

Golden haloes and hidden riches

Dr Ray Smith discovered that traces of valuable minerals migrate from buried ore bodies into the overlying, weathered rubble and soils, known as laterites. These trace concentrations can form a halo over a buried deposit, up to 500 times larger than the concealed deposit at its heart. Such haloes provide a much easier exploration target than the relatively narrow, concealed deposit. Dr Smith's techniques have slashed exploration costs and dramatically sped up the process of mineral discovery.

The concepts were used in the discovery of the world class Plutonic and Bronzewing deposits in Western Australia, which have a combined resource of 10 million ounces of gold, and are valued at over \$2.8 billion. Laterite geochemistry is now well established as an exploration technique in Australia for a wide range of commodities, including diamonds, and in appropriate terrain overseas.

Mineral exploration research – constant support from a cyclical industry

Dr Ray Smith's research began as a solo effort. It grew from there to a collaborative effort with a medium-sized tin producer, went on to a tripartite arrangement with gold miners and eventually became an industry-wide collaboration involving thirty companies and a research team of fifteen.

The expansion was part of a long term research strategy. Dr Smith and the team he recruited and led, used the 2-3 year projects funded by industry to deliver tangible and useable research outcomes, but also ensured that they provided stepping stones toward their longer term objectives.

The minerals exploration industry is well known for boom and bust. Dr Smith drew the large industry consortium together against the backdrop of one of its toughest times: the 1987 share market crash and its aftermath, which sent shock waves through the industry. He achieved this by doing his homework on the companies that he approached for funding. He then presented them with a sound business case, based on the irresistible appeal of excellent science and an excellent team.

Project origins

Dr Ray Smith joined CSIRO in 1973 from the mining industry, where he had been working as the Exploration Manager for a multi-national mining company, Union Miniere. Dr Smith was committed to the minerals industry, but was attracted to CSIRO because of the research freedom and resources available to individual researchers at the time.

A key constraint on mineral exploration during the seventies, in many of the prospecting regions, was the presence of heavily weathered layers of gravel and soils, known as laterites. These laterites covered up to 80% of the bedrock, where minable

ore bodies might be located. Rocky outcrops that could be easily sampled for indications of underlying ore bodies, made up only 15-20% of the surface.

Dr Smith's brief on joining CSIRO was to look into this problem. How he did so, was left up to him. "I had a good track record from industry" he said "and in those days, we were pretty much left to pursue research in the area we agreed with our Chief, as we saw fit".

He began by investigating the geochemical signatures in a weathered rocky outcrop near the Golden Grove copper deposit, in the Murchison area in Western Australia, which had only been recently discovered. He found a range of trace elements at concentrations of a few parts per million in the outcrop indicative of the Golden Grove copper deposit. The persistence of this signature in the highly oxidised outcrop led him to examine whether the nearby laterites also carried chemical traces of the deposit.

"What was going through my mind was that if the laterites were a product of the weathering, rather than having been transported to the area, then maybe the signal would extend around the outcrop" recalls Dr Smith. "So I took samples from about twenty metres away from the outcrop." He also took samples from 200m to 800m away to establish background levels.

He found the signals he was looking for in the lateritic samples from nearby the outcrop. But he also found that the samples he had taken for background purposes appeared anomalous compared to what he had expected. This led him to carry out further sampling and he established that there was a discernible signal within the laterites from the underlying deposit across a circular area, with a diameter of about 1km.

"This led to a paradigm breakthrough," said Dr Smith. "What we had was a continuous signal from a concealed deposit over a wide area near the surface. It provided a means of detecting hidden ore bodies by sampling the overlying laterites. This was a much easier target than simply exploring small rocky outcrops, in the hope of seeing evidence of relatively narrow ore seams. The implications were enormous. I could see the potential of cutting exploration costs by as much as 95%."

Proving the technique

Dr Smith decided to test the concept on another deposit, subjected to different climatic conditions and hence differing weathering processes. It was possible that the effect could be washed out, or not occur, if the laterites were formed under different conditions.

He opted to test it in the region around the Greenbushes tin deposit in the south west region of Western Australia. He didn't seek the permission of the Greenbush Tin Ltd to take samples because it was fairly 'way-out' research. In any event, he wasn't required to because he was staying within road reserves and taking only shallow samples. At the time, however, he didn't actually know that for sure. After he and his

assistant had been collecting samples for a couple of days the company asked him to explain what he was doing.

“We managed to quickly clarify our rights with the local authorities and then we were able to deal confidently with the company. When Greenbush Ltd realised our legal position was sound, they became friendly and enquired about our research. We explained it and they expressed interest in seeing the results. When they saw what we had several weeks later, the company’s exploration manager’s eyes nearly popped out of his head.”

Dr Smith seized the moment. “I suggested that they might like to sponsor a research project within their exploration program – nothing grand, just paying the salary of a postdoctoral fellow for a couple of years, plus on-costs and operating expenses. They virtually pulled out the cheque book then and there.”

Winning wider industry backing

The initial trial applications project sponsored by Greenbushes Tin Ltd ran between 1981 and 1983 and led to the company locating a major lithium anomaly within its original deposit and an extension of the tin deposit.

Following a market downturn for tin and tantalum which squeezed Greenbush Tin’s revenues, Dr Smith and the company decided to bring in additional partners to take the research further. Dr Smith and the Exploration Manager of Greenbush Tin, Mr Roger Thomson, made presentations to a number of companies. “We went through stock exchange reports and identified some companies who were cashed up and were investing in exploration. Then we’d ring them up and invite them to a presentation, although we asked them to first sign a confidentiality agreement,” said Dr Smith.

This quickly led to the signing up of two new partners: St Joe Mining and Peter Lalor’s Sons of Gwalia. These two didn’t take much convincing once they’d seen the results. “The St Joe’s manager was onto the phone and fax that night to his parent company in the United States seeking the funds,” said Dr Smith.

The expanded research program ran until 1986. It led to discovery of small gold deposits, which the partners later sold and which have since been brought into production, the Johnston Range deposits. “They only made a small profit, because the deposits weren’t huge. From our point of view, though, the research was extremely valuable. It proved that there were recognisable geochemical patterns in the laterites at a regional scale from the gold deposits,” said Dr Smith.

It also led to some lucrative offers to take the research out of CSIRO and into a private venture. “I suppose now-a-days that CSIRO would positively encourage me to spin-off into a commercial venture” says Dr Smith. “But at the time, I thought this would be walking out on the organisation that had backed the initial research, for personal profit. I decided to stick with CSIRO.”

The industry backing for the research continued to grow. A consortium was organised under the auspices of the Australian Mining Industry Research Association

Limited (AMIRA). Despite the AMIRA organisation's backing for the concept, Dr Smith had to do a lot of the legwork to raise the money.

"We went through the company reports again and developed a hit list of those that had about \$5 million in cash and were actively exploring. Then it was a matter of putting on the suit and tie and making presentations. We always made sure we'd done our homework on each company. We'd point out that they were paying tax on the interest of the money they had in bank deposits. We'd then ask: 'are you aware that with the 150 per cent tax deduction and the current rate of company tax, the real cost to you of this research is only about a third of the funds you outlay?' This really grabbed their interest," said Dr Smith.

"We made a large number of presentations and there was always a time lag in the decision coming through. At one point, we were getting a bit tired of the whole process, but when I sat down and looked who were signing up, we were running at about 75% success rate. Given that each presentation only lasted about two hours and the sponsorships were \$60,000 each, we realised that the return on our effort was terrific. The tiredness then quickly gave way to a lot of satisfaction," recalled Dr Smith.

This stage of the project eventually drew in \$1.5 million from industry over 5 years.

The agreement involved CSIRO putting the database from the original regional research into the AMIRA consortium as an added incentive to participants. Some of the companies followed up the anomalies identified in this database.

Amongst these were Newcrest Mining and then Hunter Resources, Western Reefs and Equigold in the Mt Magnet region of Western Australia, leading to the Dalgarranga gold mining project and the Gilbeys deposits.

Results of the first stage of the CSIRO-AMIRA research project were taken up by Great Central Mines (GCM). They greatly assisted them in the discovery of the Plutonic Gold Deposit in 1988, located some 750km north north east of Perth. Continued exploration by Plutonic Resources has shown the deposit to be world class - some 9 million ounces of gold.

GCM was forced to sell the Plutonic deposit when they ran into financial difficulties as a result of the 1987 stock market crash. But they put proceeds back into exploration as well as further research into identifying haloes in laterites beneath alluvial plains.

GCM, literally, struck gold again. Application of the research findings and concepts involved greatly assisted the company to discover a second world-class gold deposit, the Bronzewing Deposit, located 350 km north of Kalgoorlie - some 3 million ounces of gold.

From individual to team research

By 1988, Dr Smith's team had grown to 15 people, including seven scientists. It was a multi-disciplinary team, including soil scientists, a geomorphologist, geologists, a numerical geologist and geochemists. The management demands were increasing. "We had to do a lot of project reports and a quarterly overview report to AMIRA. But I still managed to spend about 70 per cent of my time on the research," said Dr Smith.

The planning was also critical. "We had a clear view of where we wanted to go. We put our strategic plan up on the wall so that we were constantly reminded of the longer term objectives. It was important that we could demonstrate that we knew where we were going. It gave us a lot of credibility with the industry partners."

"It also helped prevent us from getting side-tracked. Our time horizon in the plan was ten years or more. The projects that we put up for industry funding were self-contained and ran for 2-3 years, but they were also predetermined steps toward our longer term objectives. We had to be disciplined about keeping our eyes on the bigger picture," said Dr Smith.

External shocks - the share market crash in 1987

Dr Smith faced a major upheaval just as the AMIRA consortium was being brought together. In October 1987, the share market collapsed. The mining exploration industry was one of the sectors worst hit by the shock wave. Four of the companies in the consortium went bankrupt and many others, including Great Central Mines came under severe pressure over the next couple of years as the aftershocks brought down some of the larger-than-life entrepreneurs for which the 80's are remembered.

Dr Smith says it was a nervous time for many in the industry. "But despite the turmoil, our level of funding continued to increase as more companies joined the consortium. In fact, our project funding continued to double every 18 months. Companies like Great Central Mines may have been selling assets, but they continued to back the project, showing just how much they valued what we were doing."

"Ultimately," he says "we had excellent science and an excellent team. My experience tells me that when you've got that, industry will back you, even during difficult times."

Maintaining the strategic knowledge base

Dr Smith has continued to build on his success. The use of lateritic haloes in exploration in deeply weathered terrain is now an industry norm in Australia and is widely established overseas.

Also widely used are the generic approaches of regolith mapping, regolith stratigraphy, and geochemical dispersion models established for Western Australia's complex lateritic environments arising from several CSIRO-AMIRA research projects.

The contacts made during these AMIRA projects led to a successful bid to establish the Cooperative Research Centre for Landscape Evolution and Mineral Exploration (CRC LEME), which Dr Smith now leads. The CRC is a joint venture between CSIRO, the Australian National University, the University of Canberra and the Australian Geological Survey Organisation. It has industry funding of \$1.5 million per annum.

A priority for the CRC LEME is to develop the base of strategic science. “We use the CRC grant money for strategic science, rather than short term research. We are attempting to extend the knowledge base of landscape evolution to aid the discovery of concealed, world-class ore bodies – just as CSIRO supported my original research in the 1970s” commented Dr Smith. “Industry understands that it will be the ultimate beneficiary”.

Already the CRC has had some success. One of its research teams, led by Dr Charles Butt, has done work in calcrete geochemistry that has some parallels with the laterite geochemistry undertaken by Dr Smith in terms of the flow of pilot research, applications trials and the time scale (a decade or more) for diffusion into industry. Calcrete geochemistry is already being applied successfully in the Gawler Craton of South Australia, one of Australia’s most exciting new gold provinces.