CSA Mine Observations Applied to the Development of Regional Exploration Models

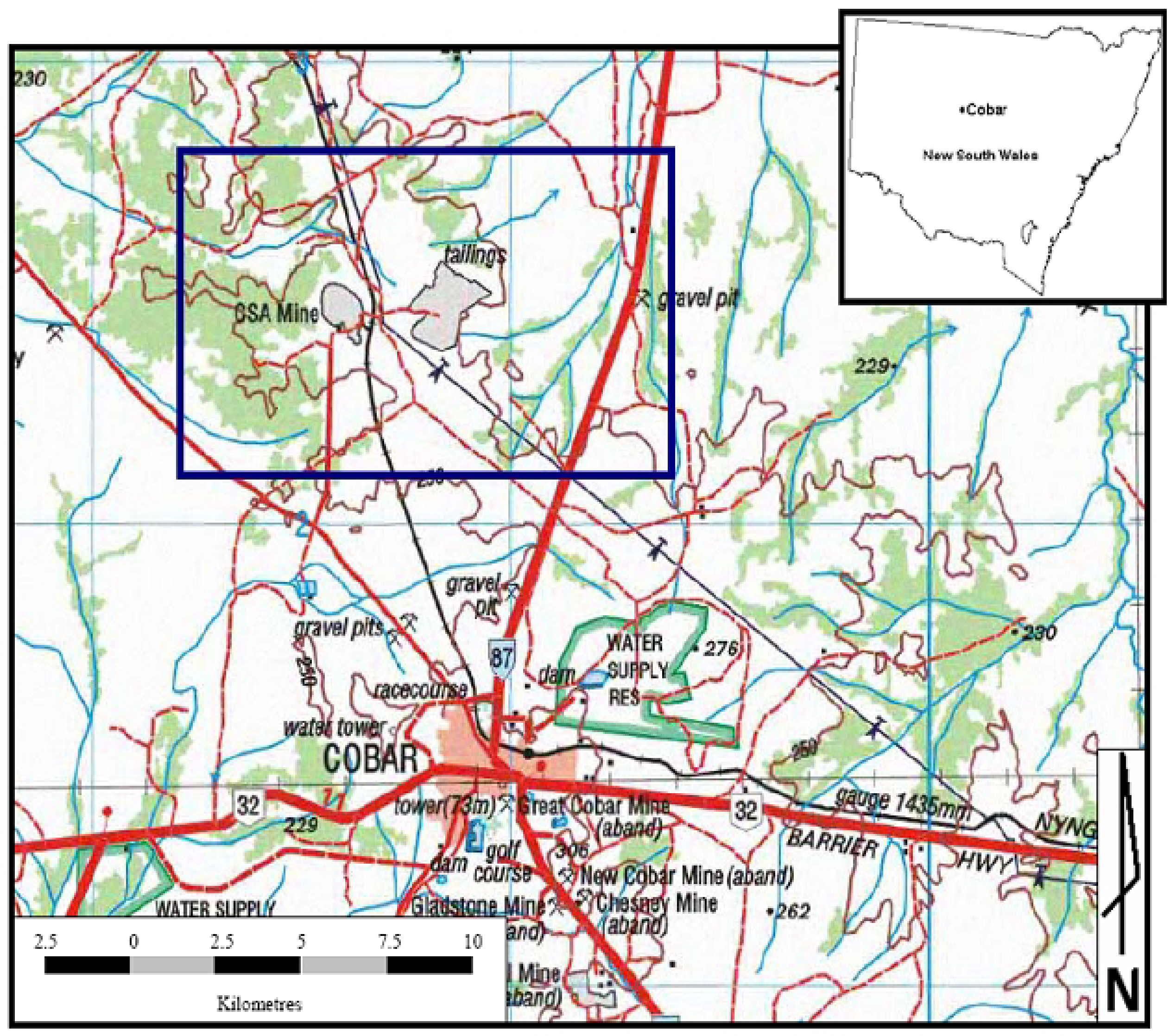
Introduction

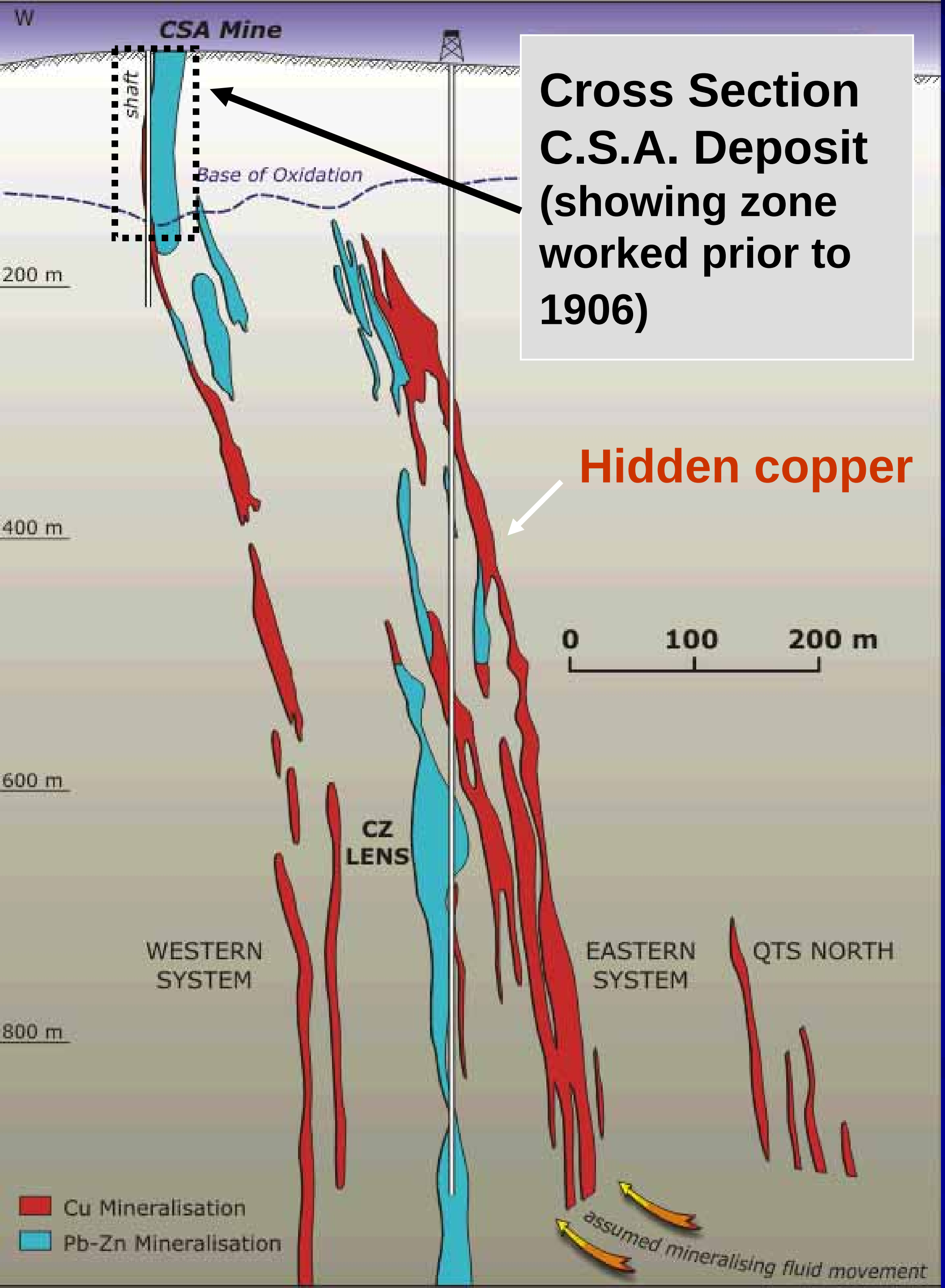
Recent work completed by the geology team has resulted in an improved understanding of the CSA mine system and it's relationship to regional geology and structure. This has assisted in the development of regional exploration models. The focus of today's talk will be;

- **Regional Geology and Implications for Development of Mine Scale Structures.**
- **Local and Surface Geology.**
- **Mine Scale Geology and Structures.**
- **Overview of Mineralisation including Morphology.**
- **Geochemistry – Surface and Downhole Data.**
- **Alteration.**
- **Geophysical Data sets.**
- **Example of CMPL's Shuttleton Project.**

CSA Mine Location

- 12km North of Cobar, Central NSW
- Hosted in <u>CSA Siltstone.</u>
- Fault hosted.
- Named CSA after the syndicate that financed initial mining (**<u>C</u>**ornishman, **<u>S</u>**cotsman, **<u>A</u>**ustralian).



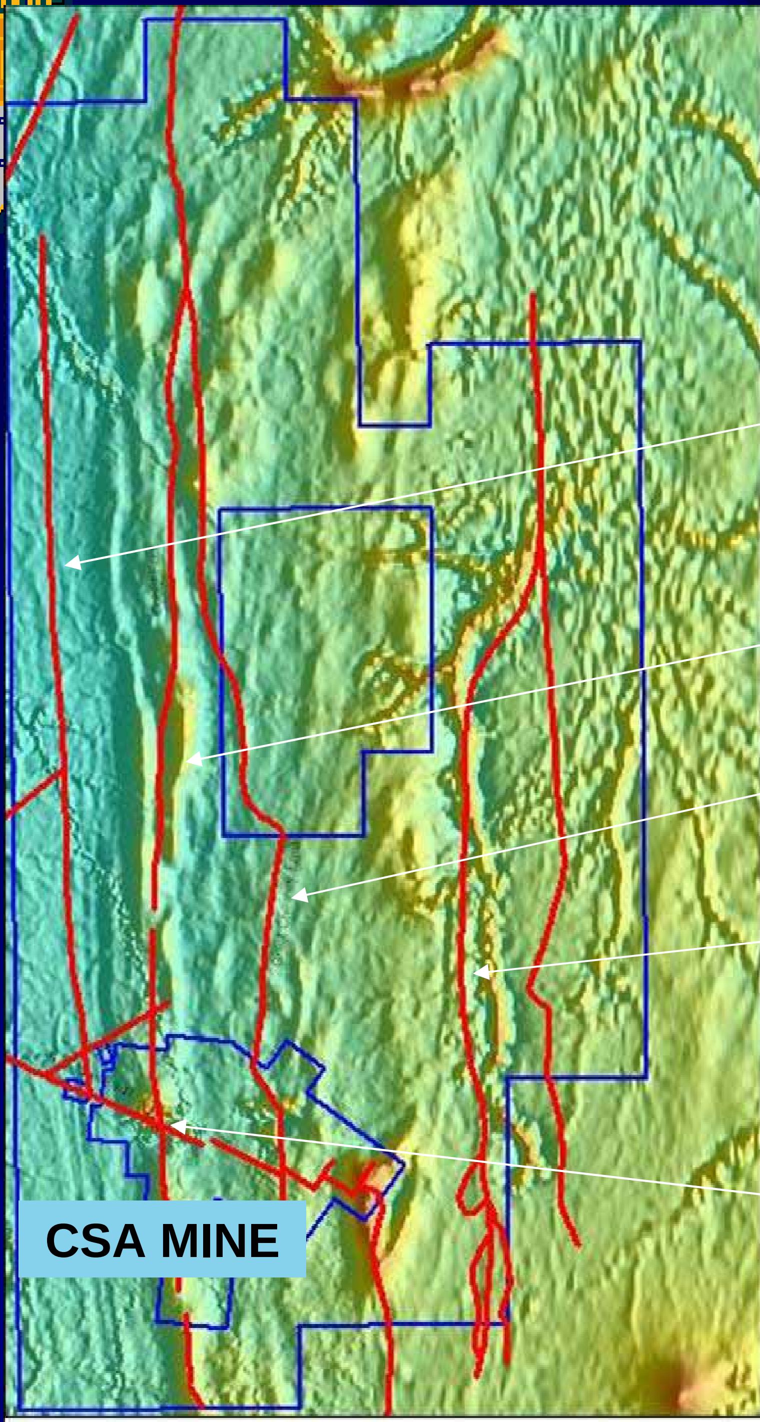


Drilling and deeper exploration from 1951 to 1962 by Enterprise Exploration Co. and Cobar Mines Pty Ltd found major copper orebodies. Mine reopened in 1964.

Ongoing exploration to the present has extended the known resources to at least 2.0 km below surface.

Largest copper deposit in the Cobar region.

CSA Regional Structural Setting



Myrt Fault

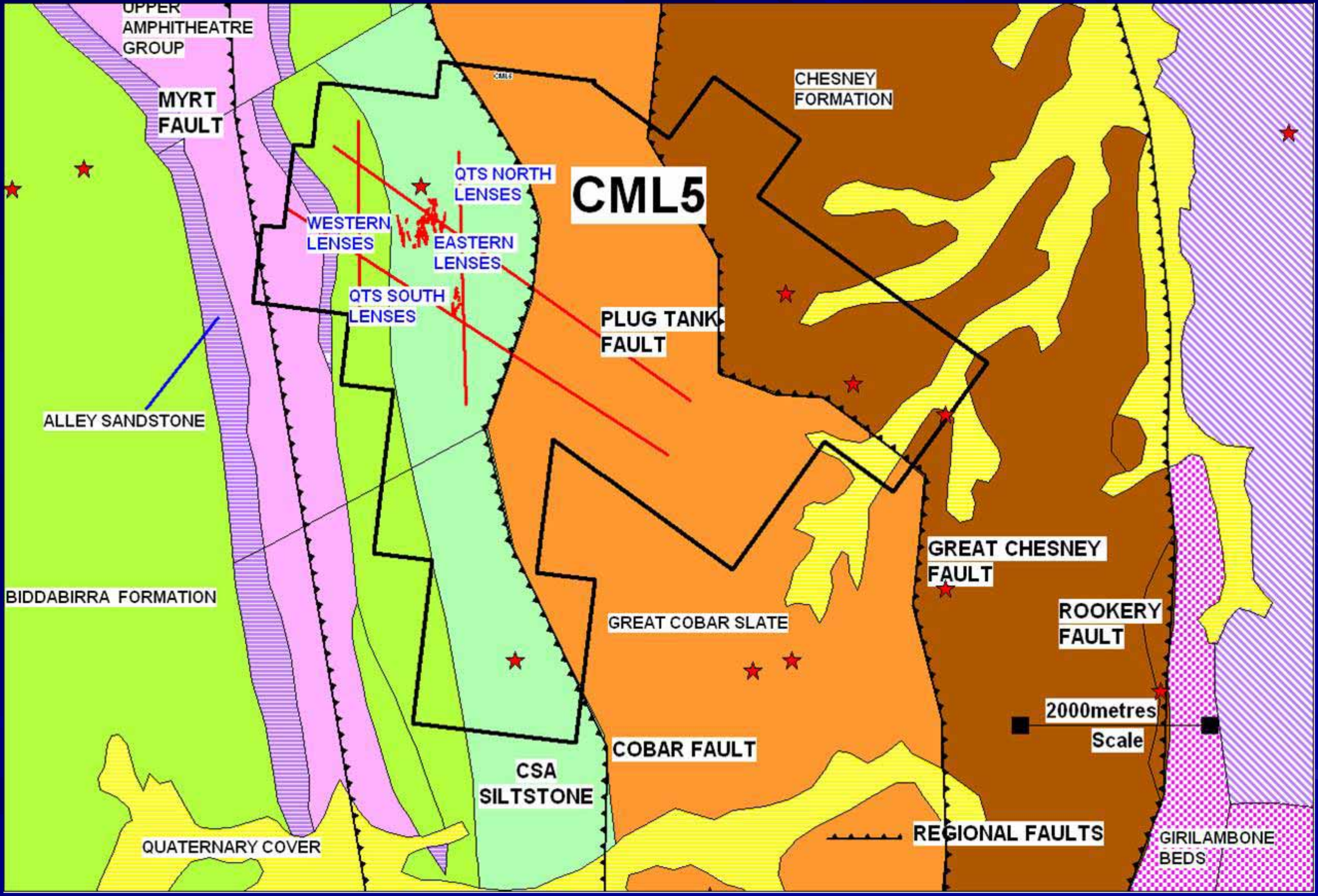
Cobar Fault

Great Chesney Fault

Rookery Fault

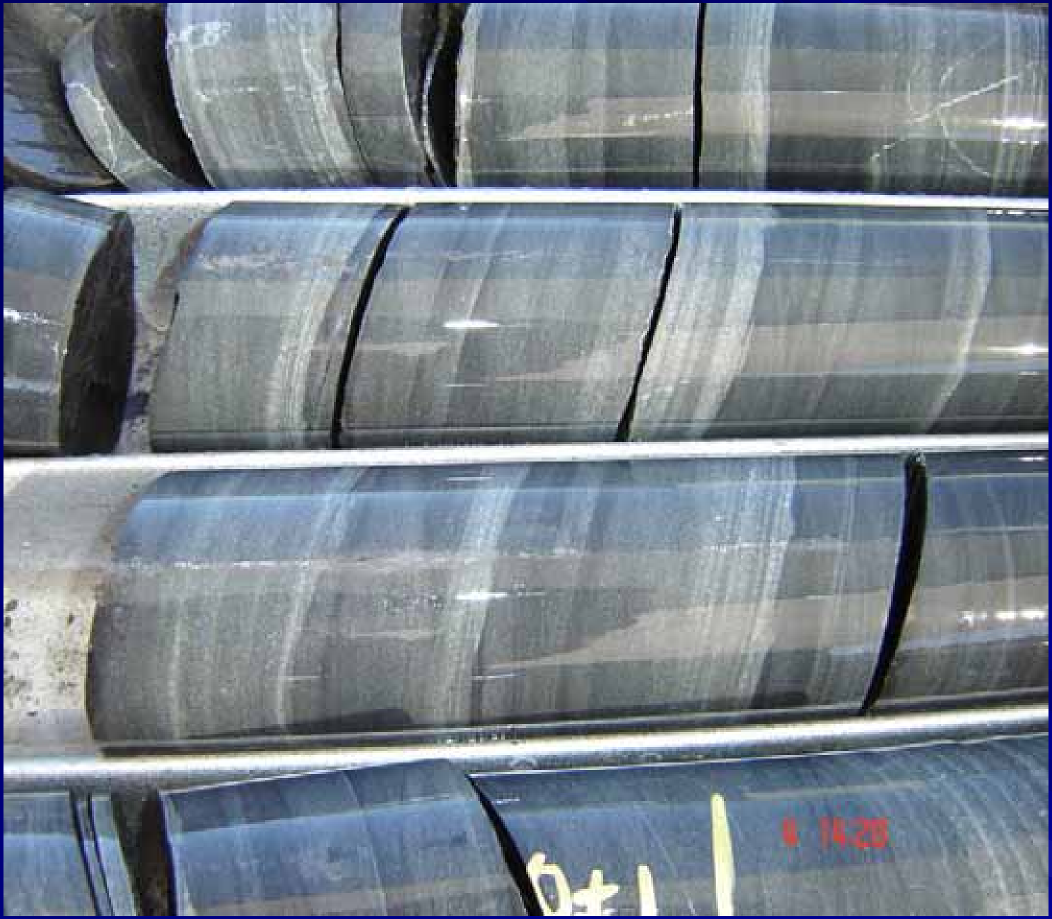
Plug Tank Fault

CSA Environs – Local Geology



Map adapted from NSW Geology Survey published maps.

CSA Geology- Lithological Observations



- The **CSA Siltstone** is as much sandstone as siltstone.
- It is characterised by **thin <4cm** of alternate siltstone to fine sandstone banding.
- Sedimentary structures include; graded bedding, cross stratification, scour structures etc.
- Typical of distal turbidite sequences.
- Small scale folding in trenches is common.

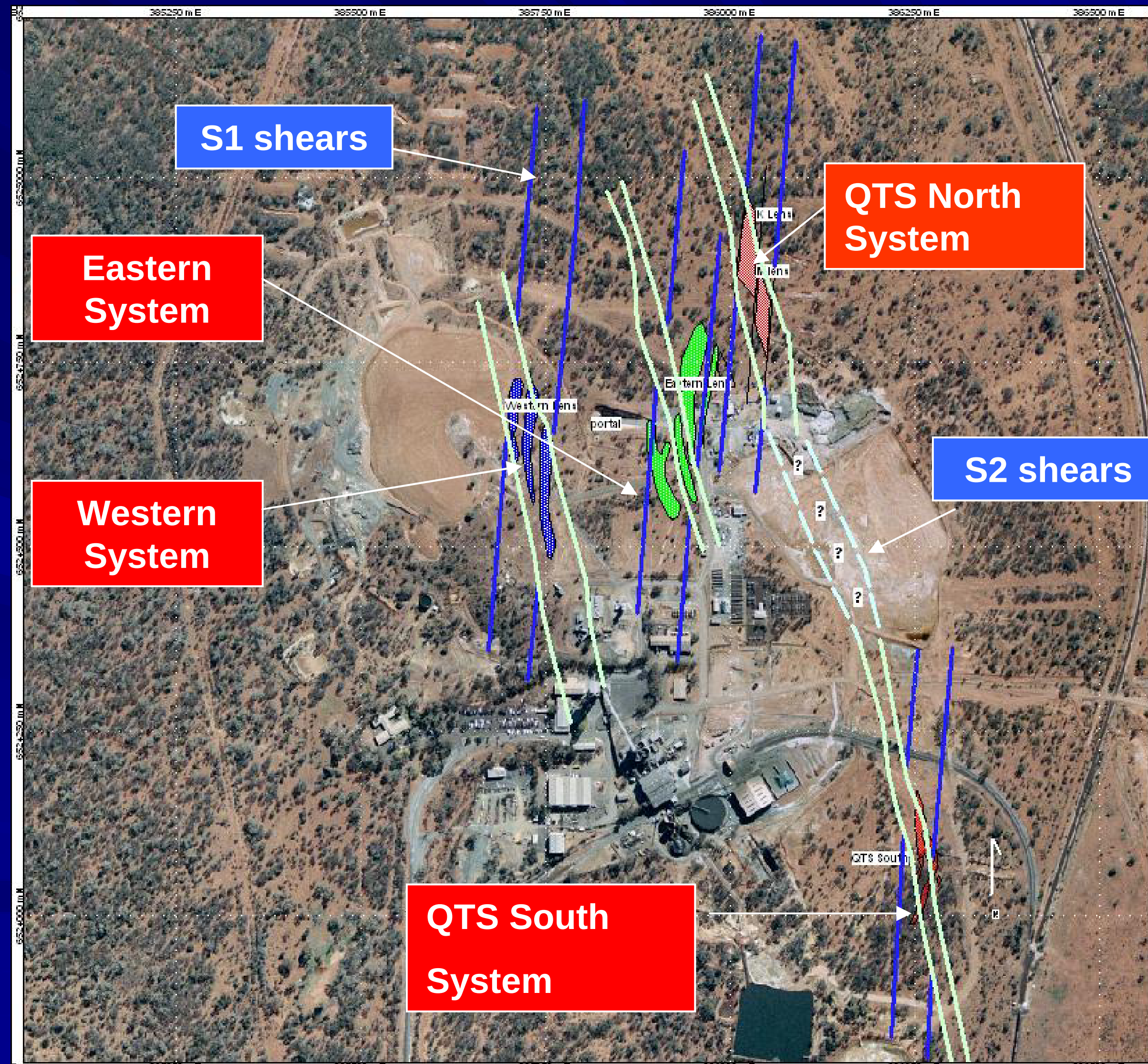
Surface Geology

Structure

- Recent efforts at interpreting the structure at the CSA have involved combining mine structure data, surface data and geophysical data

Mine Data

- All four systems are defined by mineralisation at the intersection of two sub-vertical mine scale structures
- North-northeast trending structures are interpreted as D1 events and are referred to as S1 shears (Local terms)
- North-northwest trending structures are interpreted as D2 events and are referred to as S2 shears
- Reactivation of S1 and S2 by a D3 event generated a dilation zone at the S1/S2 intersection
- The dilation zone and associated mineralisation are referred to as S3, hosting the majority of the CSA resource

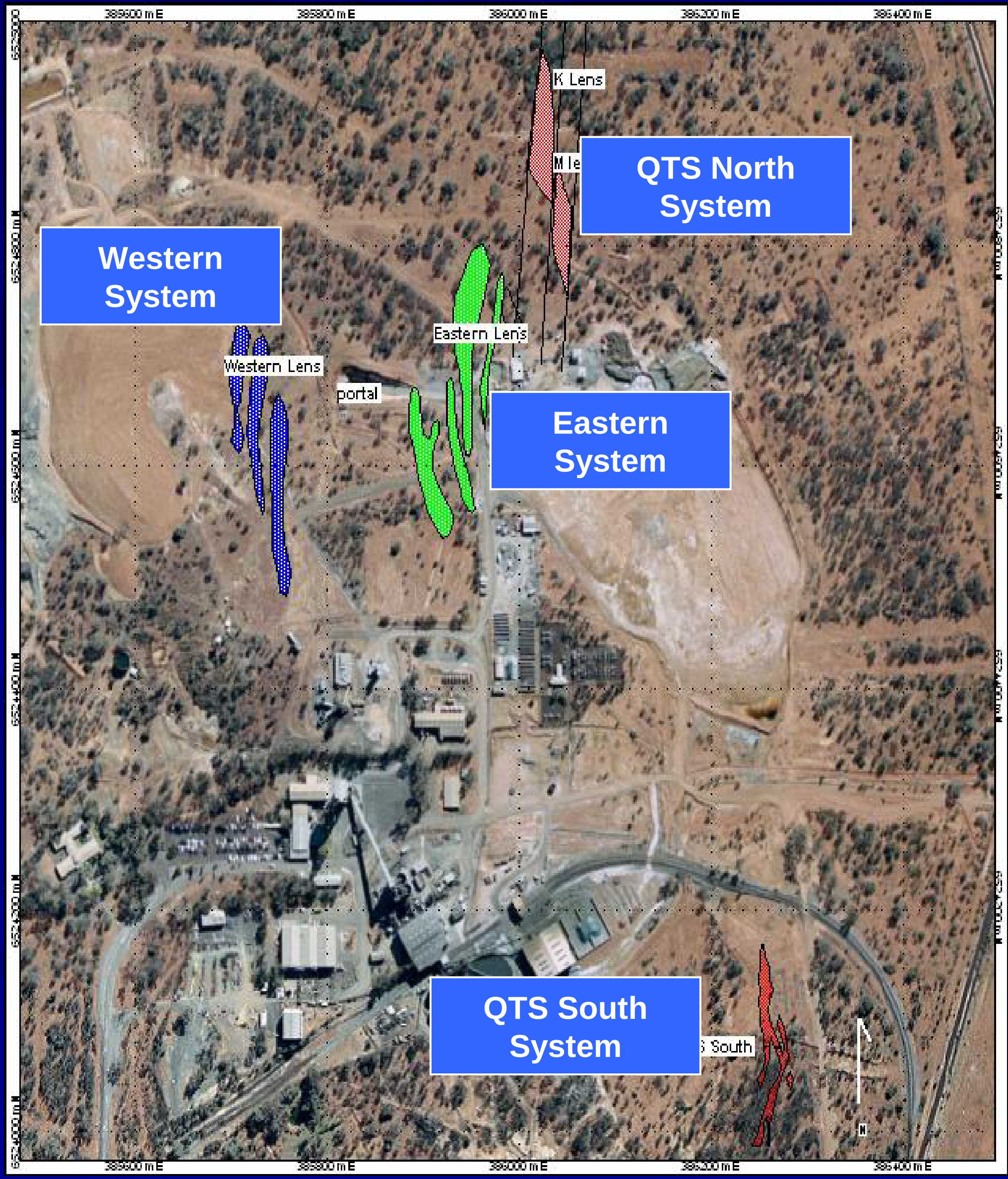


CSA Mine

CSA Mine Geology – Overview of Ore Systems

General Features

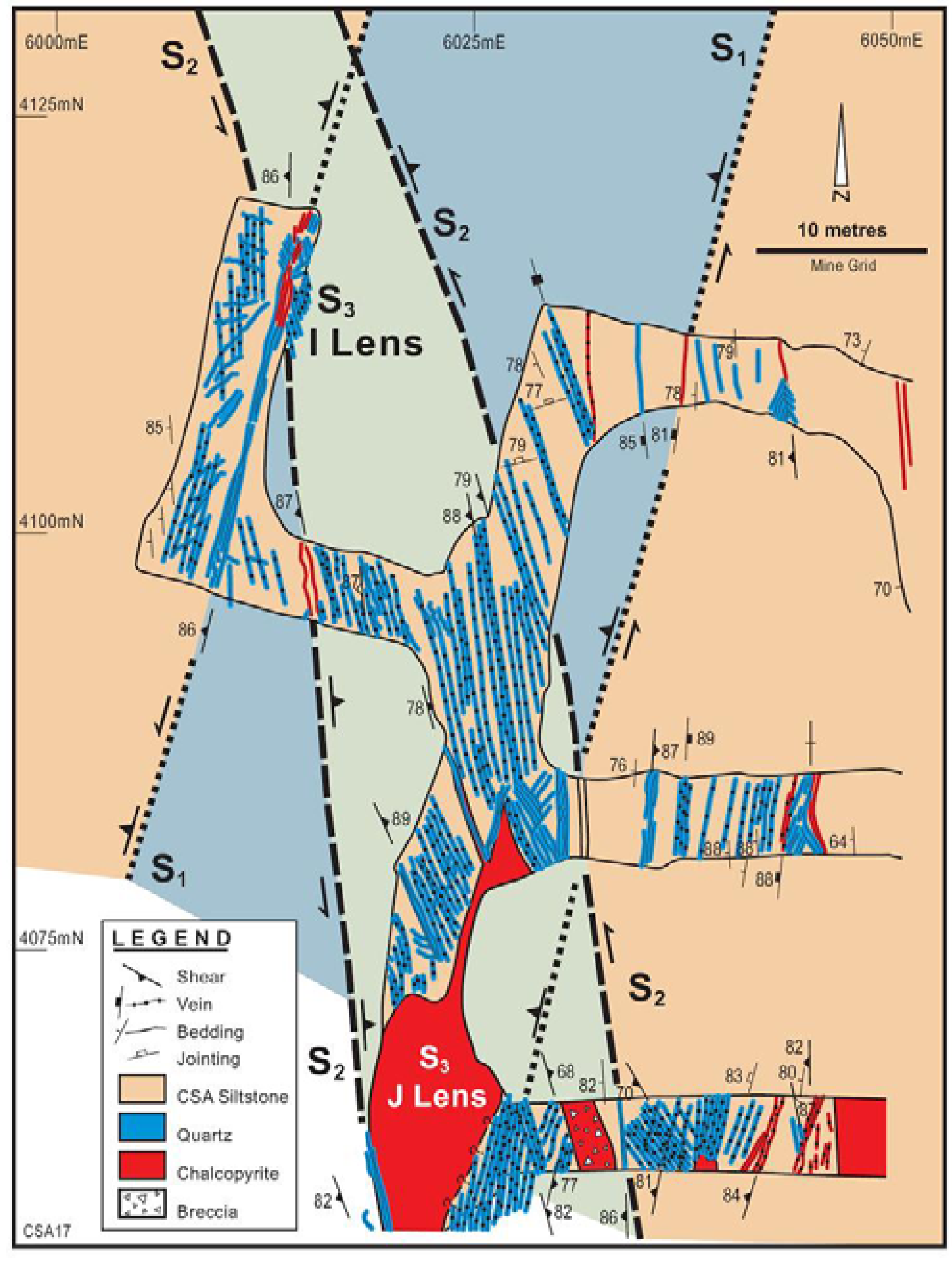
- Most of resource and reserve is at QTS North from 13 lenses; altogether about 30 lenses mined.
- Vertical extent between 200m and >+1km; QTS South 800m and QTS North ~2km. Plunge steep and generally to south. Mineralisation dips steeply east.
- Strike lengths between 15m and 130m and widths are between 5m and 30m.
- Lens systems consist of several sub-parallel lenses. Lenses strike north-south broadly.
- Mineralisation begins at surface Western otherwise 250m below the surface Eastern and from 600m at QTS North and QTS South.
- Morphology of lenses vary from massive sulphide to chalcopyrite to chalcopyrite-pyrrhotite veins to disseminated sulphide zones to brecciated sulphidic zones. Trace of Pb-Zn sulphides except near top of Western system.
- Metal zonation apparent with Pb/Zn at surface at Western grading to Cu rich at depth.
- Broad shear zones, ductile deformation apparent with local brittle fracturing developed.
- Alteration varies from silicification at the Western system to chlorite alteration elsewhere.



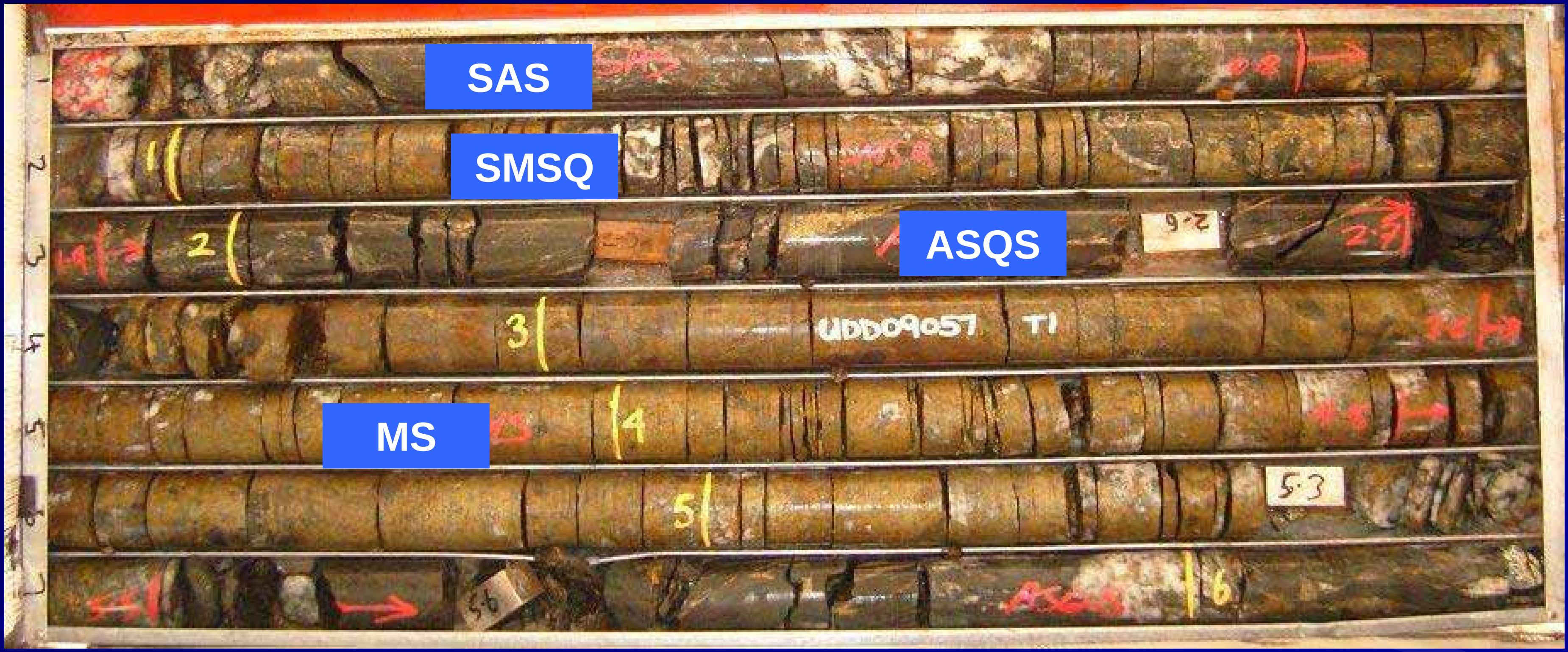
Ore Lens Morphology- Level Mapping

Typical Level Mapping J Lens

- Massive sulphide zone irregular in nature
- Stringer zone and breccia zones on either side
- Veins strike from mine grid north to just west of mine grid.
- Strike of mineralised zones variable as are nature of ore types.



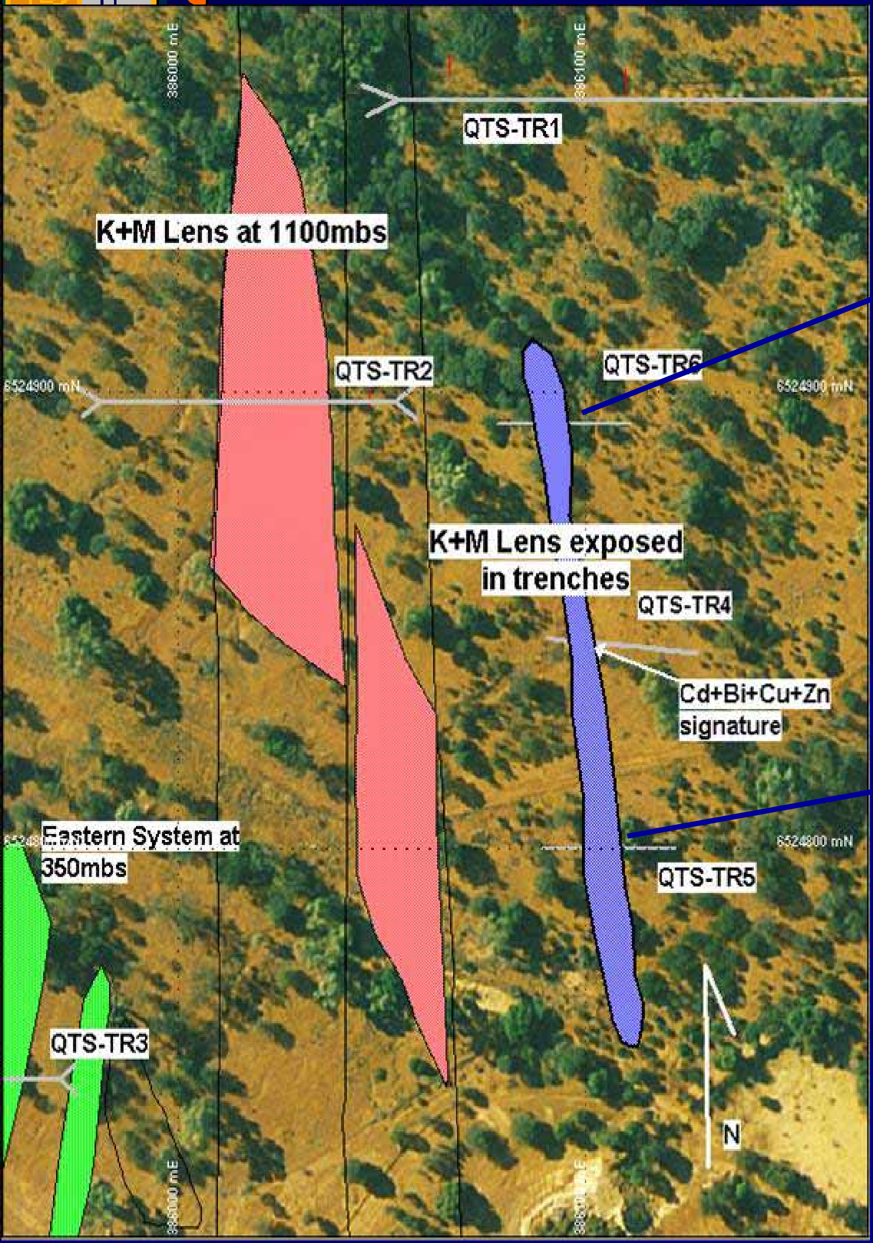
Ore Lens Morphology



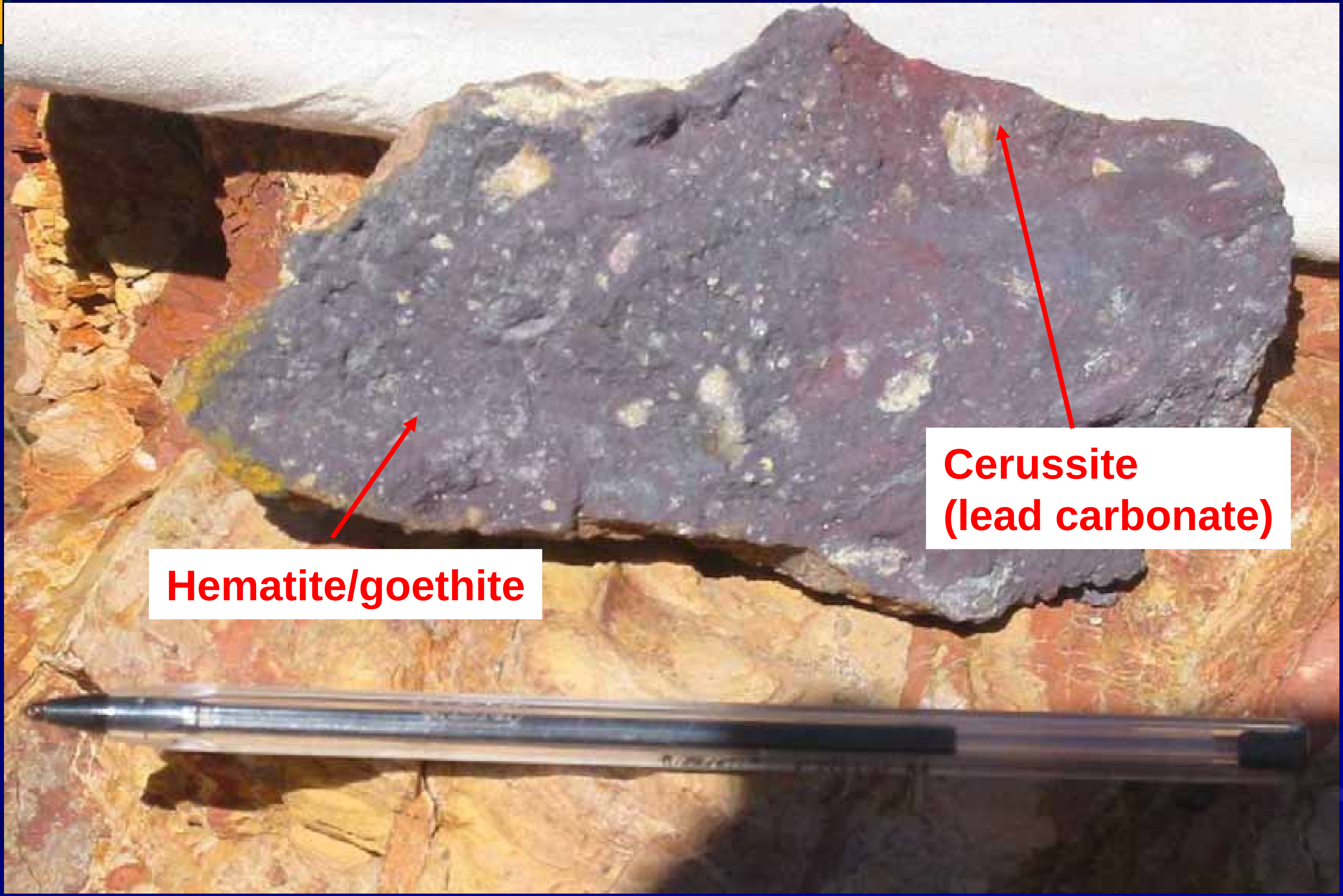
EXAMPLE:UDD09057 QTS North G Lens

Silica altered siltstone and quartz sulphide (chalcopyrite) veins grading to massive chalcopyrite.

Surface Expression – QTS North



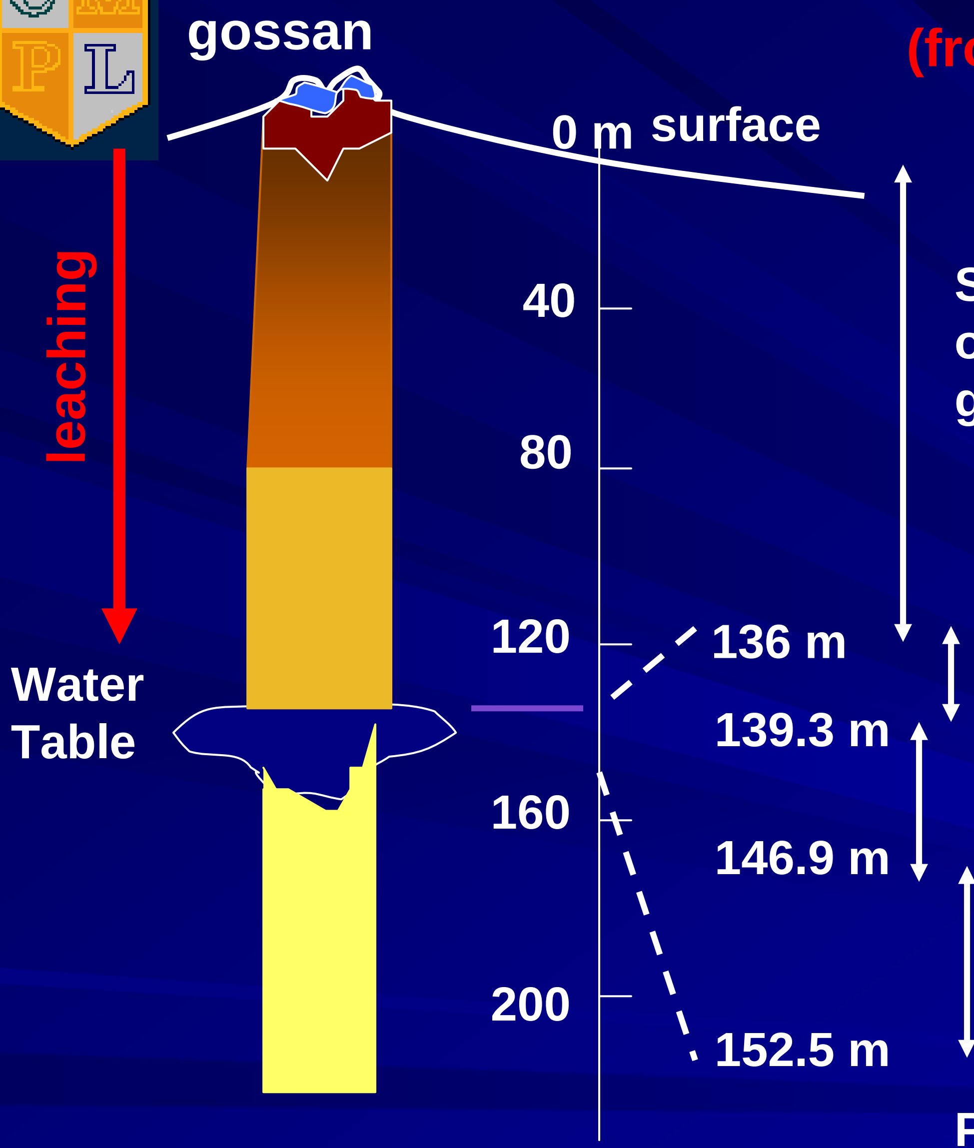
Surface Expression- CSA Gossan



Lead carbonate in CSA gossan.

Weathering Profile of the CSA Deposit

(from Andrews, 1913; Oldfield, 1917)



Strongly leached gossan with traces of malachite & cerussite. Values of gold occur throughout.

Some plates of native copper

Rich secondary lead carbonate ore cerussite, silver chlorides.

Secondary copper enrichment

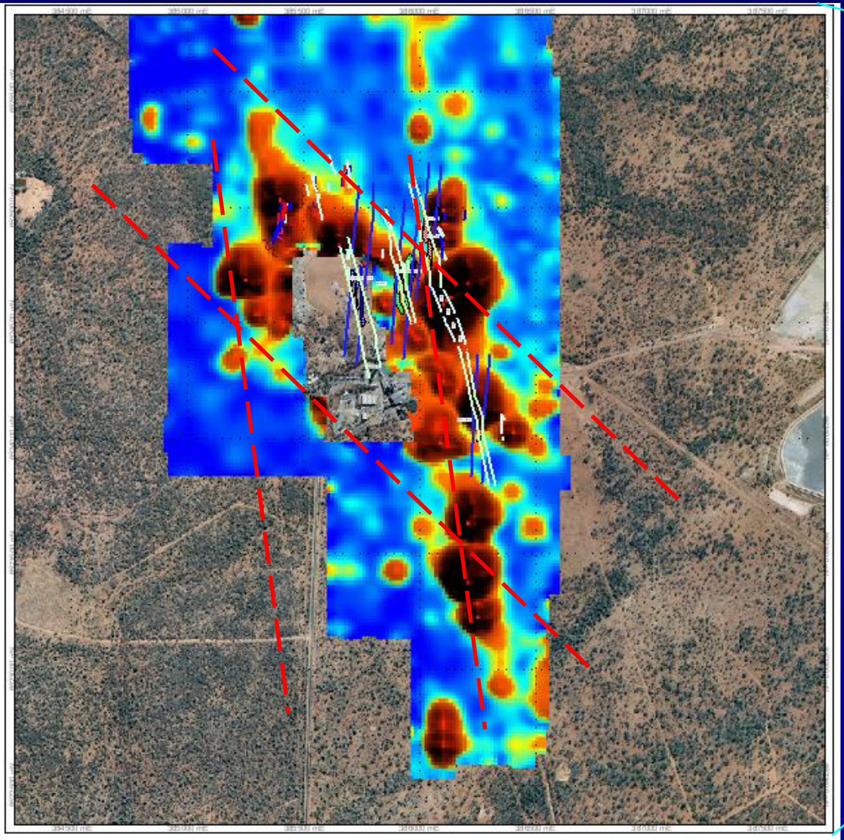
Some secondary copper enrichment in bunches, zinc & lead increasing.

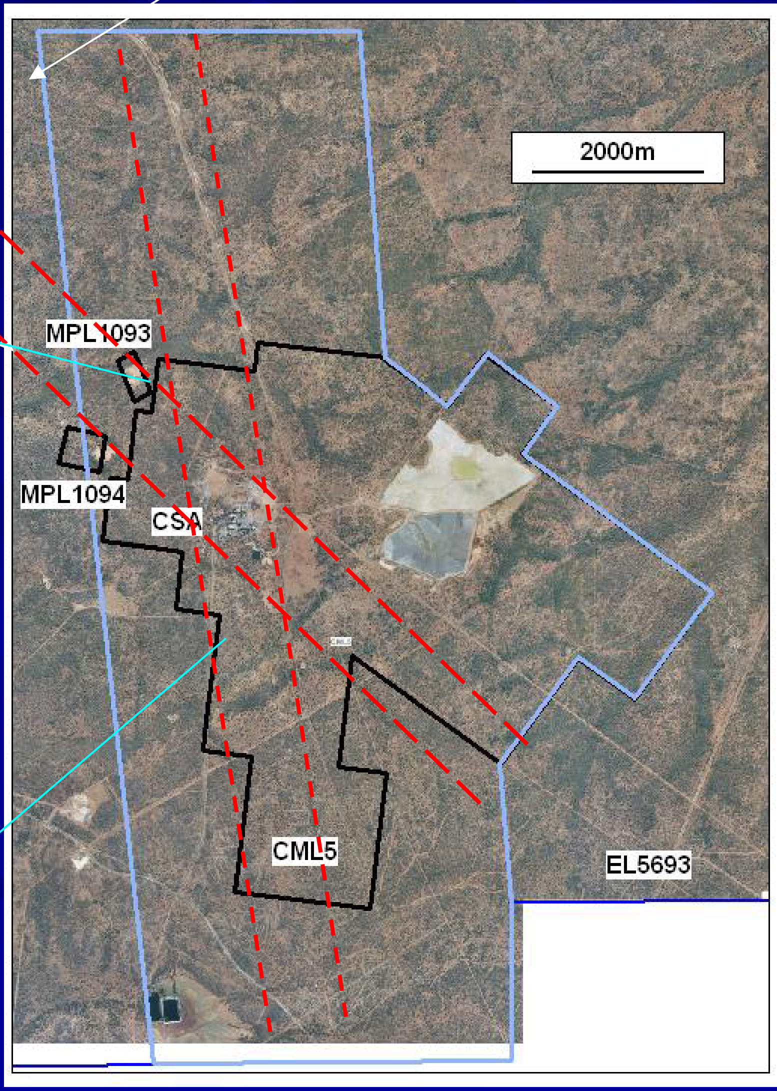
Primary sulphides low grade <2% Cu

Minerals found chalcopyrite, chalcocite, azurite, malachite, cubanite, cerussite, silver chloride, galena, sphalerite

Sharp boundary between secondary lead carbonates and supergene copper ore

Surface Geochemistry





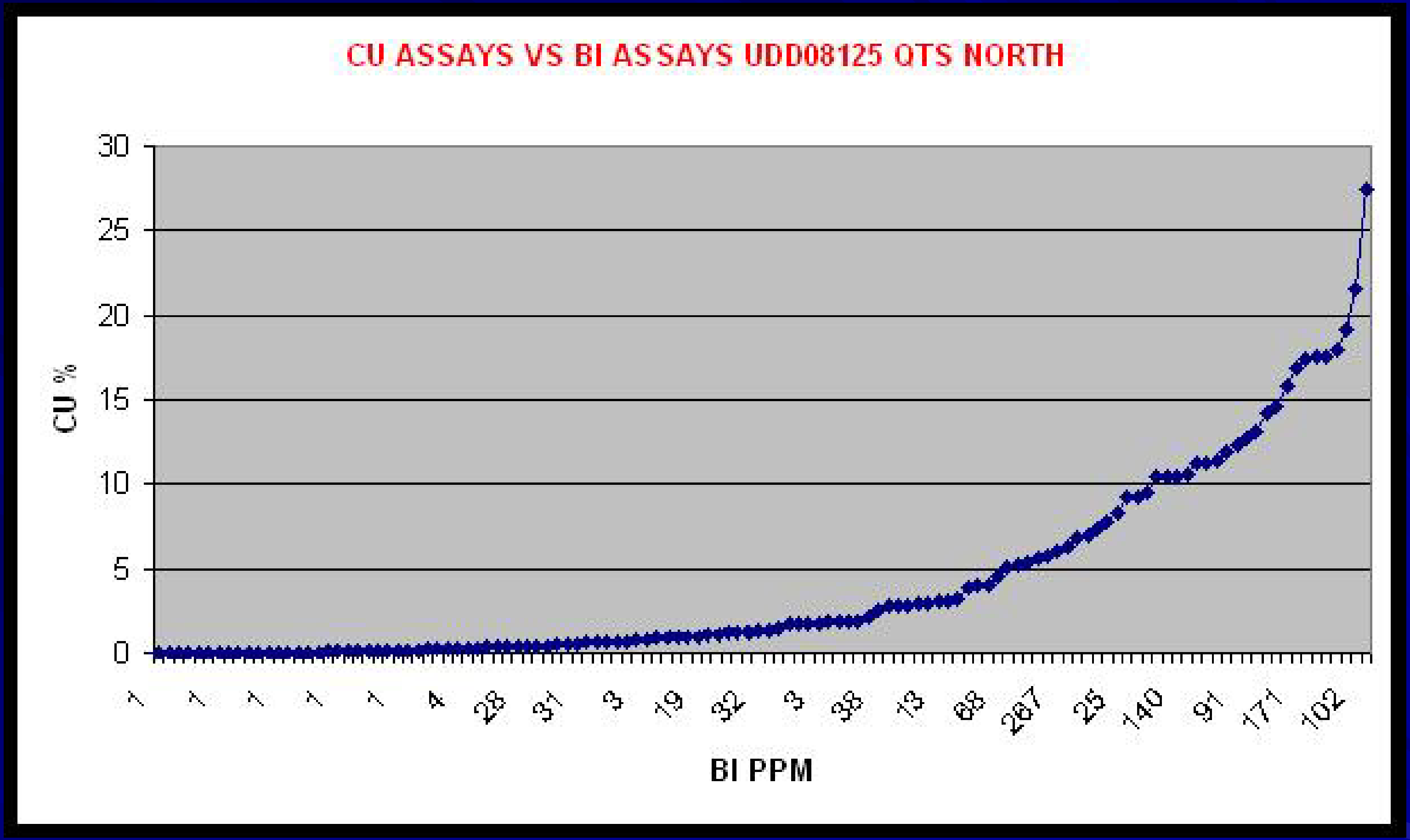
Cobar Fault

Plug Tank Fault

Cadmium in Surface Geochemical Samples

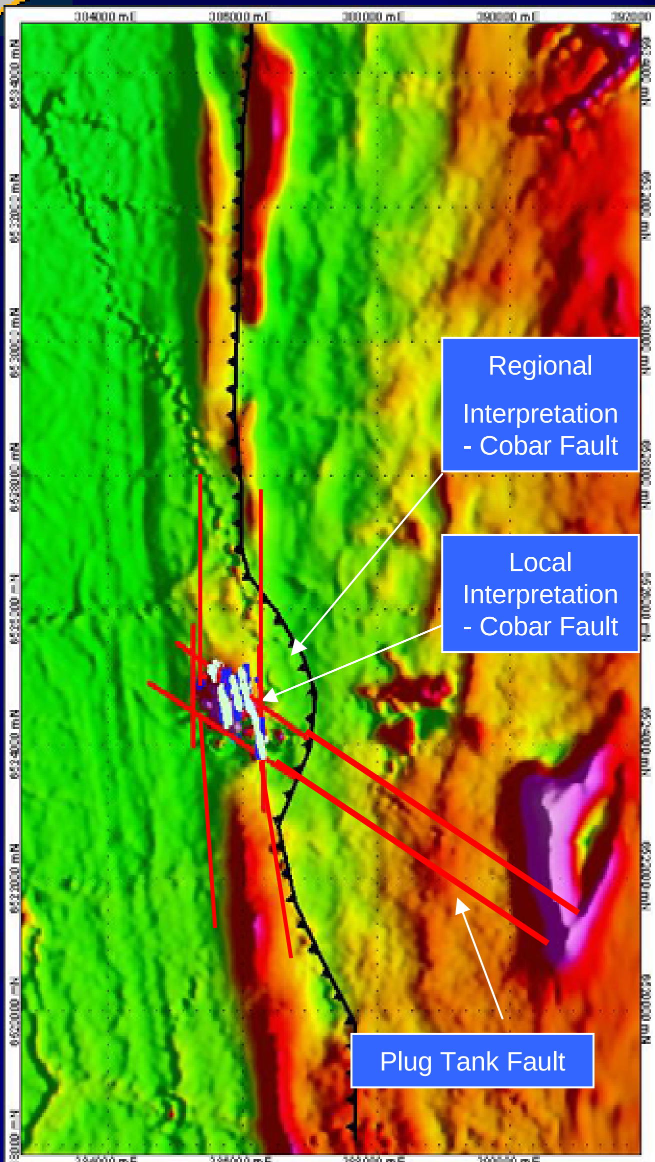
Red Coloured Contour >0.1ppm Cd

Drillhole Geochemistry –QTS North Lens System



Bismuth vs Copper assays indicate that the highest grade Cu samples correspond with highest grade Bi samples at QTS North.

Integration of Datasets

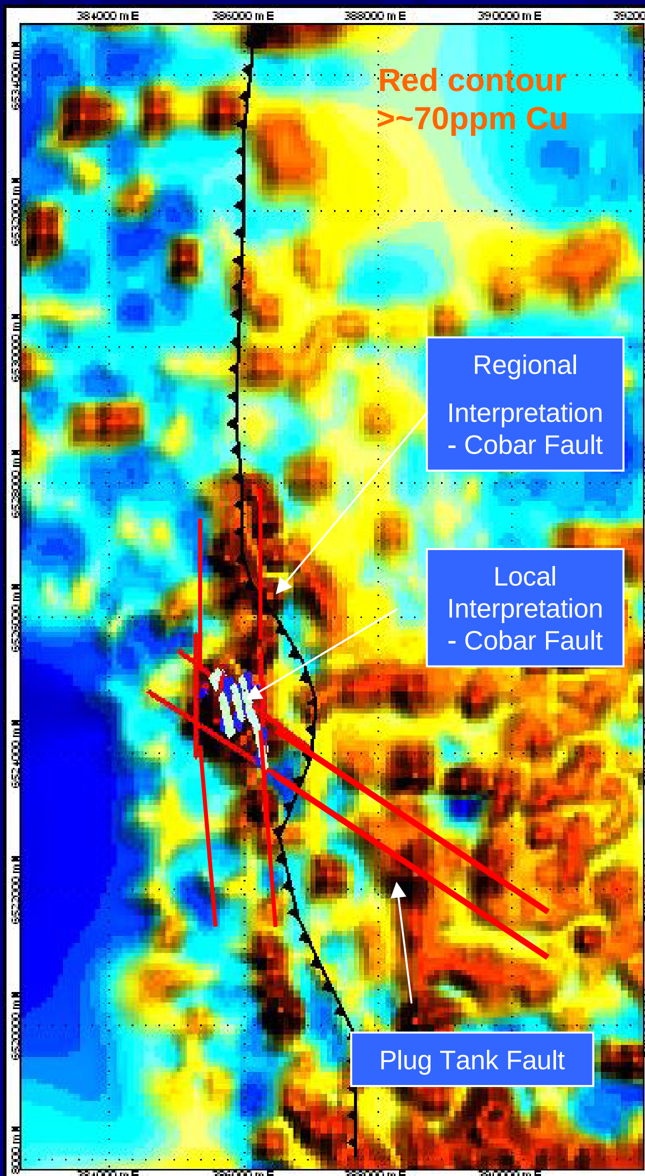


Regional Magnetics

- Local interpretation has the Cobar Fault passing through the mine – vertical/near vertical
- Plug Tank Fault continues SE direction

Regional Cu Geochemistry

- Follows the magnetic Ridge



CSA Mine

Mine Geology – Alteration

- Early pre-mineralising (S3) alteration consists of broad zones of green chlorite + silica/quartz vein alteration associated with S1 and S2 structures.

- This chlorite alteration extends out from the mineralised zone and completely encompasses mineralisation, without changing in intensity.

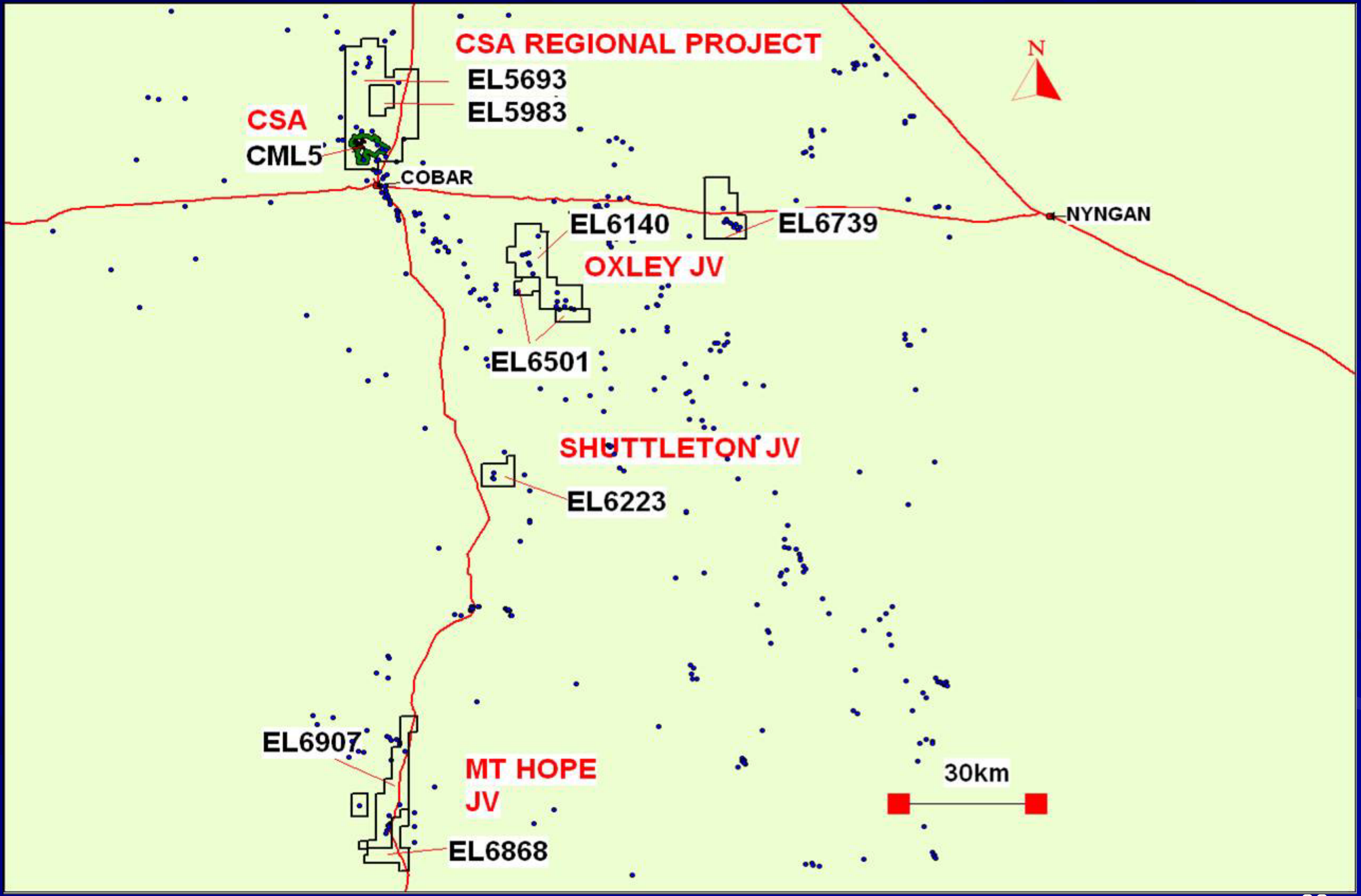
- A third “black” chlorite and silica event occurs as a limited halo to mineralisation, relating to S3 deformation.

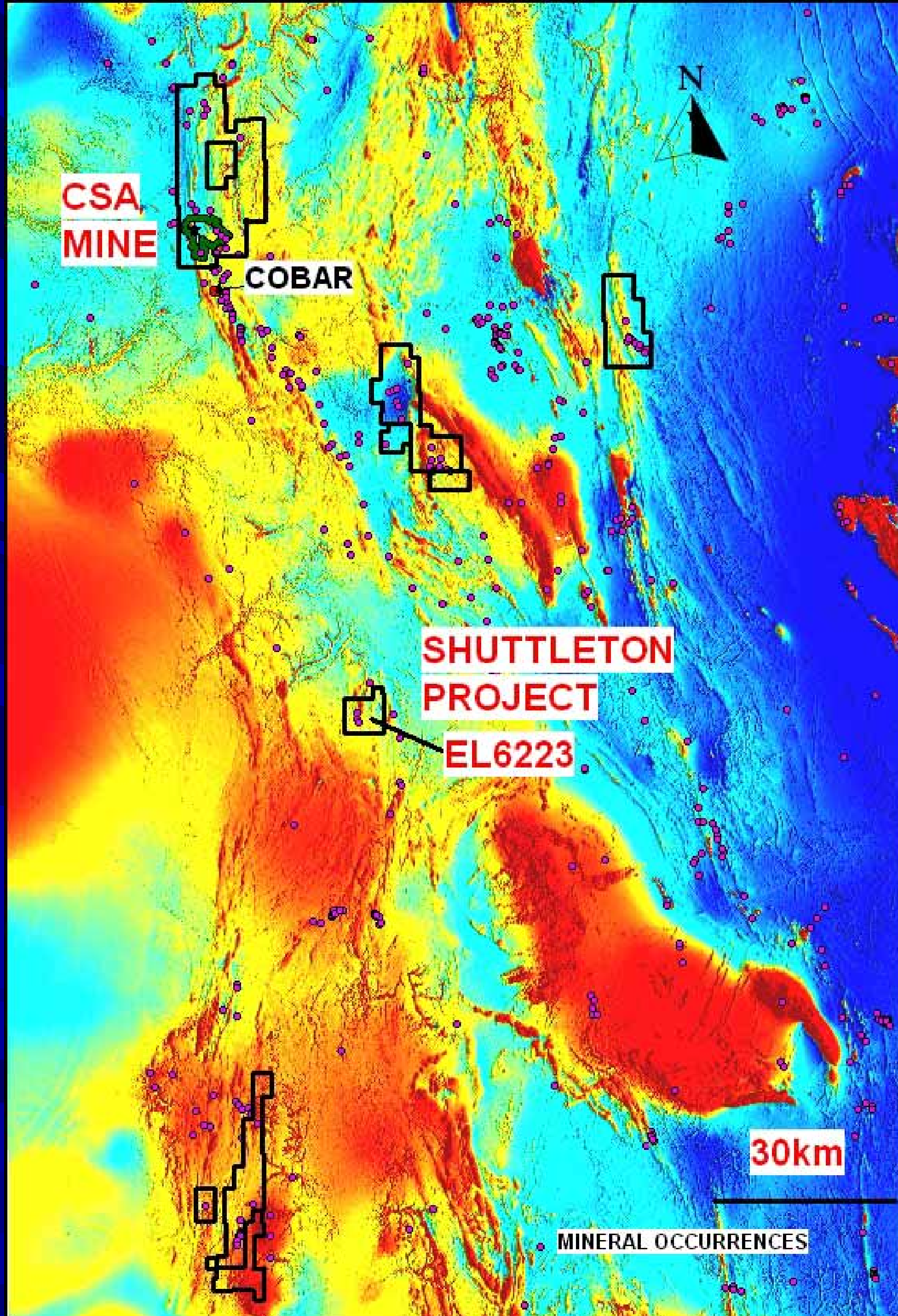
CSA MINE SCALE OBSERVATIONS – RELEVANT FOR REGIONAL EXPLORATION PROJECTS AND MODELS

- Mapped structures in the mine form a NNE (S1) and NNW (S2) orientations. These are reactivated to form S3, structures, host to the mineralisation.
- Chlorite and silica alteration is typical of the alteration associated with these structural events.
- Surface mapping reflects S1, S2 and possibly S3 structures.
- Geochemical and geophysical data sets reflect the Plug Tank Fault and Cobar Fault.
- Dilational jolts on the these structures are interpreted as causing S1 and S2 and ultimately S3.
- Integrated approach to interpret geophysical datasets such as magnetics, gravity and electromagnetics also very important in drill hole targeting.

Use of CSA Mine Observations in Regional Exploration

Regional Exploration Projects





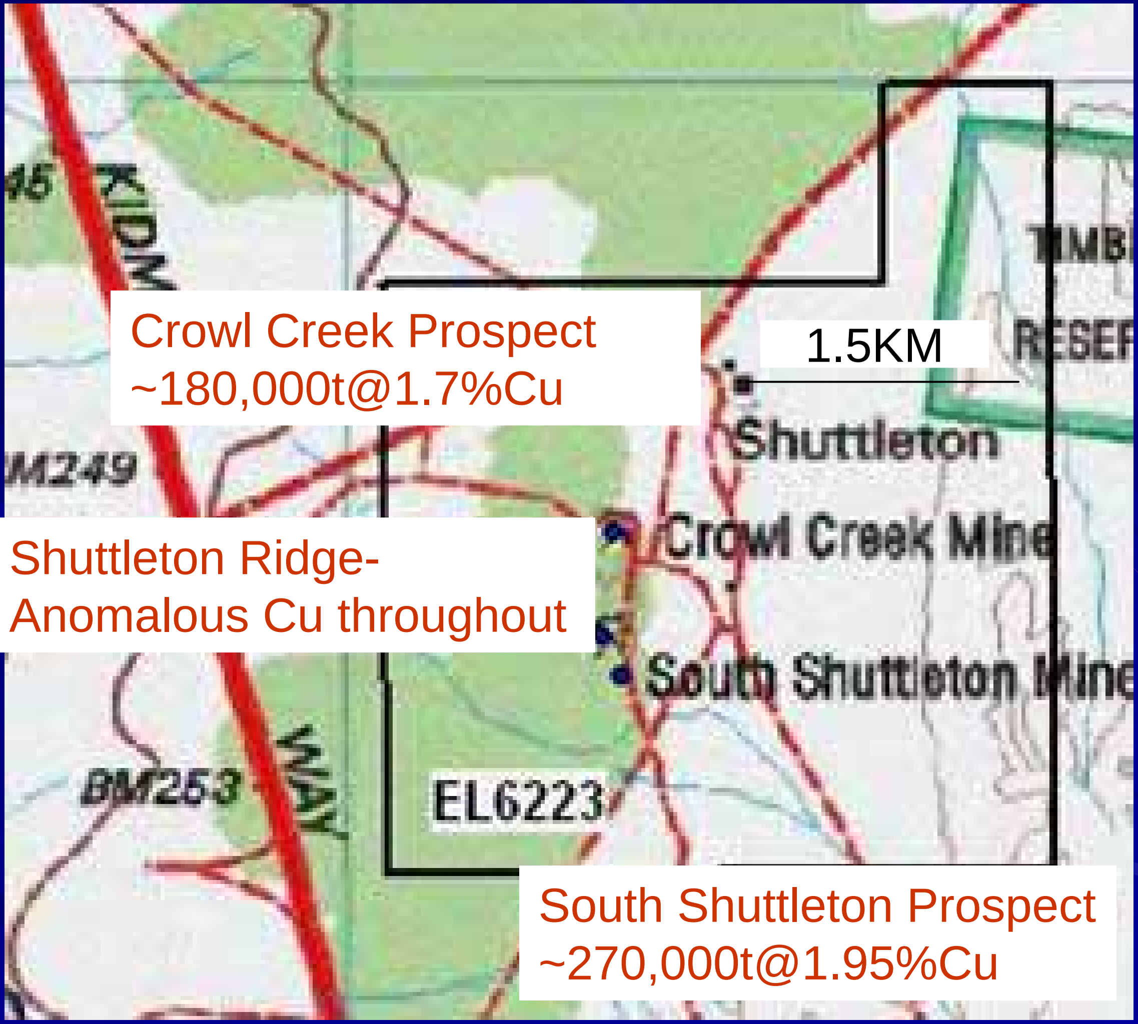
Regional Magnetics with CMPL tenement and “Farm-In and Farm-Out Ventures”

Regional Exploration- Shuttleton

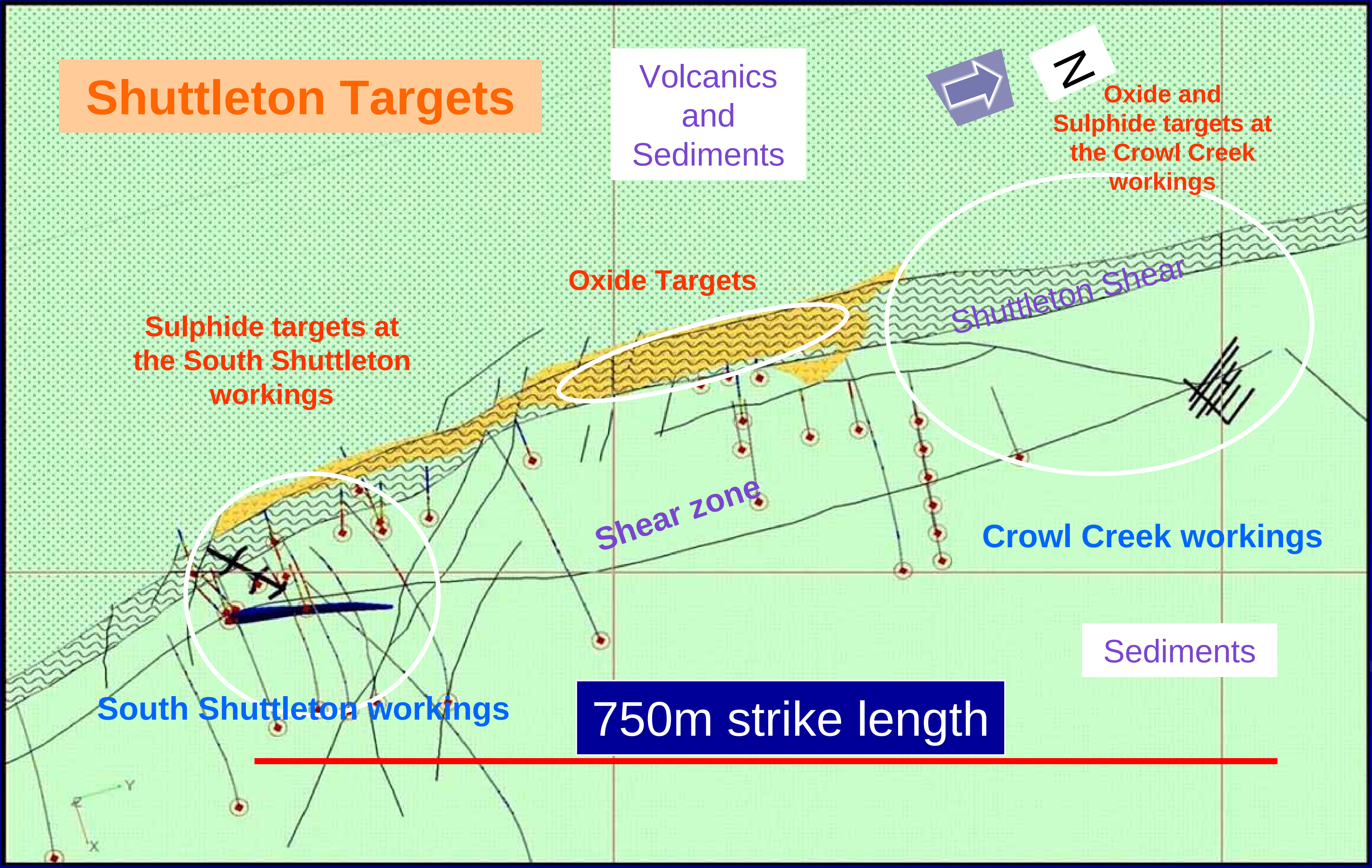
Historic Production
 - 2,960t Cu from 53,200t ore

Prospective trend from ~1km north of Crowl Creek to south of South Shuttleton prospect.

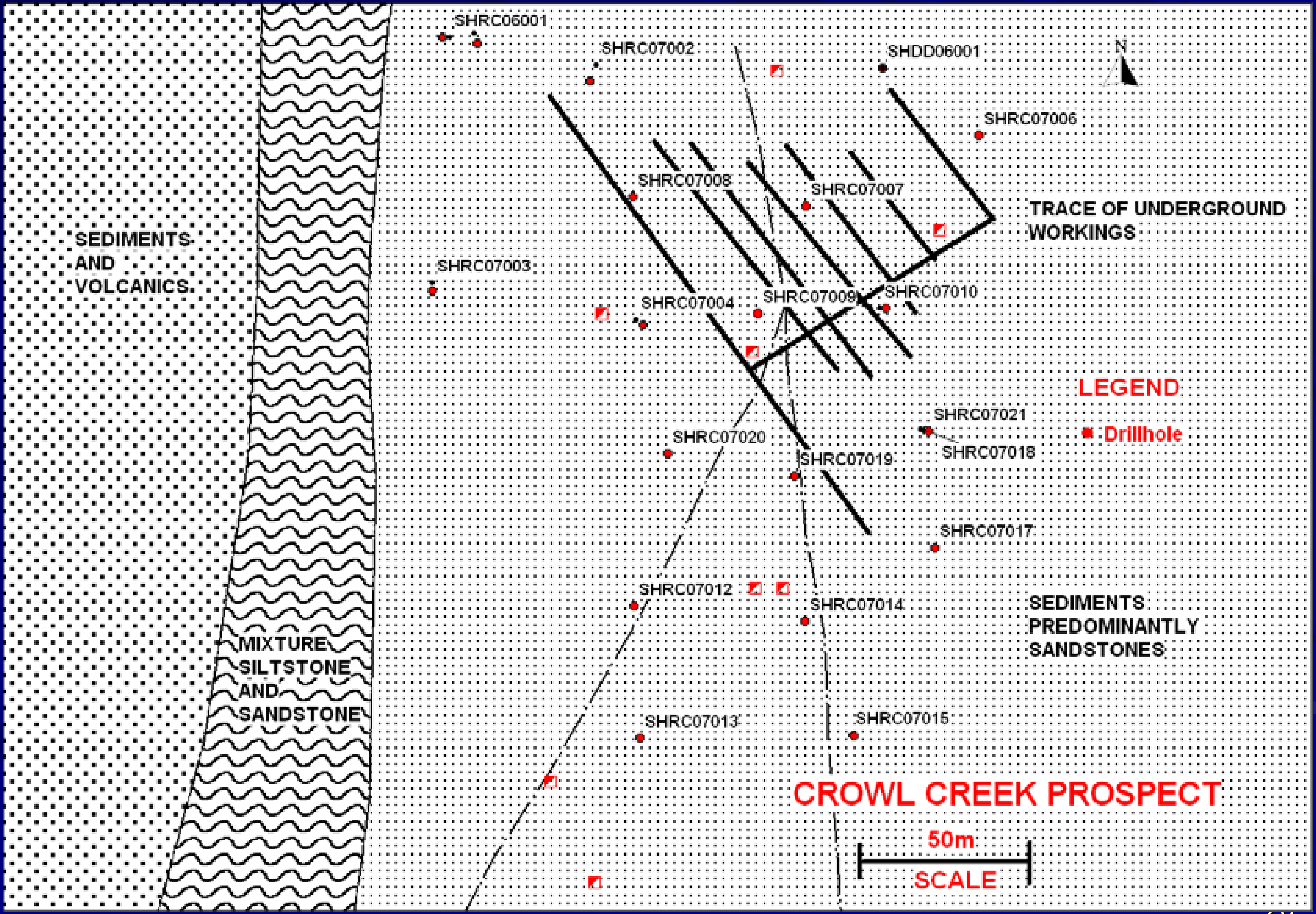
Azurite and Malachite in Surface Samples



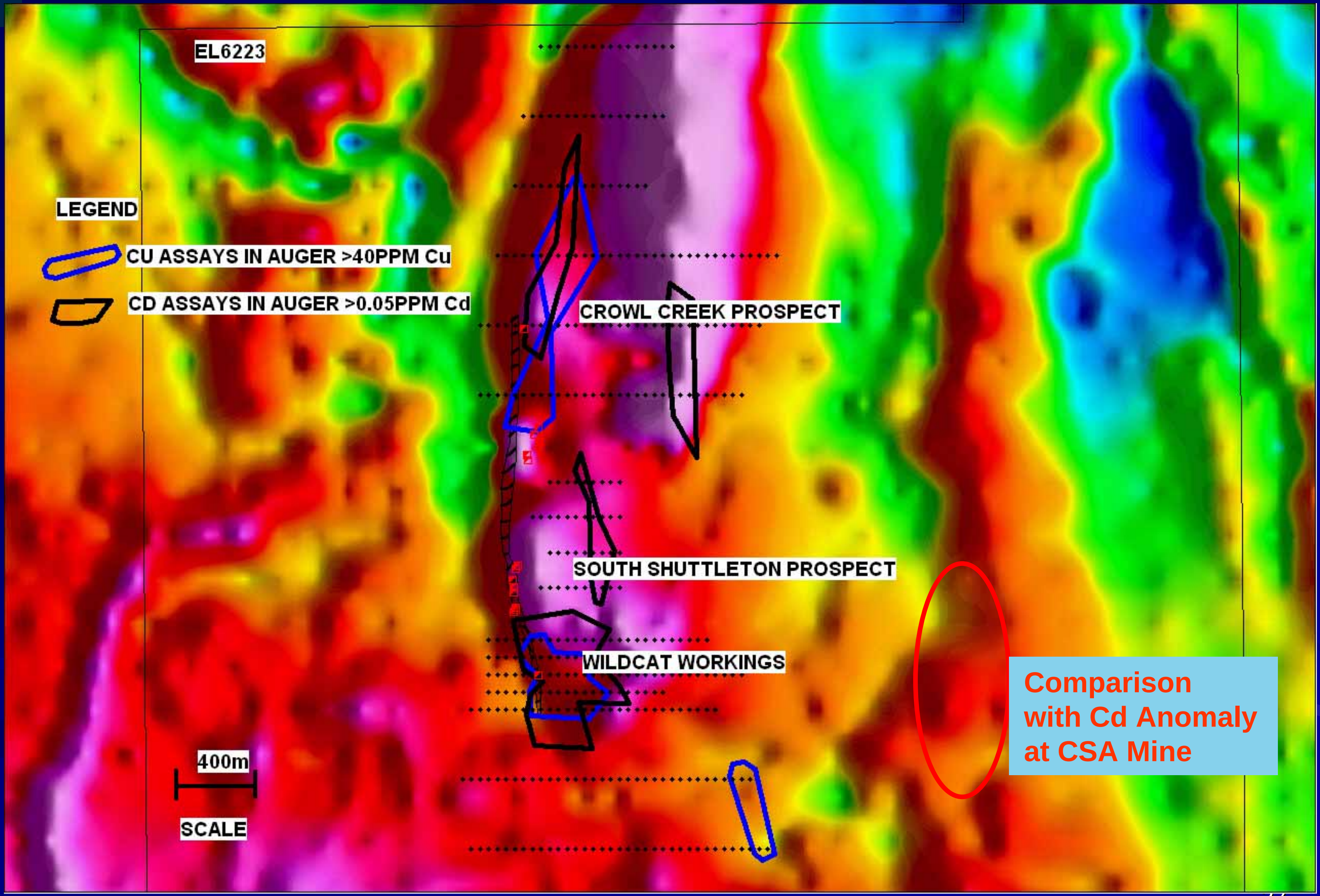
Shuttleton Project- Local Geology



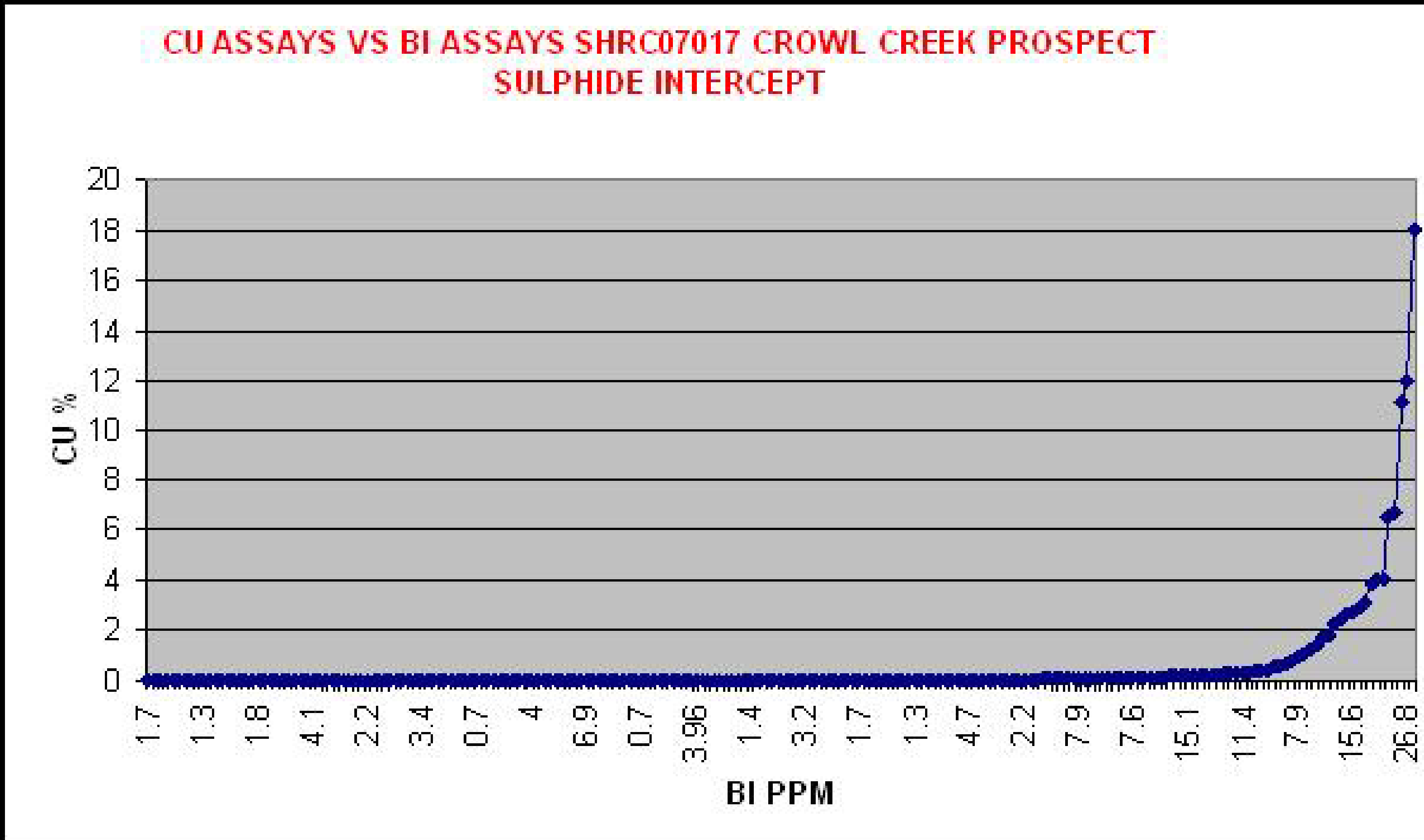
Crowl Creek Prospect



Shuttleton Cu and Cd over Magnetics

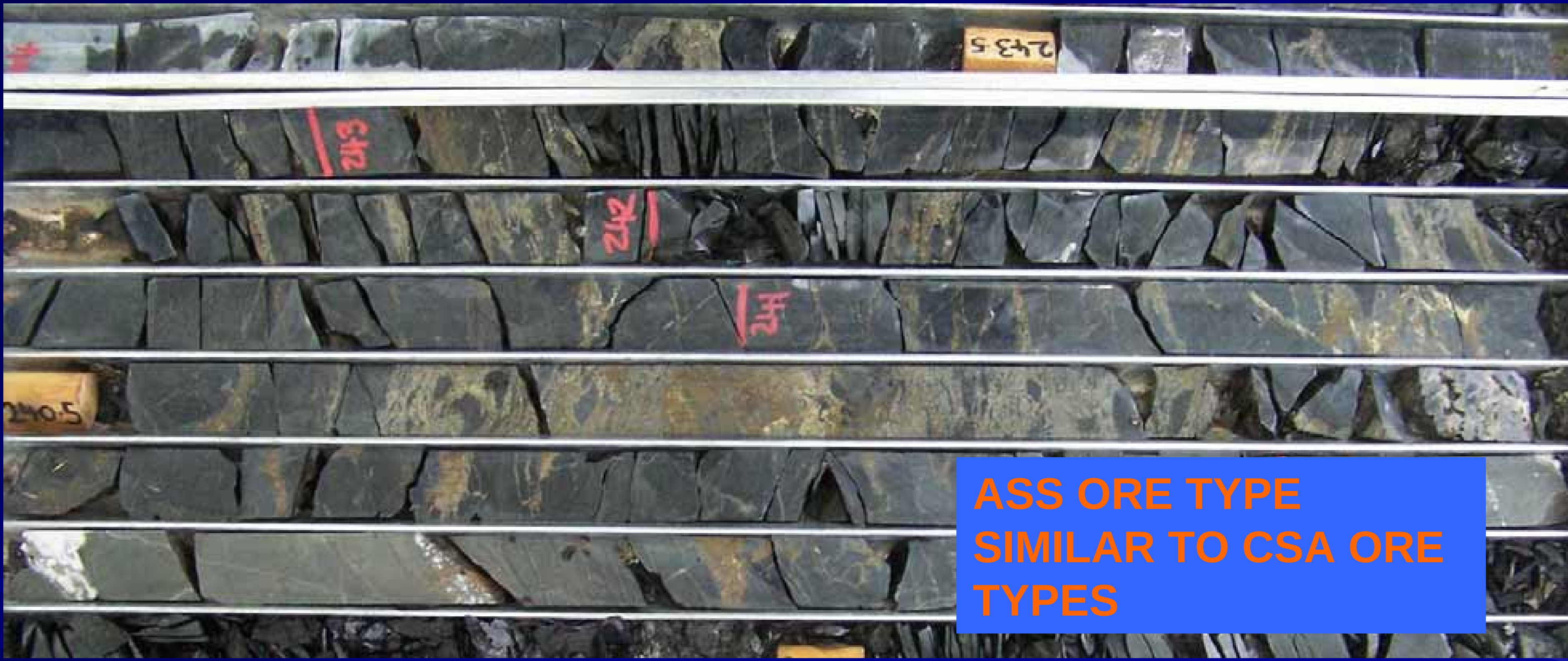


Drillhole Geochemistry-Crowl Creek Prospect



Bismuth vs Copper assays indicate that the highest grade Cu samples correspond with the highest grade Bi samples at the Crowl Creek Prospect.

Shuttleton- Ore Type Morphology



Strongly brecciated and sulphidic core at Shuttleton in hole SHDD6002.

Characteristics of Ore Deposits in the Cobar District

Geology Overview

- Structurally controlled.
- Occurs in lenses with short strike lengths.
- Narrow width (<30m).
- Strong vertical extent (+1km).
- Weak alteration halos.
- High Grade.
- Examples include CSA (Cu, Pb, Zn), Peak (Au, Cu) and Elura/Endeavour (Zn, Pb, Ag) orebodies.

Key Aspects of Cobar Regional Exploration Models

- Difficult targets due to the small “footprint”.
- Important to understand the structural geometries, hence mapping is critical.
- Important to understand the geochemical dispersion which is often narrow.
- Important to understand the geophysical signatures which requires careful filtering of “noise”.
- Integrated approach to regional datasets important for developing regional models.
- Requires persistence due to the subtle features that define mineralisation.
- Geology team is developing a better understanding of mineralised systems.

ACKNOWLEDGEMENTS

THANK YOU TO ALL STAFF AT CMPL PARTICULARLY THE GEOLOGY TEAM.