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Detailed petrological examination of four drill core samples
from a stratigraphic drill hole near Daly Waters NT.

Report No: N11/12/1708

29 July, 2012

For: NRE Operations Pty Ltd

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Sample No. NDW12-01 138.38m

Rock Type Deposit of (?hydrothermal) carbonate (mainly calcite) comprising poorly defined subparallel layers of undeformed partly clouded crystals of variable grain size. Accessory pyrite is present.

Hand Specimen A compact (non-friable) fine grained mid grey (-brown) drill core sample containing some moderately coarse grains that are well cleaved. The sample is spongy containing 10% to 20% of small voids. In some domains these occur in subparallel narrow layers. The sample reacts strongly with cold dilute HCl indicating abundant calcite.

Thin Section This sample is a deposit of undeformed (?hydrothermal) carbonate (mainly calcite – see reaction with cold dilute HCl above). The rock is almost monomineralic and comprises poorly defined subparallel layers of partly clouded crystals with a variable grain size from less than 0.2 mm (fine sand size) up to crystals that are optically continuous and more than 4 mm long. An average grain size is about 1 mm.

The carbonate grains mainly have irregular shapes and are mutually interlocking. The rock contains about 20% of small voids, many of which show subhedral projections of calcite crystals into the voids. Some carbonate crystals may comprise two types of carbonate, since coarse host crystals contain abundant inclusions of a fine grained ?second carbonate with subhedral rhombic shapes suggesting ?dolomite (or ankerite etc.).

In some elongate interstitial domains are patches of pale brown, strongly clouded carbonate that could represent an iron-bearing carbonate. This carbonate is present only in accessory proportions.

The rock is cut by numerous very narrow (less than 0.2 mm across), subparallel but branching veinlets of late carbonate that is clear of dusty inclusions. These carbonate veinlets are subparallel to the poorly defined layering.

Small spongy and irregular opaque deposits (rarely more than 1 cm long) also are accessory. Examination in reflected light suggests they are possibly ?pyrite. Some penetrate along branching mutual grain boundaries and fractures in the carbonate.

This sample may be identified as a deposit of (?hydrothermal) carbonate (mainly calcite) comprising poorly defined subparallel layers of undeformed partly clouded crystals of variable grain size. Accessory pyrite is present.

Sample No. NDW12-01 184.32m

Rock Type Extremely fine grained calcite-rich ?calcrete containing poorly defined irregular outlines of angular lithic fragments. It most likely represents a deposit of exceptionally fine grained, reworked (?aeolian) and recrystallised microfossil clasts.

Hand Specimen A compact (non-friable) fine grained, mottled pale grey and very pale grey sample, in which pale grey material could represent ?irregular fragments. Some of the latter could contain very fine sand sized ?clasts. Both fractions react very strongly with cold dilute HCl indicating calcite.

Thin Section This sample has undertone intense, extremely fine grained alteration to almost monomineralic carbonate. The carbonate is calcite (see strong reaction with cold dilute HCl above), which has an average grain size of about 0.03 mm. Nevertheless, there are poorly preserved outlines of possible lithic fragments that have a variable size, and reflect those defined in the hand specimen. The largest of these in the present section reaches nearly 4 mm long.

Although the fragments are now exceptionally fine grained calcite, they also contain irregularly disseminated, very fine grained (rarely more than 0.02 mm) translucent to near opaque granules that partly define abundant rounded and

cusped small shapes (mainly less than 0.05 mm) that could represent broken ?microfossil remains.

The rock contains small patches (mainly less than 1 mm across) of poorly crystallised subradial chalcedony. Some patches are intergrown with minor cherty quartz. Most are also intergrown with small patches of fine grained carbonate. Sparse voids and veinlets are partly coated with translucent red-brown hematite and are partly filled with coarser grained granular carbonate. This reaches 0.6 mm grain size in the present section.

This sample most likely represents a deposit of exceptionally fine grained, reworked (?aeolian) and recrystallised microfossil clasts and may be identified as extremely fine grained calcite-rich calcrete containing poorly defined irregular outlines of angular lithic fragments.

<u>Sample No.</u>	NDW12-01 230.5m
<u>Rock Type</u>	Exceptionally fine grained claystone deposit with compaction layering. Dusty oxides once could have been iron-bearing carbonate. It is most likely a shallow lake deposit.

<u>Hand Specimen</u>	A friable, mid red-brown ?hematite-rich finely laminated sample, containing sparsely disseminated small pale grey spots. These are less than 1 mm diameter. The sample lacks reaction with cold dilute HCl and therefore lacks calcite. The sample is not magnetic.
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<u>Thin Section</u>	This sample is a deposit of finely laminated ?compaction foliated claystone that is crowded with small opaque ?oxide granules and partly stained by red-brown hematite dust. It comprises almost equally abundant lensed narrow domains, some of which have irregular shapes and reach more than 5 mm long but only 0.5 mm thick, of very fine grained low birefringent clay \pm birefringent ?smectite clay that is little-stained by patchy red-brown hematite. The elongate lensed domains are set
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in host rock that is also clay-rich (possibly mainly smectite clay), stained by red-brown hematite dust. The latter contain relatively more abundant opaque granules.

Also present are sparse elongate ‘spots’ of clouded birefringent clay, some of which have subhedral shapes and may replace crystal sites. These domains also contain relatively few opaque granules compared with the host rock.

The sample contains sparse subhedral opaque ?oxide crystal sites up to about 0.2 mm that account for about 3% to 5% of the present section area. Very rare small angular grains (mainly less than 0.06 mm grain size) are quartz. These are present only in one domain and may be secondary.

This rock lacks recognisable relict texture but is not a normal sediment. It could represent an exceptionally fine grained claystone deposit with compaction layering. Dusty oxides once could have been iron-bearing carbonate. It is most likely a shallow lake deposit.

<u>Sample No.</u>	NDW12-01 262m
<u>Rock Type</u>	Fine grained, very finely laminated sparsely silty claystone. The sample contains a structure interpreted as a micro-?worm burrow.
<u>Hand Specimen</u>	A fine grained, very finely laminated mid-grey, fairly compact (not friable) drill core sample, containing visible small reflective ?detrital mica flakes parallel to layering (?bedding).
<u>Thin Section</u>	Unlike the previous sample, the present rock retains a clear clastic sedimentary texture and is sparsely silty claystone.

Silt sized (<0.05mm) detritus is angular and dominated by thin mica flakes, a few of which are bent and deformed. Angular quartz is slightly

subordinate. The detritus accounts for less than 10% of the present section area, and has a somewhat patchy distribution.

Mica flakes are strictly parallel to a compaction foliation and mainly are less than 0.15 mm long but less than 0.01 mm thick. They are dominated by birefringent 'sericite' and few are pale brown to almost colourless pleochroic micas that are most likely degraded biotite. Also present are sparse similar sized thin carbonaceous flakes.

The micas account for about 5% to 7% of the section area. Accessory detritus comprises mid green tourmaline, small green chlorite flakes, apatite, zircon and small opaque oxide grains.

The recognisable fine grained detritus is set throughout an abundant rock matrix of very fine grained wispy birefringent 'illite-smectite' clay, wispy flakes of which rarely exceed 0.03 mm long. The abundant flakes define a compaction foliation direction and are subparallel to the larger wispy detrital mica flakes.

A disrupted irregular domain more than 3 mm long and up to 0.5 mm across, is oriented normal to the layering. This could represent a micro-worm burrow. Several of these structures are present.

This sample may be identified as fine grained, very finely laminated sparsely silty claystone. The sample contains a structure interpreted as a micro-worm burrow.