

**MINERALOGICAL REPORT No. 8042**

*by Ian R. Pontifex MSc.*

30 October, 2000

**TO :**

Mr Steve Harrison  
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WAYVILLE SA 5034

**COPY TO :**

Ms Fran Parker  
North Flinders Mines Ltd  
27 Greenhill Rd  
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**YOUR REFERENCE :**

Order No. 30000963210 (part)

**MATERIAL :**

31 Drill chip samples, Arthur Hill Project  
Prospects : Baron, Kaiser, Feral.

**IDENTIFICATION :**

Thin section Nos. P06671 to P06681  
P06881 to P06900

**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

The drill chip samples petrographically described in this report is part of original order 3000093210, which covered 52 samples of drill chips submitted by Steve Harrison, from Arthur Hills and Tanami South Projects. Recent Pontifex Report No. 8028 (7/10/00) petrographically describes 21 samples of this batch from the Atlee Creek Prospect.

The remaining 31 samples discussed in this report are from Arthur Hills Project, involving three different Prospects as listed below (and not with consecutive thin section numbers or sample numbers).

<b>T.S. number (Sample Number)</b>	<b>Prospect</b>
P06671 to P06672 (2) (5308405 to 5308393)	Feral
P06673 to P06681 (9) (5308647 to 5308853)	Baron
P06881 to P06889 (9) (5308029 to 5308239)	Kaiser
P06890 to P06892 (3) (5308357 to 5308446)	Feral
P06893 to P06895 (3) (5308479 to 5308563)	Kaiser
P06896 to P06900 (5308634 to 5308693)	Baron

## **INITIAL ASSESSMENT AND EXPLANATION OF PETROGRAPHIC PRESENTATION**

An initial petrographic scan of these 31 thin sections indicates that the majority of the samples (22) represent superficial overburden material, basically as unlithified quartz-feldspar-rich sands with a supergene kaolin matrix (cement). This material consists of abundant grains of unsorted fine to coarse sand size, mostly as angular to subangular and single crystal grains of quartz, co-dominant to sub-dominant to minor microcline, rarer plagioclase. Accessory grains of tourmaline, muscovite and opaque oxides are widespread. These grains are all randomly disposed through and supported by a cement or matrix of supergene kaolin  $\pm$  limonite of variable intensity. This material has no coherent fabric.

These sand grains appear to have derived from regolithic "granitoid" bedrock. Indeed, six samples are identified to represent in-situ granitoid bedrock, some surprisingly fresh, but others deeply weathered with former feldspars and micas completely kaolinised and occurring between quartz residuals and with a relict primary crystalline fabric preserved. It is not always clear if these "granitoids" are primary-igneous or gneissic meta-igneous or metasediments. [Granitoid bedrock is seen more abundantly in samples from Atlee Creek.]

Perhaps surprisingly, most of the feldspar grains in the cover material are very fresh, together with resistate accessory minerals. Minor relatively early generation lateritic pellets, also locally have a random distribution within the limonitic kaolin cement or matrix and some whole chips which are extensively ferruginised are basically laterite. Some of this kaolin cement/matrix shows textural evidence of (supergene) migration, but most is essentially structureless, massive, cryptocrystalline to amorphous. Massive cryptocrystalline secondary carbonate (calcrete) cement/matrix occurs in one sample TS No. P06888.

Four samples are dominated by coarse quartz chips, which may be derived from hydrothermal (?or metamorphic) vein quartz, now as residuals in overlying cover. Several of these quartz-rich samples however have protomylonitic fabric  $\pm$  feldspar, and are listed below as sheared and recrystallised quartzites or quartz-rich quartz-enriched granitoid.

Given the relative persistence and similarity of the most abundant unlithified clay-rich sand and their common genetic interpretation as transported unlithified sandy overburden, the petrography requested is presented in tabular format, Table 1. This lists the relative abundances of the components, and an indication of size of the residual grains. Several representative photomicrographs are also provided to illustrate these characteristics. The several samples of in-situ regolithic bedrock, and of the minor 'fresh' quartzose-rich bedrock lithologies are also briefly described and incorporated (in order of the thin section numbers sequence) within the same Table 1. Several photo-micrographs of those are also appended.

**TABLE 1 : SUMMARY, ESSENTIAL PETROGRAPHIC CHARACTERISTICS OF DRILL CHIP SAMPLES REPRESENTING "TRANSPORTED OVERBURDEN" FROM PROSPECTS FERAL, BARON, KAISER, ARTHUR HILLS PROJECT, ALSO OF SEVERAL SAMPLES OF IN-SITU REGOLITHIC BEDROCK. [LISTED IN CONSECUTIVE ORDER OF THIN SECTION NUMBERS P06671 TO P06681 AND P06881 TO P06900.]**

T.S. No.	Matrix/ cement of kaolin Vol %	Major grains within matrix/cement						Accessory resistate grains	Comment
		Size (mm) range and average	qtz %	K-spar %	Plag %	Detrital Muscovite %	Other %		
P06671	Not transported overburden as defined, but consists of three chips of coarse to very coarse hydrothermal quartz with minute fluid inclusions, also rare small inclusions of tourmaline and muscovite.								
P06672	25 limonitic	0.1 to 3 av. 0.5	30	30	5	7	composite feldspar-qtz 10	* t, ox	
P06673	35 limonitic	0.1 to 3 av. 0.25	30	25	5	4	composite feldspar qtz <5	t, ox	finer, better sorted equivalent of 672
P06674	40-60 mostly lateritic minor kaolin	0.1 to 1.5 av. 0.2	15-20	nil	nil	5	early laterite nodules in later laterite cement	t, ox	essentially laterite
P06675	Completely weathered/supergene-altered in-situ bedrock (regolith). No quartz. Essentially smectite ± carbonate replicas after coarse random former amphibole or pyroxene, within a matrix of ultrafine, indefinite kaolin-minor admixed carbonate replacing ex-plagioclase. Veinlets of supergene carbonate, accessory disseminated opaque oxides, with original primary distribution seen in polished section to be oxidised primary magnetite. Interpreted as an <b>original dolerite</b> (undeformed) completely supergene-altered.								
P06676	Intensely ferruginised massive kaolinitic rock, minor scattered fine residual micas, including fine decussate masses, nil/negligible quartz. Basically <b>laterite</b> . Not within "normal" sandy overburden, but possibly a lateritised <b>ferruginised supergene clay layer</b>								
P06677	In-situ bedrock (regolith). Massive medium to coarse grained granular aggregate of primary or metamorphic quartz mosaic (50-60%), minor random muscovite and oxidised biotite (10-15%), minor completely kaolin-altered felspar, in one chip up to 10%. Accessory tourmaline, trace zircon. <b>Possible granitoid</b> but fibrous sillimanite in quartz in one chip to suggest a <b>possible high grade metasediment</b> . [No equivalent elsewhere in this Baron Prospect suite, but may compare with P06682 at Atlee Creek].								

\* t = tourmaline

ex = opaque Fe-oxide grains

z = zircon

T.S. No.	Matrix/ cement of kaolin Vol %	Major grains within matrix/cement						Accessory resistate grains	Comment
		Size (mm) range and average	qtz %	K-spar %	Plag %	Detrital Muscovite %	Other %		
P06678	kaolin matrix in two chips, 60% laterite matrix in one chip, 55%	0.2 to 1 av. 0.4	35	nil	nil	1-2	includes early regolithic clay fragments, in later kaolin matrix	t, ox	
P06679	80-85	0.1 to 2.5 av. 0.8	15-20	nil	nil	nil	-	nil	very extensive (clear) kaolin matrix (of several generations). Included quartz grains very corroded.
P06680	70-80	0.1 to 1 av. 0.5	25-30	nil	nil	nil	-	t, ox	cf 679 but more qtz grains, less kaolin matrix
P06681	25 coarse decussate limonitic (ex- micaceous)	0.1 to 2.5 av. 1.0	50 many grains composite	nil	nil	10-15	-  high concentration of quartz and muscovite (now kaolinised).	t, ox	Probably very close to bedrock, but ex-felspar completely altered.
P06881	40 limonitic	0.1 to 1 av. 0.35	40	5-7	1-2	3-5	5% qtz-muscovite composites  5% laterite particles	t, ox	oxide grains variably limonitic/ leucoxenitic, hematitic
P06882	10-15 limonitic	0.1 to 1.5 av. 0.5	60	15	5	3	5% fragments of sericite	t, ox	kaolin cement notably minor

T.S. No.	Matrix/ cement of kaolin Vol %	Major grains within matrix/cement						Accessory resistate grains	Comment
		Size (mm) range and average	qtz %	K-spar %	Plag %	Detrital Muscovite %	Other %		
P06883	15 to 60	0.1 to 0.8 av. 0.5	10-50	5-15	1-5	5-30 fine in matrix		t, ox	2 chips, very 'silty' kaolin, also fine muscovite- rich. One chip like 882
P06884	20	0.1 to 2.5 av. 0.5	40	35	5	2	5% quartz-sericite fragments	t, ox	anomalously felspar-rich. Sericate alteration in some coarse quartz may be hydrothermal
P06885	One chip of <b>overburden</b> : same as 881 abundant residual angular quartz grains in kaolin cement which is quite intensely limonitised. Two chips of <b>coarse "vein-quartz"</b> apparently hydrothermal, randomly inequigranular, microbrecciated, strongly stressed and irregularly recrystallised, incorporating minor, shredded-schistose fine muscovite.								
P06886	30 limonitic	0.1 to 2.5 av. 0.5	50	15	3	3	5% sericitic fragments, qtz- muscovite composition	t, ox	
P06887	40-50 limonitic	0.1 to 1 av. 0.4	40	10-15	5	1-2	-	t, ox	
P06888 ONE CHIP	15 limonitic	0.1 to 5 av. 0.8	30	35	7-0	3	10% qtz-feldspar > qtz-muscovite composites	t, ox, z	
P06888 SECOND CHIP	Quite different. Matrix (75%) of patchy micro/cryptocrystalline supergene calcite (calcrete), with minor intricately mixed kaolin. Minor angular, residual quartz grains (15%) to 1.5mm randomly scattered. Identified as kaolin-rich calcrete. Unique in this Kaiser suite.								
P06889	35	0.1 to 1.5 0.4	20	15	3	15	15% numerous qtz-feldspar composites	t, ox	abundant fine muscovite in kaolin cement.

T.S. No.	Matrix/ cement of kaolin Vol %	Major grains within matrix/cement						Accessory resistate grains	Comment
		Size (mm) range and average	qtz %	K-spar %	Plag %	Detrital Muscovite %	Other %		
P06890 TWO CHIPS	Massive, apparent primary-igneous, fine (0.,3mm) to medium grained (1.2mm) mosaic. Dominant quartz (50%), subordinate and generally finer K-spar (30%), minor plagioclase (5-10%), and numerous scattered extremely fine (0.1mm) accessory grains of biotite, tourmaline, opaque oxide, apatite. Tentatively classified as <b>(potassic) micro-aplite</b> . Unique in this suite.								
P06890 ONE CHIP	Chip of transported overburden, loose packed aggregate of fine to coarse quartz grains (rare felspar), ubiquitous intergranular limonite permeation but not distinctly kaolinitic as in other chips of typically transported overburden. Somewhat unique within the whole suite.								
P06891	Two chips composed entirely of massive recrystallised quartz. One apparent <b>hydrothermal vein quartz</b> , very coarse has protomylonitic stress fabric, subparallel fissures healed by stringers of very fine recrystallised quartz. The other chip possibly a former quartzite, equigranular, relict very stressed grains, as residuals within extensive intergranular extremely fine recrystallised quartz. Alternatively, may be an ex-quartz-rich gneiss,with any other former minerals obliterated. (Some similarities with mylonitic P06898).								
P06892 TWO CHIPS	50-60	0.1 to 1.5 av. 0.25	10-20	5	-	5-30 fine in matrix	-	t, ox	compares with 883
P06892 FOUR CHIPS	20-35 limonitic	0.1 to 1 av. 0.3	30	15	5	5	10-15 sericitic fragments	t, ox	finer and better sorted equiv of 884 (and others)
P06893 THREE CHIPS	35-40 limonitic	0.1 to 1.5 av. 0.25	25-30	7	3	3	--	t, ox	cf. 886
P06893 ONE CHIP	15 unoxidised kaolin matrix	0.1 to 1.5 av. 0.25	35-40	30	5	10 some in fine matrix	qtz-felspar composites	t, ox, z	fine equiv. of 882, 883, 884
P06894	25	0.1 to 0.6 av. 0.4	30	30	3	10 integrated in kaolin matrix	-	t, ox	cf. 882-884, 893 unusually well sorted
P06895	50-60 limonitic	0.1 to 1 av 0.4	30-35	<5	-	-	-	-	clay matrix commonly with undulating foliae texture

T.S. No.	Matrix/ cement of kaolin Vol %	Major grains within matrix/cement						Accessory resistate grains	Comment
		Size (mm) range and average	qtz %	K-spar %	Plag %	Detrital Muscovite %	Other %		
P06896		Chips of <b>fresh but strongly stressed granitoid</b> dominated by coarse unaltered microcline, composite with stressed, finer quartz, also stringers of apparent recrystallised and mobilised K-spar micromosaic. Minor associated very fine biotite.							
P06897		Chips of <b>completely altered granitoid gneiss</b> (possibly tectonised granite). Has irregular lenses and incipient foliae of (recrystallised) quartz micromosaic (30%) as residuals within irregular grains of former feldspar (35%) which is pseudomorphically replaced by cryptocrystalline kaolin. Also former irregular lenses of pre-existing biotite (35%) completely altered to indefinite decussate oxidised ?hydromica/smectitic-clay/kaolin.							
P06898		Two chips : <b>sheared and recrystallised quartz-rich (gneiss or quartzite)</b> . Consists of protomylonitic elongate quartz grains about 1mm average size (75-80%), incorporating minor feldspar, lesser muscovite, as an integral part of the fabric, apparently relict from protolith. May be a metasediment. Possibly a former granitoid but with unknown explanation for quartz-enrichment/feldspar depletion.							
P06899	40 limonic	0.1 to 1.5 av. 0.4	35	5-7	-	5-7	10% lateritic micronodules	ox	cf. 881, 885, 895
P06900 ONE CHIP	Coherent and basically fresh, <b>fine quartz-muscovite-schist</b> , with numerous accessory grains of metamorphic tourmaline up to 0.25mm size. Schistose muscovite through the fine metamorphic micromosaic locally has a weak micro-crenulation.								
P06900 ONE CHIP	Coherent <b>metaquartzite</b> , grain size mostly about 1mm. This one chip has a small remnant of fine muscovite schist with a tourmaline crystal, consistent with the other chip described above.								

**REPRESENTATIVE PHOTOMICROGRAPHS OF VARIOUS LITHOLOGIES IN  
RC DRILL CHIPS [Arranged in order of increasing thin section number]**

**Figs 1 & 2**

**TS No. P06672**

\_\_\_\_\_ & \_\_\_\_\_  
0.45 mm & 0.18 mm

Crossed nicols (Xnic), Fig 1 (x20), Fig 2 (x50). Examples of unlithified sand without any ordered fabric, representing transported overburden (derived from granitoid bedrock). Abundant, angular single-crystal fragments of quartz > felspar (some with typical microcline twinning), also sparse detrital muscovite (coloured), unsorted and randomly disposed through a matrix/cement of limonitic supergene kaolin.

**Fig 3**  
Xnic (x50). Caption as for Fig 1 and 2, kaolin matrix slightly less limonitic.

**TS No. P06673**

**0.18 mm**

**Fig 4**

**TS No. P06675**

0.45 mm

Xnic, interpreted as completely supergene-altered original undeformed dolerite. Separate patches of smectitic clays mixed with minor extremely fine carbonate, probably replacing former amphibole or pyroxene, within joined patches of extremely fine kaolin after plagioclase. Accessory scattered black-opaque oxidised magnetite grains.

**Fig 5**

**TS No. P06675**

0.18 mm

Xnic. Fine detail of Fig 4.

**Fig 6**

**TS No. P06679**

\_\_\_\_\_  
**0.18 mm**

OL, unlithified cover material, unsorted quartz grains (clear) and one coloured tourmaline, within an abnormally extensive kaolin matrix.

**Fig 7**

**TS No. P06884**

\_\_\_\_\_  
**0.18 mm**

Xnic. Unlithified cover rock, with abundant, angular, unsorted quartz and feldspar grains, some composite, probably derived from granitoid, one central coloured tourmaline. All grains unsorted and loosely packed within a kaolin cement.

**Fig 8**

**TS No. P06889**

\_\_\_\_\_  
**0.18 mm**

Xnic, as in Fig 7, this sample with an extensive fine mica-rich, kaolin matrix.

**Fig 9**

**TS No. P06894**

\_\_\_\_\_  
**0.18 mm**

Xnic, further example of unlithified cover material.

**Fig 10**

**TS No. P06895**

0.18 mm

Xnic. As above, more extensive and more limonitic clay matrix.

**Fig 11**

**TS No. P06897**

0.45 mm

Xnic. Deeply weathered granitoid (gneiss), residuals of deformed quartz between areas of extremely fine kaolin after felspar, and patches of decussate, clay-micas, probably after former gneissic felspar or biotite.

**Figs 12 & 13**

**TS. No. P06898**

**&**  
**0.45 mm & 0.18 mm**

Xnic, two photos of sheared and recrystallised apparent quartz-rich, or quartz-enriched, granitoid (?gneiss).  
Note residual feldspars in protomylonitic quartz mosaic, particularly in Fig 12.