Adding value to exploration – Reducing time and cost to discovery in Western Victoria

L. Jonathon Dugdale
Exploration Manager, Eastern Australia, MPIMines
jdugdale@sgm.mpimines.com.au

Predictive mineral discovery in Western Victoria

The adage “Gold is where you find it” is effectively an indictment on the gold exploration industry. The industry has been driven by empirical exploration for 25 years and depended on luck to gain genuine success.

As a small-medium company MPIMines cannot afford to depend on being the “lucky company”. Most small-medium sized companies go broke eventually. Exploration as a whole is a loss making business.

To quote our former Managing Director, the late Ken Fletcher, “Jon, we cannot afford to grid drill our prospects under cover – we’ll go broke before we find the orebody”. In other words, he was challenging us to deliver a step change reduction in our time and cost to discovery.

This is the reason MPI became involved with the predictive mineral discovery CRC. Our objectives as a company were aligned with the “mission statements” of the pmd*CRC. Our expectations of the pmd*CRC were not that we were buying into “silver bullet” exploration techniques, but rather, a commitment to the development of predictive models augmented by cutting edge techniques that could be melded into exploration programs in order to reduce the time and cost to discovery.

The case history presented below from the Stawell Corridor, in Western Victoria, illustrates how the location of concealed gold ore-bodies can be predicted both within active mining centres and under barren cover sequences. This is an active case history.

Gold Discovery at Stawell

The Stawell Gold Mine is located in Western Victoria, Australia (Figure 1). Stawell is an historic Goldfield having produced 2.7 Million ounces of gold between 1853 and 1926. No further mining took place until 1982 when Western Mining Corporation and Central Norseman Gold Mines in joint venture re-opened the mine commencing the Magdala Decline and Wonga Open Cut. WMC operated the mine until 1992 when the current owners Mining Project Investors Pty Ltd (MPI) in joint venture with Pittston Mineral ventures purchased the operation and one exploration tenement to the north. MPI, now MPI Mines Ltd., purchased Pittston’s interest in the joint venture at the end of February 2004. Since MPI’s involvement from 1992, the mine has produced over 1 million ounces of gold and discovered over 2.2 million ounces into resources. This brings the total hard rock endowment of the Stawell Goldfield to over 5 million ounces of gold.

The discovery of additional resources at Stawell, in particular the Golden Gift, has been in large part a predictive mineral discovery story. It was recognised that the steeply plunging Magdala orebodies systematically repeat down the western flank of the moderate northerly plunging Magdala basalt dome. This led to continued prediction and discovery of new ore-shoots down plunge. However, the available target area decreases down plunge above the South Fault. Exposure of the South Fault underground clearly indicated that the South Fault was post-ore

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and that the remainder of the ore system should be present below the South Fault, somewhere. It was also recognised that the north plunging Magdala dome was the northern part of an offset doubly plunging basalt dome, the remaining south plunging end of which lay below the South Fault.

A long established research relationship with the University of Melbourne, through Professor Chris Wilson, was called upon to help solve the movement sense and extent of displacement on the South Fault and find the offset ore system. This initial work, by Dr John Miller, indicated that the South Fault offset had an early southwest component of movement followed by later west directed transport (Miller, et al 2001). This information was combined with results of Magnetic modelling by geophysicist Kim Francombe and a best case scenario for the southern end of the offset doubly plunging dome was presented. The first drillhole, MD 2064, intersected mineralised “volcanogenics” and basalt immediately below the South Fault at –910m RL, producing an intercept of 3.2m @ 4 g Au/t. A second hole, MD 2122, was drilled further east and intersected basalt below the South Fault until holes end at 1250m below surface. A third hole, MD 2167, drilled during October 1998 was angled between these holes and intersected three repeated zones of mineralised volcanogenics with visible gold, located below the South Fault on basalt contacts. Intersections of 16.2m @ 5.15g Au/t, 19.0m @ 7.21 g Au/t and 2.85m @ 7.12 g Au/t were produced. Follow up drilling on four approximately 300m spaced sections scoped a mineralised zone ~1200m long and 300m deep from -900m to -1200m below surface, representing approximately 1 million scoped ounces. Resource definition drilling has so far defined 650,000 ounces of indicated and inferred resources (Figure 2). Development of the Golden Gift has recently commenced.

**Exploration and Discovery in the Stawell Corridor**

Interpretation of aeromagnetic and gravity imagery indicates that the Stawell Corridor passes under cover north of Stawell and continues under cover of deepening Murray Basin sediments as far as 150km north of Stawell, west of Warracknabeal. This recognition by MPI was followed by the consolidation of contiguous exploration licences over a 140km strike length of the interpreted northern extension of the Stawell Corridor (Figure 1).

It was recognised that successful exploration within buried portions of the Stawell Corridor would require a well researched predictive model. Previous grid RAB drilling and some diamond drilling of regional structures had failed to enhance targets and although initial trialling of surface geochemical techniques appeared to produce encouraging results this was also abandoned in favour of a predictive model based on detailed characterisation of the Stawell orebody and remote detection of key characteristics using geophysics.

The key predictive characteristic of the Stawell orebody is an association between the ore-system and a large tholeiitic basalt unit – the Magdala Basalt (Vandenberg et al., 2000). The northwest trending Magdala Basalt dome has a doubly plunging 1km wide unit of basalt in its core and is over 3km long. It is enveloped by a package of sulphidic, iron enriched, sedimentary rocks termed “volcanogenics” that host the majority of the ore-grade mineralization. Ore formation was associated with brittle re-activation and hydrothermal fluid flow along major reverse fault systems mostly localised on the western flank of the Magdala Dome (Miller et al., 2001), such as Central Lode. Fluid flow modelling within the predictive mineral discovery CRC program has demonstrated that the geometry and of the basalt dome and the contrasting rock properties between the basalt, “volcanogenics” and Mine Schist are the main controlling factors controlling the location of (D4) ore shoots at Stawell (Schaubs., et al 2004). Other factors such as chemical controls will be the subject of further work. However, this demonstrated association between the Magdala Dome and the ore bodies at Stawell is enough to present a powerful primary targeting tool.

The second stage in the development of the predictive model was the characterisation of the key geological elements of the Stawell ore system. It was known from previous WMC
petrophysics that Magdala basalt and “volcanogenics” were magnetic. “Dome shaped” magnetic anomalies within 5km west of interpreted extensions of the Coongee Break were selected as priority targets. The Wildwood dome, 2km northwest of Stawell, had been previously drilled by WMC and was known to be similar to the Magdala dome and also mineralised on the east flank (e.g., WLWD 113 : 15.1m @ 2.8 g Au/t). Other targets selected during this first phase included Caledonian, Wal Wal, Lubeck, Ashens, Jung, Byrneville, Kewell, Wallup and Cannum for a total of 10 conceptual domes. The Kewell target in particular was highlighted, pre drilling, in an internal memo on the 12th August 1998: “The similarity (to Stawell) is striking. The likelihood of mineralization being present in volcanogenic sediments on the western margin of the dome……. is considered to be high” (Dugdale, 1998).

Aircore drilling was selected as the principle tool for collecting bedrock samples for lithology and geochemistry. Initial testing was “highjacked” by the need to test empirical surface geochemical “anomalies” that turned out to be spurious. It was not until aircore hole MAC 42 that the centre of the Kewell magnetic target was tested. Basalt of the Magdala style was intersected and the contacts were subsequently tested with close spaced drilling in order to locate mineralised volcanogenics. On the 3 April 2000 MAC 057 intersected mineralised volcanogenics on the western flank, with a peak result of 6m @ 1.67 g Au/t from 121m including 1m @ 5.30 g Au/t.

Subsequent aircore drilling, on 400m spaced traverses, defined a 3km long, apparently doubly plunging, truncated basalt dome with mineralised volcanogenics on both flanks. An initial program of two diamond drillholes tested under the peak gold in aircore results producing a technically successful result confirming the presence of volcanogenics of the Magdala style in KD001 and a laminated quartz reef and volcanogenic hosted basalt contact mineralisation including 0.5m @ 1.6 g Au/t in KD002.

Despite the lack of an ore-grade intercept, these initial drill tests were considered technically successful, representing confirmation of the original geological concept. However, it was recognised that with a limited exploration budget the next round of diamond drill holes would need to produce an ore grade intercept for the prospect to survive. This would require additional research in order to develop sophisticated ranking criteria for selecting specific drilling targets in order to reduce the time and cost to genuine discovery. Two parallel approaches were taken; firstly, the initiation of an internal study to geochemically characterize the Stawell ore system and, secondly, MPI became an initial sponsor of the predictive mineral discovery CRC in order to gain access to cutting edge fluid-flow modelling technology.

Geochemical characterization of Stawell produced a series of mineralisation indices to be applied to regional aircore drilling, so that sparse sampling could be ranked using an ICP suite of correlating elements, which is using more than just gold.

Within the pmd*CRC, a specific research project, T1, was initiated, focusing on western Victoria. Additional geophysical data were collected over key prospects, including Kewell. In particular, detailed gravity data proved a very effective filter for basalt domes versus other magnetic features. Inversion modeling of gravity and magnetics assisted construction of 3-dimensional basalt dome models. Finite element meshes were then constructed for numerical simulation modeling of fluid flow and dilation at the time of mineralisation (Schaubs et al., 2004). Stress orientations and rock properties were as determined through previous Stawell ARC research. The combined results of ENE-WSW + E-W compression produced generally high fluid flow on the upper shoulders of the dome, particularly the shallow plunging WSW flank and steeply plunging ENE flank (Schaubs., et al 2004). Dilation was concentrated on the upper shoulders of the dome. The intersection of these areas of high fluid flow and dilation with the interface are a 1.6km long zone on the SW flank and a smaller zone on the northern nose (Figure 3). These zones are coincident with elevated aircore geochemistry.

The results of the geochemical characterization and fluid flow-dilation modeling were combined to produce specific diamond drilling targets. The first target selected for drilling was the
southern end of the dome on section 5967600mN. Drillhole KD003 intersected a brecciated quartz lode followed by a thick section of mineralised volcanogenics including a basalt bound “Waterloo” with visible gold, on a shallow west dipping basalt contact. Intersections included 4.2m @ 3.46 g Au/t from the hangingwall lode and 4.1m @ 12.6 g Au/t from the Waterloo (Figure 4).

Further drilling is in progress and time will tell whether Kewell is a significant discovery. However at this early stage it appears this may represent the first new goldfield discovery in Victoria for over 100 years and is an example of reducing time and cost through predictive mineral discovery. It is estimated that in both the Golden Gift and Kewell examples the application of predictive mineral discovery techniques has at-least halved the number of critical early stage diamond drillholes required to make the discoveries.

Figure 1. Stawell Corridor and targets, Western Victoria
Figure 2. Stawell Mineralised System, Longitudinal Projection

Figure 3. Kewell Dome Fluid Flow Model, looking north
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References


