MINERALOGICAL REPORT No. 8795

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January 31st, 2006

TO :

Mr Greg Ambrose
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Centre Point Building
48-50 Smith Street Mall
DARWIN NT 0800

YOUR REFERENCE : Order No. DME-2327

MATERIAL & IDENTIFICATION : Drill core samples, DDH LA05DD01 (Western Amadeus Basin)

WORK REQUESTED : Thin section preparation, description and report.

SAMPLES & SECTIONS : Returned to you with this report.

DIGITAL COPY : Enclosed with hard copy of this report.

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SUMMARY COMMENTS

This report presents descriptions of seventeen core samples from drillhole LA05DD01 in the Amadeus Basin in the southern part of the Northern Territory. These samples were impregnated with epoxy and made into thin sections. The deepest **samples are siltstones and cherts at 587.9, 543 and 426.4m and called Unit 1 in Figure 1 below**. These samples seem to represent a relatively starved basin compared to later sediments. **An overlying Unit 2 consists of an upwards coarsening sandstone sequence with fine to medium sandstone at 407.5m, through to a pebbly very coarse-grained sandstone at 315m**. These sediments are characterised by fresh or partly etched microcline grains as well as abundant single-crystal and polycrystalline quartz grains, flakes of muscovite and altered biotite and quartz-rich to sericite-rich metasediment clasts. Two of these samples have minor carbonate as cement and two contain kaolinite. The only heavy mineral is tourmaline (zircon was not seen). The pebbles in the shallowest sample include quartz-K-spar gneiss and altered possible volcanic clasts also with quartz and K-spar. Glauconite nodules are abundant in the sample at 315m, suggesting a shallow marine setting, but none of the other samples contain glauconite.

Pebbly sandstone at 291.4m has very different pebbles, mostly of quartz-rich sandstone with optically continuous overgrowths as well as vitric tuff and granophyre. Neither K-spar nor muscovite occurs but there are possible metamorphic clasts altered to quartz and kaolinite. This is the only sediment that contains obvious reworked sandstone debris. In the context of the whole suite, this sample is isolated as a **Unit 3**.

Eight shallower sandstones from 274.4 up to 61.05 are grouped as a Unit 4. These sandstones lack K-spar (as does 291.4m) and commonly contain partly shredded or kaolinised muscovite, also abundant kaolinite-rich clasts. These sandstones have mostly single-crystal quartz grains with some metasediments and altered probable volcanics. Three contain zircon (at 254, 166.1 and 119.5m), most contain tourmaline, but muscovite and tourmaline are absent at 197m (very coarse-grained sandstone). The two shallowest samples (at 119.5m and 61.05m) lack muscovite.

Many of the sandstones have voids or porosity but the origin and significance of this is unclear. The lower sandstones seem to represent a less weathered source, with mostly fresh K-spar and muscovite, but later sediments are richer in kaolinite, lack K-spar and have partly shredded muscovite, representing a more weathered provenance. Rare carbonate at 350 and 324m may be siderite, common in fluvial sandstones, and the only obviously marine sediment is the pebbly sandstone at 294.5m, with abundant glauconite. There is no metamorphism and no sign of significant diagenetic changes in these samples, apart from zones of microbrecciation at 197m, and hematite-clay matrix material through most of the sandstones.

Table 1: Characteristics of samples from drillhole LA05DD01

	Depth	Lithology	Lithic clasts	Diagnostic minerals			Accessories		Others	
unit 4	61.05	Medium-coarse sandstone	Metasediments, volcanics				Tourmaline			Kaolinite
	119.5	Medium-coarse sandstone	Metasediments, volcanics				Tourmaline	Zircon		Kaolinite
	147.1	Medium-coarse sandstone	Metasediments, volcanics		*Muscovite*		Tourmaline			Kaolinite
	166.1	Medium-coarse sandstone	Metasediments, volcanics		*muscovite*		Tourmaline	Zircon	Hematite	Kaolinite
	197	Very coarse sandstone	Metasediments/kaolinite-rich clasts, volcanics							Kaolinite
	232	Coarse sandstone	Metasediments,		Muscovite		Tourmaline		Hematite	Kaolinite
	254	Medium-coarse sandstone	Metasediments,		*muscovite*		Tourmaline	Zircon	Hematite	Kaolinite
	274.4	Medium-coarse sandstone	Metasediments, siltstone, volcanics		*muscovite*	Biotite	Tourmaline			Kaolinite
unit 3	291.4	Pebbly sandstone	Sandstone, tuff, granophyre		Quartz/ kaolinite					Kaolinite
top of 2	294.5	Pebbly sandstone	Volcanics	*Microcline*	Gneiss				Glauconite	
unit 2	315	Coarse to very coarse sandstone	Metasediments	*microcline*	Muscovite	Biotite	Tourmaline			Kaolinite
	324	Coarse sandstone	Metasediments	*microcline*	Muscovite	Biotite	Tourmaline		Carbonate	Kaolinite
	350	Coarse sandstone	Metasediments	Microcline	Muscovite	Biotite	Tourmaline		Carbonate	
	407.5	Fine-medium sandstone	Metasediments	Microcline	Muscovite		Tourmaline			
unit 1	426.4	Chert								
	543	Siltstone								
	543	Chert								
	587.9	Siltstone								

Note: *Microcline:* partly etched*; muscovite:* shredded and/or kaolinised, microcline and muscovite (not in italics) are fresh; hematite refers to detrital primary hematite or hematite ex-magnetite and kaolinite refers to clasts rich in kaolinite rather than interstitial clays.

INDIVIDUAL DESCRIPTIONS (IN ORDER OF YOUR SAMPLE LIST PROVIDED)

All samples from LA05DD01

SAMPLE DEPTH	587.9-587.95m
ROCK NAME from TS	Quartz-poor micaceous siltstone
HAND SPECIMEN	Pale green siltstone with irregular fractures

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral/component	Abundance	Origin
Sericite/illite, decussate	Dominant	Detrital
Single-crystal quartz grains	Very minor	Detrital (silt)
Clouded sericite/illite	Very minor	In fractures

Most of this sample is massive sericite or illite with minor quartz mostly less than 50μm in diameter irregularly disseminated in lenses and lamellae throughout the thin section. Clouded clays occur in narrow fractures mostly at a low angle to the core axis but partly oblique or at a high angle to the core axis. Clouded and limonite-stained patches occur but are not abundant.

SAMPLE DEPTH	543-543.05m
ROCK NAME from TS	Slumped interlayered chert and clay-rich siltstone with quartz-filled fractures in the chert and possible sedimentary dykes
HAND SPECIMEN	Fractured pale cream fine-grained sediment and pale yellow sediment (claystone or siltstone)

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance		Origin
	[Chert]	**[Siltstone]**	
Quartz, cryptocrystalline to microcrystalline	Dominant		Chemical precipitate or diagenetic
Clay (illite?)		Dominant	Detrital
Silt-sized quartz grains		Very minor	Detrital
Irregular small quartz veins	Very minor		Diagenetic?

This sample has irregular layers apparently affected by slumping with siltstone and chert layers. The pale yellow layers are clay-rich with very minor silt-sized quartz and have commonly curved contacts with the pale cream layers, also extending as probable sedimentary dykes into the pale layers, which seem to represent cherts. The chert could be primary or possibly diagenetic and in hand specimen has paler blocks and possibly nodular areas, although the very fine-grained nature of this lithology makes textures difficult to see in thin section. Irregular fractures contain possibly tension-gash veinlets with some offsetting along some of these veins and a planar vein along a siltstone/chert contact, where the siltstone seems to be in a sedimentary dyke.

SAMPLE DEPTH	426.4-426.45m
ROCK NAME from TS	Impure chert with quartz veins and voids
HAND SPECIMEN	Reddish siliceous rock with bands at 45° to the core axis

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Quartz with hematite staining	Dominant	Chemical precipitate?
Possible illite/sericite	Minor?	Detrital?
Vein-quartz and voids	Very minor	In fractures

This sample is weakly layered chert with abundant microcrystalline quartz and possibly some interstitial clay, but textures are unclear. Layering, as seen in hand specimen, seems to be defined by variations in hematite content. Narrow fractures have microcrystalline to microsparry quartz and small voids and crystal-lined cavities to 2mm long and 1mm wide. Most of the fractures are less than 0.2mm wide.

SAMPLE DEPTH 407.5-407.55m

ROCK NAME from TS Weakly bedded angular fine to medium-grained sandstone with quartz > microcline > lithic grains > muscovite and a clay-limonite cement or matrix with small and large voids

HAND SPECIMEN Red sandstone with bedding at a high angle to the core axis

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Angular single-crystal quartz grains	Major	Detrital
Microcline	Minor	
Lithics: quartz-rich to sericite-rich	Minor	
Muscovite	Very minor	
Tourmaline	Accessory	
Limonite and clay (kaolinite ± illite?)	Abundant	Matrix/cement
Voids	Minor	Secondary

There are poorly defined bedding laminations in this sample as well as partly anastomosing lamellae containing largely silt-sized quartz and muscovite. Sparse lamellae have quartz mostly less than 0.25mm in diameter (fine-grained sandstone) but most of the rock is coarser-grained with detritus mostly less than 0.4mm in grainsize (medium-grained sandstone). The most abundant detritus is composed of single-crystal quartz grains but there are also abundant grains of microcline and less abundant lithic grains varying from quartz-rich to sericite-rich. Weakly aligned muscovite flakes are also disseminated and define a weak bedding-parallel foliation. The detritus is mostly angular and largely set in limonite-rich or clay-rich material with probable kaolinite as the main clay species. Small pores occur in some of the coarser layers and there are irregular, elongate or circular voids to 2.5mm in length or in diameter.

SAMPLE DEPTH	350-350.05m
ROCK NAME from TS	Well-bedded coarse-grained sandstone with actinolite > K-spar and lithic grains (quartz-rich to sericite-rich) > muscovite, altered biotite > hematite, tourmaline with clays, limonite and carbonate as interstitial minerals and rare voids.
HAND SPECIMEN	Red sandstone with bedding at a high angle to the core axis

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Angular single-crystal quartz grains	Major	Detrital
K-spar (microcline > orthoclase)	Minor	
Lithic grains (quartz-rich to sericite-rich)	Minor	
Muscovite	Very minor	
Hematite/clay ex-biotite?	Accessory	
Hematite ex-opaque oxide	Accessory	
Tourmaline	Rare	
Limonite-clay aggregates	Sparse/minor	Interstitial
Carbonate (siderite?) ± limonite	Rare	Cement
Voids	Very minor	

Angular detritus in this sample is poorly sorted and as much as 0.8mm in maximum dimension (coarse sand), except for mostly parallel, partly crumpled flakes of muscovite and clay/limonite-altered biotite to 1mm or more in length. The micas seem to define a bedding-parallel foliation that is stronger than that in the previous sample, and suggest a metasediment provenance. K-spar grains seem to include untwinned orthoclase as well as twinned microcline and there are quartz-rich to sericite-rich lithic grains as in the previous samples. The micaceous lithic grains seem to represent quartz-sericite schists (low-grade metasediments). There is also minor hematite apparently derived from opaque oxide and minor tourmaline. Most of the interstitial material is clay and/or limonite, with rare patches of partly limonite-stained carbonate (possibly siderite). Sparse voids to 1.5mm long are mostly parallel to the layering.

SAMPLE DEPTH 324-324.05m

ROCK NAME from TS Quartz-lithic coarse-grained sandstone, kaolinised or with kaolinite-rich detrital grains as well as quartz-rich to sericite-rich lithics, microcline, muscovite, biotite and tourmaline. Minor hematite occurs in purplish areas and there is sparse carbonate (siderite?) as well as tourmaline and sparse voids.

HAND SPECIMEN Mottled purplish and white coarse-grained sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Major	
Aggregates of kaolinite ± carbonate ± illite	Major	
Polycrystalline quartz clasts ± sericite	Minor	
Partly etched microcline	Very minor	
Muscovite	Very minor	Mostly detrital
Quartz-sericite clasts	Very minor	
Kaolinite-hematite and/or leucoxene clasts	Minor	
Altered biotite	Accessory	
Tourmaline	Accessory	
Voids	Very minor	Secondary

The single-crystal quartz grains in this thin section are well sorted and as much as 1mm in diameter (coarse sand) with abundant patches of kaolinite ± illite ± carbonate that seem to represent clasts rather than matrix and in some areas are clouded by hematite (purple areas in hand specimen) but in other areas lack hematite (white areas). Rare clasts contain leucoxene and others seem to have a microporosity. Clasts of polycrystalline quartz are more abundant than in the previous samples but quartz-sericite schist clasts (low-grade metasediments) are uncommon as are partly shredded and possibly kaolinised muscovite flakes and altered detrital biotite. Relatively sparse K-spar grains seem to have been etched and are mostly microcline. The only heavy mineral seems to be tourmaline. It is possible that some of the kaolinite is present as matrix material, especially where it contains carbonate (probably siderite). Sparse voids are again present, mostly about 0.5mm in diameter but as much as 1.5mm long on the margins of the sample.

SAMPLE DEPTH 315-315.05m

ROCK NAME from TS Coarse to very coarse-grained sandstone, rich in quartz and kaolinite-rich clasts as well as a single granule of impure chert and minor sericite-rich metasediment. Muscovite, biotite, hematite and tourmaline are present as well as voids.

HAND SPECIMEN Friable red coarse-grained sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Major	Detrital
Polycrystalline quartz and sericite-rich grains	Abundant	
Chert clasts (includes one 'granule')	Minor	
Kaolinite ± illite as probable clasts	Common	
Etched microcline	Minor	
Muscovite and altered biotite	Very minor	
Hematite	Accessory	
Tourmaline	Accessory	
Earthy hematite ± clay	Minor	Interstitial
Voids	Very minor	Secondary

Most of the detrital grains in this sample are less than 1mm in diameter, but there are several larger clasts, mostly of polycrystalline (vein and metamorphic) quartz, to 1.5mm long and a single granule about 4mm in maximum dimension apparently composed of impure chert similar to those in deeper samples in this hole but with rare disseminated sericite. Polycrystalline quartz grains rarely contain sericite, but there are disseminated sericite-rich clasts some of which are schistose and represent low-grade metasediment. Kaolinite-rich clasts are also common and have quartz grains commonly impressed into them. Minor sericite is present in some of these clasts but no carbonate was seen. Muscovite occurs sparsely as crumpled flakes to 1.5mm long with less abundant mostly altered biotite and a single small flake of fresh biotite. There is also minor partly etched microcline. The heavy minerals include hematite and tourmaline and interstitial earthy hematite ± clay is ubiquitous, accounting for the red colour in hand specimen. Voids seem to be more abundant compared to the previous samples and are from 0.5mm to 2mm long.

SAMPLE DEPTH	294.5-294.55m
ROCK NAME from TS	Pebbly very coarse-grained sandstone with single-crystal and polycrystalline quartz grains, microcline, quartz-K-spar gneiss, possible acid volcanic-related clasts, rare schists and abundant glauconite pellets as well as hematite ± clay and voids.
HAND SPECIMEN	Layered red very coarse-grained sandstone, friable

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral/component	Abundance	Origin
Single-crystal quartz grains	Dominant	
Polycrystalline quartz	Common	
Microcline, partly etched	Minor	
Quartz-K-spar clasts ± sericite ± hematite, with graphic or volcanic textures	Minor	Detrital
Fragments of quartz-K-spar-biotite gneiss	Sparse	
Quartz-muscovite schist	Abundant	
Glauconite pellets	Rare	Authigenic/reworked?
Hematite ± clay	Common	Interstitial
Voids	Minor	Secondary

This is a very poorly sorted sediment with abundant single-crystal and polycrystalline (vein + metamorphic) quartz grains to 3mm long (coarse to very coarse sand and granules) as well as a single pebble, 5mm in diameter, of inequigranular quartz-K-spar-biotite gneiss with clay-hematite-altered biotite. The gneiss seems to have coarse-grained microcline and fine-grained orthoclase as well as recrystallised quartz and altered biotite, and separate clasts of partly etched microcline are disseminated. Rare quartz-muscovite schist clasts occur as well as quartz-K-spar-hematite clasts derived from graphic, granophyric and volcanic precursors. This sample also has abundant pellets of glauconite from 0.2mm to 1mm long, apparently of authigenic or reworked authigenic origin. Interstitial hematite ± clay aggregates are ubiquitous but there are relatively common voids to 2mm long.

SAMPLE DEPTH 291.4-291.45m

ROCK NAME from TS Pebbly very coarse-grained sandstone with pebbles of sandstone, quartz-rich to kaolin-rich altered rocks, quartz-hematite cherty pebbles, quartz-sericite schist pebbles, vitric tuff grains and abundant single-crystal + polycrystalline quartz grains. Fragments or in-situ patches of granophyre are also present as well as interstitial kaolinite and hematite and abundant voids.

HAND SPECIMEN Pebbly very coarse-grained red sandstone,

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal and polycrystalline quartz grains	Major	Detrital
Pebbles of medium to coarse-grained quartz-rich sandstone	Abundant	
Pebbles variously quartz-rich to kaolinite-rich with minor hematite	Common	
A pebble of laminated quartz-sericite schist	Minor	
A pebble of fine-grained quartz and hematite	Minor	
A clast of quartz-hematite-altered vitric tuff	Minor	
Two probable clasts of granophyre	Minor	
Aggregates of sericite and/or kaolinite	Minor	Interstitial or detrital
Interstitial kaolinite and hematite	Minor	Interstitial
Voids	common	Secondary

Pebbles of quartz-rich sandstone are present in this sample and are at least 25mm in diameter, with abundant rounded single-crystal quartz grains largely cemented by optically continuous overgrowths. Some of the quartz has deformation lamellae suggesting low-grade metamorphism and deformation. Other pebbles include several with minor to abundant ragged quartz grains and minor to abundant massive or vermiform kaolinite as well as minor hematite staining, possibly weathered metamorphic rocks. One pebble is laminated with quartz-rich lamellae alternating with lamellae of very fine schistose sericite. There is also a

pebble rich in microcrystalline quartz and interstitial hematite, possibly representing impure chert. A single clast, altered to sericite and hematite, has textures indicating that it was formerly a vitric tuff with relatively large former shards. Poorly sorted single-crystal quartz grains are also abundant, with less abundant fine-grained polycrystalline quartz grains, and are mostly less than 1mm in diameter. Some grains are from 1mm to 2.5mm in diameter, however. In some lenses most of the single-crystal quartz grains are quite small (less than 0.1mm in grainsize or very fine sand to silt).

Two areas of unusually granophyric quartz-rich material occur: one is 3,5mm x 2.5mm and seems to be a fragment, but the other is 6-7mm in diameter and contains a cavity as well as apparently enclosing single-crystal quartz grains similar to those in the adjacent sediment. If this had formed in situ it would suggest that the sandstone had been partially melted, although there is no obvious cause for this. In both cases, any feldspar that may have been present seems to have been altered to kaolinite.

Interstitial partly vermiform kaolinite is common with less abundant hematite and common irregular voids, partly small but as much as 6mm long.

SAMPLE DEPTH 274.4-274.45m

ROCK NAME from TS Interbedded medium to coarse-grained sandstone with rare very fine-grained sandstone and a single intraclast of micaceous siltstone. Quartz-rich, sericite-rich and kaolinite-rich clasts are common with less abundant mica, rare tourmaline and interstitial hematite/kaolinite plus voids.

HAND SPECIMEN Laminated red very coarse-grained sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Dominant	Detrital
Polycrystalline quartz	Minor	
Quartz-sericite schist	Very minor	
Silicified acid volcanics	Minor	
Partly shredded muscovite ± kaolinite/illite	Very minor	
Altered biotite	Accessory	
Decussate or vermiform kaolinite	Very minor	
Tourmaline	Trace	
Hematite ex-opaque oxide	Accessory	
Micaceous siltstone	One clast	Intraclast
Kaolinite/hematite	Minor	Interstitial
Clay-lined voids	Minor	Secondary

Abundant angular single-crystal quartz grains occur in this sample, with most layers having grains to 0.4mm (medium-grained sandstone) or 0.8mm (coarse-grained sandstone) in diameter. One layer has grains mostly about 0.1mm in diameter (very fine-grained sandstone) but this is narrow and not a major component. Much of the quartz is elongate parallel to the layering and there is a single intraclast of micaceous siltstone, at least 6mm long, also elongate parallel to the layering. Polycrystalline quartz grains and quartz-rich clasts are not abundant but include metamorphic quartz and quartz-clay-hematite-altered possible acid volcanics, rarely with possible quartz phenocrysts. Detrital micas are also disseminated, but are not abundant, with altered biotite less abundant than fresh or shredded

muscovite. Some of the muscovite may have interlayer illite or kaolinite. Clasts of kaolinite ± illite are also present as well as decussate or vermiform kaolinite and hematite in interstitial patches. Smaller voids, to 0.5mm long, are more clearly defined in this sample and are lined by colloform clays, possibly illite, but larger voids, to 4mm long, are not lined.

SAMPLE DEPTH 254-254.05m

ROCK NAME from TS Bedded medium to coarse-grained sandstone, quartz-rich with quartz-rich, sericite-rich and kaolinitic grains as well as hematite, tourmaline and zircon. A single siltstone intraclast is present as well as interstitial hematite/clay and voids.

HAND SPECIMEN Layered red sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Dominant	Detrital
Polycrystalline quartz-rich grains ± clays	Minor	
Sericite or kaolinite-rich clasts	Very minor	
Hematite-rich clasts	Very minor	
Partly shredded muscovite	Very minor	
Hematite	Accessory	
Tourmaline and zircon	Accessory	
Micaceous siltstone	One clast	Intraclast
Hematite/kaolinite	Minor	Interstitial
Voids	minor	Secondary

There are again abundant angular single-crystal quartz grains with maximum grainsizes of 0.4mm to 0.8mm in different layers (medium to coarse-grained sandstone) as well as part of a single intraclast of micaceous siltstone along one edge of the thin section. Polycrystalline quartz grains, mostly metamorphic, occur as well as quartz-clay-rich clasts that may be partly of acid volcanic origin. Sericitic (metasedimentary) and kaolinite-rich clasts are also common as well as shredded and fresh muscovite and hematite ex-opaque oxide. Rare zircon is visible for the first time as well as tourmaline. Interstitial material is mostly hematite and kaolinite with irregular, unlined voids to 2mm long, especially in the vicinity of the intraclast.

SAMPLE DEPTH 232-232.05m

ROCK NAME from TS Quartz-rich coarse-grained sandstone with less abundant quartz-rich to sericite-rich and kaolinitic clasts, minor muscovite, tourmaline and hematite and irregular voids.

HAND SPECIMEN Red sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Dominant	Detrital
Quartz-rich to sericite-rich grains	Common	
Kaolinite-rich grains	Minor	
Muscovite	Very minor	
Tourmaline, hematite	Accessory	
Kaolinite/hematite	Very minor	Interstitial
Voids	Minor	Secondary

Subrounded and subangular single-crystal quartz grains to 0.8mm in diameter (coarse-grained sand) dominate this sample with less abundant fine-grained quartz-rich to sericite-rich lithic grains, mostly of low-grade metamorphic origin. Partly shredded muscovite is disseminated as well as kaolinite-rich detrital grains and sparse interstitial hematite/clay masses. Tourmaline is more abundant than usual and there is minor hematite ex-opaque oxide. Small irregular voids are ubiquitous, and there is a crosscutting fracture.

SAMPLE DEPTH	197-197.05m
ROCK NAME from TS	Quartz-lithic very coarse-grained sandstone with quartz-rich, quartz-sericite and kaolinite ± illite clasts, hematite-clay as interstitial material, zones of microbrecciation and sparse voids
HAND SPECIMEN	Red very coarse-grained sandstone with sparse white clasts

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral/Component	Abundance	Origin
Single-crystal quartz grains	Dominant	
Polycrystalline quartz grains	Abundant	
Kaolinite ± illite ± hematite, mostly clasts	Common	Detrital
Sericite ± quartz clasts	Minor	
Quartz-hematite altered possible acid volcanics	Very minor	
Hematite-clay aggregates	Very minor	Interstitial
Voids	Very minor	
Zones of microcrystalline quartz	Minor	Microshears/fractures

Abundant single-crystal quartz grains are disseminated through this sample, from 0.25mm go 2mm in diameter (medium to very coarse sand), mostly subangular or subrounded, with less abundant polycrystalline quartz clasts and variously quartz-rich to sericite-rich clasts, partly schistose and representing low-grade metasediments. The polycrystalline quartz grains are partly massive and partly composed of elongate quartz grains (vein-quartz or deformed). Clasts composed of massive quartz-sericite aggregates and quartz-hematite aggregates, possibly derived from acid volcanics, are also disseminated. Probable clasts of kaolinite ± illite are common and locally contain hematite, with interstitial material also composed of hematite ± clay, giving the red colour to the sandstone. Two parallel zones contain fractured and fragmented quartz grains set in microcrystalline quartz with minor hematite. These zones seem to represent brittle fractures but may be bedding-parallel. Voids are not abundant and are mostly less than 2mm long.

SAMPLE DEPTH 166.1-166.15m

ROCK NAME from TS Medium to coarse-grained quartz-lithic sandstone with more abundant heavy minerals (hematite > tourmaline > zircon), quartz-rich to sericite and kaolinite-rich clasts and minor voids

HAND SPECIMEN Red coarse-grained sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Dominant	
Polycrystalline quartz (vein and metamorphic)	Abundant	
Quartz-hematite ex-volcanics	Minor	
Quartz-rich to sericite/muscovite-rich (metasediments)	Minor	Detrital
Kaolinite ± illite ± quartz	Common	
Muscovite	Rare	
Tourmaline, hematite	Accessory	
Zircon	Rare	
Hematite/clay	Minor	Interstitial
Voids	Very minor	

Most of the detrital grains in this thin section are less than 0.6mm in diameter, indicating medium to coarse-grained sandstone, with subrounded and subangular or angular single-crystal quartz grains as well as polycrystalline quartz and quartz-rich to sericite-rich metasediment clasts. Silicified probable volcanic clasts are more abundant than in the previous samples but there are less abundant kaolinite-rich clasts, usually with minor illite and/or quartz. Very minor muscovite is present, partly shredded with possible kaolinite. Heavy minerals are more abundant and varied with rare zircon to 0.2mm in diameter as well as tourmaline and hematite (ex-opaque oxide). The hematite is most abundant in a single heavy mineral lamination. The red colour is again partly due to a red cement dominated by hematite ± clay. Small voids are disseminated but are mostly less than 1mm in diameter.

SAMPLE DEPTH	147.1-147.15m
ROCK NAME from TS	Unsorted fine to very coarse-grained sandstone with quartz, metasediment, volcanic and kaolinite-rich clasts as well as tourmaline and minor voids
HAND SPECIMEN	Red coarse-grained sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Dominant	
Polycrystalline quartz (metamorphic)	Minor	
Quartz-rich to sericite-rich metasediments	Minor	
Massive quartz ± clay ± hematite (volcanic?)	Very minor	Detrital
Kaolinite ± illite ± quartz	Minor	
Muscovite (± kaolinite)	Accessory	
Tourmaline	Accessory	
Hematite/clay	Very minor	Interstitial
Voids	minor	

This sandstone has unusually poor sorting with subrounded and angular single-crystal quartz grains from 0.1mm to 2mm long and relatively less abundant lithic grains. Some of the lithic grains are quartz-rich and seem to have mostly metamorphic textures as do quartz-rich to sericite-rich clasts, with decussate or schistose sericite or muscovite. Clasts of possible altered volcanic material are present but are nor abundant. Clasts rich in kaolinite are also less abundant than in the previous samples but again include grains with illite and/or quartz as minor components. There are also sparse flakes of muscovite, partly shredded and interlayered with kaolinite, as well as kaolinite flakes with minor illite or muscovite. The main heavy mineral is tourmaline and there is interstitial clay ± hematite as well as voids to 2mm long.

SAMPLE DEPTH 119.5-119.55m

ROCK NAME from TS Weakly layered medium to coarse-grained quartz-lithic sandstone with lithic clasts variously rich in quartz, sericite or illite, kaolinite and limonite, rare muscovite (± kaolinite) and tourmaline and scattered voids

HAND SPECIMEN Banded reddish sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Dominant	
Polycrystalline quartz ± sericite	Minor	
Quartz/sericite/limonite-rich altered volcanics	Minor	
Kaolinite and sericite-rich lithics	Minor	Detrital
Muscovite ± kaolinite	Very minor	
Tourmaline	Rare	
Zircon	Rare	
Hematite/clay	Very minor	Interstitial
Voids	Common	

The maximum grainsize of single-crystal quartz grains in this sample varies slightly between layers, from 0.4mm to 0.6mm, suggesting medium to coarse-grained sandstone. Most of he grains are subrounded to subangular with many grains showing a parallel elongation parallel to the bedding. Sparse fresh or shredded and kaolinised muscovite flakes are poorly oriented and rarely parallel to the bedding, however. Minor lithic clasts include polycrystalline quartz-rich to sericite-rich metasediments, some of which are schistose, as well as probable altered acid volcanics, commonly quartz-rich with sericite and/or limonite. Some sericite-rich grains also occur and seem to have been partly altered to kaolinite, with disseminated kaolinite-rich grains with or without illite and/or quartz. Rare tourmaline is present and a single small zircon was seen. Interstitial clay and hematite again result in the reddish colour but voids are more abundant compared to the previous samples. The voids are again mostly less than 2mm long.

SAMPLE DEPTH	61.05-61.1m
ROCK NAME from TS	Medium to coarse-grained sandstone, quartz-rich with quartz, sericite and kaolinite in lithic grains. Rare tourmaline is present and mostly small voids are common.
HAND SPECIMEN	Mostly pale layered sandstone

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin
Single-crystal quartz grains	Dominant	Detrital
Polycrystalline quartz	Minor	
Variously quartz, sericite and kaolinite-rich lithic grains	Minor	
Tourmaline	Rare	
Hematite/clay	Rare	
Voids	Minor	

Subangular single-crystal quartz grains with maximum grainsizes of 0.4mm to 0.8mm indicate medium to coarse-grained sandstone in this thin section, with less abundant metamorphic and vein-quartz as polycrystalline grains as well as metasediments and altered acid volcanics, varying from quartz-rich to sericite-rich. Many of the quartz grains are elongate parallel to the bedding. Less abundant clasts have kaolinite as well as quartz and/or sericite and seem to represent weathered lithic clasts. There are also kaolinite-rich clasts and possible interstitial kaolinite, rarely with hematite as well as or instead of clay. The only obvious heavy mineral is tourmaline and single flakes of muscovite seem to be absent. Voids are common and mostly 0.5mm to 1.5mm long, parallel to the layering.