THE DISCOVERY HISTORY OF THE NORTHPARKES DEPOSITS

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Abstract

Porphyry copper-gold mineralisation was discovered in the Northparkes area in 1976 when one kilometre spaced roadside traverse drilling by Geopeko intersected the E22 deposit. Grid based RAB drilling discovered the E27 and E26 deposits in 1978 and 1980 respectively. Testing of a discrete magnetic target with co-incident copper geochemistry in 1992 led to the discovery of the E48 deposit. Sub-vertical quartz monzonite porphyries intrude the host volcanic sequence, with mineralisation and alteration zoned around these porphyries. Production at Northparkes commenced in 1993 and the operation has produced 490,000 tonnes of copper and 691,000 ounces of gold to the end of 2005. Exploration continues today with the aim of extending the current mine life.

Introduction

Northparkes Mines is a copper-gold mine located at Goonumbla, approximately 27 kilometres north / north-west of the town of Parkes in Central West New South Wales, Australia. The mine is a joint venture between Rio Tinto (80%) and the Sumitomo Group (20%).

Porphyry copper mineralisation at Northparkes was discovered in 1977 and open cut mining at Endeavour 22 (E22) and Endeavour 27 (E27) commenced in 1993. Production from the Endeavour 26 (E26) underground mine commenced in 1996, employing the block cave mining method.

In 2005 the operation processed 5.5 Mt of ore from the E26 underground block cave mine, the E27 open cut and oxide ore stockpiles. Since July 2005, the E26 underground block cave mine has been the sole supplier of ore to the mill. The Endeavour 48 (E48) orebody is currently subject to a Feasibility Study, and an Exploration Drive is being developed to further assess the characteristics of the deposit. A decision to proceed with development is anticipated in October 2006.

At 31 December 2005, the operation had produced 490,000 tonnes of copper and 691,000 ounces of gold, and had ore reserves of 52.2 Mt grading 1.1% Cu and 0.5g/t Au for underground block cave mining and 3.75 Mt grading 0.67% Cu and 0.58 g/t Au of stockpiled open cut ore, sufficient for a further 11 years of production.

Northparkes produces a high grade copper-gold concentrate. This product is shipped to smelters in Japan, China and India under long term supply contracts.

Geology

The Northparkes deposits occur within the Ordovician Goonumbla Volcanics of the Goonumbla Volcanic Complex (Simpson et al, 2000). The Goonumbla Volcanics form part of the Junee-Narromine Volcanic Belt of the Lachlan Orogen (Glen et al. 1998). At Northparkes, the Goonumbla Volcanics are a folded sequence of trachyandesitic to trachytic volcanics and volcaniclastic sediments that are interpreted to have been deposited in a submarine environment.

In the Northparkes region the Goonumbla Volcanics have been intruded by equigranular monzonite stocks. Quartz monzonite porphyry pipes and dykes, some of which are associated

with mineralisation, have intruded both the Goonumbla Volcanics and the equigranular monzonite stocks.

The Northparkes deposits are typical porphyry copper systems in that the mineralisation and alteration are zoned around quartz monzonite porphyries. The porphyries form narrow (typically less than 50 metres in diameter) but vertically extensive (greater than 900 metres) pipes. Mineralisation extends from the porphyries into their host lithology. The E26 and E48 deposits range from 60 to 400m in diameter (>0.4% copper) and extend vertically for more than 900m.

Sulphide mineralisation occurs in quartz stockwork veins, as disseminations and fracture coatings. Highest grades are generally associated with the most intense stockwork veining. Sulphide species in the systems are zoned from bornite-dominant cores, centred on the quartz monzonite porphyries, outwards through a chalcopyrite-dominant zone to distal pyrite. As the copper grade increases (approximately >1.2% Cu), the content of covellite, digenite and chalcocite associated with the bornite mineralisation also increases. Gold normally occurs as fine inclusions within the bornite.

The alteration zonation is complex but tends to be zoned around the quartz monzonite porphyries with a central K-feldspar altered zone surrounded by biotite magnetite alteration. The K-feldspar alteration zone at E26 is well developed and extends up to 100 metres outboard from the porphyry. This is in contrast to E22, E27 and E48 where K-feldspar alteration is generally less than 10 metres outboard from the porphyries. The biotite magnetite zone is strongly developed at the E22, E27 and E48 deposits, and forms a zone up to 200 metres from the porphyry. It is this biotite-magnetite zone that forms the distinctive annular magnetic features at E22 and E27.

A central white sericite-quartz +/- alunite alteration zone occurs at E26, and to a lesser extent at E48, and is generally associated with the high grade zones within the deposits (Wolfe, 1994, Wolfe et al, 1996; Harris & Golding, 2002). At E48, an alteration assemblage of hematite-sericite+/- carbonate occurs both within and proximal to the mineralisation.

All of the Northparkes deposits are cross cut by late faults/veins filled with quartz-carbonate+/-gypsum, anhydrite, pyrite, chalcopyrite, sphalerite and galena. The associated sericite alteration extends up to 10 metres from the fault.

Oxide mineralisation blankets were well developed over the E22 and E27 deposits. The upper blanket was gold rich and copper poor. The lower blanket was enriched in copper by supergene processes. The dominant copper oxide minerals at E22 and E27 were copper carbonates (malachite and azurite) and phosphates (pseudomalachite and libethenite) with lesser chalcocite, native copper, cuprite and chrysocolla. A gold poor, less well developed, supergene copper blanket was also developed over the E26 deposit. At E26 the oxide copper minerals included atacamite, clinoatacamite and sampleite, in addition to those copper minerals observed in E22 and E27.

The Goonumbla Volcanics at Northparkes have undergone little deformation, with gentle to moderate bedding dips as a result of regional folding. The dominant structure observed to date in the Northparkes area is the Altona Fault, an east dipping thrust fault, which truncates the top of E48, and is known to extend from east of E26 to east of E27.

Discovery History to 1998

Geopeko commenced exploration in the Northparkes district in 1972 assessing the potential for VHMS hosted Pb–Zn deposits in the submarine volcanics of the Goonumbla Volcanic Complex. Regional mapping and rock geochemical sampling discovered outcropping lead-zinc skarn mineralisation in 1973 at the Endeavour 7 prospect. Several more prospects were identified before 1975 when mapping and sampling of outcropping areas was complete. An aeromagnetic survey was flown in 1974 to extend coverage in areas of cover to the north.

Exploration efforts remained focussed on VHMS style deposits, however the identification of skarns had demonstrated the importance of intrusive related mineralisation. In 1975 a

programme of regional scale auger-core drilling was commenced along public roads perpendicular to the regional strike. This technique had been successfully used in the Ranger Uranium field in the Northern Territory to obtain a sample of core from beneath thick soil cover for geological and geochemical analysis.

In the summer of 1976 a traverse of auger-core holes, at 1 kilometre centres, was conducted along Adavale Lane. Drill hole ACH697-21, located in the eastern side of what is now the E22 open pit, intersected pink K-feldspar alteration and minor chalcopyrite-bornite mineralisation in the 2 metres of drill core, assaying 0.25 % Cu. Follow-up RAB drilling defined a large Cu-Au anomaly and in 1977 a diamond hole was drilled beneath the peak of the anomaly, returning 229 metres at 0.61 % Cu and 0.67 g/t Au from 65 metres. Follow-up drilling of weak copper anomalism (0.15 % Cu) in the auger-core hole 1 kilometre to the east of E22 was undertaken and resulted in the E27 discovery in 1978.

Regional mapping and rock chip sampling continued in 1978. Quartz-malachite veined monzonite was mapped at the E28 prospect, 2 km south east of E22. Quartz-sericite altered outcrops were sampled in the vicinity of what is now E26, however these returned low geochemical values. Southerly extensions of the E28 RAB drilling grid identified a bedrock copper anomaly over the E26 deposit (originally the E26N prospect) in 1980. The first diamond drill hole to test the anomaly, DDH26, returned 441 metres at 0.67 % Cu from 63 metres depth.

In 1992, based on recently acquired 120 metre line spaced aeromagnetic data, a magnetic targeting programme was completed by Stolz (1992) using the signatures of the known deposits. Magnetic target MT9, located midway between E26 and E27, in part had a coincident copper geochemistry anomaly and was selected for drill testing (Hooper et al, 1996). The first reverse circulation drill hole, MT9RP1, returned an intersection of 83 metres at 0.95 % Cu and 0.15 g/t Au from 49 metres to end of hole.

Exploration between 1978 and 1998 led to the discovery of additional porphyry systems at E20, E22 North, E28 North, E31 North, E37, and E37 West. All these systems were discovered by RAB drilling with the exception of E37 West which was a discrete magnetic high target located immediately west of E37.

Mine Development History

North Limited approved development of Northparkes Mines in November 1992, 15 years after the first discovery was made, based on open cut mining of E22 and E27 and underground mining of E26. The aggregate 'Mining Reserve' was 64.1 Mt grading 1.31% Cu and 0.60 g/t Au of sulphide ore, 1.68 Mt grading 1.95 g/t Au of oxide gold ore and 1.66 Mt grading 1.10 % Cu and 1.34 g/t Au of oxide copper-gold ore.

Development was staged with initial production in November 1993 from the E22 and E27 open pits and later from the E26 underground block cave mine in 1996. The ore processing plant comprised two modules and began treating oxide ore from E22 and E27 in April 1994. Module 1 processed oxide gold ore at a rate of 1.5 Mtpa using CIP recovery from April 1994 until September 1995, producing 74,000 oz of gold. The flotation circuit was commissioned in September 1995 when Module 1 switched to sulphide ore at an increased rate of 2 Mtpa and Module 2 began processing oxide copper-gold ore at a rate of 2.6 Mtpa. In January 1996 both circuits processed sulphide ore, reaching the combined design capacity of 5 Mtpa in 1997 and record production of 5.5 Mt in 2005.

Construction of the E26 underground block cave mine, Australia's first, commenced in October 1993. The initial mine, Lift 1, was designed to extract ore to 480 metres below the surface, based on a reserve of 28.7 Mt @ 1.45% Cu and 0.39 g/t. In 1997 Lift 1 reached its design production rate of 3.9 Mtpa and become the world's most productive underground hard rock mine, producing 42,600 tonnes of ore per underground employee year (including contractors). Productivity peaked in 2000, reaching over 50,000 tonnes per employee.

Construction of the second block cave mine to extract ore between 480 and 830 metres below surface, E26 Lift 2, was approved by the Joint Venture partners in 2001 and development was completed in 2004. Full production ramp up to an annualised production rate of 5.5 Mtpa was achieved in 2005.

As production from Lift 1 declined, stockpiled ore from the earlier open cut mining campaigns was processed. Open cut mining resumed in both E22 and E27 in July 2000 to maintain the mill at full capacity during the transition to Lift 2, with mining completed in June 2002. The most recent opencut mining campaign in E27 commenced February 2003 and ceased in August 2005.

Production from Lift 2 is expected to wind down from early 2009, coinciding with the initial production from E48. E48 is currently subject to a Feasibility Study and, subject to approval, is scheduled to commence production in 2009, extending the mine life to 2016.

Northparkes Mines Exploration

All exploration activities in the Northparkes area were conducted by the corporate exploration groups of Geopeko and North Limited until 1998. In December 1998 the North Limited Exploration Group withdrew from the Northparkes area as they considered the potential for discovery of deposits consistent with corporate objectives low (Lew, 2003).

Northparkes Mines considered exploration could add value to the business unit and committed to fund exploration internally from 1999. The primary objective of exploration was the delivery of another 'E26', however the value of modest discoveries and incremental ore from the existing deposits was also recognised. The value of continuing near mine exploration was also recognised by Rio Tinto following the acquisition of North Limited in September 2000 (Lew, 2003).

The Northparkes Mines exploration programme initially involved extensive compilation of all existing geological, geochemical and geophysical datasets (Lew, 2003). Exploration efforts were subsequently focused on understanding the deposit characteristics, in particular their mineralisation and alteration halos (Lew, 2003).

The exploration efforts since 1999 have led to the discovery of four new porphyry systems within 6 kilometres of the existing infrastructure (Veedas, Hopetoun Gold, Brazen and GRP314).

A discrete magnetic high target, 1 kilometre north-east of the E37 prospect, was identified following the acquisition of 25 metre line spaced aeromagnetic data in 2000. Drill testing led to the discovery of the Veedas porphyry system.

Hopetoun Gold was discovered in 2002 by drill testing a multi-element bedrock geochemical target, following a review of historical bedrock geochemical data.

Construction of the Lift 2 infrastructure provided the opportunity to explore beneath the Altona Fault north of E26 towards E48. The Brazen system, located blind beneath the Altona Fault, was found following lateral underground drilling in 2002, and application of the improved understanding of the mineralisation and alteration halos.

The identification of the Brazen system further highlighted the prospectivity of the untested ground beneath the Altona Fault. A programme of reverse circulation drilling was conducted to explore beneath the Altona Fault south of E48 to E26. This programme led to the discovery of the GRP314 system, located only 1km from E26, in 2004. Exploration programmes continue to assess GRP314.

Recent exploration efforts have also added incremental tonnage to the E26 and E48 resources. The potential for additional mineralisation at E22 is currently being re-evaluated.

As the Northparkes area matures new and innovative technologies are being developed to better locate mineralised systems. These technologies will be applied to test new targets and also to re-assess old prospects. Recent exploration activities have provided extensive deep drill coverage

in the mine corridor. Updating and refining the three dimensional geology model within the mine corridor, in conjunction with an improved understanding of known systems, will help direct future exploration.

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