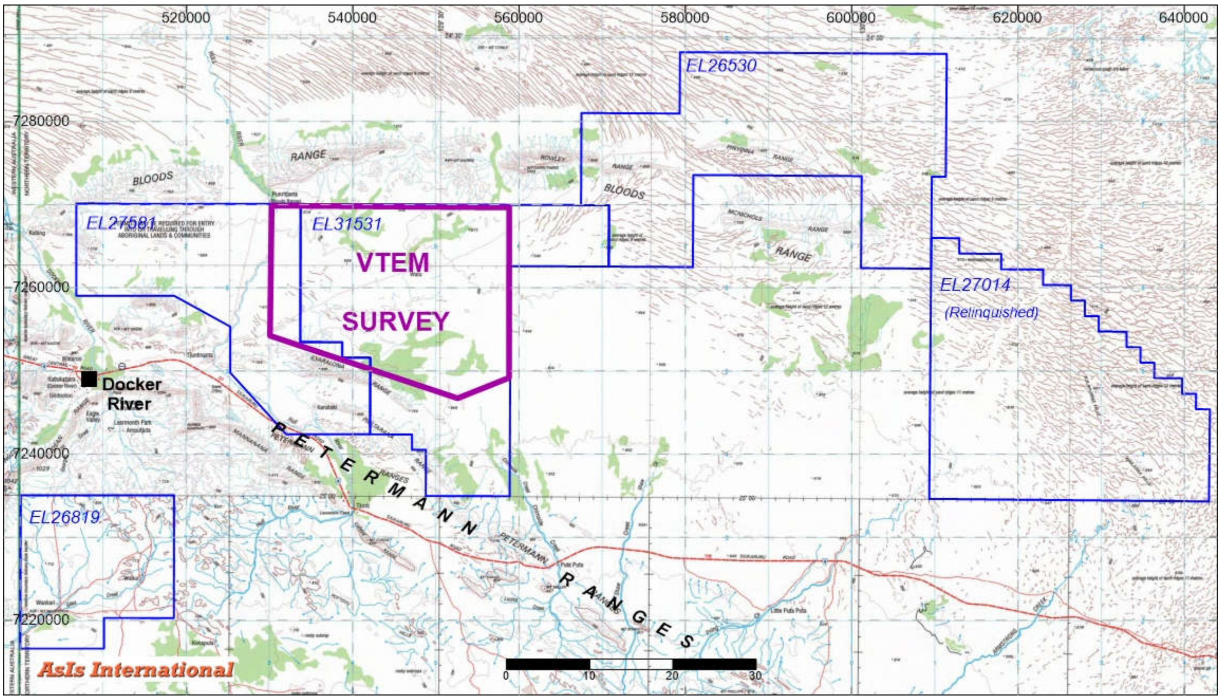
GEMPART (NT) PTY LTD

GR472 2nd ATR

APPENDIX 2

DOCKER RIVER VTEM REVIEW



Kelvin Blundell
Geophysical Consulting

GEMPART (NT) PTY LTD

Musgrave Ranges
(EL25566, EL31383)
& Docker River
(EL27581, EL31531)
Geophysics Processing and Review

15 February 2018
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Scope of Work

Review of the VTEM survey data and recommendations for follow-up taking into consideration the geological context and relationship with regional magnetic and gravity anomalies.

- Ranked VTEM target summary
- Target shapefiles for ARCGIS
- Summary report

VTEM Imagery

Sets of imagery have been produced for the three individual VTEM survey areas.

Images have been produced using Linear (L) and Non-Linear (NL) colour stretches.

Linear colour images highlight the high-amplitude anomalies and show the true relative amplitude difference over the area

Non-Linear colour images evenly distribute the colours over the range of values, and as such highlights lower-amplitude features.

The background intensity in the imagery is sun-shaded to test highlight geological trends. In areas of large dynamic variation in amplitudes, a logarithmic stretch has been applied to the intensity to amplify subtle trends and features.

Regional Airborne Magnetic Imagery

To aid in the geological context of any VTEM anomalies, a comprehensive set of Geoimagery was produced over each area from the best available regional Government airborne data.

Nomenclature for the supplied Magnetic Geoimagery is as follows:

TMI: Total Magnetic Intensity

RTP: TMI Reduced to Pole — calculated using magnetic inclination of -64.58° and declination 8.12°

1VD: First Vertical Derivative

2VD: Second Vertical Derivative

Tilt: Tilt Angle Derivative

AnSig: Analytic Signal of the TMI

VRMI: Vector Residual Magnetic Intensity

1VD/2VD_greysale: greyscale imagery using a non-linear histogram

RTP_on_1VD/2VD_lin: RTP linear colour image draped over greyscale 1VD or 2VD imagery.

NshadeL: Linear colour image draped over sun shaded intensity with sun at 45° inclination from the North

NshadeNL: Non-linear colour image draped over sun shaded intensity with sun at 45° inclination from the North

General Comments on VTEM

The 500m line-spacing for the Musgrave Ranges and Docker River VTEM surveys is considered a regional, broad spaced line spacing, and as such there is a high chance of missing significant local bedrock conductors. The AEM response of the Babel deposit in the West Musgrave is around 1200m, but the parts of the Nebo deposit that were detectable from the AEM system are around 500m in length. Thus, there is a chance that a Nebo-analogue could be missed with the 500-m VTEM surveys if it lies between the survey lines.

There are a number of interpretation pitfalls that need to be considered when picking VTEM anomalies of potential interest. These include:

- "diffraction-tails" or "lobe" anomalies often seen adjacent to zones of conductive cover,
- residual positive responses of broader fault anomalies,
- late-time super-paramagnetism (SPM) anomalies due to fine-grained maghemite at the surface,
- local elevated noise due to wind gusts.

Examples of each of these are shown in the following slides.

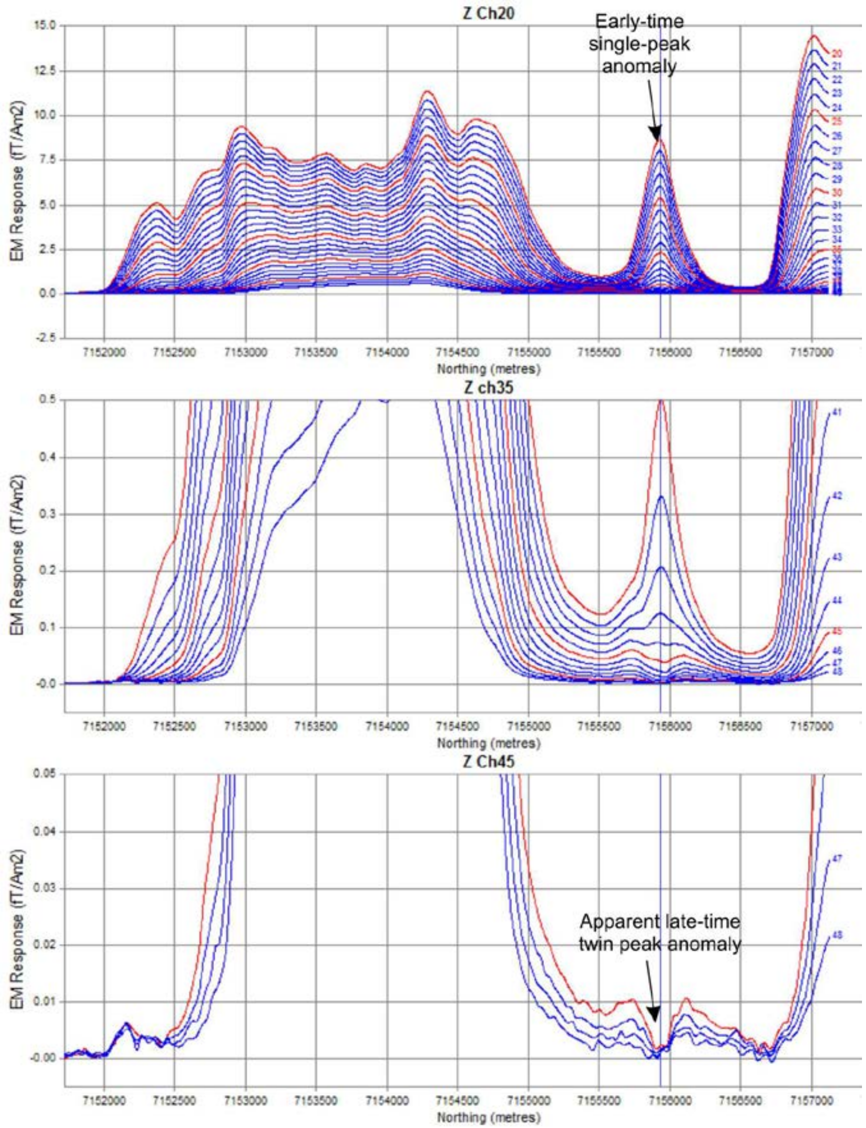
Anomaly picks have been made for both the dB/dt and B-field datasets. Generally there are more apparent bedrock responses in the B-field data that the dB/dt because the overburden response is less dominant in the former, and the amplitudes of larger time-constant anomalies are amplified relative to their dB/dt response. However, SPM anomalies and late-time noise is also amplified in the B-field data, so the confidence in an anomaly is dependent on its character in both the dB/dt and B-field datasets.

VTEM interpretation pitfalls

Fault response

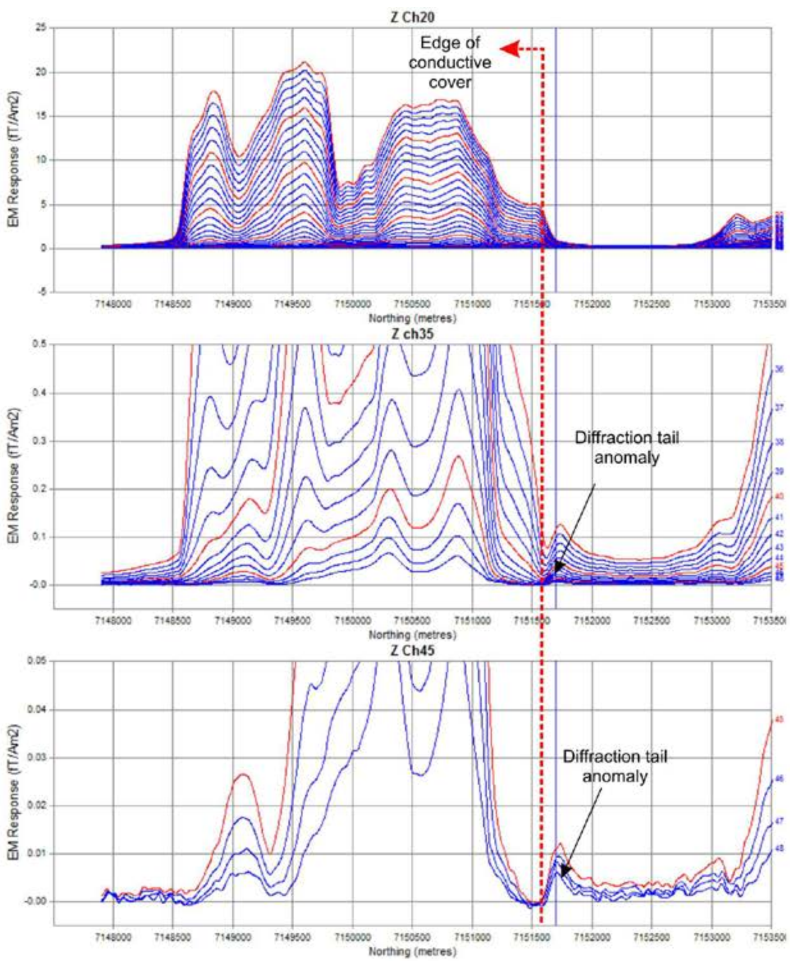
Often an early-time single peak due to weathering over the fault, migrating to a late-time negative IP effect.

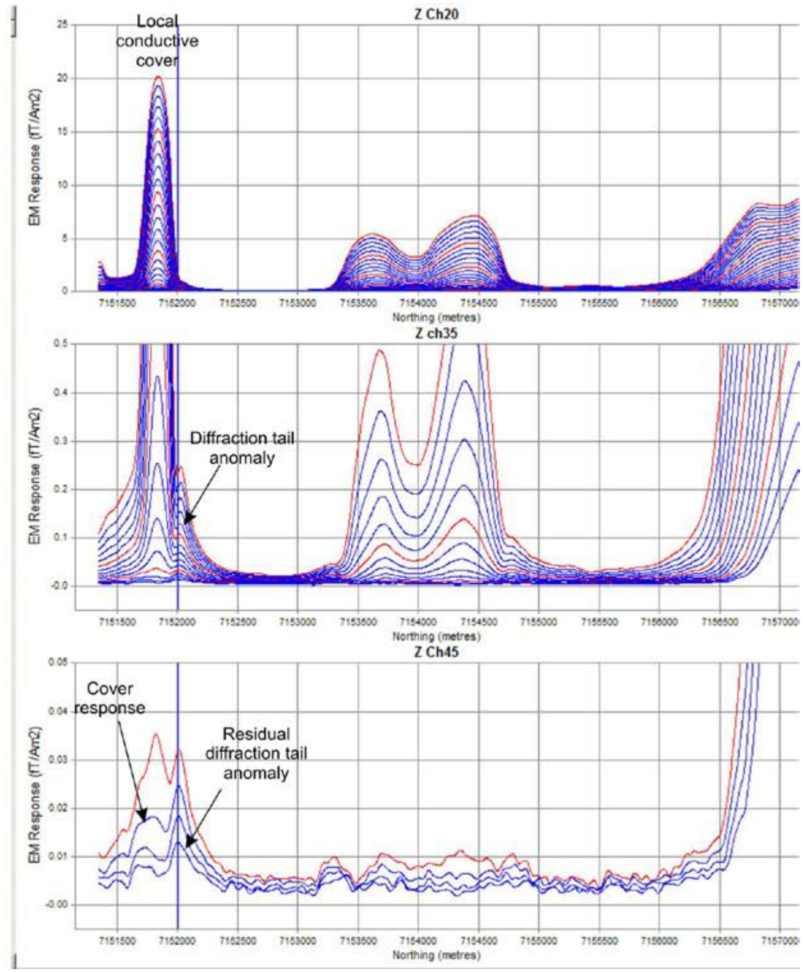
Where the IP response is not as strong as the enveloping EM response, it can produce apparent late-time twin-peak anomalies, or single asymmetric late-time anomalies on the flank of the early-time fault response.



VTEM interpretation pitfalls

Diffraction Tails -- always on the edge of early-time overburden response

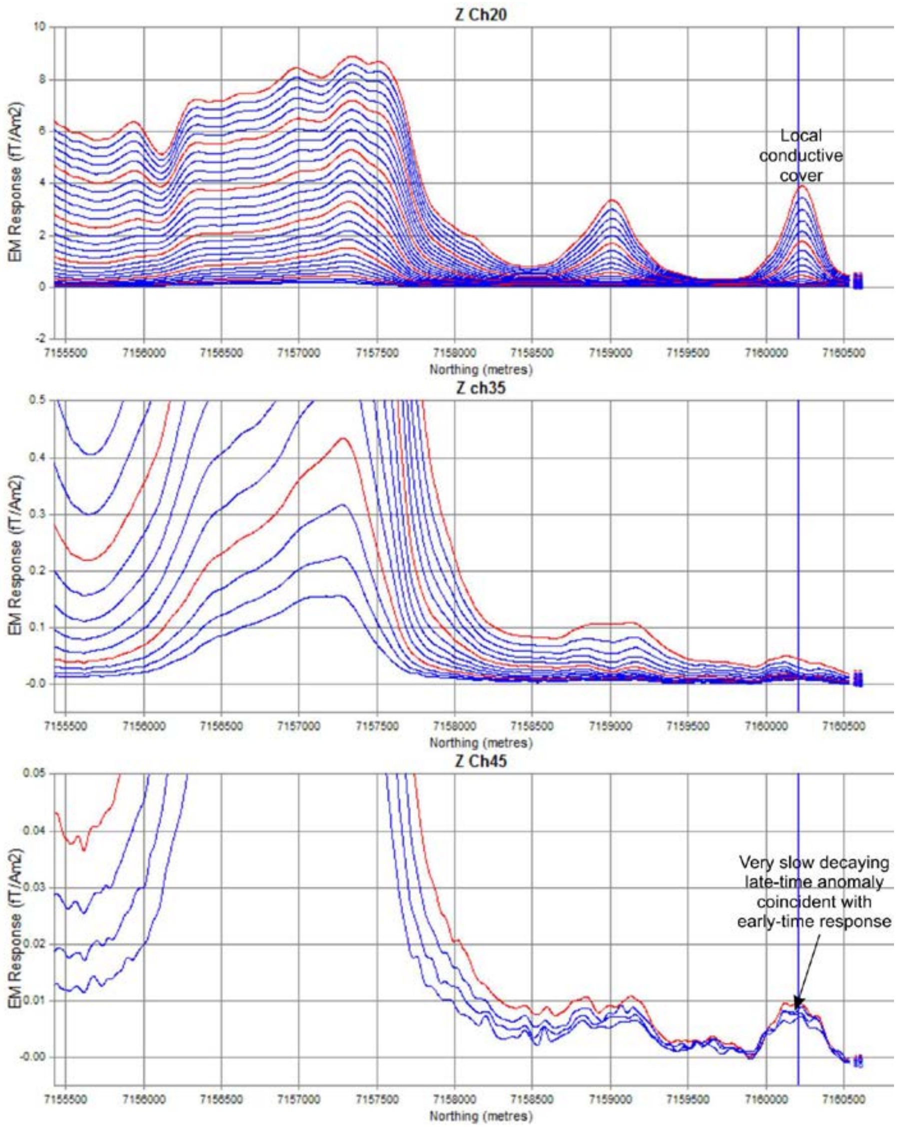




VTEM interpretation pitfalls

Late-time super-paramagnetism (SPM)

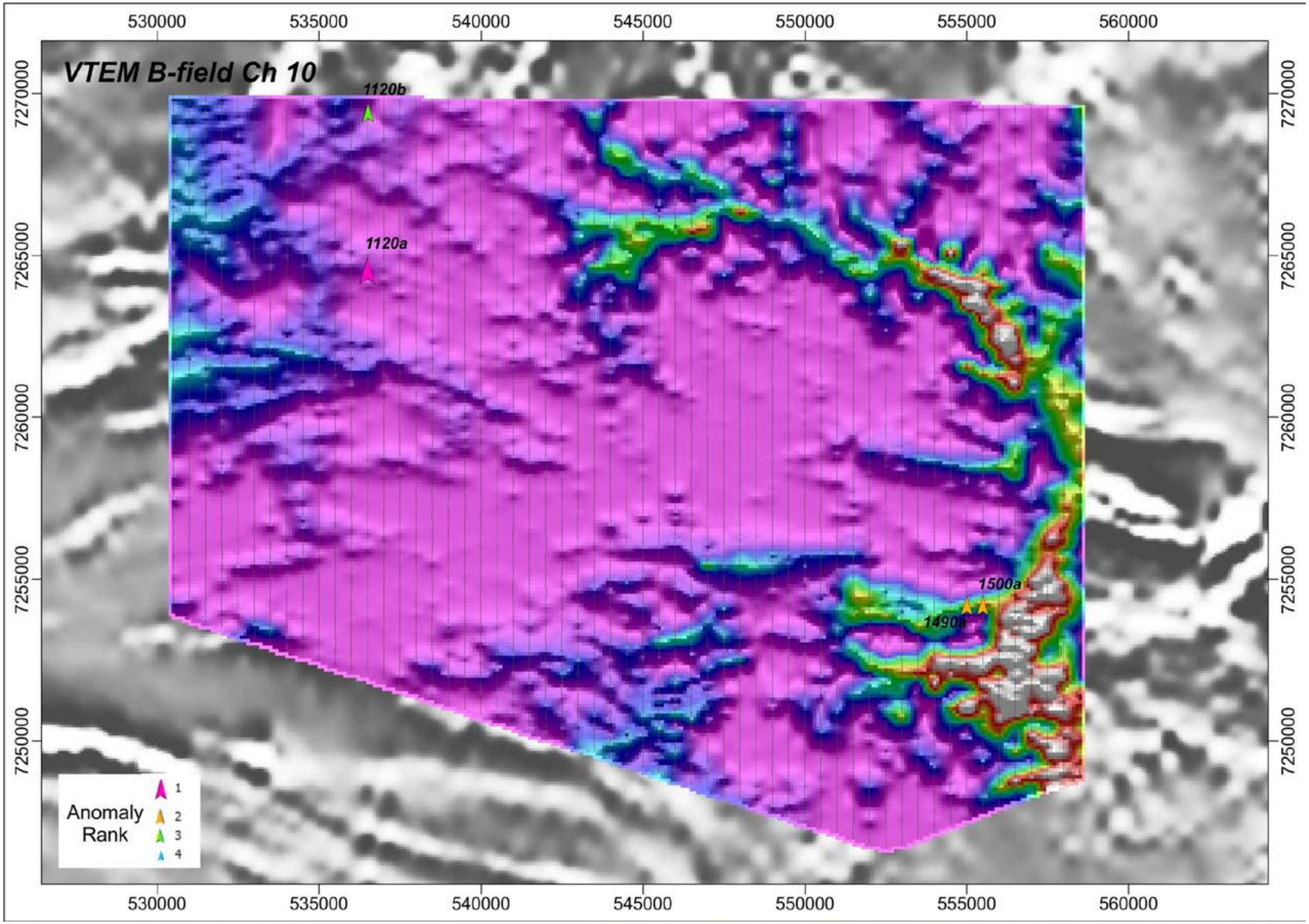
Often coincident with early-time cover response where fine-grained maghemite forms as part of the weathering process and accumulates in palaeochannels



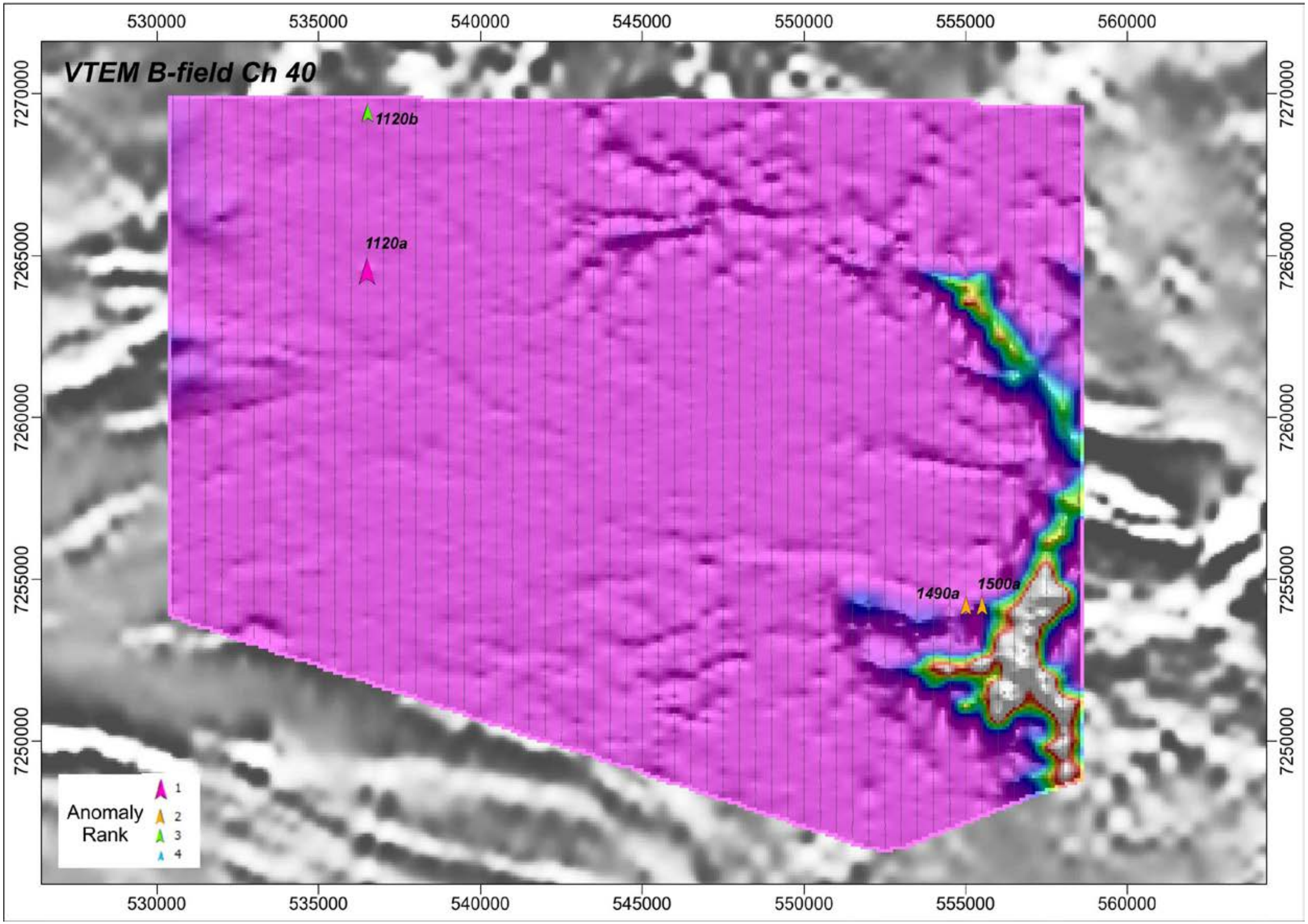
Docker River

- The majority of the Docker River VTEM survey is resistive and ideal for AEM methods (see Ch10 image on next slide). The late-time data (Ch 40 image) show that only the eastern edge of the area is affected by a N-S palaeochannel response.
- There are only four anomalies of interest in this area.
- Only Two anomalies (1490a and 1500a) are late-time responses on the flank of an east-west fault response and may not be bed-rock responses.
- The other two anomalies of interest are both on line 1120. Anomaly 1120a is a clear local late-time bedrock source, and 1120b is a broad late-time response that could be a deeper bed-rock source.

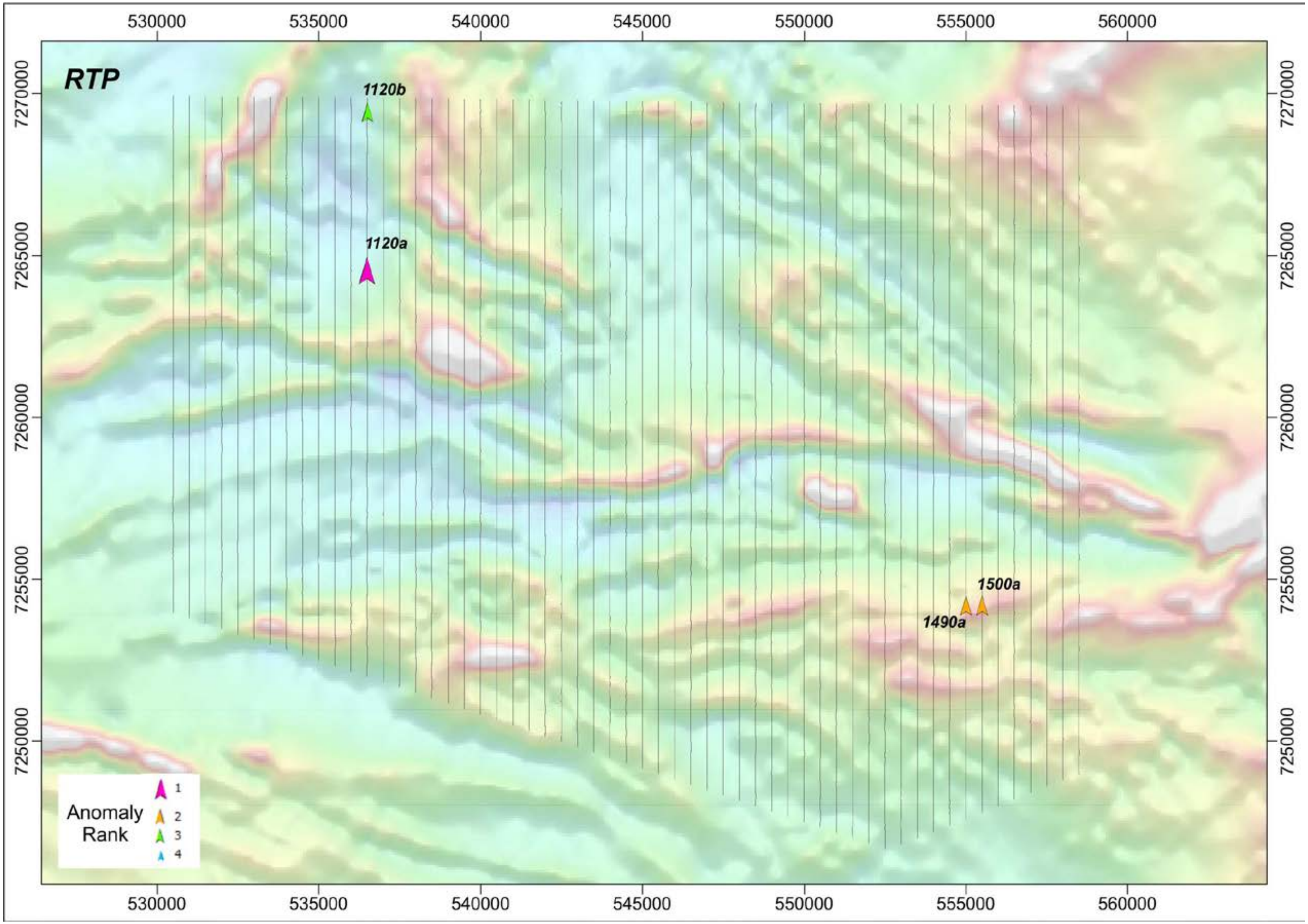
Docker River



Docker River



Docker River

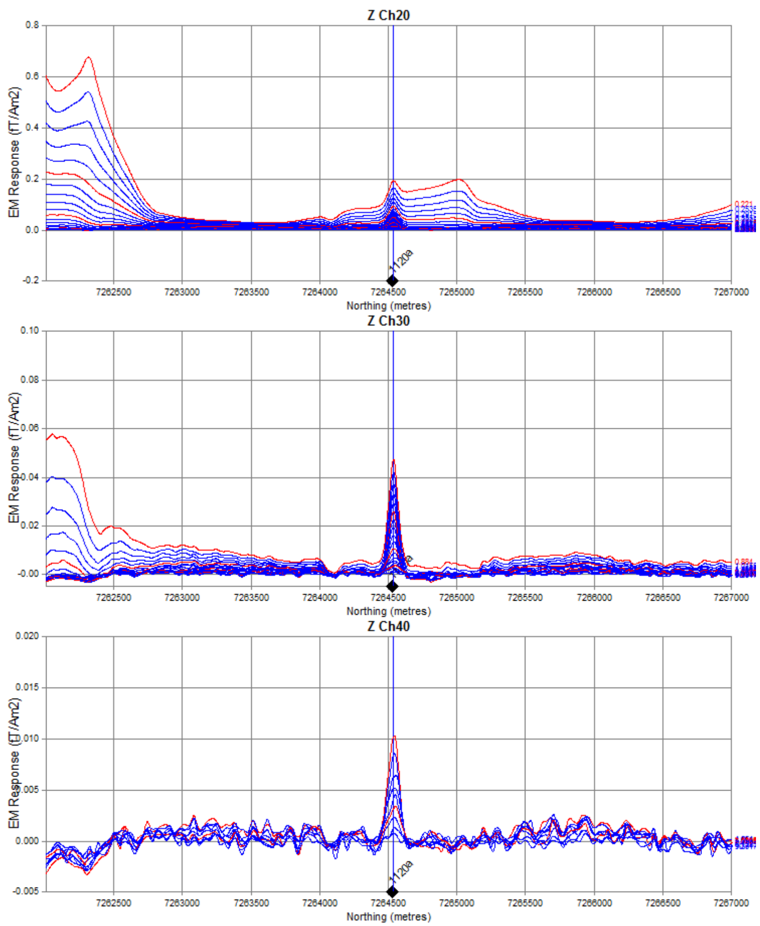


Docker River Anomalies

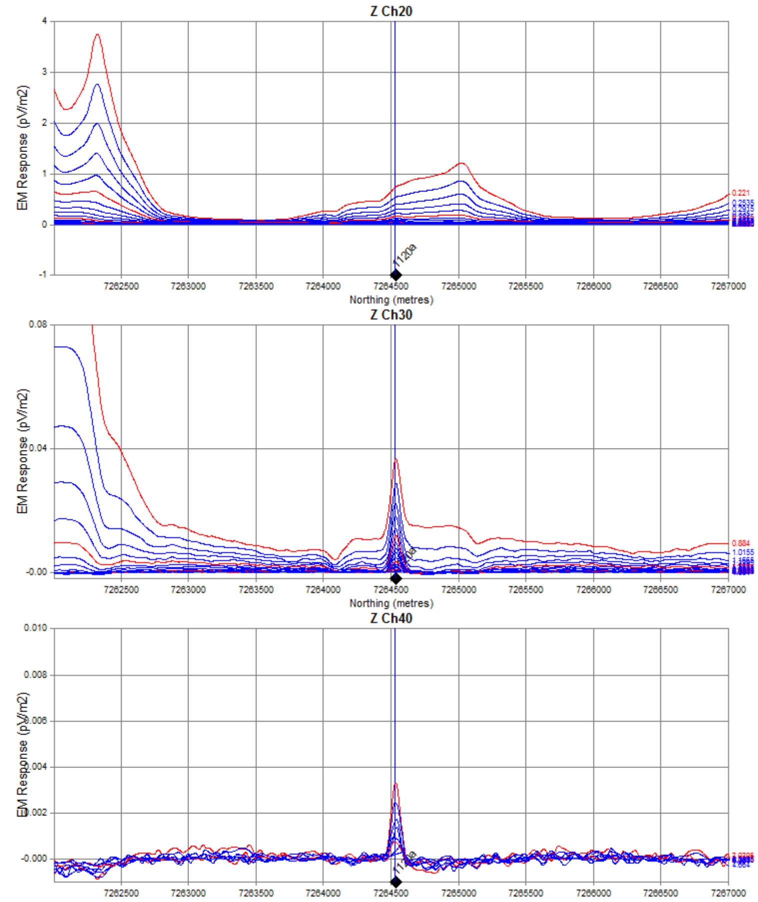
Anomaly 1120a

- Local late-time anomaly in B-field and dB/dt
- Good local late-time anomaly
- Within magnetically quiet area
- Clear local bedrock conductor = Rank 1

B-field



dB/dt

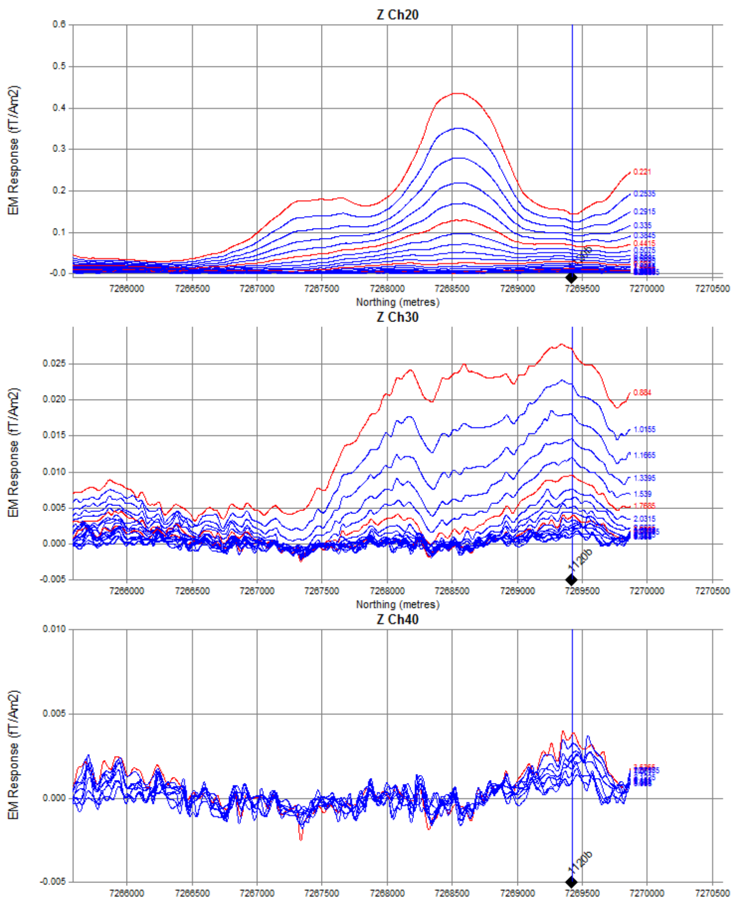


Docker River Anomalies

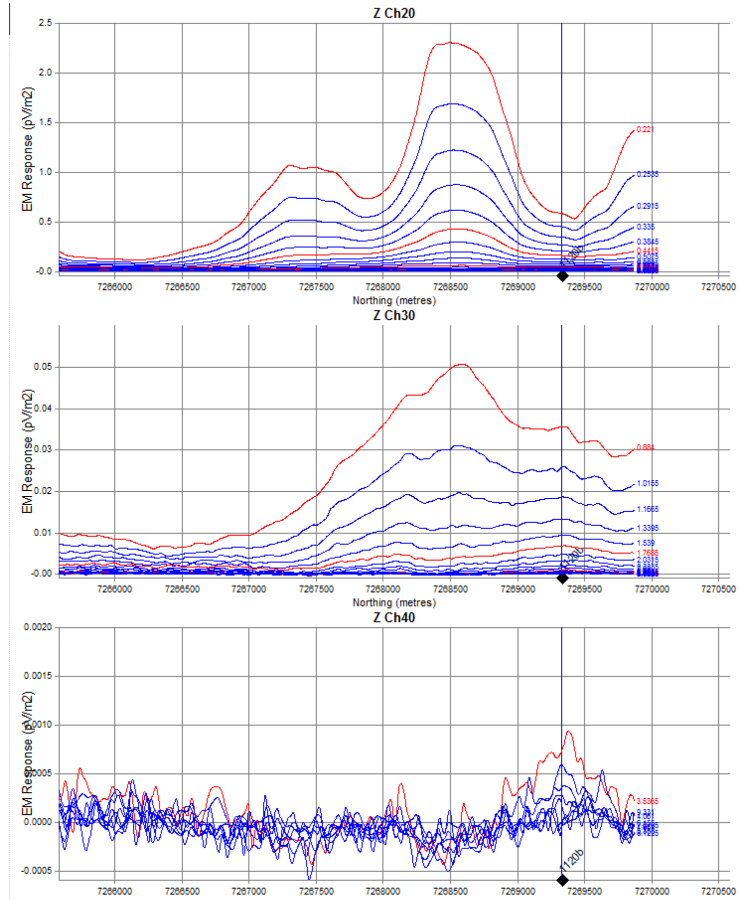
Anomaly 1120b

- Broad shielded anomaly in B-field and dB/dt
- Possible locally thicker regolith or SPM
- Within magnetically quiet area
- Tenuous anomaly = Rank 3

B-field



dB/dt

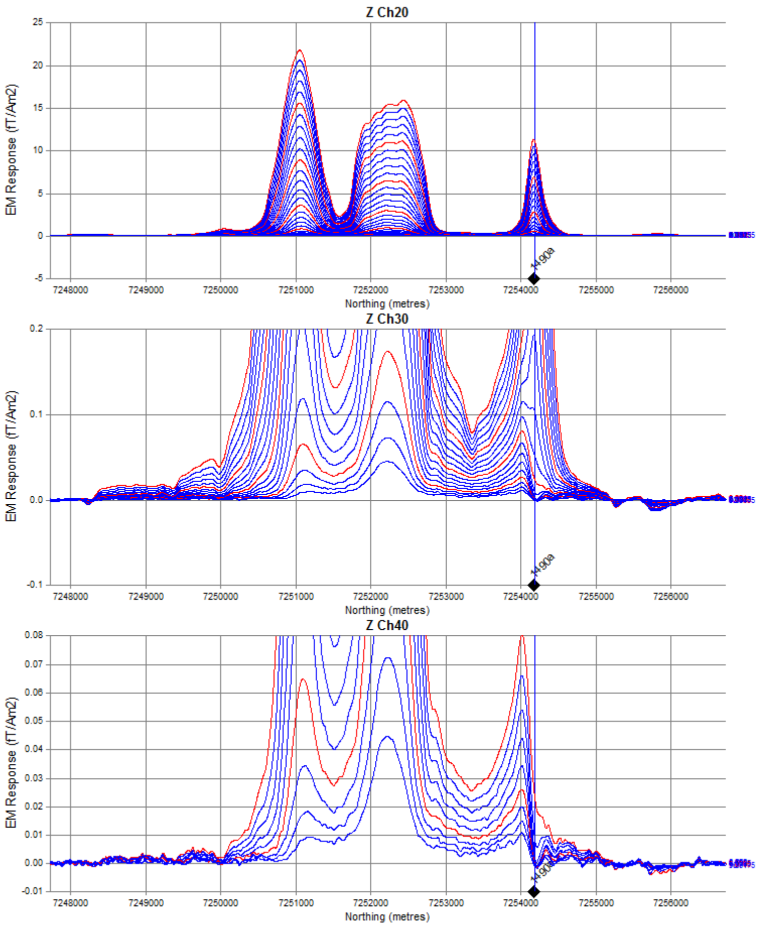


Docker River Anomalies

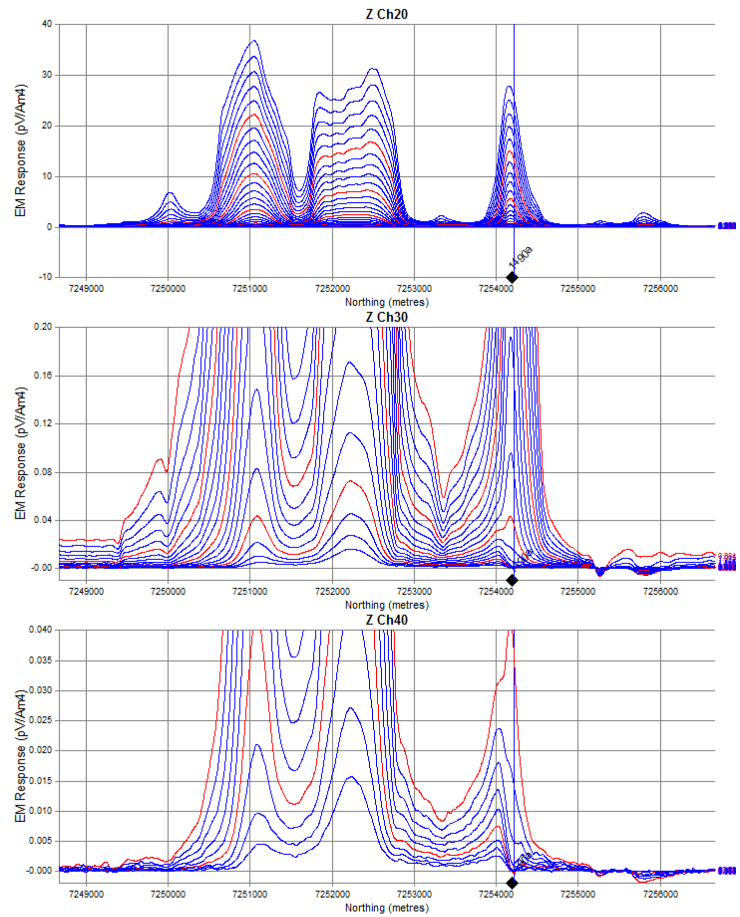
Anomaly 1490a

- Late-time anomaly on the southern flank of fault response
- Coincident with linear magnetic anomaly
- Interesting complex anomaly = Rank 2

B-field



dB/dt

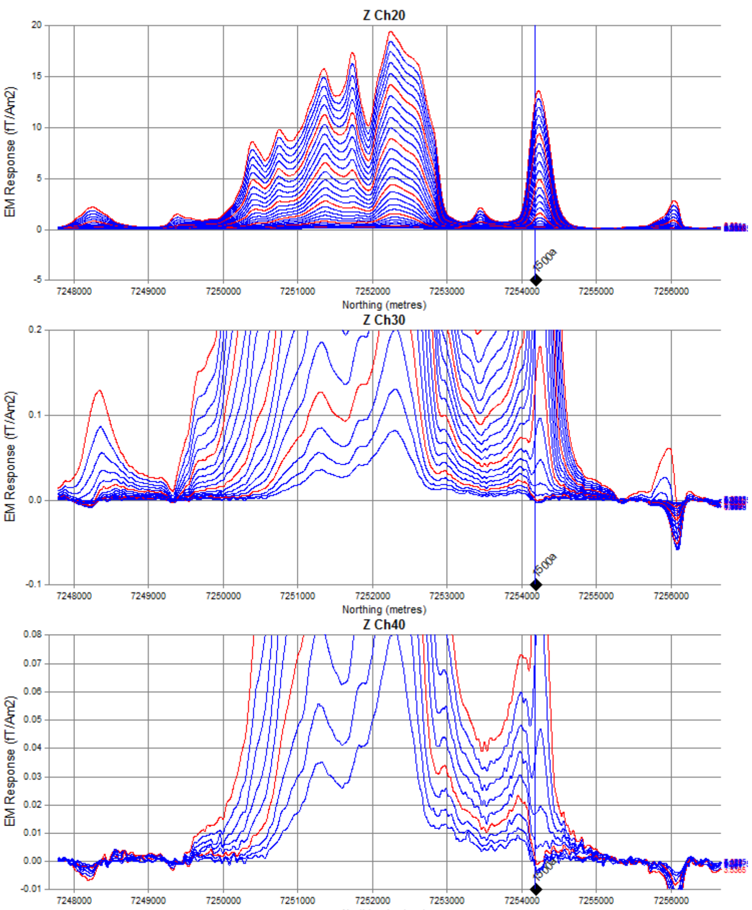


Docker River Anomalies

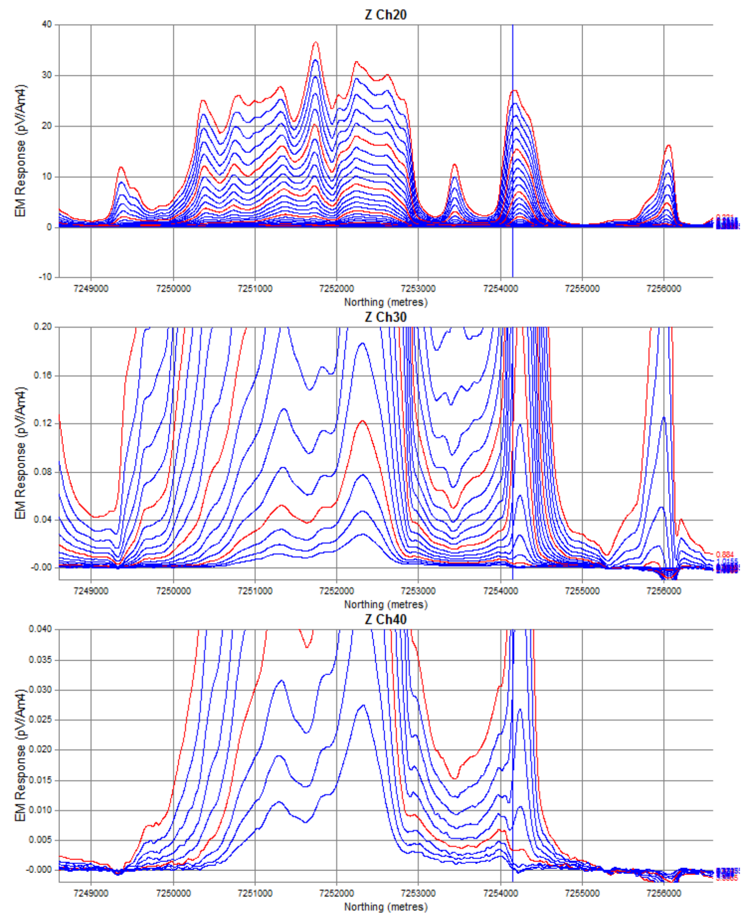
Anomaly 1500a

- Late-time anomaly on the southern flank of fault response
- Coincident with linear magnetic anomaly
- Interesting complex anomaly = Rank 2

B-field



dB/dt



Docker River Anomaly Summary

Anomaly	***East***	***North***	***Priority***	***Note***
1120a	536496	7264533	1	Good local late-time
1120b	536499	7269418	3	Broad shielded late-time. Possible SPM
1490a	555004	7254169	2	Early time fault response migrating to south-dipping late-time
1500a	555498	7254184	2	Early time fault response migrating to south-dipping late-time

Conclusions

- The majority of anomalies highlighted as possible bed-rock responses are ranked low or very low due to a consistent correlation with the edge of overburden responses, and it is likely that these lower-order anomalies are diffraction-tail effects caused by the sharp contrast in near-surface conductivity at the edge of palaeochannels and weathered fault zones.
- Some other lower ranked anomalies look suspicious and could be due to surficial SPM effects.
- Overall there are only two clear local late-time bed-rock conductor responses in the three areas surveyed -- anomaly 1400a in the Musgrave Ranges Area 1, and anomaly 1120a in the Docker River survey area.
- In addition to these, there are eight Rank-2 anomalies. It should be noted that these anomalies can also be explained by diffraction tail effects at the contact between resistive and conductive areas, but appear to also have characteristics of valid bedrock responses.

Recommendations

- Ground moving-loop TEM surveying is required to validate all VTEM anomalies. The VTEM system only reads the secondary field amplitude to around 10 msec, which is a very limited time from which to differentiate between valid bed-rock conductors and local shallow regolith effects. Surface TEM surveys operated at between 1 and 2 Hz (125 to 500 msec off-time) are usually sufficient to weed out the near surface effects from the true bed-rock conductors.
- There are too many Rank-2 anomalies to realistically follow-up with ground TEM. These should be re-evaluated after ground truthing and further assessment to select a few .
- SPM and IP effects are known to be common throughout the Musgraves, and can be problematic when the EM receiver is located close to primary field as in the in-loop array. It is therefore recommended that any follow-up ground EM be acquired using a slingram array, with the receiver located at least 100m from the loop edge.
- 500m spacing is considered very broad for a VTEM survey targeting magmatic Ni-Cu-Co-PGE sulphide mineralization. It is recommended that 200-250m line-spacing be considered for any future AEM surveys.