CSA – 40 years Old and Enjoying a Mid Life Renaissance!!! No Crisis here folks! Aspects of Mine and Surface Geology and Recent MIMDAS Surveys at the CSA Mine, Cobar NSW SUPERBASIN METALLOGENESIS

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Key Words: CSA, mining, copper, structure, MIMDAS, regional geology

Background

The CSA deposit was discovered in 1871 by Tom O'Brian and subsequently sold to a syndicate consisting of a Cornishman, a Scotsman and a Australian, from whose nationalities the mine was subsequently named (CSA).

The mine operated intermittently until 1964, when the current infrastructure was built. Modern mining commenced from this time at approximately 700 000 tonnes per annum from the Eastern System (Cu+/-Zn) and the Western System (Pb+Zn+Ag) lenses. The copper rich QTS System was discovered in the mid 1970's and is currently the main source of ore.

Mineralisation consists of steeply dipping sulphide and quartz sulphide lenses. These are hosted in the CSA siltstone and may be structurally related to the Cobar fault.

Historical mine production from 1964 to 2005 is estimated 21mt @ 2.76% Cu for 592,000t of Cu. Total reserves and resources on the QTS North System as of March 2006 were 9.5mt at 6.7% Cu and 29 g/t Ag for 641,500t Cu. Current throughput is 810,000t per annum. Current development is at 1.42km below surface and the resource is open at depth, 1.8km from surface.

The CSA mine is operated by Cobar Management Pty Ltd (CMPL), a wholly owned subsidiary of Glencore International.

Regional Geology

The CSA mine is located on the eastern side of the Cobar Basin (Figure 1). The basin was formed during the early Devonian, depositing the Cobar Supergroup, consisting of the Kopyje and Wiltagoona shelf sequences and the deeper water Nurri and Amphitheatre Group sediments (Glen, R.A. 1994). The Nurri group is an upward fining turbidite sequence passing up from the lower Drysdale Conglomerate through to the Chesney Formation consisting of massive sandstone, interbedded sandstone and siltstone and mudstone. The Amphitheatre Group overlies and interfingers the Nurri Group at the eastern margin, consisting of thin bedded turbidite sequences, including the CSA siltstone and a thick bedded turbidite sequence (Biddabirra Formation).

In the Late Devonian the Cobar basin underwent inversion and reactivation of Syn-depositional Faults. These faults are interpreted as steeply dipping at surface, developing into a single thrust fault at depth (Glen, R.A. 1994). These faults separate the major lithological units (Figure 1). A pervasive cleavage developed during inversion is interpreted as being related to the timing of mineralisation.

Local Geology

The local geology of the CSA mine is dominated by the CSA siltstone, a thinly bedded and occasional slaty sequence. Bedding is commonly 1-4 cm thick, consisting of silt sized to fine grained sandstone bedding. Occasional thicker and coarser sandstone units also occur. Numerous sedimentary structures occur within the bedding (graded bedding, cross stratification, scour structures etc), which is interpreted as being a distal turbidite sequence. Small scale folding and faulting is common through the CSA siltstone, increasing in intensity towards the top of the sequence to the west and the Biddabirra Formation.

The CSA siltstone borders with the Cobar slate to the east. Mapping within the interpreted Cobar fault contact area has yet to determine the nature boundary of the two units, however this is interpreted as being an inter-fingering and probably gradation boundary. No surface expression of the Cobar fault has been identified and it is quite possible that the Cobar Fault encompasses the CSA mine as a broad fault zone.

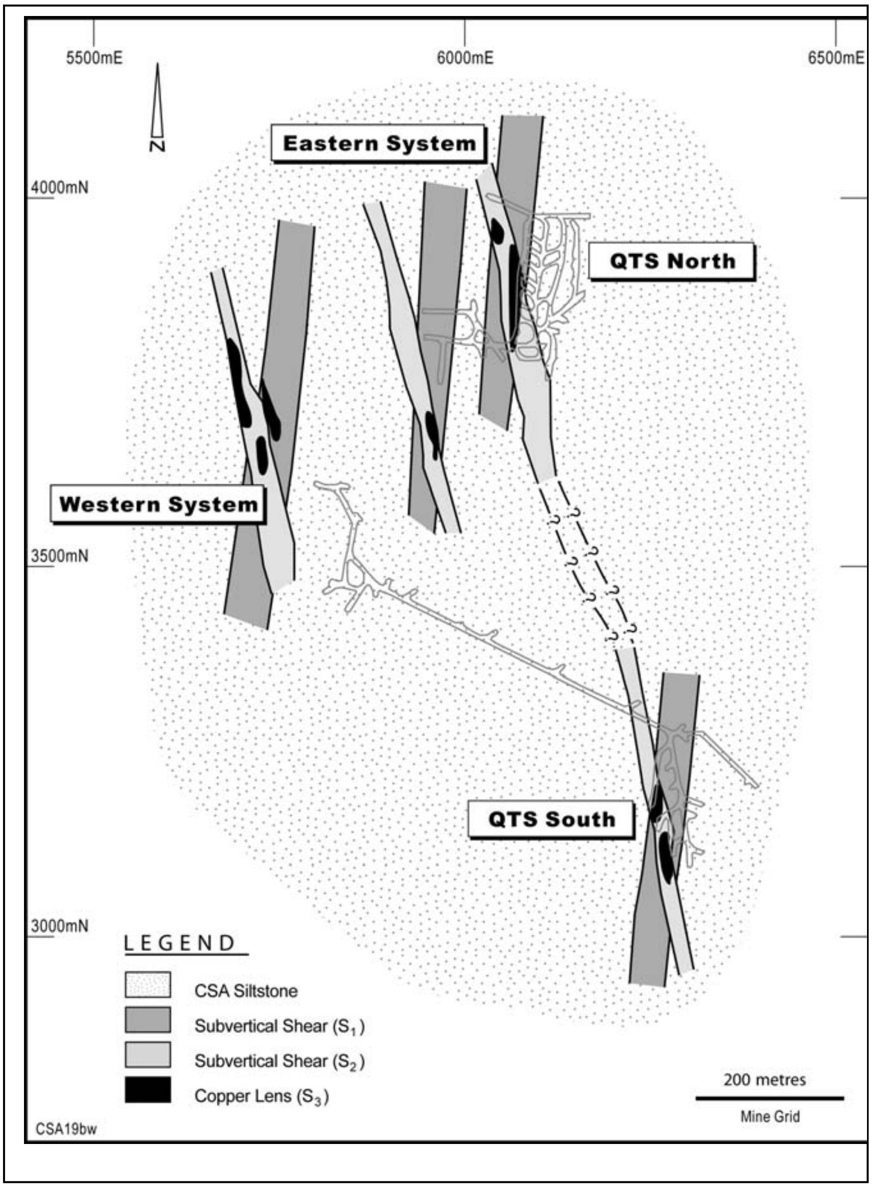

Figure 2- Plan view showing ore systems and structure, 11 level, CSA mine (1000 m below surface).

Mineralisation

The CSA mine is comprised of four mineralised systems, QTS North, Eastern System and QTS South (Figure 2). The principal sulfide phase in all the CSA ore systems is chalcopyrite. Other copper bearing phases include cubanite and trace amounts of bornite, chalcocite and covellite. A copper-silver correlation exists within the ore lenses indicating silver is in solid solution with chalcopyrite. A moderate amount of zinc and lead were extracted from the Western System.

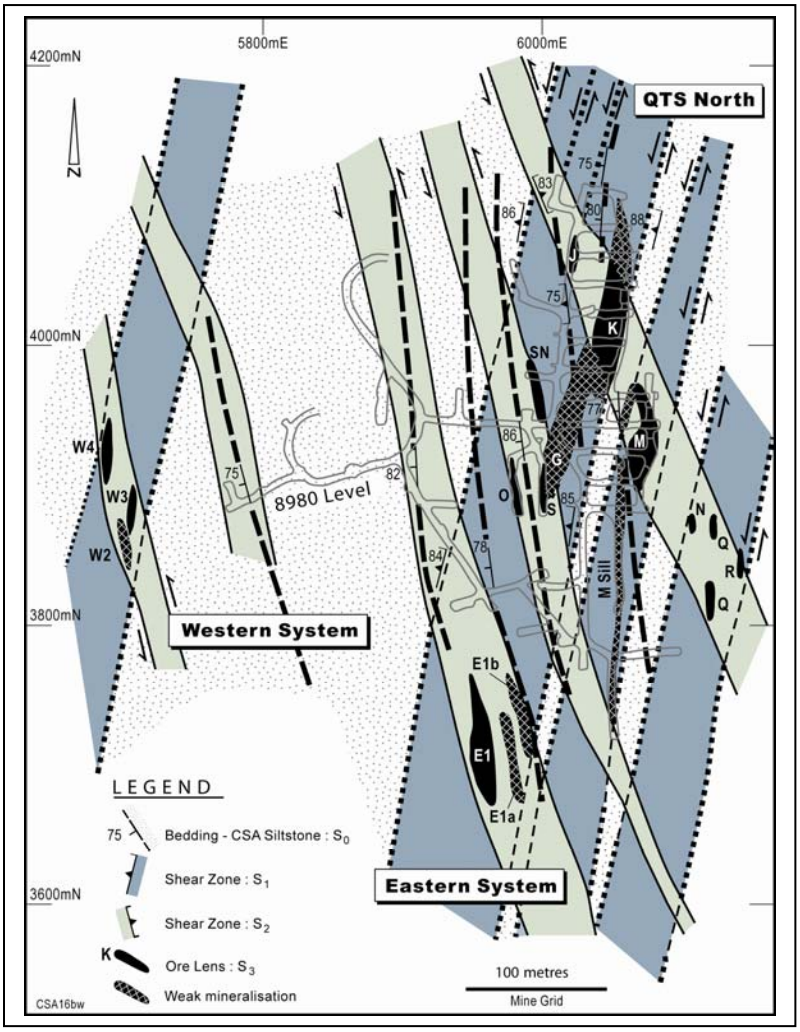

Figure 3 - North looking geological cross-section of 4065 N within the CSA mine illustrating typical QTS North style mineralisation and structural controls.

QTS North system

The QTS North System, currently mined is the largest ore system consisting of purely copper lenses. Mineralisation begins 600m below the surface. Thirteen lenses have been interpreted within the QTS North system and form the majority of the CSA resource and reserve.

QTS North Lenses trend north-south and are sub vertical to steeply west dipping with strike lengths between 15m and 130m as shown in Figure 3. Widths are between 5m and 16m. Down plunge lengths range between 400m to in excess of 1km. Lenses are clearly defined by semi massive to massive chalcopyrite hosted within S3 structures. The margins of the lenses are usually defined by chalcopyrite and quartz veining.

Eastern system

The Eastern system mineralisation begins 250m below the surface and consists of multiple lenses of moderate length between 50m to 80m and variable width averaging 10m. Mineralisation consists predominantly of chalcopyrite, pyrrhotite and numerous quartz and pyrite veins in an intensely cleaved chlorite siltstone. Less commonly, sulfides are massive and contain granular to nodular quartz with little or no quartz veining (Scott and Phillips, 1990).

Western system

The Western System is the only outcropping system at the CSA. Lenses average 45m long and 7m wide and extend down plunge in excess of 200m. Lenses consist of high grade pods of copper rich and lead-zinc rich ore. The copper lenses consist of vein type chalcopyrite, pyrrhotite, pyrite and quartz, and the lead-zinc rich lenses consist of galena, sphalerite, pyrrhotite, pyrite and chalcopyrite and are often banded.

QTS South system

The QTS South system is blind to the surface with mineralisation occurring 700m below surface and some 500m south of the other systems. The mined portion of QTS South consists of several north-south trending steeply east dipping lenses with a strike length of 200m and average widths of 8m to 10m. The system has a steep southerly down plunge component of 300m. Mineralisation occurs in a chlorite altered siltstone similar to the Eastern system. The system is principally copper rich, with minor pyrrhotite and isolated pods of galena and sphalerite at the extremities.

A south plunging extension named QR1 was discovered below and to the south of the old QTS South workings during 2005. The lens is north-northeast trending with a steep westerly dip. The lens extends down plunge for greater than 400m with a strike length of 90m and average width of 15m. The mineralogical zoning is unusual with a 10m wide zone of quartz-chalcopyrite-chlorite veining bounded to the east by a 5m wide zone of massive chalcopyrite. Cubanite inclusions are common within the chalcopyrite.

Structure

Recent efforts at interpreting the structure at the CSA have involved combining mine structure data, surface data and geophysical data. Local terminology has been used here to describe deformation (D) and Shear (S) events at the mine scale. These are not implied to reflect regional deformation events.

All four systems are defined by mineralisation at the intersection of two sub-vertical mine scale structures. The north-northeast trending structures are interpreted as D1 events and are referred to as S1 shears (figure 3 and 4). The north-northwest trending structures are interpreted as D2 events and are referred to as S2 shears. Subsequent 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. S3 structures host the majority of the CSA resource.

S1 shears are defined by north-northeast trending quartz vein shear zones that transect bedding and dip steeply west (85°) (Figure 3). At QTS South they dip steeply east at 85°. The S1 shears are characteristic of all underground workings and may extend well beyond the mine and are likely to be associated with the regional Cobar Fault. Shear zone widths range from 1m to 100m with varying intensities of parallel quartz veining.

S2 shears are north-northwest trending quartz vein shear zones that dip 85° to the east as shown in Figure 3. The S2 shears at QTS South dip 85° towards the west. The structures are clearly visible throughout the underground workings and clearly post date the S1 shears proximal to mineralisation. It is unknown whether the S2 structures are hosted within the Cobar Fault or extend beyond its boundaries. The structures are defined by zones of closely spaced quartz stringers similar to S1 veining. Parallel sulfide veining is common within areas immediate to lode structures.

S3 structures are north-south trending sub-vertical dilation zones. They are best developed in zones of intense S1 and S2 quartz veining. The northern and southern margins of S3 are usually defined by north-south trending sub-vertical quartz-sulfide veins and randomly orientated quartz-sulfide stock-work veins. The intersection of the sub-vertical S1 and S2 shears ensures the S3 domains have an extensive steep northerly plunge. At QTS South S3 has a steep southerly plunge due to the opposite dip directions of S1 and S2. S3 is a product of sinistral strike slip movement along the S1 and S2 boundaries.

At QTS North, S3 structures are clearly defined as large dilations filled with semi massive to massive sulfide exhibiting sharp contacts with the early quartz rich S1 and S2 veins. S1 and S2 quartz veins sets are often seen with brittle terminations at the S3 margins (Figure 5). Brecciation on the S3 margins is common up to several metres wide.

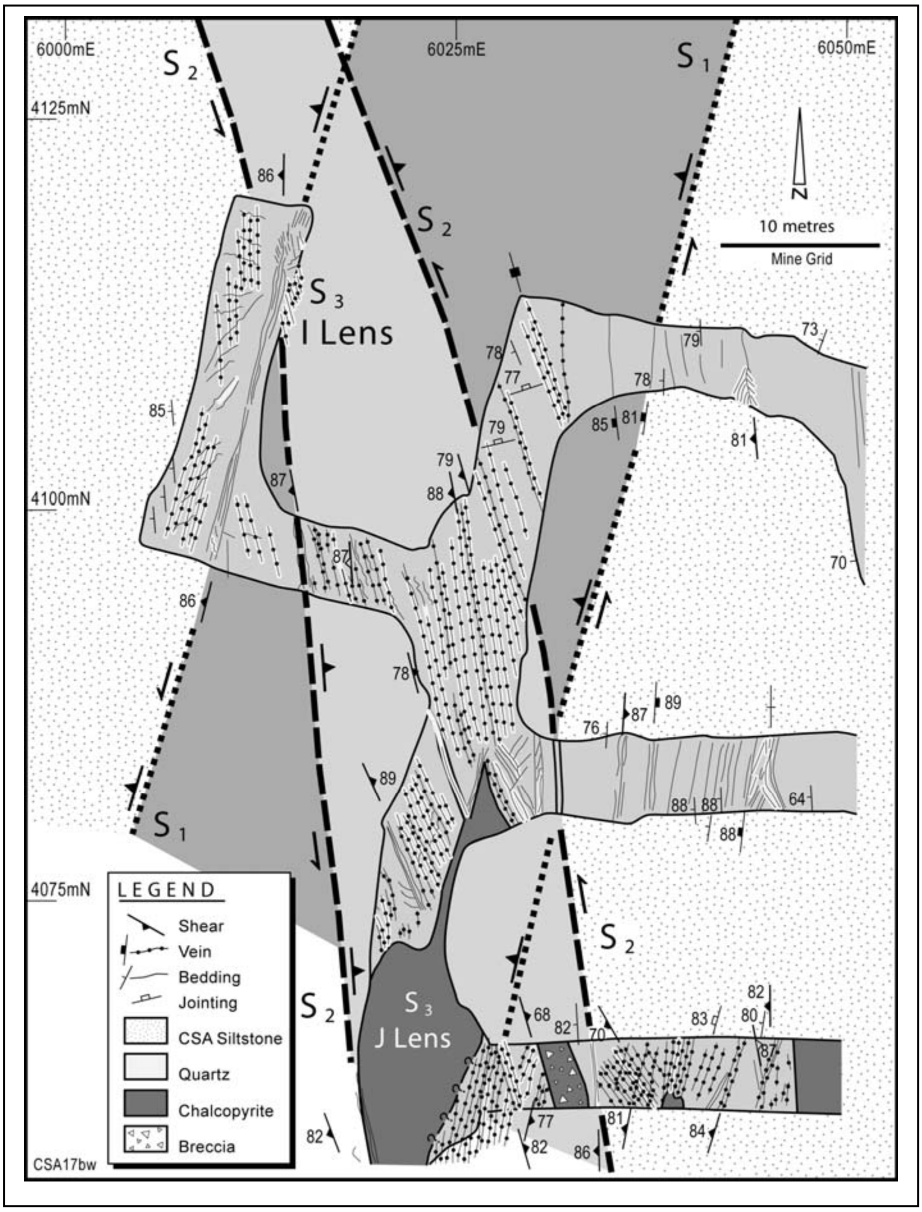

Figure 4 - Geological plan view of CSA geology, 8980 level (1290 m below surface), illustrating the relationship of mineralisation (S3) to earlier generated shear zones (S1 and S2).

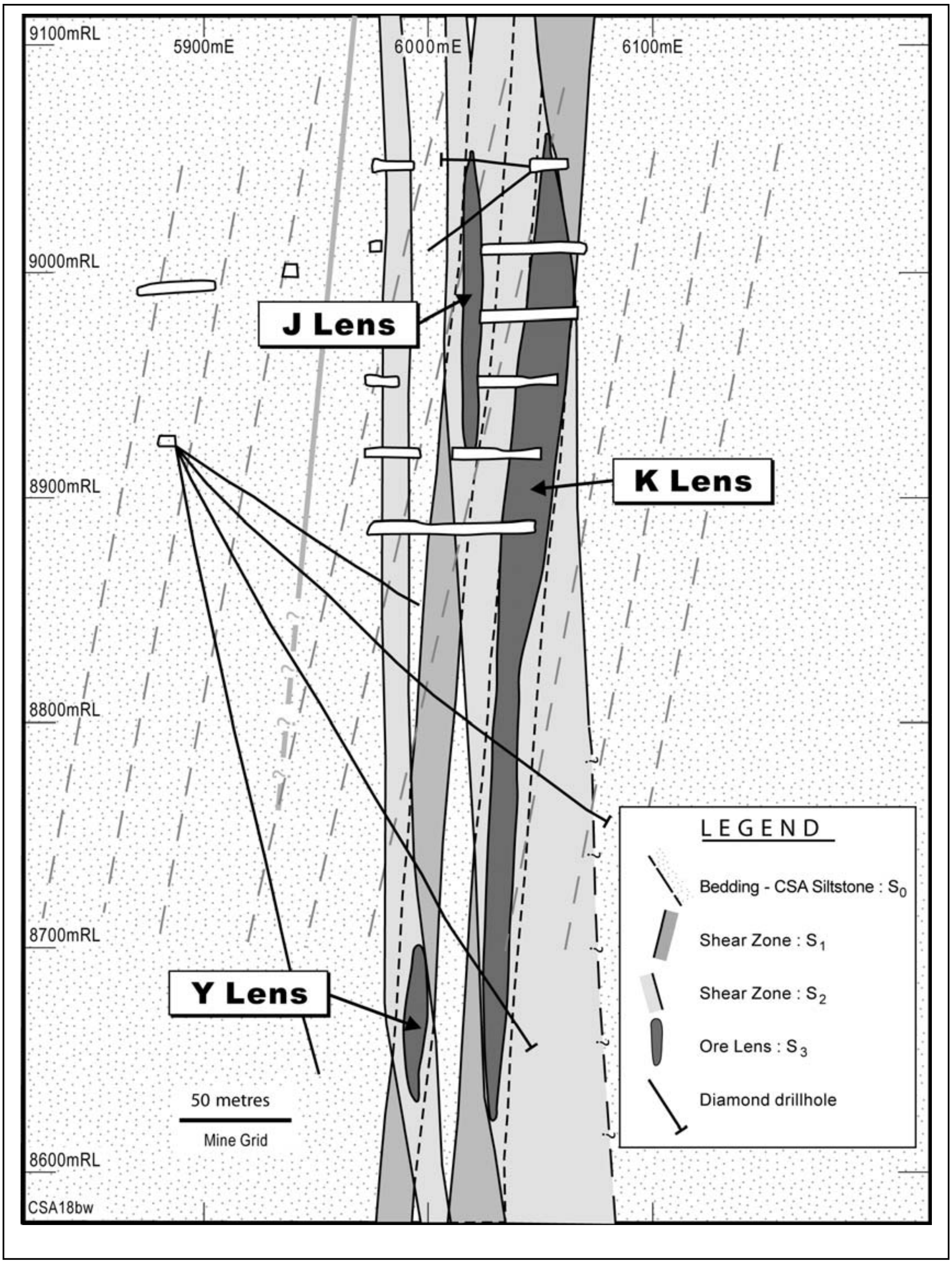

Figure 5 - Geological plan view of J lens, 8980 level (1290 m below surface), highlighting the brittle termination of S1 and S2 veins at the margin of J lens (S3).

Alteration

Alteration around the CSA mineralisation consists of two early generations of chlorite and (?) silica/quartz alteration events, relating to the deformation events described above. Early pre-mineralising alteration consists of broad zones of green chlorite +/- silica/quartz vein alteration associated with S1 and S2. This chlorite alteration extends out from the mineralised zone and completely encompasses mineralisation, without changing in intensity. This early alteration may have acted as ground preparation prior to the mineralising events. A third “black” chlorite and silica event occur as a limited halo to mineralisation, relating to S3 deformation.

MIMDAS Trial - 2006

A trial MIMDAS survey was conducted immediately to the north of the CSA mine infrastructure in February 2006 (Figure 6). Survey lines passed across QTS North, just to the north of the Eastern System. The trial had two overall objectives.

To determine whether MIMDAS could detect mineralisation and/or the structures that host mineralisation.
To assess the applicability of MIMDAS to exploration for CSA style systems.

The survey was conducted as two overlapping blocks of 3D pole-dipole IP, the first using 100m line spacing and the second 200m. A dipole length and station spacing of 100m was used for both blocks. Receiver lines for each block were 2000m long with transmit points along all receiver lines plus extensions (Figure 6). Standard MIMDAS field procedures and processing techniques were used to generate final data sets. UBC software was used for both 2D and 3D inversion modelling.

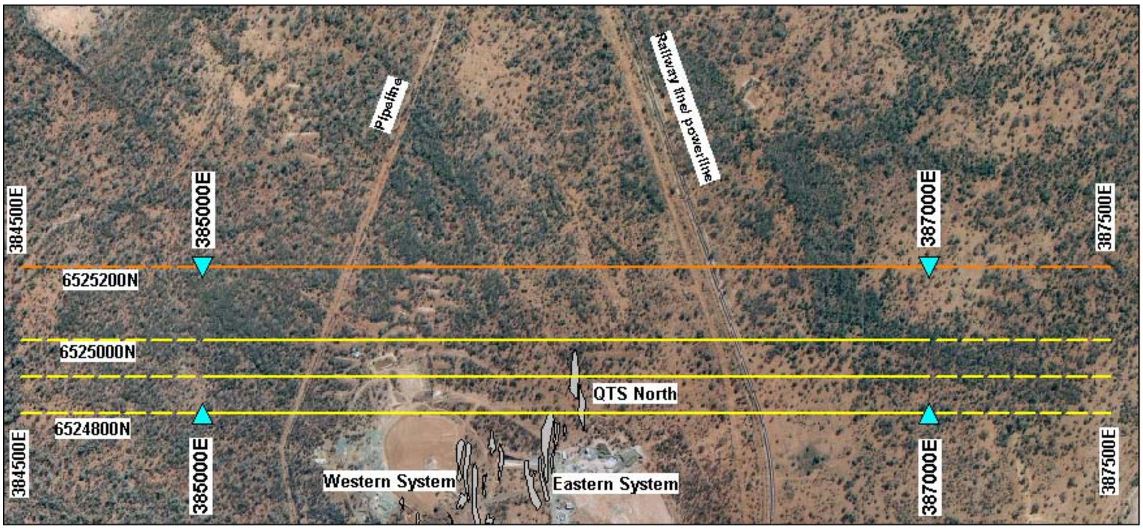

Figure 6 - Line locations, MIMDAS trial survey. Yellow lines indicate the Stage One 100m line spaced 3D array and the orange line the northernmost line for the Stage Two 200m line spaced 3D survey. Solid line sections are shown for receiver arrays, dashed sections indicate line extensions for signal injection only.

Results indicate that the overall CSA mineralised system is conductive to the point that, at this stage, the chargeability data is unusable due to strong negative responses (Figure 7). On the other hand, the resistivity data contains a wealth of information and is of a quality to allow model fits to the level where the average misfit for each observation is less than 1%.

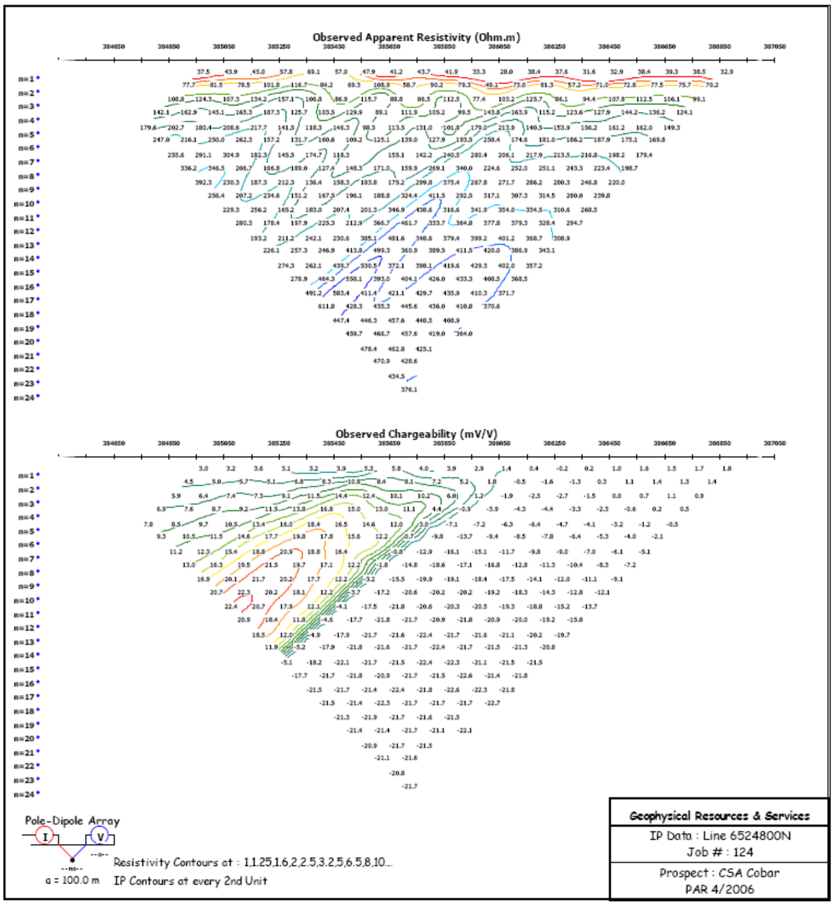

Figure 7 - Pole-dipole apparent resistivity and chargeability pseudosections for Line 6524900N. Note the strong negative chargeabilities for the eastern end of the line.

Resistivity modelling results are very encouraging with several significant structures being identified and traceable (variably) for several hundred metres vertically. These include structures hosting/ controlling the QTS North/ Eastern Systems (Figure 8). Structures outside the current known mineralised system have also been identified. Figure 7 shows a plan section at 480mbs through the resistivity model generated from all combined DC resistivity data. Structures labelled 1 and 2 in the figure are of interest to exploration. The apparent conductor toward the eastern end of the survey (marked 'dubious') does not appear in other models and is considered to be an artefact controlled by data from line 6524900N.

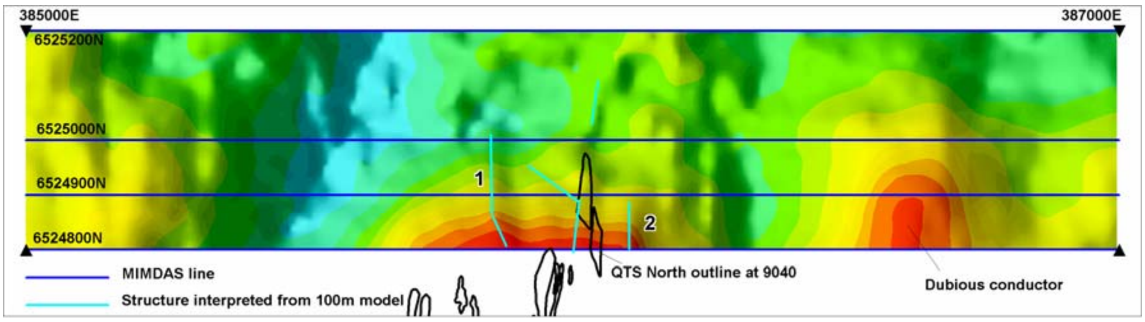

Figure 8 - Plan section through DC resistivity inversion model at 480mbs, shading is from the east. Note the interpreted controlling structure passing parallel to QTS North and the northern end of the Eastern System. Blue colours indicate higher resistivity, red higher conductivity with the range across the image from ~50ohm-m to ~1500ohm-m.

Two dimensional surveys are preferable from an exploration perspective. In the first instance, a potential ore system need only be detected, not defined and hence the detail of a 3D survey is not required. Field procedure for MIMDAS 3D surveys allows the extraction of 2D data from the 3D dataset and it is this data that was used to assess the applicability of MIMDAS to wider exploration.

Figure 9 shows 2D inversion results for Lines 6524800N, 6525000N and 6525200N. These lines show a diminishing ‘offline’ response to the CSA mineralised system, implying that a ‘CSA system’ would be detectable to between 200m and 400m offline. A line directly over such a system should see it to almost 500m.

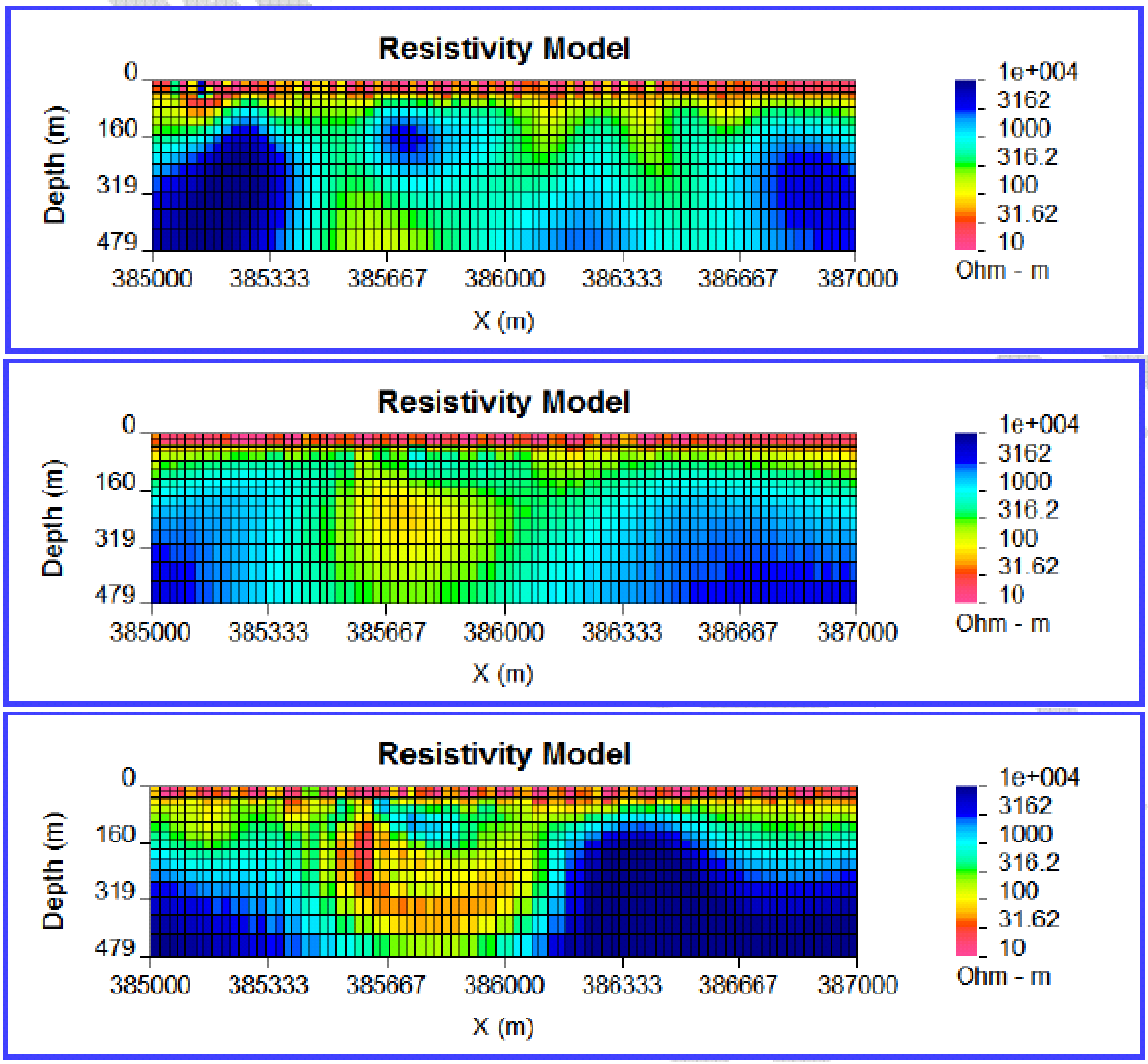

Figure 9 - 2D resistivity inversion models for 6524800N (bottom), 6525000N (middle) and 6525200N (top)

Overall, the MIMDAS trial has shown that MIMDAS can detect CSA style mineralisation and that it can define structures relating to mineralisation. The method is applicable to wider exploration for CSA style mineralisation.

Conclusions

Early structural deformation (S1 and S2) at the CSA mine created a brittle, fertile structure for S3 structures to develop, possibly in sync with a major mineralising event. The timing of structural development and mineralisation is an important consideration. Many of the major structures in the Cobar Basin are interpreted as listric in nature, reflecting basin development.

The vertical nature of the mineralised structures suggests a relationship with a different structural event, possibly the regional deformation event responsible for cleavage development. This is partly supported by the presence of minor mineralisation associated with cleavage.

The relationship between the CSA mineralised systems and the Cobar Fault have yet to be determined, though it could be part of or related to a later subsidiary or splay off the fault.

Efforts to incorporate surface information and underground mapping are currently in progress. MIMDAS trials have demonstrated success in detecting structures associated with mineralisation as well as the physical properties of the systems. Current exploration is developing 3D models incorporating structures mapped at surface, geochemical patterns and underground mapping to identify targets within 500m of the mine. This work will also increase the understanding of the nature of the broader system away from the mine.

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Acknowledgements

CMPL are acknowledged for approving publication of this paper.