UNLOCKING
RESOURCE
POTENTIAL

HiSeis

Reflection Seismic in the Search for IOCG Deposits on the Stuart Shelf

Presented at
Geoconferences (WA) Inc.
TeamWA Workshop
Iron Oxide Copper Gold (IOCG) Deposits Workshop
29th May 2014

SEISMIC REFLECTION ON THE STUART SHELF: WHY?

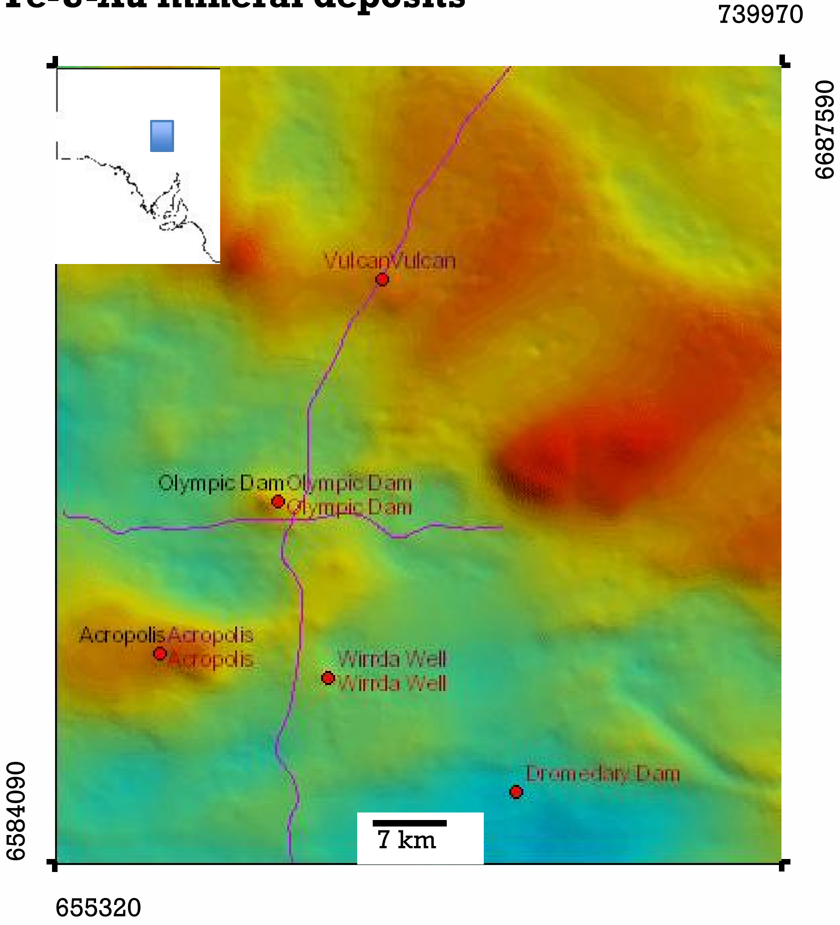
- Gravity shows only combined effect of basement lithotype and basement topography. *2D seismic maps basement topography and lithostructure*
- How do you target subsequent holes after a bonanza intersection in an IOCG system at depth? *3D seismic will map the distribution of iron oxides from which structure and lithology could be inferred.*

HISEIS MULTICLIENT STUDY

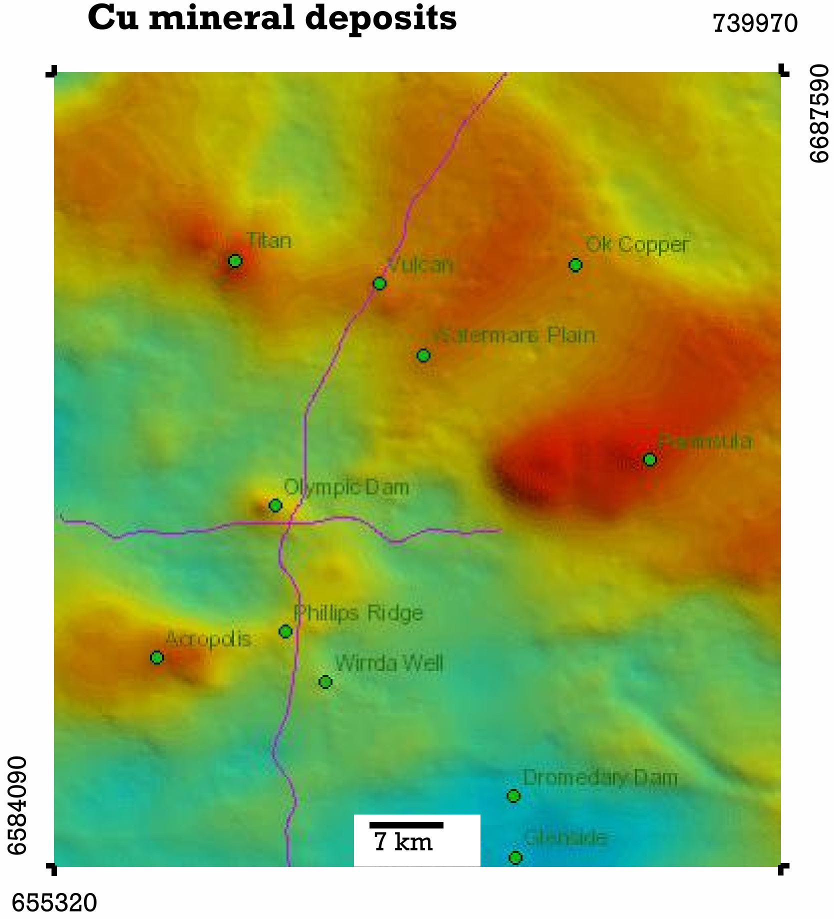
- Measured Vp and density on representative cores from DMITRE library.
- Compute synthetic seismic images over basement relief.
- Compute synthetic seismic images over Olympic Dam from Ehrig et al. (2013) X- sections.
- Reprocessed approximately 160km Geoscience Australia seismic lines Olympic Dam 1 (GA_OD 1) and Olympic Dam 2 (GA_OD 2) using Partially Preserved Amplitude processing.

Locations of significant Fe, U, Au and Cu projects adjacent to the seismic sections

Fe-U-Au mineral deposits



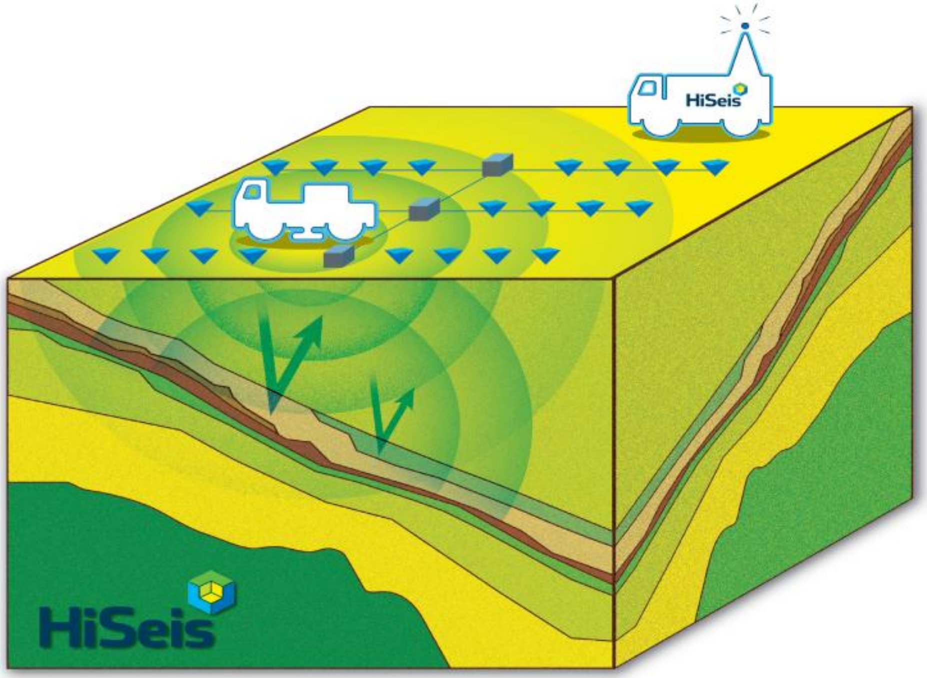
Cu mineral deposits



Bouger gravity

Pink lines- position of GA_OD1 and GA_OD2 seismic lines

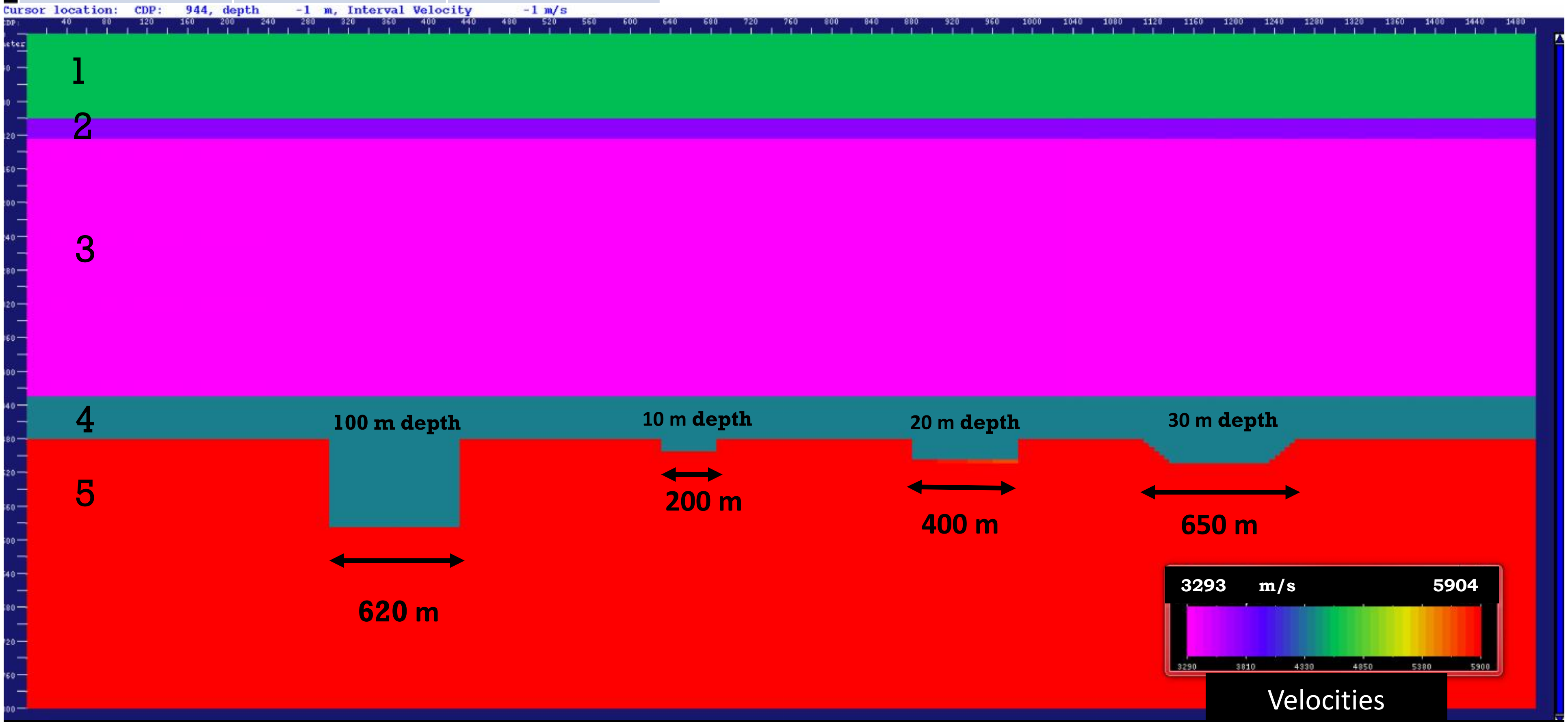
REFLECTION SEISMIC



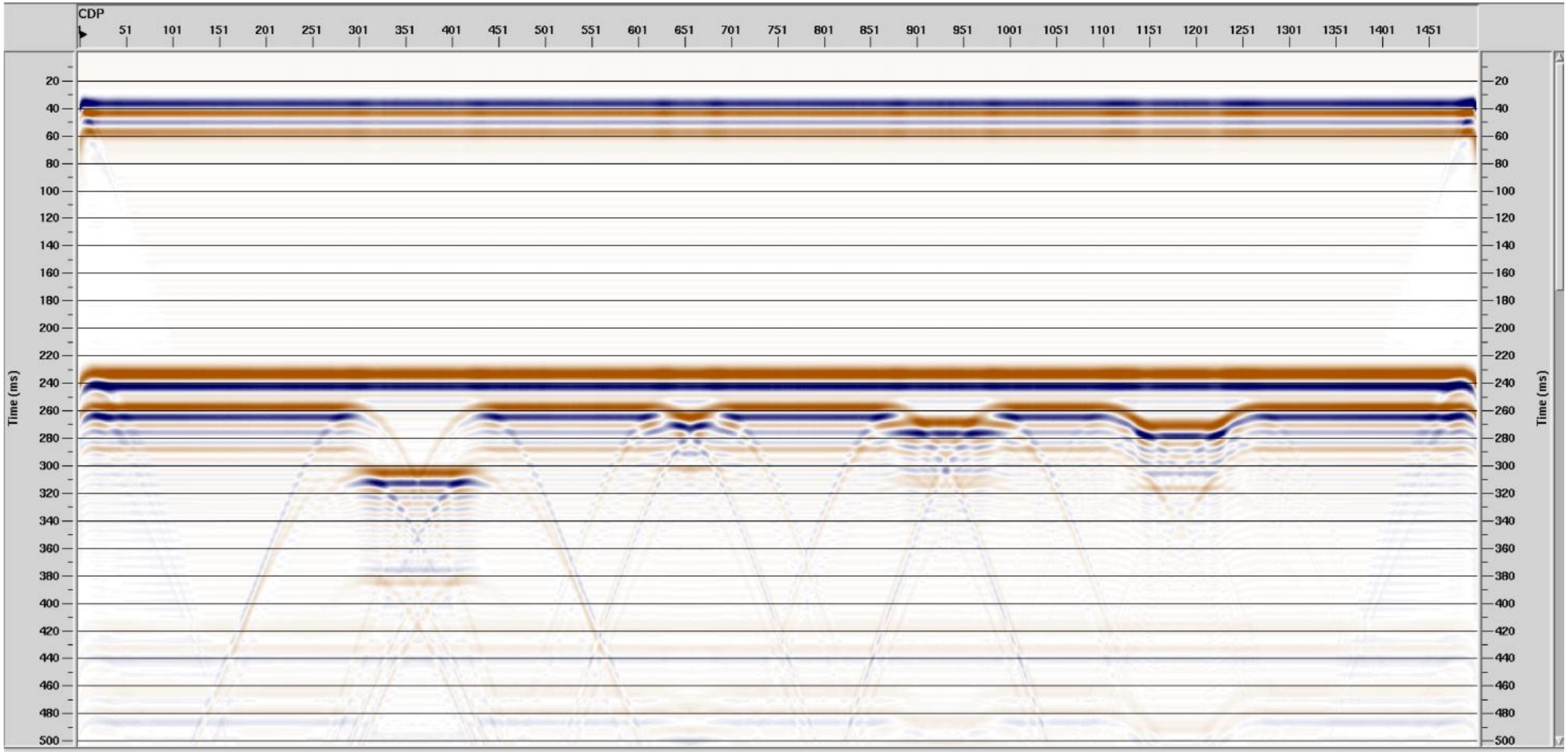
The seismic reflection method uses a controlled source which generates seismic waves that are reflected from interfaces between different rock units, as shown in the left figure. An explosive or vibratory (as shown in the image) source is used. Continuous 2D/3D coverage is achieved by moving sources and receivers along seismic traverses.

STUART SHELF BASEMENT RELIEF MODEL

Name	Vp (m/s)	Density (g/cc)
1. Quartzite	4610	2.42
2. Sandstone	3737	2.22
3. Shale	3293	2.73
4. Siltstone	4385	2.69
5. Basement	5896	3.64

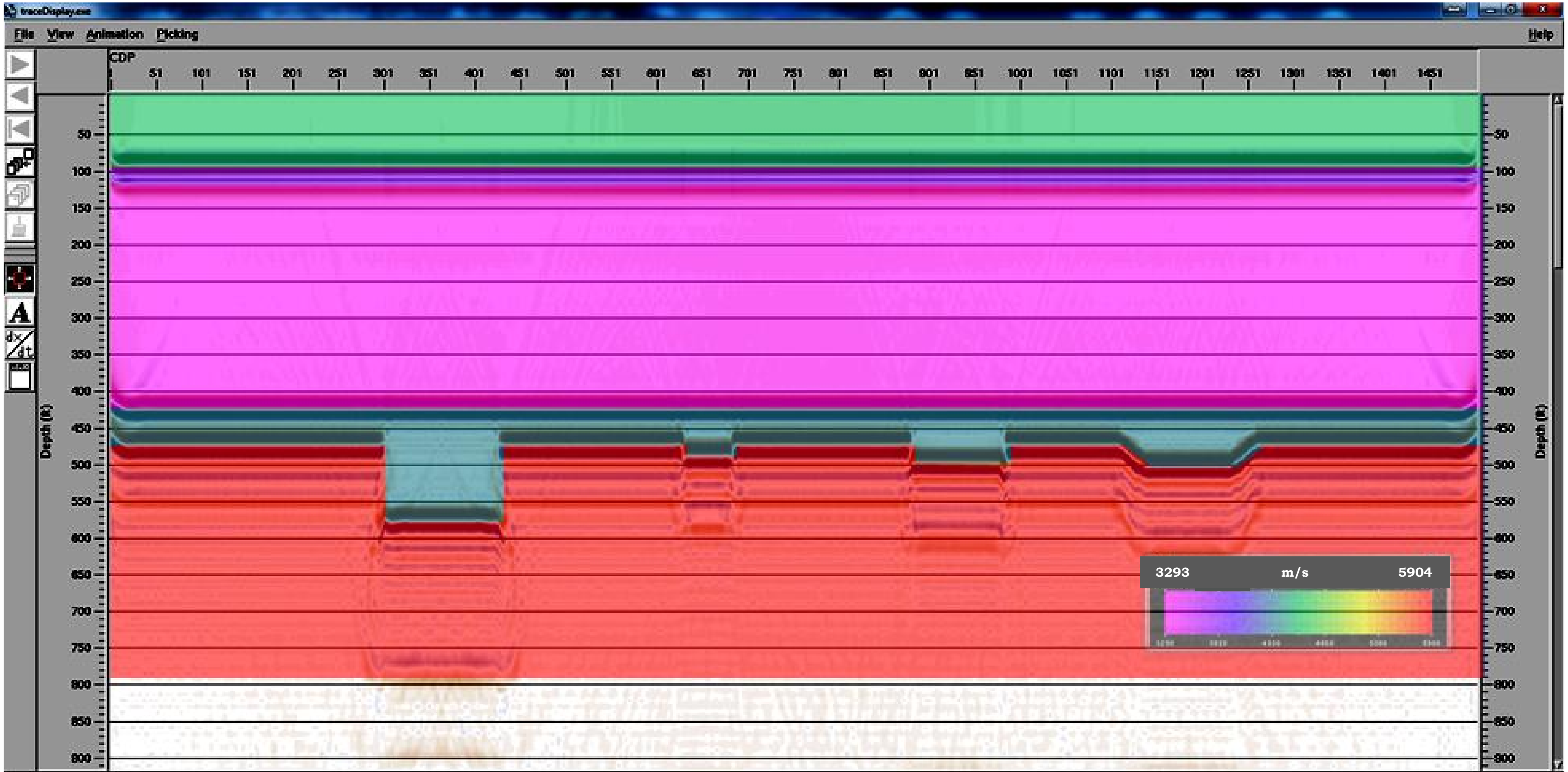


STUART SHELF BASEMENT RELIEF
2D SEISMIC (UNMIGRATED) IMAGE
Sx 50m Rx 25m 240 ch

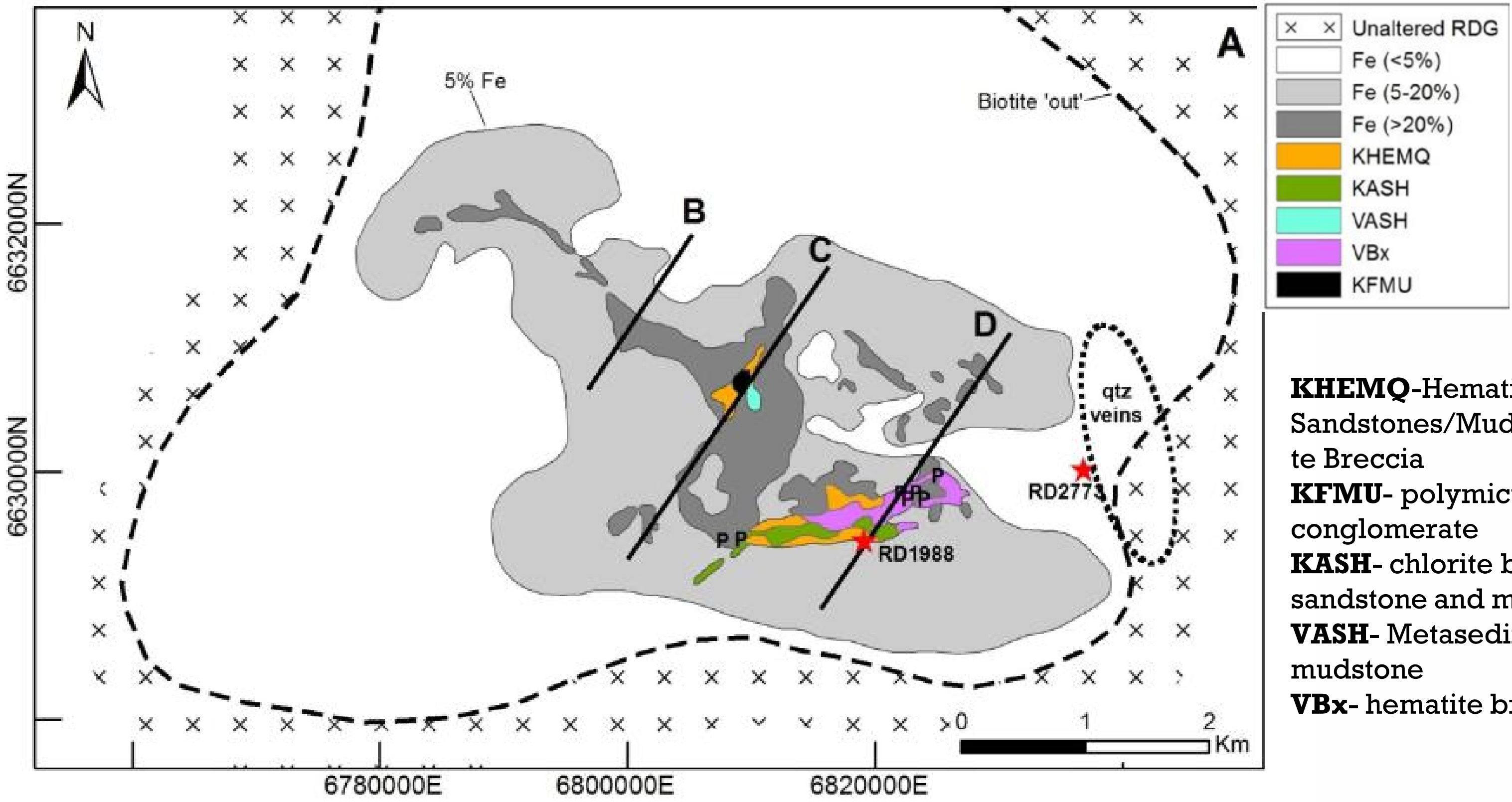


STUART SHELF BASEMENT RELIEF MODEL

Geology and Seismic Response



Olympic Dam (Ehrig, 2013)



KHEMQ-Hematite rich Sandstones/Mudstones/conglomerate Breccia
KFMU- polymictic volcanic conglomerate
KASH- chlorite bearing,laminated sandstone and mudstone
VASH- Metasediments hematite rich mudstone
VBx- hematite breccia + clasts

Three Olympic dam breccia complex cross sections used in conjunction with velocity and density measurements, on over 190 representative samples from DMITRE core library, to compute the synthetic seismic image over Olympic Dam.

Olympic Dam (Ehrig et al., 2013)

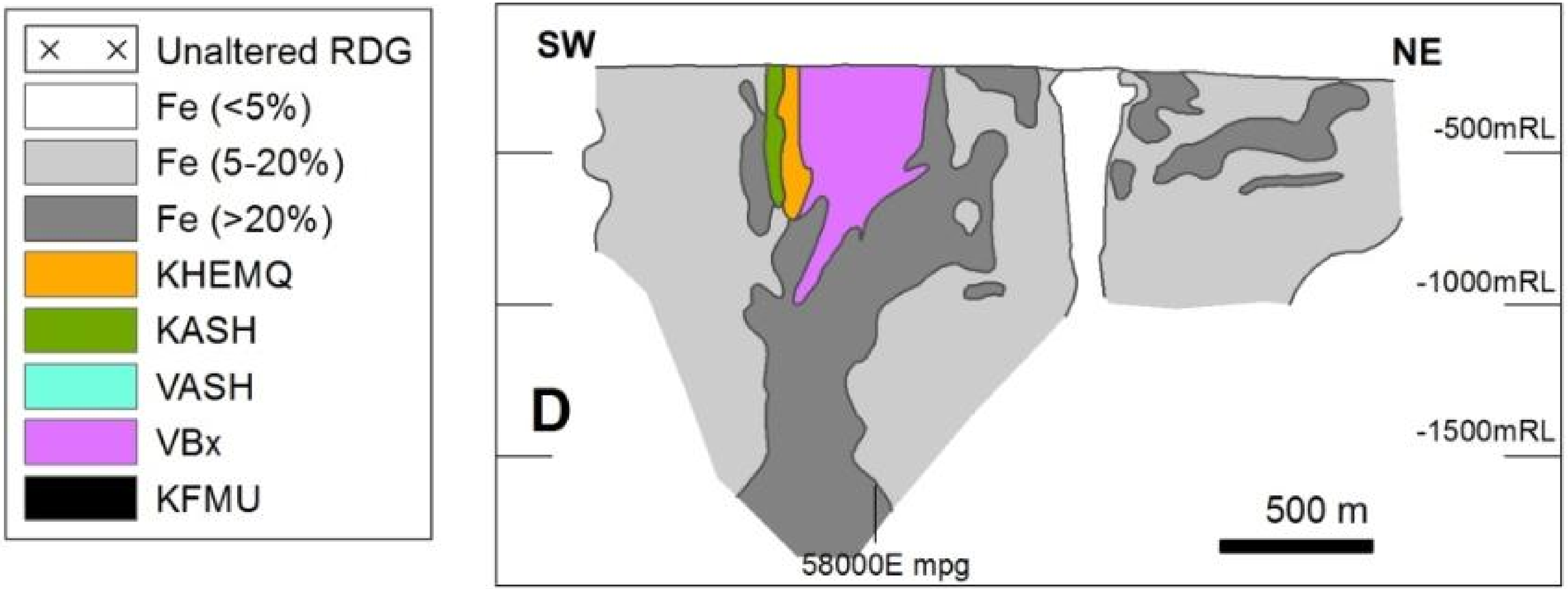


Table of Reflection Coefficients

$$R = \frac{AI2 - AI1}{AI2 + AI1}$$

The reflection coefficient is proportional to a relative difference in acoustic impedances of the upper and lower media.

	AI (m/s.g/cc)	Granite (RDG)	Granitic Breccia Fe<5%	Granitic Breccia Fe5-20%	Hematite rich breccia Fe>20%	Hem rich SS/MS/conglomerate Breccia (KHEMQ)	hematite breccia+clasts (VBx)	Metasediments (KFMU) (polymictic volcanic conglomerate)	Metasediments (KASH) Mafic and Chlorite	Metasediments (VASH) hematite rich mudstones
Granite (RDG)	13504		-0.08	0.11	0.17	0.22	0.24	0.15	0.16	0.17
Granitic Breccia Fe<5%	11418			0.19	0.25	0.30	0.32	0.23	0.25	0.25
Granitic Breccia Fe5-20%	16914				0.06	0.11	0.02	0.03	0.05	0.06
Hematite rich breccia Fe>20%	18987					0.06	0.07	-0.02	0.00	0.00
Hem rich SS/MS/conglomerate Breccia (KHEMQ)	21306						0.02	-0.08	-0.06	-0.06
hematite breccia+clasts (VBx)	22066							-0.10	-0.08	-0.08
Metasediments (KFMU) (polymictic volcanic conglom	18087								0.02	0.02
Metasediments (KASH) Mafic and Chlorite	18830									0.00
Metasediments (VASH) hematite rich mudstones	18956									

Reflection Coefficients between ODBC lithological units, based on the rock property measurements collected over the 5 representative drill holes from Olympic Dam.

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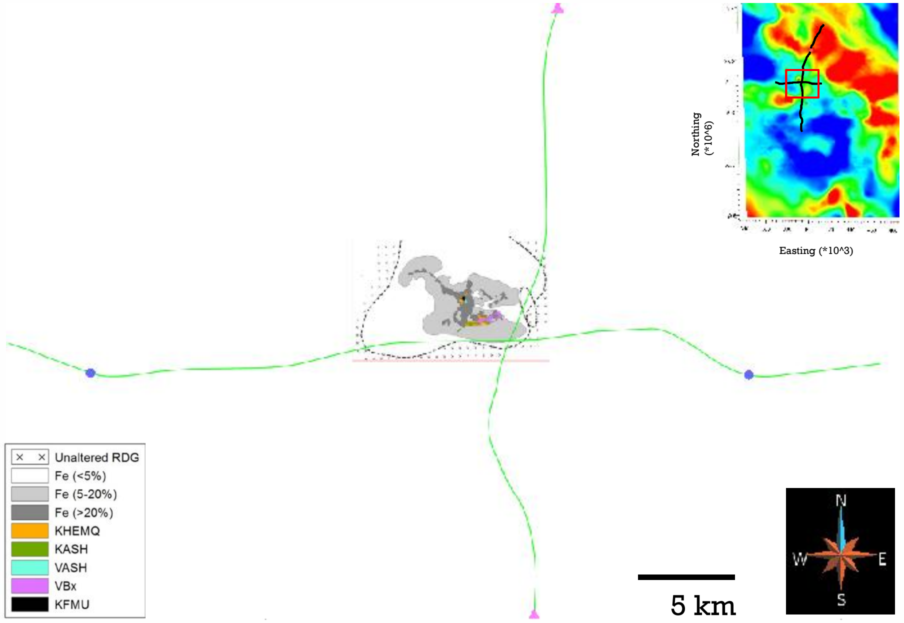
Model Studies

Confidentiality precludes publishing the model studies.

Model Studies

- Unmigrated data shows strong diffractions from contacts between units with different iron content
- Migration positions the contacts so that the overall geometry of the iron rich system is identified
- Burial at a depth of 1km does not downgrade the resolution

Olympic Dam (Ehrig, 2013)



Position of Olympic Dam Breccia complex after Ehrig et al., 2013, in relation to Olympic Dam seismic profiles GA_OD1 and GA_OD2.

KHEMQ-Hematite rich Sandstones/Mudstones/conglomerate Breccia
KFMU- Metasediments polymictic volcanic conglomerate
KASH- Metasediments Mafic and Chlorite
VASH- Metasediments hematite rich mudstone
VBx- hematite breccia + clasts

Reprocessed Seismic Sections

Confidentiality precludes publishing the reprocessed GA Deep Crustal Seismic Lines.

Conclusions

- Seismic can map depth to basement with high precision in many environments

- Principally because of the density contrast seismic can map the variation of Fe content in IOCG systems with high resolution

- Partially Preserved Amplitude (PPA) processing of GA deep crustal seismic data shows a direct response from the Fe-rich lithologies which are associated with the Olympic Dam mineralisation.

Next steps

- MOU with GSSA to jointly interpret the reprocessed seismic and integrate with the other data sets
- Publish the results in the MESA Journal

Acknowledgements

- Great assistance in all facets of the study from GSSA
- GA for providing the RAW Data