Alteration and Mineralization at the Red Chris Cu-Au Porphyry Deposit, northwestern British Columbia

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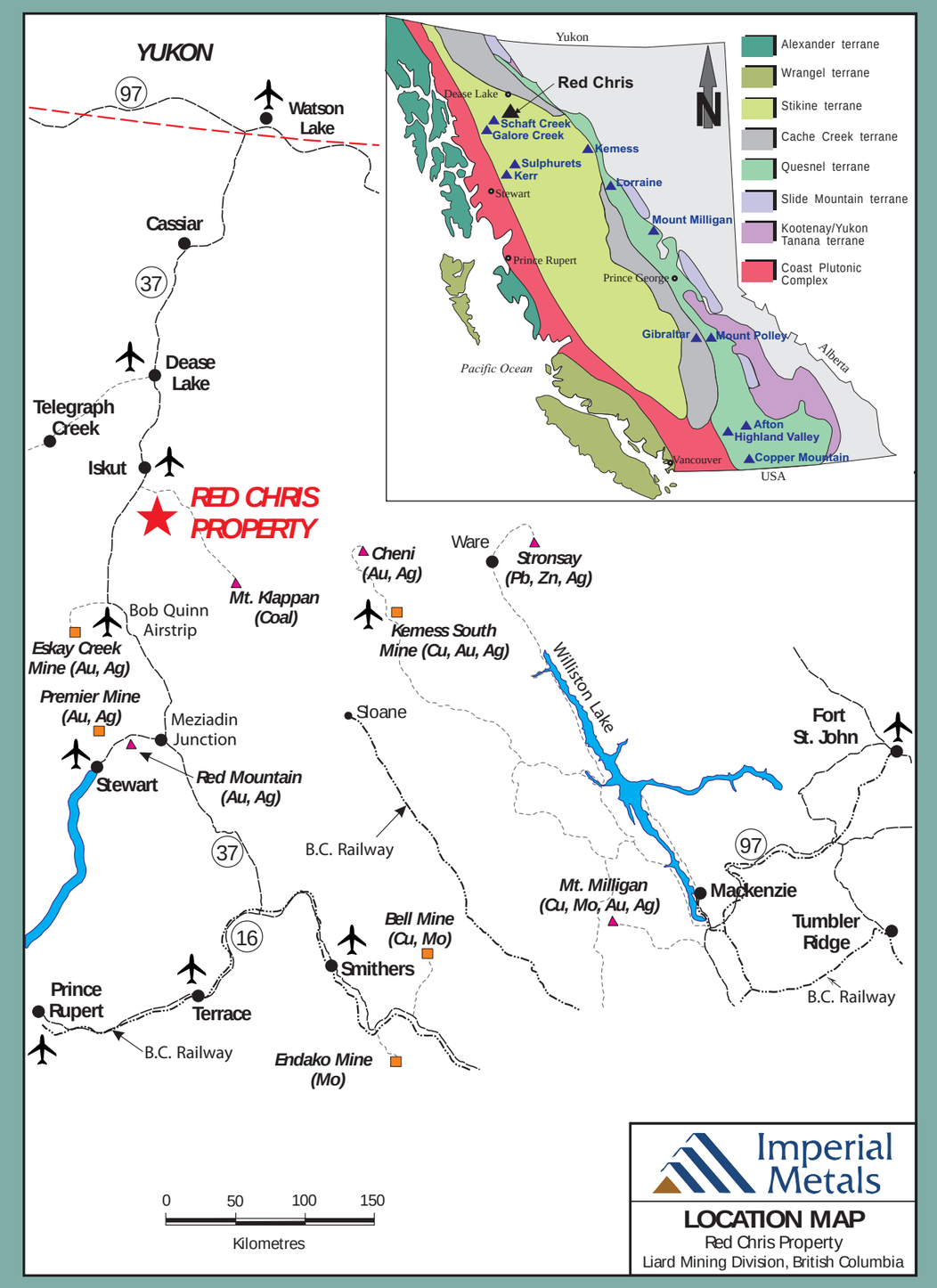
Introduction

The Red Chris porphyry Cu-Au deposit in British Columbia has geological features typical of both alkalic and calcalkalic porphyry deposit types:

- Quartz-vein stockwork characterize the mineralized zones, typically absent in alkalic porphyries
- Intense late-stage sericitc (illite-kaolinite) alteration, characteristic of calcalkalic porphyry deposits
- Widespread and intense late carbonate alteration (Baker et al., 1999), which is not a common feature of porphyry Cu systems (Seedorf et al., 2005)
- High Au grades typical of BC alkalic porphyry deposits (Newell and Peatfield, 1995; Baker et al., 1999; Holliday and Cooke, 2007)



Location

- Northwestern British Columbia
- ~80 km south of the town of Dease Lake
- Northern tip of the Stikinia Terrane
- Quesnellia and Stikinia are two terranes in BC that host most of the province's porphyry deposits

Regional Geology

LTrS - Stuhini Group (host of the Red Stock)

-Late Triassic volcanic and volcanically-derived sedimentary rocks. Augite-phyric basaltic pillowed flows and breccias (Ash, 1995)

LTrEJmd - Red Stock (host of mineralization)

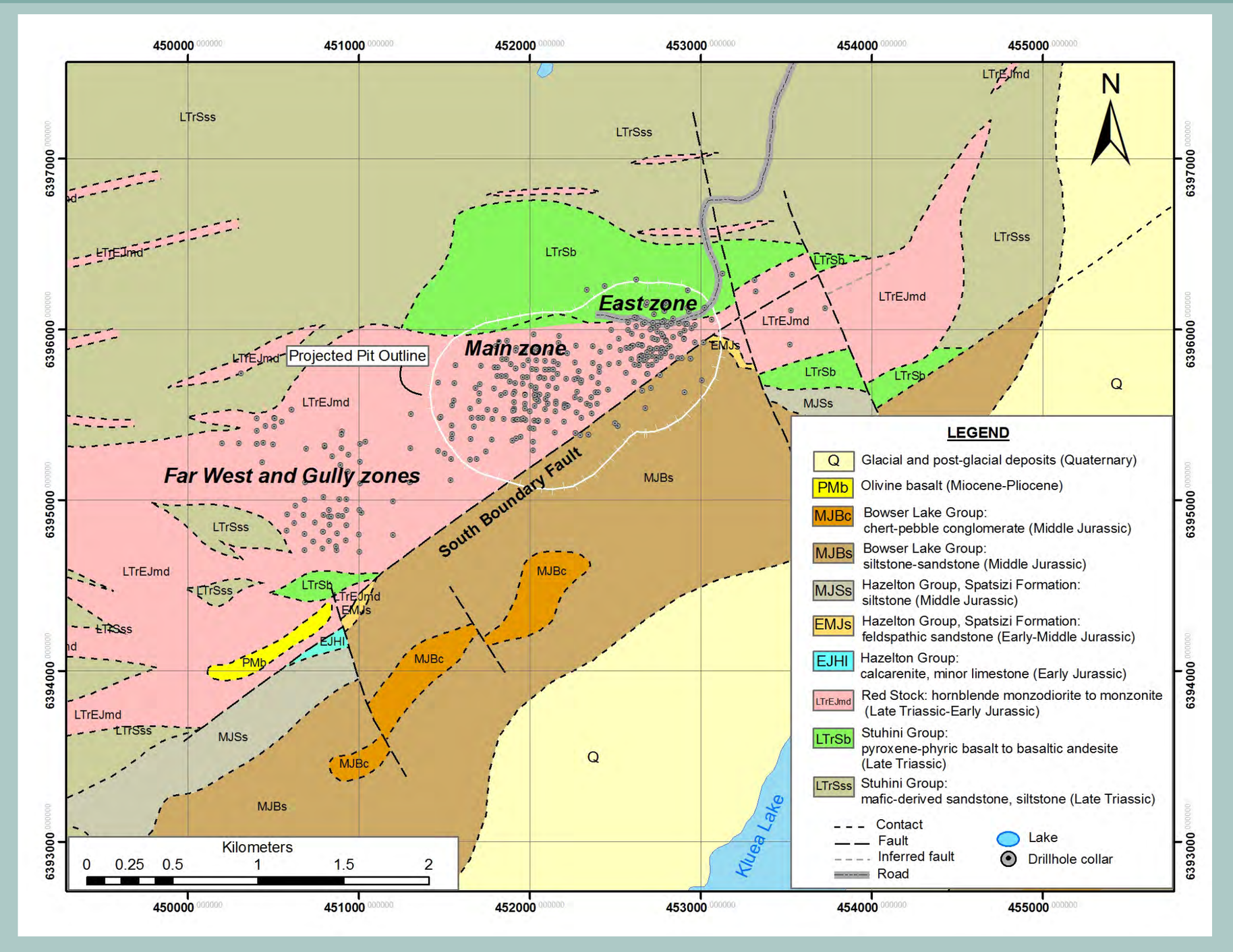
-Late Triassic to Early Jurassic plagioclase-hornblende porphyritic monzodiorite.

-U-Pb dating from zircons place the Red Stock as 203.8 Ma (Friedman and Ash, 1997)

-Elongated in an east-northeasterly direction, ~4.5 km long and up to ~1.5 km wide (Ash, 1995; Ferreira, 2009)

MJB - Bowser Lake Group (Ashman Formation)

-Middle Jurassic marine clastic sedimentary rocks deposited unconformably on top of LTrS and LTrEJmd (Evenchick and Thorkelson, 1993)



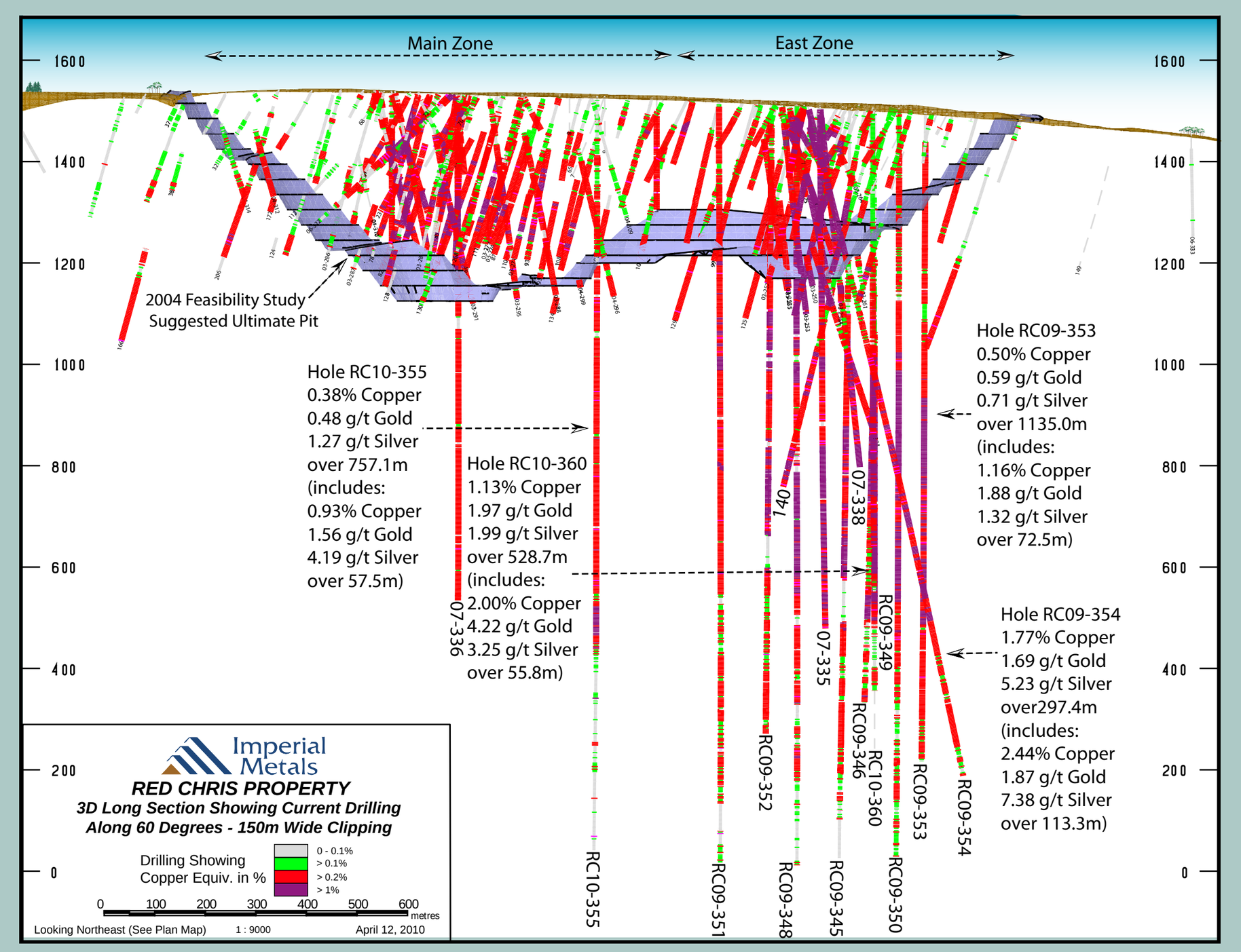
Ore Zones and Mineralization

There are several mineralized zones at Red Chris, currently only the Main and East zones are of economic importance. This study is focused on the East zone.

- The orebodies are vertical to subvertical pipe-like structures, elongated along general east-northeast trending faults in the region (Collins et al., 2004)
- Copper mineralization occurs as disseminated and fracture controlled bornite and chalcopyrite. Gold occurs as microscopic inclusions within the Cu-sulphides.
- Copper and gold occur within banded quartz sulphide veins, sulphide only veins and locally within anhydrite veins

***Resources** (2010)*
Measured and Indicated:
619 Million Tonnes at
0.38% Cu and 0.36 g.t Au
Inferred:
Over 619 Million Tonnes at
0.30% Cu and 0.32 g/t Au
(>=0.1% Cu-equivalent cut-off)

***Reserves** (2010)*
Proven and Probable:
301.5 Million Tonnes at
0.359% Cu and 0.274 g/t Au



Selected Drill Results

RC07-335
4.90m - 1029.00m
1.02% Cu
1.26 g/t Au
3.92 g.t Ag

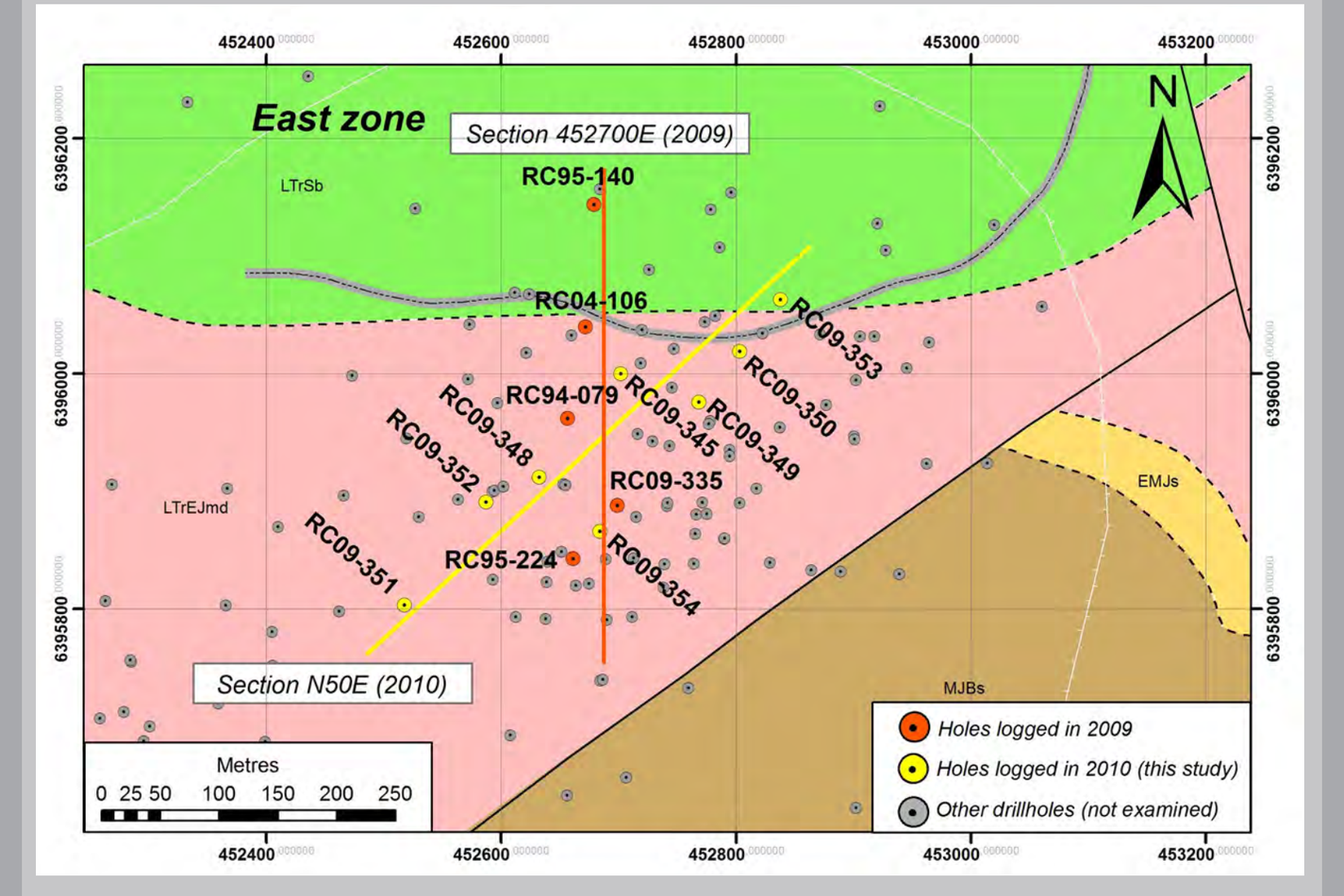
RC09-350
@504m depth, 152m of
4.12% Cu
8.83 g/t Au
10.46 g/t Ag

RC10-360
@474m depth, 528.7m of
1.13% Cu
1.97 g/t Au
1.99 g/t Ag

Observations

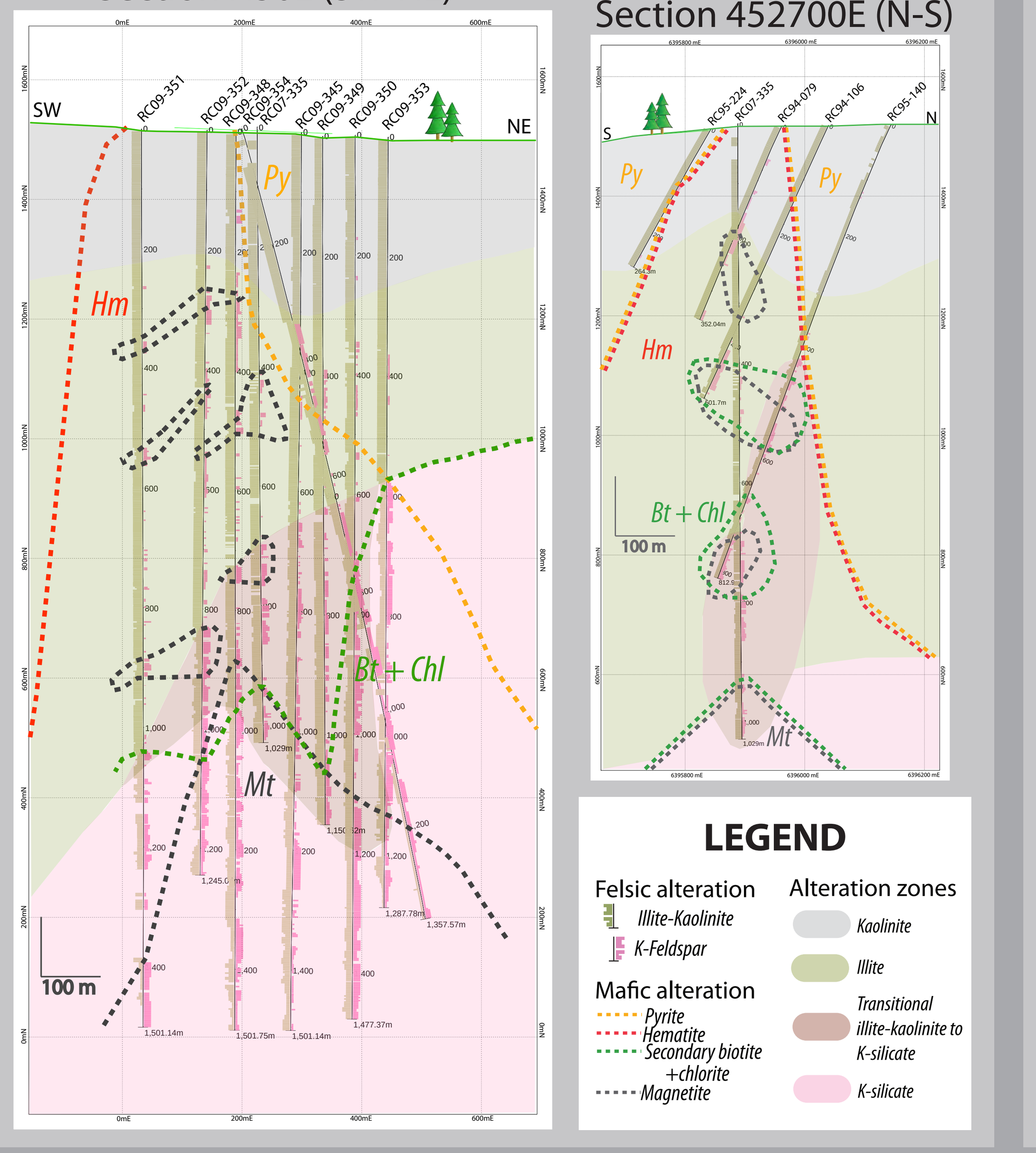
All observations are based on detailed drill logging completed over two field seasons (2009 and 2010)

- Two Cross-sections
  - **452700E** *(North-South)*
  - **N50E** *(Roughly parallel to axis of elongated Red Stock)*
- 13 Diamond drill holes
- 13,980 m of drill core



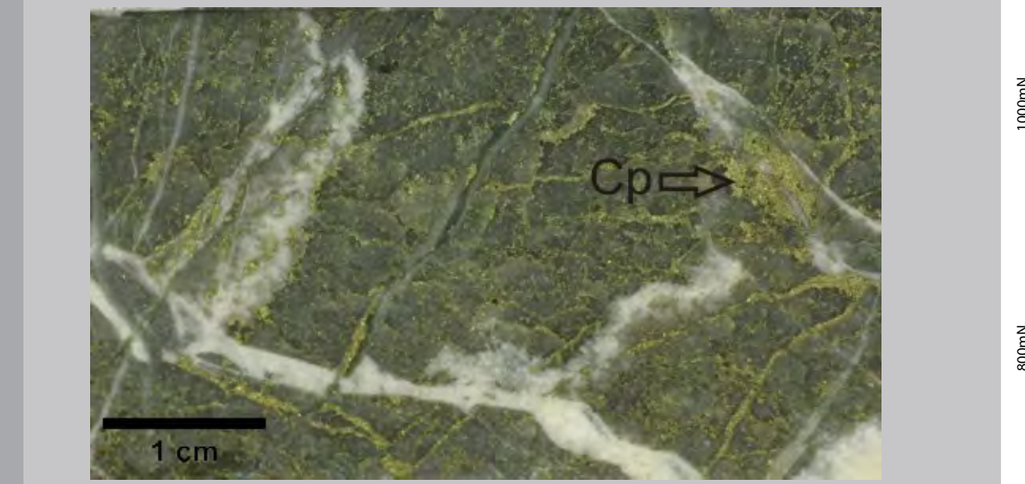
Alteration

Section N50E (SW-NE)   Section 452700E (N-S)

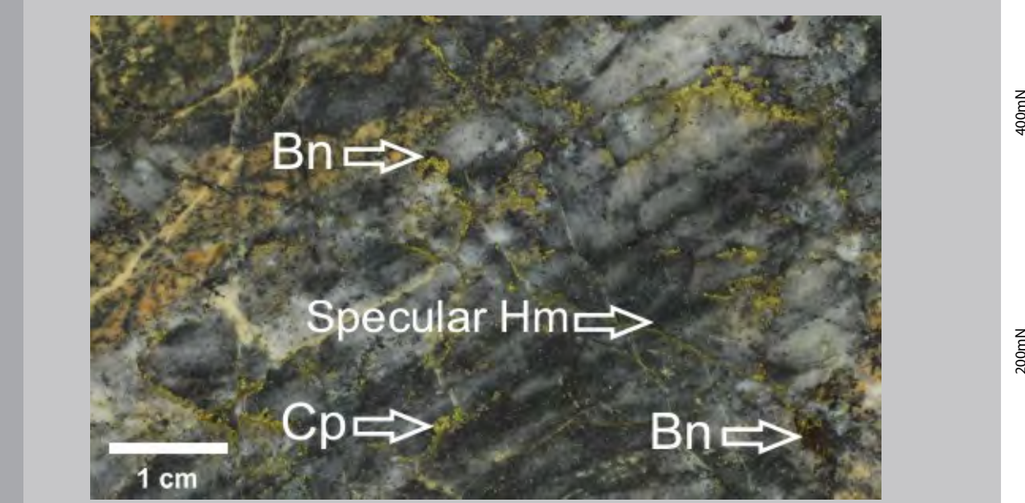


Mineralization

RC353-003: Quartz, pyrite veins +/- carbonate +/- chalcopyrite (94.51m).
0.58% Cu, 0.91 g/t Au

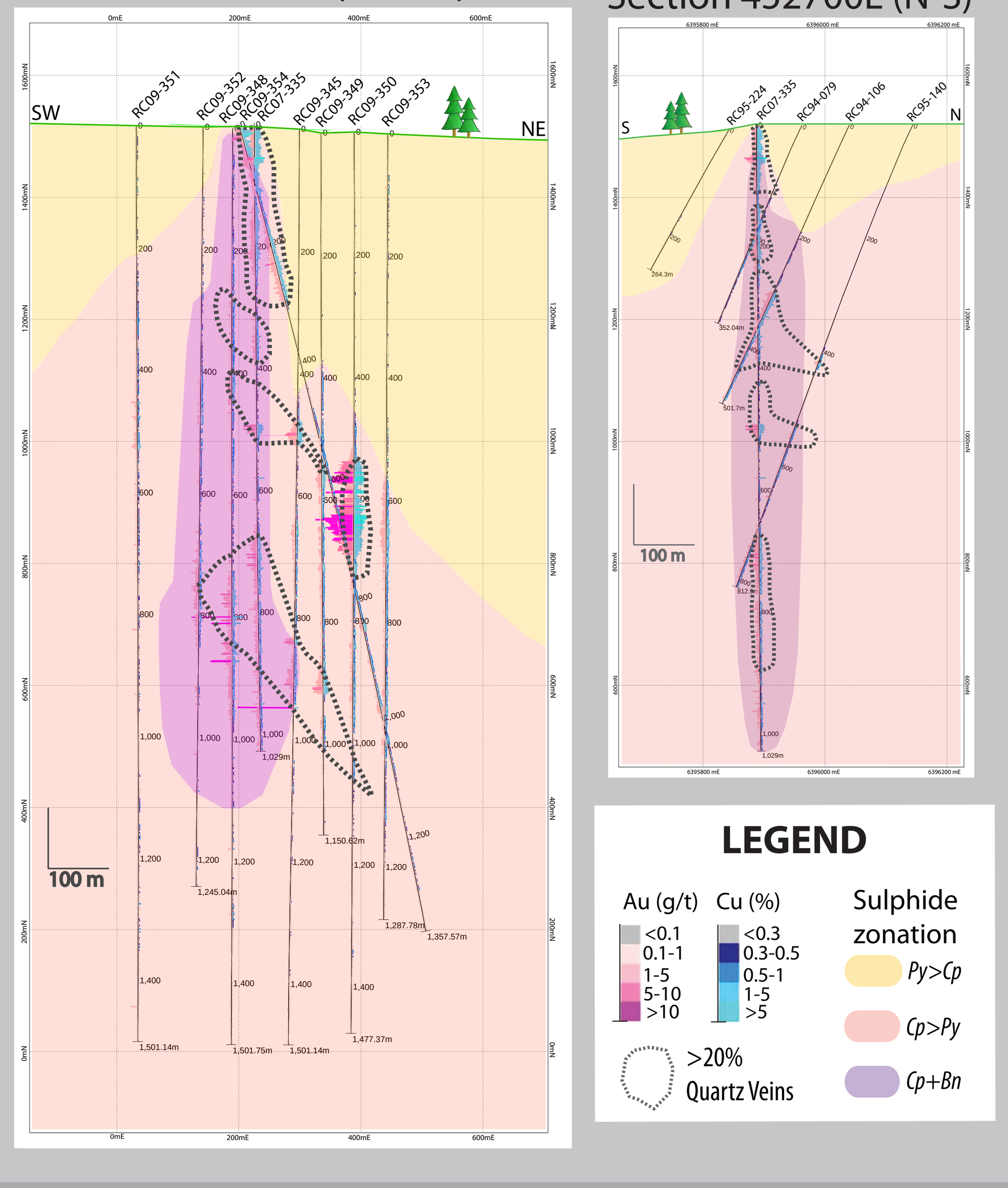


RC350-018: Massive quartz with chalcopyrite and carbonate (628.52m).
6.06% Cu, 11.94 g/t Au



RC345-025: Banded quartz with specular hematite, chalcopyrite and bornite (842.30m).
2.78% Cu, 5.18 g/t Au

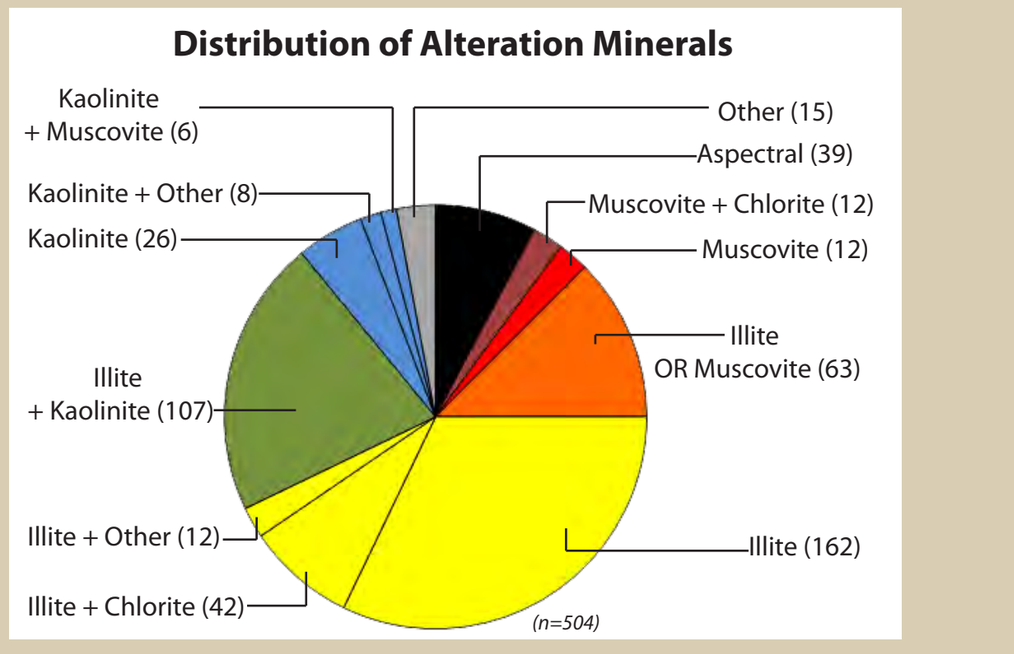
Section N50E (SW-NE)   Section 452700E (N-S)



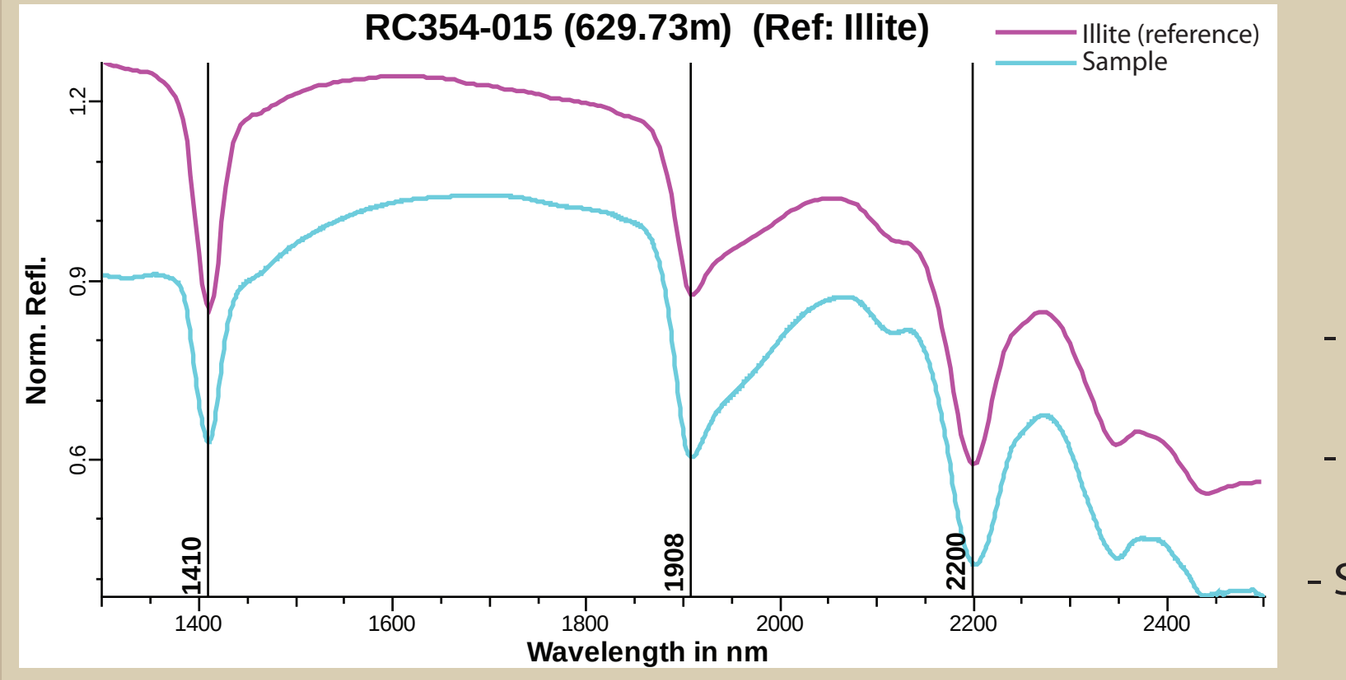
Interpretations

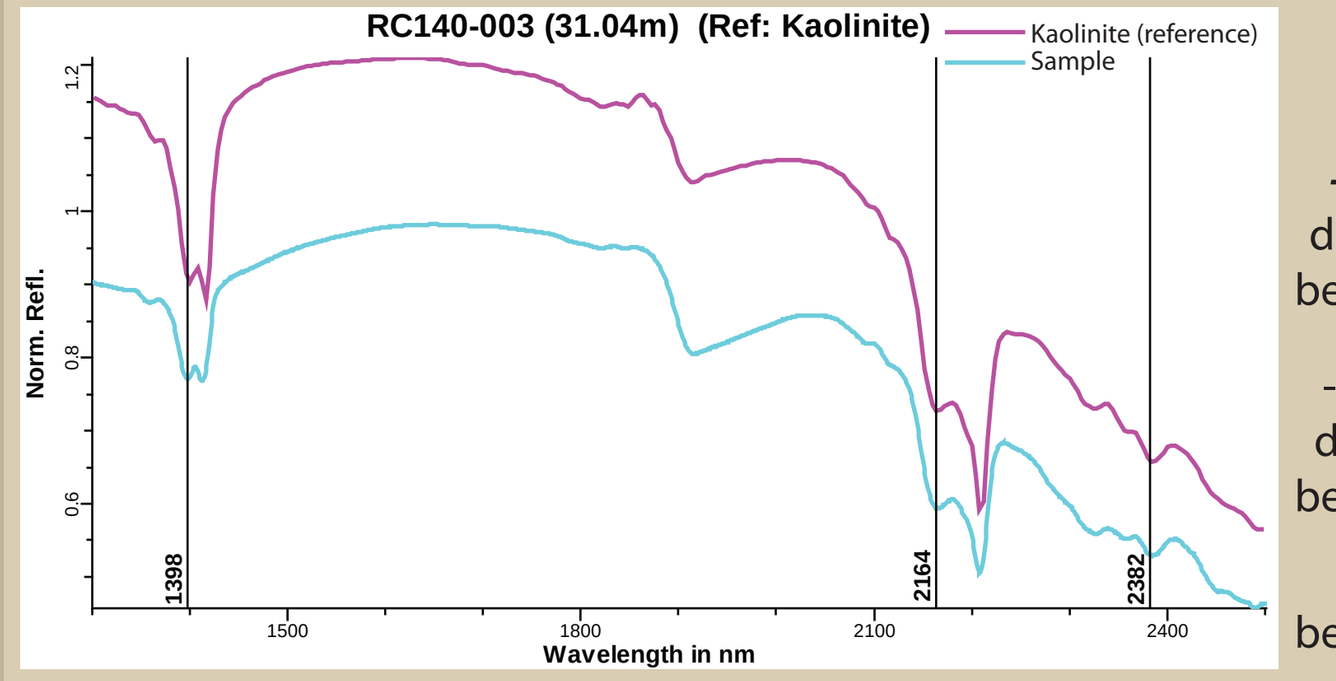
Short Wave Infrared Spectroscopy - 'TerraSpec'

- Analyses of over 500 samples
- Dominant alteration minerals are illite and kaolinite
- Minor muscovite
- The illite-kaolinite alteration indicates a lower temperature assemblage than muscovite alteration.



Reflectance Spectra *(In TSG Pro Software)*





Diagnostic Absorption Features:

Illite
- Strong 1400nm (H2O, OH)
- Strong 1900nm (H2O)
- Strong 2200nm (Al-OH)

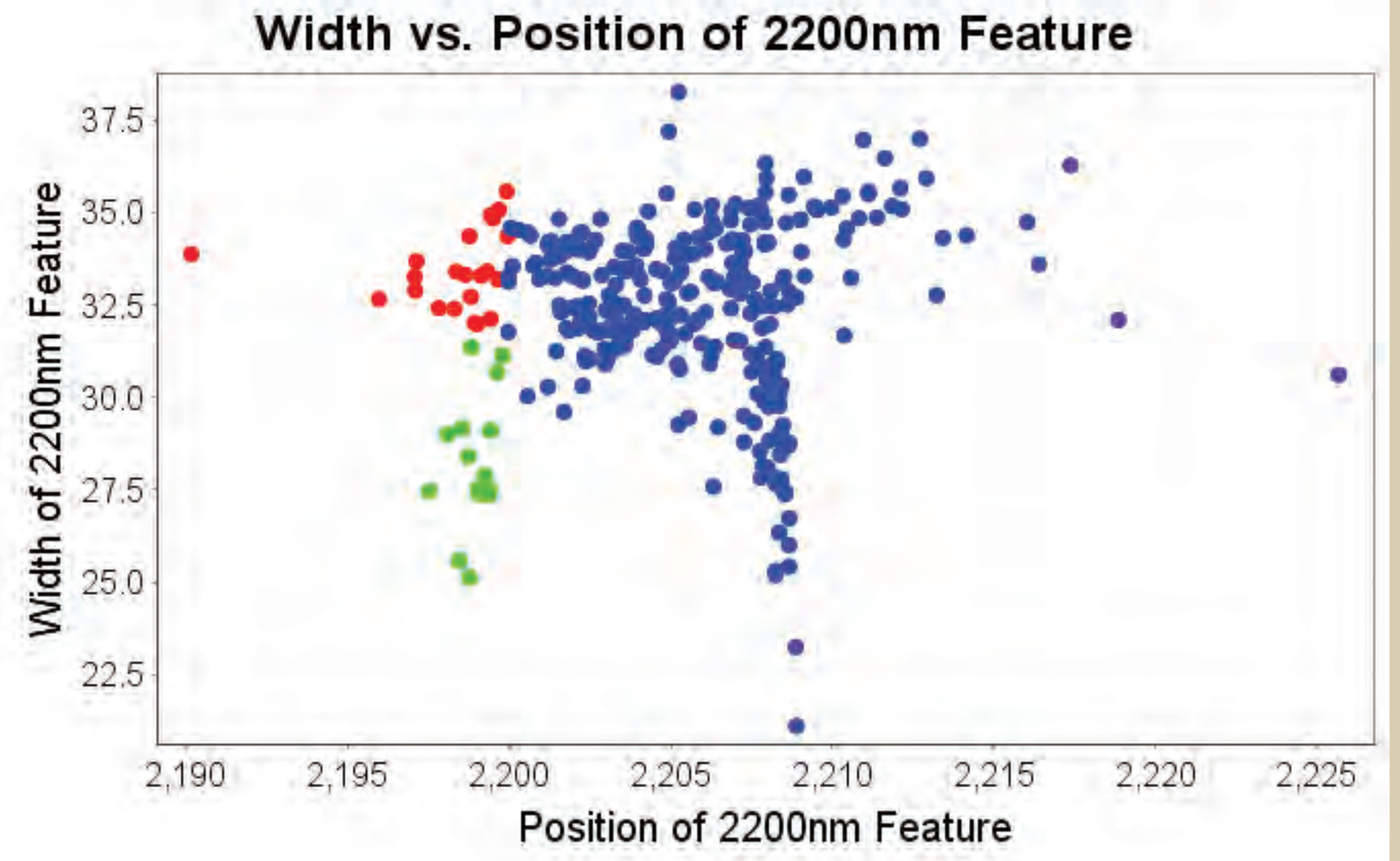
Kaolinite
- Lower wavelength doublet: First minima between 1392-1402nm
- Higher wavelength doublet: First minima between 2162-2168nm
- Subtle feature between 2382-2389nm

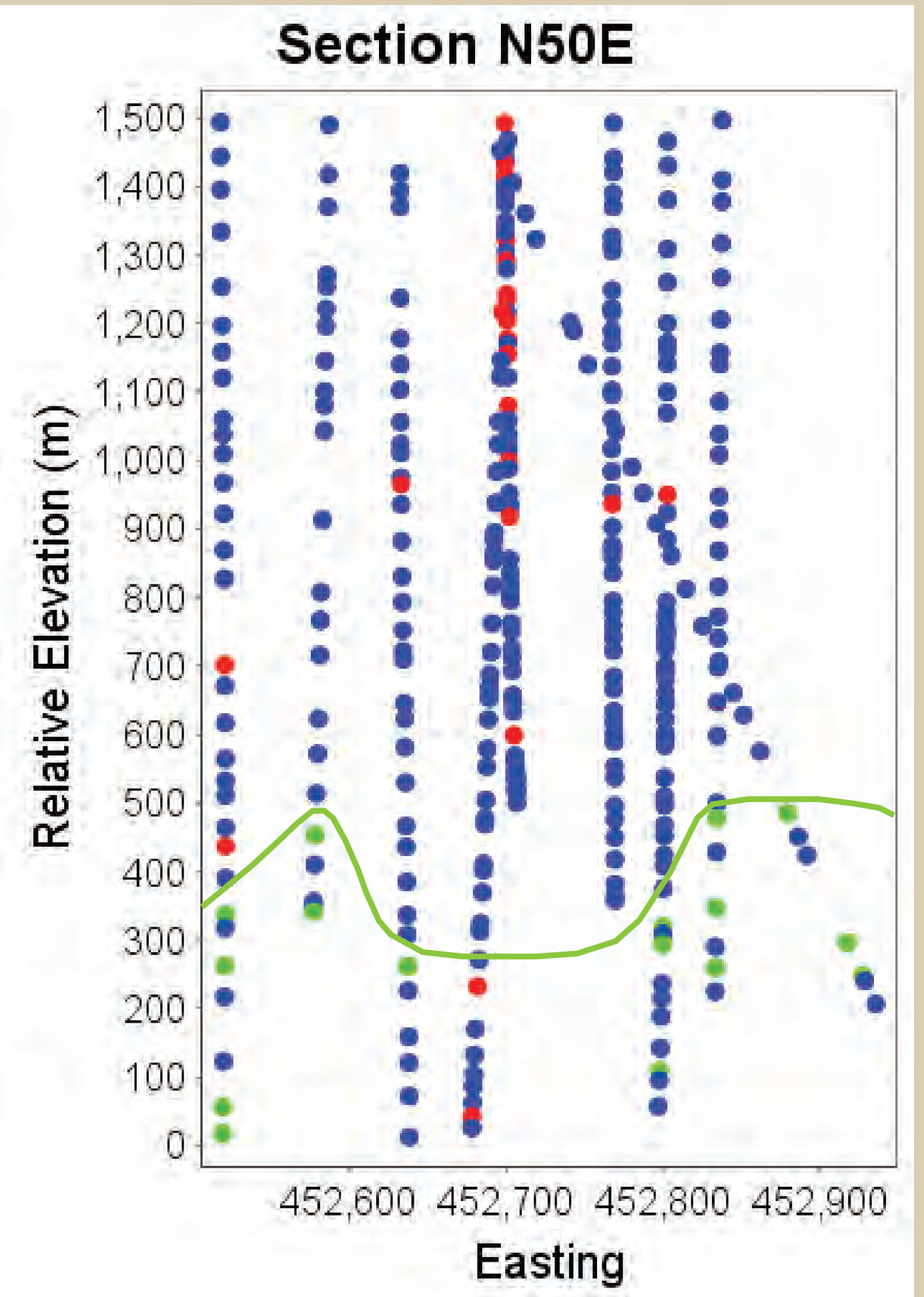
The 2200nm (Al-OH) Absorption Feature

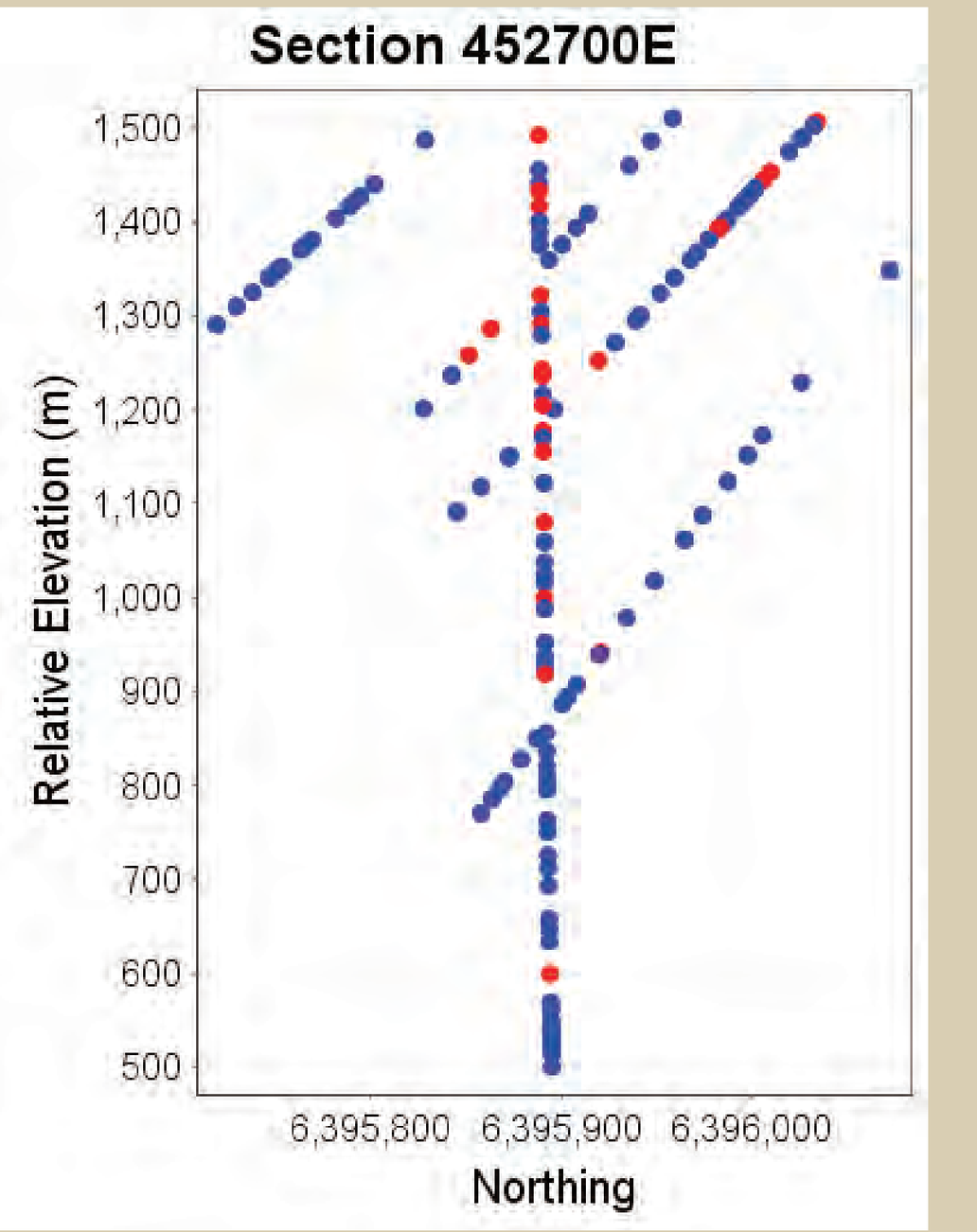
- Al-Micas at 2194 to 2220nm   - Illite at 2190 to 2220nm
- The 2200nm feature of K-rich muscovite typically occurs at shorter wavelengths, up to 2200nm
- Plotted the width vs. the position of the 2200nm feature for samples containing any illite or muscovite
- Separated the 'possible muscovites' from the rest of the samples (illites, kaolinites, phengites ●)
- Mixture of kaolinite and illite is widespread, however there are 2 distinct groups of possible muscovites:

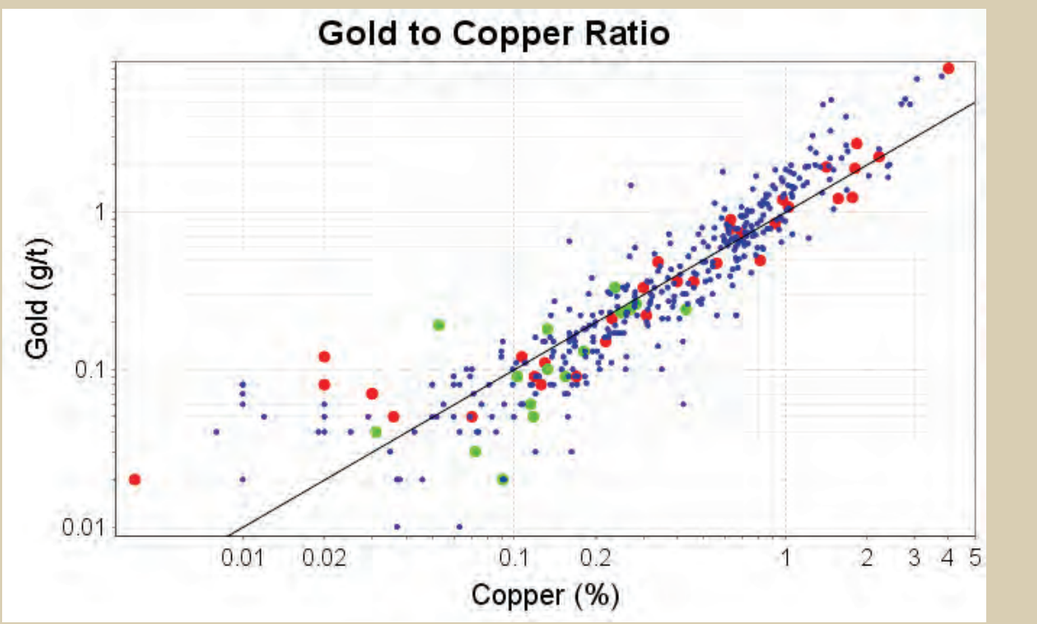
● -Greater width of 2200nm feature (red)
  -occur generally above 1000m depth
  -max grade: 4 % Cu and 8.1 g/t Au

● -Narrower width of 2200nm feature (green)
  -occur below 1000m depth
  -max grade: 0.43 % Cu and 0.33 g/t Au







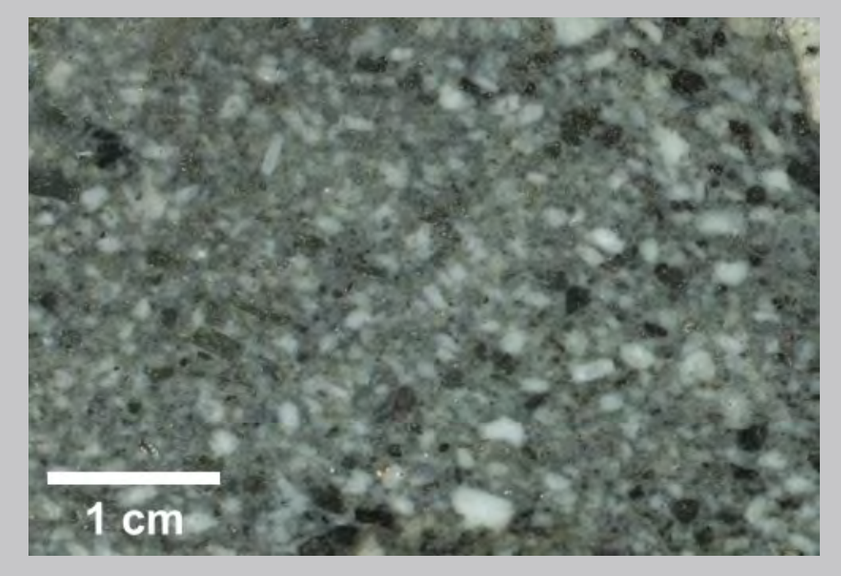


Narrower, sharper 2200nm feature indicates more crystalline muscovite (Higher Temperature) ●

Alteration

Least Altered

Few occurrences, typically below 1200m depth



RC354-028: Least altered monzodiorite with black hornblende and grey-white plagioclase phenocrysts. Weak secondary biotite/chlorite alteration of mafics. (1168.26m)

RC353-029: Weakly K-feldspar altered groundmass. Mafics weakly altered to secondary biotite and magnetite. Anhydrite, chalcopyrite veinlets. (1244.15m)

K-Silicate

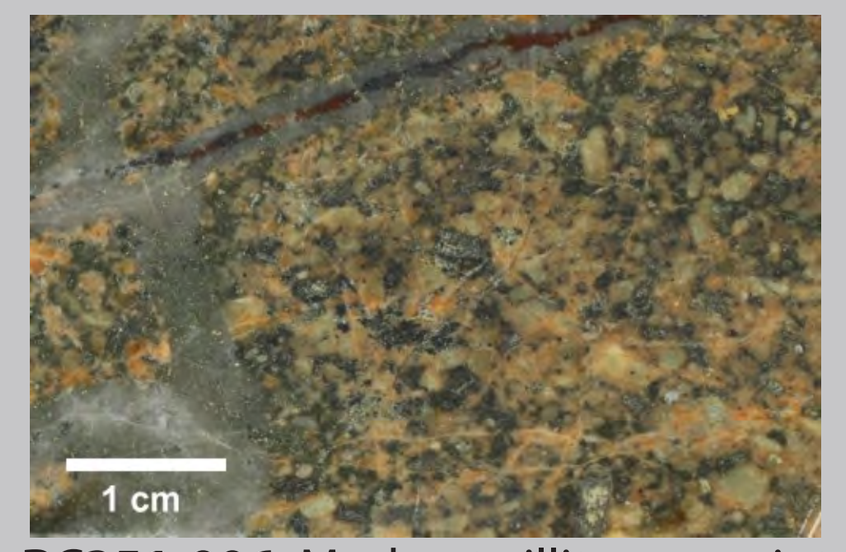
Dominant below 1000m depth and locally below 600-800m depth

RC350-055: K-feldspar altered groundmass and local felsic phenocrysts. Mafics altered to secondary biotite and magnetite. Quartz, anhydrite, chalcopyrite veins. (1291.95m)

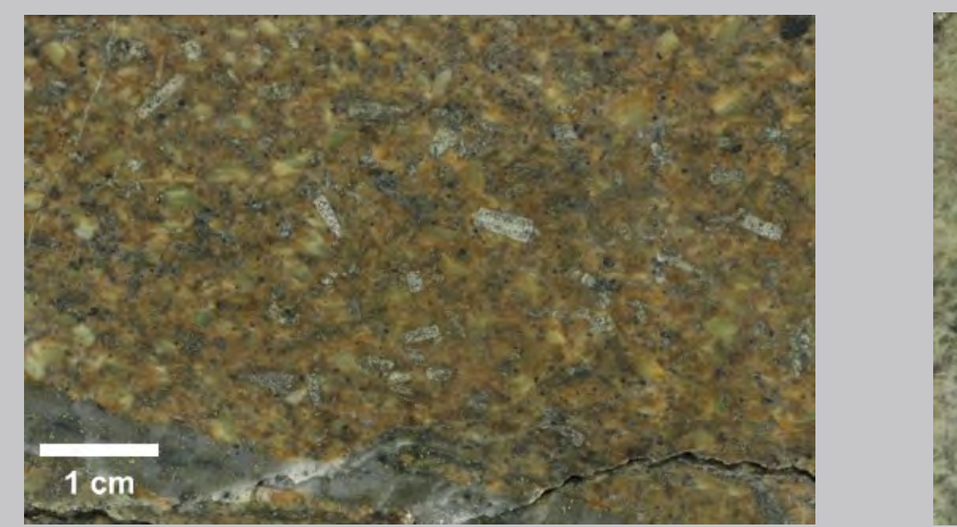
RC354-025: K-feldspar altered groundmass. Mafics altered to secondary biotite and magnetite. Weak illite/muscovite overprint. Quartz, Py, Cp, Mt, Hm veins. (1063.00m)

'Transitional'

Typical below 400m depth, and as localized lenses



RC351-006: Moderate illite overprint on K-silicate altered monzodiorite. Secondary biotite partially altered to illite. Felsics and groundmass also overprinted by illite. Quartz, Py, Cp, hematite veins. (264.24m)



RC351-008: Moderate to strong illite overprint. Mafics and felsics strongly illite altered. Weak relict K-feldspar alteration of groundmass. Quartz, Cp and hematite vein. (358.91m)

Illite

Dominant between 200m and 600-800m depth

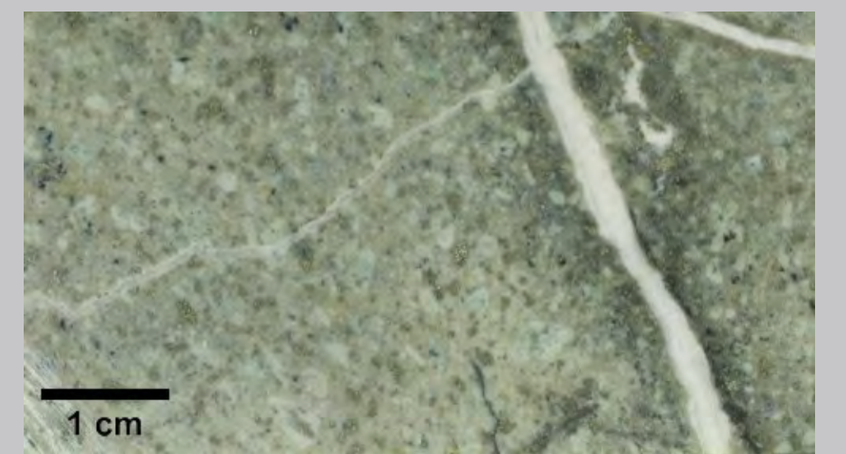
RC354-015: Intense illite alteration of phenocrysts and groundmass. Minor red hematite in mafic sites. Quartz, hematite +/- chalcopyrite veins. (629.73m)

RC351-024: Intense illite alteration of phenocrysts and groundmass. Felsics are 'greasy green' in colour. Quartz, carbonate +/- chalcopyrite veins. (1005.91m)

Kaolinite

Dominant in upper 200m

RC348-006: Intense kaolinite alteration of phenocrysts and groundmass. Minor red hematite in mafic sites. Quartz, chalcopyrite, carbonate veins. (188.94m)



RC140-003: Intense kaolinite alteration. Moderate pyrite in mafic sites. White-beige felsics. Buff beige groundmass. Carbonate veins (31.04m)

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