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MT OWEN RESOURCES

MT OWEN: RESULTS OF

CSAMT SURVEY

APRIL 2011

J H COGGON

MAY 2011

MT OWEN:

RESULTS OF CSAMT SURVEY, APRIL 2011

SUMMARY

A controlled source audiofrequency magnetotelluric (CSAMT) survey was carried out in April 2011 to provide additional information on the geological structure. The survey was completed on a single northeast trending traverse that had been previously laid out for an induced polarisation (IP) survey.

Some of the data collected was too noisy to use but most has been utilised for inversion modelling. The noise probably comes from a combination of cultural interference and difficult ground contact conditions. Apparent resistivity values are generally very high.

Smooth two-dimensional modelling results show near-surface variations in conductivity/resistivity that correlate approximately with those inferred from the IP survey.

There are two deep zones of weakly enhanced conductivity indicated by the results. One is in the vicinity of steel pipes on the surface and is of doubtful significance. The other lies toward the northeast end of the CSAMT traverse and corresponds to a weakly conductive and polarisable zone also below 200 m depth inferred from the IP survey.

CONTENTS

LIST OF PLANS

Following page 8:

INTRODUCTION

A single line survey using the controlled source audiofrequency magnetotelluric (CSAMT) method was carried out at the Mt Owen project in April 2011. This followed completion of several traverses of induced polarisation (IP) measurements. The objective of the CSAMT survey was to test the effectiveness of the method for mapping resistivity variations that could assist with identification of structures favourable for metallic mineralisation.

A controlled source was chosen in preference to natural sources in view of the uncertain strength of natural signals and the known cultural noise (from communication transmission equipment etc.). The transverse magnetic mode (ie with the primary magnetic field approximately perpendicular to the survey line) was used, with seven 100 m electric dipoles and one magnetic induction coil connected to the receiver for each setup. The previously completed IP survey had utilised several east-west traverse lines and one northeast trending line. Due to the difficulties in finding a suitable transmitter site for CSAMT measurements on the east-west lines the northeast trending traverse was used for the CSAMT work. .

Plan 1 shows the location of the northeast trending traverse line ‘Q’ used for the CSAMT survey. A 1700 m transmitter bipole was laid out parallel to the traverse and about 7½ km to the west-northwest.

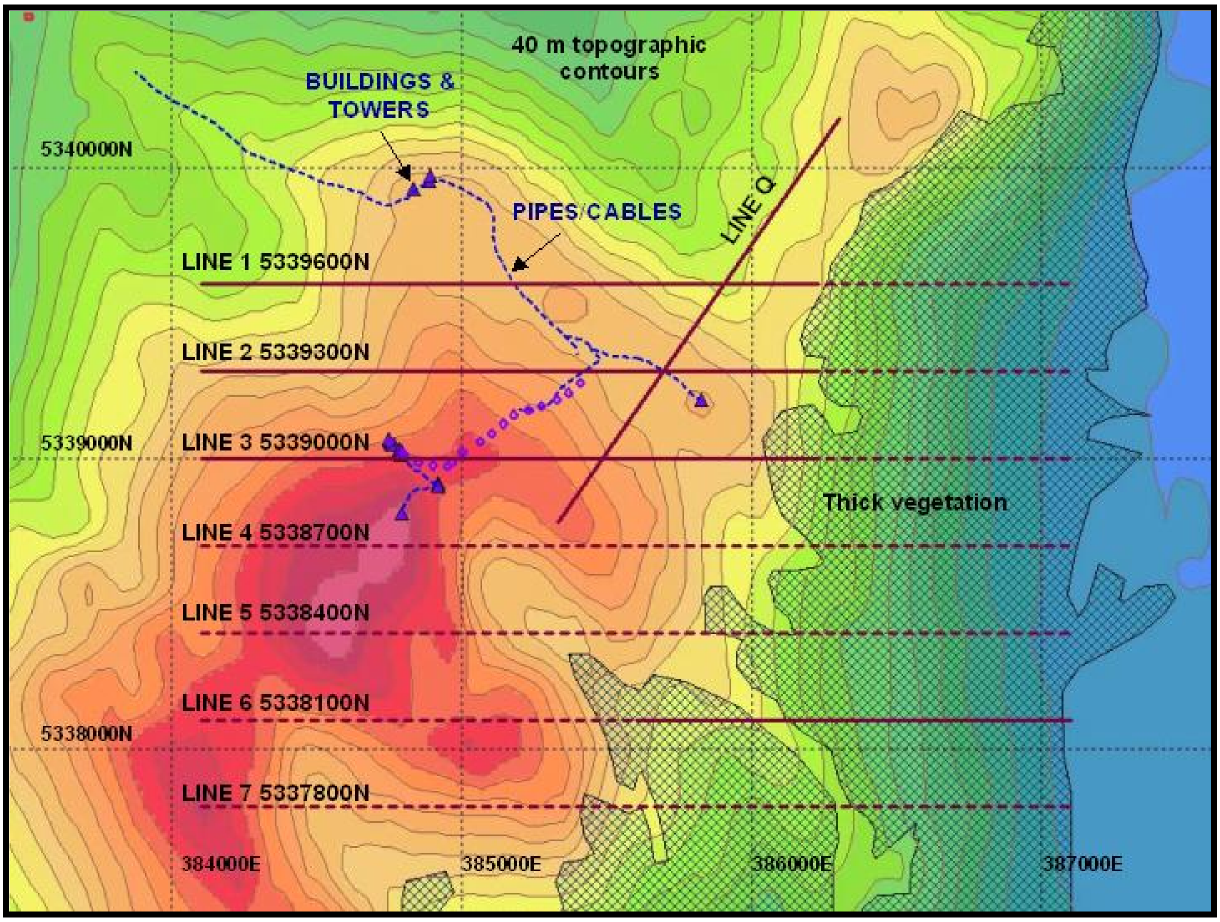
Zonge Engineering and Research Organization Australia were contracted to carry out the survey. The measurements were made over a frequency range of 4 Hz to 8192 Hz using a Zonge manufactured transmitter and GDP-32II receiver.

This report presents the results from the CSAMT survey and discusses results from inversion modelling.

Plan 1: Mt Owen – layout of CSAMT survey.

Colour shows topography, red – high to blue – low.

The northeast trending line 'Q' was used for the CSAMT measurements.
The solid east-west lines show completed IP traverses. Line 'Q' was also used for IP.



Coordinates: MGA (GDA94) zone 55.

The southwest end of line 'Q' has along-line coordinate 1000 and is at 385330E 5338780N MGA.

The northeast end of line 'Q' has along-line coordinate 2700 and is at 386303E 5340174N MGA.

RESULTS

Pseudosections of apparent conductivity and phase angle are shown in Plans CQ-A and CQ-B respectively. The data are plotted with decreasing frequency going down as lower frequency signals give information about greater depths. The sections do not include the measurements that were made at the southwest end of the line (1050 to 1250) as these, taken on a different day, appear to have been heavily contaminated by cultural noise. Some of the other data are noisy, but have been included in preparation of the sections and for inversion modelling. The noise probably is due to cultural interference and to ground contact problems in the rocky, highly resistive, terrain.

The apparent conductivity is the reciprocal of apparent resistivity, which is proportional to the square of the ratio of the amplitudes of the electric and magnetic fields. This calculation is valid and the apparent resistivities give a reasonable indication of the real ground resistivities when the transmitter is sufficiently 'far away'. The actual transmitter is about 7½ km away, and this is far enough away for frequencies above about 100 Hz and ground conductivities above 0.1 mS/m (resistivity 10000 ohm m). This corresponds approximately to the upper half of the pseudosection of Plan CQ-A.

The phase angle is the phase between the electric and magnetic fields and is shown in milliradians in Plan CQ-B. In moderately uniform ground phase angles in the vicinity of 45 degrees (785 milliradians) are expected when the transmitter is far away. The lower part of the pseudosection of Plan CQ-B shows very large phase angles that reflect the 'nearness' of the transmitter.

From the upper part of the section of Plan CQ-A there appear to be some quite sharp variations in high-frequency (~near-surface) conductivity, but conductivities are low (nearly everywhere less than 0.2 mS/m, corresponding to resistivities greater than 5000 ohm m). The results from 2650 are suspect, with relatively high conductivities for all frequencies and erratic phase angles. Deeper in the section (region of 128-1024 Hz) there are weak indications of more conductive material, from 1350 to 1650 and around 2250.

There are also significant variations in phase angle at the high frequencies (Plan CQ-B). High values at 1650 might be related to the steel pipe that crosses the line 1630 (see Plan 1), but the high phases at 2250 cannot be blamed on anything similar. In the 128-1024 Hz range the phase angles do not vary greatly from 45^0 (785 milliradians).

INVERSION MODELLING

Inversion modelling, designed to recover reasonable estimates of the ground resistivity or conductivity structure, has been carried out using both one- and two-dimensional models. With significant variations evident along the line, the two-dimensional models are more appropriate. The modelling assumes plane wave excitation, so only 'far field' data can be used. This corresponds to values from the upper halves of the pseudosections of Plans CQ-A and CQ-B. Frequencies from 128 Hz to 8192 Hz were utilised.

Several similar two-dimensional ground models were obtained, using different data error estimates and requirements for matching. It was found that calculated model responses matched the observed apparent resistivity (or conductivity) variations reasonably well, but that the large phase angles observed at high frequencies at some locations could not be adequately fitted. This suggests either that there are local ground variations that are not simulated by the smooth models and/or that the measurements are invalid (due to noise) at some stations/frequencies.

Plan CQ-C shows the conductivity section for a chosen inversion model. The actual model was restricted to flat terrain, but this section has been distorted to fit the real topographic profile on line 'Q', and it may be compared with a model derived from the induced polarisation survey on the line – shown in Plan CQ-D.

The model in Plan CQ-C shows small patches of weakly conductive material at the surface near 1400, 2000 and 2600. These correlate moderately well with very shallow features in the IP inversion model of Plan CQ-D.

A buried relatively conductive zone is suggested at 1500-1600. This does not have a corresponding feature in the IP model shown in Plan CQ-D. As mentioned above, there is a pipe crossing the traverse at 1630, and the IP model is based on data excluding that from electrodes near the pipe. When all data are used, the IP also suggests a buried conductive zone. In addition there is a pipe about 200 m away to the northwest and running roughly parallel to the traverse (see Plan 1). These pipes probably influenced the CSAMT measurements. Rejection of the measurements from 1650 led to a model with a weaker zone at 1500-1600, but did not remove the feature entirely. Another buried (>200 m) weakly conductive region is indicated at 2300-2500. This does correspond to a mildly conductive zone in the IP inversion model.

Another two-dimensional model inverted from the CSAMT has been provided by Zonge. This shows buried conductive zones near 1700 and 2250, at a depth of 100-150 m. The zone at 2250 appears as the top of deeper, broader and weaker zone at around 2350. The main features correspond to those seen in Plan CQ-C although the locations and depths of the peak responses do show differences.

CONCLUSION

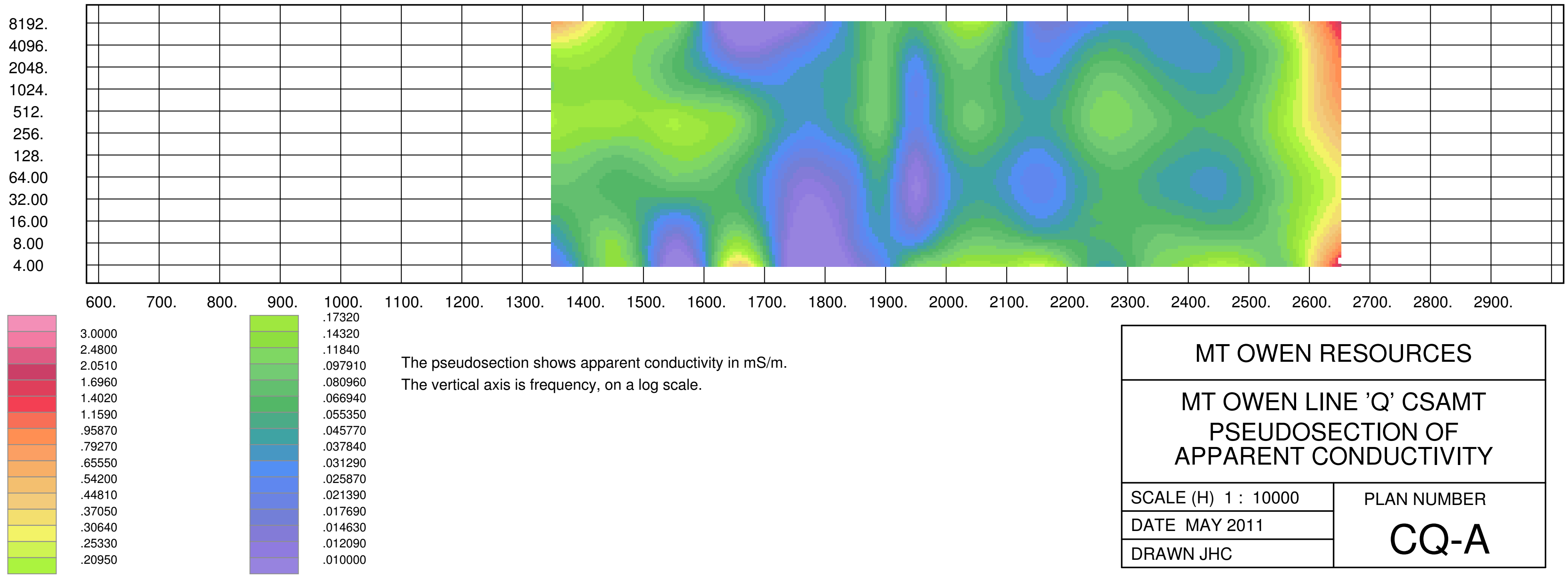
Some of the data collected in the CSAMT survey along line ‘Q’ was noisy and had to be rejected, but most measurements could be used for modelling.

The ground is clearly highly resistive, with localised patches of lower resistivity very near the surface. The CSAMT and IP surveys generally agree in showing these.

The CSAMT model results show two zones of reduced resistivity (increased conductivity) deeper than 100-200 m below the surface.

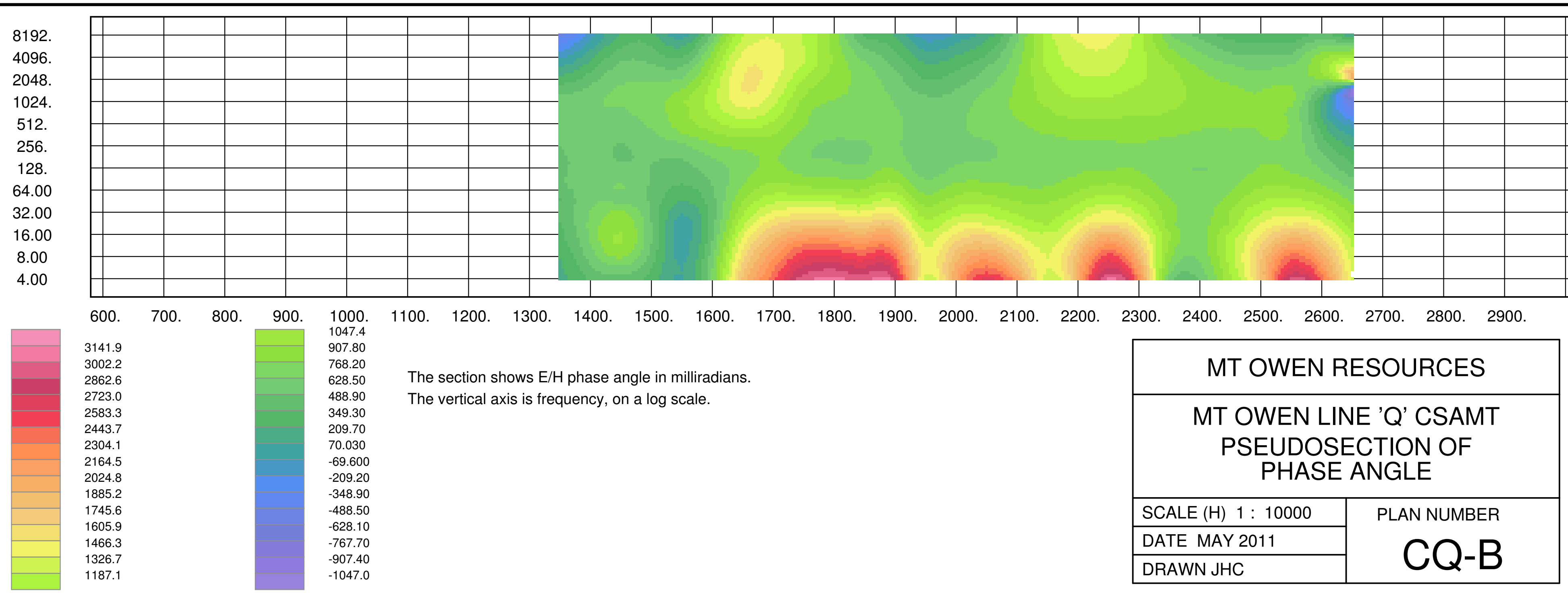
The zone near 1600 on line ‘Q’ is in the vicinity of steel pipes at the surface, and because of this as well as different responses evident from the IP/resistivity survey cannot be considered reliable as an indication of the real ground structure.

The measurements supporting the deep zone at 2300-2500 should not be affected by surface culture. This rather weak and deep zone is also evident from the IP/resistivity survey, where it appears to be weakly polarisable as well as relatively conductive.



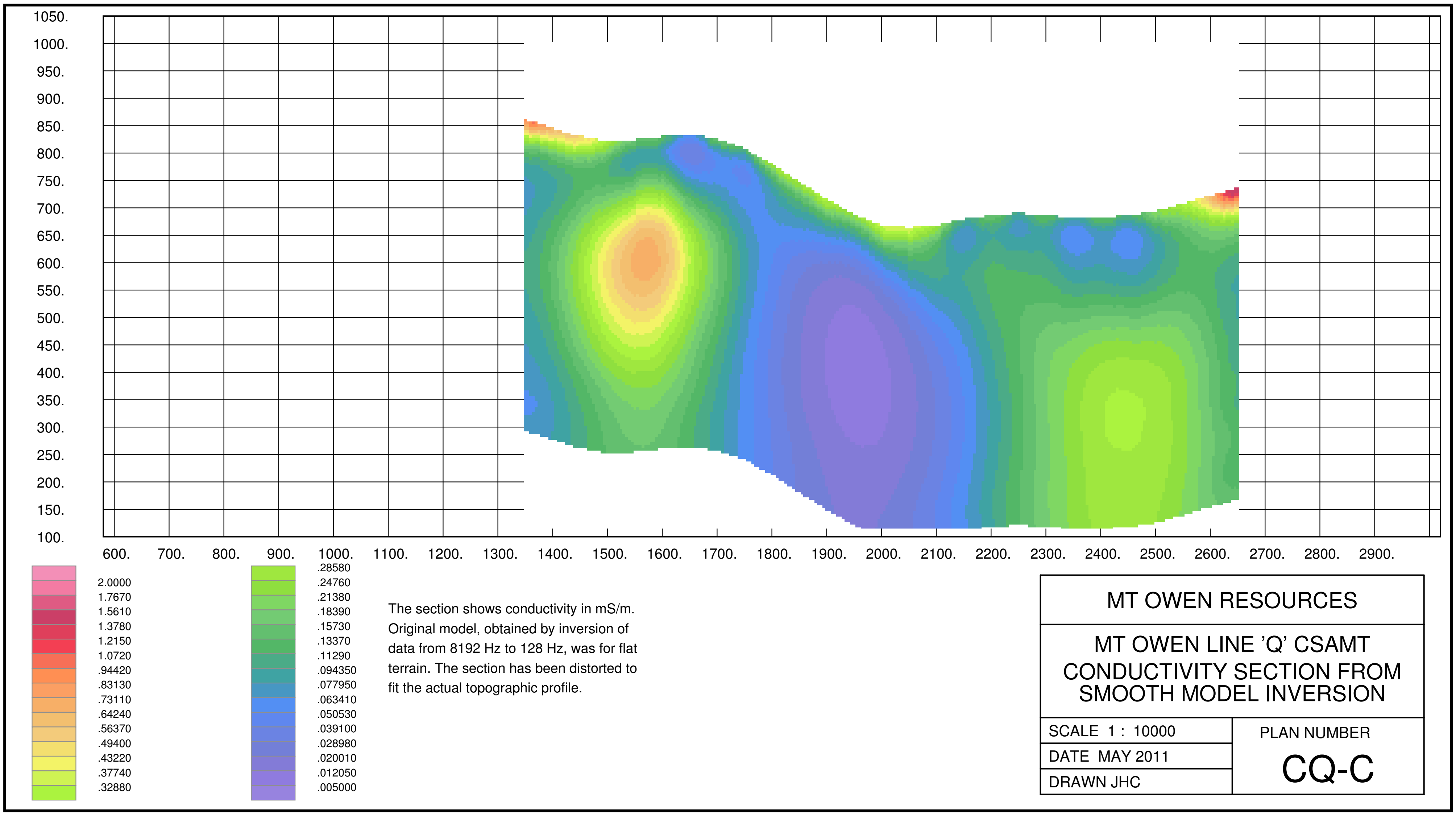
The pseudosection shows apparent conductivity in mS/m.
The vertical axis is frequency, on a log scale.

MT OWEN RESOURCES	
MT OWEN LINE 'Q' CSAMT PSEUDOSECTION OF APPARENT CONDUCTIVITY	
SCALE (H) 1 : 10000	PLAN NUMBER
DATE MAY 2011	CQ-A
DRAWN JHC	



The section shows E/H phase angle in milliradians.
The vertical axis is frequency, on a log scale.

MT OWEN RESOURCES	
MT OWEN LINE 'Q' CSAMT PSEUDOSECTION OF PHASE ANGLE	
SCALE (H) 1 : 10000	PLAN NUMBER
DATE MAY 2011	CQ-B
DRAWN JHC	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.83130
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.32880
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.24760
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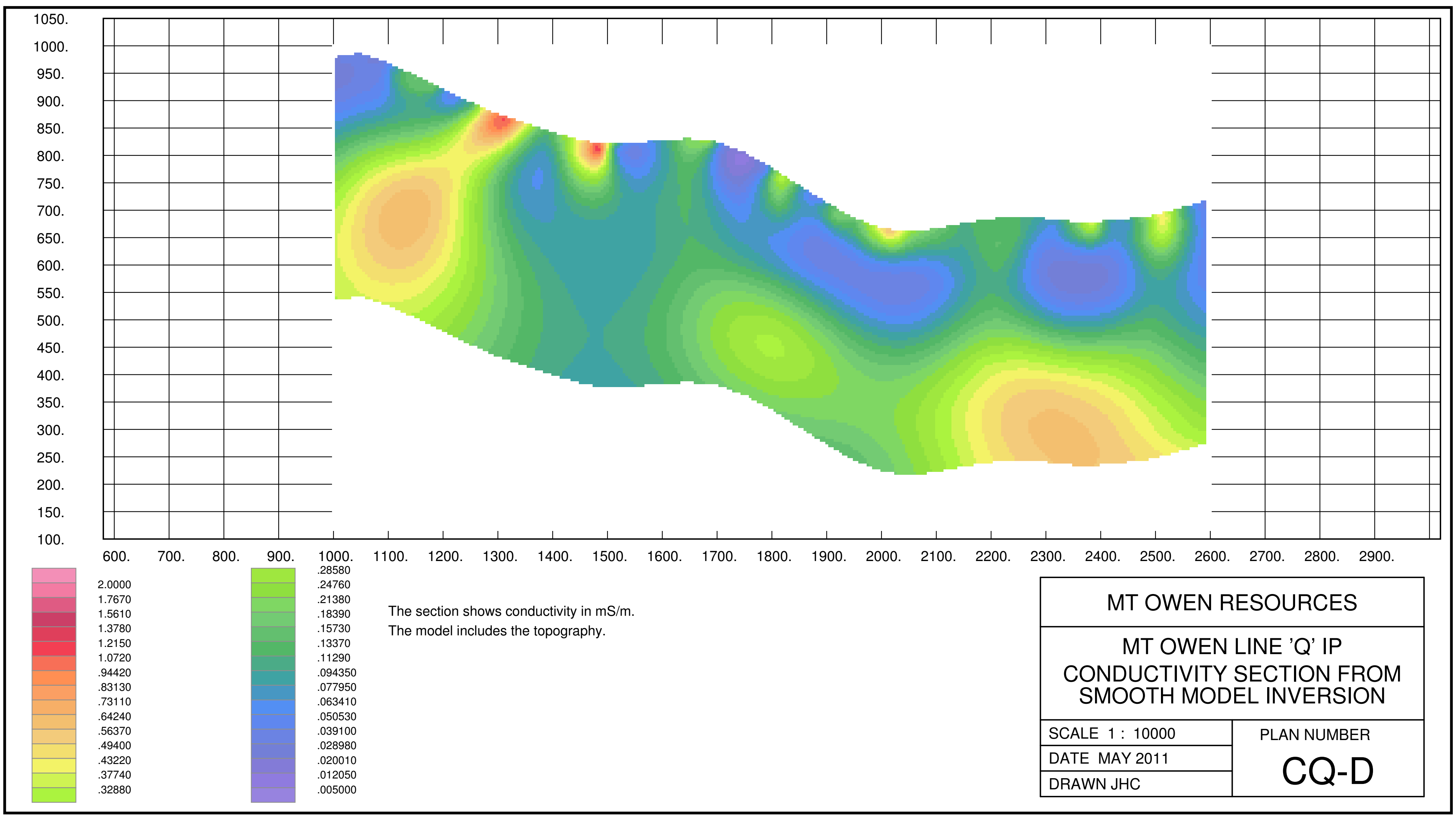
.18390
.15730
.13370
.11290
.094350
.077950
.063410
.050530
.039100
.028980
.020010
.012050
.005000
The section shows conductivity in mS/m.
Original model, obtained by inversion of
data from 8192 Hz to 128 Hz, was for flat
terrain. The section has been distorted to
fit the actual topographic profile.
MT OWEN RESOURCES
MT OWEN LINE 'Q' CSAMT
CONDUCTIVITY SECTION FROM
SMOOTH MODEL INVERSION
SCALE 1 : 10000
DATE MAY 2011
DRAWN JHC
PLAN NUMBER
CQ-C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The section shows conductivity in mS/m.
The model includes the topography.
MT OWEN RESOURCES
MT OWEN LINE 'Q' IP
CONDUCTIVITY SECTION FROM
SMOOTH MODEL INVERSION
SCALE 1 : 10000
DATE MAY 2011
DRAWN JHC
PLAN NUMBER
CQ-D