Seismic Tool for Miners to Unlock Value

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Mining goes 3D as seismic technology unlocks value and saves miners' lives

DESLEY BLANCH : Now to exploring in 3D and following on from New Zealand's coalmine disaster last November when an explosion at the Pike River Coal mine killed 29 miners, West Australian company HiSeis is developing specialised technology that could lead to detecting the next Olympic Dam mine -- one of the largest in the world and located at Roxby Downs in South Australia, and save lives in the process.

HiSeis is a Curtin University spin-out commercialising an innovative three-dimensional seismic imaging technology which gives a clear picture of hard rock geology up to 1.5 kilometres deep and maps major shears and faults, as well as intrusive rocks. For structural safety, it gives a much better picture of how rocks have moved along structures and in some cases the tool can directly image the ore system.

Peter Williams is the managing director of HiSeis. From Perth, he explains why he believes their technology is pertinent to the events at New Zealand's Pike River mine when many miners' lives were lost.

PETER WILLIAMS : I guess with these coal mines, the explosions there result from a mixture of methane in air, which is about 5 to 15 percent methane and when that comes in contact with electricity you get explosions, and so really the question is just how you map out the methane distribution in the coal mines or how you try and predict that methane distribution and it's been well known that faults control the distribution of methane.

It's certainly one of the main controls on the distribution of methane and so with our technology, we are looking to map in much more detail than previously the definition of these faults and hence you can't say immediately that a fault has actually got methane on it or it's or it's hard for methane to travel down. But just knowing that there is a fault there is really a first step and mapping that out in three dimensions is a very important part of the whole mine design and safety and planning of the life of a mine.

DESLEY BLANCH : Well, you're company is a young company and it was launched only 18 months ago and after 15 months, you've landed more than 2.3 million dollars worth of contracts and one of which is up in Lapland, in an arctic winter. Now what could you do with a seismic survey in the middle of winter? Obviously weather doesn't preclude you operating?

PETER WILLIAMS : Well, I'd have to qualify that a little bit because weather does and especially up in the arctic winter and I must say that none of us have actually worked in the Arctic winter before starting that job, but very quickly we found out that the Arctic winter includes temperatures going down under minus 40 degrees.

Well, just working under minus 20 degrees is certainly a challenge to people and a challenge to equipment. For example, plastics become very brittle, break; ignition systems freeze up and refuse to work, hydraulic systems can also freeze unless you actually have the system warming up 24 hours, so yeah, it's certainly a very challenging environment to work in.

But the objective that we had up there in the Arctic was to try and map sub-vertical faults in a mine that a company was planning to put into operation in the next 12 to 18 months and the significance of the mapping of these faults was the presence and the attitude of these faults dictated the slope of the pit that they were going to dig as a mining operation and it turned out the economic analysis was that for every one degree change in the slope of the pit it made a difference of about 50 million dollars in the NPV of the project.

So it was something very significant to try and map out these sub-vertical faults in a 3D sense within the mine development area.

DESLEY BLANCH : So can you just give us a picture, a word picture of how your seismic technology does work.

PETER WILLIAMS : Really very simply, we generate acoustic waves, put them into the earth and just see how they behave and we map out how these waves behave at the surface of the earth by using things called geophones.

So hence we have a seismic source of acoustic waves such as dynamite, vibrating tracks, hammers, shot guns. They're all different sources with different characteristics, different frequencies and amplitudes etc and we measure using what we call a geophone sensor array. It's like we're measuring the vibrations of the earth, at specific points and we have virtually a wide area network spread out of such geophones across the earth in a grid-like fashion.

DESLEY BLANCH : So you're bouncing, banging, dropping, clanging, making a noise as much as you can to see how far those vibrations go and then map them as they come back up again?

PETER WILLIAMS : That's right, yes. We've virtually just measuring from the surface, which is a little bit different from medical imaging where you can measure a lot more different illumination positions or illumination angles. We can only measure from the surface, so we have this surface seismic source and a surface geophone or geophone array and from those measurements we then can reconstruct an image of the earth in three dimensions.

DESLEY BLANCH : Well, this technology has spun out of Curtin University, in Perth, where the use of high resolution 3D seismic surveying for coal - this was pioneered and commercialised. And then, they've built on that technology and adapted the latest seismic imaging technology so that today, you have this broader application across many areas. So how are you using the technology today in what kind of contexts?

PETER WILLIAMS : We're using the technology across a wide range of commodities in the mineral business, if you like, in very different geological and geographical environments. For instance, at the moment, we're working in Western Europe, in what they call a volcanogenic massive sulphide belt, which has been mined for zinc and copper for more than 100 years.

They're now at a stage of searching for ore between depths of 500 to 1200 metres and this ore is of quite high value, so you do find that you can mine it, but the problem that we're trying to solve is to try to find these new ore positions before the old mining activity stops.

So we're working in Western Europe, looking for zinc and copper. We've been working in Nevada, looking for gold at depths of 500 to 1200 metres. We've been working in the Northern Territory looking for uranium, which is a special sort of uranium deposit associated with they call palaeo-unconformities.

And we've been very successful at that and I guess we've also been working in other areas that are related to minerals and more related to human beings and life on the planet and that is working in water exploration and water delineation and associated businesses there.

DESLEY BLANCH : Well, it's a wide range. Are there other technologies available that are similar or the same as yours? I mean what's your point of difference?

PETER WILLIAMS : Our point of difference -- there would be a few. If I could just summarise it in one word it's scale. We've basically taken what started as petroleum technology, which is used every day in petroleum reservoir engineering and exploration for oil and gas and we've scaled it down to look at the mineral business.

The mineral business happens mostly in the top one kilometre. The petroleum business can happen anywhere down to I guess 7, 8 kilometres and deeper? So what this means in practice is that we run with a much tighter measuring system, we have closer geophones; we have smaller crews as well just to give you an example.

Our crews might only consist of between six and 20 people. If you go to a petroleum seismic crew you're dealing with 100 people, so this is actually quite important, not only in the economics, but in the whole logistics and practicality of doing mineral seismic, because it's very difficult to turn up to a mine site with 100 people. It's not a trivial operation and it's very, very expensive and so we've worked out just how to be able to deliver the technology to a mine site in a very practical way as well as have the technology more tuned to the geological problems that we have in minerals.

DESLEY BLANCH : So tell us the advantages of HiSeis technology over traditional techniques, what are they?

PETER WILLIAMS : Well, the traditional techniques would include other low resolution geophysical imaging techniques, such as, for example, electromagnetics and with electromagnetics you can do the same sorts of experiments and the same sort of survey, but you have to do it at a lot lower frequency and what this lower frequency means in practical terms is that the three dimensional images that you get out of the survey are much lower resolution, so you do not see the detail and as you know, it's quite commonly said the devil is in the detail and it certainly is in the minerals game. So that's one of the key points of difference.

DESLEY BLANCH : And what are your clients using your technology for? You've mentioned a couple, but what sort of reasons do they come to you?

PETER WILLIAMS : I guess we're either working in the mine design, how do you design a mine, where are the faults in the mine, where does the ore extend to, where doesn't it extend to and so we're working in very close to mining problems, but then as we just move a slight distance away from the mine, there's a lot of exploration potential there that extends down to a kilometre or a kilometre-and-a-half depending on the actual value of the ore in the ground and this is really what I was talking about before at Portugal, where they've been mining for 20, 30 years at the near surface, so less than 500 metres and now, 30 years on, they're now having to explore at much greater depths, but still very close to the mine and I'm talking about distances of say three, four kilometres from the actual mining site right now.

DESLEY BLANCH : Give us a cost comparison between doing a seismic survey and using traditional methods.

PETER WILLIAMS : Say if you wanted to look at cost comparison and try and sort of maintain the resolution of the image you get, we can actually compare seismic with conventional drilling and with 3D seismic, the actual cost of surveying over a kilometre by a kilometre in eastern north distance to a depth of say one-and-a-half kilometres, the actual cost of imaging that geology in three dimensions using seismic is of the order of say 200,000 250,000 dollars and that gives you a 3D continuous image of the geology.

If you compare that with drilling, and said well Okay how many holes can we actually drill for that 250,000 dollars down to a depth of 1500 metres and the answer comes back as being one, maybe 1.5 holes and a hole is really just a one dimensional sample of the earth, so for the same dollar cost, you can get a 3D image from which you can get a much better appreciation of the structure, the lithology, the alteration within the earth down to one-and-a-half kilometres and we compare that with just a line of information from conventional drilling.

DESLEY BLANCH : Well Peter, you mentioned that the company is fairly young and because your technology is still emerging, are you finding that company executives, maybe they're more reluctant to take a punt on your new technology? How's it feel for you?

PETER WILLIAMS : Oh yes, in the mining business there is probably a very significant educational issue for mining executives, because seismic is not really part of the mining culture at all and so we have to very much develop the case for using seismic in each of the different mineral provinces, if you like, and be able to talk up at that executive level and the reason we have to really talk at the executive level was because the cost involved with these surveys are quite high in a normal conventional minerals exploration budgets.

So for a junior exploration company to do a one million dollar survey, that's a very significant cost for them -- it's a matter for a board discretion really and we're really conscious of this and we have a program of rolling out workshops and educational programs for executives and senior staff and even board people as part of our business development plan in the next couple of years.

DESLEY BLANCH : So how are you expanding the business and getting the word out there?

PETER WILLIAMS : We've been going for nearly two years now and we really haven't done a lot of advertising. It's more been just using networks of people and some of these people have been aware of our work through their support of the CRCs, the Cooperative Research Centre and Centre of Excellence that's been operating at Curtin University for the last five years, so there's a number of sponsor companies there.

They've been privy to the development of this technology and they're the ones who've been saying Okay, right, we understand the technology, we would like you to deliver that technology to our mine site. And we've really just been operating like that.

But that is going to change as the business grows and for the business to grow and so we are, as I said, starting to roll out workshops for people both in Australia, in Canada and in Europe.

- **Contact:** Peter Williams, Managing Director
- **Address:** HiSeis Pty Ltd
  Perth, WA
- **Telephone:** +61 8 9266 3408 +61 8 9266 3408 CELL: +61 (0) 422 593 601
- **Email:** pkw.hiseis.@gmail.com
- **Website:** http://www.hiseis.com.au