



HUNTINGTON
HYPER SPECTRAL

HyLogged mineralogy of three drillholes from the Davie Prospect EL 43/2004, Western Tasmania

Prepared for Shree Minerals Ltd September 2012

Part 1 Sulphide drill holes SCDDH4 + SCDDH5 + SCDDH2

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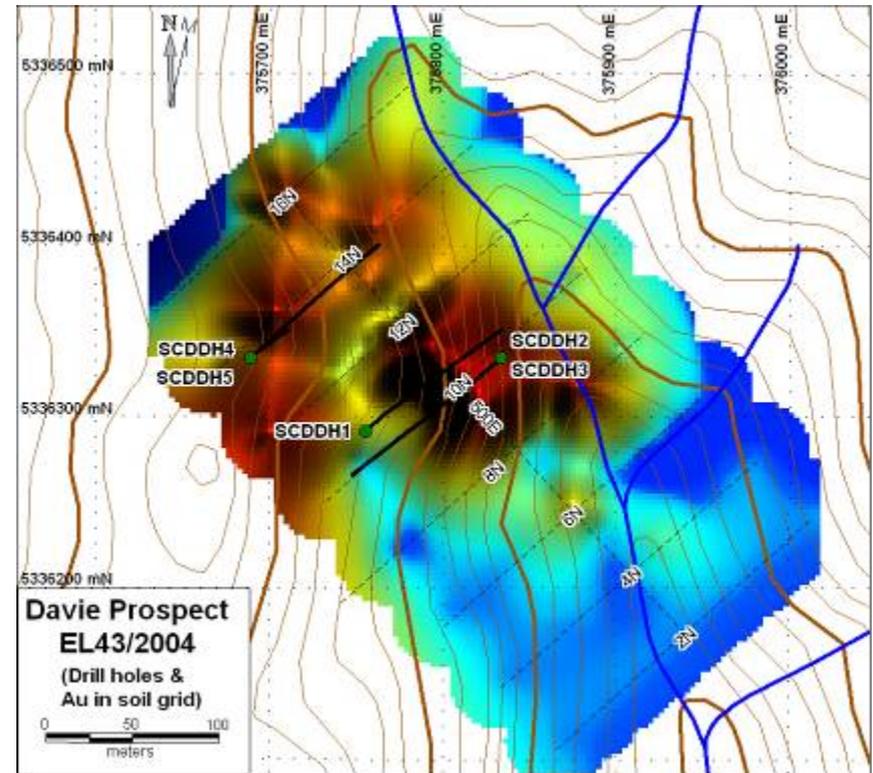
34 Craiglands Avenue
Gordon NSW 2072
Australia

Summary

- While there is ubiquitous distal white mica (sericite) and silica development, the HyLogging data indicate a spatial association between a particular proximal mineral alteration assemblage and the highest gold assays.
- For all drill holes this assemblage mostly comprises signatures of dickite +/- hematite, commonly with least white mica and kaolin.
- The dickite +/- hematite concentrate within zones of extensive goethite development and broken core related to two major fault zones that have focused the Au mineralisation.
- In SCDDH4 and 5 the upper of these two faults defines a strong boundary in white mica chemistry composition, interpreted to be probably lithological in origin. This boundary is absent in SCDDH2.
- Variation in the degree of silica development is confused by siliceous sandstone and siltstone hosts and structurally-controlled core breakage which has focussed the strong clay and goethite development. This has led to a distinctive distorted silica signature and an *apparent* relative reduction in quartz in the mineralised zones.
- Away from the fault-controlled clay / goethite development and in fresh, less broken and oxidised host rocks higher quality quartz signatures map zones of quartz (+/- carbonate) stockwork development.
- No evidence of alunite, pyrophyllite or topaz, also found in the high sulphidation parts of the Mt Lyell and Henty mineral systems, has so far been located.
- The HyLogging data has brought to light significant new information on the distribution of host rock and alteration mineralogy than was available from past studies. This information has included much more detailed information on the relative abundance and spatial distribution of a variety of hydrous, iron oxide, silica and carbonate mineralogies that are often hard to recognise with the naked eye.
- The HyLogging data also provides a long-term digital record of these drill holes and high resolution drill core and core tray images for future reference.
- Detailed descriptions of each drill hole follow.

Background

- Six diamond drillholes were scanned by Mineral Resources Tasmania (MRT) using the CSIRO-developed and AuScope-funded HyLogger-3 hyperspectral core logging technology. The aim was to characterise the iron oxide, hydrous (clay) and anhydrous silicate mineralogy of these drill cores. Initial pre-processing and depth reconciliation was carried out by MRT staff.
- Spectroscopic sample resolution was $\sim 8 \times 18$ mm sampled every 8 mm along the core. The HyLogging system collects 125 samples per metre of core (before masking). Digital imagery with a resolution of ~ 0.2 mm was acquired simultaneously with the mineral spectroscopy.
- Data analysis was carried out by the author using “The Spectral Geologist” (TSG-HotCore) software.
- To minimise initial bias a first pass interpretation of the spectroscopic data was undertaken “blind” without reference to previous work. Subsequently the assay data was considered and correlated and then the previous geological review by S. Tear (2011) and drilling report by R. Reid (2010).



Davie Prospect plan view showing grid and drill hole locations over a gridded Gold in soils image (AGD66, Zone55). From Reid (2010).

Drill hole 29032-SCDDH4

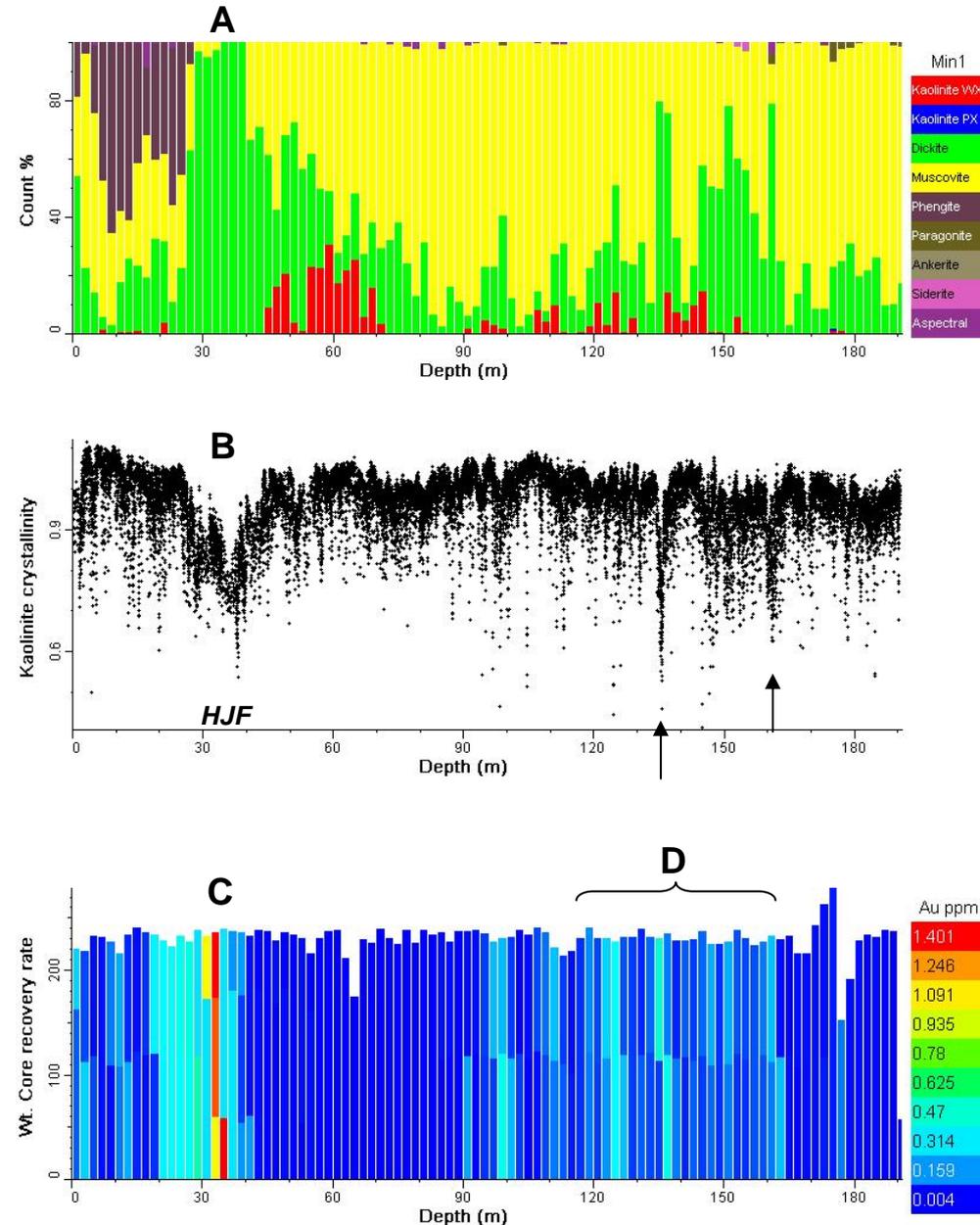
29032-SCDDH4

- A. Dominant mineralogy per 2 m interval
- B. Kaolinite crystallinity per sample.
- C. Gold assays in ppm per 2 m interval

Background mineralogy is dominated by white mica (yellow) with sub-domains defined by variable kaolin group and Al-poor white mica mineralogy.

The highest gold grades (C) fall in a zone of maximum development of the kaolin polytype “dickite” (A) often associated with high temperature hydrothermal alteration. This is also defined by decreased kaolin crystallinity (B). Intermediate Au grades (D) also fall within narrow zones (arrowed) of increased dickite development and decreased kaolin crystallinity from 120-165 metres.

Highest Au grades lie on a gradient of changing mineralogy (longer wavelength, Al-poorer mica) and increased dickite from 20-30 m at the location of the Harvey Junior Fault (*HJF*).



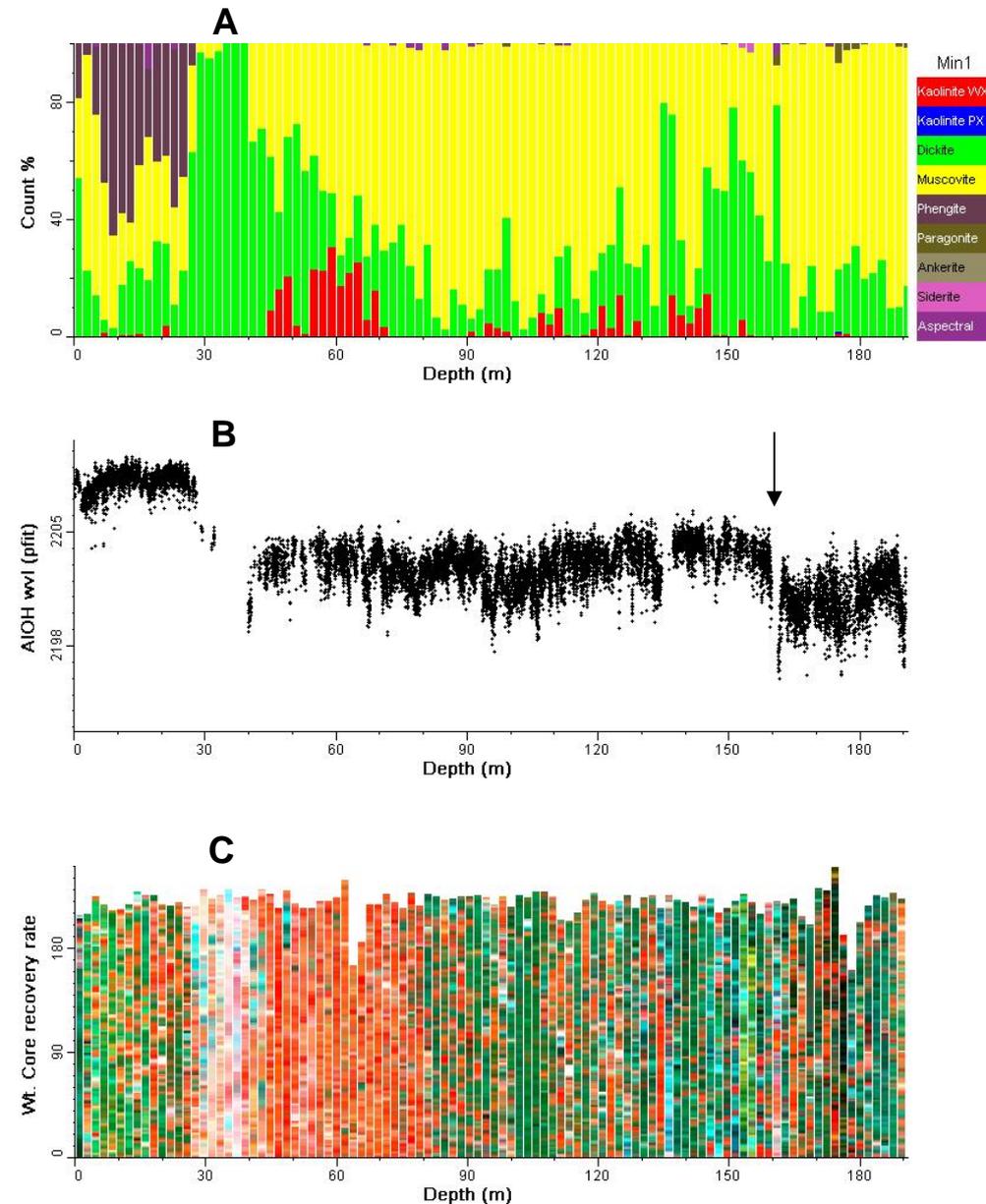
29032-SCDDH4

- A. Dominant mineralogy per 2 m interval
- B. White mica chemistry scalar
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

The wavelength of the AIOH band near 2200 nm is influenced by both mica chemistry, and kaolin group mineralogies. Plot B shows only samples classified as containing mica as the dominant phase.

Highest gold grades occur in an interval at the boundary (B) of two white mica chemistry domains indicative of a change in mica Al content and where mica abundance is minimised or absent (relative to dickite). A weaker mica domain boundary is evident near 160 m (arrowed)

The aforementioned higher Au assay zone (B) is also evident as a white zone in a colour composite combining iron oxide, OH and clay information bands (plot C), plus further red, blue, dark green and light green domains.



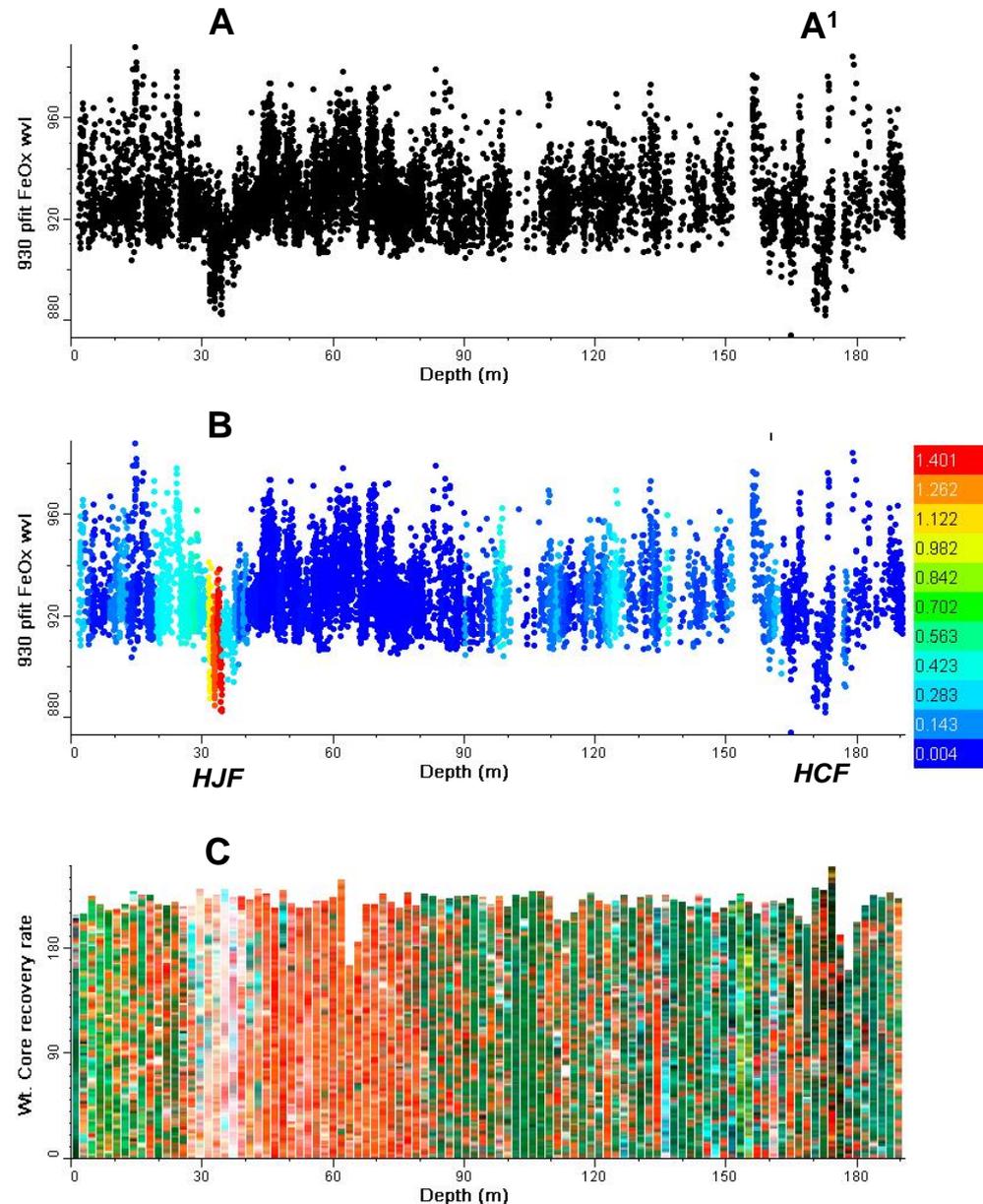
29032-SCDDH4

- A. Hematite / goethite wavelength index
- B. Hematite / goethite wavelength index coloured by Au assays
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

The wavelength of the 930 nm band (A) is indicative of a change from hematite (shorter wavelengths) to goethite (longer wavelengths).

Two zones of more hematitic signatures are apparent at A and A¹ in a background of dominantly goethitic character. A and A¹ appear coincident with the Harvey Junior Fault (*HJF*) and Harvey Creek Faults (*HCF*) respectively.

The strongest of these hematitic zones corresponds to the zone of highest Au assays (plot B) and is the cause of the white zone in plot C.

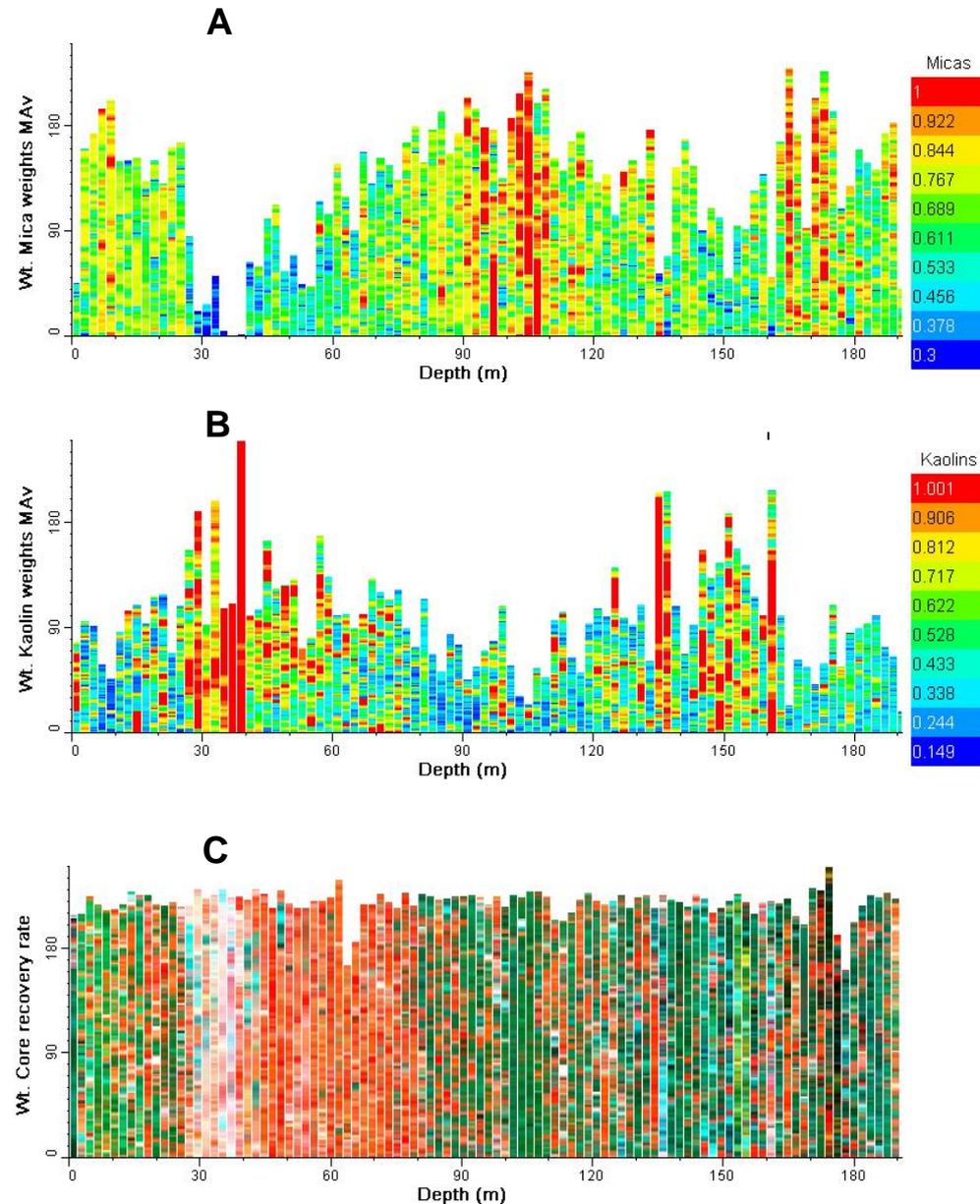


29032-SCDDH4

- A. Proportion of all white mica bearing samples.
- B. Proportion of all kaolinite group samples.
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

Plots A and B indicate the inverse relationship between the development of white mica and kaolin group minerals.

The zone of higher Au grades coincident with reduced mica and maximum kaolin group (dickite) bearing samples is clearly evident.



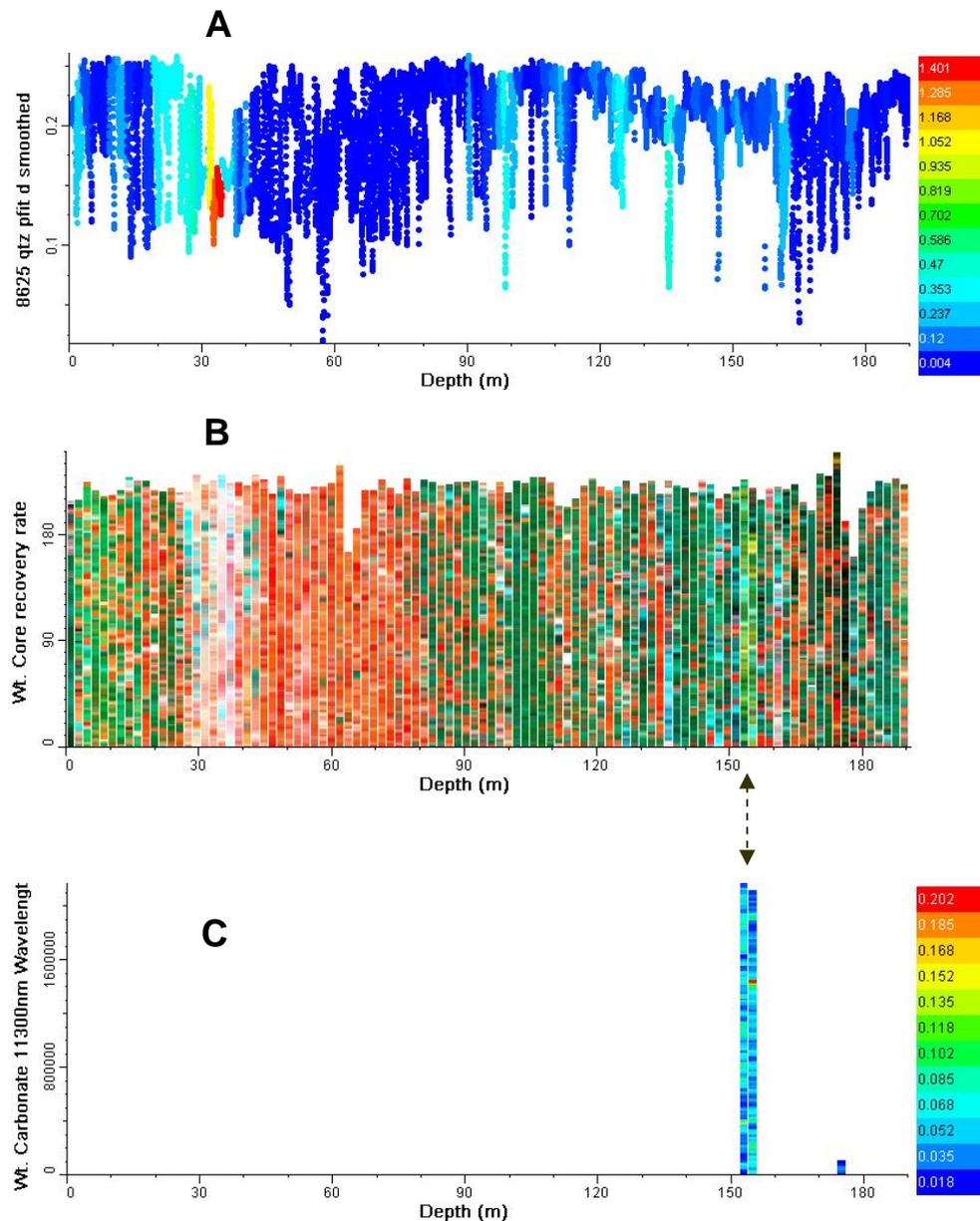
29032-SCDDH4

- A. Intensity of quartz development
- B. False colour composite using 920, 1413, 2178 nm bands in RGB.
- C. Carbonate distribution.

Plot A measures the normalised depth of the quartz absorption feature at 8625 nm and indicates an apparent reduced intensity of quartz development in the zone of highest Au grades. This is interpreted as due in part to the increase in clay development in this interval. Lower in the drill hole further narrow zones of low quartz development (high clay) also have slightly higher gold grades (cyan).

Plot B provides a reference to plots on previous pages.

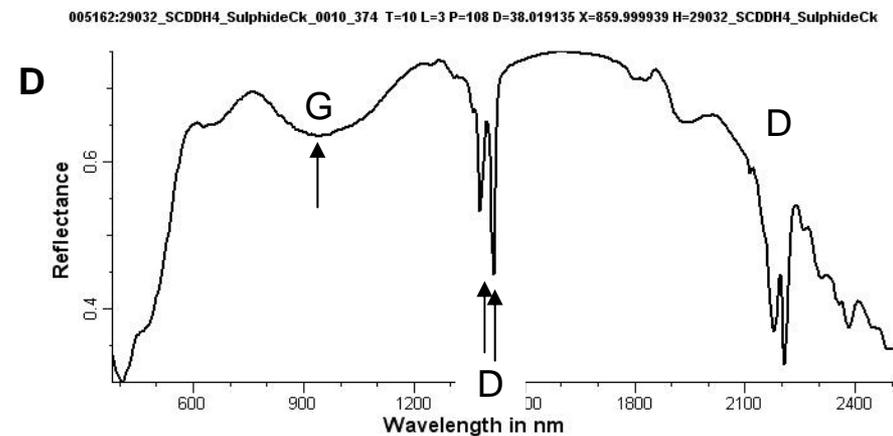
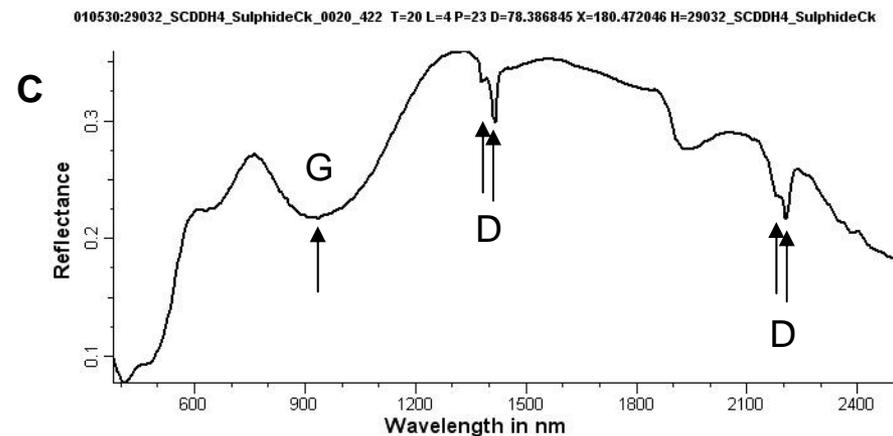
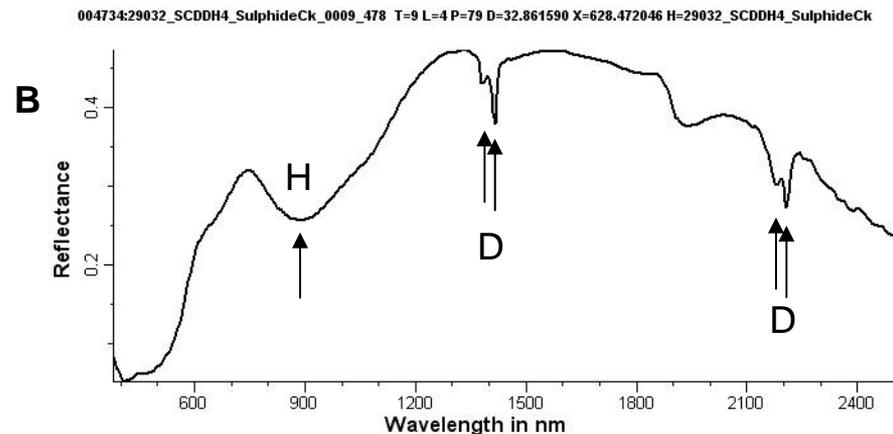
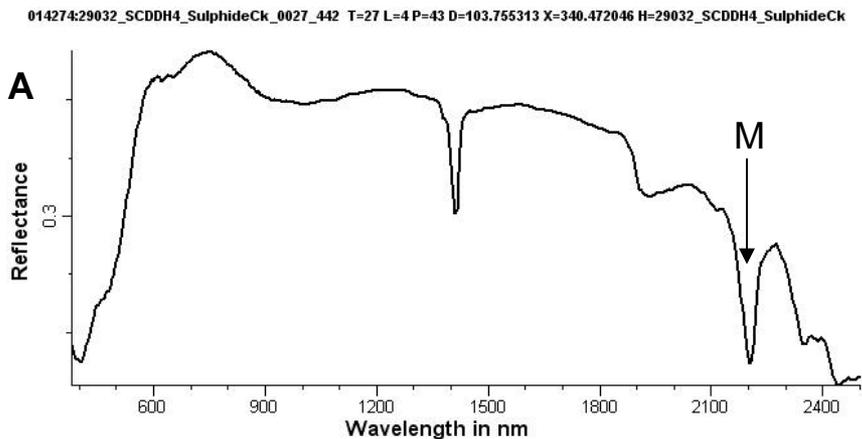
Plot C indicates the localised developed of carbonate near 154 and 175 metres in two quartz + dickite + carbonate zones. Some of this carbonate is strongly ferroan in character and gives rise to the light yellow-green colours in the false colour composite (arrowed).



29032-SCDDH4

Example mineral spectra

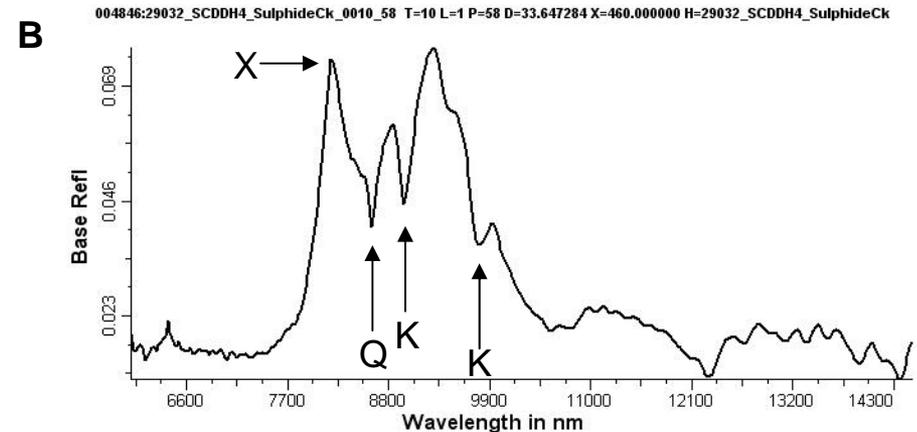
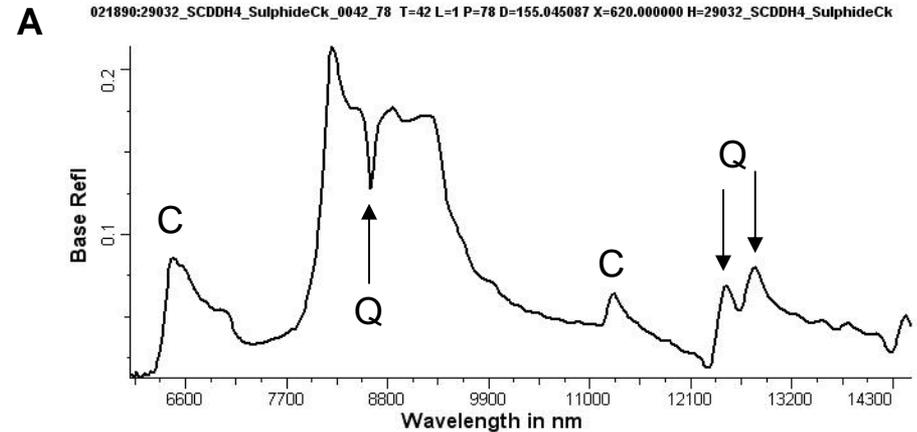
- A. Typical muscovite (M) spectrum
- B. Typical Hematite (H) + Dickite (D) spectrum
- C. Typical Goethite (G) + Dickite (D) spectrum
- D. Typical Goethite + very strong Dickite spectrum (D)



29032-SCDDH4

Example mineral spectra

- A. Typical carbonate (C) + quartz (Q) spectrum
- B. Typical quartz (Q) + kaolin (K) spectrum where the left-hand horn of the quartz spectrum is especially distorted (X) by the fine surface clay fraction.



29032-SCDDH4

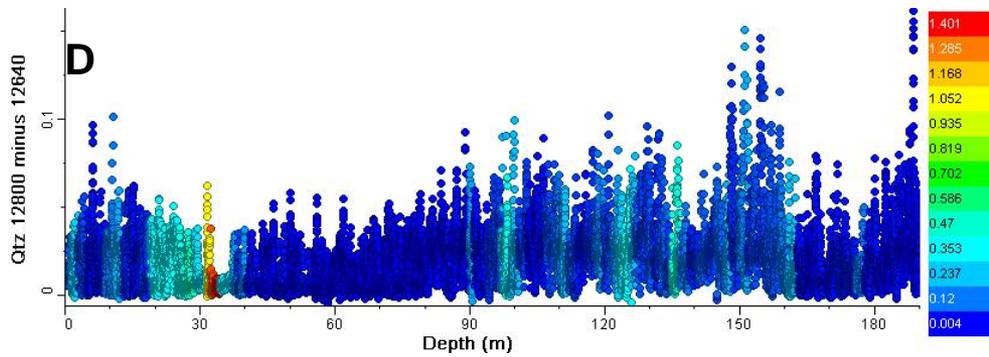
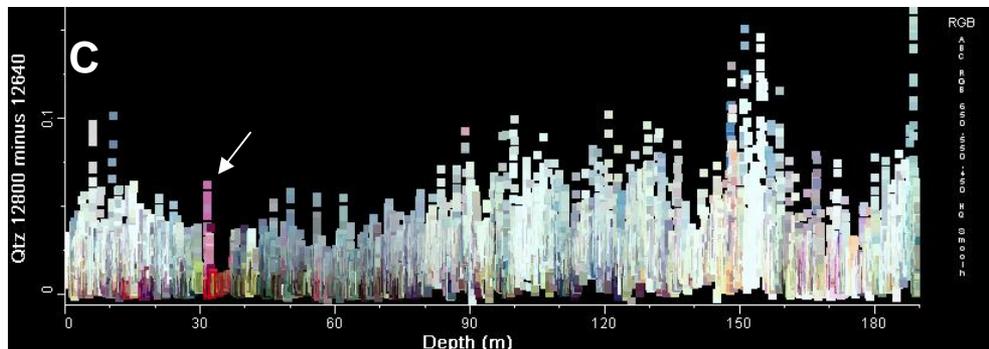
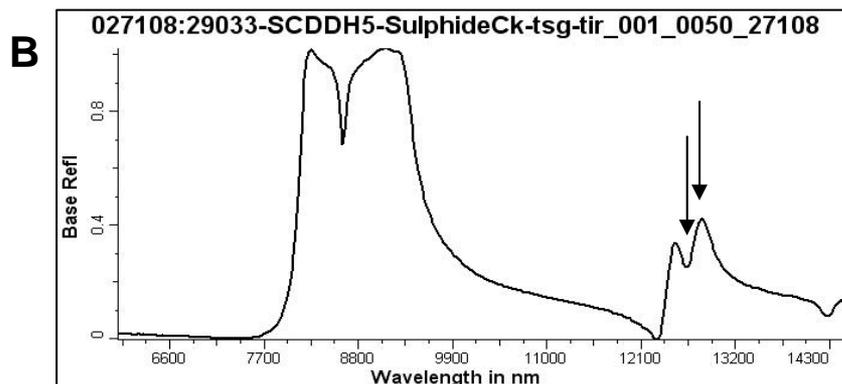
A/B/C - Pure quartz development

An alternative to the normalised quartz index shown earlier (which is impacted by goethite and clays) this page addresses the longer wavelength quartz feature near 12800 nm.

The 12800 nm minus 12640 nm quartz feature (see arrows in B), which is less impacted by the presence of goethite/clay, successfully enhances purer quartz occurrences (plot C).

The index in C is coloured by a contrast enhanced natural colour composite which draws attention to red, hematitic-stained quartz (arrowed and see also in A). Unlike drill hole SCDDH2 such situations are not also carbonate bearing.

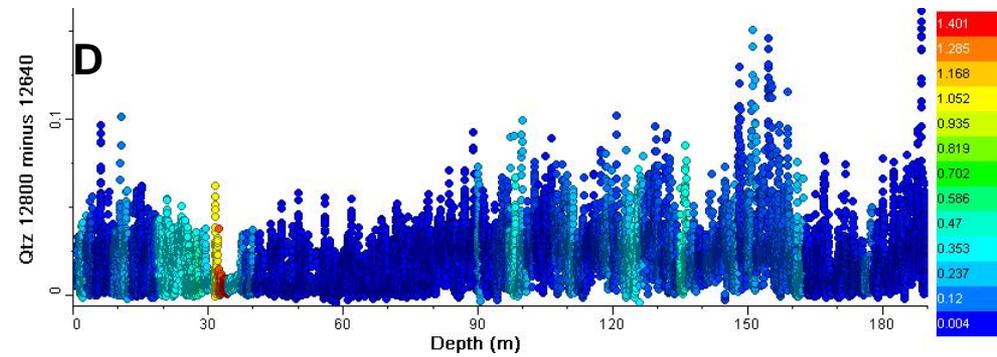
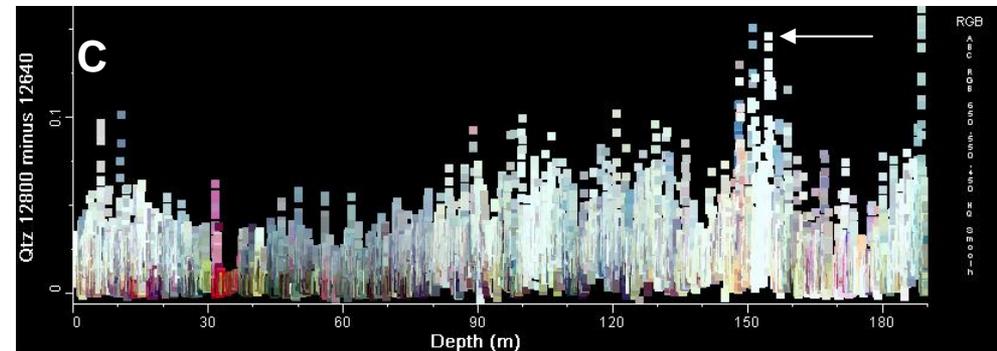
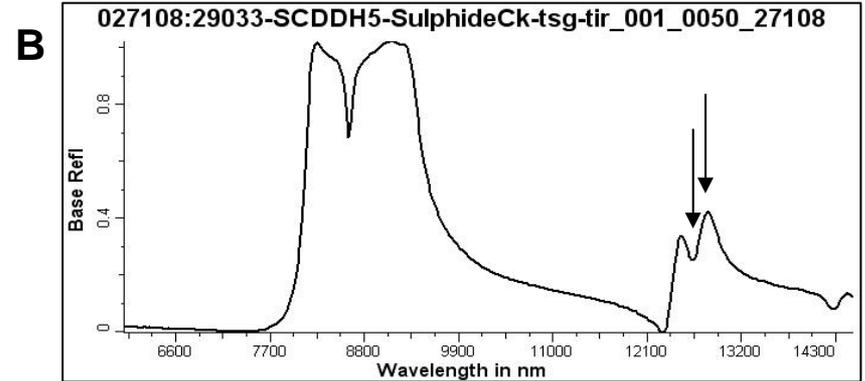
In plot D the same quartz index is coloured by Au assays and shows that there are local increases in this quartz index intensity in the vicinity of elevated Au values (bearing in mind the different sampling intervals).



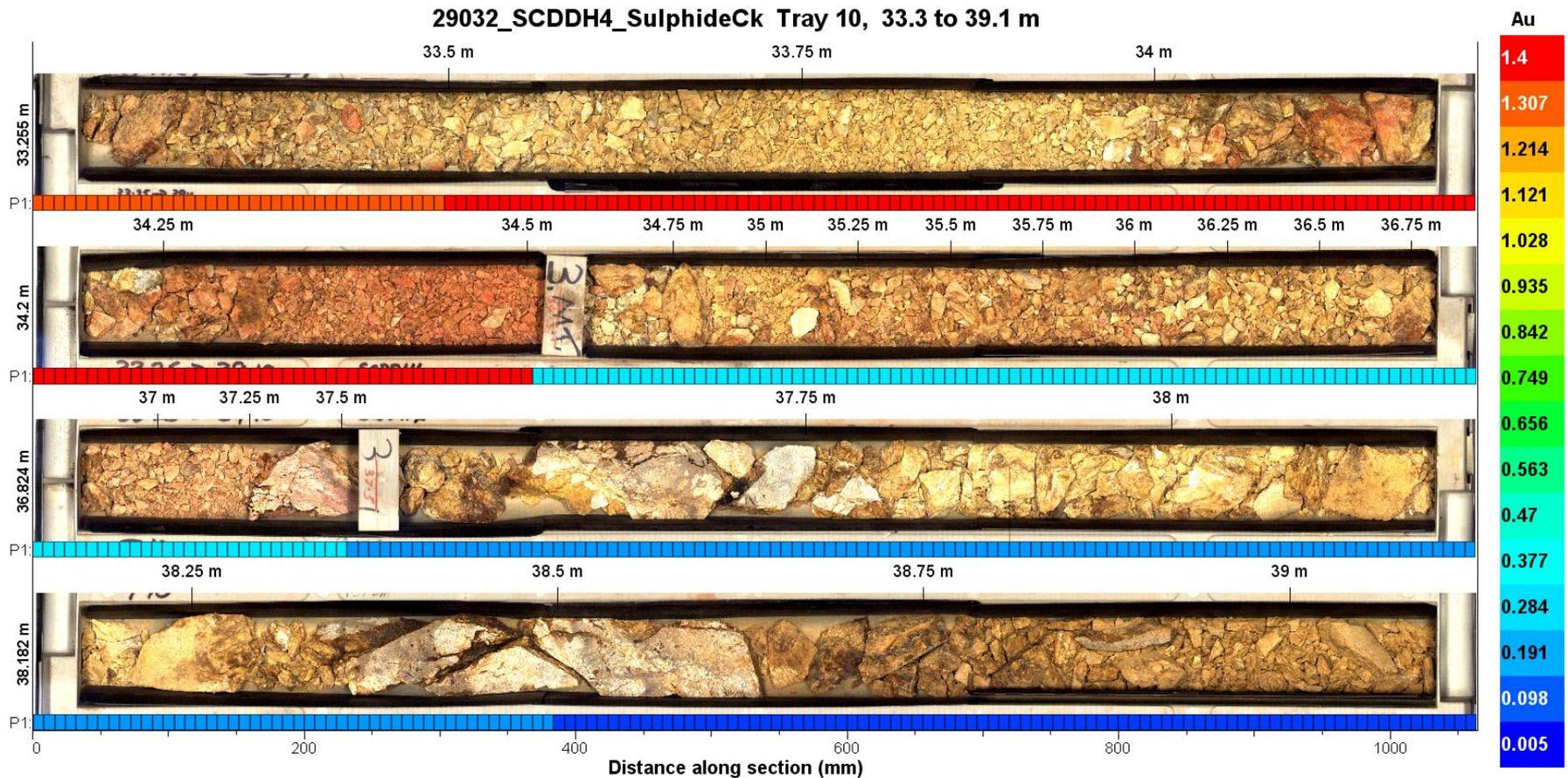
29032-SCDDH4

A/B/C - Pure quartz development

The highest index values in C (white arrow) also show an increase in multiple generations of fine cross-cutting quartz veins and thicker blue quartz veins (image A).



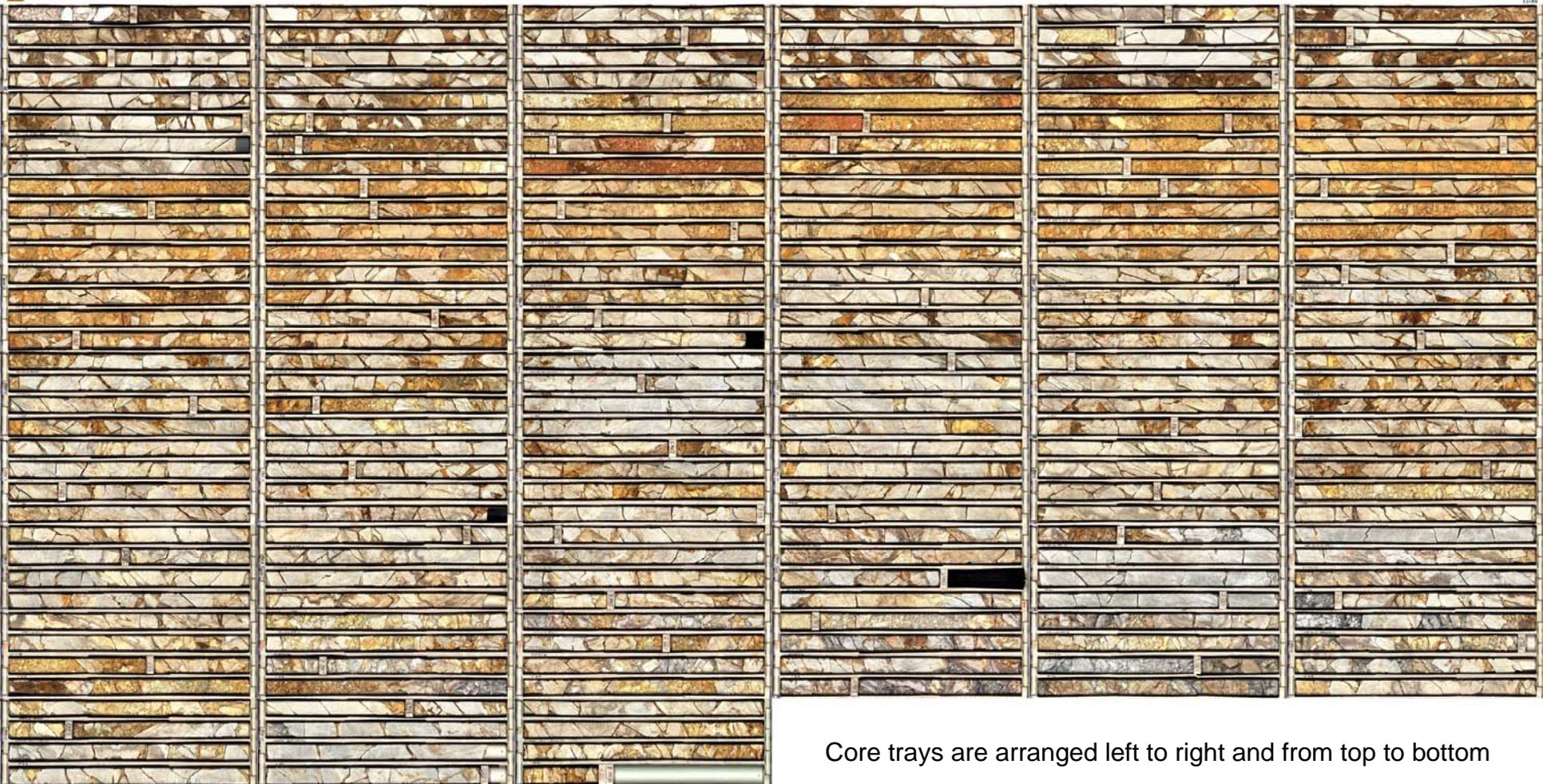
29032-SCDDH4 – Core Tray 10 with Au Assays



Core trays 9 and 10 illustrate the hematitic alteration but also substantial core loss raising caution over the correlation of assays and the core logs.

29032-SCDDH4 - Drill hole mosaic

29032-SCDDH4 Sulphide Creek HyLogging Systems



Core trays are arranged left to right and from top to bottom

Drill hole 29033-SCDDH5

29033-SCDDH5

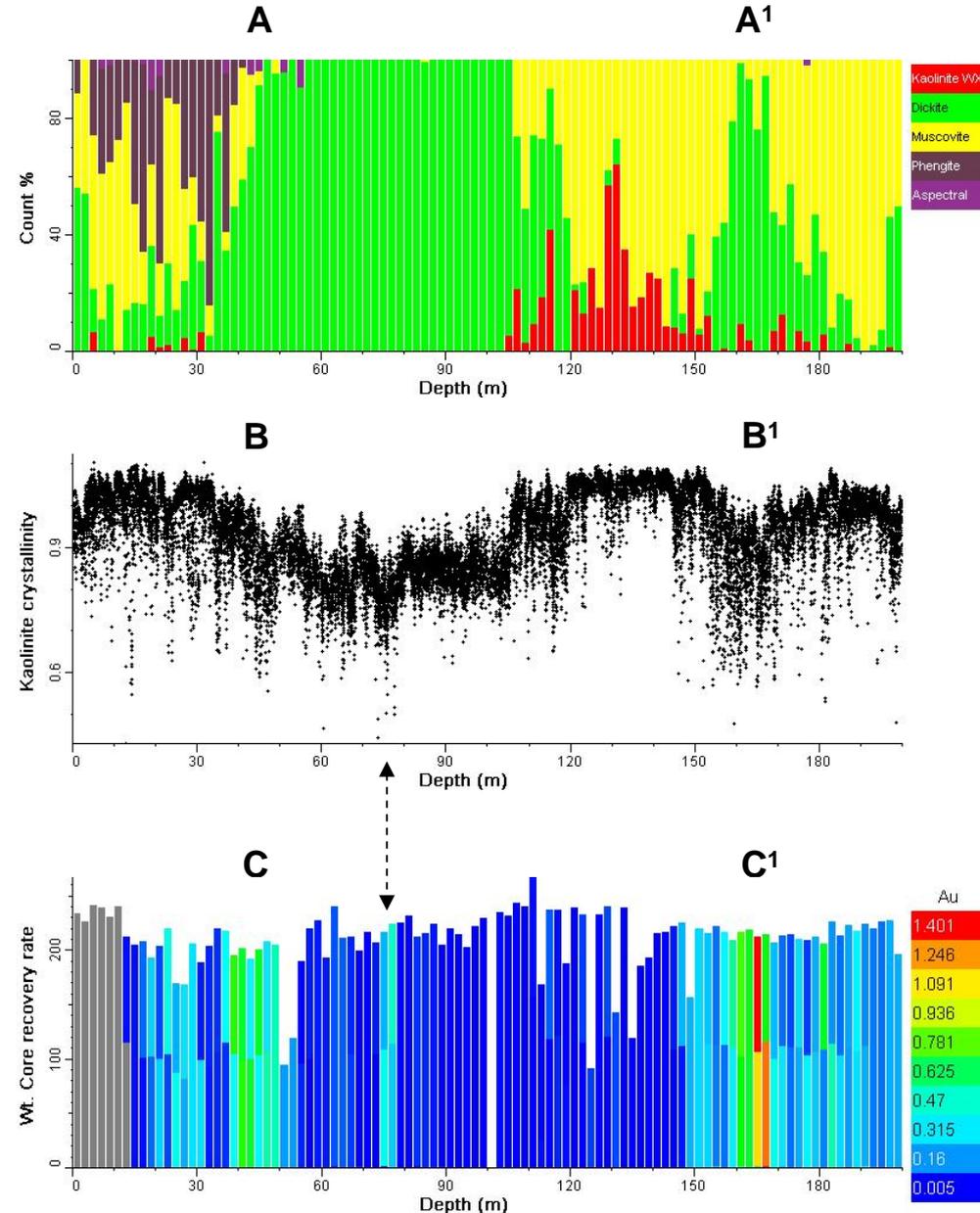
- A. Dominant mineralogy per 2 m interval
- B. Kaolinite crystallinity per sample.
- C. Gold assays in ppm per 2 m interval

Background mineralogy is dominated by white mica (yellow and brown) with sub-domains defined by variable kaolin group and Al-poor white mica mineralogy.

The highest gold grades (plot C) occur in two situations.

Situation 1: In a zone defined by increased dickite development / lower kaolin crystallinity index (at A¹, B¹, C¹). Additional Au grades also fall within narrow zones of lower kaolin crystallinity, e.g. at 75 metres (arrowed).

Situation 2: High Au grades also lie on a gradient of changing mineralogy or a lithological / structural domain boundary at A, B and C (defined by a change from longer wavelength, Al-poorer mica to increasing dickite from ~38 - 48 metres.



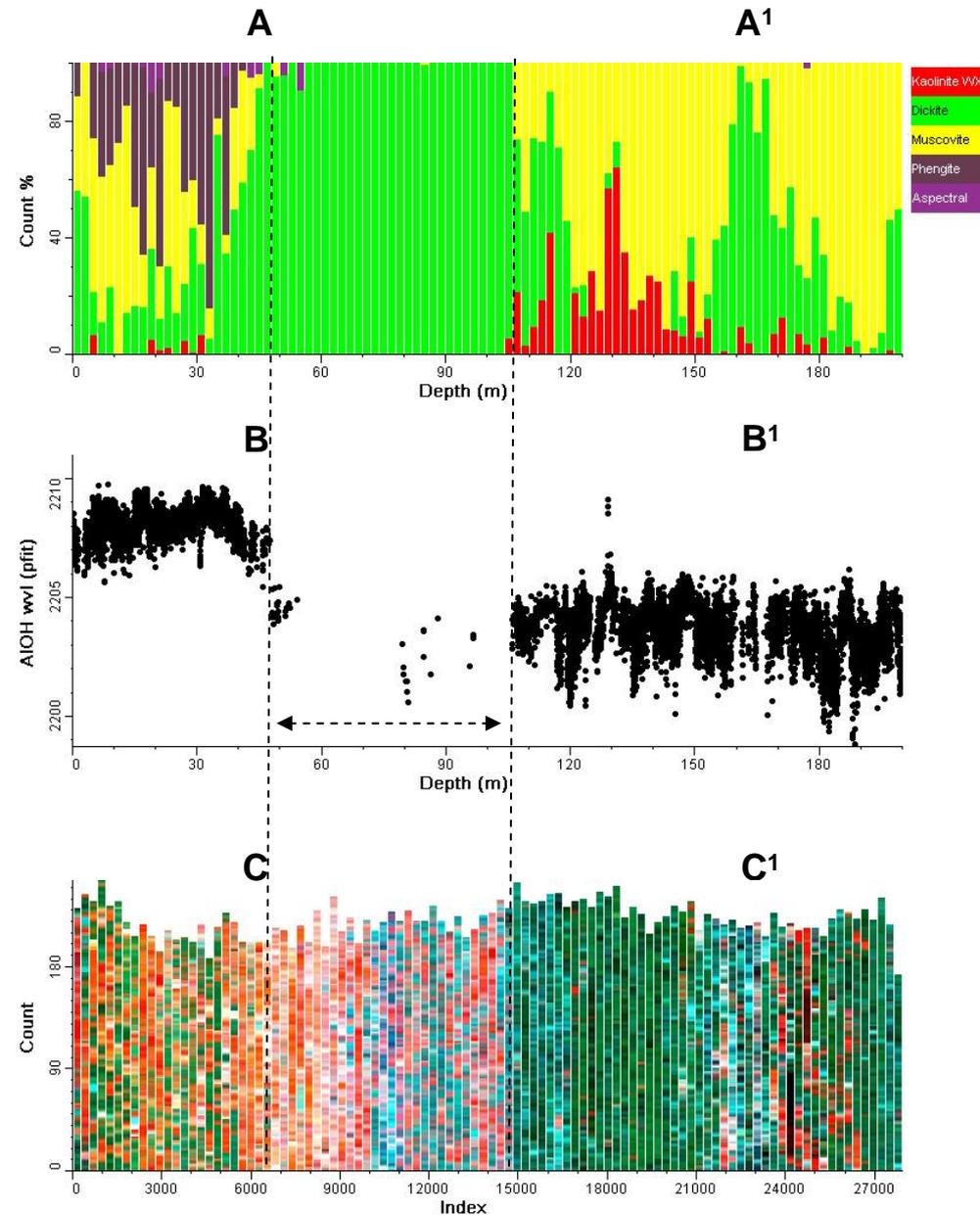
29033-SCDDH5

- A. Dominant mineralogy per 2 m interval
- B. White mica chemistry scalar
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

The wavelength of the AIOH band near 2200 nm is influenced by both mica chemistry, and kaolin group mineralogies.

Plot B shows only those samples classified as dominantly white mica-bearing defining a clear-cut domain from ~48-105 metres (arrowed) where only dickite occurs.

In plot C the absence of yellow-green colours (seen in SCDDH4 and 2) confirms the relative lack of carbonate in this hole.



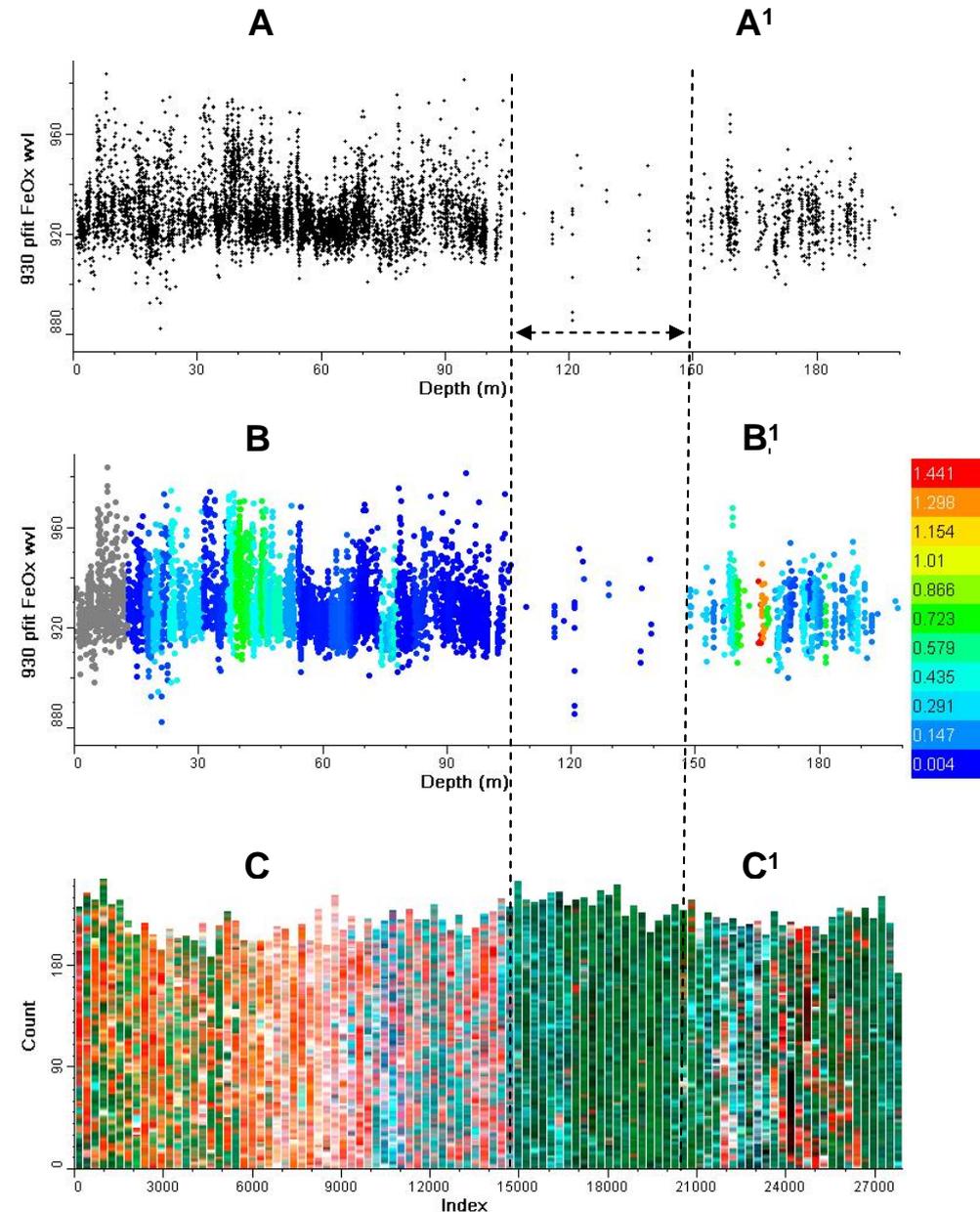
29033-SCDDH5

- A. Hematite / goethite wavelength index
- B. Hematite / goethite wavelength index coloured by Au assays
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

The wavelength of the +/-930 nm band (A) is indicative of a change from hematite (shorter wavelengths) to goethite (longer wavelengths).

Relative to the equivalent plot for drill hole SCDDH4 there is less hematite and the correlation with Au assays less apparent. Almost all data points fall within a wavelength range typical of goethite (a few points near 20 m are associated with slightly redder sediments).

The arrowed interval defines a domain of no iron oxide and equates to the zone of lowest Au assays and the presence of kaolinite between 105 and 149 metres. It also equates to a dark green + blue green interval on the false colour composite (plot C).



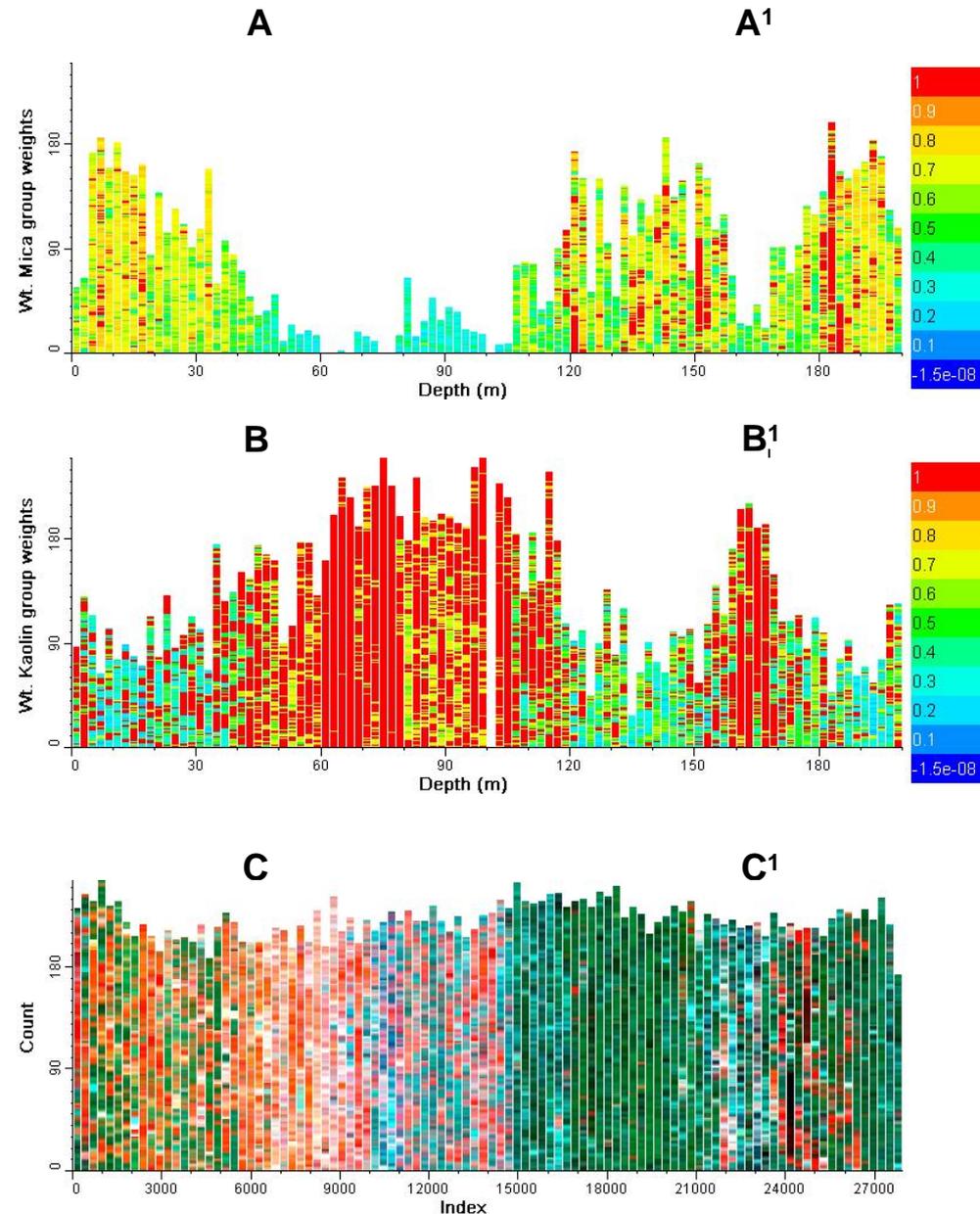
29033-SCDDH5

- A. Proportion (weights) of all white mica bearing samples.
- B. Proportion (weights) of all kaolinite group samples.
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

Plots A and B indicate the inverse relationship between the development of all white mica and kaolin group minerals, regardless as to whether they are dominant or subordinate.

The best gold grades align with the kaolin group (dickite) peak at B¹. Unlike SCDDH4 the second gold concentration near points A, B & C, lies on a gradient of kaolinite group / mica group proportions.

Concentrations of group kaolin minerals impart shades of blue to the false colour composite image (plot C).



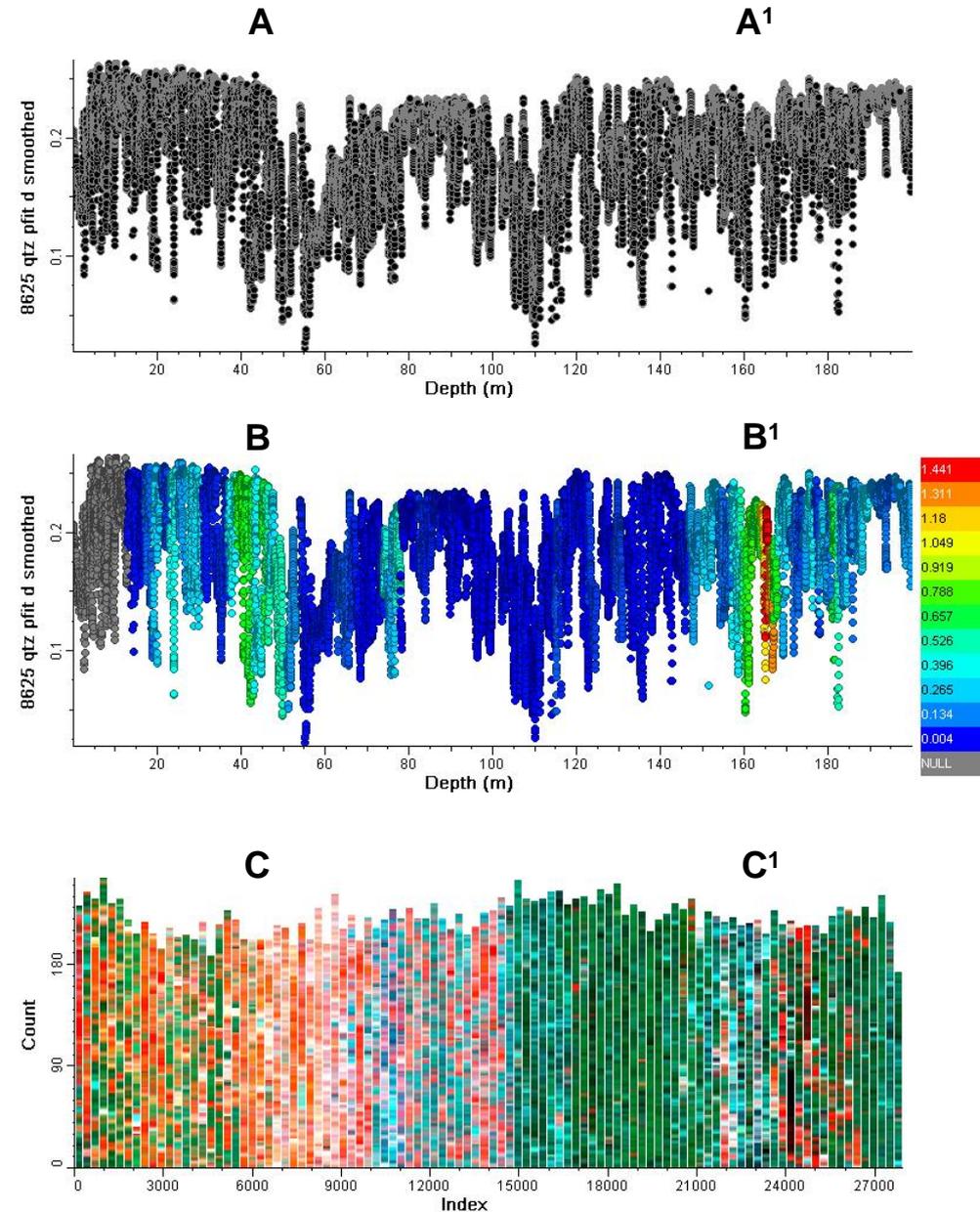
29033-SCDDH5

- A. Intensity of quartz development
- B. Intensity of quartz development coloured by Au assay
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

Plot A measures the normalised depth of the quartz absorption feature at 8625 nm. The reduction in apparent quartz development in selected zones is interpreted in part as due to the relative increase in clay and goethite development (see next page).

In plot B the relationship with Au assay noted in SCDDH4 is not so clear here.

Plot C provides a reference to plots on previous pages.



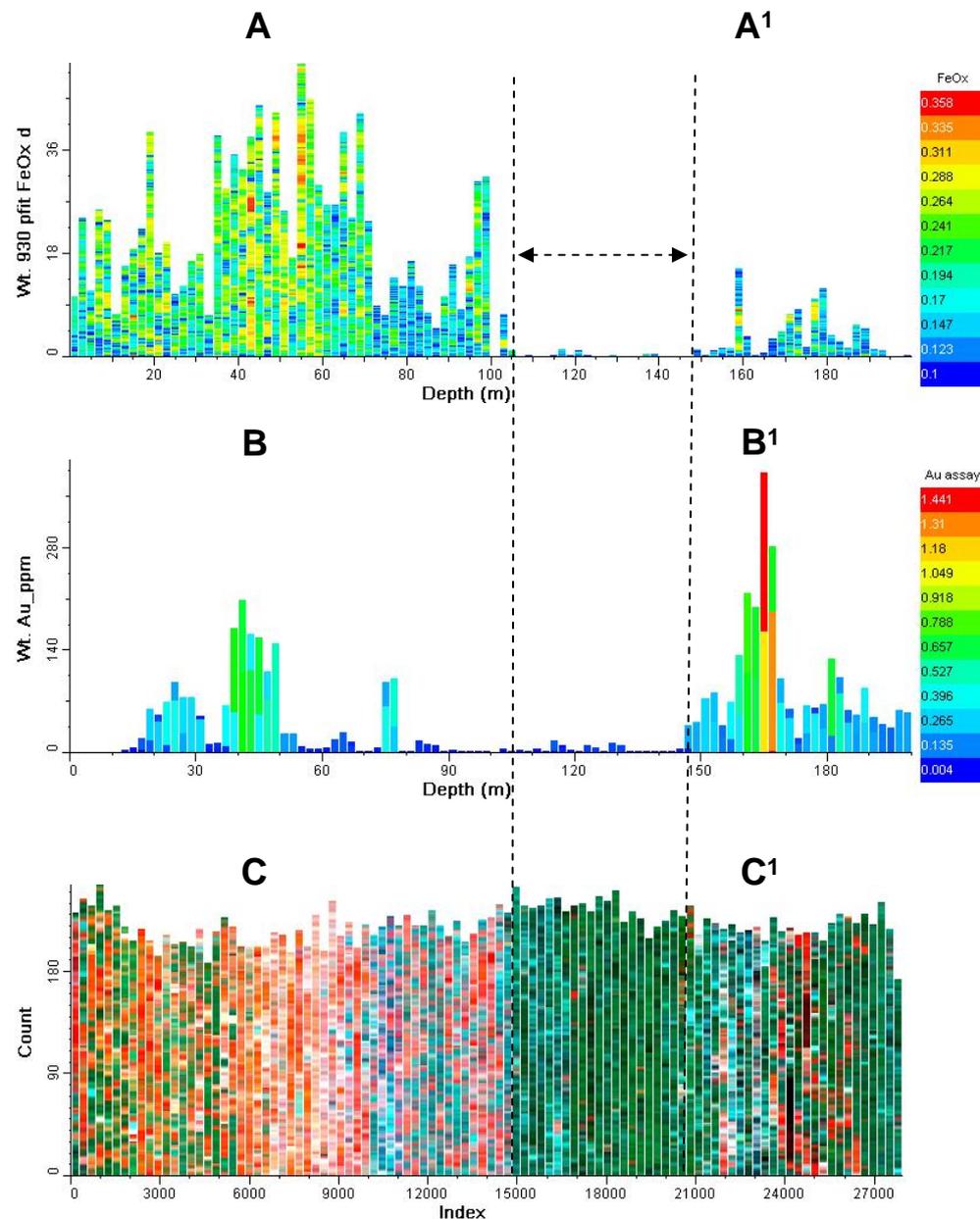
29033-SCDDH5

- A. Intensity of iron oxide development
- B. Weighted Au assay distribution
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

Plot A measures the depth (relative abundance) of the iron oxide absorption feature near 930 nm. The dominant iron oxide here is yellow brown goethite. The deeper the goethite colour the stronger the relative absorption. See next three pages for examples of these goethite characteristics, including the drill hole mosaic.

Plot B of the weighted Au assays indicates that Au does not occur in intervals without iron oxide development.

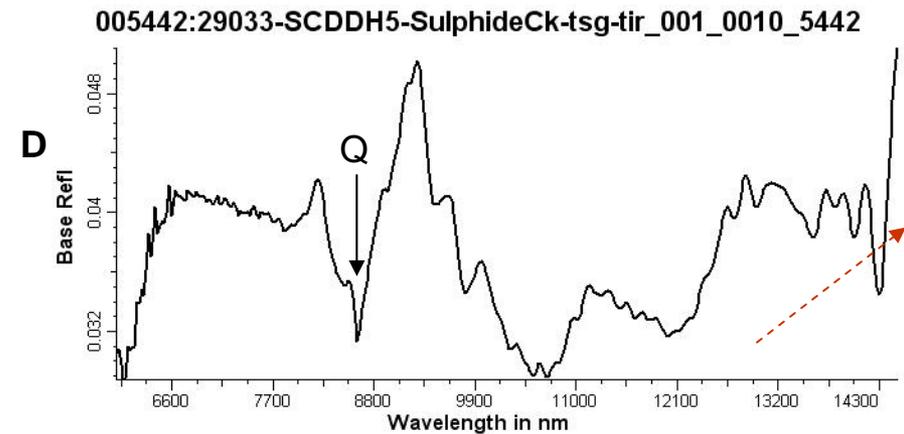
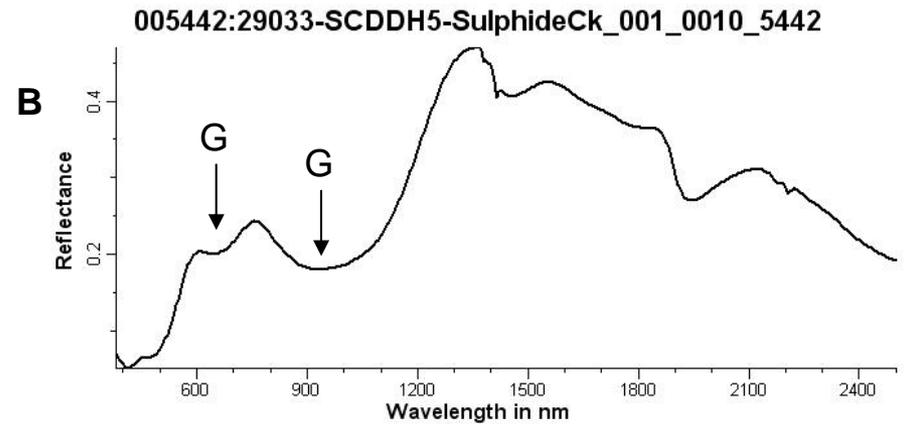
Plot C provides a reference to plots on previous pages.



29033-SCDDH5

Example mineral spectra

- A. Typical goethite (G) spectral characteristics from the shortwave infrared (SWIR).
- B. Image of joint surface represented in A.
- C. Quartz thermal infrared spectrum of A and B showing the completely distorted quartz (at Q) spectrum due, we think, to the goethite and clay signatures. We speculate as to whether there might be another phase present on the joint surface, such as MnO, that is lifting the extreme right-hand end of this spectrum (red arrow). It would be valuable to know what the mineralogy of these joint surfaces are.



29033-SCDDH5

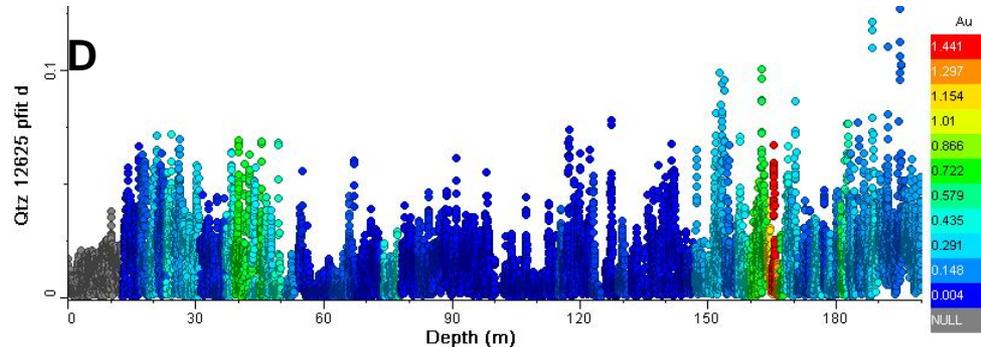
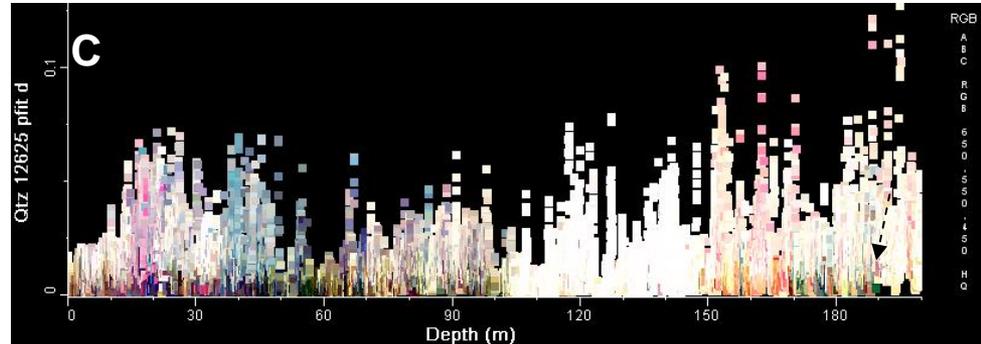
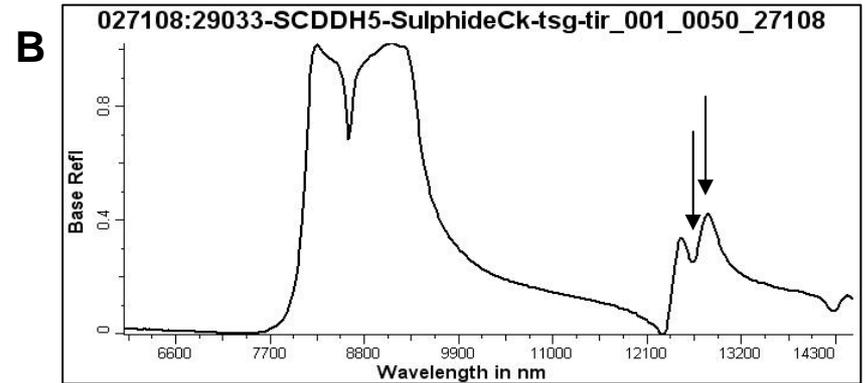
A/B/C - Pure quartz development

An alternative to the normalised quartz index shown earlier (which is impacted by goethite and clays) this page addresses the longer wavelength quartz feature near 12800 nm.

The 12800 nm minus 12640 nm quartz feature (see arrows in B), which is less impacted by the presence of goethite/clay, successfully enhances purer quartz occurrences (plot C).

The index in C is coloured by an contrast enhanced natural colour composite which draws attention to the lower part of the hole where there is an increase in red (hematitic-stained) quartz veining (A). Unlike drill hole SCDDH2 such situations are not also carbonate bearing.

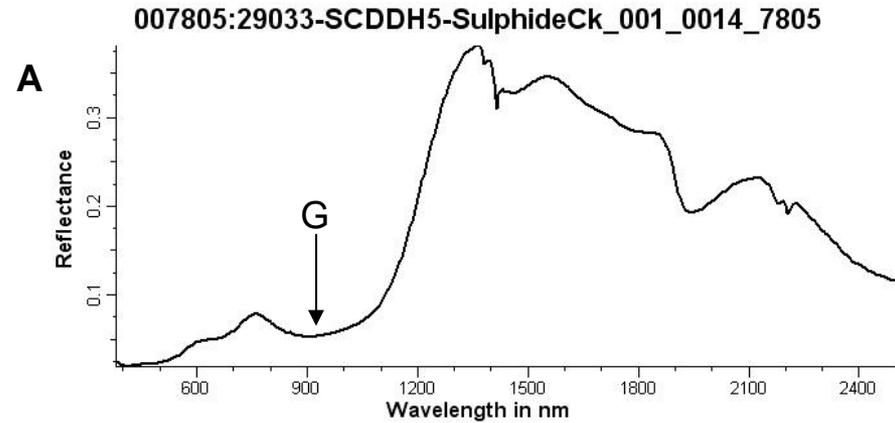
In plot D the same quartz index is coloured by Au assays and shows that there are local increases in this quartz index intensity in the vicinity of elevated Au values.



29033-SCDDH5

Example mineral spectra

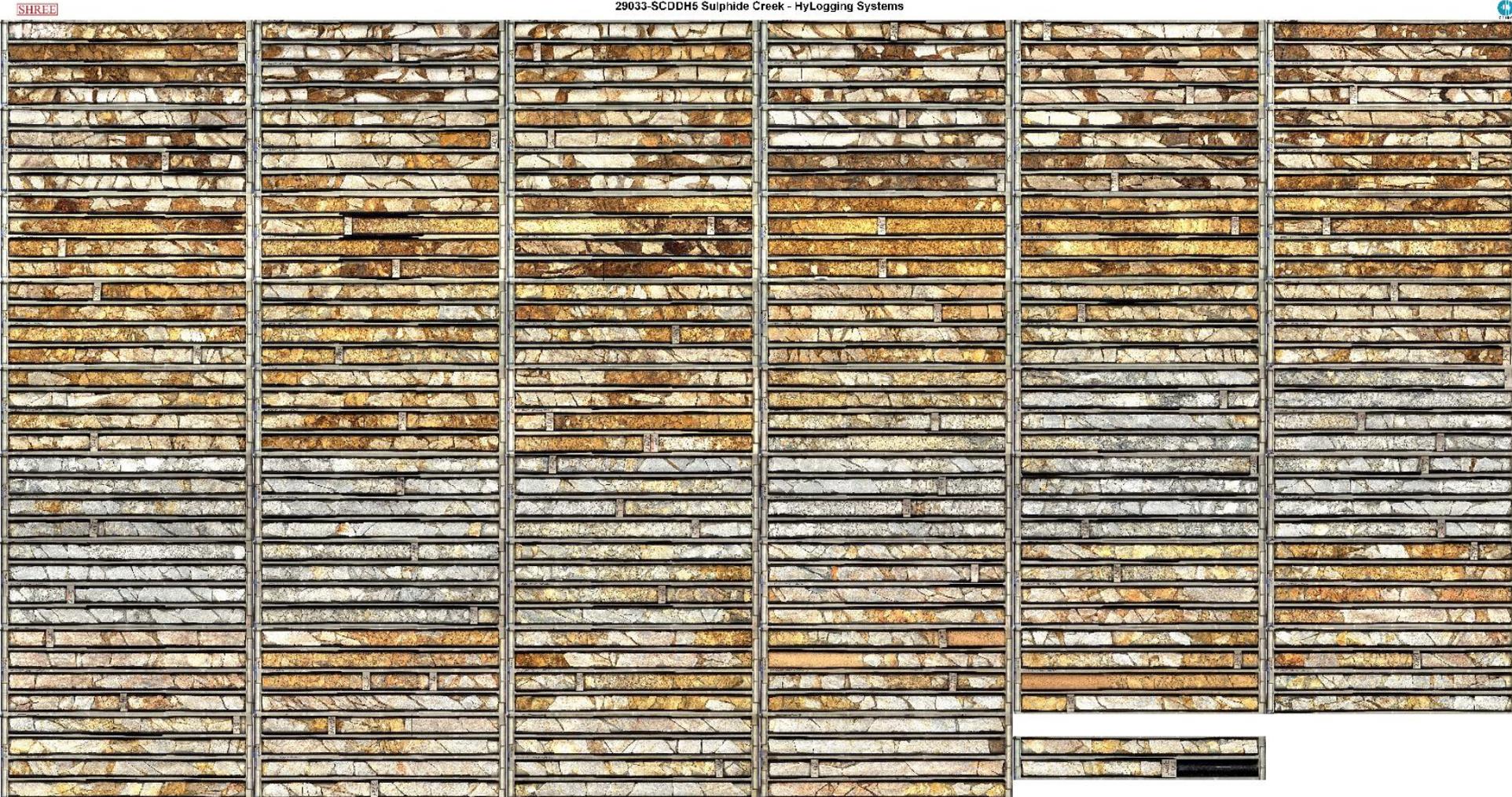
- A. Extreme goethite spectrum (also contains dickite).
- B. Image of sample A.



B



29033-SCDDH5 - Drill hole mosaic



Core trays are arranged left to right and from top to bottom

Drill hole 22878-SCDDH2

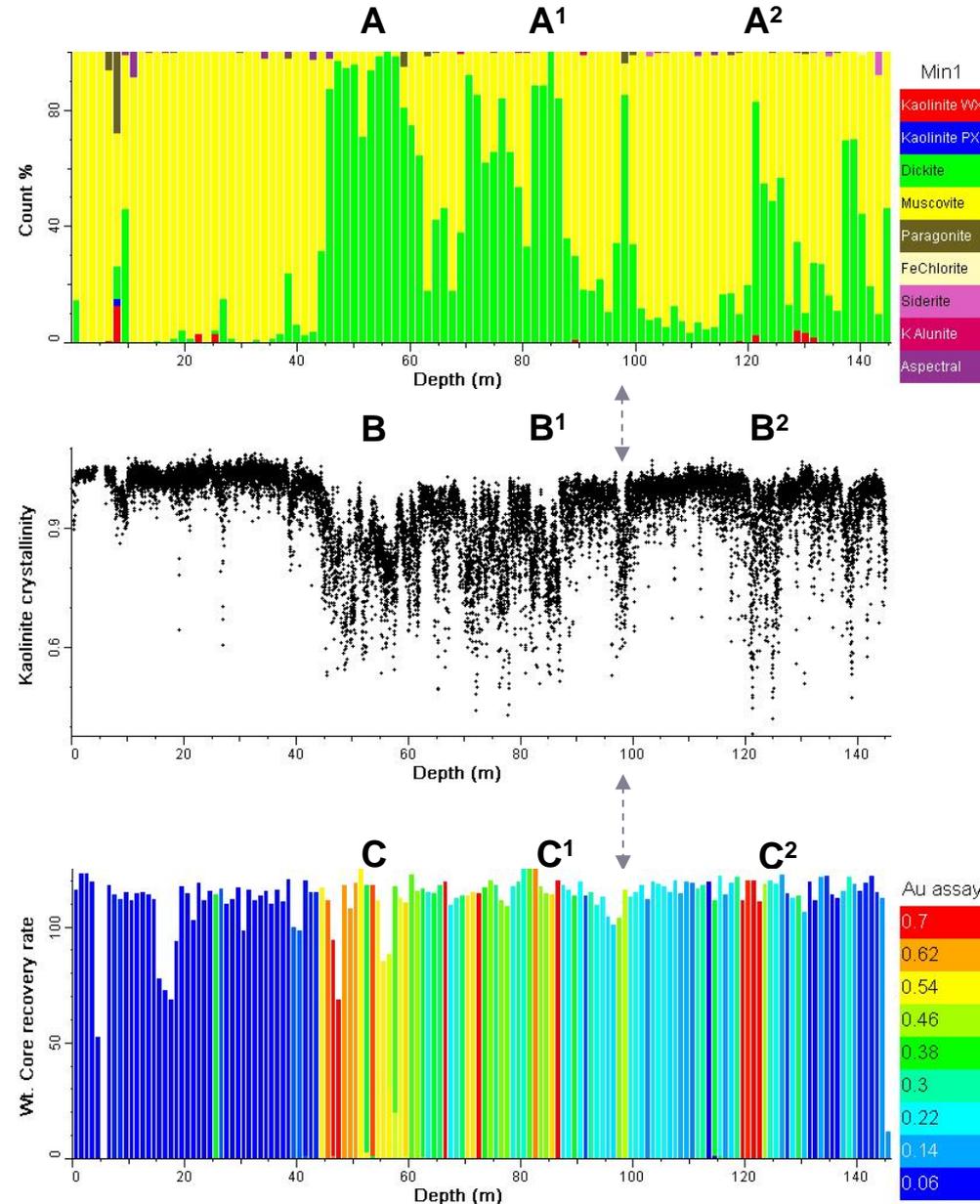
22878-SCDDH2

- A. Dominant mineralogy per 2 m interval
- B. Kaolinite crystallinity per sample.
- C. Gold assays in ppm per 1 m interval

In plot A background mineralogy is again dominated by white mica (yellow) with sub-domains defined by variable kaolin group mineralogy. Other phases add only minor contributions.

The highest gold grades (plot C) fall in zones of maximum development of “dickite” (A-A¹ & A²) comprising proximal hydrothermal alteration zones. These are also defined by decreased kaolin crystallinity index values (plot B).

Lower Au grades (light blue in plot C) fall within intervals of relatively higher kaolinite crystallinity and more abundant mica, e.g. from 100-118 metres. Additional narrow dickite zones (arrowed) also have slightly elevated Au values.



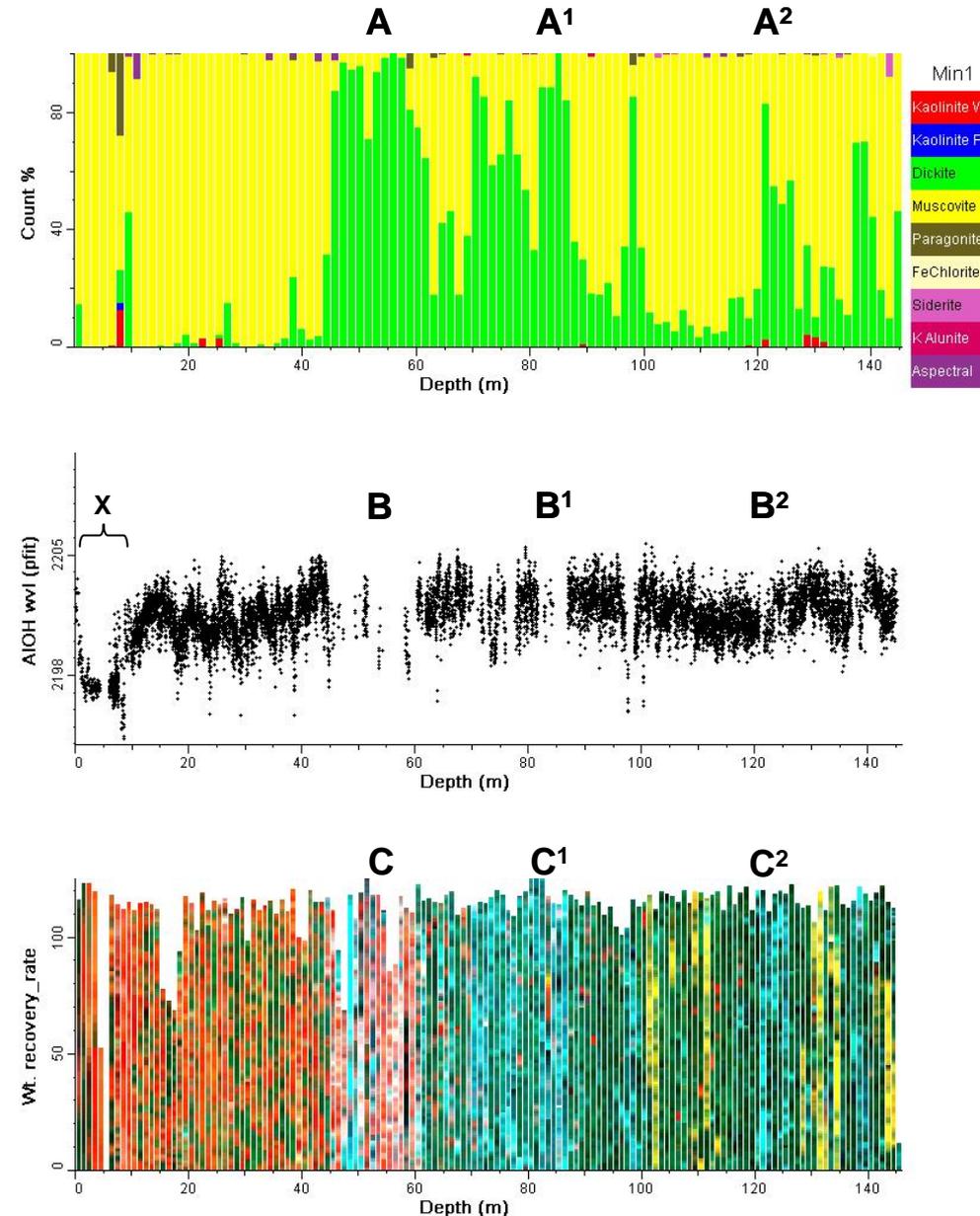
22878-SCDDH2

- A. Dominant mineralogy per 2 m interval
- B. White mica chemistry scalar
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

The wavelength of the AlOH band near 2200 nm is influenced by both mica chemistry, and kaolin group mineralogies.

Plot B shows only those samples classified as dominantly white mica-bearing defining gaps where dickite is dominant. Unlike SCDDH4 & 5 there is no zone of longer than average mica wavelengths. If anything the top of the hole is defined by an interval of shorter than average wavelength mica (bracketed at X) from 0-10 m. Such wavelength variations imply changes in the Al content of the micas.

In plot C light blue colours align with the zones of highest gold grade (C, C¹ & C²) on the previous page.



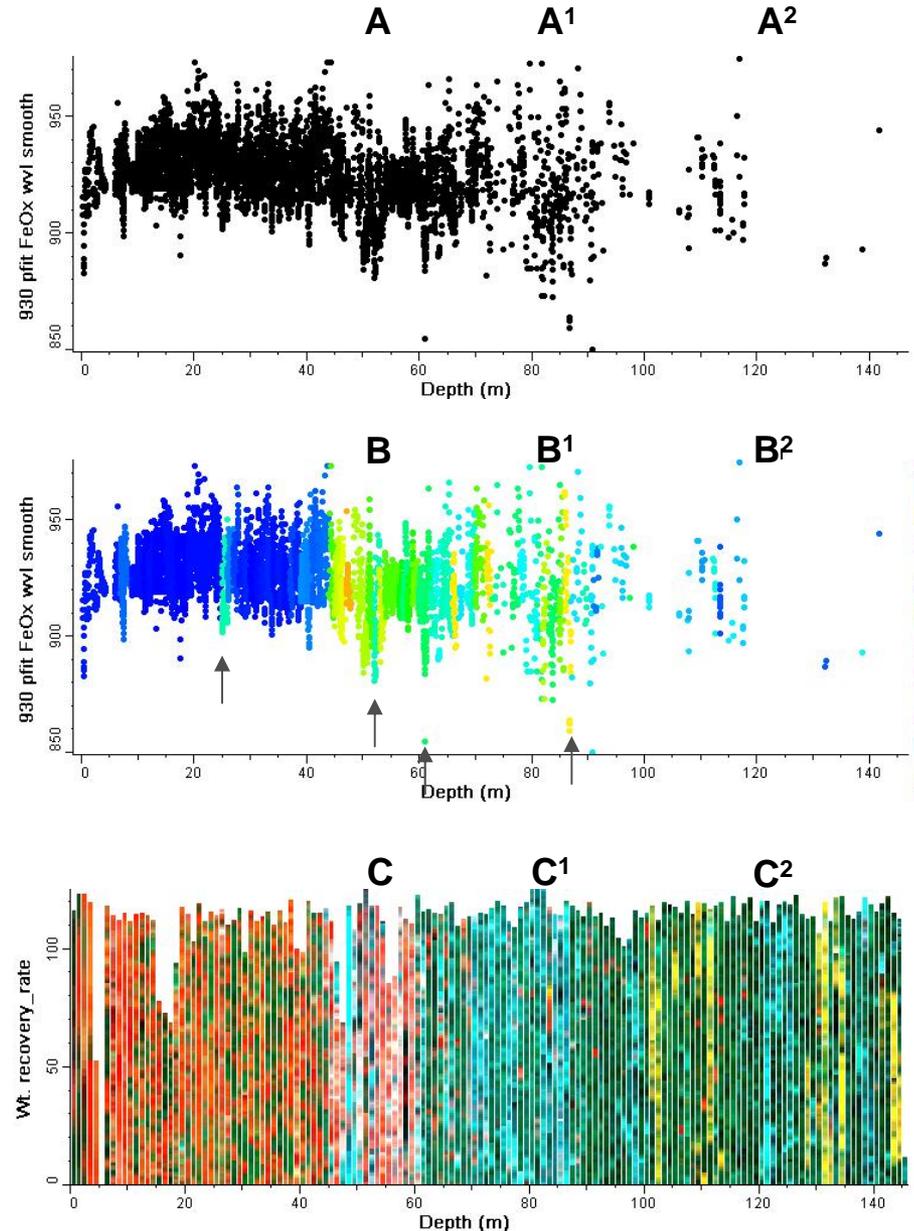
22878-SCDDH2

- A. Hematite / goethite wavelength index
- B. Hematite / goethite wavelength index coloured by Au assays
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

The wavelength of the +/-930 nm band (plot A) is indicative of a change from hematite (shorter wavelengths) to goethite (longer wavelengths).

Most data points cover wavelengths typical of goethite with two exceptions where more hematitic signatures and redder cores are apparent (at A and A¹). Indeed wherever there is a rise in Au assay there are locally shorter iron oxide wavelengths, bearing in mind that the two datasets are sampled at very different intervals.

Notable the 1 metre of highest average Au grade at A²/B² occurs in the absence of all iron oxides (grey rocks). With the exception of the light blue, Au-rich zone at C² the lower part of the hole beyond 90 m is largely iron free and matches the dark green and yellow colours on plot C.



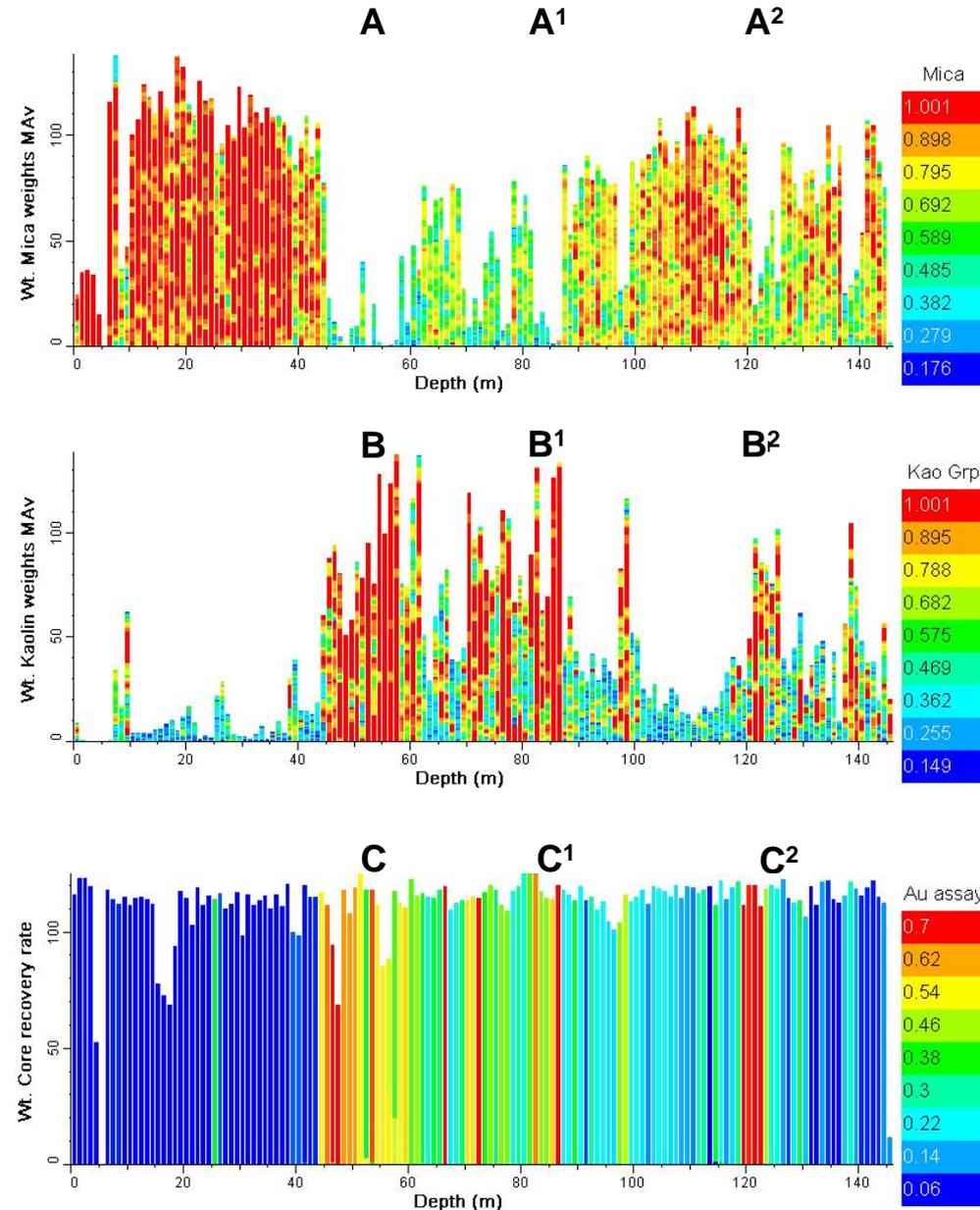
22878-SCDDH2

- A. Proportion (weights) of all white mica bearing samples per 1 m interval.
- B. Proportion (weights) of all kaolinite group samples per 1 m interval.
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

Plots A and B once again indicate the inverse relationship between the development of all white mica and kaolin group minerals, regardless as to whether they are dominant or subordinate.

The best gold grades (plot C) align with the kaolin group (dickite) peaks at B, B¹ & B².

Concentrations of group kaolin minerals impart shades of light blue to the previous false colour composite image.

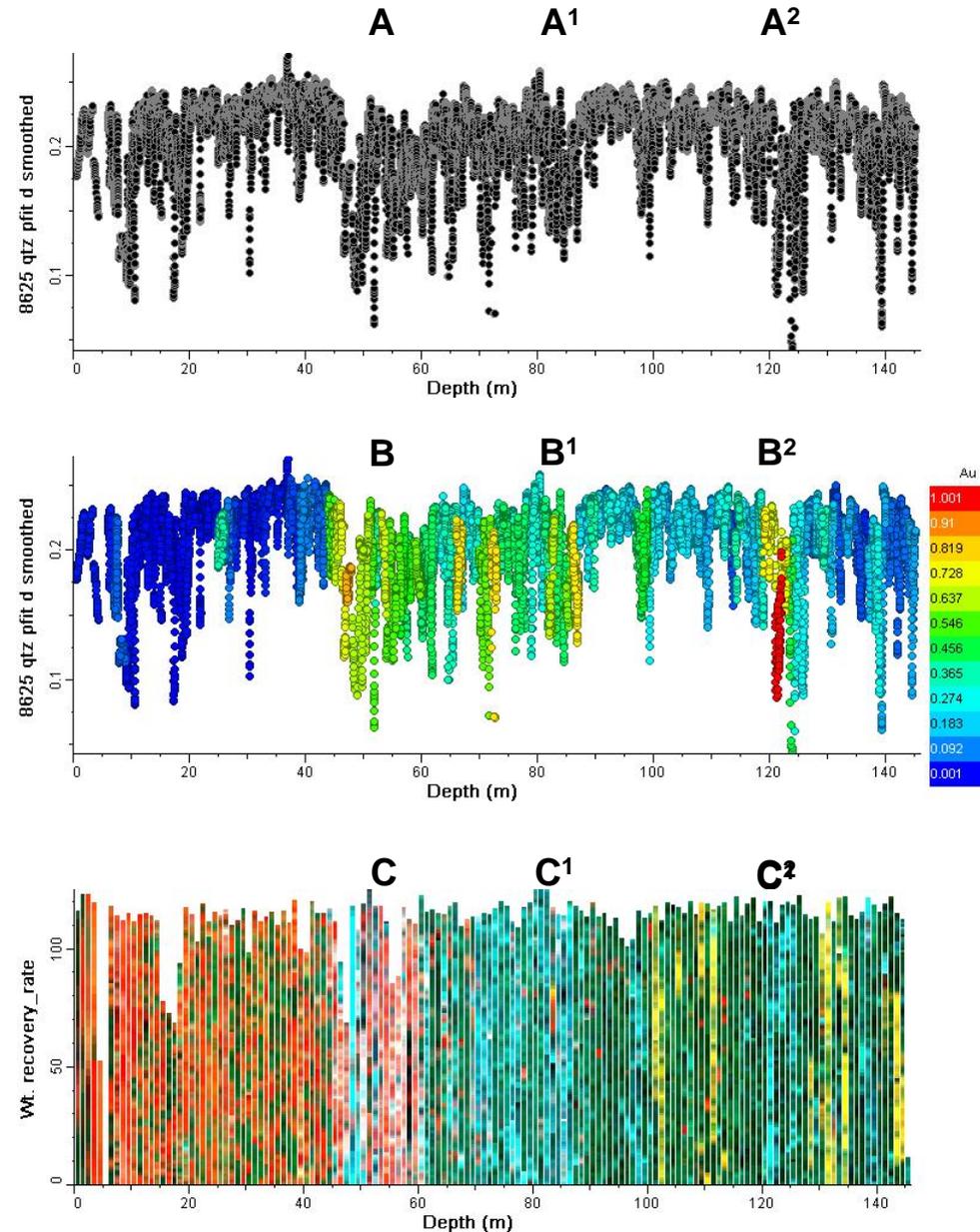


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Plot A measures the normalised depth of the quartz absorption feature at 8625 nm. The reduction in apparent quartz intensity in selected zones is interpreted in part as due to the relative increase in clay and goethite development.

Plot C provides a reference to plots on previous pages.



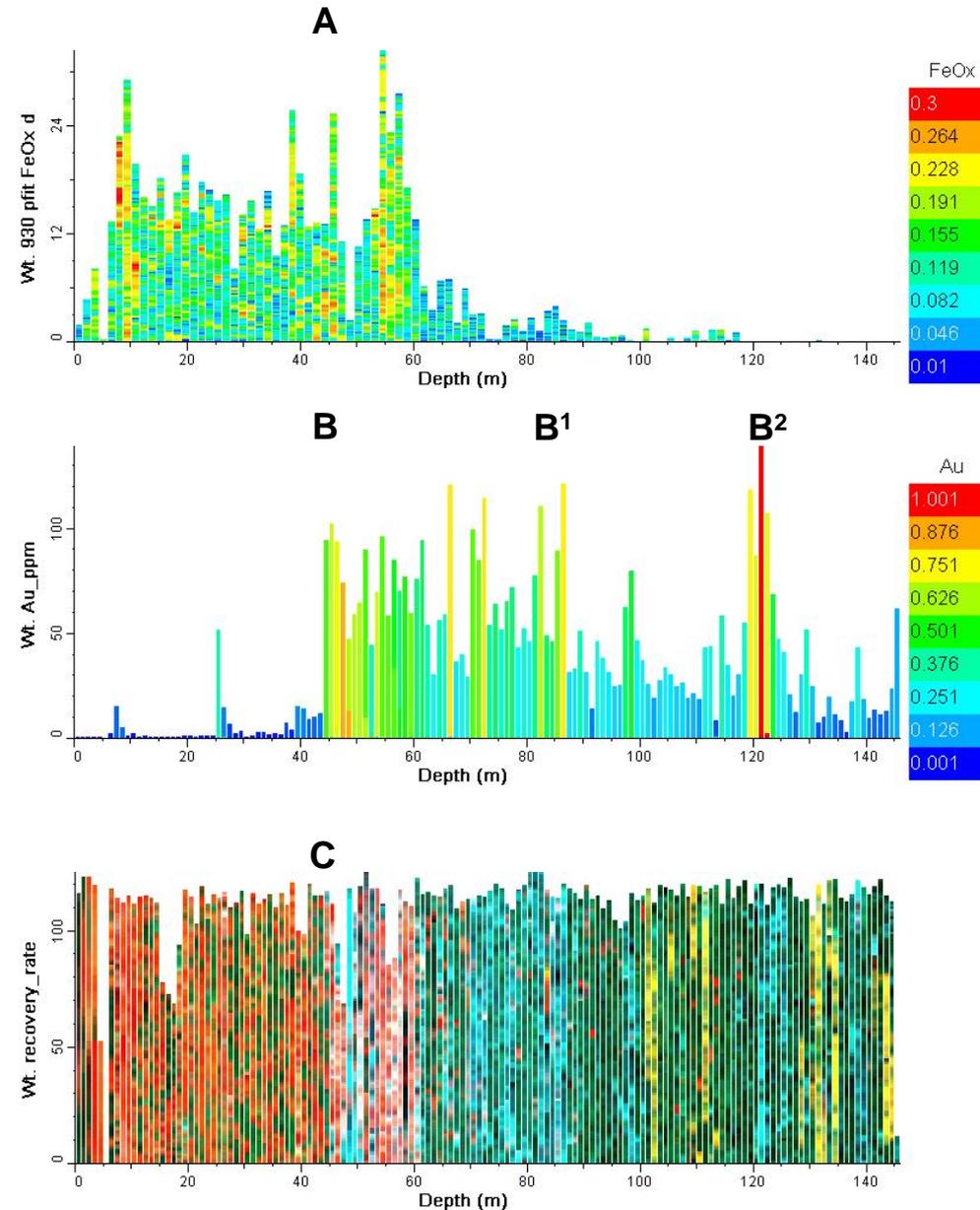
22878-SCDDH2

- A. Intensity of iron oxide development
- B. Weighted Au assay distribution
- C. False colour composite using 920, 1413, 2178 nm bands in RGB.

Plot A measures the depth (relative abundance) of the iron oxide absorption feature near 930 nm. The dominant iron oxide here is yellow brown goethite. The deeper the goethite colour the stronger the relative absorption. Iron oxides are largely limited to the upper parts of the hole above 62 metres.

Plot B of the weighted Au assays indicates that Au occurs in two situations: with (B-B¹) and without (B²) iron oxide development. Structural control is implicated.

Plot C provides a reference to plots on previous pages.

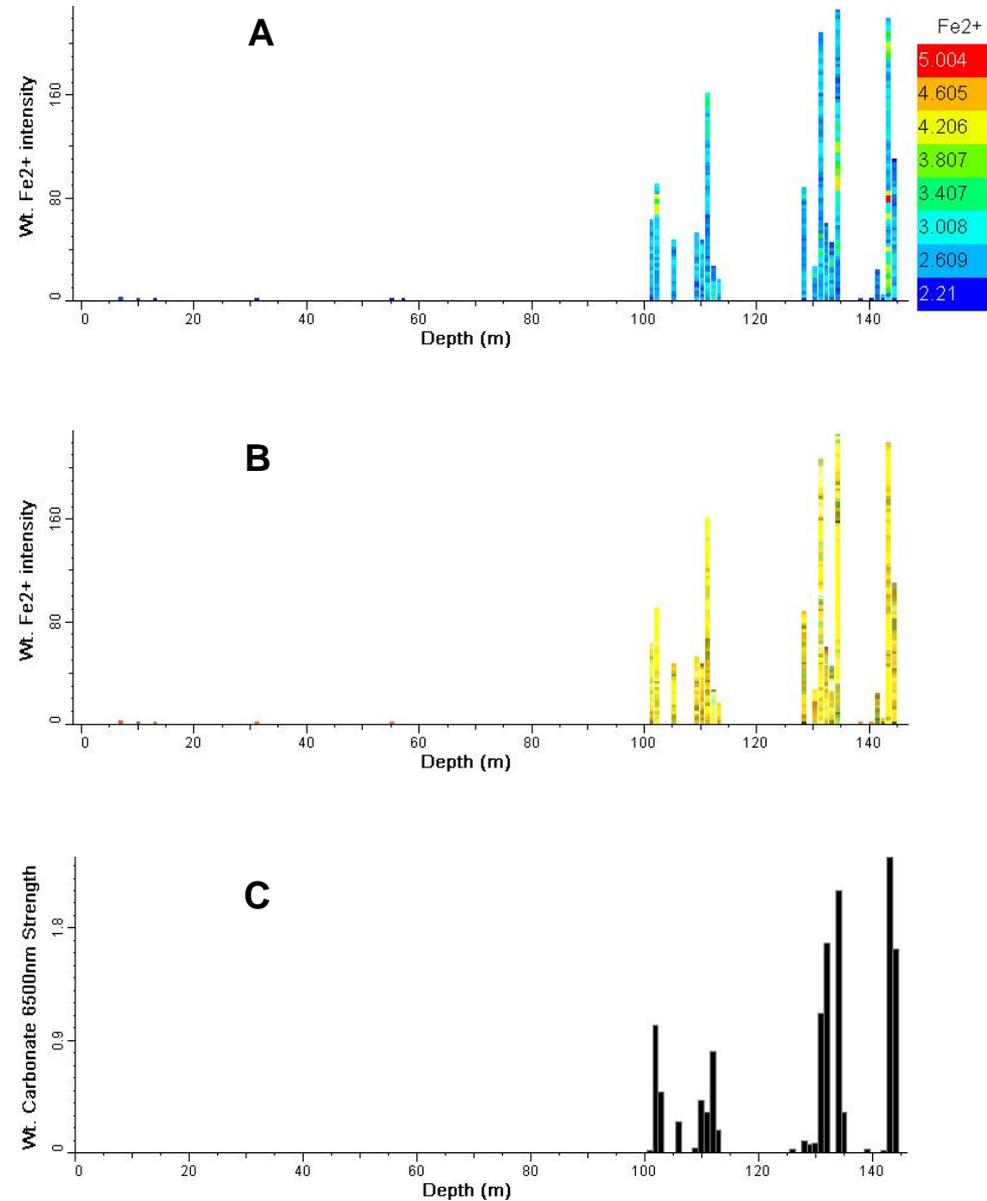


22878-SCDDH2

- A. Ferrous iron (Fe^{2+}) index
- B. Ferrous iron (Fe^{2+}) index coloured by the false colour composite
- C. TIR carbonate distribution per 1 m interval

Plots A & B map the distribution of ferrous iron bearing minerals, in this case yellow-brown to red coloured ferroan carbonates. Plot B provides the explanation for the yellow colours in the earlier false colour composite logs.

Plot C shows the distribution of carbonates as mapped by the height of the 6500 nm thermal infrared (TIR) CO_3 peak.



22878-SCDDH2

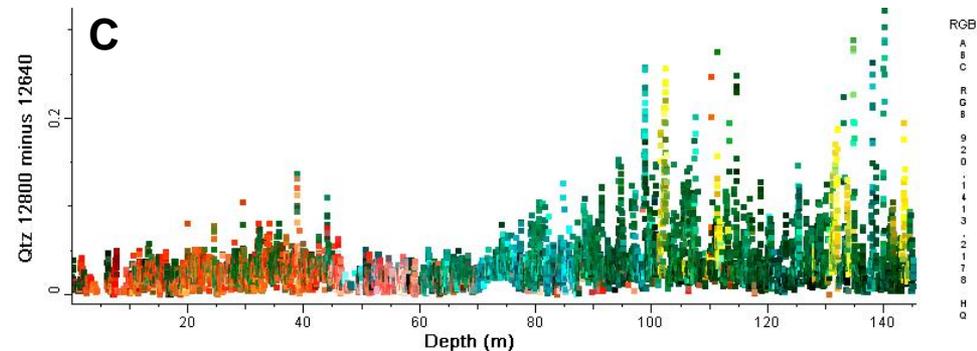
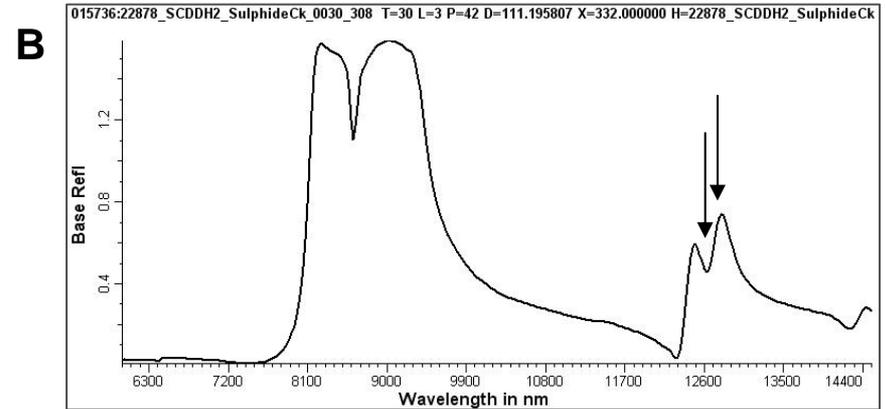
A/B/C - Pure quartz development

From ~87 m onwards SCDDH2 changes character to a fresher, less limonitic, but noticeably more siliceous rock with numerous generations of white and blue cross-cutting quartz veining +/- carbonate (A).

Because most of the drill hole is quartz bearing and the classic quartz signatures are compromised by the surface goethite and clay coatings it is hard to quantify the relative abundance of these lower grey siliceous and multiply veined rocks.

An index of the 12800-12640 nm quartz feature (see arrows in B), which is less impacted by the presence of goethite/clay, successfully enhances this part of the drill hole (C) with its quite different character. The index maps the purest quartz signatures in the hole.

The index (C) is coloured by the previous false colour composite – with high-value blue samples being the purest quartz and the yellow samples being quartz plus carbonate.

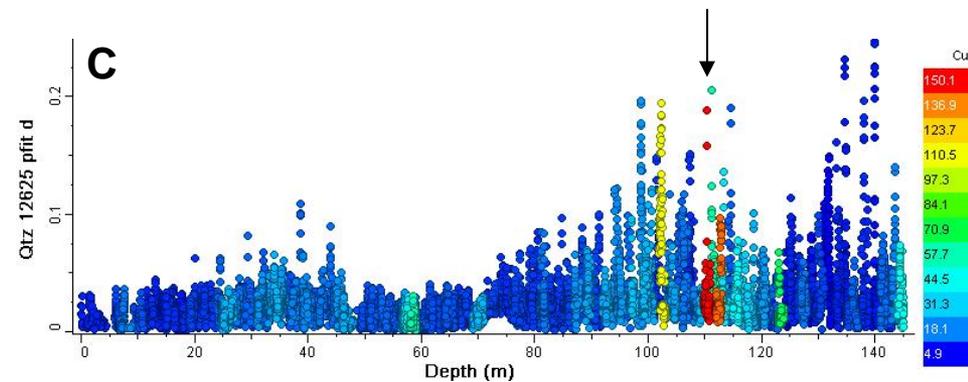
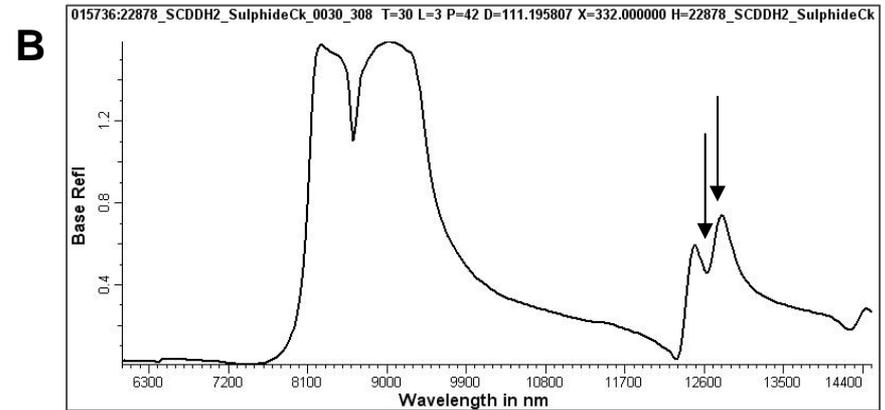


22878-SCDDH2

A/B/C - Pure quartz development + Cu

In plot (C) the 12800 minus 12640 pure quartz index (plot B) is coloured by the Cu assays.

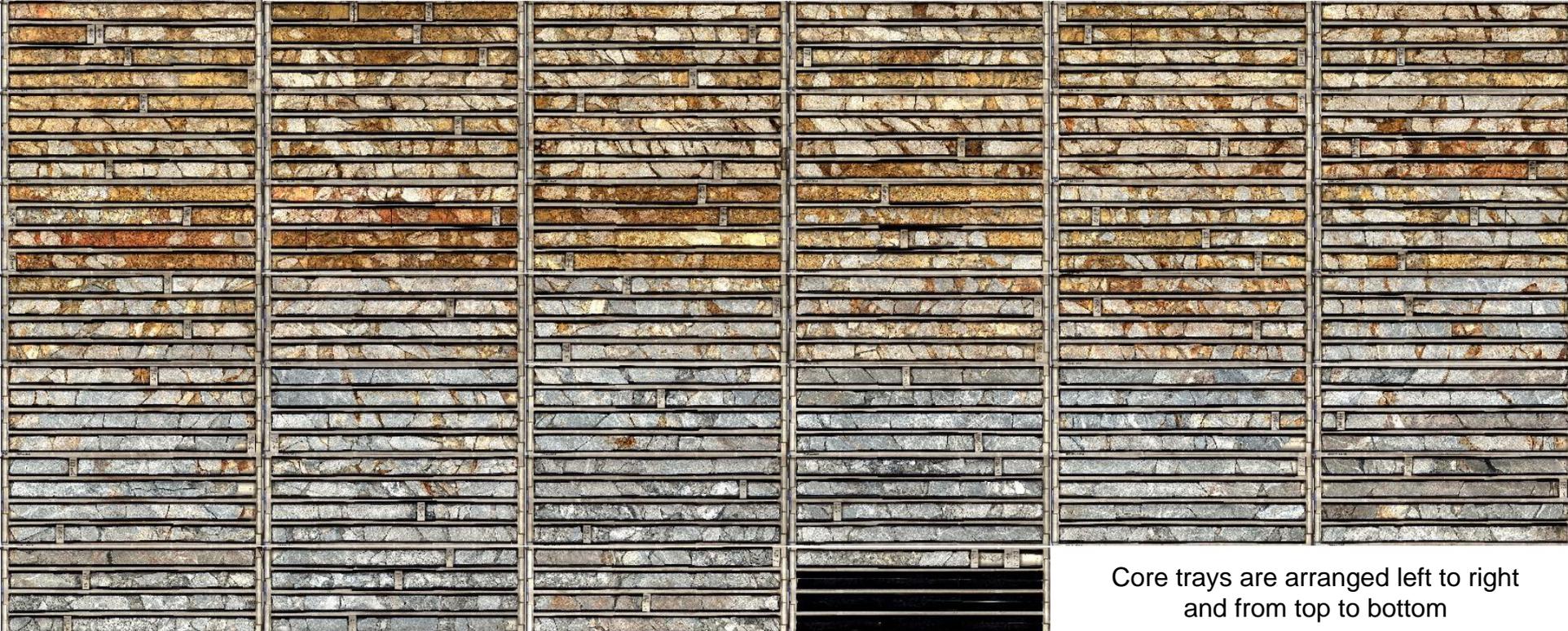
The core image in A comes from the interval of maximum Cu grade (arrowed in C).



22878-SCDDH2 - Drill hole mosaic

SHREE

22878-SCDDH2 Sulphide Creek - HyLogging Systems



Core trays are arranged left to right
and from top to bottom

Conclusions

- Past studies have made little reference to clay mineralogy. The HyLogging data offers fresh insight that should be valuable in re-thinking mineralised alteration signatures in the region.
- For drill hole SCDDH4 a spatial association is observed between Au assays and spectroscopic signatures of an alteration mineral assemblage comprising dickite plus hematite, minus white mica and kaolin, occurring at a boundary (gradient) in mica chemistry composition.
- For drill hole SCDDH5 two Au associations are noted.
 - i. where the highest grade Au association is again with dickite, plus goethite (no obvious alteration hematite) near 159-167 m, and an absence of kaolinite and weaker mica signatures.*
 - ii. near 36-46 m where lesser Au values are associated with a strong change / gradient in white mica chemistry, a sudden increase in dickite development (reduced kaolin group crystallinity index), and very strong goethitic signatures.*
- In drill hole SCDDH2 highest Au grades occur with maximal development of dickite (and least white mica and kaolinite).
- Two iron oxide associations are noted in SCDDH2: (i) where a moderate increase in Au is associated with dickite + hematitic signatures, and (ii) where the increase in dickite has no iron oxide at all (e.g. from 120-130 m).
- Quartz mapping is ambiguous. There are definite quartz spectral patterns that relate spatially to the broader Au-bearing intervals. However quartz signatures are strongly influenced by the clay and goethite development. Away from clay/goethite development indices of pure quartz are indicative of multiple quartz (+/- carbonate) vein events.
- The major newly-defined dickite +/- iron oxide zones are interpreted to be structurally controlled fluid pathways and important vectors to future mineralisation search.
- White mica (sericite) is considered a regional or distal effect, whereas dickite plus goethite is considered a proximal vector, especially where they appear most intensely developed in pervasive structures. Sharp boundaries in white mica chemistry suggest a lithological rather than alteration control.
- No evidence of alunite, pyrophyllite or topaz, also found in the high sulphidation parts of the Mt Lyell and Henty mineral systems, has so far been located.

Recommendations

- XRD Validation of the dickite versus kaolinite is recommended. Dickite can form through diagenetic processes but is considered here to be hydrothermal, and because of its extensive development, little previous recognition and strong association with Au assays validation is recommended to refine the local alteration model.
- Further analysis is required of the silica signatures which are known to be influenced by grain size and surface scattering effects. The observed variation in quartz development is confused by structurally-controlled core breakage and the strong clay / goethite development leading to a distinctive distorted silica signature and an *apparent* relative reduction in quartz in the mineralised zone.
- Spectroscopic mineralogical HyLogging achieves its greatest value when it can be integrated with, even conducted before or simultaneously with, conventional logging.
- Spectroscopic indices developed in this study can be exported to CSV files for import into 3D visualisation pages.
- A free TSG-Viewer is available from www.thespectralgeologist.com for examining the HyLogging and processed TSG data, including the core and tray images.

Acknowledgements



Core scanning, initial masking and depth reconciliation was undertaken by staff of Mineral Resources Tasmania at their Mornington Core library in Hobart.

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Drill hole Comparisons

False colour plots of all three drill holes at the same scale and common 2 m intervals.

