

LEWINS, J.D., HUNNS, S. and BADENHORST, J. The Kalahari Platinum project. *Third International Platinum Conference 'Platinum in Transformation'*, The Southern African Institute of Mining and Metallurgy, 2008.

The Kalahari Platinum project

J.D. LEWINS*, S. HUNNS* and J. BADENHORST†

*Platinum Australia Limited

†GeoActive (Pty) Ltd

Introduction

The Kalahari Platinum (Kalplats) project is located 350 km west of Johannesburg in the North West Province and 45 km west of the Kalgold open pit gold operations on the Kraaipan greenstone belt. The project area lies approximately 25 km north of the township Stella within a farming area and a local population of approximately 2 500 inhabitants (Figure 1). The N18 national highway linking the towns of Mafikeng and Vryburg is to the south of the area. The topography is slightly undulating to flat-lying with the average surface elevation variable between 1 245 m to 1 275 m above mean sea level.

The Kalplats project is advanced, with a Definitive Feasibility Study due to be completed in October 2008 and

where drilling to date has defined a resource of 4.2 million ounces Pt + Pd + Au.

The soil thickness in the project area is typically 3–8 m deep and consists of unconsolidated aeolian Kalahari sands. The prevailing wind direction is from the west. Rock exposures across the area are sparse in this region of extensive soil cover.

History

The PGM potential of the area was recognized during gold focused exploration programmes over the Kraaipan Greenstone Belt in the early and late 1990s carried out by Anglo American Prospecting Services (AAPS).

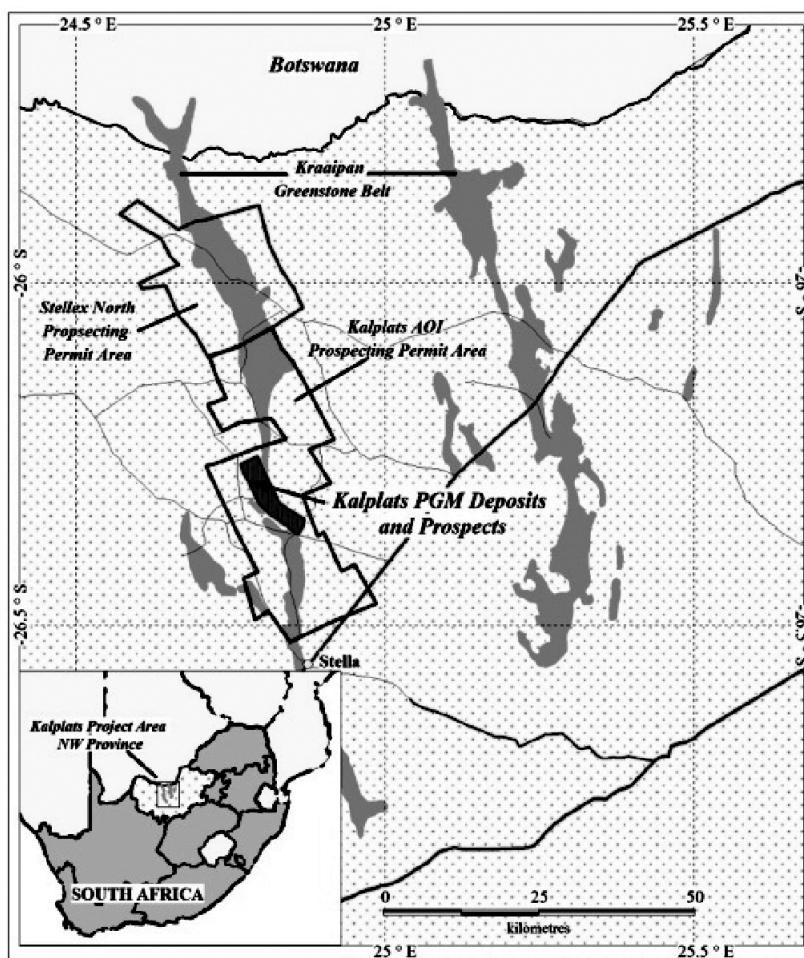


Figure 1. Location map of the Kalplats project and prospecting permits held by PLA and its JV partners

Following the acquisition of the ground by Harmony Gold Mining Company Limited (Harmony), an extensive exploration programme was undertaken, during which some 40 000 metres of drilling was completed. Further work including metallurgical testing, geotechnical, mining and environmental studies and the mining of a box cut were also undertaken and incorporated into a 'Feasibility Study' which was completed in February 2004.

The study focused on developing the project as an underground operation, mining a wide, low grade horizon. At the prevailing metal prices this was not a viable option.

As part of a transaction involving Angloval Mining Limited, African Rainbow Minerals & Exploration Investments (Pty) Ltd (ARM) and Harmony, the Kalplats project was acquired by ARM in 2004. In August 2004 Platinum Australia Limited entered into an agreement with ARM Platinum to earn up to 49% of the Kalplats project for completing a Definitive Feasibility Study on the project.

In December 2005, PLA and ARM Platinum established a joint venture covering the extensions of the Kalplats area (AoI) under which each party will have a 50% contributing interest.

PLA is the manager of both the Kalplats project and the Kalplats Extension project through to the decision to develop, at which point ARMplats has the right to take over management.

To date, eight deposits (Crater, Vela, Sirius, Mira, Orion, Serpens North, Serpens South and Crux) have been identified over a 12-km strike distance (Figure 2). Several additional prospects (Scorpio, Tucana, Pointer, Serpens East) have also been identified through limited open hole/RC drilling or where geochemical aircore overburden drilling has indicated the possible presence of underlying mineralization. As of yet there are still yet a number of exploration targets that have either not been tested or have only been lightly tested by shallow drilling.

By the end of July 2008, PLA had completed over 80 000 metres of drilling on the project in addition to the 46 000 metres previously drilled by Harmony and AAPS.

Regional geology and mineralization

The Kraaipan Greenstone lithologies comprise three discontinuous belts and a number of small outliers of deformed and metamorphosed volcano-sedimentary rocks and associated granitoids. The western belt is referred to as the Stella Belt (Kalplats project area) and the eastern belt as the Goldridge Belt (Kalgold Mine).

The Stella Layered Intrusion (SLI) is a layered intrusion of gabbroic and magnetite-rich gabbroic material with an age of approximately 3 billion years. The magmatic intrusion took place with the Greenstone Kraaipan rocks forming the roof and floor to the intrusion. The Kraaipan rocks consist of banded iron formation (BIF), magnetite-rich quartzite, amphibolites and some conglomeritic layers. The entire sequence has been overturned and a dips of 80° to 85° to the west-southwest.

The dimensions of the SLI within the current project area are estimated from magnetic bedrock signatures and borehole information at 12 km long and 1.5 km wide. The rocks comprise essentially unfoliated cumulate-textured gabbros, leucogabbros and magnetite gabbros. Magnetite content ranges from low disseminated (1–2%) to strong segregations forming magnetite layers (50–90% magnetite).

Archaean granites and subordinate clastic and mafic rocks (probably belonging to the Ventersdorp Supergroup) lie to the east and west of the greenstone terrain. However, due to structural deformation, these rocks are sometimes interlayered with the greenstone/SLI rocks.

Mafic diabase dykes are commonly associated with younger sub-vertically dipping north-north-easterly striking shear zones and their association with the shears/faults suggests that they are coeval. The dykes are very fine-grained, greenish and usually non-magnetic, with typical widths of 0.5–3 m.

The PGM mineralization occurs as magmatic segregation reef deposits that are hosted in magnetite gabbro within the sub-vertically dipping SLI that is structurally closely associated with the Kraaipan Greenstone Belt. The mineralized package is approximately 50 m thick, but may be up to 100 m thick due to duplication by faulting and/or folding. The mineralized package is enriched in platinum (Pt), palladium (Pd) and some gold (Au), but generally devoid of and other platinum group elements. The continuity of the mineralization is disrupted by the NNE trending structures with the current identified mineralization totalling up to ~8 km combined strike length over the known deposits.

Project scale geology

Two slightly different strike orientations exist for the SLI and the Kraaipan Greenstone rocks in the project area. Over the southern part of the project area the strike is approximately north-west (bearing 300° true north), whereas in the northern part it is more north-north-westerly at 330°. Dips are generally steep (>70°), commonly resulting in an overturned stratigraphy.

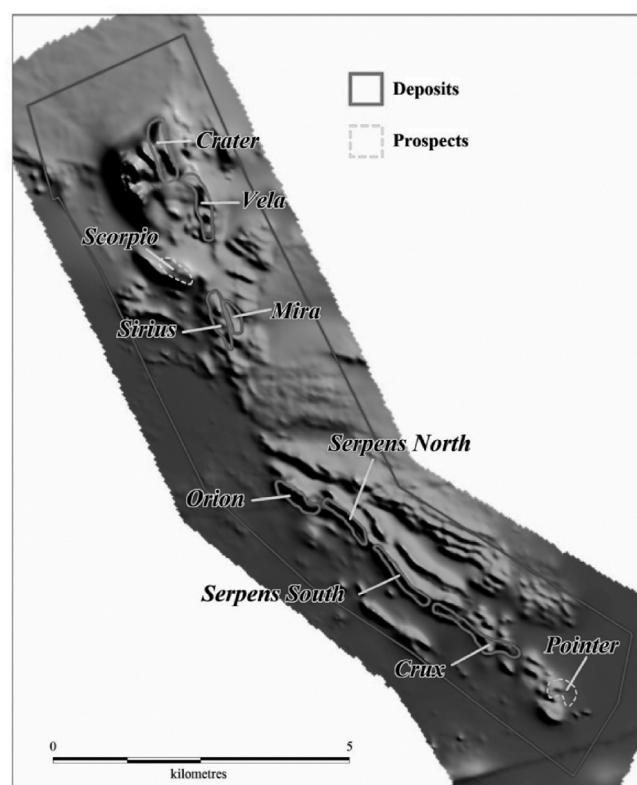


Figure 2. Location and surface projection of the mineralization of the various deposits and prospects at the Kalplats project, superimposed on the aeromagnetic data

The average depth of the weathered/fresh interface is at approximately 30–40 m. Locally the weathering (i.e. the ‘oxide’ zone) may extend to depths >50 m due to the presence of faults/dykes/joints. The fresh gabbroic rocks furthest to the west tend to be coarser grained (pyroxene grains up to 20–30 mm), unfoliated and more mafic-rich and non-magnetic (informally termed ‘deep footwall’ gabbros). The footwall to the mineralized package of the SLI is a feldspathic gabbro. The gabbro often shows signs of potassic alteration with the alteration causing the footwall to appear coarser than the rest of the sequence. Parts of the footwall were previously described as a crosscutting feldspathic pegmatoidal gabbro, but the mottled appearance is now believed to be caused by later potassic alteration. No crosscutting relationship of this unit has been identified to date. Distinct layering in these rocks is absent. About 80 m to the east (i.e. stratigraphically above) the contact with the Kraaipan group rocks the gabbro becomes more magnetite- and feldspar-rich and are termed ‘footwall gabbros’. They also contain discrete magnetite bands varying in width from a few centimetres to 1–2 m are present. The western contact of the magnetite bands is usually sharp, whereas the eastern contact often displays a gradational change to a magnetite gabbro lithology. Feldspar-rich ‘anorthositic’ units up to 2 m wide are also developed, commonly to the west of some of the magnetite units.

A generalized lithological description can be seen in Figure 3. The continuity of these units down dip and along strike is exceptional. Even though there are local changes in thickness and grade distribution and some structural complexities, the same sequence can be seen from Crater in the north to Pointer in the south.

Alteration

The rocks that comprise the SLI are seldom fresh, and the entire lithostratigraphic sequence has been affected by several episodes of intense alteration. The alteration can be attributed to one of two processes, igneous alteration or Greenstone belt deformation and alteration.

The only alteration that can be definitely linked to a magmatic source is the high-temperature clinozoisite/epidote (occurred during the cooling phase of the magma), and a white mica that affected mainly the plagioclase.

The clinozoisite (epidotization) alteration mainly affected the core of the plagioclase crystals. As the alteration progressed, the epidotization turned more pervasive and affected the majority of the lithologies. Where the epidotization became pervasive, it formed nests and/or a fine-grained groundmass that proved to be almost totally impervious to the later highly channelized chloritization that was associated with the main carbonate alteration. Epidote alteration continued post-cooling of the magma during the Greenstone deformation and metamorphism phases.

Sericite (white mica) alteration occurs as a late sparse alteration product after the plagioclase.

Carbonate alteration appears to have been focused along low-angle thrusting. Mineralogically, the carbonate alteration was almost complete, drastically altering the composition of the precursor lithologies, and forming typical ‘breccia-like’ textures or complete ‘limestone/dolomite’-like features. The dominant carbonate is dolomite.

Chlorite alteration generally occurs replacing directly secondary tremolite after amphiboles and/or pyroxenes in gabbros or replacing epidote and/or plagioclase after the initial epidotization.

The primary titaniferous magnetites (with ilmenite ex-solutions along 111) form layers associated with the PGM mineralization, at least in the upper sequence of the SLI. Where the Ti-magnetites were flushed by the carbonate/chlorite-rich hydrothermal solutions the ilmenite was transformed to sphene, rutile or leucoxene and the Ti-magnetites were transformed into pure magnetite. The magnetite may have been further altered into specular hematite where the alteration was very strong.

The pyroxenes and amphiboles of the gabbros have been partly or totally altered to tremolite. It is thought that tremolite alteration occurred during the very early stages of the intense carbonization (dolomitization) alteration, and was centred specifically on the hornblendes and pyroxenes. As the carbonate alteration continued, the tremolite became more unstable was then replaced by chlorite and carbonate.

The silification and the introduction of pyrite are almost penecontemporaneous with all previous alteration events, there is a specific feature consisting of the introduction of blue tourmaline (scorl) that makes it a distinct event.

Within the SLI are some steep structures that display little or no movement (possibly tension structures) that are infilled with albite-quartz and K-feldspar. Sometime the matrix within these zones is slightly cataclasized. It is thought that these structures represent late metasomatic events, post-mineralization, post-deformation and alteration. These structures may be simple dilatational features, possibly marking the end of the greenstone belt deformation at Stella and along the Kraaipan belt.

Mineralization

PGM mineralization is hosted in the magnetite-rich gabbros approximately 150–230 m above the contact with the Kraaipan Greenstone rocks. In certain deposits, however, the footwall gabbros have almost completely been sheared/thrust out with the result that the proximal footwall to the mineralized package consists of Kraaipan Greenstone rocks and/or granites (Figure 4—Simplified stratigraphic column).

From the eastern-most contact of the mineralized package, the rocks display a pronounced cumulate texture for several tens of metres. Higher hangingwall rocks appear to be relatively homogeneous, medium-grained magnetite gabbro rocks with no distinctive zones developed within.

A late phase of very coarse-grained relatively feldspar-rich gabbro (referred to as a ‘pegmatoidal gabbro’) intrudes and cross-cuts the earlier cumulate rocks of the SLI. Although generally non-magnetic, magnetite does occasionally form coarse intercumulate segregations within this rock and occasionally cross-cuts the mineralized package, resulting in loss of reef. The thickness of this unmineralized pegmatoidal gabbro is poorly constrained but is estimated at 20–30 m.

The individual deposits are thought to represent the dismembered remnants of a once continuous reef zone. The deposits themselves are characterized by complex faulting, with north-easterly striking sub-vertical shear zones and low-angle thrusts. Movement along the shear zones has dextral sense of can be in the order of hundreds of metres (separating the individual deposits), or in smaller increments of 2–100 m that locally disrupt the reefs package within the defined deposits.

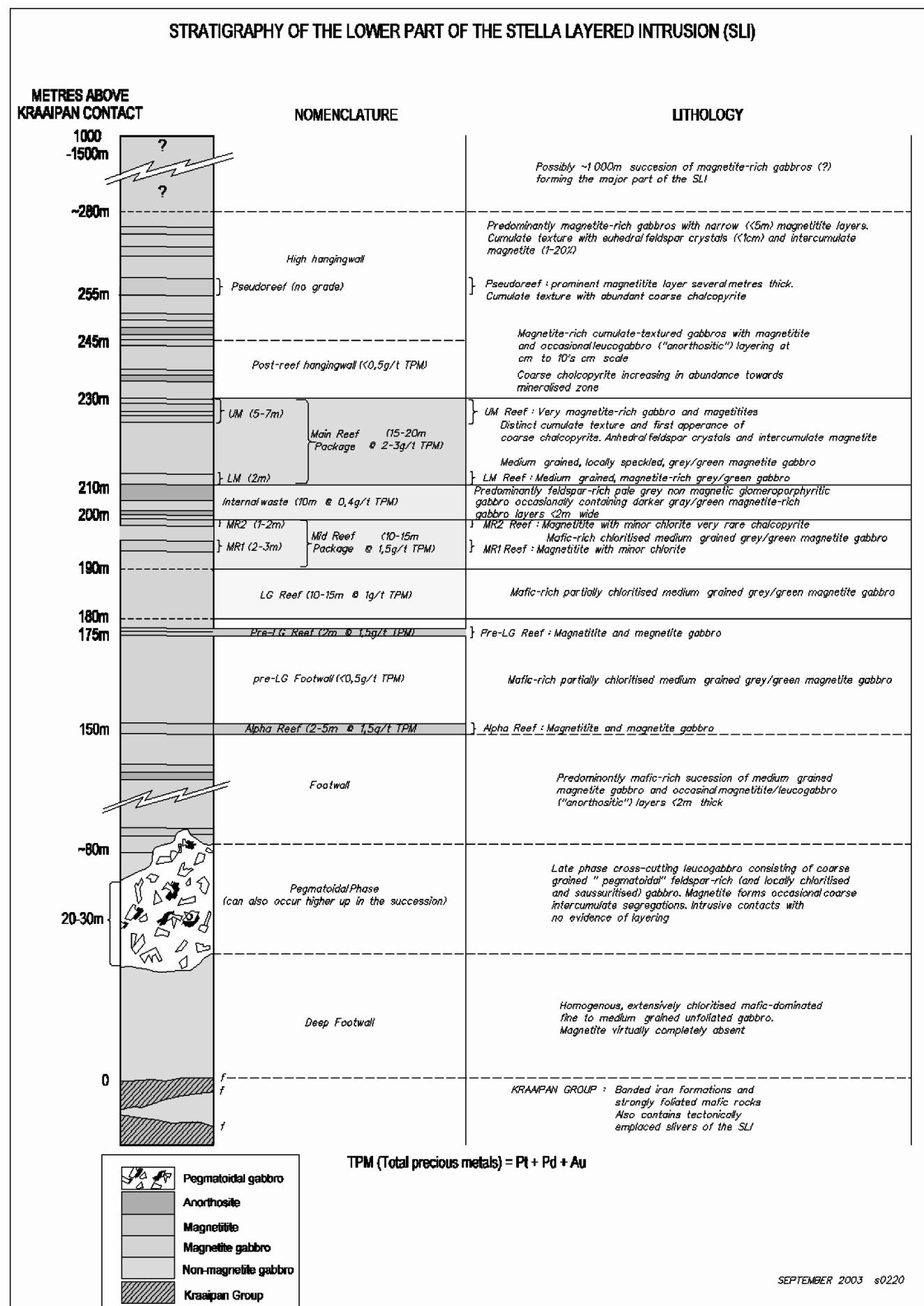


Figure 3. Generalized stratigraphy of the Stella Layered Intrusion

	Nomenclature	Width (m)	Av. Grade g/t	Pt/Pd ratio	Reef Code	Lithology	
1000						Possibly >1,000m succession of magnetite-bearing gabbros forming part of the Stella Layered Intrusion	
280	?						
	“High” Hangingwall	+25	0			Magnetite-rich gabbro, narrow (<5cm) magnetite layers. Cumulate textures, euhedral feldspars & intercumulate magnetite (1 - 20%), with minor cpy	
255	Pseudo Reef	1-5	0			Prominent magnetite layer m's thick. Cumulate texture, coarse grained, minor cpy, No PGMs	
245	Hangingwall	10	0			Magnetite-rich gabbro, narrow (<5cm) magnetite layers. Cumulate textures, euhedral feldspars & intercumulate magnetite (1 - 20%), minor chlorite alteration & cpy	
230	Post-reef Hangingwall	15				Magnetite-rich, subhedral cumulate-textured, chlorite altered gabbro, with occasional leucogabbro (anorthositic) layers (cm's - 10's cm). Coarse-grained cpy increases towards mineralised zone	
210	UM Reef	Main Reef Package	5 - 7	3.7 - 4.3	1 : 1	101	Cumulate-textured magnetite-rich, chlorite altered gabbro & magnetites. Coarse-grained cpy, euhedral feldspar & pyroxene & intercumulate magnetite
	LM Reef		15 - 20	1.0 - 1.4	1 : 1	102	Medium-grained locally speckled, grey/green coloured magnetite-bearing gabbro. May be “mottled” due to alteration of feldspar by clinzoisite. Strong, pervasive chlorite alteration
	Mid-Main Waste		2	2.6 - 4.2	1 : 1.2	103	Medium-grained magnetite-rich, chlorite altered, grey/green coloured gabbro
200	MR 1 Reef	Mid-Reef Package	8 - 10	0.1 - 0.4		401	Feldspar-rich, pale grey coloured, non-magnetic, glomerophytic, mottled gabbro, with minor chlorite alteration. Darker grey/green coloured magnetite-rich gabbro layers are also present (<2m wide).
	MR 1 Reef		2 - 4	2.0 - 2.5	1 : 3	201	Magnetite, minor chlorite alteration, rare cpy
	LG Reef		10 - 15	0.8 - 0.9		202	Mafic unit, medium-grained , chlorite altered, grey/green coloured magnetite-bearing gabbro
190	LG Waste		2 - 3	2.0 - 2.5		201	Magnetite, with chlorite alteration
180	Pre-LG Reef	10 - 15	0.8 - 1.0	4 : 3	301	Mafic unit, medium-grained, grey/green coloured magnetite-bearing gabbro, partially chloritised	
175	Pre-LG Footwall	3 - 5				Feldspar-rich unit with minor magnetite,medium-grained, grey/green coloured, magnetite-bearing gabbro, partially chloritised	
150	Alpha Reef	1 - 2	1 - 2.5	1 : 1		Magnetite layers within a magnetite-bearing gabbro	
80	Footwall	10 - 15				Feldspar-rich, medium-grained, grey/green coloured, partially chloritised gabbro with minor magnetite	
0	“Pegmatite” Gabbro (may also occur higher in the stratigraphy)	3 - 5	1 - 2.5	1 : 1		Magnetite & magnetite-bearing gabbros.	
		70	0			Feldspar-rich, medium-grained, gabbros & occassional magnetite-bearing leucogabbros (anorthositic layers up to 2m thick)	
	“Deep” Footwall	20 - 30	0			“Pegmatoidal” feldspar-rich (locally chloritised/saussuritised) gabbro. Magnetite forms occassional coarse intercumulus segregations, with no evidence of layering	
	Kraipan Complex	80	0			Homogenous, extensively chloritised fine-medium grained mafic-mineral dominated, unfoliated gabbro. Magnetite virtually absent	

Figure 4. Generalized stratigraphy of the mineralization seen within the Stella Layered Intrusion, along with average grades, Pt:Pd ratios and thicknesses

The footwall is poorly mineralized with no little or no Pt, Pd or Au being present (<10 ppb). The footwall is Cu-poor with grades of less than 10 ppm having been reported. A magnetite-rich layer called the Alpha reef has elevated Pt and Pd values with some Rh. This reef is approximately 2 m thick but has been intersected rarely as it is situated deep in the footwall. The grades of approximately 2 000 ppb Pt plus Pd has not thus far warranted targeting the layer during the drilling programme.

The lower-most reef to the mineralized package is called the LG (low grade) reef. This reef is characterized by less feldspar-rich gabbro, anhedral-shaped minerals, moderate amount of chlorite alteration, weak to moderate amounts of shearing, Pt and Pd grades of 500 to 600 ppb (Pt + Pd + Au grades are in the 1.0 to 1.2 g/t range) The Pt:Pd ratio for the LG reef is approximately 1.2. The unit is generally magnetite-poor, with similarly low Cu and Au grades as seen in the footwall.

The Mid-Reef is the next stratigraphically higher mineralized unit, and the main distinguishing factor for this unit is that it has a Pt:Pd ratio of approximately 0.3. The change in ratio from the LG to the Mid-Reef unit takes place sharply over one to two metres. The Mid-Reef is more magnetite-rich with up to 20% of its mineral assemblage being made up of magnetite. The minerals are still anhedral-shaped, the chlorite alteration and shearing increases and it still shows low Cu and Au values, although the Cu starts increasing to 100 ppm values. The unit is subdivided with the high grade mineralized zones called the MR1 and MR2 and the low grade units inbetween called the Mid-Reef Low Grade (MRLG). The MR2 is a continuous high grade zone of mineralization found at the top of the Mid-Reef, while the MR1 represents a more lensoidal unit within the Mid-Reef. Both these units are often found in very magnetite-rich units. While the general average Pt + Pd + Au grade for the MRLG is in the 1.5 g/t range, the higher grade units have grades >2.5 g/t.

The MR2 is followed by the Main Low Grade unit (MLG). This unit is a feldspathic unit with very little magnetite, and has lower grades for the Pt + Pd + Au (0.8 to 1.0 g/t) and a Pt:Pd ratio of 0.8 to 1.0. The ratio change from the MR to the MLG is not as sharp as seen between the LG and MLG and takes place over 4 to 5 metres. The MLG is usually non-sheared with has minor chlorite alteration.

The upper unit to the mineralized package is termed the Main Reef and has been subdivided into three sub-units, the Lower Main (LM), Mid-Main (MM) and Upper Main (UM) mineralized units. The LM is characterized by a four to five metre wide zone with average Pt + Pd + Au grades of >3.5 g/t. The LM unit contains up to 20% magnetite again, is usually sheared and chlorite-altered. The minerals are generally subhedral in shape and the Pt:Pd ratio is around 1.0. The MM has the same mineral composition as the LM and has the same Pt:Pd ratio, but the Pt + Pd + Au grades are approximately 1.0 g/t. The UM forms the top of the mineralized package and is visually the most distinguishable unit in the mineralized package. The reason for this is the sudden appearance of chalcopyrite close to the top of the unit. Due to the presence of chalcopyrite there is very sharp increase in the Cu grade, with Cu grades now jumping from ≤100 ppm to >1 000 ppm. Elevated Au grades appear for the first time at the top of the UM with grades of >1 g/t having being reported. There is a sudden drop of Pd at the top of the UM with the Pt:Pd ratio changing from 1.0 to >20 over approximately 2 metres. The average Pt + Pd + Au grade for the UM is 4.5 g/t over ~5 metres.

The hangingwall (HW) is generally more magnetite-rich than the any of the lower units with euhedral minerals. The chalcopyrite continues in the HW for approximately 50 metres. The Au seen at the top of the UM decreases gradually into the HW but stays anomalous, i.e. some >50 ppb kicks have been reported.

The PGMs within the SLI occur as very fine-grained blebs, ranging in size from 0.5 micron up to 45 microns in size, with the average size being between 5–10 microns. The PGM minerals are dominated by sperrylite (PtAs_2) and stibio-palladinite (PdSb), as well as minor amounts of native Pt. The PGMs are normally hosted by the Ti-magnetites and by cracks within the Ti-magnetites and they may also occur as occlusions in the gangue minerals (amphiboles, carbonates and chlorite). Occasionally the PGMs may form atoll-type structures that are intimately associated with chalcopyrite and safflorite, $(\text{CoFe})\text{As}_2$.

Primary sulphides are rare, and primary chalcopyrite is possibly the only common sulphide that was part of the primary Pt/Pd paragenesis. Pyrite apparently appears to be associated with PGMs, however there are at least three late-stage generations of pyrite present with the mineralization. The chalcopyrite is frequently altered to bornite, chalcocite and covellite. Native copper has also been recognized in hand specimen.

Aeromagnetic surveys

AAPS completed a fixed wing aeromagnetic survey during their phase of exploration. This survey was flown at 200 m line spacing by AAPS. Both AAPS and Harmony acquired more detailed local magnetic data from ground magnetic traverses, which assisted with their target drill hole planning.

PLA recognized the value of airborne magnetic surveys for detection of the magnetite-rich rock types of the Stella Layered Intrusion. The airborne surveys have enabled determination of the position and strike of many of the SLI's mineralized lithological layers and linear structural features such as intrusive dykes and faulting. PLA completed a high resolution airborne magnetic survey in early 2005. Lines were spaced at 50 m apart and oriented at 045° or approximately perpendicular to the strike orientation. The lines were flown at a mean height of 25 m above surface. A total of 1 723 line kilometres were flown for this survey.

Resource Potentials of Perth, Australia completed a first pass interpretation of the dataset.

The interpretation has highlighted the strike orientation of the magnetite-rich gabbros of the SLI. In addition to the stratigraphic interpretation, the position of the major faults along with their relative displacement has also been interpreted.

Structure

The early deformational history of the SLI and the Kraipan greenstones was dominated by an eastward verging orogenic event. Progressive deformation during this event first resulted in overturned folding with consequent steepening of strata. Only rarely is evidence illustrating the folded nature of these rocks seen in borehole core. An open synformal geometry has, however, been identified at the Sirius deposit with the stratigraphy the right way up. At this deposit the mineralized package reaches a maximum depth of 50 m and 100 m below surface for the upper-most and lowest-most reefs, respectively.

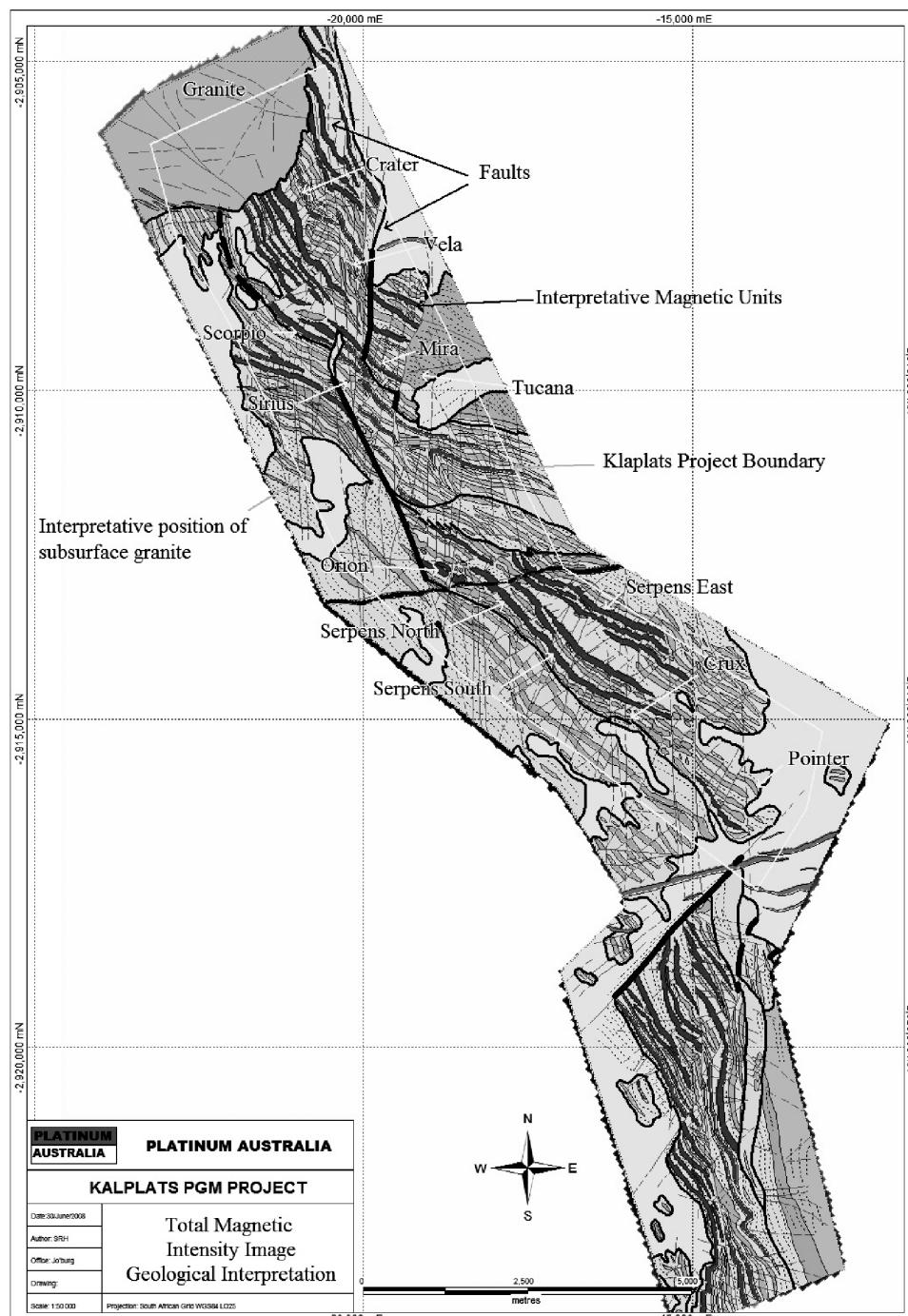


Figure 5. Total magnetic intensity image

A phase of granitoid intrusion occurred during the latter stages of the deformation event prior to thrusting. During the subsequent thrust event brittle-ductile, thrust-sense shear zones developed along overturned limbs of the folds. These shear zones exhibit a 'ramp and flat' thrust geometry and locally cause imbrication of strata (particularly at the Orion deposit). Kinematic indicators consistently indicate a west block up sense of movement. Deformation during this orogenic event was accompanied by green schist to amphibolite facies metamorphism. The alteration mineral assemblage is dominated by epidote and chlorite. Focussed fluid flow along thrust-sense shear zones resulted in intense carbonate alteration occasionally extending for several metres into the host rock.

Thrust imbrication of the PGM mineralized layers has resulted in duplication of reef-packages in some zones but has caused significant disruption and reef loss in others. Felsic granitoids have, locally, introduced a significant amount of waste into the reef zones. Apart from bedding sub-parallel thrusting, younger sub-vertically dipping north-north-easterly striking shear zones (bearing of 000°–040°) are the other dominant structural feature that disrupts the mineralized reef package.

Doleritic dykes are commonly associated with these shears, and their association with the shears/faults suggests that they are coeval. The dykes are very fine-grained, greenish and usually non-magnetic, with typical widths of 0.5 to 3 m. They are often (but not always) jointed and their

contacts vary from highly sheared to intrusive. Predominantly dextral-lateral displacements along these north-northeast trending structures have resulted in the displacement of the reef packages for hundreds of metres (separating the deposits) or in smaller increments of 2 to 100 m that locally disrupt reef continuity within an individual deposit. The structural interpretation of the Crater deposit indicates that the frequency of the dextral shears/ faults with small (5 to 25 m) displacements is 3 to 5 faults per 100 m of reef strike. The frequency of shears/ faults with larger (>25 m) displacements is approximately 1 fault per 100 m of reef strike. Occasionally these structures are also associated with extensive carbonate alteration zones.

A conjugate structural orientation (trending 060°–100°) is often associated with sub-vertically dipping highly jointed felsic dykes ('quartz-albite dykes/veins') <5 m wide. They display a variety of colours (light to dark grey/ greenish to pinkish) and all of them contain silica as a major component and plagioclase feldspar (often forming small white phenocrysts) as a minor component. Trace components of the felsic dykes include chlorite, sericite, carbonate (associated with highly altered/sheared felsic dykes) and/or pyrite. The contacts of the felsic intrusives vary from highly sheared (displaying a strong fabric and commonly showing strong potassic or carbonate alteration), to completely unfoliated with intrusive contacts. No significant displacement along these structures has been observed to date. Together with the north-northeast orientated mafic dykes, the intrusive fault rocks constitute approximately 10% of the rock by volume.

More east-north-easterly trending coarser-grained dolerite dykes are apparent on the aeromagnetic images. These dykes appear to be relatively young (crosscutting other lithologies) and may be tens of metres thick. A 50 m thick coarse-grained steep southerly dipping magnetite gabbro dyke crosscuts the mineralized package on the Orion deposit. No significant displacement is, however, associated with this dyke.

Kalplats database

The current Kalplats data is an amalgamation of the historical database and the data acquired by PLA. Before the different datasets were amalgamated, the historical data was validated and where errors were found, these were then checked against the original 'hard' information and, where appropriate, the necessary changes were made to the database.

The drill holes are manually logged and then the data is transferred into an electronic database using OCRIS. Here the data undergoes a validation procedure before being transferred into a GBIS database, where it is once more subjected to a rigorous validation procedure. The drill hole database not only includes the assay data, and the geological information (lithologies, mineralogy, alteration, mineralization and structure), but also the SG of every diamond drill core sample submitted for analysis and the geotechnical data.

All completed drill holes were accurately surveyed for collar position using a sub-metre differential GPS and down hole survey information was acquired using a 'Maxibore' survey tool for both inclination and azimuth. Surveys were taken approximately every five metres.

All diamond drill holes drilled by PLA at the Kalplats project were orientated using an 'Ezi-Mark' orientation tool. Orientations were taken at the end of every run,

nominally every 3–6 metres. All diamond core where possible was reassembled (jig-sawed) according to the drillers 'orientation mark'. An orientation line defining the bottom of the drill core was marked on the core using a black paint marker. This methodology has enabled PLA to capture both accurate and detailed geotechnical and structural geological data.

Sampling and assaying QA/QC

PLA has conducted both a reverse circulation (RC) and diamond drilling (DD) programme on the Kalplats project. For the RC drilling, holes were sampled at one metre intervals for the total drill hole length. Sample chips were passed through a cyclone and collected in polyurethane bags for storage. Each one metre sample was then riffle split on site providing two 1–2 kilogram samples. On site supervision minimized sample contamination with regular cleaning of the cyclone and riffle splitter. One of the 1–2 kilogram samples was sent to the Genalysis laboratory in Johannesburg and the other was retained for future analysis or sample assay checking.

The DD core was halved for NQ diameter core and quartered for HQ3/HQ diameter core. Sampling was completed at approximately one metre intervals or at the nearest lithological contact. Lithologies units which were less than 50 cm wide were seldom individually sampled. Core samples were sent to the same laboratory as the RC samples.

The geochemical data for the Kalplats project has been subjected to several quality control tests to ensure that base data is not spurious and that JORC code (2004) guidelines were maintained. To this end, PLA as well as Harmony submitted their own in-house standards, certified reference materials, completed duplicate analysis of sample pulps and submitted a portion of the total samples to an umpire laboratory.

During submission of samples to the appropriate certified laboratories, standard samples were submitted after every 20th drill hole sample. The submitted standards consisted of certified commercially available standards of varying grades. Standards included blank materials for control of contamination. In addition, approximately five per cent of the submitted samples were duplicated as pulps.

Resource estimates

Platinum Australia Limited has produced updated Mineral Resource estimates for the Crux, Orion and Crater Deposits in the Kalplats project, with significant increases in both the Crux and the Crater Deposits. The updated Crux resource estimate has increased the total contained ounces (ozs) of Platinum Group Metals (PGM's) by over 100% to 1.24 Moz 3E PGM (platinum + palladium + gold) and the updated Crater resource estimate has increased the total contained ozs by 33% to 680 000 ozs 3E PGM. The Orion resource estimate has decreased by 9% to 602 000 ozs 3E PGM. Both the Crux and the Orion resources are considered to be an interim resource and will be updated again when further drill results are received.

At the time of writing, updated Mineral Resource estimates are outstanding for a further four deposits, Serpens North and South, Sirius, and Vela which will be completed as the drilling on these deposits is completed by PLA over the next few months.

The Mineral Resource estimates were completed by Snowden Mining Industry Consultants (Snowden) and are

based on a 0.5 g/t 3E PGM cut-off and extend to a maximum depth of approximately 200 metres below soil cover. The new combined Mineral Resource estimate for the three deposits may be summarized as follows:

- High Grade (UM and LM) Mineral Resource – 10 Mt @ 3.08 g/t 3E PGM, containing ~988 000 oz 3E PGM
- Main Reef package (UM, Main and LM) Mineral Resource – 25 Mt @ 1.88 g/t 3E PGM, containing ~1 512 000 oz 3E PGM
- The total Mineral Resource for all seven layers is 57 Mt @ 1.37 g/t 3E PGM, containing ~2 520 000 oz 3E PGM.

The Kalplats deposits mineralization extends over a continuous sequence of seven alternating high and lower grade lithological layers. The stated Mineral Resources are based on the Mineral Resource estimate for each of these seven layers. These layers from top to bottom are the Upper Main Reef (UM), the Main Reef Low Grade (MRLG), the Lower Main Reef (LM), the Middle-Main Low Grade (MMLG), the Middle Reef 2 (MR2), the Middle Reef 1 (MR1) and the Low Grade reef (LG). The Main Reef package Mineral Resource (UM, Main, and LM layers) consists of the three uppermost layers of the sequence and the High Grade Mineral Resource (UM and LM) is comprised of the two highest grade layers of the seven mineralized layers. The Total Mineral Resource is comprised of all seven layers.

The Mineral Resource estimate is based on the results of mineralized intersections from a total of 92 drill holes at Crater, 84 drill holes at Orion and 104 drill holes at Crux, in addition to a detailed high resolution aeromagnetic survey interpretation and geological mapping and cross sectional interpretations. In addition, the Crater estimate includes closely spaced sampling and mapping in the 40 metre deep box cut.

A summary of the Mineral Resource estimates results are provided in Table I, while Table II provides a comparison with the previous Harmony Mineral Resource estimate. When compared to the previous Harmony estimates, the changes in the Mineral Resource estimates for these deposits are a function of increased drilling by PLA, which has improved our confidence and understanding of the continuity and structure of the mineralized layers. In addition, the estimates were enhanced with the application of computer-aided structural modelling and geostatistical estimation techniques applied by Snowden. The structural geological interpretation was aided by the data from a high resolution aeromagnetic survey completed by PLA which covers all of the Kalplats deposits.

The updated Mineral Resource is reported above a cut-off grade of 0.5 g/t 3E PGM and has been classified as Measured, Indicated and Inferred Mineral Resources and reported in Table I according to the guidelines of the JORC Code (2004).

The total Mineral Resource estimated for the Crater Deposit is 12.98 Mt at a grade of 1.63 g/t 3E PGM (Table I). This includes 5.64 Mt at a grade of 2.41 g/t 3E PGM in the Main Reef (Table I) or 2.83 Mt at a grade of 3.59 g/t 3E PGM in the High Grade Reefs (Table I). The total Mineral Resource estimated for the Orion Deposit is 13.05 Mt at a grade of 1.44 g/t 3E PGM (Table I). This includes 5.89 Mt at a grade of 1.97 g/t 3E PGM in the Main Reef (Table I) or 2.60 Mt at a grade of 3.08 g/t 3E PGM in the High Grade Reefs (Table I). The total Mineral Resource estimated for the Crux Deposit is 31.33 Mt at a grade of 1.23 g/t 3E PGM (Table I). This includes 13.44 Mt at a grade of 1.62 g/t 3E

PGM in the Main Reef (Table I) or 4.55 Mt at a grade of 2.76 g/t 3E PGM in the High Grade Reefs (Table I).

Definitive feasibility study

A definitive feasibility study (DFS) was commenced on the Kalplats Project in XXX and is due for completion in October 2008. The DFS is being completed using a number of external consultants coordinated by a PLA project manager and covers the following major elements:

Resource definition

As noted above, this work is being completed by Snowden Mining Consultants and is based on the results from over 120 000 metres of drilling in over 1 100 drillholes, combined with detailed high resolution aeromagnetic survey interpretation and geological mapping and cross sectional interpretations. In addition, the Crater estimate includes closely-spaced sampling and mapping in the 40 metre deep box cut.

Geotechnical evaluation

The work undertaken includes geotechnical logging of diamond drill core and, in addition, logging of a limited number of specific geotechnical holes, together with site investigations and laboratory testing and analysis.

This is being used to develop geotechnical models that identify key design constraints including the volumes of unplanned dilution, areas affected by oxidation, faulting and geological structures, ore loss factors and ground support requirements for the mining methods as well as recommending slope angles for the open cut.

Hydrogeology

The major focus of this work is to identify the potential water supply for the project and work includes evaluation of information such as annual rainfall, river flows, surface topography, local climate information, geological data and the drill logs. Other work includes drilling of specific boreholes to evaluate groundwater and testing of these and other boreholes.

The scope of this programme of work is also looking at potential water supplies on a regional basis. The engineering design and detailed costing of any pipelines or other infrastructure necessary to deliver water from remote sites are included in the study.

The outcomes of this work will identify mine dewatering requirements and options for the supply of water, together with any potential impacts on surface and groundwater supplies and quality.

Mine design

The DFS is focused on only the open pit potential for the project and the work being completed includes the following:

- Estimate of open cut reserves
- Use of Whittle 4X or equivalent to optimize the pit limits and assess pit development strategies
- Develop layouts and production schedules that demonstrate the practicality of the optimum pit development strategy
- Determination of manpower requirements
- Optimize the production schedules in line with optimum pit development strategy and integrate with underground production schedules

Table I
Crater Orion and Crux deposits mineral resource summary

		Crater deposit mineral resource summary					
		Tonnes (1 000 t)	3E PGM (g/t)	Pt (g/t)	Pd (g/t)	Au (g/t)	3E PGM (Ozs)
High Grade ¹	Measured	492	3.43	1.75	1.52	0.16	54 000
	Indicated	612	3.56	1.75	1.65	0.17	70 000
	Inferred	1 729	3.64	1.75	1.77	0.12	202 000
	Total	2 834	3.59	1.75	1.70	0.14	327 000
Main Reef ²	Measured	960	2.36	1.20	1.07	0.10	73 000
	Indicated	1 285	2.34	1.15	1.10	0.09	97 000
	Inferred	3 397	2.45	1.18	1.20	0.07	268 000
	Total	5 642	2.41	1.17	1.16	0.08	437 000
Total Mineral Resource ³	Measured	2 357	1.54	0.72	0.77	0.05	117 000
	Indicated	3 075	1.55	0.71	0.80	0.05	154 000
	Inferred	7 543	1.69	0.76	0.89	0.04	410 000
	Total	12 975	1.63	0.74	0.84	0.04	680 000
Orion deposit mineral resource summary							
High Grade ¹		Tonnes (1 000 t)	3E PGM (g/t)	Pt (g/t)	Pd (g/t)	Au (g/t)	3E PGM (Ozs)
	Measured	373	3.10	1.58	1.33	0.19	37 000
	Indicated	797	3.09	1.53	1.35	0.21	79 000
	Inferred	1 428	3.07	1.55	1.32	0.20	141 000
	Total	2 598	3.08	1.55	1.33	0.20	257 000
Main Reef ²	Measured	908	1.83	0.92	0.82	0.09	53 000
	Indicated	1 675	2.07	1.02	0.94	0.11	112 000
	Inferred	3 306	1.96	0.98	0.89	0.10	208 000
	Total	5 889	1.97	0.98	0.89	0.10	373 000
Total Mineral Resource ³	Measured	1 888	1.41	0.66	0.70	0.05	86 000
	Indicated	3 708	1.48	0.68	0.73	0.06	176 000
	Inferred	7 458	1.42	0.67	0.70	0.05	341 000
	Total	13 054	1.44	0.67	0.71	0.06	602 000
Crux deposit mineral resource summary							
High Grade ¹		Tonnes (1 000 t)	3E PGM (g/t)	Pt (g/t)	Pd (g/t)	Au (g/t)	3E PGM (Ozs)
	Measured	532	2.78	1.37	1.24	0.16	48 000
	Indicated	1 828	2.79	1.39	1.24	0.16	164 000
	Inferred	2 192	2.73	1.35	1.25	0.13	192 000
	Total	4 553	2.76	1.37	1.24	0.15	404 000
Main Reef ²	Measured	1 842	1.62	0.78	0.79	0.06	96 000
	Indicated	5 213	1.65	0.81	0.78	0.06	277 000
	Inferred	6 385	1.60	0.78	0.78	0.05	329 000
	Total	13 440	1.62	0.79	0.78	0.06	702 000
Total Mineral Resource ³	Measured	4 775	1.27	0.55	0.69	0.03	195 000
	Indicated	11 712	1.24	0.56	0.65	0.04	468 000
	Inferred	14 841	1.20	0.53	0.65	0.03	574 000
	Total	31 328	1.23	0.54	0.65	0.03	1 238 000

Table II
Comparison of Snowden and Harmony resource estimates

	Total Mineral Resource 3			Main Reef Resource 2			High Grade Reefs 1		
	Tons (1 000t)	3E PGM (g/t)	Ounces	Tons (1 000t)	3E PGM (g/t)	Ounces	Tons (1 000t)	3E PGM (g/t)	Ounces
SNOWDEN ⁴									
Crater	12 975	1.63	680 000	5 642	2.41	437 000	2 834	3.59	327 000
Orion	13 054	1.44	602 000	5 889	1.97	373 000	2 598	3.08	257 000
Crux	31 328	1.23	1 238 000	13 440	1.62	702 000	4 553	2.76	404 000
Total	57 357	1.37	2 520 000	24 971	1.88	1 512 000	9 985	3.08	988 000
HARMONY ⁵									
Crater	9 867	1.62	513 404	4 695	2.18	329 382	2 484	3.55	283 858
Orion	12 182	1.69	661 845	7 185	2.02	467 760	2 907	3.71	346 657
Crux	13 583	1.33	582 798	6 062	1.64	319 755	1 667	3.47	185 917
Total	35 632	1.53	1 758 047	17 942	1.94	1 116 897	7 058	3.60	816 432

¹Includes the high grade UM and LM Reefs (and MR1 Reef in the Harmony estimate)

²Includes the UM Main Reef Residual and LM which constitute the Main Reef

³Includes the low grade MR LG and the Main Reef Residual layers which is the total mineralized width for all seven layers

⁴ Harmony Mineral Resource estimate of Indicated and Inferred resources

⁵Snowden Mineral Resource estimate of Measured Indicated and Inferred resources

- Identification of the optimum items of the major and auxiliary mining fleet
- Estimate mine capital and operating cost for contract mining scenarios to an accuracy of $\pm 10\%$.

Metallurgical testwork

A test work program has been developed which includes the following:

- Preparation of composites, variability samples and bulk samples for pilot testing
- Comminution test work, including BWI, JK autogenous, UCS, hardness, etc.
- Dense media and magnetic separation
- Batch flotation test work, including optimization, depressants, reagent conditions, deslime, MF1/2/3 options, ore variability and cleaning
- Locked cycle flotation test work
- Calcine – leach test work and optimization
- Metals recovery including precipitation and ion exchange test work
- Settling, filtration, and viscosity
- Mineralogy
- Pilot plant grind and flotation
- Provision of concentrate samples to potential offtake customers.

Engineering and process plant design

The work is being done by the Lead Engineer in consultation with the PLA Project Manager and Metallurgical Consultant will develop the design criteria and a process flowsheet based on industry practice and the test work results. The work will provide the following outputs:

- Detailed equipment lists and equipment specifications
- Piping designs and quantities
- Power distribution and requirement details, including single line diagrams
- Cable lists and quantities

- Foundation and major structure designs
- Documented design calculations
- Control philosophy
- Instrument list and specifications
- Detailed site plan
- Multiple plans and elevations for the treatment plant; tailings and raw water systems, buildings and infrastructure
- Logistics and lead times;
- Capital and operating cost estimate to an accuracy of $\pm 10\%$
- Project implementation plan.

A general flowsheet of the processing plant as envisaged based on current results and design work is provided in Figure 6.

Environmental

The work here includes development of an environmental monitoring program and of an Environmental Management Programme Report (EMPR) to be submitted for approval prior to completion of the DFS. The work is designed to ensure that the EMPR complies with all of the requirements of the Mineral & Petroleum Resources Development Act (MPRDA) including the following:

- Identification of all approvals required and scheduling of approval process
- Completion of a Public Consultation and Disclosure Process
- Compile Social and Labour Plan
- Conduct a socio-economic baseline investigation and impact assessment
- Cultural Impact Assessmen;
- Baseline Environmental study of the affected area
- Complete an Environmental Impact Assessment (EIA)
- Complete a geohydrogeological study
- Develop an Integrated Water Use Management Plan and complete Application for Water Licences
- Identification of all other approvals and licences necessary to develop the project.

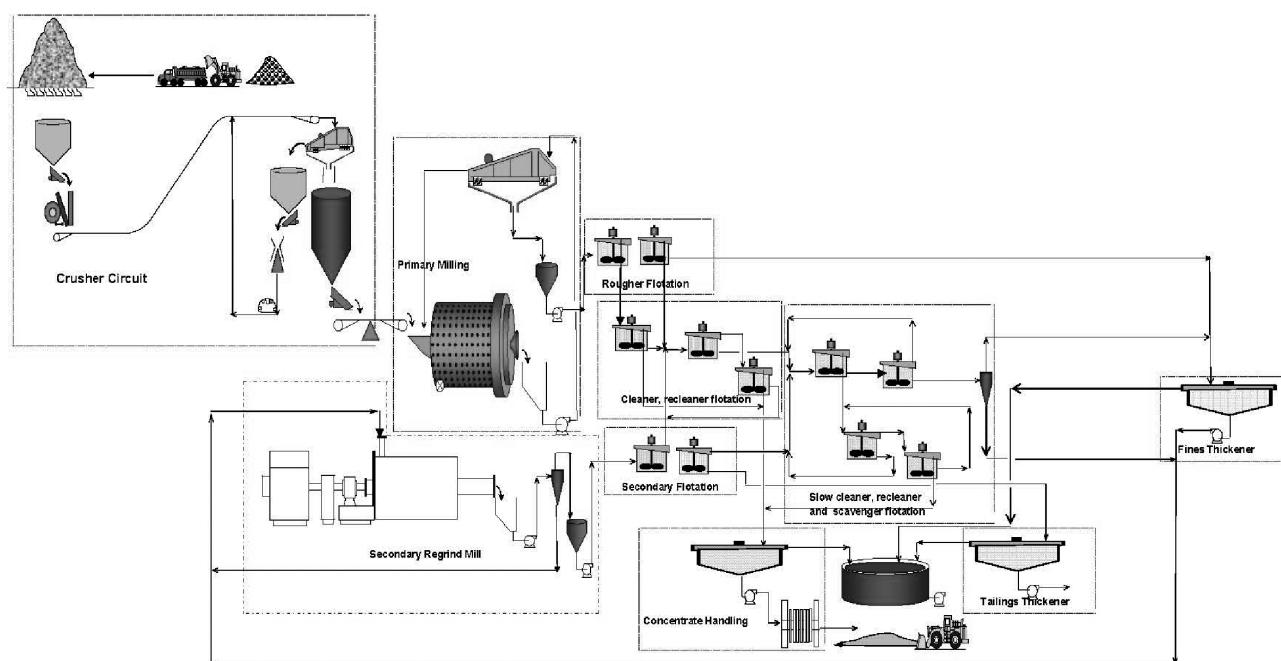
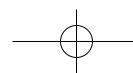


Figure 6. Kalplats processing plant flowsheet



Cost estimate and financial analysis

The DFS will have capital and operating cost estimate to an accuracy of $\pm 10\%$ which will be suitable for submission to third parties for obtaining suitable project finance.

In addition, the DFS will provide a financial evaluation of the project in a format suitable for use by third party financiers. This evaluation will cover the following:

- Capital and operating costs and schedules
- Production forecasts and schedules
- Impact of concentrate grade on realized revenue
- Revenue and cashflow over life of project
- Sensitivity analysis on key variables such as commodity prices, exchange rates, grade, recovery, capital and operating costs
- Impact of royalty, taxation and other indirect costs
- Impact of various funding scenarios and loan repayments;
- Evaluation of the project on the basis of DCF, NPV, and payback
- Evaluation of funding scenarios, gearing ratios, cost of funds, repayment schedules, etc
- Evaluation on a pre- and post-tax basis.

The output would include an electronic financial model of the project suitable for provision to third parties with the ability to vary set inputs to allow a dynamic evaluation of the financial aspects of the project.

Project implementation

The DFS is due for completion in October 2008 and based on the outcome of this, it is anticipated that a Mining Right application would be submitted in late 2008 and based on a 12-month timeframe, a Mining Right being issued by late 2009. On current information on construction time and delivery of long lead time equipment, it is anticipated that the Kalplats project could be in production in late 2010 or early 2011.

References

- GARTZ, V.H. Pt/Pd (\pm Au) Mineralisation in the Kromdraai Intrusive Complex: A summary report of Anglo American Prospecting Services' Work. Unpublished report to Harmony Gold Exploration (Pty) Ltd. 2000.
- GRAY, D and SULWAY, R. Platinum Australia: The Kalplats Crater Deposit of the Stella Layered Intrusion, Project No. 59905990. Mineral Resource Estimate 9 November 2007. Unpublished Report prepared by Snowden for Platinum Australia Ltd.
- HUNNS, S.R. Stella Platinum Kalplats Project Annual Report for the period 8th September 2006 to 7th September 2008. Unpublished report submitted to the Department of Minerals and Energy, Klerksdorp, South Africa. 2007.
- STEFAN, L.D. Stella PGM Project. Petrography of selected core samples from Stella PGM project. Unpublished report to Harmony Gold Exploration (Pty) Ltd. 2002.
- STEFAN, L.D., (undated). Stella PGM Project. Petrography of core and chip samples. Unpublished report to Harmony Gold Exploration (Pty) Ltd.
- Anonymous. Feasibility Study, Kalplats Project, Main Report Final Report. Unpublished report to Harmony Gold Exploration (Pty) Ltd. 2004.
- Anonymous. Platinum Australia Limited. Kalahari Platinum Project Site Tour February 2007. Platinum Australia Ltd. 2007.
- Anonymous. ASX Release 14 May 2008 Australian Stock Exchange Release by Platinum Australia Ltd. 2008.



John D. Lewins

Platinum Australia Limited

Mr Lewins is an Engineer with more than 20 years experience in Senior mining management roles, including development of mining projects from a resource stage through feasibility studies, commissioning of mines to sustained profitable mining operations
Mr John Lewins was appointed a Director on the 3 May 2001.