

MINERALOGICAL REPORT No. 8256
by Alan C. Purvis, PhD

September 02, 2002

TO :

Mr Peter Simpson
Giant's Reef Mining Limited
PO Box 1244
TENNANT CREEK NT 0861

YOUR REFERENCE :

Order No. 200931
(EL8882, Sample Nos. 80585 to 80595)
Order No. 200938
(EL8883, Sample Nos. 80596 and 80597)

MATERIAL :

RC Drill chip samples

WORK REQUESTED :

Thin section preparation, description and report
with comments and interpretations as specified.

SAMPLES & SECTIONS :

Returned to you with this report.

DIGITAL COPY :

Enclosed with hard copy of this report.

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INTRODUCTION

Eleven samples of drill chips from EL8882 (O/N 200931) and two samples of drill chips from EL8883 (O/N 200938) are described in this report from the chips mounted in epoxy and prepared as thin sections. One sample (80595) was also examined in polished section to check for minerals which may contain the chemically anomalous Cu (2000 ppm) and P (2.53%) reported for this sample [but without success].

The locations of the drill holes, other than BBRC-006 are plotted in Fig 1 below. [Drill hole BBRC-006 appears to have been given the wrong co-ordinates in your covering letter, which places it about 616 Km from BBRC016.] The samples are numbered consecutively from 80585 to 80597 and a list of the essential petrography of each sample (as repeats of headers to the individual descriptions) appears in this report after the location Fig 1. These are basically the same as faxed to Giant's Reef, Tennant Creek office 30/8/02.

SUMMARY COMMENTS

Chips from two samples in drillhole BBRC-004 consist of tremolite-actinolite-rich schists with minor chlorite and accessory fine opaque oxide and these are interpreted to be primarily of ultramafic origin (metapyroxenite?). Chips in the adjacent hole BBRC010, (2 samples) consist of quartz-biotite-plagioclase schist and microcline-biotite-schist, representing metasediments partly with potassium enrichment and an attenuated quartz fabric suggesting some shearing. These metasediments may be related to metasandstones described in Pontifex Report No. 8158.

Igneous lithologies are more abundant in the southern area (BBRC12-016). Dacite porphyry occurs in BBRC-012 and 014, tonalite and altered plagioclase-porphyritic volcanic in BBRC-013, and pyroxene \pm plagioclase-porphyritic lavas and breccias in BBRC-015-016. The lava in BBRC-015 has abundant actinolite and albite/sericite-altered plagioclase as well as disseminated leucoxene. The breccia in BBRC-016 has abundant epidote with various amounts of actinolite, albite and calcite. These lavas may relate to the more pyroxene-rich ankaramites and picrites described in Pontifex Report No. 8142, with similar metamorphism and alteration.

The lithologies in BBRC-006 have supergene alteration, with limonite in two samples and supergene or low-temperature hydrothermal quartz in the other. One sample 80595 from BBRC-006, 75-76m, has reported 2,000ppm Cu and 2.53% P. No minerals containing Cu or P were located in the thin section or the polished section of this sample, but possibly relevant comments follow. All chips examined from 80595 consist of massive earthy to microcrystalline limonite which appears to have invaded and largely replaced a very fine grained extensively altered metasediment, most recently of microdecussate clays with randomly scattered silt to fine sand size quartz grains, and lesser mica flakes. There are rare veinlets of microcrystalline quartz and of relict possible leached and ferruginised carbonate, also small interstitial fillings of 'exotic' clay and silt. There are no diagnostic textures indicating any specific genesis, but an intensely altered and weathered fine grained metasediment is possible. If both the anomalous Cu and P were to occur in the same phase, then the coloured secondary Cu-phosphate minerals may be suspected, with excess P (relative to Cu) in possible Fe-phosphate minerals or apatite? Such minerals were not seen (but may be too fine and totally camouflaged by limonite to allow optical recognition). Resampling and re-assaying may be considered as a follow-up check on the current determinations.

There are no samples described in this report that would seem to relate to those described in Pontifex Reports Nos. 8124 or 8246 as questioned in the letter accompanying these samples.

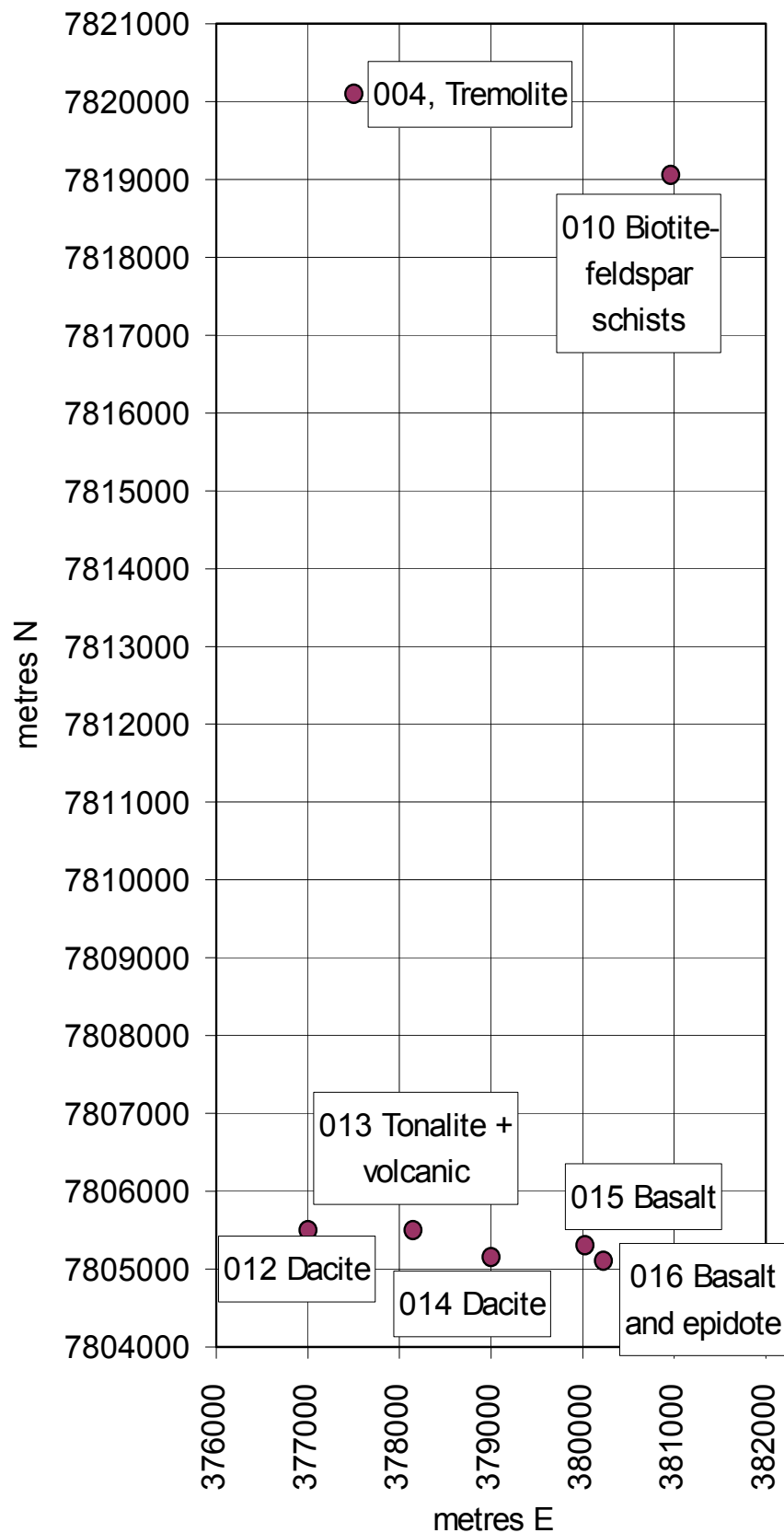


FIG 1: DISTRIBUTION OF DRILLHOLES BBRC004, 010 AND 012-016, REPORT NO. 8256

TABLE 1: SUMMARY OF HEADERS TO EACH PETROGRAPHIC DESCRIPTION

80585 BBRC-004, 47-48m	Tremolite-actinolite-chlorite schist with clays and limonite possibly after metamorphic olivine, lenses of possible ilmenite and areas flooded by hematite: metamorphosed ultramafic rock.
80586 BBRC-004, 52-53m	Tremolite-actinolite schist with minor chlorite and opaque oxide: metapyroxenite?
80587 BBRC-010, 47-48m	One small chip of tremolite-actinolite-chlorite schist. Numerous chips of quartz-plagioclase-biotite schist with very strong quartz fabrics and sericitised plagioclase. Two chips of quartz-biotite-muscovite schist with layer-parallel quartz veins or with quartz-microcline layers. Two chips of quartz-muscovite-biotite schist and one of muscovite-biotite-microcline schist. Almost all metasediment, probably amphibolite facies.
80588 BBRC-010, 58-60m	Quartz-biotite-plagioclase, biotite-plagioclase and biotite-microcline-plagioclase \pm quartz schists, rarely with muscovite, locally with layer-parallel quartz veins: amphibolite-facies metasediments.
80589 BBRC-012, 64-66m	Albitised and sericitised dacite porphyry, with altered biotite in chips with fine-grained groundmasses. Minor quartz veinlets, also fractures with fine quartz, albite or K-spar.
80590 BBRC-013, 56-66m	Chips of variable composition : <ol style="list-style-type: none"> 1. Altered biotite tonalite with sericite, hematite, chlorite and clays 2. Brecciated granitoid flooded by clay and possible granitoid with abundant secondary K-spar 3. A sericite-chlorite-hematite-leucoxene-K-spar-altered lithology, possibly sheared and extensively altered intermediate or mafic volcanic rock.
80591 BBRC-014, 56-60m	Albite-sericite-clay-chlorite-limonite-leucoxene-altered dacite or dacite porphyry (with less abundant quartz phenocrysts compared to the porphyry in BBRC-012).

80592 BBRC-015, 70-72m	Pyroxene ± plagioclase-porphyritic basalt with alteration involving albite-smectite-limonite-leucoxene. Veins contain clay, quartz and sparse limonite after sulphide.
80593 BBRC006, 45-46m	Limonite-rich chips, with minor microcrystalline or very fine-grained scattered quartz ± rare sericite in vague layers. Interpreted as weathered largely fine-grained sediments or metasediments?
80594 BBRC-006, 60-61m	Massive to vaguely fine layered, cryptocrystalline to microcrystalline fibrous and locally microsparry (cherty) quartz. Probably of unspecified supergene or low-temperature hydrothermal origin. Rare limonite after pyrite and crystalline cavities, partly filled by limonite (primary or derived from carbonate?).
80595 ** BBRC-006, 75-77m	Chips of massive extremely fine limonite replacing a possible totally clay-altered very fine metasediment. Rare residual veinlets of quartz and of possible relict fine carbonate. Reported to be anomalous in Cu and P, but no minerals containing these elements were seen.
80596 BBRC-016, 47-48m	Partly weathered mafic lavas, with plagioclase and mafic phenocrysts, xenolithic vesicles, and cloudy actinolite-albite-sericite-leucoxene alteration.
80597 BBRC-016, 52-54n	Brecciated probable mafic lava, with extensive alteration to clouded epidote, actinolite, albite, limonite and calcite. Cut by limonite-filled micro-fractures and carbonate stringers.

** If the reported Cu (2000ppm) and P (2.53%) were to occur together in the one phase, then possible minerals could include turquoise $[\text{CuAl}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 5\text{H}_2\text{O}]$, pseudomalachite $[\text{Cu}_5(\text{PO}_4)_2(\text{OH})_4]$ and cornetite $[\text{Cu}_3\text{PO}_4(\text{OH})_3]$, but with excess phosphorus (a relative to Cu) possibly in apatite or in iron-bearing phosphates such as vivianite $[\text{Fe}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}]$ or vauxite $[\text{FeAl}_2(\text{PO}_4)_2(\text{OH})_2 \cdot 5\text{H}_2\text{O}]$. No such coloured Cu-phosphates were seen in these chips however. Fe-rich phosphates may be extremely fine and camouflaged by the dominant limonite throughout these chips, but probe analysis would be required to investigate this.

INDIVIDUAL DESCRIPTIONS

80585
BBRC-004, 47-48m **Tremolite-actinolite-chlorite schist with clays and limonite possibly after metamorphic olivine, lenses of possible ilmenite and areas flooded by hematite: metamorphosed ultramafic rock.**

Field Note: *Fine dark metamorphic*

The eight chips included in this thin section are largely composed of inequigranular tremolite-actinolite, from 0.1 to 1mm in grainsize, poorly oriented in some chips but strongly schistose in others. Most of these have a single schistosity, but a weak second schistosity is evident in one or two chips. Minor chlorite is disseminated (5-15% in the various chips) and is usually schistose. One chip also has patches altered to clay, possibly derived from metamorphic olivine, to 4mm in diameter. These areas also contain limonite-filled fractures, with other areas flooded by earthy hematite in lamellae parallel to the foliation. Attenuated lenses of black fine-grained opaque oxide, possibly ilmenite, to 1mm long and parallel to the main schistosity or to the second schistosity, where this is present. These opaque oxide lenses form up to 5% of some chips.

The original lithology was probably of ultramafic origin, possibly a pyroxenite.

80586 **Tremolite-actinolite schist with minor chlorite and opaque**
BBRC-004, 52-53m **oxide: metapyroxenite?**

Field Note: *Fine dark metamorphic*

Twelve chips of tremolite-actinolite-rich schist in this thin section are similar to those in the previous sample with some chips having poorly oriented amphibole and others having a strong schistosity. Some of the chips are fine-grained throughout, but others are inequigranular, with amphibole from <0.05mm to ~1mm in different areas. Chlorite is less abundant compared with the previous sample, with less than 5% chlorite in any one chip, but areas rich in opaque oxide (hematite ± ilmenite) are more widespread.

These chips are also interpreted to have an ultramafic origin, with pyroxenite as the most likely protolith. (A former impure dolomite is less probable.)

80587	One small chip of tremolite-actinolite-chlorite schist.
BBRC-010, 47-48m	Numerous chips of quartz-plagioclase-biotite schist with very strong (attenuation) quartz fabrics and sericitised plagioclase. Two chips of quartz-biotite-muscovite schist with layer-parallel quartz veins or with quartz-microcline layers. Two chips of quartz-muscovite-biotite schist and one of muscovite-biotite-microcline schist. Almost all metasediment, probably amphibolite facies. Attenuated quartz fabric suggests shearing.

Field Note: *Quartz-biotite schist*

There is a single small chip of tremolite-actinolite schist in this thin section, but most of the samples are metasediments. The tremolite-actinolite schist is similar to the more schistose chips in the previous two samples, with 2-3% chlorite but no opaque oxide. There are several types of metasediment, however.

The most common lithology, represented by numerous chips, is metasediment with abundant quartz and sericitised probable plagioclase as well as 10-15% altered schistose biotite. The altered plagioclase seems to have been from 0.1 to 0.4mm in grainsize in different layers, with quartz 0.2 to 0.8mm in grainsize, partly as grains elongate parallel to the schistosity. Many of these chips seem to have two schistosities at 20-30° to each other, including a crenulation cleavage affecting the first schistosity. The biotite is commonly parallel to the crenulation cleavage, but the quartz lamellae are parallel to both schistosities. In six or seven chips the quartz c-axes are aligned at a low angle to these foliations, but in three others the quartz c-axes are at a high angle to the foliations. One chip has relatively coarse-grained brown tourmaline and apatite, suggesting that the grainsize has been reduced during metamorphism. Finer-grained tourmaline in other chips is mostly green and may be of authigenic origin. One chip has a single small grain of garnet.

One chip has lamellae of altered schistose biotite, less abundant schistose muscovite and minor sericitised plagioclase, similar to that in the chips described above, with abundant quartz veins to 1mm wide parallel to the schistosity. A layer of similar quartz-biotite-muscovite schist occurs in a second chip, without quartz veins but passing into a lithology with lamellae of quartz and minor microcline, alternating with layers of biotite schist

There are also two chips with about 25% muscovite as flakes to 1mm long aligned parallel to the first schistosity, with a crenulation cleavage at about 25° to the main schistosity. These chips have less abundant disseminated quartz than the more abundant muscovite-free chips, with correspondingly more biotite and altered plagioclase. Narrow quartz veins, to 0.2mm wide, are parallel to the first schistosity and have been crenulated. A third chip has abundant muscovite, as seen in the two chips described above, and in a band of pure muscovite 1mm wide. This chip also has lamellae of altered schistose biotite, but instead of quartz and altered plagioclase this chip has abundant fine-grained microcline, to 0.4mm in grain size (40%), suggesting potassium metasomatism.

80588 **Quartz-biotite-plagioclase, biotite-plagioclase and biotite-**
BBRC-010, 58-60m **microcline-plagioclase ± quartz schists, rarely with**
muscovite, locally with layer-parallel quartz veins:
amphibolite-facies metasediments.

Field Note: *Quartz-biotite schist?*

This sample again has a number of chips of quartz-biotite-plagioclase schist containing sericitised plagioclase. In these the quartz is partly disseminated and partly in layer-parallel quartz veins from 0.2 to 1.5mm wide, but the quartz fabric is not as well-defined as in the previous sample. One chip has been cut parallel to the schistosity but has a diffuse compositional layering and has biotite flakes elongate in a parallel arrangement, apparently defining a lineation within the schistosity. The quartz c-axes in this chip are parallel to the layering and at a high angle to this apparent lineation. The same chip has a zoned zircon fragment 0.3mm in diameter, suggesting that its grain size may have been reduced during metamorphism.

One chip has a layer composed largely of schistose biotite, totally sericite-altered plagioclase and very minor muscovite as unoriented flakes. This layer is in contact with a layer rich in schistose biotite and granular microcline (55%) as well as minor sericitised plagioclase. Other chips in this sample have microcline and schistose biotite as the main components, with or without quartz and/or altered plagioclase. These chips are laminated with biotite-plagioclase and microcline-rich layers, but in some chips the schistosity is at 25° to the layering.

80589
BBRC-012, 64-66m **Albitised and sericitised dacite porphyry, with altered biotite in chips with fine-grained groundmasses. Minor quartz veinlets, also fractures with fine quartz, albite or K-spar.**

Field Note: *Felsic porphyry*

The chips in this sample contain or consist of large phenocrysts, including albite ± sericite-rich altered plagioclase phenocrysts to 6mm long and highly embayed quartz phenocrysts to 4mm long. Minor to abundant groundmass material is mostly fine-grained and quartzofeldspathic, with quartz and altered plagioclase as well as clay-limonite-altered biotite and limonite-filled fractures. Two chips contain or consist of coarser groundmass material, with quartz and largely albitised plagioclase to 0.25mm in grain size, with albitised plagioclase phenocrysts in one of these chips. These chips seem to represent dacite porphyry.

One chip is composed of inequigranular vein-quartz, with cherty fine-grained areas and areas of coarse granular to prismatic quartz. Narrow fractures in other chips seem to contain quartz, albite or K-spar in different areas.

80590

Chips of variable composition :

BBRC-013, 56-66m

- 1. Altered biotite tonalite with sericite, hematite, chlorite and clays**
- 2. Brecciated granitoid flooded by clay and possible granitoid with abundant secondary K-spar**
- 3. A sericite-chlorite-hematite-leucoxene-K-spar-altered lithology, possibly sheared and extensively altered intermediate or mafic volcanic rock.**

Field Note: *Basic Volcanic?*

There are several lithologies in this sample. Although some seem to be related, the other is extremely altered and difficult to interpret.

The most abundant lithology is a granitoid with abundant red-stained, sericitised plagioclase, with or without albite, generally euhedral and about 2-5mm in grain size. There is also abundant interstitial quartz to 3mm in grain size and disseminated altered biotite to 1mm in grain size, altered to chlorite and/or clay (vermiculite?). Very minor (5-7%) microcline is present as interstitial grains to 2mm in diameter. Apatite occurs as prisms to 0.4mm long, with rare zircon to 0.3mm long but less than 50µm wide. This lithology has about 30% quartz and is probably an altered tonalite. One chip has fragments of quartz and red-stained, altered plagioclase in a matrix of mustard-yellow clay, possibly smectite, as well as abundant limonite-filled fractures. Another chip has red hematite-clay-altered plagioclase laths to 2mm long in a porous matrix largely composed of secondary K-spar, possibly adularia, with irregularly disseminated quartz and oxidised opaque oxide. Orange clays have replaced minor biotite in this chip. This may also represent an altered granitoid.

The other main lithology has massive sericite replacing what may have been plagioclase phenocrysts, from 1 to 4mm long in one chip and as much as 8mm long in the other. These are enclosed in a mass of sericite ± limonite ± microcrystalline quartz, with disseminated former biotite flakes, to 0.6mm long, altered to chlorite or clay, ± sericite, and leucoxene. Small opaque oxide grains occur, now altered to leucoxene, and irregular lenses rich in granular K-spar, possibly microcline or adularia, are present. This lithology has no primary quartz and may represent a plagioclase-porphyritic mafic or intermediate volcanic rock or a shallow intrusion.

80591	Albite-sericite-clay-chlorite-limonite-leucoxene-altered
BBRC-014, 56-60m	dacite or dacite porphyry (with less abundant quartz phenocrysts compared to the porphyry in BBRC-012).

Field Note: *Possibly a basic tuff?*

These chips have minor (5%) scattered quartz phenocrysts to 1.5mm in diameter, partly angular and subhedral, partly rounded and resorbed, occurring singly or in small aggregates. Altered plagioclase phenocrysts are far more abundant (35% of each chip) and much larger, to 6mm long. These have been altered to albite and also have minor chlorite and minor to abundant clouded sericite. Some of the chips have clays, limonite and leucoxene after aggregates of fine decussate biotite, apparently replacing mafic phenocrysts (5%). In several chips there are lenses of clays of this type defining a foliation and these pass into anastomosing limonite and clay-filled fractures also defining a foliation. Accessory apatite occurs largely in the clay aggregates and there are accessory microphenocrysts of opaque oxide, partly altered to leucoxene. The bulk of the groundmass areas are composed of a plagioclase-rich quartzofeldspathic micromosaic with abundant clays in many chips, but with very few clays in at least one chip. There are also irregular narrow quartz veins, partly extensional and partly related to shearing.

The overall mineralogy indicates a dacite or dacite porphyry, with fewer quartz phenocrysts compared to the porphyry in BBRC-012.

80592 **Pyroxene \pm plagioclase-porphyritic basalt with alteration**
BBRC-015, 70-72m **involving albite-smectite-limonite-leucoxene. Veins**
 contain clay, quartz and sparse limonite after sulphide.

Field Note: *Intermediate Volcanic*

These chips are all altered/weathered with minor to abundant altered phenocrysts, mostly less than 1mm long, largely altered to smectite, but some albitised plagioclase phenocrysts occur in one chip. One chip has an altered phenocryst composed of microcline and smectite, adjacent to a clay-filled vein, suggesting that the microcline is secondary. The smectite seen in this thin section is most commonly derived from amphibole, but any amphibole in this sample may have formed from former pyroxene. Some of the chips have abundant fine-grained albitised plagioclase in the groundmass, mostly unoriented, as well as clays, limonite and leucoxene, but most are poor in, or lack, albite. The abundance of disseminated leucoxene suggests a reasonably titaniferous lithology, such as basalt, rather than an intermediate volcanic as suggested in your notes.

One chip has a vein with minor quartz in massive smectite possibly derived from chlorite. Veins containing clays, quartz and sparse limonite, possibly after sulphide, occur and there are small, deformed quartz-rich chips that may represent silicified material that has been sheared. Overall, the major lithology represented is interpreted as pyroxene (\pm plagioclase)-porphyritic basalt.

80593
BBRC-006, 45-46m **Limonite-rich chips, with minor microcrystalline or very fine-grained scattered quartz ± rare sericite in vague layers. Interpreted as weathered largely fine-grained sediments or metasediments?**

Field Note: *Ferruginous sediment*

The ten small chips that make up this thin section consists very largely (90%) of opaque limonite, which is seen to have various micro textures in low-angle incident light. Several chips have minor (5-10%) fine quartz, mostly <0.1mm and which may be microcrystalline and/or fine detrital, disseminated or in small aggregates, some in poorly defined layers. Lesser somewhat coarser quartz grains (to 0.6mm in grainsize) are also scattered. The larger grains are commonly irregular and may be from veins, but may have been etched during weathering. Traces of sericite occur with the very fine-grained quartz, suggesting former silty sediments or metasediments, but the original lithologies represented by the other chips are uncertain. These chips may therefore represent ferruginised, but not necessarily originally iron-rich, metasediments.

80594
BBRC-006, 60-61m **Massive to vaguely fine layered, cryptocrystalline to microcrystalline fibrous and locally microsparry (cherty) quartz. Probably of unspecified supergene or low-temperature hydrothermal origin. Rare limonite after pyrite and crystal-lined cavities, partly filled by limonite (primary or derived from carbonate?).**

Field Note: *Chert or quartzite?*

These chips are composed of quartz and very minor limonite. In several chips nearly all of the quartz is cryptocrystalline to microcrystalline, with bands defined by cryptocrystalline limonite in one chip, and small lenses of slightly coarser quartz in others. Other chips have lenses or pellets of clouded crypto-crystalline quartz, from 0.5 to 2mm long, separated by areas of fibrous or microgranular to microsparry quartz mosaic, locally as 'dog-tooth' spar. Minor small cavities in some chips are lined by similar micro-'dog-tooth' spar quartz, locally with rims of chalcedony, and there is rare limonite after pyrite cubes to 0.3mm long. In one chip there are larger crystal-lined cavities, to 5mm or more in length, filled by limonite. The limonite may be a primary infill or could be after carbonate.

Silica with these textures may be regarded to have a supergene or low-temperature-hydrothermal (?epithermal) origin, but the objective microscopy of isolated samples cannot really be more specific.

80595
BBRC-006, 75-76m **Chips of massive extremely fine limonite replacing a possible totally clay-altered very fine metasediment. Rare residual veinlets of quartz and of possible relict fine carbonate. Reported to be anomalous in Cu and P, but no minerals containing these elements were seen.**

Field Note: *Dark fine-grained sediment? Has 2,000ppm Cu and 2.53% P.*

Four chips examined in thin section show massive opaque, extremely fine supergene limonite, with rare quartz, stringers in one chip and minor interstitial clay-silt filling in some more voids i.e. negligible information is offered in thin section.

Reflected light microscopy of another four of these chips examined in polished section, confirms the ubiquitous compact, extremely fine (opaque) earthy to cryptocrystalline limonite (± hematite). Microtexture is recognised within the limonite however (which cannot be seen in transmitted light).o Basically, it is massive but extremely fine decussate, suggesting pervasive supergene ferruginisation of pre-existing clays with the same texture. This forms a matrix (70%) to minor chaotically scattered, very small angular quartz grains (20%) of silt to fine sand size, and minor minute micas locally vaguely laminated. This lithology may be interpreted therefore as an intensely clay-altered (deeply weathered) pre-existing fine grained (?meta) sediment.

Variations to the above are :

1. In some areas, up to 80% in one chip, quartz grains are nil or negligible, with decussate fabric in limonite is slightly coarser, with more interstitial microporosity and in isolation could be objectively considered as intensely ferruginised, massive micro-amphibole aggregate. There is no real basis for proving or extending this interpretation, however.

2. One vein, to 0.5mm wide, has relict boxwork/replica, with a geometry suggesting former carbonate, but without apparent associated relict minerals (which could be considered as “mineralisation” for example).

If the reported anomalous Cu (2000pm) and P (2.53%) were to occur together in the one phase, then possible minerals could include turquoise $[\text{CuAl}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 5\text{H}_2\text{O}]$, pseudomalachite $[\text{Cu}_5(\text{PO}_4)_2(\text{OH})_4]$ and cornetite $[\text{Cu}_3\text{PO}_4(\text{OH})_3]$, but with excess phosphorus (a relative to Cu) possibly in apatite or in iron-bearing phosphates such as vivianite $[\text{Fe}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}]$ or vauxite $[\text{FeAl}_2(\text{PO}_4)_2(\text{OH})_2 \cdot 5\text{H}_2\text{O}]$. No such coloured Cu-phosphates were seen in these chips however. Fe-rich phosphates may be extremely fine and camouflaged by the dominant limonite throughout these chips, but probe analysis would be required to investigate this.

80596 **Partly weathered mafic lavas, with plagioclase and mafic**
BBRC-016, 47-48m **phenocrysts, xenolithic vesicles, and cloudy actinolite-**
albite-sericite-leucoxene alteration.

Field Note: *Basic volcanic?*

Up to 15% of these dark chips consist of uralitic amphibole, locally replaced by smectite, replacing scattered primary phenocrysts of clinopyroxene to 3mm long. Rarer plagioclase phenocrysts (3%), to 2mm long, have been replaced by sericite \pm albite. Clouded aggregates of amphibole and albite possibly fill vesicles (5-7%). Small aggregates of composite uralitised pyroxene (partly altered to smectite) and albitised plagioclase seem to represent xenoliths.

The groundmasses are rich in clouded extremely fine actinolite and leucoxene, with lesser sericite in interstitial areas, apparently derived from plagioclase. Early threads and stringers with actinolite and smectite are cut by later micro-fractures, largely filled by probable adularia.

These chips represent altered pyroxene and plagioclase-porphyritic mafic lavas as described in previous reports on samples from this area.

80597
BBRC-016, 52-54m **Brecciated probable mafic lava, with extensive alteration to clouded epidote, actinolite, albite, limonite and calcite. Cut by limonite-filled micro-fractures and carbonate stringers.**

Field Note: *Felsic volcanic?*

The chips in this sample seem to represent breccias with millimetre to centimetre-scale clasts altered to clouded very fine to fine-grained epidote. Some clasts have clear granular epidote patches apparently replacing phenocrysts, but it is not entirely clear whether the original phenocrysts were plagioclase or pyroxene. Some seem to have been pyroxene, however, and more obvious small plagioclase phenocrysts have been replaced by albite with minor epidote, actinolite and limonite. Irregular limonite-filled microfractures are abundant in many of the fragments.

Minor local interstitial areas are rich in granular to prismatic epidote, with minor to abundant albite, actinolite or quartz. In some chips the interstitial material is largely granular albite with less abundant granular to prismatic epidote, but in others epidote is more abundant, with minor to abundant actinolite and/or with common to abundant calcite.

One chip has parallel stringers of granular and fibrous carbonate, separated by lamellae of limonite.

The clouded nature of the epidote makes specific identification of any leucoxene quite difficult. Some of this clouding must surely be dispersed leucoxenitic dust, and considered together with the other gross mineralogy, a brecciated mafic volcanic would seem to be the most likely protolith.