

4362

92J/15E, 16W 4362  
PETROGRAPHIC REPORT

20 SPECIMENS FROM  
NEPHRITE DEPOSIT  
MARSHALL CREEK, B.C.

Lang, Royal, Jim, Lease M 52 =  
4-Ton, Jim #1 Fr.

Prepared for  
WOLLEX EXPLORATION LTD.  
Calgary, Alberta

by  
GEORGE A. WILSON GEOLOGICAL CONSULTANTS LTD.

Calgary, Alberta

Department of  
Mines and Petroleum Resources  
ASSESSMENT REPORT

NO. 4362 MAP.....

## INTRODUCTION

This report is the findings of a petrographic investigation of 20 specimens conducted by the undersigned at the request of Wollex Explorations Ltd., Calgary, Alberta.

All colours are defined according to the Rock Colour Chart published by the Geological Society of America.

Percentages of minerals are based on visual estimates.

Two of the specimens, 3 and 7, are rich in clay minerals. Thin sections could not be made from them by ordinary means (see note, specimen 3). Oil immersion tests would afford an opportunity to identify at least some of the components but would produce much less information regarding texture than thin sections.

## CONCLUSIONS

Different rock types are represented in the set of 20 specimens. Most are altered sedimentary rocks. Three specimens are derived from crystalline silicate rocks. R-Y is derived from an andesite. R11 is an augite porphyry, probably a volcanic, but possibly a hypabyssal intrusive. R-21 is a hornblende andesite.

All of the 20 specimens are low rank metamorphic rocks with mineral assemblages characteristic of the Greenschist Facies.

Sillimanite was questionably identified in two specimens, R-X and 9. This identification must be treated with some skepticism at the present time. The questionable mineral is too fine for the exact recognition of optic character.

Two specimens, RZ and R-19, appear to be of fairly good quality nephrite.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72-2  
Specimen: RD  
Location: Not specified

Rock Name: Chlorite-plagioclase-epidote assemblage of greenschist facies.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: greyish orange (10YR 7/4) to light brown (5YR 5/6).  
Lustre: chalky.  
Surface: smooth jointed in three directions.

##### Fresh Surface:

Colour: greyish olive (10Y 4/2) with 2 mm wavy to straight tapered streaks of olive grey (5Y 3/2) and veinlets of light olive brown (5Y 5/6).  
Texture: very fine grained.  
Structure: some olive grey (5Y 3/2) streaks have form of ptygmatic folds.

#### MICROSCOPIC EXAMINATION

##### Felsic Minerals:

###### Feldspar:

Plagioclase, 10%, phenocrysts with subhedral to euhedral shape as large as 0.4 x 0.1 mm. Also occur as lenticular clusters as large as 0.5 x 2.5 mm and as veinlets as wide as 1 mm in two directions nearly perpendicular to one another. Could not be identified.

Plagioclase 30%, very fine equant, anhedral grains less than 0.015 mm across. All appear to have mosaic borders. Could not be identified.

Epidote 55%, pale yellow grains 0.010 to 0.020 mm long. Faintly pleochroic from pale yellow to pale green. Randomly distributed throughout. Epidote also occurs in small veinlets.

Chlorite 2%, small plates in some feldspar veinlets.

Kaolinite; trace.

Iron Oxides: transparent, moderate red (5R 4/6) in veinlet 0.005  
mm on each side.

*George A. Wilson*

George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72-2  
Specimen: RE  
Location: Not specified

Rock name: Epidote-chlorite assemblage of greenschist facies.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: Pale olive (10Y 6/2) grading to dark bluish grey (5B 7/1).  
Lustre: chalky.

##### Fresh Surface:

Colour: greyish yellow (5G 7/2) with veinlets of dark bluish grey (5B 7/1) and dark yellowish orange (10YR 6/6).  
Texture: very fine grained.  
Structures: dark bluish grey veinlets range from linear to lenticular to pygmatic. Very narrow calcite veinlets cross all other veinlets.

#### MICROSCOPIC EXAMINATION

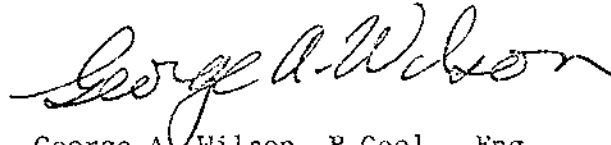
Epidote: 70%, equant anhedral grains, less than 0.1 mm long.  
Chlorite: 20%, minute flakes with brown interference colour intergrown with epidote.  
Kaolinite: 5%, small flakes with chlorite and epidote.

##### Depositional Minerals:

Epidote: coarse in veinlets as wide as 1.5 mm, some are intergrown with antigorite. Minerals in epidote veinlets are not deformed.  
Chlorite-Antigorite: Chlorite has dark brown interference colour, antigorite has pale blue. Chlorite-antigorite appears to have been deposited perpendicular to walls but to have been dragged into a sigmoidal shape by subsequent movement. Chlorite is probably a replacement of antigorite.

This assemblage was, in turn, fractured and calcite and/or quartz-calcite deposited.

Iron Oxide: traces, moderate red (5R 4/6), transparent deposit in veinlets with antigorite.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72-2  
Specimen: RX  
Location: unspecified

Rock Name: Nephrite composed of tremolite and sillimanite.

#### MACROSCOPIC EXAMINATION

Weathered Surface.

None on specimen.

Fresh Surface:

Colour: Two ranges of colour occur on the specimen. The dominant colour consists of dusky green (5G 3/2) with streaks of dark yellowish green (10GY 4/4). The lighter patches consist of greyish yellow green (5GY 7/2) and pale yellowish green (10GY 7/2).

Lustre: resinous.

Minerals: trace chlorite.

Texture: micrograined.

Structures: The lighter coloured phase exists as bulging streaks and as veinlike structures with two directions; approximately 30% of the rock is the light phase.

#### MICROSCOPIC EXAMINATION

Felsic Minerals:

Feldspar:

Plagioclase: none.

Mafic Minerals:

Tremolite: 80%,  $-2V = 85-90^\circ$ ,  $Z \wedge C = 23^\circ$ . Occurs in two forms, fine and coarse; both being colourless in thin section.

Coarse form: 50-60% of thin section, subhedral to anhedral grains to 0.35 mm long and 0.3 mm wide. Orientation is random. Coarse tremolite occurs in streaks as wide as 1.5 mm with trace to extensive fine tremolite matrix. The coarse streaks are curved and coalesce in places.

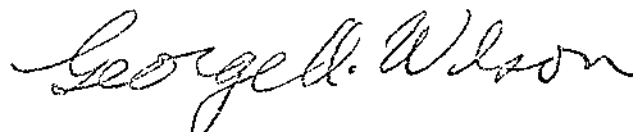
Fine form: 30-20%, subhedral grains less than 0.02 mm in orbicular aggregates as large as 2 mm x 4 mm in which tremolite has random orientation.

Sillimanite: 20%, acicular prisms ranging in size from 0.005 x 0.015 mm to 0.02 x 0.3 mm. It occurs as single grains, clusters of grains, and as very abundant randomly oriented grains in both fine and coarse tremolite. It tends to be coarser in the coarse tremolite.

Kaolinite: traces, occurs as very fine grains along wavy surfaces.

Opaque oxides: trace, small grains, rectangular to irregular, less than 0.2 mm long.

Hydrated Iron Oxides: pale yellowish orange (10YR 7/6), transparent. It occurs in and adjacent to some wavy streaks.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.



Program: Wollex 72-2  
Specimen: RY  
Location: Not specified.

Rock Name: Tremolite-andesine hornfels

#### MACROSCOPIC EXAMINATION

Weathered Surface:

None on specimen.

Fresh Surface:

Colour: dominantly greyish green (10GY 5/2), 60%, with layers and lenticles of greyish yellow green (5GY 7/2, 30%, and layers of dusky green (5G 3/2).

Lustre: resinous.

Texture: Very fine grained.

Structures: Color phases consist of layers and lenticles .5 to 3 mm wide. All are gently undulating. A poorly developed schistosity is subparallel to layering.

#### MICROSCOPIC EXAMINATION

Feldspar, 60%:

Plagioclase, 60%, An<sub>36</sub>. Occurs in two forms, one coarse and one fine. The coarser form consists of anhedral grains as large as 0.7 mm in clusters as large as .3 mm x 5 mm. These are probably the greyish yellow green (5GY 7/2) lenticles on fresh surface. Within the clusters there are sparse acicular grains of tremolite as long as 0.1 mm. The fine form consists of equant interlocking anhedral grains with maximum size 0.03 mm. This form is the principle groundmass mineral of the rock. It is intergrown with acicular tremolite and traces of kaolinite.

Both forms are clear and fresh but have reddish bleb shaped inclusions. Much of the coarser plagioclase has been clearly deformed. The composition of only the coarser variety was determined.

Tremolite, 20%; acicular prisms with maximum size 0.1 mm. Occurs throughout rock but is mostly in fine feldspar. Filament character of these grains renders identification of optic character difficult but  $Z' \wedge C$  appears to be near  $13^\circ$ .

Sericite, 10%; subhedral flakes 0.05 to 0.07 mm long. It is concentrated in thin wavy layers 0.2 to 0.4 mm wide which tend to feather out at both ends.

Epidote, 3%: anhedral to subhedral grains as long as 0.03 mm, randomly distributed throughout specimen.

Kaolinite, 1%: Occurs in wavy layers some of which are also sericite rich laminae.

Sphene, trace: small equant grains less than 0.15 mm long.

Iron Oxides, trace: transparent moderate reddish brown (10R 4/6), anisotropic.

Opaque Minerals: Strings of spherical to rectangular masses less than 0.01 mm across.

Depositional Minerals:

Feldspar veinlets 0.005 mm wide cross all laminae.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72/2  
 Specimen: RZ  
 Location: Not specified

Rock Name: Nephrite of good quality. Amphibole schist of the greenschist facies.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: yellowish grey (5Y 7/2) with pale greenish yellow (10Y 6/2) band on one side.  
 Lustre: chalky.  
 Texture: very fine grained.  
 Structures: faint layering together with poorly developed schistosity parallel with pale greenish yellow layer.

##### Fresh Surface:

Colour: moderate green (5G 5/6) grading to brilliant green (5G 6/6). Along one side is a 1.5 cm layer with light greenish grey (5GY 8/1) color, corresponding to the pale greenish yellow (10Y 6/2) on weathered surface.  
 Within all color phases are discontinuous streaks composed of rounded masses as large as 1 mm of olive black (5Y 2/1).  
 Texture: very fine grained.  
 Structures: There is a fairly prominent tendency to parallel alignment of colour phases. Within the light greenish grey (5GY 8/1) color phase there are enterolithic structures. The margin of the zone has similar character.  
 This block has separated from adjacent phases along a zone of talc schist.

#### MICROSCOPIC EXAMINATION

Amphibole, 98%: Variety tremolite, feathering clusters of crystals to 0.05 x 0.2 mm.  $Z'AC = 18^{\circ}$ , very pale green colour. Approximately 60% of the tremolite is oriented along wavy lines generally in sheaf-like clusters. The remainder is in patches of randomly oriented grains. Such clusters of randomly oriented grains are as large as 1 x 2 mm.

##### Opaque Minerals:

Trace, very dark red (SR 2/6) rhombic to rectangular grains as large as 0.2 mm.

Kaolinite?: Not represented in thin section but was probably present as traces in small veinlets. During manufacture of thin section it became wet, expanded and was plucked out of the thin section.

Structures: "S" planes in which tremolite tends to be aligned more perfectly extend across the thin section at an angle to the more general orientation of tremolite.



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GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72-2  
Specimen: R-3  
Location: Not specified.

Rock Name: Chlorite talc schist, probably with abundant quartz.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

None on specimen.

##### Fresh Surface:

Colour: greyish green (10GY 5/2) with streaks of greyish yellow green (5GY 7/2).

Lustre: vitreous to resinous.

Minerals: Chlorite and talc are abundant, quartz probably present. Kaolinite or other expanding clay minerals abundant on foliation surface.

Texture: fine grained, even.

Structures: well developed foliation in wavy lines.

#### MICROSCOPIC EXAMINATION

No thin section could be made by ordinary methods. The high proportion of expanding clay mineral resulted in expansion and disintegration of the rock during processing.

Cementing the rock to glass by means of 170C resulted in the expanded rock separating from glass. Cementing by means of strong epoxy resins resulted in shattering of the glass on expansion.

These rocks can be processed and thin sections manufactured at considerable cost using special techniques.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
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Program: Wollex 72/2  
Specimen: R6b  
Location: Not specified

Rock Name: Chlorite schist.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: greyish green (10G 4/2) with patches of light greenish grey (5GY 8/1).  
Lustre: resinous on greyish green, chalky on light greenish grey.  
Structures: faint schistosity with traces of joints.

##### Fresh Surface:

Colour: dark greenish grey (5G 4/1) with flecks and streaks of dusky green (5G 3/2) and irregular patches and veinlets of very light greenish grey (5GY 8/1).  
Lustre: resinous.  
Texture: Very fine grained.  
Structures: Faint foliation exists throughout specimen; veins and folded veins or laminae especially of calcite.

#### MICROSCOPIC EXAMINATION

Chlorite, 75% of specimen, 99% of groundmass.

Consists of clusters of platy grains ranging from 0.01 by 0.02 mm to 0.04 by 0.08 mm. Most are the smaller size. Parallel alignment is good except for a small proportion which are deposited in veins perpendicular to walls. In some cases chlorite is arranged perpendicular to hairline fractures.

Characteristics: Colour very pale green, nearly colourless, +2V = 10-15°; interference colour very pale yellowish green (5GY 8/2).

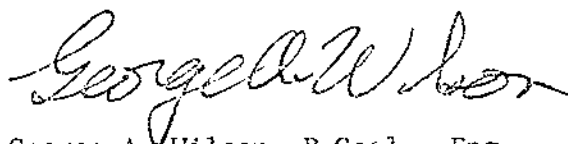
Opaque Minerals, 1%: rounded blebs less than 0.005 mm diameter.

##### Depositional Minerals:

Calcite: Irregular veinlike masses to 1 cm wide distributed along a fracture with branching veinlets extending into chlorite schist. Other patches of calcite are isolated replacements of chlorite.

Texture: fine grained, entirely secondary minerals.

Structure: Chlorite schist cut by carbonate veinlets. Branching veinlets consist of an earlier deposit of chlorite perpendicular to walls adjacent to the host. Within the comb structure, chlorite carbonate replacement has taken place along both sides of fine fractures. The trace of the original fracture is visible along the centre of the veinlet.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72/2  
Specimen: R-7  
Location: Not specified

Rock Name: Chlorite talc schist probably with abundant quartz.

#### MACROSCOPIC EXAMINATION

Weathered Surface:

None on specimen.

Fresh Surface:

Colour: greyish green (5G 5/2) with flecks of pale green (5G 7/2).

Minerals: Chlorite, talc, clay minerals and probably quartz and tremolite.

Texture: very fine grained.

Structure: well developed schistosity along which expanding shale minerals are abundant.

#### MICROSCOPIC EXAMINATION

As a result of the high proportion of expanding clay minerals, no thin section could be made. See remarks relating to specimen 3.



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GEORGE A. WILSON GEOLOGICAL  
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Program: Wollex 72-2  
Specimen: R-9  
Location: Not specified

Rock Name: Tectonic breccia

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: greyish yellow green (5GY 7/2).  
Lustre: resinous.

##### Fresh Surface:

Colour: angular patches of greyish yellow green as large as 1 cm in a matrix ranging from dusky green (5BG 3/2) to olive grey (5X 4/1).  
Texture: very fine trained.  
Structure: fragmental texture with traces of schistosity.

#### MICROSCOPIC EXAMINATION

##### Felsic Minerals:

Quartz 60%, occurs in two forms, fine matrix and coarse vein or augen.

Fine quartz 20%; equant anhedral randomly oriented grains less than 0.005 mm in diameter. This type is intergrown with tremolite. It composes angular masses as large as 1 x 1.5 cm.

Coarse quartz 40%; veins and eyes as large as 2 cm, composed of strained quartz grains as large as 1.4 mm. In the narrower veins there is a tendency for quartz to lie perpendicular to the vein walls. In all cases grain margins are sutured. Replacement of quartz by tremolite along grain boundaries is clear in a few places.

Tremolite 20%; acicular crystals with maximum width 0.002 mm and length 0.040 mm are abundant in fine groundmass and sparingly present in coarse quartz. Conclusion that this exceptionally fibrous material is tremolite and not sillimanite is based entirely on an apparent inclined extinction of some 15°. It is too fine to yield conclusive data regarding identity.

Epidote 2%; layers of small crystals with light brown (5YR 5/6) colour and faintly pleochroic.

Sillimanite(?) 3%; nearly square prisms 0.005 mm across distributed throughout thin section but most abundant in epidote-rich layers.

Kaolinite, trace; occurs as dusky clusters in epidote-rich layer.

Iron Oxides, trace; moderate reddish brown (10R 4/6) grains to 0.05 mm. Also occur as abundant dark reddish brown (10R 3/4) inclusions in some quartz.

Hydrate Iron Oxides: light brown (5YR 5/6) stain in some areas.

Structures: This rock appears to be a tectonic breccia composed of angular fragments to 2 cm of tremolite-quartz in a matrix of coarse hydrothermal quartz.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
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Program: Wollex 72/2  
Specimen: R-10  
Location: Not specified

Rock Name: Quartz sericite schist, probably derived from very fine grained impure quartz sandstone.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: moderate yellowish brown (10YR 5/4).  
Lustre: chalky.

##### Fresh Surface:

Colour: dark greenish grey (5GY 3/1).  
Texture: very fine grained.  
Structures: faintly discernible parallel variations in colour.  
These are 1 to 3 mm wide.

#### MICROSCOPIC EXAMINATION

Quartz, 60%; equant grains with maximum size 0.01 mm. Boundaries are obscure but seem to be mosaic.

Feldspar, 3%; occur as subhedral grains in sparse clusters.

Tremolite, 10%; fibrous prisms as large as 0.15 mm but generally smaller. Randomly distributed throughout specimen but is concentrated in lenticules as large as 2 mm x 1.2 cm. Very fine prisms distributed in fine quartz have appearance of sillimanite but wherever character can be established it has inclined extinction.

Sericite, 12%; plates as large as 0.13 mm in clusters as large as 2 mm x 3 mm.

Epidote, 5%; clusters of light olive brown (5Y 5/6), faintly pleochroic grains.

Sphene, 5%; strings of grains, many of them wedge or rhomb shaped less than 0.05 mm long.

Kaolinite, 1%; concentrated in lenticules 0.2 x 3 mm.

Texture and Structure: Components of metamorphic origin are concentrated in augen or in veinlets. Layering which may have been depositional is much deformed in the vicinity of augen.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72/2  
 Specimen: R-11  
 Location: Not specified

Rock Name: Augite porphyry

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: yellowish grey (5GY 8/1) with patches of light greenish grey (5GY 8/1).  
 Lustre: chalky.

##### Fresh Surface:

Colour: dark greenish grey (5G 4/1) grading to light green (5G 7/4) with rectangular patches of greyish purple (RP 4/2).  
 Minerals: pyroxene 30% in very fine matrix; kaolinite abundant.  
 Texture: porphyritic.

#### MICROSCOPIC EXAMINATION

##### Felsic Minerals:

###### Phenocrysts:

Pyroxene, 30%; variety augite, subhedral to euhedral crystals as large as 2.5 mm in clusters as large as 5 mm. Optic character  $+2V = 50-60^\circ$ ,  $Z'Ac = 46^\circ$ . Contains abundant inclusions. Has zoned extinction pattern. Some grains are slightly deformed. Replaced by amphibole along fractures, around grain periphery and in patches within crystals. Replaced by antigorite along other fractures and cleavages.

Groundmass, 70%; appears to be devitrified glass. It now consists of ?feldspar less than 0.003 mm, chlorite and epidote.

##### Secondary Minerals:

Amphibole, 10%; probably tremolite, colourless. Occurs as a replacement around periphery of augite, as replacement in random patches in augite and as deposit with replacement in fractures. Amphibole is replaced by antigorite.

Epidote, 10%; two forms, coarse and fine, both replaced matrix.

Fine 4%, randomly oriented and randomly distributed grains less than 0.1 mm.

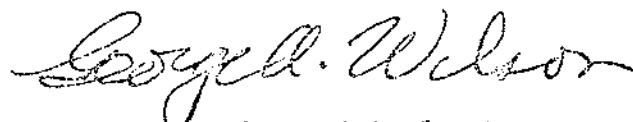
Coarse 6%, euhedral grains as large as .1 mm occurring alone and in clusters. Interference colour ranges from pale blue (5B 5/2) to moderate yellow (5Y 7/6). High positive relief, colourless, low birefringence.

Antigorite, 15%; replaced augite, amphibole and matrix. Most antigorite is in matrix. It occurs as minute fibres with low birefringence.

Kaolinite, 1%; abundant in matrix and is most common along fracture planes in matrix.

Texture: This rock is clearly an augite porphyry, probably a volcanic rock.

Structures: "S" planes marking zones of deformation are abundant in the matrix and notable in the phenocrysts.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
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Program: Wollex 72-2  
 Specimen: R-13  
 Location: Not specified

Rock Name: Plagioclase zoisite hornblende, probably in the greenschist facies.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: greyish olive green (5GY 3/2) flecked with olive black (5GY 2/1) 1 mm and very pale orange (10YR 8/2) to 1 mm.  
 Lustre: chalky.

##### Fresh Surface:

Colour: greyish green (5G 3/2) with flecks to 1 mm of white.  
 Minerals: 60% amphibole, probably hornblende; 40% groundmass, probably epidote-chlorite. Abundant kaolinite.

#### MICROSCOPIC EXAMINATION

##### Feldspar 30%:

Plagioclase, 10%; anhedral grains less than 0.1 mm long, zoned, extensively replaced by zoisite and sericite.

Amphibole 70% hornblende, subhedral, randomly oriented grains with maximum size 0.4 mm.  $Z' \wedge c = 19^\circ$ . Pleochroism  $X'$  = greyish yellow green (5GY 7/2),  $Z'$  = moderate yellowish brown (10YR 5/4),  $Z'$  = moderate yellowish green (10GY 6/4),  $-2V = 60^\circ \pm$ .

##### Accessory Minerals:

Zircon, trace; euhedral grains less than 0.050 mm.

##### Secondary Minerals:

Zoisite, 70%; abundant replacement as clusters of grains in feldspar.  
 Sericite, 5%; flakes and clusters of flakes in plagioclase.  
 Kaolinite 10%; abundant alteration product occurring as small flakes in epidote.

Texture: Entirely crystalline but much altered without preferred orientation of products.

A handwritten signature in cursive script that reads "George A. Wilson".

George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.



Program: Wollex 72-2  
Specimen: R-14a  
Location: Not specified

Rock Name: Epidote-chlorite assemblage of greenschist facies; probably derived from a basic lava.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: pale yellowish brown (10YR 6/2) on surfaces nearly perpendicular to foliation, olive grey (5Y 3/2) on surfaces nearly parallel with foliation.

Lustre: chalky.

##### Fresh Surface:

Colour: greyish green (10GY 5/2) with arc shaped streaks of dusky green (5G 3/2) to 1 cm long.

Minerals: chlorite and kaolinite are both abundant.

Texture: very fine grained.

Structures: fairly well developed schistosity.

#### MICROSCOPIC EXAMINATION

Plagioclase, trace; coarse grains, long, much replaced by chlorite.

Epidote, 60%; euhedral equant 1.5 mm grains with maximum size 0.3 mm.

Chlorite, 20%; plates as large as 0.1 mm but generally smaller distributed throughout rock as well as in 0.2 mm clusters of randomly oriented grains. Pale green, faintly pleochroic in plane polarized light, pale bluish grey interference colour. Chlorite along feathery "S" planes has replaced epidote.

Kaolinite, 15%; abundant dusty flecks throughout specimen.

Carbonate, trace; crystals with maximum size 0.4 mm generally in chlorite clusters.

Sericite, trace; occurs in some chlorite-rich layers.

Texture: very fine grained.

Structures: Wispy slightly wavy streaks of chlorite with fairly well developed, preferred orientation are late and the chlorite-sericite assemblage of which they are composed appears to have replaced the epidote assemblage.

Comment: This is probably a much altered basic lava.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72-2  
Specimen: R-16  
Location: Not specified

Rock Name: Calcite plagioclase assemblage of greenschist facies.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: yellowish grey (5Y 7/2) with small patches of greyish orange (10YR 7/4).  
Lustre: chalky.  
Structures: moderately distinct foliation.

##### Fresh Surface:

Colour: medium bluish grey (5B 5/1) with dark greenish grey (5G 4/1) along fractures and some foliation planes.  
Texture: very fine grained.  
Structures: moderately well developed foliation with pyrrhotite grains strung out along some foliation planes.

#### MICROSCOPIC EXAMINATION

##### Feldspar:

Plagioclase, 15% (Oligoclase An<sub>24</sub>); subhedral grains 0.2 to 0.4 mm long. Randomly distributed but occurring principally in a ground-mass of feldspar grains less than 0.02 mm. All have irregular to sutured boundaries. Where plagioclase is in contact with carbonate it is replaced by carbonate.

##### Calcite, 70%; two size ranges.

Fine carbonate near 0.050 mm. This size is the dominant ground-mass constituent. It is intergrown with traces of tremolite, kaolinite and oxides.

The coarse size ranges from 0.125 to 0.275 mm. These coarser carbonate grains are nearly all deformed. This is shown by bending and disruption of twinning and cleavage planes.

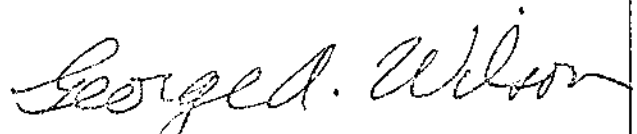
Clay minerals: probably kaolinite, randomly distributed through specimen.

Tremolite, 3%; feathery aggregates in some feldspar.

Opaque minerals: clusters and strings of bleb shaped grains along foliation or sub parallel fracture planes. Such planes are wavy and discontinuous.

Texture: fine grained.

Structures: Within the carbonate-kaolinite groundmass there are orbicular masses of fine plagioclase-actinolite within which are phenocrysts of plagioclase.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollux 72-2  
 Specimen: R18  
 Location: Not specified.

Rock Name: Chlorite schist with quartz-tremolite eyes.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

None on specimen.

##### Fresh Surface:

Colour: dark grey (N3) altered to greenish grey (5GY 6/1) in massive and vein-like areas. Within the greenish grey zones there are wispy patches of light greenish grey (5GY 8/1).

Texture: very fine grained.

Structures: This specimen is from a hard siliceous mass with elliptical cross-section. Its dimensions are 4 cm major diameter x 1.5 cm in minor diameter. The length is unknown but must be in excess of 15 cms.

The enveloping rock is a chlorite schist with abundant kaolinite.

#### MICROSCOPIC EXAMINATION

This section represents a relatively massive hard zone 4 cm x 1.5 cm with a small amount of schist attached to its rim.

Quartz, 70%; anhedral strained grains less than 0.02 mm. Texture is mosaic.

Amphibole Tremolite 28%; feathery, partly radiating aggregates,  $\alpha/\lambda c = 19^\circ$ , colourless. Growth of this mineral appears to be at the expense of quartz. Where radiating clusters are not well developed around the periphery of tremolite masses, quartz grains are visible through tremolite. Where development of radiating clusters is extensive, quartz is not visible.

Opaque Minerals, 2%; rounded to elliptical clusters as large as 0.01 mm of very fine faintly brownish or reddish grains, randomly distributed throughout specimen except in quartz veinlets.

##### Depositional Minerals:

Quartz; euhedral grains grading from 0.1 to 0.2 mm, with poorly developed comb structures in veins. Some are parallel to foliation strained and in lenticular structures, others are transverse

to structure and less strained. Veinlets parallel with foliation occurred during growth of tremolite clusters, but near the end of that period of metamorphism. Quartz veinlets transverse to foliation clearly postdated the quartz veinlets with parallel foliation.

Texture: very fine grained, entirely crystalline.

Structure: This is a very siliceous, lenticular zone within a schist rich in clay minerals.

Adjacent to the principal nodule is a small selvedge of host schist. It is characterized by abundant kaolin and chlorite. It has a good schistosity but is otherwise mineralogically similar to the nodule described. Small similar nodules a few mm long are common within the schist.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72-2  
Specimen: R-19  
Location: Not specified.

Rock Name: Quartz-tremolite nephrite in chlorite quartz tremolite schist.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: pale olive (10Y 6/2) with small patches of light olive (10Y 5/4).  
Lustre: chalky.

##### Fresh Surface:

Colour: greyish green (10G 4/2) with elliptical patches of greyish yellow green (5GY 7/2) and small patches of dusky green (5G 3/2) within the greyish yellow green.  
Minerals: chlorite, kaolinite, tremolite.  
Texture: very fine grained.  
Structures: Strongly schistose hard lenticules ranging from dusky green (5G 3/2) to greyish yellow green (5GY 7/2) and as large as 1 cm x 4 cm.

#### MICROSCOPIC EXAMINATION

Quartz 70%; angular grains ranging in size from 0.005 mm to 0.15 mm. All appear to be angular but this may be partly a result of metamorphism. Long dimensions tend to be subparallel.  
Subrounded to subangular grains as large as 0.2 mm (fine sand) occur in lenticular clusters as large as 1 x 3 mm.

##### Amphibole 20%:

Tremolite 20%;  $Z/A c = 17^\circ$ . Occur as feathery clusters of radiating fibres as long as 0.15 mm. Its abundance ranges from sparse clusters in some quartz rich lenticules to lenticules composed entirely of tremolite.  
Chlorite 10%; abundant as strings oriented flakes in some layers sparse in others.  
Kaolinite 5%; abundant as microscopic flakes in chlorite rich layers.  
Sphene, trace; small crystals in some chlorite rich layers.

Texture: fine to coarse grained.

Structures: Schistosity is well developed in some fine layers, poorly developed in coarser light coloured layers. The central quartz rich part of the thin section is from one of the greyish yellow green (5GY 7/2) layers. It is lenticular in shape, 2 cm in minor diameter, 4 to 10 cm in major diameter and of unknown length.

The matrix is a chlorite-quartz schist derived from an impure fine grained quartz sandstone.

The lenticules range from fine to medium grained quartz to augen quartz. Some consist of quartz with minor tremolite development, others are entirely radiating clusters of tremolite. The composition of the remaining lenticules consists of various proportions of tremolite and quartz.



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GEORGE A. WILSON GEOLOGICAL  
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Program: Wollex 72-2  
Specimen: R-21  
Location: Not specified

Rock Name: Hornblende andesite

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: moderate yellowish brown (10YR 5/4) grading to light olive grey (5Y 5/2).  
Lustre: chalky.  
Structures: 1 fair joint set; 2 poor joint sets.

##### Fresh Surface:

Colour: greyish green (10G 4/2).  
Minerals: Hornblende 60%, light mineral 40%.  
Texture: fine grained.  
Structure: Vague tendency to parallel alignment of hornblende possibly due to flow.



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Program: Wollex 72-2  
Specimen: R-21  
Location: Not specified.

Rock Name:

#### MICROSCOPIC EXAMINATION

##### Primary Minerals:

###### Felsic Minerals:

Feldspar: 40%.

Plagioclase 40%; equant grains 0.03 to 0.06 mm comprising a large proportion of matrix. Too fine grained for precise identification. Extensively replaced by pale green chlorite.

###### Mafic Minerals:

Amphibole 60%, hornblende, euhedral to subhedral crystals ranging from 0.05 to 0.08 mm in diameter and as long as 0.5 mm forming a groundmass. Within these are phenocrysts of similar amphibole as large as 0.3 x 1.5 mm,  $Z' \wedge c = 36^\circ$ , Pleochroic  $X' =$  pale yellowish orange (10YR 8/6),  $Y' =$  light brown (5YR 5/6),  $Z' =$  light brown (5YR 5/6). Hornblende is fresh and unaltered.

###### Carbonate 2%; 2 modes of occurrence, vein and porphyroblastic:

The vein mode consists of linear clusters less than 0.030 mm wide distributed along fractures.

The porphyroblastic mode consists of rounded patches as large as 1 mm with as much as 30% included hornblende. It appears that feldspar and chlorite have been replaced in preference to hornblende.

Kaolinite: scattered dusty material distributed throughout the thin section.

###### Texture: This rock is fine grained and at least partly crystalline.

The groundmass to hornblende may have been partly glass prior to replacement by chlorite. The hornblende has two distinct size ranges. The larger grains are clearly phenocrysts.

Structures: No really distinct structures exist apart from a general poorly developed flow texture with swirls which may be due to intrusion or extrusion.

It has a poorly developed preferred orientation which has swirls and irregularities resembling flow lines in a volcanic rock.

Sphene: trace, anhedral grains less than 0.02 mm in diameter.

Opaque Minerals, trace; bleb shaped to elliptical or rectangular masses as large as 0.06 mm. Random distribution.

Secondary Minerals:

Chlorite, 10%; very pale green replacement of feldspar and matrix.



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Program: Wollex 72-2  
Specimen: R-22  
Location: Not specified

Rock Name: Tremolite-epidote sericite schist.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: greyish green (10G 4/2) grading to greyish green (10GY 5/2).  
Lustre: resinous to chalky.

##### Fresh Surface:

Colour: dominant colour greyish blue green (5G 5/2) with layers of very pale orange (10YR 8/2).  
Texture: very fine grained.  
Structures: The very pale orange streaks are dominantly layers which have been folded into complex shapes. Some of the pale orange streaks are alteration along zones transverse to layering. Layering is continuous through the transverse zones.

#### MICROSCOPIC EXAMINATION

Light Patches: clusters of tremolite or similar amphibole of very fine grain; in radiating, parallel and swirled structures. Individual crystals less than 0.005 mm and too thin to permit measurement of character.

Sericite: flakes and clusters intergrown with some tremolite. Minor.

##### Dark Areas:

Epidote: clusters of randomly oriented grains 0.1 x 0.15 mm. Pale brown in thin section.  
Clusters of epidote envelope the tremolite(?) and tremolite-sericite masses and is in general a swirled matrix to them.

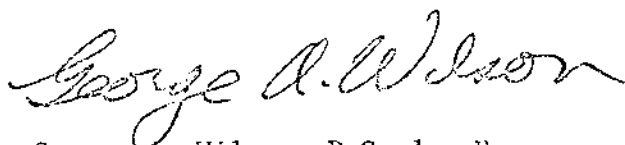
##### Transverse light areas:

Zoisite: Striking blue to purple interference colour. Layers in remainder of rock can be traced through zoisite zones. This alteration appears to have taken place without recognizable fractures. In some cases the zoisite zones bifurcate and wedge out.

Kaolinite: It is abundant throughout.

Sillimanite? Prism shaped crystals with faint brown colour in tremolite-sericite. Extinction is parallel, length is slow.

Birefringence is fairly high. Other optic characters are obscure.

A handwritten signature in cursive script that reads "George A. Wilson". The signature is written in dark ink and is positioned above the printed name and company information.

George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
CONSULTANTS LTD.

Program: Wollex 72-2  
Specimen: R-23  
Location: Not specified

Rock Name: Siltstone

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: dominantly pale yellowish brown (10YR 6/2) grading to light brown (10YR 6/2) and greyish olive (10Y 4/2).  
Lustre: chalky.

##### Fresh Surface:

Colour: dark yellowish orange (10YR 6/6) grading to moderate yellowish brown (10YR 5/4). Within the rock are isolated patches of light bluish grey (5B 7/1).

Texture: very fine grained.

Structures: The small isolated patches of light bluish grey (5B 7/1) are probably remnants of unaltered rock.

#### MICROSCOPIC EXAMINATION

Unaltered Isolated areas considered to be representative of original rock.

Quartz 95%; equant grains less than 0.005 mm forming matrix with coarser grains as large as 0.08 mm.

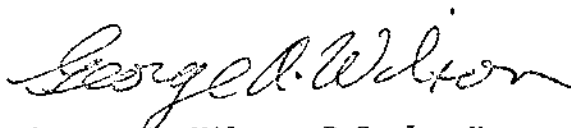
Feldspar 5%; plagioclase as large as 0.1 mm.

Altered areas: Similar to unaltered areas but stained with iron oxides, moderate reddish brown in colour. Veins in altered areas have discontinuous moderate red (5R 4/6) hematite.

##### Depositional Minerals:

Calcite: Both altered and unaltered areas have abundant vein and replacement calcite. Deposition of calcite in veins was accompanied by replacement of walls equal to half the width of the veins on both sides.

This rock is a slightly altered siliceous sediment.



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GEORGE A. WILSON GEOLOGICAL  
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Program: Wollex 72/2  
 Specimen: R-24  
 Location: Not specified

Rock Name: Epidote-albite-chlorite assemblage of the greenschist facies.

#### MACROSCOPIC EXAMINATION

##### Weathered Surface:

Colour: yellowish grey (5Y 7/2) grading to pale olive (10Y 6/2).  
 Lustre: chalky.  
 Structure: schistose host with coarse massive lenticule.

##### Fresh Surface:

Colour: matrix is greyish green (5G 5/2) with angular patches 1 mm to 2 cm long, very pale green in colour (10G 8/2).  
 Minerals: Feldspar, in light masses, chlorite in darker matrix.  
 Texture: matrix and most fragments very fine grained, some fragments coarse grained.  
 Structures: schistosity bends around lenticule of which the part in the specimen is 8 cm x 15 cm and of unknown length.

#### MICROSCOPIC EXAMINATION

Plagioclase 65%; Albite An<sub>0</sub>. Wide range of grain size from 0.05 mm to 1 mm. Plagioclase is all euhedral. Some grains have been bent and fractured. All plagioclase has been partly replaced by actinolite which occurs as randomly oriented acicular grains of great abundance. Vein plagioclase and its actinolite have been deformed into reverse curves by movement along veins.  
 Plagioclase is much kaolinized.

Actinolite, 25%; acicular grains and prisms abundant in plagioclase. Most of it is too fine grained to permit recognition of optic character. Approximate character is  $Z^1 A c = 11^0$ , colourless. Besides its occurrence in plagioclase it occurs in feathery veinlet systems crossing plagioclase veins with deformed actinolite.

Kaolinite 2%; abundant, distributed throughout as submicroscopic grains.

Epidote 5%; equant grains less than 0.01 mm across disseminated in some plagioclase grains.

Texture: medium to fine grained.



Structures: The original rock has been fractured, plagioclase was deposited in a vein system. The whole rock was then subjected to conditions which produced an abundance of actinolite in the plagioclase. It was then deformed again with movement along the earlier plagioclase veins. This resulted in bending of plagioclase and included actinolite.

Deposition of actinolite in feathery veinlet systems is an enigma. The actinolite veinlets appear both to cross plagioclase veins and to be crossed by them.

The thin section is from a feldspar rich segregation in a biotite-albite-epidote mineral assemblage.



George A. Wilson, P.Geol., Eng.  
GEORGE A. WILSON GEOLOGICAL  
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