



Northern Star Plutonic Operations

Fact Sheet

Location and Climate

Plutonic Gold Mine Operations is located approximately 850km NNE of Perth in the Eastern Gascoyne region of Western Australia, 180km NE of Meekatharra. The mine, which commenced production in 1990, is currently owned by Northern Star Resources Limited (ASX: NST).

The Plutonic tenement package comprises 18 Mining Leases, 1 Prospecting Licence, 10 Miscellaneous Licences and 1 Petroleum Pipeline Licence, all covering 20,871ha of land. The Plutonic operation also includes two pastoral leases: Bryah & Three Rivers Stations covering ~499,401ha of land.

The climate is classed as semi-arid with a historic annual rainfall of ~236mm per year. Average monthly rainfall data recorded at stations in the region indicate moderate seasonality, with higher average monthly rainfall totals during the summer months (peak period January to March), early winter rains and a dry spring (August to October).

Average maximum temperature in January is 40°C and for July is 25°C.

Average minimum temperature in January is 23°C and for July is 5°C.

History of Ownership

The significant historical events of the Plutonic project can be summarised as follows:

- In the 1970s, International Nickel Company (Inco) undertook nickel exploration over the Plutonic Well Greenstone Belt and abandoned the area in 1976 after failing to identify an economic nickel deposit.
- In 1986, Redross Consultants Pty Ltd (Redross) was granted an Exploration Licence over the southern portion of the Plutonic Mining Lease. Titan Resources NL (Titan) commenced exploration in the area surrounding Marymia Hill.
- In 1987, Redross optioned the Plutonic Exploration Lease to Great Central Mines (GCM). Resolute Resources Ltd (Resolute) and Titan entered into a joint venture over the Marymia Hill leases. Battle Mountain Australia (BMA) commenced exploration in the Plutonic Bore area. Stockdale Prospecting Ltd conducted a regional sampling program in the vicinity of Marymia Dome.
- In 1989, GCM sold the Plutonic lease to Pioneer Minerals Exploration who changed their name to Plutonic Resources Limited.
- In 1990, the Plutonic Gold Mine opened, with open-pit production from the Plutonic Main Pit.
- In 1991, Plutonic Resources and GCM purchased the adjacent "Freshwater" property from Horseshoe Gold Mine Pty Ltd and commenced reverse circulation (RC) drilling of previously identified targets and a regional geochemical program.
- In 1992, mining was commenced in the K1 and K2 open pits by Resolute Samantha Ltd.
- Mining of satellite open pit deposits away from the Main Plutonic Mine by Plutonic Resources commenced in 1993 when mining started in the Salmon deposit, followed by mining at Perch in 1996 and Area 4 (open pit for Plutonic East Underground) in 1998.
- Joint venture partners Resolute and Titan purchased mining leases from BMA in 1993, and started production at the Triple P open-pit with treatment at the Marymia Plant.
- Plutonic Gold Mine underground development started in 1995 with production commencing in 1997.
- In 1998, Homestake Mining Company acquired Plutonic Resources and Homestake Gold of Australia Limited bought all of the Marymia property and assets from Resolute.
- Homestake Mining (USA) merged with Barrick Gold in 2001.
- In August 2010, Barrick Gold Plutonic Ltd sold many of the Marymia and Freshwater tenements to Dampier Gold Ltd.
- On 23 December 2013 Northern Star Resources announced the acquisition of the Plutonic Gold Mine for A\$25M, Northern Star commenced operation of the mine on 1 February 2014.

History of Exploration

Inco conducted nickel exploration in the "Crows Nest Well" Project between 1969 and 1976 using soil geochemistry, geophysics, costeaning, rotary air blast (RAB), and reverse circulation (RC) drilling. Although no



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economic nickel was discovered, Inco were the first to identify and record the greenstone rocks within the Plutonic Well Greenstone Belt in 1976 (PWGB).

Gold exploration was undertaken across the PWGB concurrently between 1987 and 1999 by a number of companies across the Plutonic, Freshwater and Marymia tenement group areas.

In 1987, exploration work on the Plutonic tenements undertaken by BMA (as GCM) identified an arsenic and gold anomaly by geochemical sampling in the Plutonic tenements. Grid based mapping, soil and lag geochemical surveys followed which led to the discovery of the Plutonic deposit (Bucknell, 1995). The satellite open pit operations, Area4 and Channel, were also discovered in 1990 by geochemical sampling work undertaken by BMA (as GCM) and are located 4km east of the Main Pit. Both were mined between 1999 and 2001, and produced a total of 0.13Mozs.

Exploration work on the Freshwater Tenements between 1990 and 1995 by Plutonic Resources Exploration Division discovered a total of 1 underground and 30 surface prospects. Follow up resource definition drilling resulted in conversion of these prospects to 10 open pits and one underground mine on the Freshwater tenements, including Area 4 open pit (123,619oz prod) and the Plutonic East underground deposit, Salmon (192,953oz prod), Trout (28,167oz prod), and Perch (106,105oz prod). All of these open pits mines are located on the current Northern Star Resources tenement package.

On the Marymia tenements, exploration commenced in June 1988 by Resolute (75%) and Titan Resources NL (25%), with gold mineralisation first discovered in the Keillor Shear Zone following regional exploration soil, stream sediment and rock chip sampling and geological mapping. This work was followed by several phases of RAB, AC, RC and diamond core drilling to define the resources. Exploration became more focused with the discovery of the Keillor 1 (K1) deposit in 1989. A number of prospect scale geophysical surveys including magnetics and gradient array IP were undertaken between 1989 and 1994 by Resolute.

BMA carried out exploration between 1987 and 1993, and in 1992 discovered the Triple P deposit as a result of regional mapping, Bulk Leach Extractable Gold (BLEG) soil sampling, and RAB drilling. BMA followed up with RAB drilling in 1992 and discovered three deposits: Pelican, Albatross and Flamingo. Further RAB, Air Core (AC), RC and diamond drilling programs were conducted to define the deposits. Seven phases of drilling were undertaken including five RAB phases, one diamond drill phase and one RC phase and further defined A, B, and C zones.

In 1999, following acquisition of all tenements in the PWGB, Homestake Gold of Australia undertook acquisition of a detailed aeromagnetic and radiometric survey over the entire lease area. Additional IP and moving loop geophysical surveys were undertaken by the Homestake Exploration group between 2000 and 2004 across a number of prospects. The largest of which was across the K1-K2 project area in 2004.

In 2004, the Plutonic Development department undertook a large soil sampling programme over the north-western end of the Marymia tenements, in conjunction with the IP survey. These surveys identified a number of targets that were followed up with some additional surface geochemical sampling; however no additional drilling was undertaken in these areas.

Between 2001 and 2007 exploration and resource definition drilling by RAB, RC and diamond core drilling was undertaken by the Plutonic Development department across numerous prospects outside of the Plutonic Mine area. Many of these drilled prospects were proven up to become small satellite open pit mines such as Triple P B-Zone, Albatross, Flamingo, Kookaburra, Ibis, Piranha, to name a few.

Between 2009 and 2012, RC and diamond core drilling concentrated on extensions to the known Plutonic deposit. Outside of this area two 2D seismic lines were shot in conjunction with Curtin University and diamond core drill was undertaken at Plutonic West and Cod prospects.

Processing History

Plutonic Gold Mine established a processing plant in 1990, with the milling circuit and support infrastructure built on the mining lease to begin processing operations in July 1990 through to the present day.

The milling circuit constructed by JR Engineering had a SAG mill and ball mill supported by a single toggle jaw crusher and CIL to process the oxide ore. The workforce was housed at the newly constructed Plutonic Accommodation Village only 2km from the processing plant.



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In 1994 the Plutonic processing plant underwent a substantial upgrade with the addition of another ball mill and a three-stage primary ore crushing circuit raising capacity to 2.0mtpa. At this time it was decided to build a gas fired power station to power both mining and processing operations across the site and place the diesel power station on a backup role. The foresight of this decision would provide great benefit over the future years.

In 1998 the Paddy's Flat processing plant was moved from Meekatharra to Plutonic to enable the processing of oxide and laterite ore from numerous satellite pits within the mining lease expanding production to over 2.5mtpa. The standout year from a production standpoint was 2003 when over 330,000 ounces were produced. This second plant operated for 7 years before being placed on care and maintenance when mining supply was exhausted. The process plant now operates on a two mill configuration with an ability to increase through-put should demand require.

To date the Plutonic operation has processed over 50M tonnes of ore (at 3.20gpt average from open pit and underground ore sources) and poured over 5.0M fine ounces of gold since operations commenced.

Geology

Plutonic is located within the Archaean Plutonic Well Greenstone Belt, an elongated northeast trending belt within the Marymia Inlier. The Marymia Inlier is an Archaean basement remnant within the Proterozoic Capricorn Orogen comprising two mineralised greenstone belts (Plutonic Well and Baumgarten), with surrounding granite and gneissic complexes. The Capricorn Orogen is situated between the Pilbara and Yilgarn Cratons and is possibly the result of the oblique collision of the two Archaean cratons in the early Proterozoic.

Dating thus far indicates a Yilgarn-type age for rocks of the Plutonic Well Greenstone Belt. McMillan, 1996 interpreted ages of 2.72Ga and 2.69Ga of surrounding granitoids and porphyry intrusions within the greenstones in the Marymia District and Pb isotopic compositions of galena in mineralised zones at the Marymia and Triple P deposits consistent with the circa 2.63Ga mineralising event in the Yilgarn Craton. Previous workers have attempted to correlate the Marymia Inlier to the West Yilgarn, Southern Cross, and Eastern Goldfield super-terrane, however, large discrepancies exist with all three, including age differences with the Eastern Goldfields and stratigraphic contrasts with the West Yilgarn and Southern Cross super-terrane.

The Plutonic Well Greenstone Belt is approximately 50km long and 10km wide, trending northeast-southwest, located in the central portion of the Marymia Inlier.

The Belt is sub-divided into two volcano-sedimentary sequences, consisting of mafic and ultramafic units which are overlain by predominately mafic volcanoclastics and sedimentary rocks. These units have been subjected to greenschist and amphibolite facies metamorphism, deformed by polyphase folding, shearing, faulting and intruded by felsic porphyry and granitoid bodies. This has resulted in a strong northeast trending fabric which is paralleled by multiple low-angle thrust faults which occur throughout the belt and are intimately associated with the known gold mineralisation.

The north-western edge of the Belt consists of amphibolite-facies metamorphosed and foliated assemblages of ultramafic rocks, tholeiitic basalt, banded iron-formation, chert, felsic tuff, arkose and pelite. The central and southern part of the greenstone belt consists of metamorphosed boulder conglomerate with sub-rounded clasts of monzogranite, banded iron-formation and mafic schist in a foliated mafic matrix. The conglomerate is interlayered with arkose and rhyodacitic volcanic rocks, quartzite, pelite and amphibolite. Proterozoic dolerite dykes intrude the greenstones and the surrounding granites.

In general, the greenstones dip shallowly to moderately to the northwest, parallel to the granite-greenstone contacts, and are cut by a number of east-westerly faults. Gently open folding determines the outcrop pattern in the southern part of the belt around the Plutonic Gold Mine. The MMR and MPS Fault form the southern boundary of the greenstones against the granite.

A number of later, mainly Proterozoic, deformation events have substantially shaped the final architecture of the greenstone belt.

The main style of gold mineralisation (Plutonic brown-lode) typically occurs as thin (~1 - 3 m wide) lodes that consist predominately of quartz-biotite-amphibole-titanite-epidote-carbonate-tourmaline-arsenopyrite-pyrrhotite ± chalcopyrite ± scheelite ± gold. Visible gold is considered to have occurred at a late-stage during the evolution of the deposit as it is largely undeformed and overprints most, if not all, of the minerals and fabrics. It is typically associated with thin, discontinuous quartz-calc-silicate veins within the brown-lodes.



Where these gold-bearing zones are well developed, they tend to be near-parallel to the stratigraphy as marked by the rare metasedimentary horizons and to the dominant foliation, which is also typically parallel to metasediment horizons. Geochemistry suggests that these lodes developed on the boundary between mafic units or are focussed along or adjacent to minor metasedimentary units within the Mine Mafic unit. Lodes may be rich in arsenopyrite or pyrrhotite, and while arsenopyrite is a good indicator of mineralisation, it is not present in all mineralisation.

Mining Operations

Open cut mining operations commenced at the Plutonic Main Pit in 1990 and continued through to 1997. A string of satellite pits throughout the belt including Salmon pit continued surface production through to mid-2005. In 1995, underground mining in the Plutonic Main Mine commenced from the west portal. Plutonic mine is accessed from 3 portals (west and vent located in the Main Pit) and the 550 box-hole cut portal. Underground mining takes place from 4 major declines with a series of internal ramps to access mining zones. Mineralisation zones extend over an area roughly 3.5km north to south and 2km east to west with a vertical extent of over 1350m.

Currently, Plutonic produces around 0.85mtpa from mechanised mining methods with other mining techniques also used. Longhole stopeing is the main mining method used with a number of stopeing techniques utilised to address the variations in orientation and shape of the stopes. Due to these variations, stope size varies from ~500t to ~10 000t, with some occasional stopes up to 20 000t. To meet production requirements the mine has a high stope turnover rate with over 120 stopes mined in 2013. Jumbo stripping is often used to extract small pockets of ore and for pillar extraction. Airleg mining is used to extract some of the more intricate and narrow ore bodies at Plutonic. Northern Star Resources (NST) has seen the potential for airleg mining to bolster high grade production and access narrow ore bodies at the mine.

The mine design process at Plutonic is rigorous and includes detailed mine plans and comprehensive approvals prior to execution of the plan. Planning commences with the generation of a Preliminary Block Model (PBM) which is based on the resource block model and modified to reflect localised geological features, and any infill drilling. Development designs are based upon the Preliminary Block Model (PBM). After development the area is reassessed and a Measured Resource Model (MRM) is produced from which stope designs are prepared.

The large footprint of Plutonic and differing mining methods creates a number of operational and technical challenges. The production schedule requires attention to detail and a degree of flexibility with a constant focus on short term interval control required to ensure the mining cycle can be coordinated efficiently. Several interconnecting access ramps help to provide access to work areas from several directions and various haulage options when required. These ramps also help form the primary ventilation circuit which is powered by several underground and surface exhaust fans which move approximately 600m³/s through the mine.

All mining operations are operated by Northern Star Mining Services (NSMS) excluding diamond drilling which is contracted to Barmenco. The mining fleet currently consists of:

- 3 Tamrock D07 and 1 Tamrock DD421 development drill rigs
- 2 Tamrock Solo 07 production drills (76mm/89mm diameter holes)
- 3 Sandvik TH663 Haul trucks and 1 Toro 50D3 Sandvik 5-14 and 3 Sandvik 5-17 Loaders and 1 Toro 006
- 2 Getman 2-500 charge-up units
- 8 Service vehicles (integrated tool carriers, store truck, etc)
- 1 Cat 988 loader for ROM and surface works

Process Operations

The Plutonic processing circuit is a conventional CIL plant with a hard rock processing capacity of approximately 2.0 million tonnes per year. Processing on the current rate at 850,000tpa of underground ore the processing plant has the ability to substantially increase production to full capacity (2mtpa) at a moment's notice should the need arise.

The grinding circuit is preceded by a double toggle Jaques 60x48 (185KW) crusher at 420tph crushing capacity. The jaw crusher discharge feeds the secondary and tertiary cone crushers and double deck screening sections. The crushed minus 10mm screened product reports to a 4500 tonne enclosed fine ore bin. This product is then reclaimed by variable speed conveyors to the grinding section.



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The grinding circuit comprises a Svenson 4.5m diameter by 5.63m long primary mill and two Svenson 4.2m diameter by 5.63m long secondary ball mills. The primary mill has a grate discharge and is rubber lined. Its speed is fixed at 14.6 rev/min (72% of critical) and the installed power is 1600KW. The secondary mills are rubber-lined overflow mills also with 1600KW power. The grinding circuit throughput is currently operated at 165tph with a primary mill and one ball mill configuration; this however can be increased to 230tph by running the stand-by ball mill.

Pre-leach classification is achieved using a hydro-cyclone classifier circuit consisting of 16 cyclones that are fed from a distributor. Only 6 to 8 of the cyclones are operated at any one time depending on volume of slurry in the milling circuit. The cyclones are operated at a feed pressure of 110-130kpa.

The cyclone overflow reports to the leaching and adsorption circuit where the recoverable gold is extracted by cyanidation. The circuit comprises a Carbon in Leach (CIL) circuit with two leach tanks and six adsorption tanks. Two oxygen plants supply 8-10 tonne of oxygen per day to inject into the slurry via the agitators down shaft injection. The slurry residence time in the leach and adsorption circuit is approximately 36 hours and each tank has a volumetric capacity of 1,000m³. The total amount of activated carbon distributed in the adsorption tanks is about 70t. The tails slurry is directed to a high rate thickener to recover water and cyanide to the process water dam with the resulting tails slurry deposited in the TSF's facilities approximately two kilometres from the process plant.

Loaded carbon is pumped from adsorption tank 1 in daily batches. Gold is then recovered from the carbon using a process called elution. The Plutonic elution circuit is based on the Split Anglo-American Research Laboratories (AARL) elution process in which the gold laden carbon is first acid washed, and then eluted in a stainless steel elution column using hot (120°C) caustic cyanide solution.

The gold bearing eluate produced from the desorption process (pregnant solution) is then circulated through electrowinning cells for approximately 12 hours. During this stage gold is electrowon onto cathodes of steel wool. The barren solution remaining at the end of the electrowinning cycle is then returned to the second leach tank to fully utilise the excess cyanide associated with the solution.

The gold laden steel wool is removed from the electrowinning cells, oxidised in a calcining oven and smelted directly with fluxes in a gas-fired furnace. The smelt produces a vitreous slag containing all the base metals and impurities and gold doré bars that contain approximately 90% gold and 10% silver.

The electrowinning, calcination and smelting processes are all performed inside a high security gold room.

Plutonic uses approximately 400t of solid Sodium Cyanide (NaCN) in its process each year and uses online cyanide monitoring equipment to control leach circuit dosing. The cyanide analyser determines the CN concentration in leach tank 2 every four minutes and this value is relayed electronically to the mill control system. The mill control system then increases or decreases the speed of the CN feed pump depending on the value of the measured CN value in relation to an operator selected set point.

Plutonic has a fully functioning assay laboratory capable of both aqua regia and fire assay to analyse mill and underground samples.

Tailings Storage Facilities

The Plutonic operation maintains two active Tailings Storage Facilities (TSFs); TSF2 and TSF3. A third facility, TSF1, is an inactive facility that operated from 1990-2000. TSF1 has been rehabilitated successfully with an abundance of flora and fauna now resident.

The In-pit TSFs were commissioned in 2000 and the last in-pit ceased deposition in 2014. The in-pit deposition period filled 10 variously sized satellite pits. Of the ten in-pits, seven have been rehabilitated. The remaining three in-pits are currently filled to 90% capacity and awaiting rehabilitation. Water recovery from the in-pit TSFs can be as high as 85%. To prevent seepage from entering the water system, the in-pits are supported by numerous seepage recovery bores and monitoring bores.

TSF 2 and 3 are paddock style TSFs and cover approximately 50ha each in surface area. TSF2 was raised by 2.5m in Q1 2014. Water recovery averages from the TSF's central decant wells is around 50% with remaining water lost through evaporation. A network of recovery bores is employed around the facility to compliment the under drainage and perimeter toe drain systems which also recover any seepage.



Constant operational and environmental monitoring maintains the TSFs within the regulatory conditions at all times.

Support Infrastructure

Plutonic has two power stations – one operational 15MW gas-fired station, and one standby 8MW diesel fired station. The standby unit is the original diesel-fired power station which was replaced in 2000 with the completion of the gas pipeline off-take. The gas fired station has six generators, with natural gas supplied by a lateral connected to the main Dampier to Perth supply. Power is supplied to the processing, mining, borefield, camp and administration areas via high voltage overhead transmission line.

Water supply for the project is pumped from two bore fields either side of the Great Northern Highway; 30kms and 12kms west of the Plutonic plant. The water is of very good quality and is used for both processing and potable supply. It is pumped from bores using submersible pumps with power supplied from the main power station via overhead power lines. The water is piped to the plant via a 400mm HDPE pipe.

The Plutonic Accommodation Village has rooms for 550+ employees and boasts some excellent recreation facilities including two squash courts, a fully equipped gymnasium, Tennis court, Basketball court, grassed sporting ground, a swimming pool and a well-equipped tavern/shop.

The Plutonic Airstrip is a 2,071m gravel strip and caters for turbo-prop aircraft. There is a local regional airport located at Meekatharra 180km and Newman 220km away.

The site operates on a fly-in fly-out basis 24 hours per day/365 days per year with work rosters predominantly either eight days on and six days off or fourteen days on and seven days off – there are however some variations to this.

An emergency response capability is paramount in such a remote location as Plutonic and the operation receives a tremendous service from the many individuals that have volunteered to provide this essential service.

Occupational Health and Safety

Plutonic utilises Northern Star's safety program and management systems, which include detailed standards and procedures. Together, these programs and systems form the cornerstone of safety at Northern Star, ensuring that employees have the tools they need to work safely.

The Company also strives to ensure employees are fit to conduct their work in a safe manner. With this goal in mind, Northern Star offers healthy meal alternatives, fitness equipment and a quality medical service for live-in employees.

Mining is not dangerous but it is hazardous and reducing residual risk to acceptable levels by driving the use of higher order controls from the hierarchy of controls remains a focus.

Summary of Previous Production (2008-2013)

Total production from Plutonic (includes mineralised waste).

PLUTONIC PRODUCTION

Year	Tonnes (Million)	Grade (gpt)	Recovery (%)	Ounces Produced (000)
2008	1.21	3.62	89.5	136
2009	1.76	2.84	89.3	146
2010	1.75	2.63	87.5	133
2011	1.70	2.42	86.4	114
2012	1.60	2.49	87.3	112
2013	1.40	2.92	86.8	114



Total UG Production (excludes mineralised waste milled).

PLUTONIC UNDERGROUND ORE PRODUCTION

Year	Tonnes (000)	Grade (gpt)	Recovery (%)	Ounces Produced (000)
2010	887.3	4.65	87.5	116.0
2011	771.0	4.57	86.4	98.0
2012	757.2	4.68	87.3	99.4
2013	763.9	4.80	86.8	102.3

Closure and Reclamation

The site has undergone numerous changes of ownership in its operating history and accordingly has been subjected to various internal reclamation standards. Mining commenced at Plutonic in 1990 and was expected to have a mine life of five years. In 2014 PGM celebrated its 24th anniversary and today continues to operate as an underground mine. Over time the operations have resulted in 36 open mine pits over a strike length of some 50km extending along a north-easterly strike towards the Marymia Mining Tenements. The majority of these tenements were however divested in 2010.

The mining operations have been approved under the Mining Act 1978 and as such the Department of Mines and Petroleum (DMP) require, as per the Tenement Conditions, that the existing Plutonic Mine Closure Plan and Rehabilitation Plans be reviewed in accordance with the DMP (2011). Plutonic has submitted an updated Mine Closure Plan and approval has been granted by the DMP.

Plutonic includes a number of distinct operational areas, these being the underground mines and their associated infrastructure; the original Plutonic open pit and associated waste rock landform; the Plutonic satellite open pits and associated waste landforms; and the central mineral processing facility with associated logistical support infrastructure.

For further information, please contact:

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