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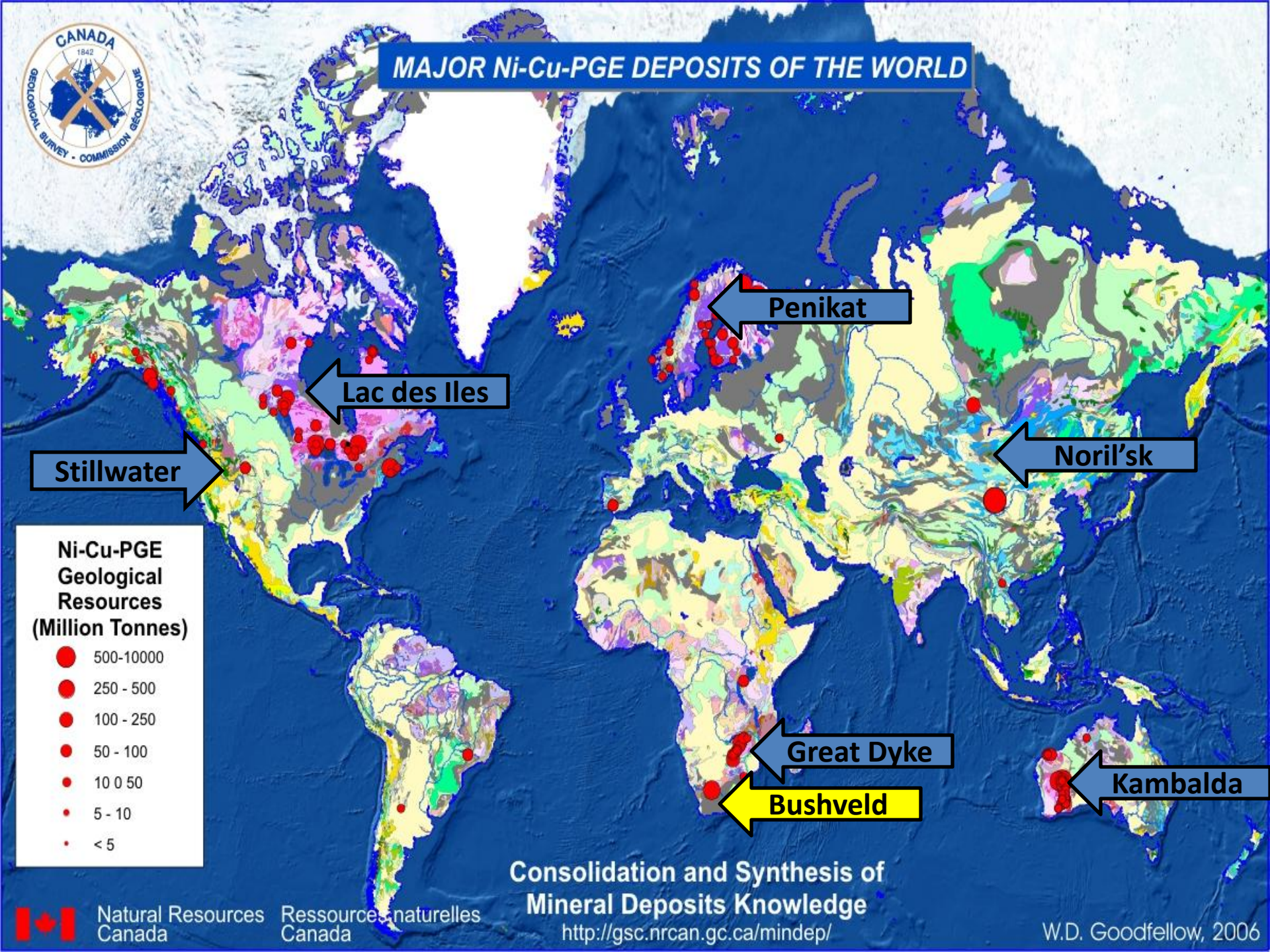
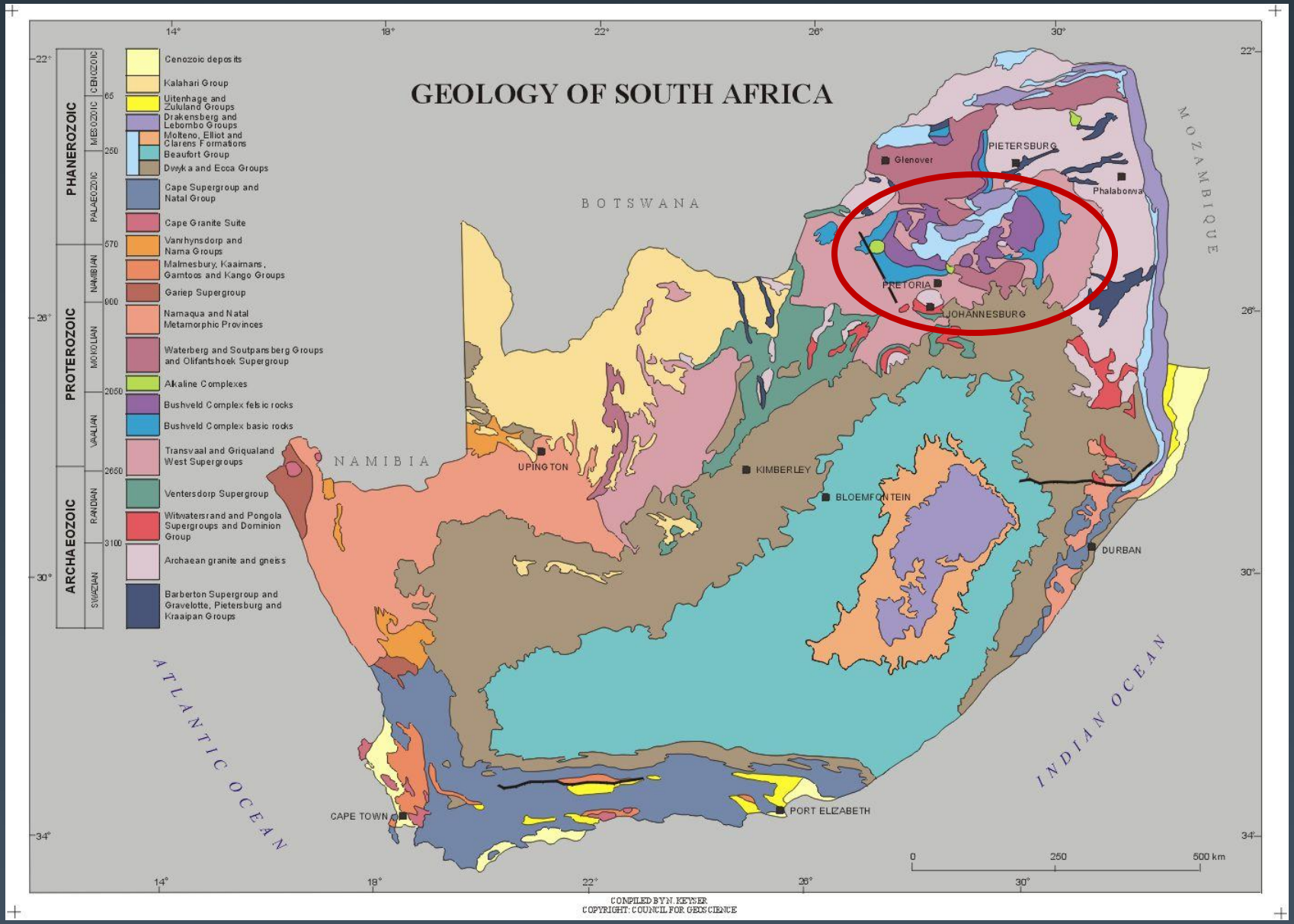
STRATEGIC AND TACTICAL DETERMINANTS FOR SOUTH AFRICAN PGM SUPPLY

Dr. Jeannette E. McGill


MAJOR Ni-Cu-PGE DEPOSITS OF THE WORLD
CANADA
1842
GEOLOGICAL SURVEY - COMMISSION GÉOLOGIQUE
Penikat
Lac des Iles
Stillwater
Noril'sk
Great Dyke
Bushveld
Kambalda
Ni-Cu-PGE
Geological
Resources
(Million Tonnes)
500-10000
250 - 500
100 - 250
50 - 100
10 0 50
5 - 10
< 5
Consolidation and Synthesis of
Mineral Deposits Knowledge
http://gsc.nrcan.gc.ca/mindep/
Natural Resources
Canada
Ressources naturelles
Canada
W.D. Goodfellow, 2006



(*Source: http://www.fdi.net/documents/WorldBank/databases/safrica/geoscience/)*

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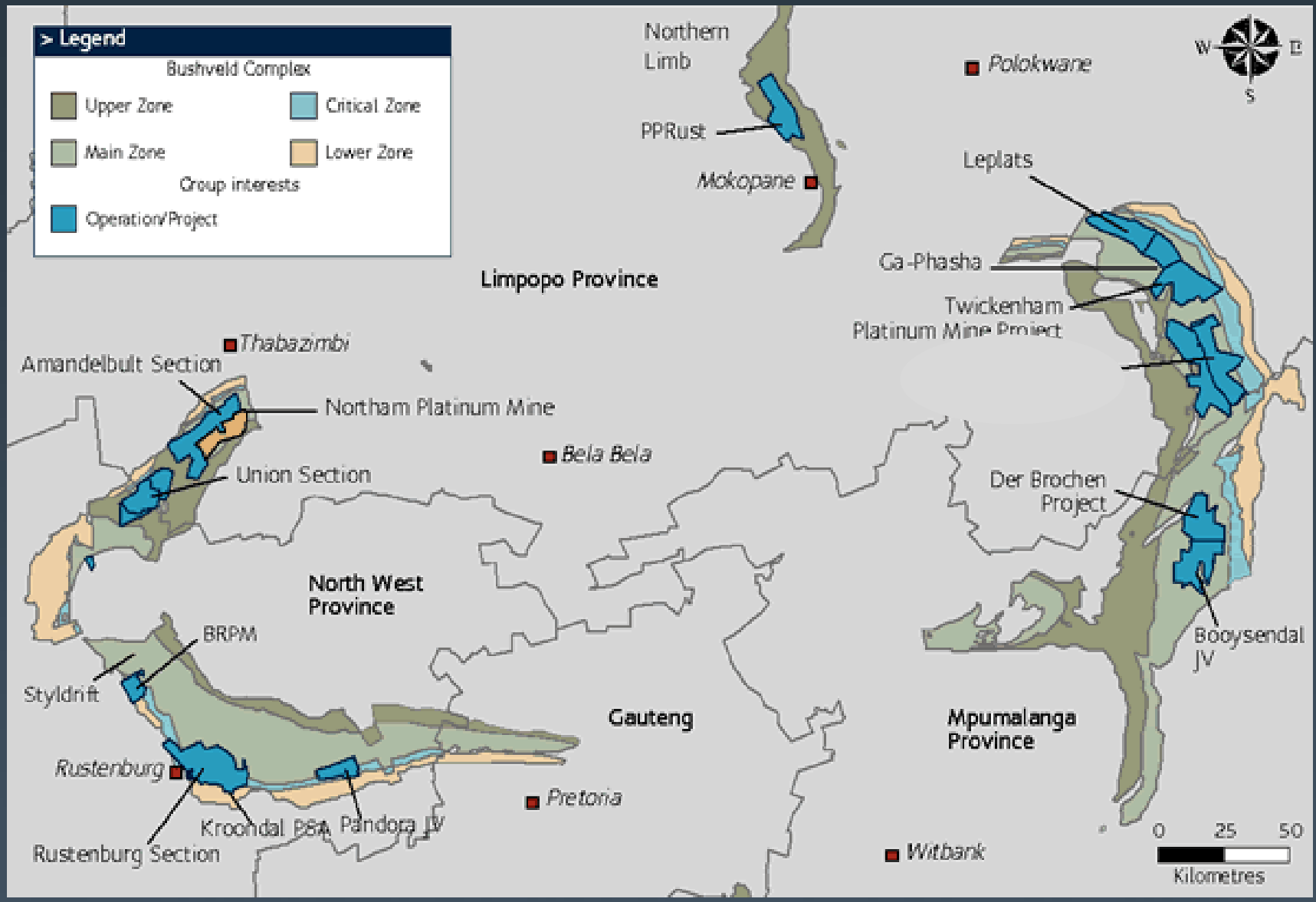
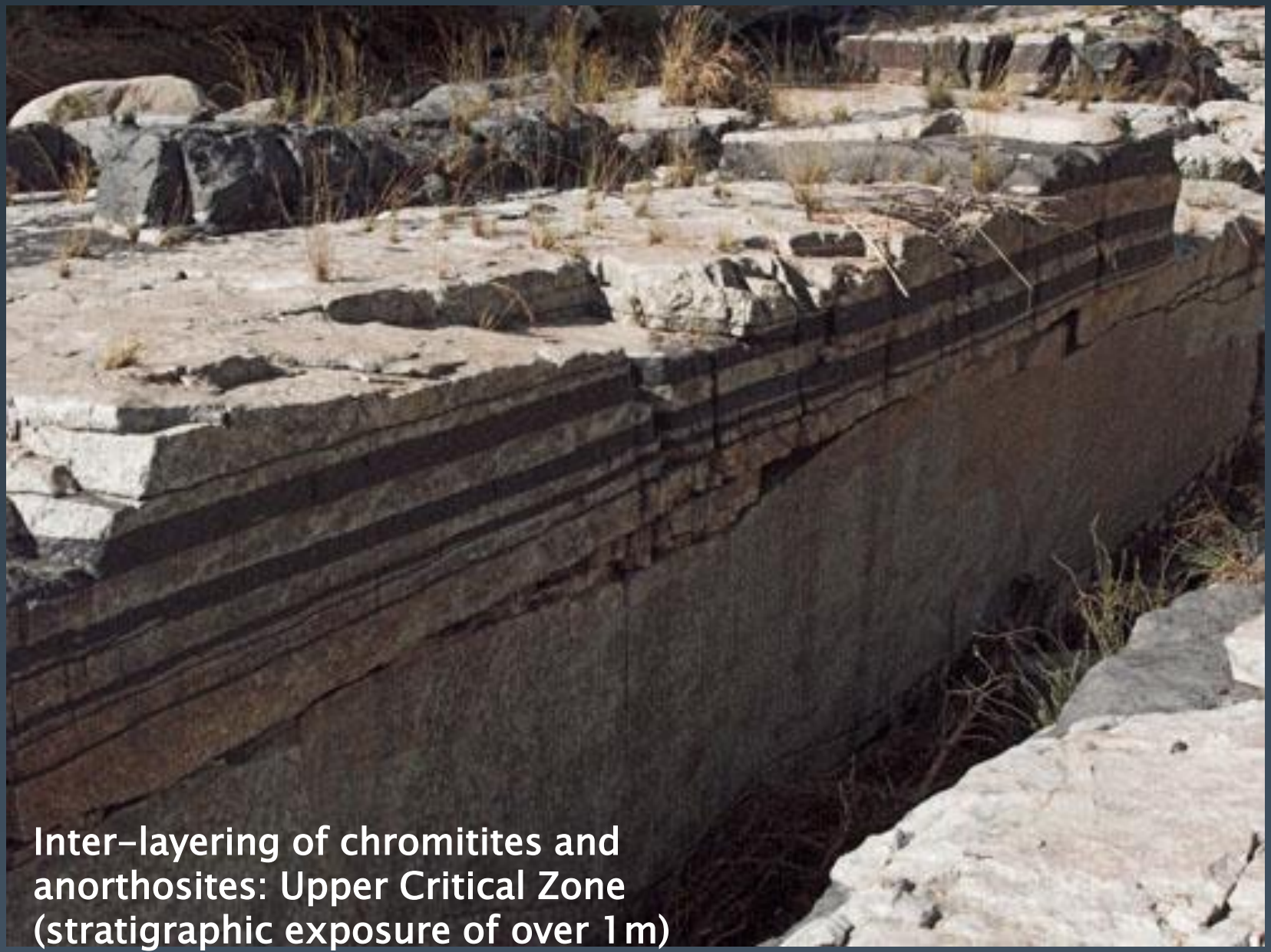
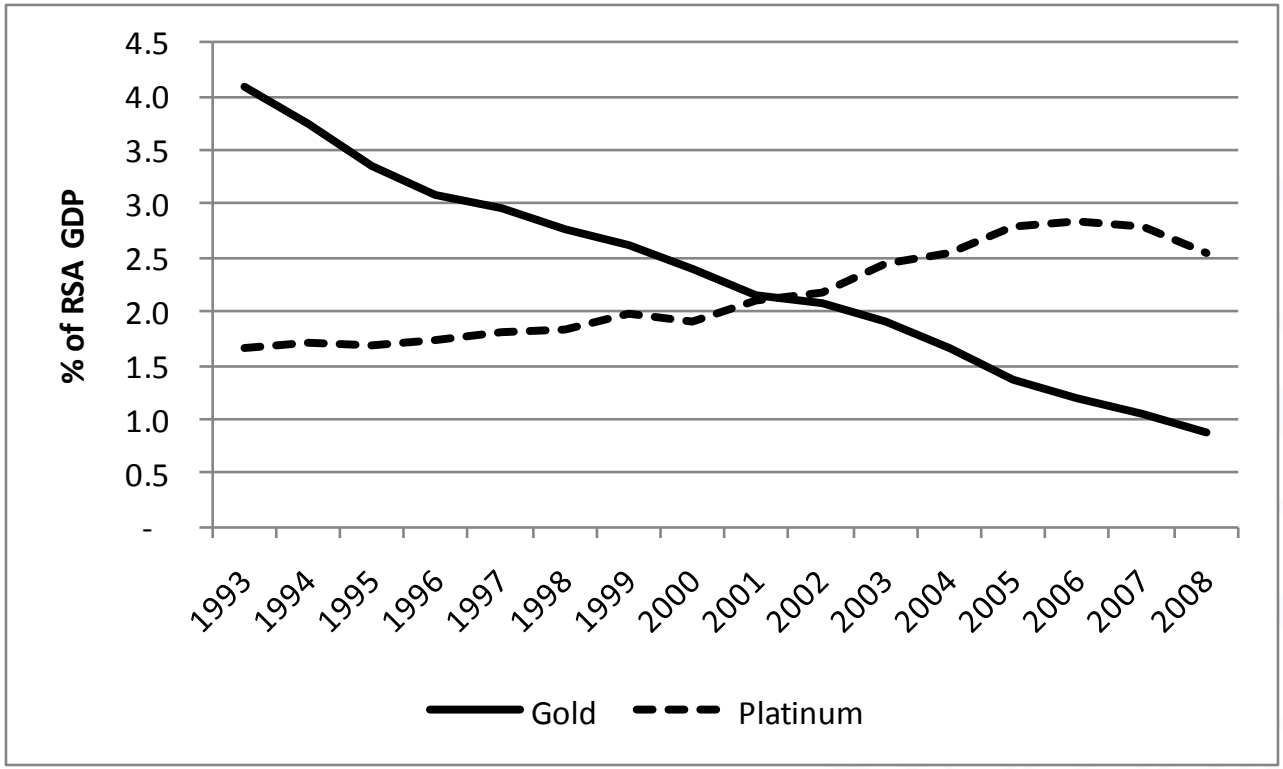


(Source: http://web.wits.ac.za/)



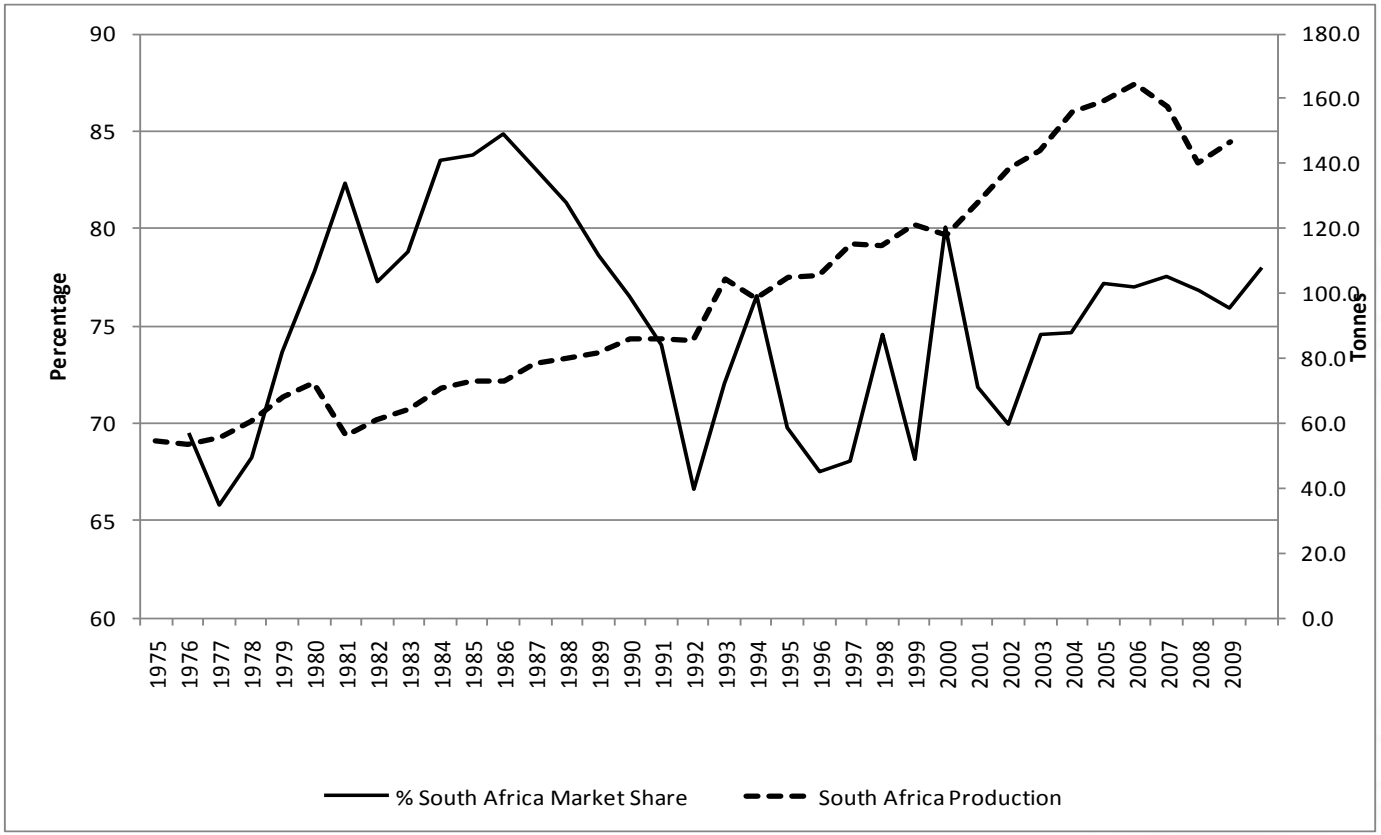
Inter-layering of chromitites and anorthosites: Upper Critical Zone (stratigraphic exposure of over 1m)

Gold and PGM sector South African GDP contribution



(Data source: Chamber of Mines)

Total South African PGM production and associated market share (1975–2009)



(Data source: Johnson Matthey, Raw Materials Group)

An analysis of South African PGM production potential to prolong global competitiveness

Can the Eastern Limb, Bushveld Complex, be considered, by investors, in preference to the Western Limb?

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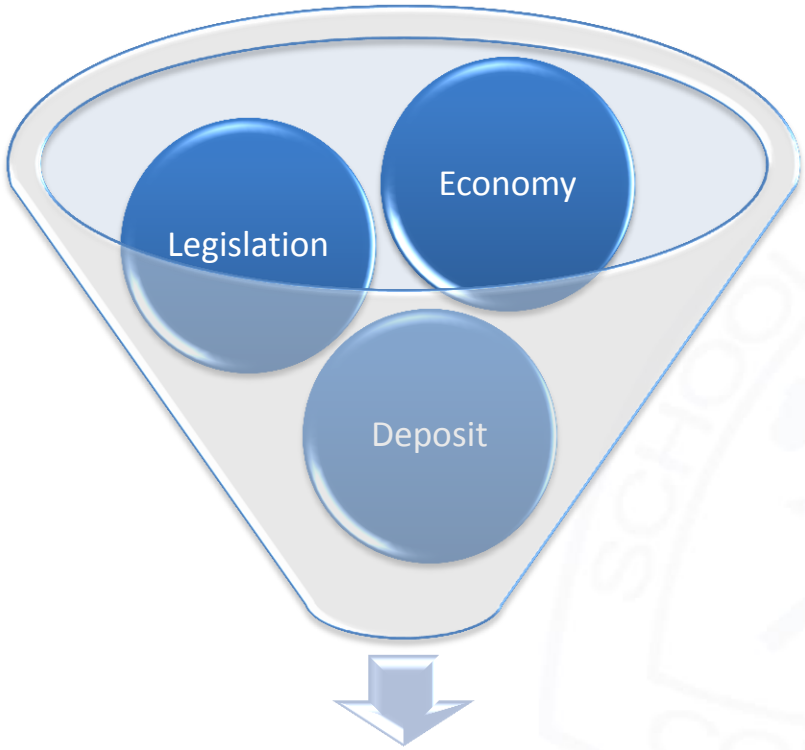
Strategic & Tactical determinants for the PGM sector



Geology | Mining | Econ | Infra

Strategic Determinants

	Factor	Description	Decision support
S1	Global PGM sector	Economic Fundamentals	Global Economy
S2	National Policy Framework	Legislative Environment to support resource development	RSA Governmental Frameworks
S3	Direct eastern limb factors	The Eastern limb contains sufficient deposit	Corporate strategic directives

Tactical Determinants

Geology | Mining | Econ | Infra

	Factor	Description
T1	Supply pipe-line – development phases	Resources and Reserves
T2	Mining supports safer mechanized techniques	Mining Engineering
T3	Economically competitive	Deposit economics, cash costs
T4	Adequate power and water, and refinery capacity	Infrastructure related

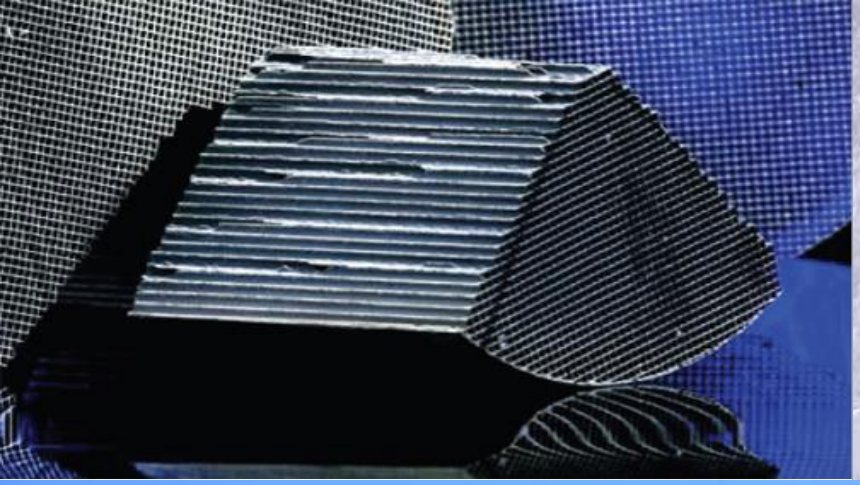
This work provides

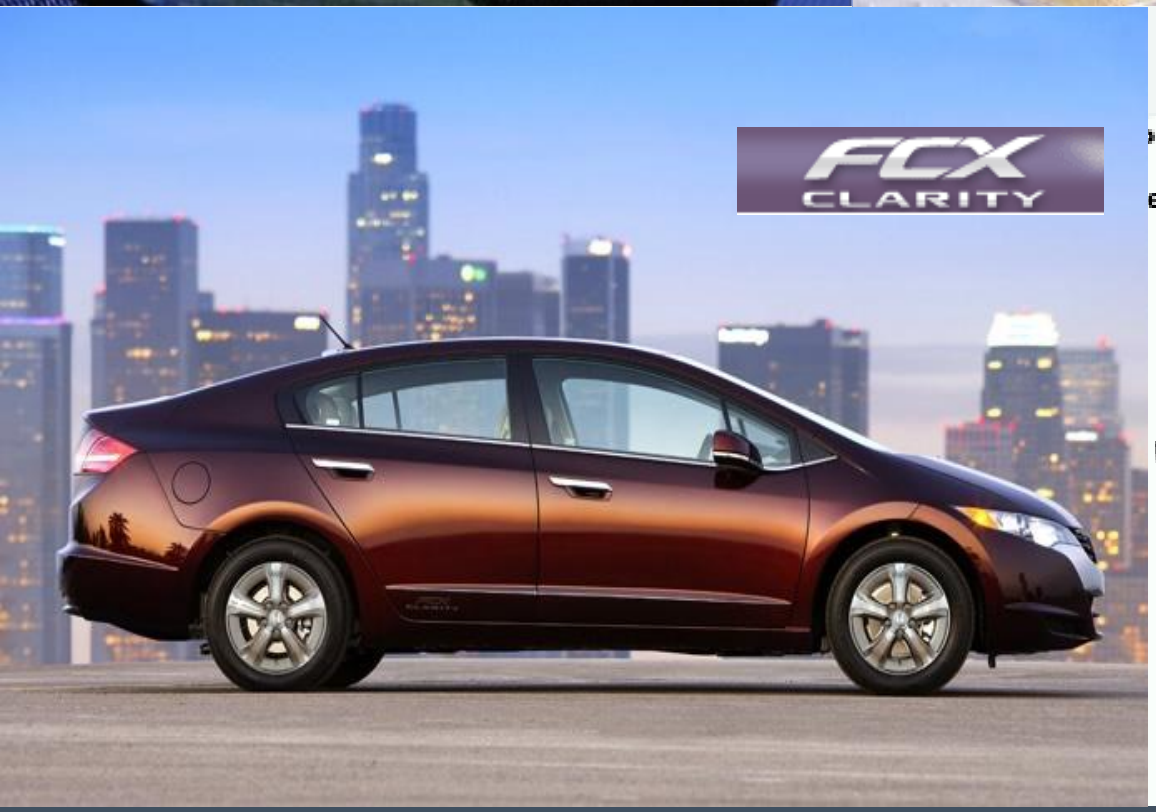
Integration of diverse data sources to provide a holistic, and strategic, view of the South African PGM landscape, with specific reference to the eastern limb, Bushveld Complex

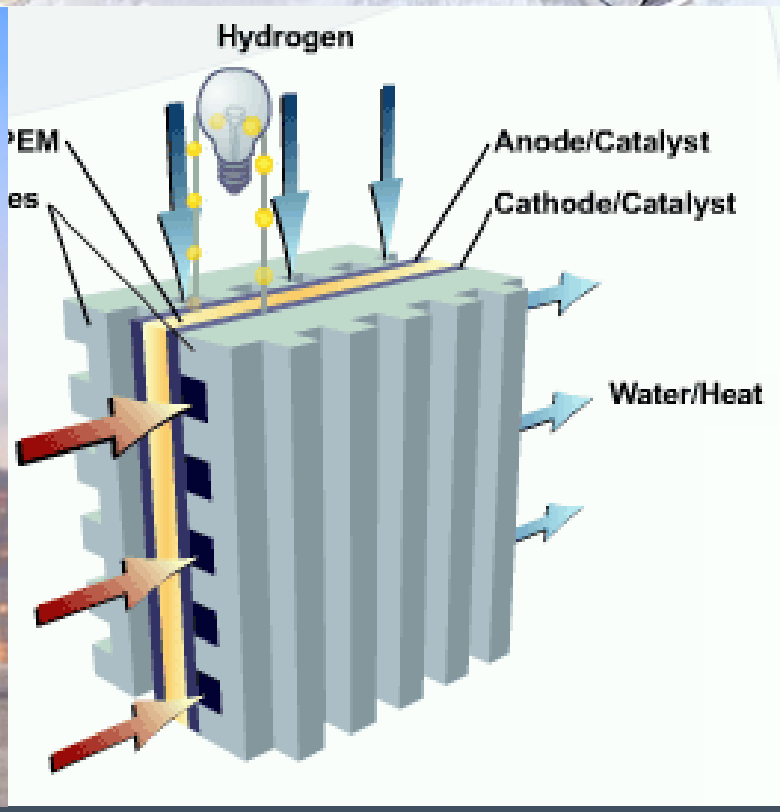
There is an overall lack of cumulative studies, in the public domain, that strategically and tactically appraise the South African PGM production sector

Strategic 1

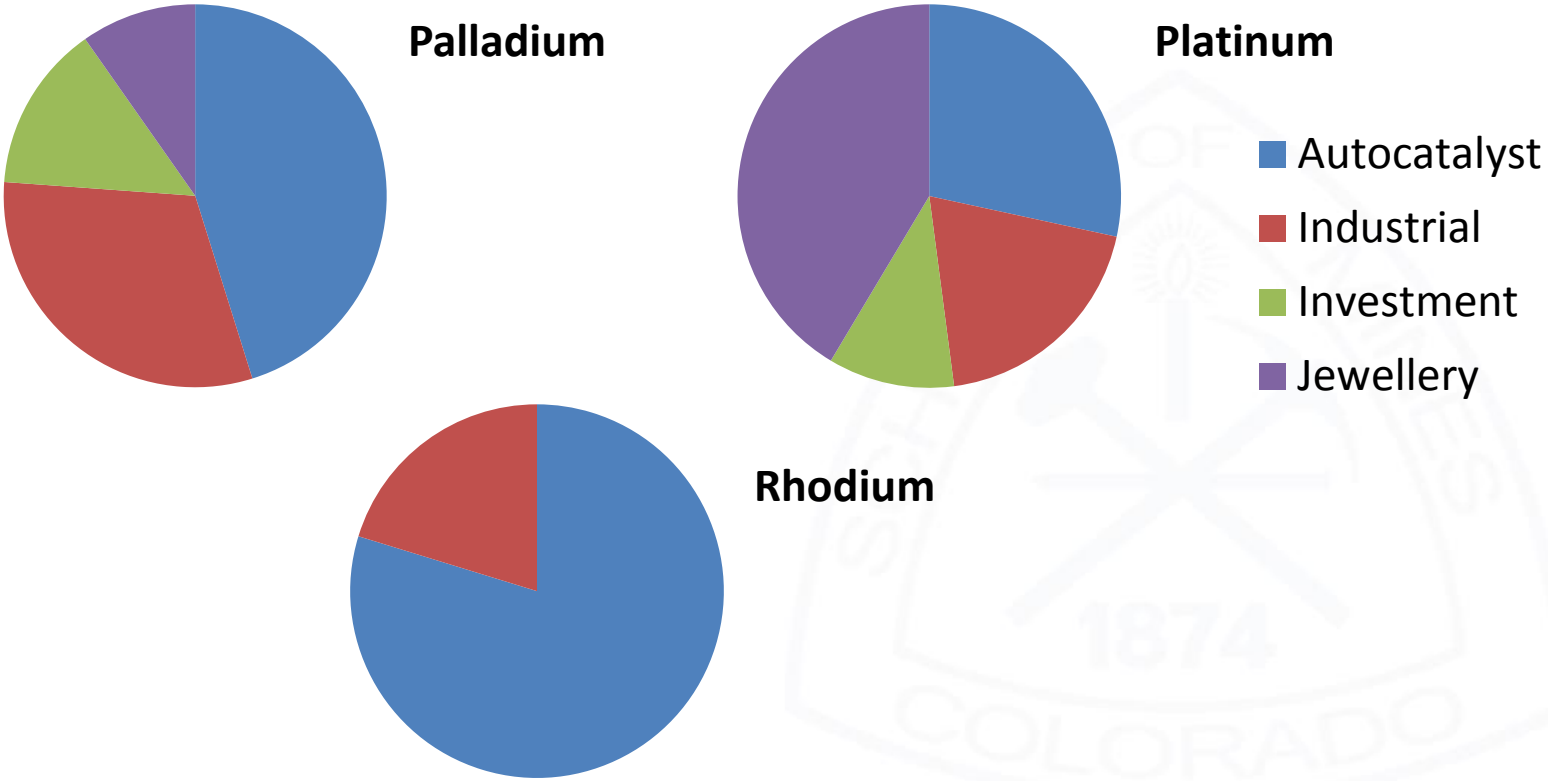
The long-run forecast of demand and supply dynamics underpin a continued need for PGM production




FCX
CLARITY


Hydrogen
Anode/Catalyst
Cathode/Catalyst
Water/Heat

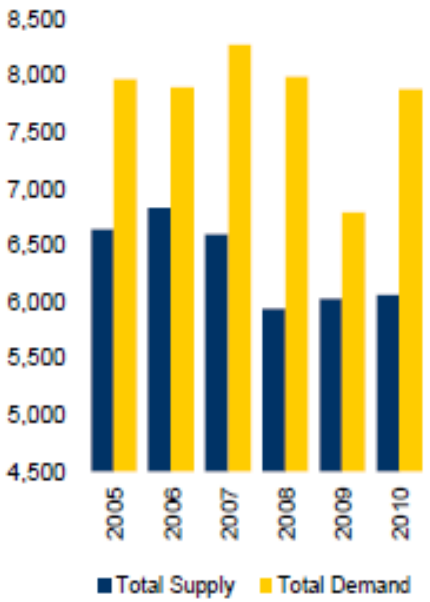
Global PGM demand per use sector (2010)



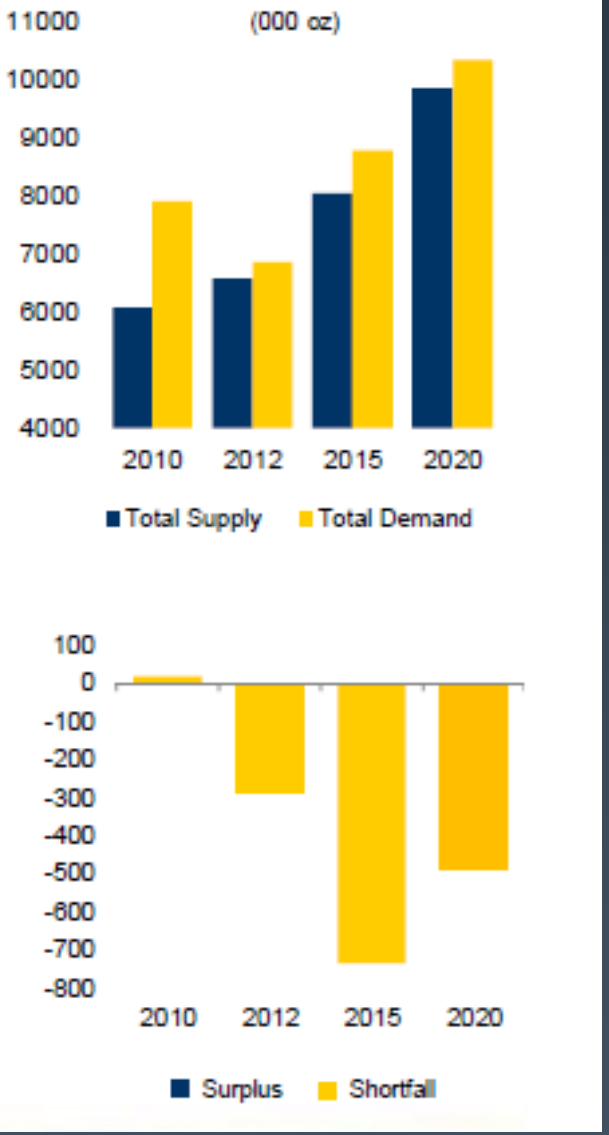
(*Data source: Johnson Matthey)*

Platinum Supply and Demand (JM 2010 Report)

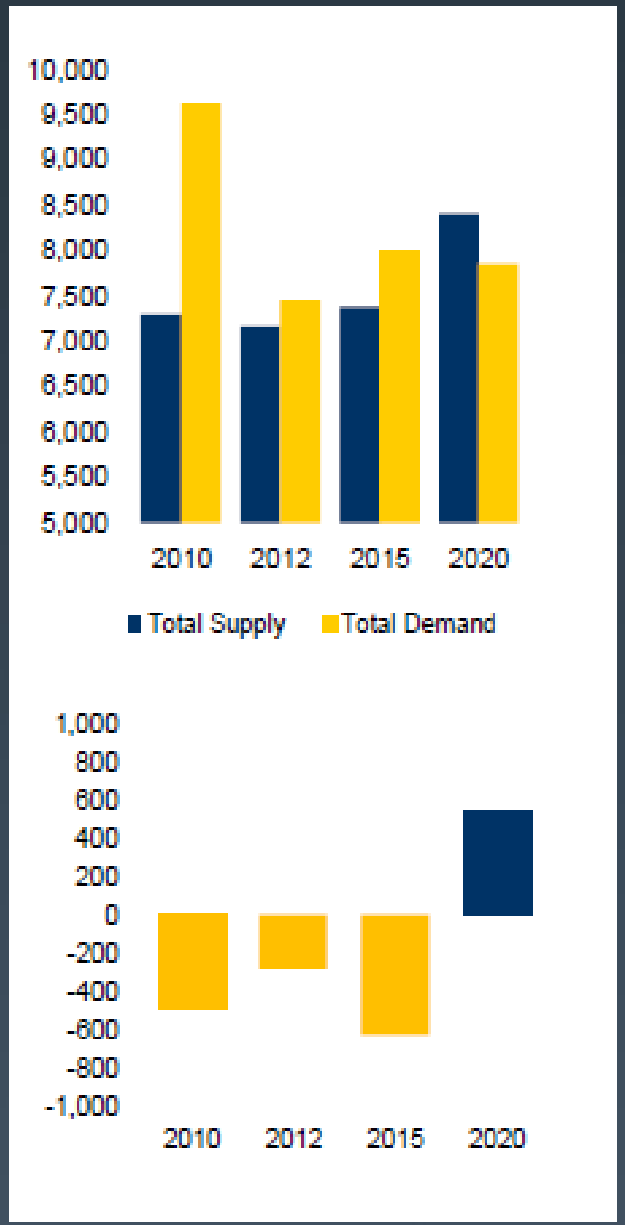
'000 oz		2005	2006	2007	2008	2009	2010
Total Supply		**6640**	**6830**	**6600**	**5940**	**6025**	**6060**
of which:	South Africa	5115	5295	5070	4515	4635	4635
	Russia	890	920	915	805	785	825
	N America	365	345	325	325	260	210
	Zimbabwe	155	165	170	180	230	280
Total Demand		**7965**	**7890**	**8270**	**7990**	**6795**	**7880**
of which:	Autocatalyst	3795	3905	4145	3655	2185	3125
	Jewellery	2465	2195	2110	2060	2810	2415
	Recycling	(1270)	(1415)	(1590)	(1830)	(1405)	(1840)
Movement in Stocks		**(55)**	**355**	**(80)**	**(220)**	**635**	**20**



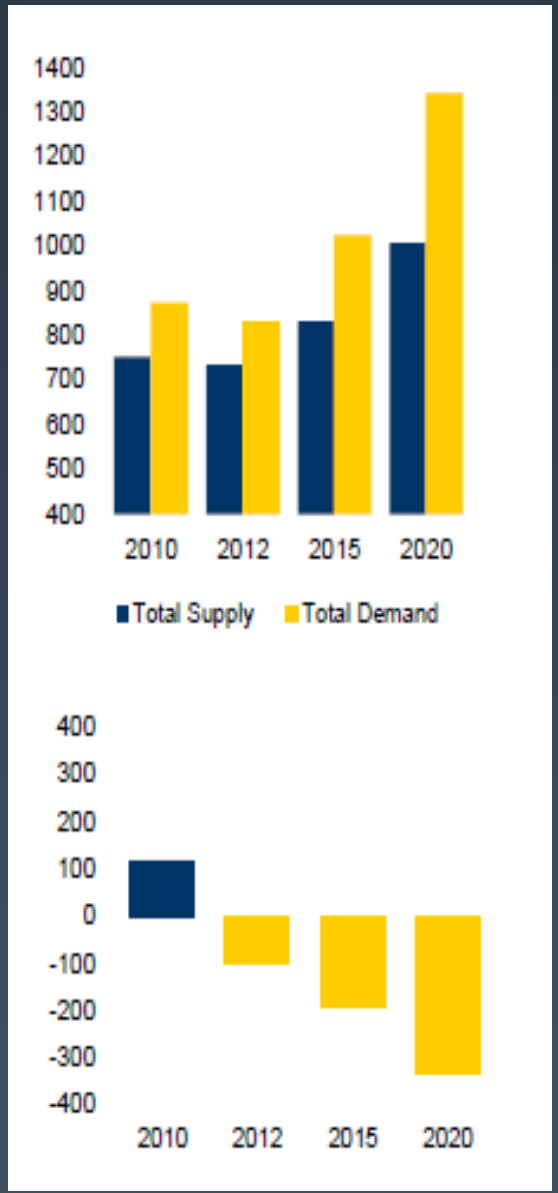
Platinum



Palladium



Rhodium



(Source: JM, 2010)

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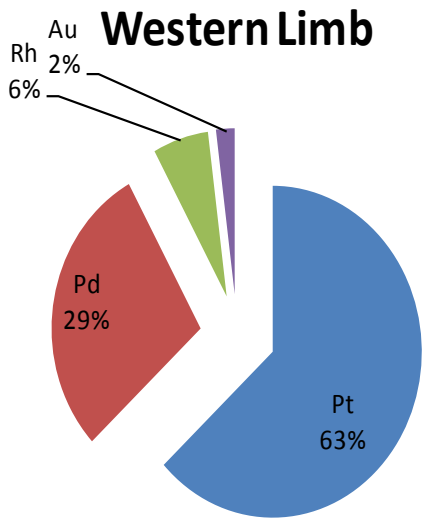
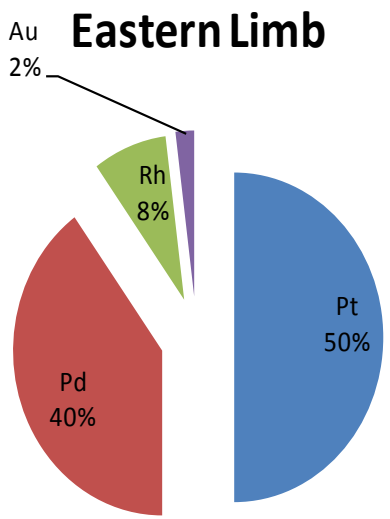
Mineral basket comparison





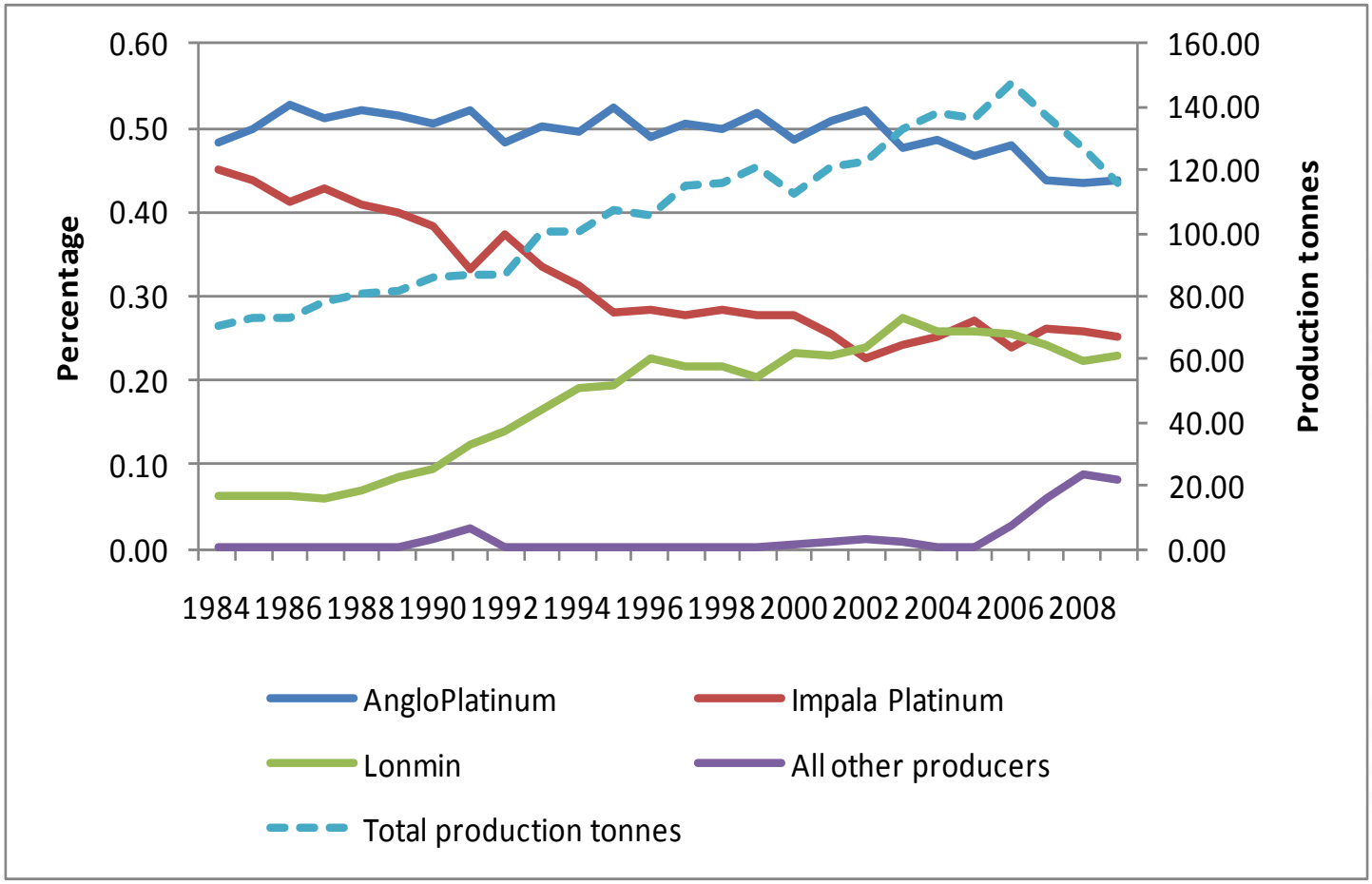
Long-run demand and supply trends

- Global demand for PGM's is forecast to be sustained – underpinned by auto catalyst and jewellery sector demand growth (especially from China)
- The world needs PGM's
- Can South Africa remain the number one global supplier?

Strategic 2

- Mineral and Petroleum Resources Development Act No. 28, 2002 (MPRDA)
- The Mineral and Petroleum Resources Royalty Act (28/2008) (MPRAA)

Legislative impact on market share

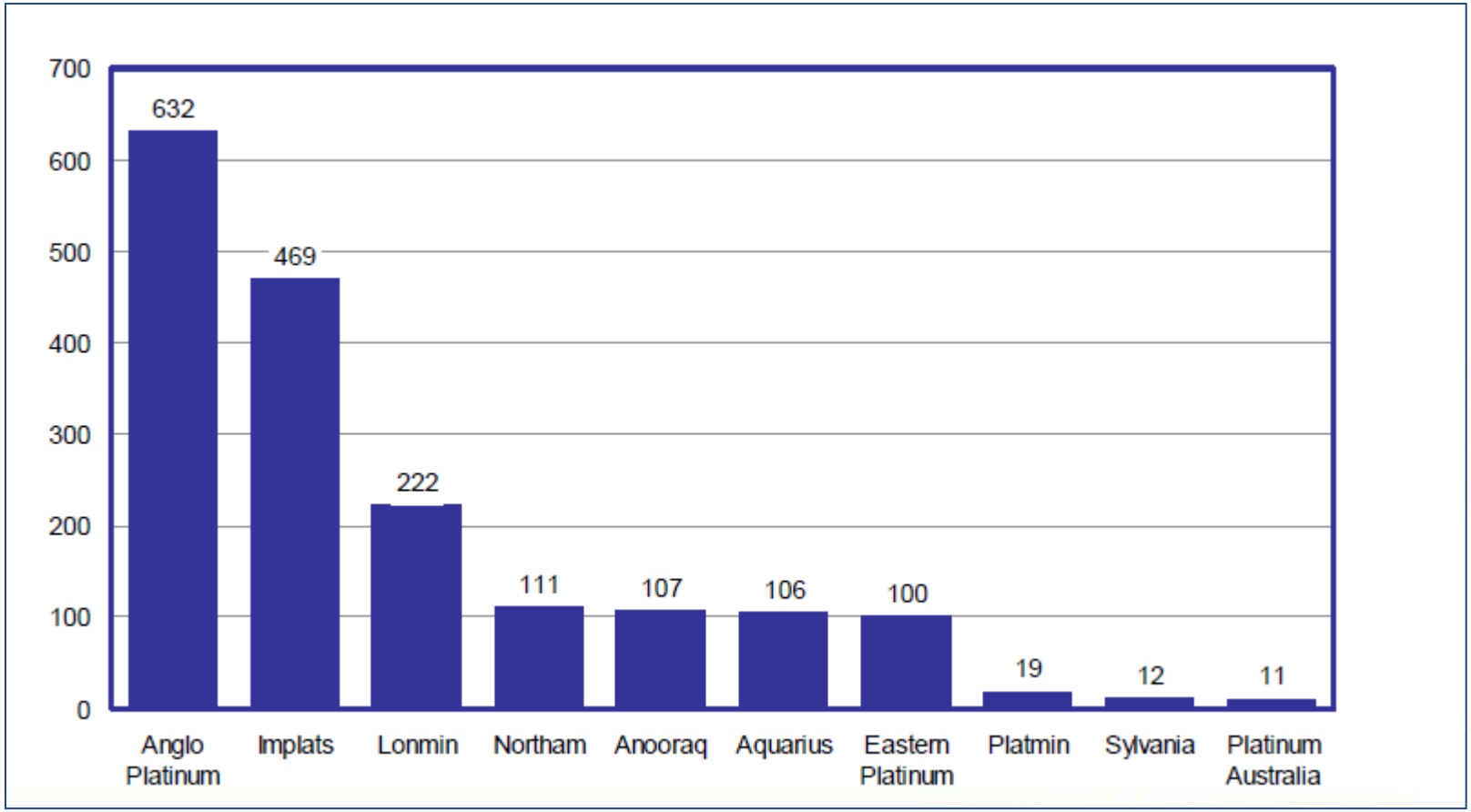


Mine Nationalization

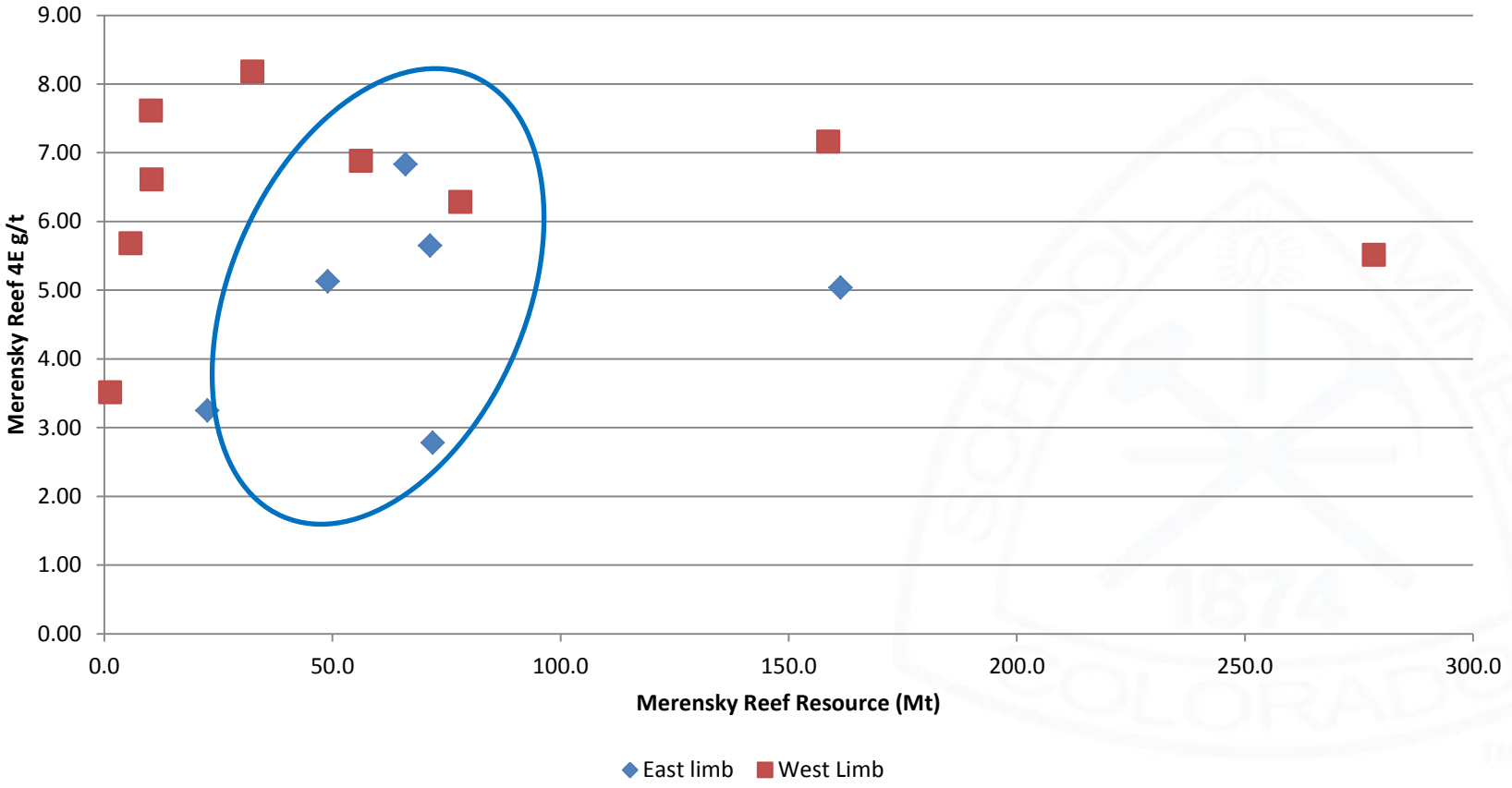
Strategic 3

The eastern limb contains deposits of sufficient size, and grade, to support mineral production

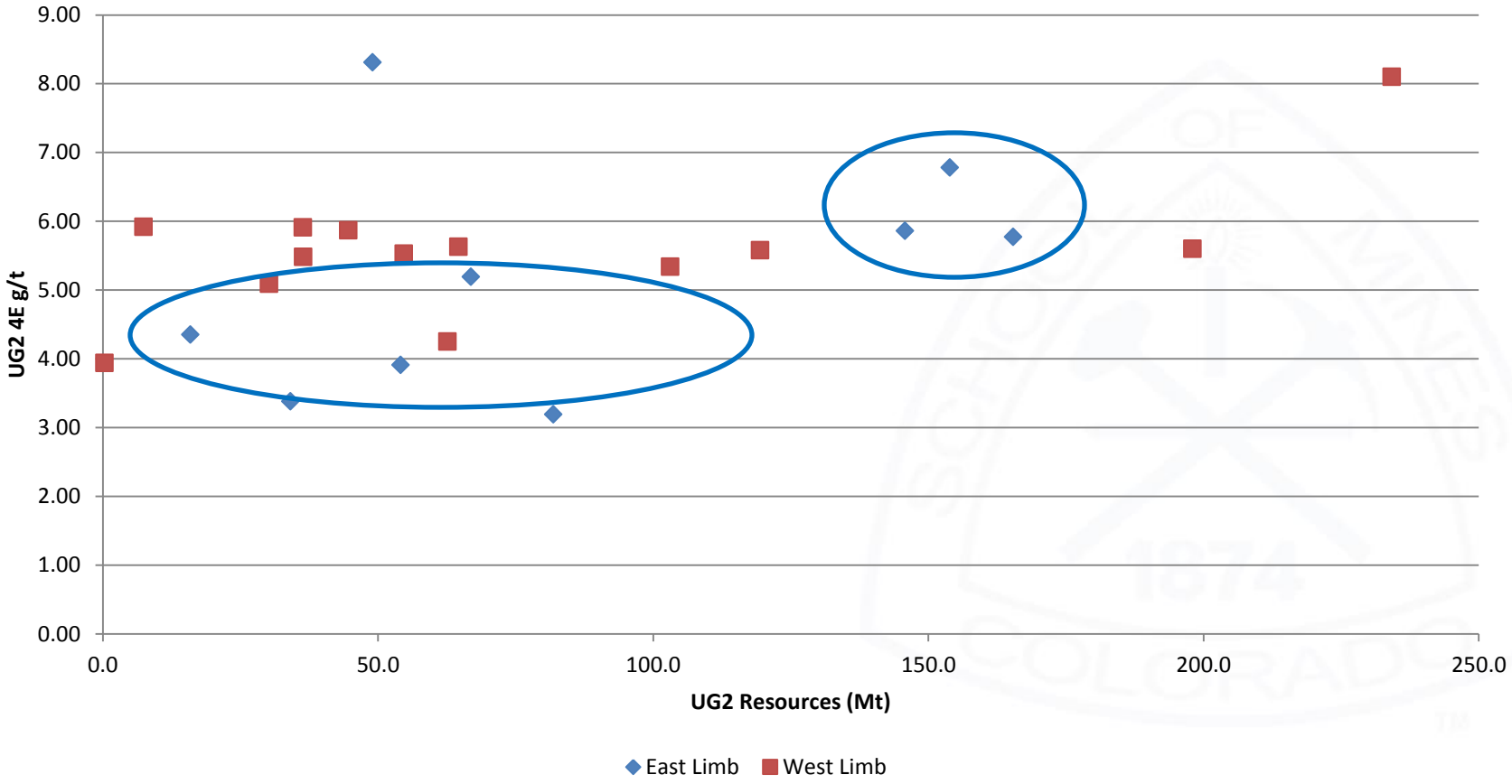
Producers – 4PGM resource base (ozM)



MR Resources versus grade



UG2 Resource versus grade



Tactical 1

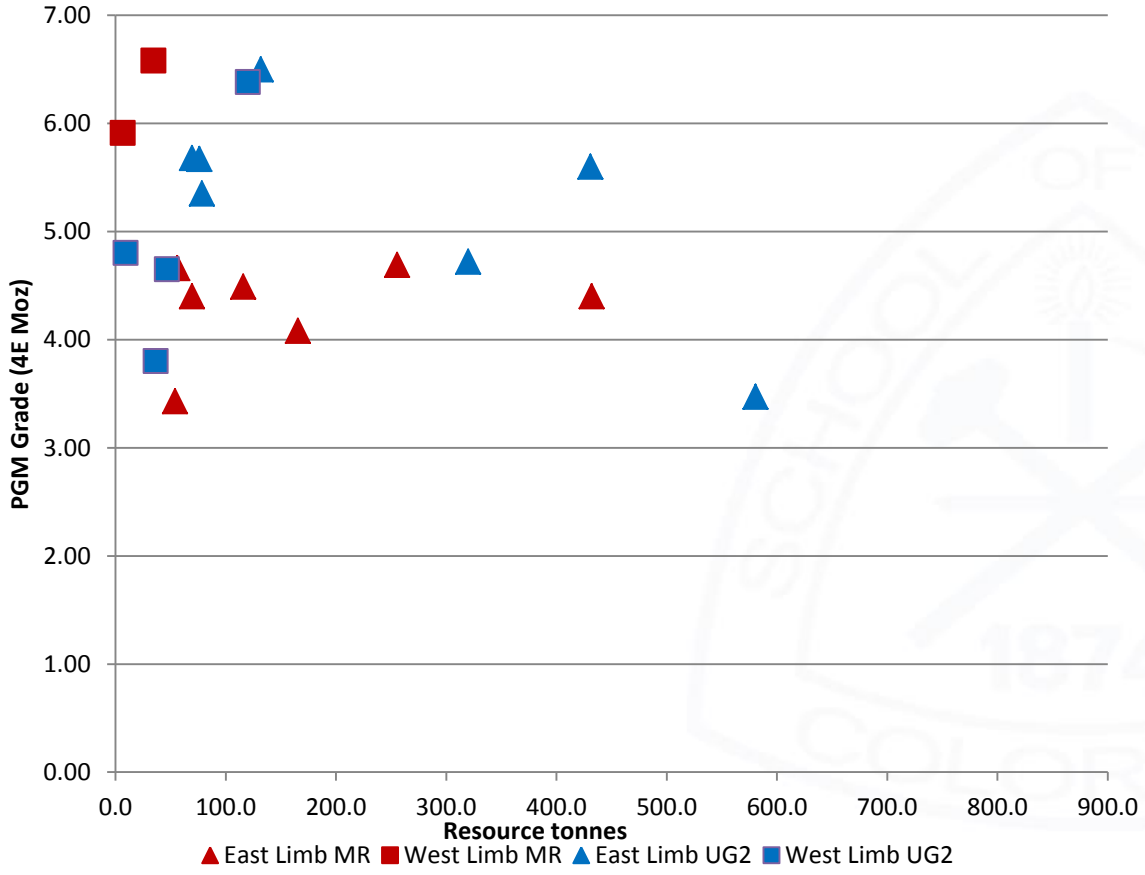
An eastern limb supply pipeline, comprising all phases of the mineral resource value chain is currently present

PGM pipeline per development phase

Phase	Total (2006)*	Total (2010)*	West (2010)	East (2010)
Initial Expl.	18	20	6	9
Adv Expl.	13	17	6	7
Pre-Feasibility	7	9	2	2
Feasibility	9	6	0	5
Construction	6	3	2	1
SUM	53	55	16	24

** Total includes North*

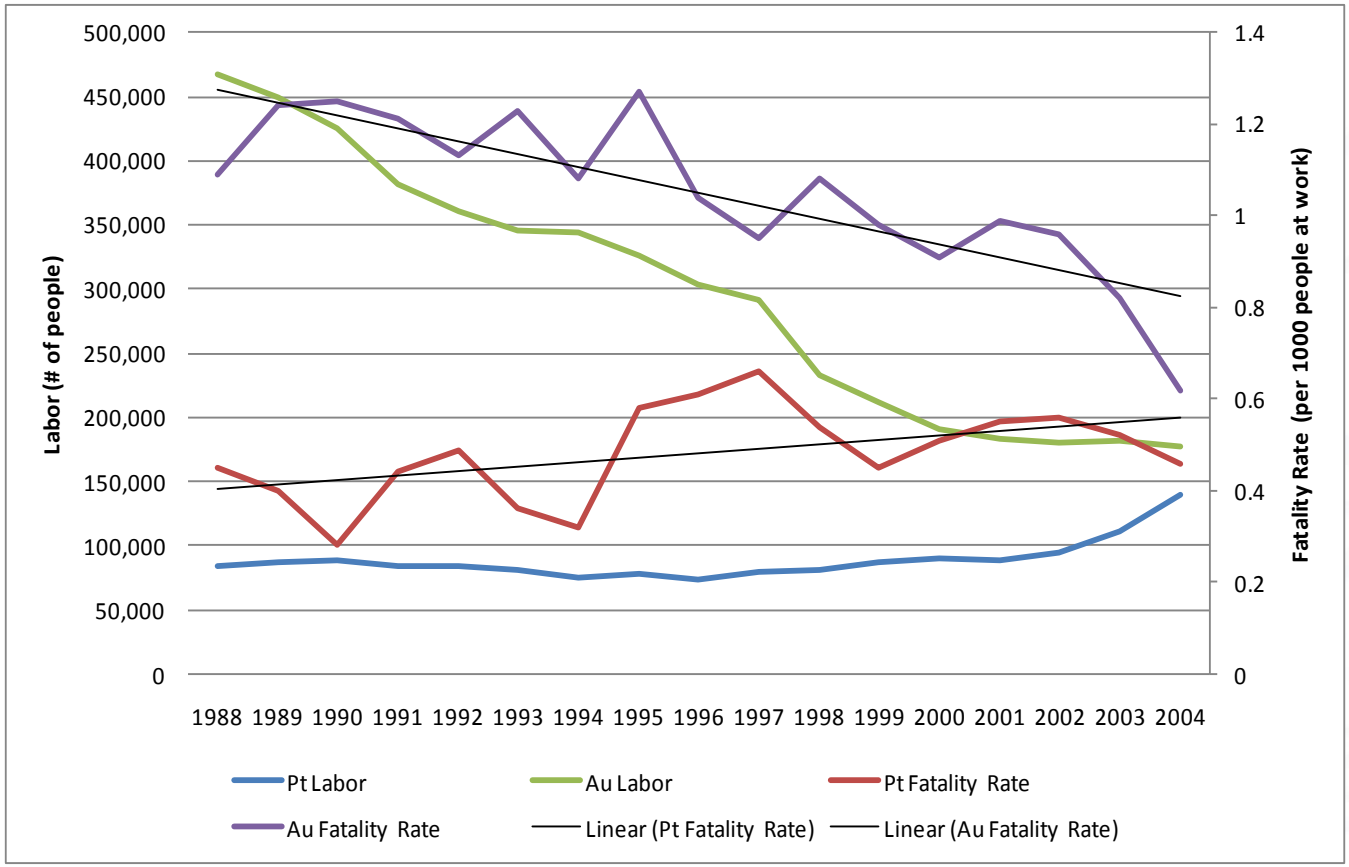
And pipeline resource tonnes



Tactical 2

Initial mining of the eastern limb will be at shallow to intermediate depth facilitating largely mechanized operations that are cost effective and safe

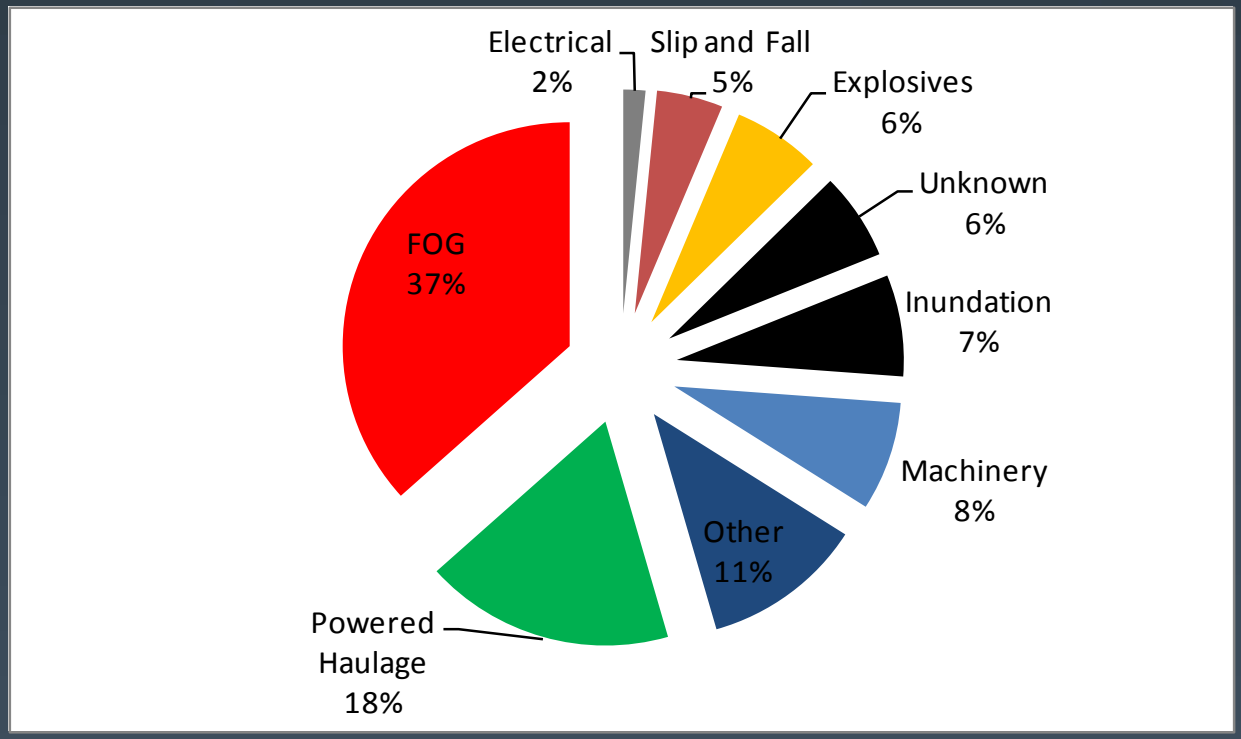
Mining safely



Western Limb – 1 fatality for 3.3 million tonnes broken

Eastern Limb – 1 fatality for 4 million tonnes broken

RSA – PGM
2005-2010
N=191
(Source: DMR)



West: 38% FOG
19% P/H

East: 41% FOG
12% P/H

Rock engineering implications

- The development of Bushveld specific rock-mass rating systems
- Optimal sequencing of UG2 and overlying Merensky reef – inducing comparable conditions to deep level mining

Conventional versus mechanized mining

Principle choice of mining method

Mining method	Prevalence	West	East
Mechanized – Bord and Pillar; XLP	26%	3	4
Hybrid – Mechanized tramming, conventional stoping	48%	10	5
Conventional – longitudinal breast, with handheld rock drills, material removal via box-holes using scrapers, rail hoppers	26%	3	2

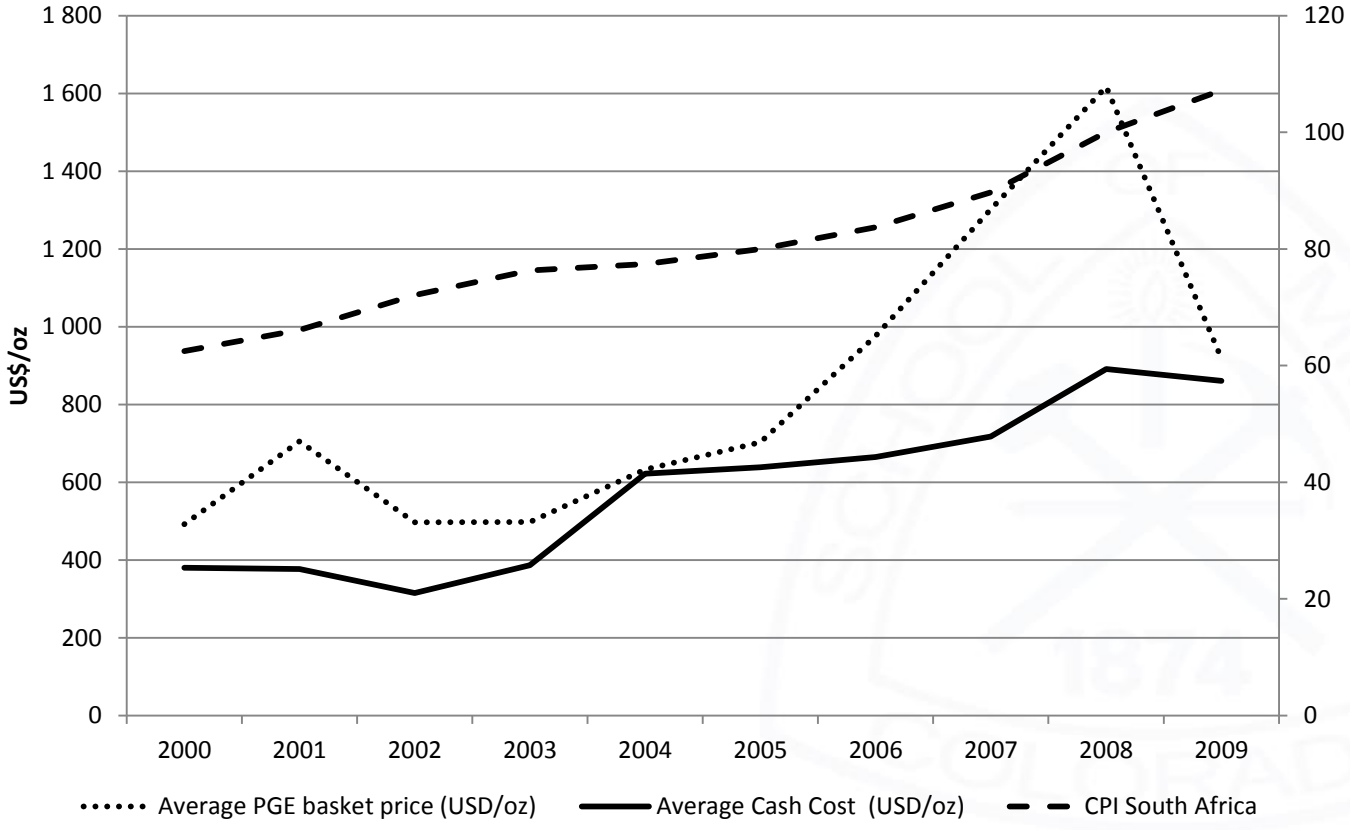
Mining costs per method

	Direct mining costs (July 2010)		
Mining method	**USD/m²**	**USD/tonne mined**	**USD/equiv reef oz**
Conventional	643-357	50-92	857-1643
Hybrid	472-542	57-93	1114-1643
Mechanized	257-414	39-42	886-1000
Open-pit		9-14	357-428

Tactical 3

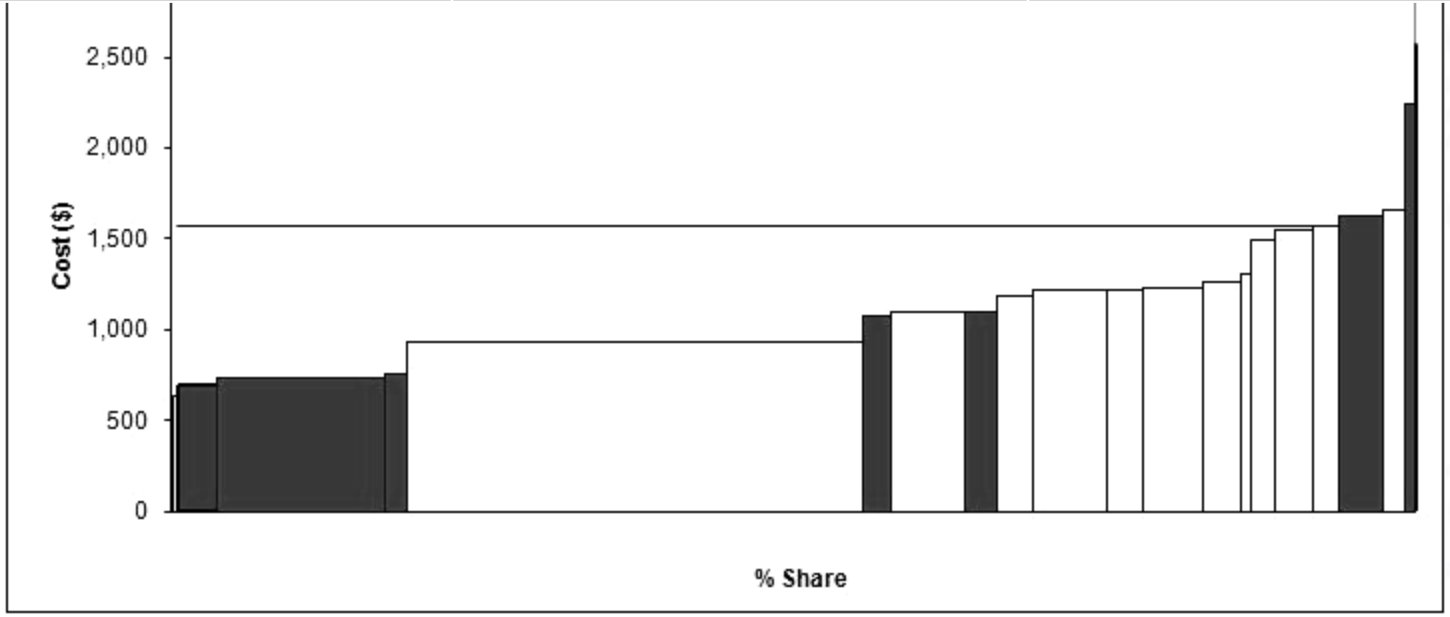
The production of PGM's on the eastern limb is economically competitive, relative to the continuation of western limb production

Producer economics



Cumulative cash costs – existing operations

	West	East
Average (USD/oz)	1,264	1,355
Range (USD/oz)	638 – 1,661	696 – 2,575



Tactical 4

Adequate power and water supply exists to support mine development on the eastern limb

Western versus Eastern limb infrastructure

WEST **EAST**

our future through science

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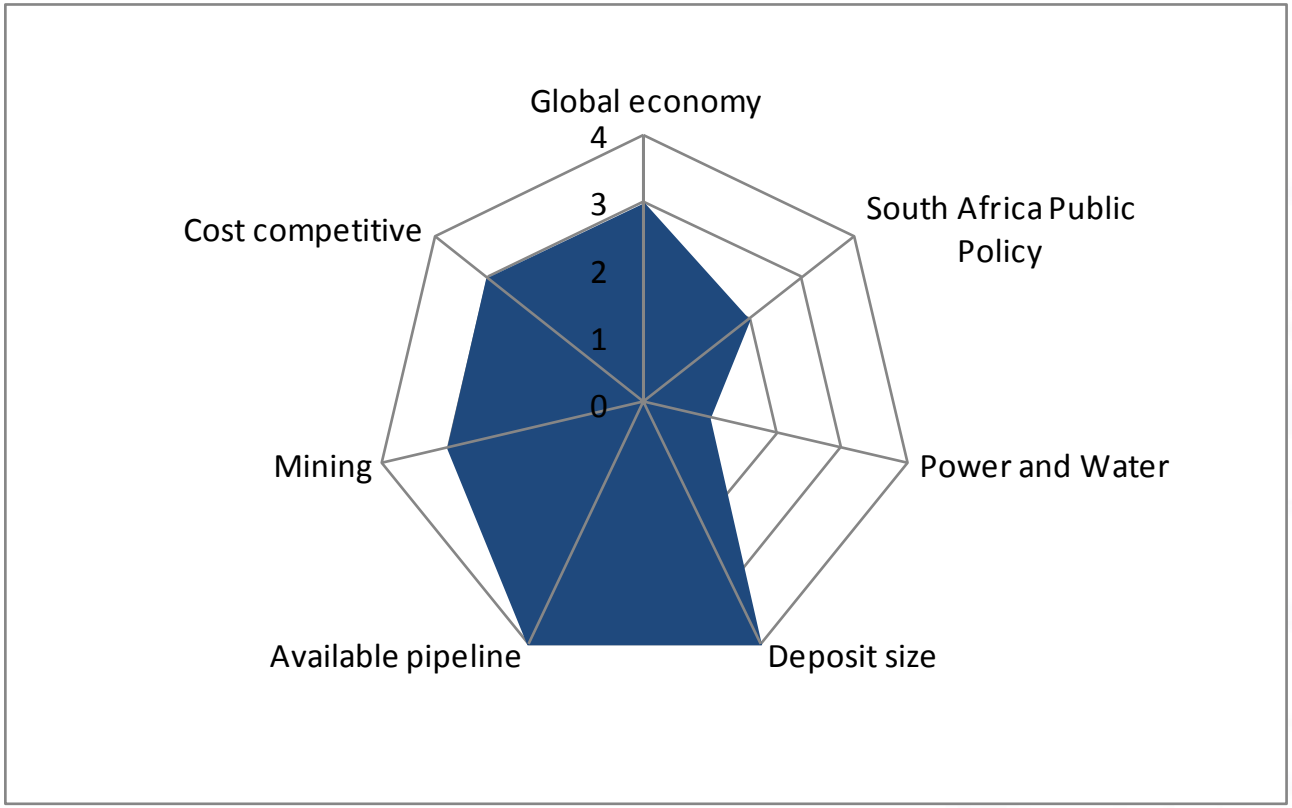
Power and water supply

2009	West	East
Power (MJ/t ore)	524	346
Water (M^3/t ore)	1.26	1.35

Data Source: Mudd (2010)

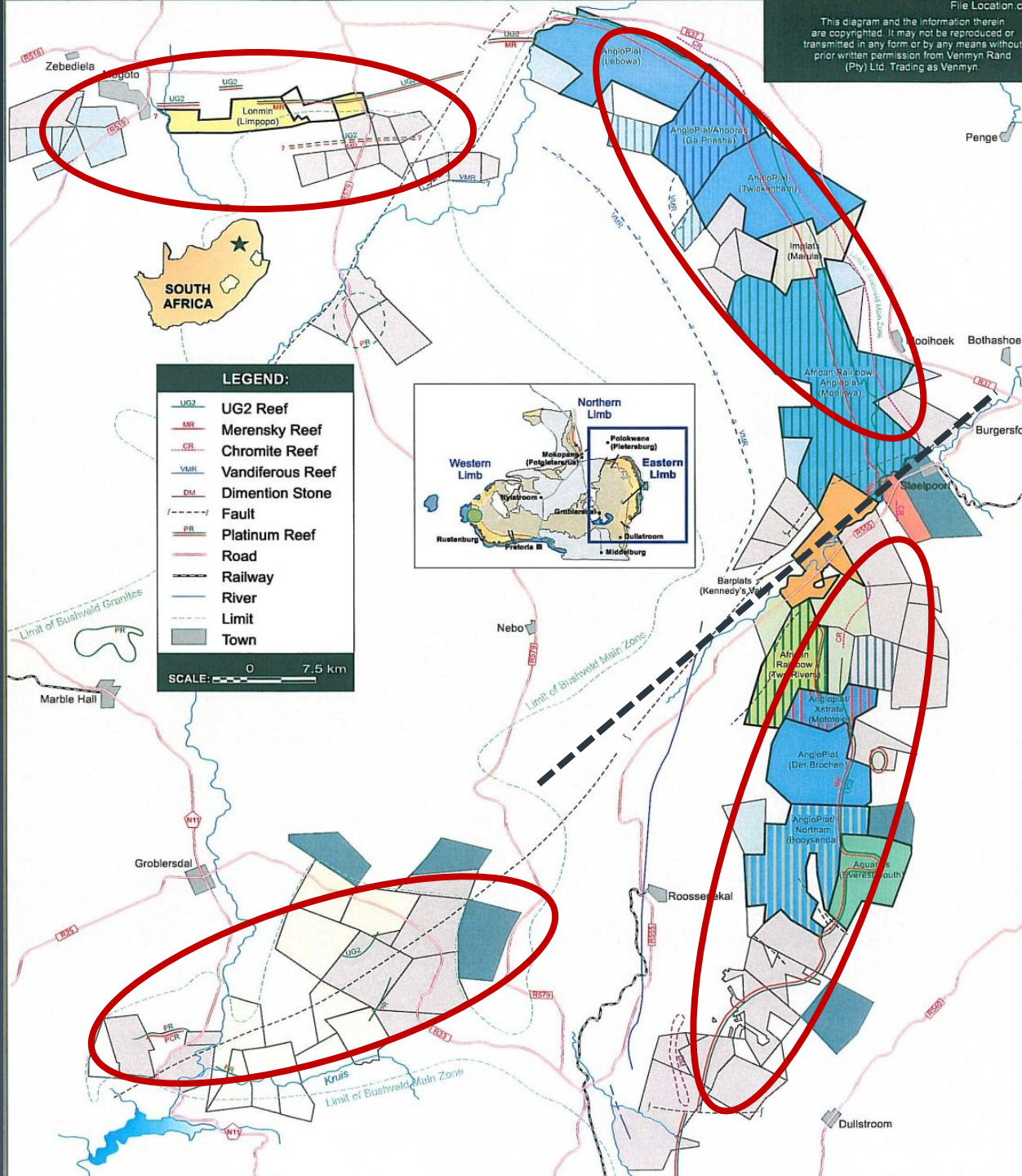
- Reality: Impact of global economic downturn has resulted in financing and development delays for: de Hoop Dam, Medupi power station
- With increased production there will be constraints
- Smelter availability and increased chromite concentrations

Core conditions – cumulative impact

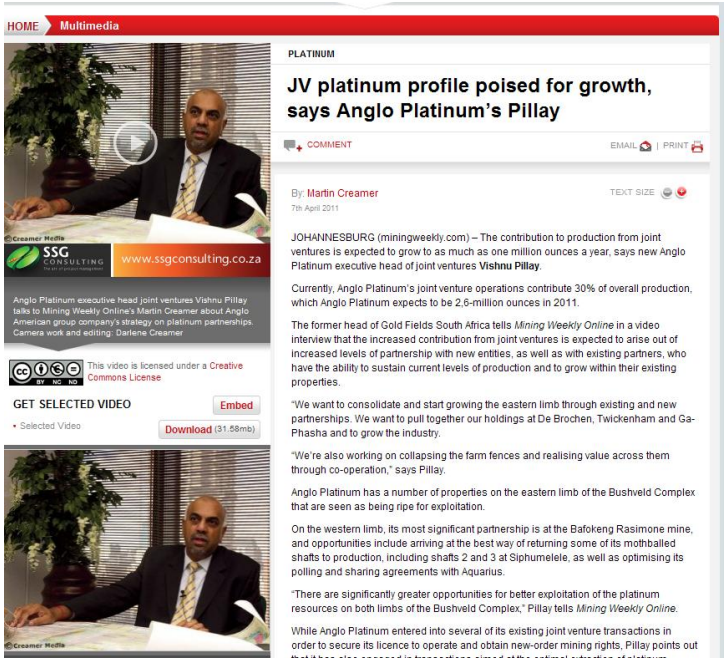


Regional development prospects

- Four main “regions”
- Contiguous lease area synergies
- Especially for water and power supply delineation



Creamer Media's MINING WEEKLY.com



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PLATINUM

JV platinum profile poised for growth, says Anglo Platinum's Pillay

COMMENT EMAIL | PRINT

By: Martin Creamer
7th April 2011

TEXT SIZE

JOHANNESBURG (miningweekly.com) – The contribution to production from joint ventures is expected to grow to as much as one million ounces a year, says new Anglo Platinum executive head of joint ventures **Vishnu Pillay**.

Currently, Anglo Platinum's joint venture operations contribute 30% of overall production, which Anglo Platinum expects to be 2,6-million ounces in 2011.

The former head of Gold Fields South Africa tells *Mining Weekly Online* in a video interview that the increased contribution from joint ventures is expected to arise out of increased levels of partnership with new entities, as well as with existing partners, who have the ability to sustain current levels of production and to grow within their existing properties.

"We want to consolidate and start growing the eastern limb through existing and new partnerships. We want to pull together our holdings at De Brochen, Twickenham and Ga-Phasha and to grow the industry.

"We're also working on collapsing the farm fences and realising value across them through co-operation," says Pillay.

Anglo Platinum has a number of properties on the eastern limb of the Bushveld Complex that are seen as being ripe for exploitation.

On the western limb, its most significant partnership is at the Bafokeng Rasimone mine, and opportunities include arriving at the best way of returning some of its mothballed shafts to production, including shafts 2 and 3 at Siphumelele, as well as optimising its polling and sharing agreements with Aquarius.

"There are significantly greater opportunities for better exploitation of the platinum resources on both limbs of the Bushveld Complex," Pillay tells *Mining Weekly Online*.

While Anglo Platinum entered into several of its existing joint venture transactions in order to secure its licence to operate and obtain new-order mining rights, Pillay points out

We want to consolidate and start growing the eastern limb through existing and new partnerships. We're also working on collapsing the farm fences and realising value across them through co-operation"

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Outcomes

- Significant potential exists for regional planning and co-operation: contiguous lease area synergies, regional geological (pothole) investigations; also consider lessons from the western limb and Witwatersrand
- The most inhibiting production constraints are “above-ground” risks
- South Africa could remain globally competitive in the supply of PGM’s if the above ground risks are mitigated successfully

Can the Eastern Limb, Bushveld Complex, be considered, by investors, in preference to the Western Limb?

Through investigation of both strategic and tactical determinants; the eastern limb is considered *moderately* viable to produce PGM's in preference to the western limb

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THANK YOU