Mining Equipment, Technology and Services

PARTNER ECONOMY: UNITED STATES OF AMERICA
ORGANISATION: CODES, UNIVERSITY OF TASMANIA

INNOVATION STORY

2016 PRIMING GRANTS

DR NATHAN FOX

When it comes to sustainability, the mining industry has a bad reputation, and University of Tasmania's Dr Nathan Fox thinks this demonization is a little unfair.

"Our lifestyles demand mining. People think it's done badly and think we don't need mining, and yet still want these high-end products that are really mining's economic driver. I find it very frustrating," Dr Fox says.

His research in geometallurgy is focused on improving how ore deposits are mined. Using various analytical techniques, his aim is to more effectively predict the outcomes of the mining process.

"We can improve the way we mine, including the way that we dispose of our mine waste and be a lot more predictive in the way things are going to go," Dr Fox says.

"I want to build into that future direction of making things a lot better."

Another area Dr Fox is working towards is improving the efficiency of mining practices. He explains that different disciplines use the same data and waste time and money collecting it more than once.

"People go out and collect the same data three times and what we really want to encourage is good practices that can be used in a more integrated team."

But already the sector is making progress.

"Technologically, we're seeing better integration of techniques. It's quite an exciting time to be working in this space because it's pretty much only going to get better," he says.

Dr Fox was a recipient of a Priming Grant, and used the funds to partner with a US company called SciAps, which specialises in designing and manufacturing portable analytical instruments.

One was a handheld LIBS (laser induced breakdown spectroscopy) analyser. Dr Fox says it has opened up opportunities for faster chemical analysis, and he used it to analyse minerals including pyrite.

Pyrite, or iron sulphide, is found in most mineral deposits, and Dr Fox explains that analysing it can be a guide towards the centre of the deposit – "a fundamental tool for exploration vectoring".

But, he adds, when that technique is used to look at other minerals, it allows geoscientists to analyse other elements that may be inside.

For instance, Dr Fox used the technique to get a closer look at the chief ore of zinc, sphalerite, and saw trace metals of other valuable metals like indium.

"The idea of the Priming Grant was to see how to integrate that technology into industrial scale programs and bring it directly to mine sites," he says.

Mining Equipment, Technology and Services

PARTNER ECONOMY: UNITED KINGDOM
ORGANISATION: UNIVERSITY OF TASMANIA

INNOVATION STORY

2016 PRIMING GRANTS

DR ANITA PARBHAKAR-FOX

Australia has a long mining history, but the stringent safety measures now in place weren't always there.

University of Tasmania's Dr Anita Parbhakar-Fox is a geo-environmental scientist making sure mining operations today don't make the same mistakes historic mine sites made.

She says her research is focused on transforming the mining value chain, and specifically, her role is focussed on geo-environmental characterisation.

"We're looking at ways we can avoid the geo-environmental risks of mining operations way before they're commissioned," Dr Parbhakar-Fox says.

"We're trying to be predictive about what the environmental impacts are going to be so that mining companies have a better idea of the environmental liabilities, and how to plan for them."

There are around 50,000 abandoned mine sites in Australia, and most are producing acidic water, polluting the surrounding environment.

And in some cases, the acid can threaten our drinking water, according to Dr Parbhakar-Fox.

The main culprits that cause acidic drainage are sulphide minerals. If miners don't manage their waste and sulphide minerals are on the surface of the waste mound, they will oxidise and transform into sulphuric acid.

If the acid gets into the environment, it can enter creek systems, impact aquatic life and then propagate down the food chain, Dr Parbhakar-Fox says.

"If we understand the characteristics of the waste materials, we know how to better design waste landforms."

The 34-year-old post-doc geoscientist moved to Australia from the UK 11 years ago.

She was a successful recipient of the Priming Grant, and together with collaborator Dr Christopher Brough from Petrolab UK, she set her sights on improving one of the tests for acid-mine drainage: kinetic tests.

Kinetic tests are designed to check whether the sulphide minerals in mining waste will potentially oxidise.

One of the problems with it, Dr Parbhakar-Fox explains, is there's a minimum cut-off point for when the waste can be declared safe – usually in around six months' time – and the two researchers believe this isn't long enough.

"We're trying to help the industry understand what's happening in that column better by introducing forecasting tests that we know work.

"We know the tests need to be formally in the protocol. If it's not stated in the protocol or global standards, people could potentially cut corners."

Dr Parbhakar-Fox adds the global standards organisations are currently looking to improve kinetic testing standards.

"This is a really opportune time to have won this grant and to be able to do this work, so we're very happy and excited about changing it. We just want to set the standards high."

Mining Equipment, Technology and Services

PARTNER ECONOMY: UNITED STATES OF AMERICA
ORGANISATION: UNIVERSITY OF WESTERN AUSTRALIA

INNOVATION STORY

2016 PRIMING GRANTS

DR TODD ERICKSON

Some scientists are so dedicated to their trade they'll battle floods and fires to get results. This is certainly true for Dr Todd Erickson, a seed ecologist from the Botanic Gardens and Parks Authority and The University of Western Australia, who primarily works in Australia's tumultuous desert landscape.

"That's what I love about deserts and desert ecology, it's an environment of extremes," Dr Erickson says.

"I've been involved in torrential downpours that, in a space of ten minutes, you've got a flying river on a relatively flat landscape."

One time, Dr Erickson recalls, he and a colleague scrambled to collect seeds off a rare species as bush fires raged in the South Australian outback.

"As seed collectors, and being crazy scientists, we're running at the fire-front trying to collect seeds before they burn, and then driving as quickly as we can with the fire keeping up with us," he says.

"We were trying to collect rare species and conserve them in storage conditions, and at the same time you've got farmers next door losing their properties. That's the most extreme moment I'll always remember."

When he's not battling the Aussie outback, he's helping miners restore land in Western Australia when they've finished their work.

Mining companies in Australia are required to rehabilitate their disturbed land to some degree.

But each mine site has a different level of obligation. Dr Erickson helps mining companies with the biggest job – to restore the biodiversity of native species in an area back to its pre-disturbed condition.

"We work with them from a scientific non-profit point of view, so we're not a consulting business we're just in it for the science and to help them overcome a problem," he says.

Dr Erickson received a Priming Grant which he and other research colleagues used to further develop the technique "flash flaming" – a way to burn off the hairs of spinifex grass seeds to make their path through mechanised machinery smoother, resulting in easier planting.

"Spinifex is a very important perennial grass in Australia. It covers up to a quarter of the country in some sort of association in the desert environment, and it's unique to Australia," he says, explaining that he's been researching spinifex for the past nine years.

He says this innovation could have a global impact as the technique could be applied to many other species of grass.

"That's one of the reasons I applied for the Priming Grant. Taking a step above spinifex, grasses are one of the most utilised plants globally.

"In the agricultural market, most people just bred those traits out, but in wildland restoration globally where there's a huge human footprint, grass will fundamentally be the core of any future rehabilitation."

Mining Equipment, Technology and Services

PARTNER ECONOMY: **GERMANY**
ORGANISATION: **GEO9 PTY LTD**

INNOVATION STORY

2016 PRIMING GRANTS

MS MAYA SYDNEY

Some farmers turn to 'diviners' to locate water hidden in the subsurface, but with a team of geoscientists and the right technical equipment, the company Geo9 can expertly map groundwater on properties with sophistication.

"Farmers in Australia to this day rely on divining and random drilling as their fundamental starting point to look for water," Geo9 co-founder Maya Sydney says.

"And scientific solutions have, until now, generally been out of their reach in terms of cost and complexity. Since its inception in 2008, Geo9 has narrowed that gap."

The company is made up of exploration geologists, and the skillset they bring to the groundwater market is an explorative perspective of the subsurface.

"A lot of our work is in aquifer mapping and we've had considerable breakthroughs in the way we're using technology in this way," she says.

Aquifers – a unit of rock beneath the surface that holds or conducts water – are vital for Australian farmers as they often rely on groundwater to irrigate their crops during droughts.

Since Ms Sydney doesn't have a scientific background in geoscience, she says part of her job is to communicate their science to other non-specialists, typically farmers.

"I'm not trained as a geologist but I do happen to understand a lot of it now – and I love it. I think the role I play is being quite good at communicating the science in an accessible way for our customers," she says.

"It's one thing dealing with a geologist or engineer who may have some familiarity with geophysical aspects, but a farmer won't necessarily have that. I think I help breach that gap."

Some members of Geo9 recently travelled to Germany, thanks to Priming Grant funds, and met with the German Research Centre for Earth Sciences (GFZ) - an institute near Berlin that works on remote sensing for exploration of the subsurface.

"Those meetings with the scientists in Potsdam enabled this daisy chain effect with other German scientists who are also using the satellite data and combining it with other remote sensing data for minerals exploration," Ms Sydney says.

Their visit enabled Geo9 to build a strong body of contacts, and they're now better informed to use the data from the GRACE satellite on a critical metals exploration project. Ms Sydney says she has now signed a letter of intent to form a partnership with the German agency.

"It's an incredibly strong example of how well it's gone," she says.

"So, we have one collaboration underway and we have a few more in discussion, so the Priming Grant has been extremely beneficial."

Mining Equipment, Technology and Services

PARTNER ECONOMY: **REPUBLIC OF KOREA**
ORGANISATION: **WESTERN AUSTRALIAN SCHOOL OF MINES, CURTIN UNIVERSITY**

INNOVATION STORY

2016 PRIMING GRANTS

DR RICHARD ALORRO

Not all precious and coveted metals come from the subsurface. Dr Richard Alorro from Curtin University works in 'urban mining' where he sifts through industrial waste-products and end-of-life materials to extract useful metals.

"Normally industrial residue or waste-products, such as slag, spent photovoltaic cells and e-wastes are just dumped in the environment, but sometimes they contain valuable metals."

This technique is also known as recycling, as it's an opportunity to retrieve metals that were mixed in with the by-product of metallurgical process, like smelting.

The by-product of tin, for instance, can contain valuable metals such as niobium or tantalum (metals used for alloying and high temperature applications). These metals can be dissolved out with acid or other solvents, Dr Alorro says.

"If they're not recovered, they can be a source of environmental problems as well. It's attractive for both economic and environmental benefits," Dr Alorro says.

Dr Alorro was a successful recipient of a Priming Grant and used the funds to build a relationship between Curtin University and a South Korean SME involved in urban mining of precious metals.

The project bringing them together is developing a technique Dr Alorro researched in his PhD – using magnets to pull valuable metals from waste-product.

Dr Alorro says the company is creating technology to effectively retrieve precious metals from waste. Still at the development stage, the prototype is inefficient at sifting unwanted metals, like copper and iron, from the gold.

"The efficiency is very low when there are other impurity metals in the solution. They need a purification stage prior to the application of the technology," Dr Alorro says.

"We discussed applying the previous study I did to their purification stage."

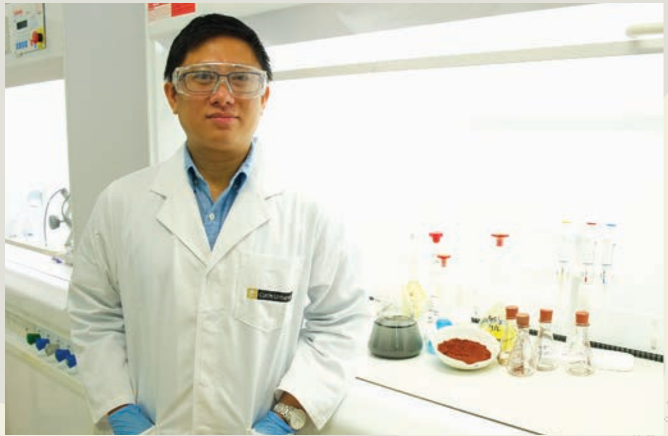
Dr Alorro explains that the Priming Grant allowed him to build this collaboration, and now the company will continue to fund the improvement of his technique – called Magnetic Solid Phase Extraction – for the next three years.

Dr Alorro is an expert on metallurgy – the production and purification of metals – and is based at the Curtin University's Western Australian School of Mines in the small rural town of Kalgoorlie.

Born in the Philippines, the 37-year-old moved to Australia in 2013 after living in Japan for eight years. He says living in Western Australia is exciting for mining research as the state is a hub for rare and valuable metals.

"We're a country driven by our resources sector and metallurgy plays a very important role here. We work closely with the mining industry," he says.

"Metallurgy is highly specific, so we can dig deeper and we can be more specialised."



GLOBAL CONNECTIONS FUND

The Global Connections Fund (GCF) is a component of the Global Innovation Strategy under the Australian Government's National Innovation and Science Agenda. The GCS enables Australian SMEs to link with international researchers and Australian researchers to collaborate with international SMEs to seize opportunities in priority areas of importance to the strategic growth sectors of Australia.

The GCF is comprised of two types of grants: Priming Grants and Bridging Grants. Priming Grants are small grants of $7,000 to enable Australian SMEs and Australian researchers to physically meet with their international partners and develop their collaborative ideas. Bridging Grants are larger grants (up to $50,000) designed as seed funding capital to enable viable projects to grow in scope and scale, to test commercialisation and proof of concept activities.

www.globalconnectionsfund.org.au

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The Global Connections Fund is a project of the Australian Academy of Technology and Engineering (ATSE) and is supported by the Australian Government.
This program forms part of the Global Innovation Strategy under the Australian Government's National Innovation and Science Agenda.