

MD060001 **Quartz-rich medium to very coarse-grained sandstone with partly etched quartz in a matrix of limonite ± clay. Some leaching is evident in the presence of etched grains and irregular voids.**

Field Note: *Ferruginous altered coarse sandstone with weakly elevated cps; leached clayey sandstone from Cretaceous?*

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin/location
Quartz (single crystals)	Major	Detrital ± overgrowths
Polycrystalline quartz	Very minor	Detrital
Limonite, reddish, ± clay	Abundant	Interstitial
Limonite ± clay, yellowish	Minor	Interstitial
Voids	Minor	Interstitial

Quartz in this thin section occurs partly as rounded or partly etched grains from 0.25mm to 1.5mm in diameter (medium to very coarse-grained sandstone) and partly as polycrystalline grains, including apparently fibrous vein-quartz and microcrystalline quartz. Some of the more rounded grains have well defined rounded cores and partial optically continuous overgrowths and may have been inherited from a Proterozoic source but others, especially smaller grains, are ragged in outline and seem to have been partly dissolved. Irregular voids occur, and seem to have partly coalesced, partly in areas with yellow interstitial material and also in areas with reddish interstitial material. These also seem to represent leaching and dissolution of the sandstone. This sandstone is poorly consolidated and may be of Cretaceous age as suggested in your notes.

MD060006 **Clay-limonite \pm leucoxene-altered flow-textured sparsely
feldspar-porphyritic possible basalt**

Field Note: *Ferruginous basal Phn basalt that looks like siltstone*

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin/location
Clay	Dominant	} Replacement
Limonite/leucoxene (yellow)	Pervasive	
Limonite/hematite (red)	Very minor	

This sample has a gross layering that seems to represent variations in the character of secondary clay-limonite-leucoxene alteration. All parts of the thin section seem to contain patches that seem to represent former phenocrysts to 1.3mm long, possibly mostly feldspar, and in most areas flow-oriented microlites can be identified as paler material with interstitial darker clay-limonite-leucoxene aggregates. This suggests that the rock was formerly flow-textured, sparsely porphyritic basalt but the abundance of clay and the apparent layering makes it look like fine-grained sediment in hand specimen, as suggested in your notes. Small fractures contain reddish limonite or hematite and similar material occurs in small patches.

MD060012 **Medium to coarse-grained quartz sandstone with optically continuous overgrowths, films of illite and interstitial patches of illite \pm quartz \pm limonite.**

Field Note: *Fine planar-bedded facies sandstone of lower Phr*

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin/location
Quartz	Dominant	Detrital
Quartz-II	Very minor	Overgrowths
Sericite/illite \pm quartz \pm limonite	Very minor	Interstitial

This sandstone has poorly defined bedding laminations with rounded or subrounded single-crystal quartz grains and rare polycrystalline quartz grains that vary in maximum grain size from 0.5mm (medium sand) to 1mm (coarse sand) between layers. Many of the grains have optically continuous overgrowths but there are also intergranular films of sericite/illite as well as interstitial patches of decussate illite, partly microporous and partly enclosing microcrystalline quartz. These interstitial patches are commonly stained by limonite.

MD060015

Granule-bearing very coarse-grained quartz sandstone with polycrystalline quartz that is partly of low-temperature hydrothermal origin; optically continuous overgrowths are abundant but there are also patches of interstitial microporous-decussate illite and rare patches of muscovite. One quartz grain has inclusions of zircon.

Field Note: *Pebbly facies sandstone of upper Phr*

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin/location
Quartz, single crystals	Dominant	} Detrital
Polycrystalline quartz	Common	
Fine-grained quartz \pm chalcedony	Minor	
Quartz	Minor	overgrowths
Illite \pm limonite	Very minor	Interstitial
Muscovite	Sparse	Detrital?
Zircon	Trace	Enclosed in quartz

Rounded single-crystal and coarse-grained polycrystalline quartz grains are abundant in this thin section and mostly less than 2mm in diameter (very coarse sand) but there are less abundant granules from 2-4mm in diameter. Less abundant smaller and finer-grained clasts of polycrystalline quartz include grains with a micromosaic texture, slightly deformed inequigranular quartz and aggregates of cherty to microsparry quartz and/or chalcedony, partly clouded by limonite. The quartz \pm chalcedony clasts seem to be of low-temperature hydrothermal origin. Most of the rounded single-crystal and polycrystalline quartz grains have optically continuous overgrowths and in some areas these have totally infilled interstitial areas. In other areas there are patches, locally more than 1mm long, filled with interstitial illite that is partly decussate and microporous. Some of these are adjacent to voids that may represent leached quartz and illite. Rare interstitial patches contain lamellar aggregates and single flakes of muscovite and one quartz grain contains four small crystals of zircon to 0.1mm long.

MD060020A

Medium to coarse-grained quartz-rich sandstone with sparse clay-hematite-altered possible lithic grains and polycrystalline quartz partly of low-temperature hydrothermal origin. Narrow optically continuous overgrowths occur as well as illite \pm hematite in interstitial areas.

Field Note: *Coarse ferruginous lithic sandstone of upper Phr*

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin/location
Quartz, single crystals	Major	Detrital
Polycrystalline quartz	Very minor	Detrital
Quartz	Minor	Overgrowths
Illite \pm hematite/limonite	Common	Interstitial
Sericite-clay-hematite	Very minor	Altered clasts
Hematite	Rare	Ex-opaque oxide?

Different layers in this thin section have quartz with maximum grainsizes of 0.8mm (coarse sand) or 1.2-1.3mm (very coarse sand), mostly single crystals but with minor polycrystalline grains that are mostly fine-grained and include cherty quartz of low-temperature hydrothermal origin. Many grains have optically continuous overgrowths but these have not filled the interstitial spaces and areas of interstitial mostly microporous decussate illite are more abundant than in the previous sample. Patches of more massive microcrystalline illite are also common. All of these interstitial patches have been stained irregularly by hematite or limonite, but some clay-hematite aggregates seem to represent altered lithic grains and there are hematite-altered possibly detrital oxide grains. One quartz grain has an inclusion of muscovite.

MD060020B

Three chips of medium to coarse-grained sandstone with optically continuous overgrowths, interstitial illite and rare clay-rich lithic grains, as well as one chip of partly recrystallised vein-quartz

Field Note: *Clast chips from sandstone of upper Phr; pre-existing sandstone, basaltic volcanic or cherty amygdale clasts*

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin/location
Quartz-I	Dominant	Detrital
Quartz-II	Minor	Overgrowths
Sericite/illite \pm limonite	Very minor	Interstitial
Quartz-III	Abundant	Coarse vein-quartz
Quartz-IV	Abundant	Recrystallised

Three of the four chips in this sample are composed of quartz-rich sandstone, with two chips of medium-grained sandstone to 0.5mm in grainsize and one chip of coarse-grained sandstone to 0.8mm in grainsize. The medium-grained sandstone chips have optically continuous overgrowths and sparse sericite/illite, partly interstitial but also apparently replacing partly elongate clasts in one chip. The coarse-grained sandstone chip has optically continuous overgrowths and interstitial fine-grained recrystallised quartz as well as minor illite and small clay-limonite aggregates. The fourth chip has zones of coarse-grained vein quartz and areas of microcrystalline recrystallised quartz including microcrystalline quartz along fractures in the coarse quartz. This chip represents a partly recrystallised quartz vein.

MD060022 **Very coarse-grained sandstone with detrital muscovite, optically continuous overgrowths, interstitial illite \pm kaolinite and unidentified interstitial minerals.**

Field Note: *Fine planar-bedded facies sandstone of lower Phr*

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin/location
Quartz	Dominant	Detrital
Quartz	Minor	Overgrowths
Muscovite	Very minor	Detrital
Illite \pm kaolinite	Very minor	Interstitial
Unidentified mineral(s)	Very minor	Interstitial

Rounded mostly single-crystal quartz grains are abundant in this thin section and mostly less than 1.3mm in diameter with rare grains to 2mm long, possibly parallel to the bedding. Rare fine-grained polycrystalline quartz grains also occur and there is rare detrital muscovite as crumpled flakes to 2mm long. Most of the quartz has optically continuous overgrowths that in some areas fill the interstitial areas but other areas have partly microporous aggregates of sericite/illite \pm kaolinite, passing into small voids in some areas. There are also interstitial large poikilitic grains that enclose abundant quartz, fan-like aggregates of mica and patches of granular to prismatic material with a weak positive relief against quartz and a large negative 2V. The mineralogy of these patches is unclear and may require X-ray diffraction or probe analysis.

MD064022 **Medium to very coarse-grained quartz sandstone with abundant optically continuous overgrowths and rare interstitial illite \pm limonite; traces of tourmaline and zircon occur as well as rare small voids.**

Field Note: *Fine planar-bedded facies sandstone of lower Plr*

PETROGRAPHY:

A visual estimate of the modal mineral abundances:

Mineral	Abundance	Origin/location
Quartz-I	Dominant	Detrital
Quartz-II	Common	Overgrowths
Illite \pm limonite	Trace	Interstitial
Tourmaline, zircon	Trace	Detrital
Voids	Rare	Dissolution

This poorly sorted quartz-rich sandstone has abundant single-crystal quartz grains with maximum grainsizes varying across the section from 0.5mm (medium sand) to 1.5mm (very coarse sand). Rare heavy minerals include tourmaline and zircon about 0.1mm in grainsize. Most of the interstitial areas are filled with optically continuous overgrowths but there are rare patches of illite \pm limonite and rare small voids. Polycrystalline quartz is rare and mostly fine-grained (low-temperature hydrothermal quartz?) with very sparse possible vein-quartz.