**Video Transcript**

**Victorian Gold Mining and Exploration Forum - Regional geophysical datasets in north-central Victoria: acquiring most value from the data**

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Okay, good morning everyone.

So today I’m just going to be giving you a very brief outline of some of the geophysical datasets that we have available in Victoria relative to gold exploration and some of the techniques we can apply to enhance the value of those datasets, and then briefly talk about how we apply them to our interpretations.

[Slide: Talk outline]

So, just a brief outline of the talk.

[Slide: Pre-competitive data - Geological mapping]

So to start off with, I guess we’re really lucky in Victoria because we’ve got a great history of geological mapping in the state spanning back over 150 years.

And, most recently we’ve come up with some great seamless geology products, so 1:250 and the 1:50k seamless geology maps.

And they’re great for interpreting the Palaeozoic bedrock, so the blue and purple sort of rocks through the centre of Victoria there, and these rocks are typically the ones that are associated with historical gold exploration and occurrences.

Everyone knows about the golden triangle in central Victoria there where most of the gold has come from.

And so I guess the current focus of exploration in the state is to expand that search base, and going north under the Murray Basin cover is one of the great options to be able to do that.

[Slide: Pre-competitive data - Cenozoic cover - The Murray Basin]

So the Murray Basin is a younger set of sediments that cover the Palaeozoic rocks in the northern parts of the state, and we’ve done some work to try to help understand that basin, so a depth to basement surface is available for download and for use, and that contains various units within the basin derived from drill hole intersections and geophysical modelling as well.

[Slide: Pre-competitive data - regional airborne magnetics]

We’ve also got great regional airborne magnetics coverage, so here you can see all the different types of surveys that have been acquired and then merged together into a state-wide grid.

You can see there it’s a 50x50m grid cell size covering the whole state, so again a great resource when looking for exploration targets and to help your exploration, particular in areas under cover.

And that’s all freely available from GADDS.

[Slide: Pre-competitive data - regional ground gravity]

As is the gravity database and dataset so nominal 1.5km spacing over the whole the state, which is really good coverage for a regional dataset of ground gravity.

And in place, that spacing is much more detailed, anywhere down to sort of a 100 and even 50m spacing.

And again a state-wide grid is available, 300x300m grid cell size available from GADDS.

[Slide: Pre-competitive data - Seismic Transects]

We also have a full crustal transect, east-west transect, across the state that gives us great information about the third dimension, so with depth we can correlate the seismic interpretations with the surface mapping and surface outcrops, so again been really great in trying to understand the evolution of the state and the geology.

[Slide: Correlating geophysical response to geology …]

And, a way that we can link the geophysics to the geology is petrophysics, really important when we’re doing our interpretations and modelling, and again we have a fairly good database of around 250,000 rock property measurements, not evenly spread over the state but gives you some really good insight into the response that you see in the geophysics and how that correlates with the geology.

[Slide: Victorian Orogenic Gold Mineral System]

So looking at the Murray Basin, just before we do that a quick kind of review of what you’ve heard already today, orogenic gold systems in Victoria, we’ve got our source down in the lower crust, the thickened MORB volcanics, and then we have fluid pathways, the faults, the deep tapping faults that are conduits for the hydrothermal fluids that then provide and produce the mineralisation near the surface.

[Slide: Cenozoic cover - The Murray Basin]

So zooming into this area in the northern and central Victoria region, we can see our mapping in the blues and purples with the major north-south trending structural faults, and all the gold occurrences.

And as you’d expect they’re limited by the outcrop of the Palaeozoic basement, so stopping at the Murray pretty much, apart from a few.

So how do we extend that interpretation and that knowledge under cover to the north?

And you probably kind of can guess already.

We can use geophysics, gravity in this case, to interpret those structures by tracing anomalies that we can correlate with the mapped geology in areas of outcrop and trace those further north under cover.

And similarly we can do the same with magnetics.

And looking at the seismic sections here you can see some of the lines that we’ve acquired.

[Slide: 2006 Central Victoria Deep Seismic Reflection Transect]

If we just take these two for example, there’s the whole section covering the Bendigo and Stawell zones.

And zooming in to this particular area here we can see how we can trace those faults, so these deep crustal faults coming up to the surface where we have control, and where we can correlate them with anomalies we see in the potential field data, in this case the gravity.

And so we can trace those faults to the north under cover where we wouldn’t be able to map them directly.

[Slide: Filtering of potential field data - gravity]

So we have our potential field datasets, our standard datasets, and we can apply a whole bunch of different filters and enhancement techniques to those data to bring out some of the subtle features and some of the different sources of the response that we see.

So for example here, we’ve got some filters that are showing up these higher frequency signals in the gravity data, and they correlate really well to some of the mapped faults that we see as well.

Conversely we can strip away some of that shallower response, so high frequency response, and look at what’s happening at depth in the sort of mid-crustal to lower-crustal levels.

And there’s a whole bunch of different filters that we can apply to enhance these datasets.

[Slide: Filtering of potential field data - magnetics]

And we can do a similar thing with the magnetics, so you can see here there’s the TMI, standard magnetic dataset, and once we apply all these different types of filters we’re getting different sets of information about the geology and about what’s happening in different levels of the crust from the magnetics as well.

[Slide: Image enhancement - combining gravity & magnetics]

So not only can we look at those independently but we can actually cross-correlate and combine some of these datasets to give us an even better understanding and more information about what’s happening.

So here for example, we’ve got a high pass filtered gravity dataset in the colours, and that’s draped over a RTP intensity, so we’re able to correlate the different datasets into one – I guess one dataset that we can utilise in our interpretations.

[Slide: Image enhancement - combining magnetic filters]

And we can also do that with different filters for example.

So here’s a tilt filter on the left and a band pass filter on the right from magnetics in the northern Bendigo Zone, and if we combine those we’re kind of getting the best of both worlds in one image.

So we’ve got these broader anomalies coming from deeper sources, and obviously shallow high frequency anomalies that are giving us information about the shallower sources, so in this case all these dendritic Paleo channels and some of the Heathcote volcanic responses that you see there.

[Slide: Case study - Northern Bendigo Zone Gravity]

So how do we go about applying all these datasets and techniques to our interpretations?

So I’ll just run through a couple of examples, in the Northern Bendigo Zone here we’ve got our geology on the left with the interpreted faults and gold occurrences.

Again, you can see that correlate and are associated with these deep crustal faults, these west dipping faults, and we can, if we overlay them on the gravity we can interpret them and infer them from some of the response.

So this is a 15k high pass gravity image, so if we strip away the cover you can see these trends, these anomalies extending north under cover and really mapping out some of the faults that are interpreted in the outcropping areas.

And if we overlay the major sort of prospects and mines you can see again that they correlate really well with the anomalies and the interpreted faults.

And in particular the Four Eagles and Tandarra prospects which are located beneath cover, beneath the Murray Basin, so gravity was a really useful tool for targeting that exploration and for being able to define those prospects.

[Slide: Case study - Northern Bendigo Zone Gravity]

In particular, the Bendigo-Mitiamo survey acquired in 2007, which was an infill survey, added a whole bunch more resolution to the dataset and was instrumental in that discovery.

[Slide: Case Study - Rochester Antiformal Stack]

So looking at another example from Northern Bendigo Zone, this is the Rochester antiformal stack, we’ve done some magnetic inversion modelling in this case.

[Slide: Magnetic inversion modelling]

And here is the magnetic image, and you can see all these lines are cross-sections where I’ve modelled and inverted the magnetic response.

And what we see here is that in the south, as was mapped in the sort of outcrop regions in the south, we have these west dipping volcanic units, the Heathcote volcanics.

And as we move north there’s a lot more complexity that comes out from the modelling, in fact some of these units are dipping to the east and have been overturned.

And if we look at that in 3D we can see these bodies that have been modelled and inverted, and looking at them with the seismic section you can see that actually the geometries line up really well with what we interpreted from the seismic.

And as you go north to this area of the antiformal stack you can see that there’s quite a bit of deformation of the west dipping volcanics.

So what we’re seeing is that about 420 Ma, this area was undergoing north-south compression and that caused the buckling of the volcanics so that the volcanic thrust faults and the volcanic units, and that has led to these features like the Tooborac megakink in the south there that we can map, and what we see in the magnetics and the gravity the antiformal stack further north.

And from the modelling we can see that the volcanics have been locally overturned in this region and buckled.

So what does that mean about the turbidites?

So if there’s deformation within the volcanics there had to be deformation of the turbidite pile as well.

And in the south we see that as a south dipping thrust fault, and presumably there would have to be a similar structure in the north there as well.

And these structures trend, they line up along strike with Fosterville fairly well, and into north Lockington, so perhaps this is telling us something about the localisation of mineralisation along the north-south primary structures.

[Slide: Magnetic inversion modelling]

So having a look again at the modelling, you can see the overturned beds there where the antiformal stack sits.

This is gravity overlayed on the top now, we can see some of these north-south faults showing up in the gravity, and we’ve modelled that in our 3D Victoria Modelling Project that you can see here, and again matching up quite well with the latest modelling of the magnetic bodies as well.

[Slide: Regional transpressional trending structures]

So you know, here’s the two structures that I showed earlier, you can see the mines and prospects in the stars there, and really the question is, you know, what are these regional transpressional north-west trending structures potentially a secondary control on mineralisation along the north-south primary structures that are tapping the volcanics and bringing up the gold-bearing fluids.

So maybe they’re being localised by these other north-south and potentially – sorry north-west and potentially north-east structures.

[Slide: Case study - Northern Stawell Zone: Gravity]

So moving over the west now, looking in the Stawell Zone, we’ve got our seismic lines.

[Slide: Case study - Northern Stawell Zone]

If we look at this line here, you can see again a very similar mineralisation system as we see in the Bendigo Zone, so deep crustal faults.

The Moyston Fault being the western margin of the Stawell Zone, the Avoca Fault mapping out the eastern margin, and we have all these faults within the zone, west dipping faults within the zone that are tapping down to the Moyston and again bringing up hydrothermal fluids, gold-bearing fluids to the surface.

So interestingly enough, the Moyston Fault is tapping the very deeper crustal levels beneath the Bendigo Zone, so presumably the fluids have moved up the Moyston Fault and then come off the Moyston Fault up into the upper crustal positions.

And just for reference, St Arnaud Goldmine is located about there, so again associated with these faults.

[Slide: Case study - Northern Stawell Zone Magnetics]

And if we just have another look at further west in the Stawell Zone, we’ve got another seismic line through there, the AR1 line from 2009, there it is there, there’s the Murray Basin cover and TMI magnetics underneath.

You can see where Stawell Goldmine is in association to the line there, so the model for this region is the Stawell corridor which is the Moornambool Metamorphic Complex, and mineralisation here is associated with Cambrian basalt domes that we can identify in the magnetics in the south, and utilise the magnetics under cover as well.

[Slide: Case study - Northern Stawell Zone Magnetics - Total Magnetic Intensity]

So just looking at the section here, there’s our Moyston Faults and Coongee Faults and they extend to the north beneath cover, so if we strip away the cover and look at the TMI image, you can make out where it sort of is heading, but it’s a bit hard to continue that further north there I think.

Again looking at the magnetics with the basin stripped away here, if we apply some filtering to that data I think it makes it a lot clearer, and easier to trace where these faults go.

So there’s Stawell Goldmine and Navarre-Irvine prospect which is looking really good at the moment, and using the magnetics we can map out the boundaries of the Stawell corridor, the Moornambool Metamorphic Complex fairly well.

And interestingly enough, there’s, you know, in the magnetics I think there’s a whole bunch of interesting looking features potentially mapping out basalt domes and the volcanics themselves.

[Slide: 3D Geological Models]

And so just finally, we can utilise all of these datasets and bring in all the mapping, the drilling, the geophysics interpretation modelling, and use that as a framework to build these 3D models that are really useful for understanding the bigger picture and the regional mineral systems in Victoria, and how they relate to specific areas.

[Slide: Summary - Victorian Goldfields - more of a distorted rectangle than a triangle?]

So finally I guess we’ve heard of the golden triangle but maybe we should be thinking more about some sort of deformed golden rectangle, or in this case rectangle, but thank you.

[Slide: Geological Survey of Victoria]