copper and gold mineralization	High quartz content of the mineralized zone
molybdenum deficiency	calcalkaline composition of the Red Stock
High level, sub-volcanic character of the stock	Phyllic alteration
Relative small size of stock and limited lateral extent of mineralization	Association with minor amounts of sphalerite, galena and tourmaline

NEW MINERAL OCCURRENCE

Small areas of previously undocumented gossans with associated sulphide mineralization were identified during the course of mapping. Areas of gossan were found primarily in Mesozoic volcanics and to a lesser degree in sediments. In almost all cases the only metallic mineral identified was pyrite, occurring as disseminations and thin stingers, and less commonly as massive 2 to 4-centimetre clots. Chip samples taken throughout the areas of alteration, with preference for sulphide-bearing rock fragments, were analyzed for precious and base metals.

Two sulphide samples from one of the gossanous areas sampled returned anomalous copper values (Table 3).

TABLE 3. PRECIOUS AND BASE METAL ABUNDANCES OF SULPHIDE SAMPLE.

	Au	Ag	Cu	Mo	Pb	Zn
	ppb	ppm				
CAS-30A	11	71	20611	1	27	77
CAS-30B	18	13	14527	1	12	44

This mineralized outcrop is located on the east side of the Eddon plateau roughly 3.5 kilometres due north of the centre of Ealue Lake, at an elevation of 1600 metres (5200 feet), (UTM 45040E by 6410705N). A 3 by 5 metre area is exposed in a near-vertical, northeast-facing rock face, 150 metres long by 6 to 8 metres high. Chalcopyrite mineralization is hosted by a polymictic volcanic lapalli-tuff breccia. Volcanic breccia varies from matrix to clast supported, with subangular to subrounded, 1 to 4-centimetre plagioclase-hornblende-porphyritic volcanic clasts in a poorly sorted plagioclase phyric tuffaceous matrix. Chalcopyrite and pyrite forms thin stringers and fine to locally coarse disseminations comprising from 10 to 15% of the rock over widths of less than 0.5 metre within the broader rusty stain zone.

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