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Options for PGM supply outside of Africa

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This conference paper provides an overview of PGM junior sector activities outside of Africa. An analysis of project resources, in terms of size, PGM grade and co-/by-product associations, is presented and contextualized with existing miners' resources in the corresponding regions. A high-level assessment of regional risks to production is provided. Finally, using SFA's independent supply-demand projections and estimates of the potential contribution from global PGM projects, conclusions are drawn on whether the industry can meet future demand requirements.

Introduction

Africa hosts the two largest PGM deposits globally: the Bushveld Complex in South Africa and the Great Dyke in Zimbabwe. These deposits are estimated to contain close to 2.5 billion ounces of PGMs combined. However, the Bushveld Complex is mature and most of the known mineable resources have been exploited or staked out by major producers and, to a lesser extent, by the junior sector.

The Great Dyke as a mining region is at an early stage of development, with a comparatively small proportion of its PGM resource potential delineated. The country has historically presented a heightened investment risk owing to political instability and social and economic mismanagement, which has inhibited or deterred both major producer and junior company activities. Despite the formation of a unity government, security of land tenure is an issue that continues to affect the timing of planned expansions and projects.

This paper considers the potential for PGM production in other regions. The aims are to provide a concise outline of junior sector activities outside of Africa, comparing deposits in terms of size and composition, and highlighting potential barriers to production.

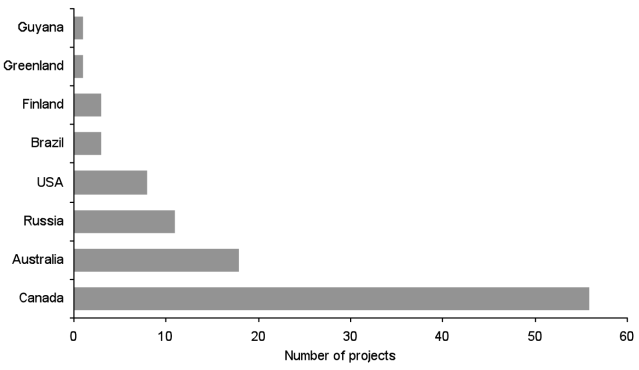

Figure 1. Location of projects. Source: SFA (Oxford)

Junior sector activity

SFA has examined the global PGM junior sector in detail, identifying upwards of 100 projects and prospects outside of Africa. These projects target PGMs and co- and by-product metals in varying combinations and concentrations, depending on the region. Junior companies are exploring in at least eight countries around the world and encompass a broad spectrum of development, from reconnaissance work to scoping, feasibility and construction. A breakdown for the peer group analysed in this paper is illustrated in Figures 1 and 2.

Financing

Appreciating PGM and base metal prices established a buoyant junior sector in PGMs prior to mid-2008. A number of junior companies subsequently halted their activities following the deterioration of the global financial markets that made securing finance extremely challenging and the accompanying decline in metal prices, which substantially eroded project valuations. Moving into 2010,

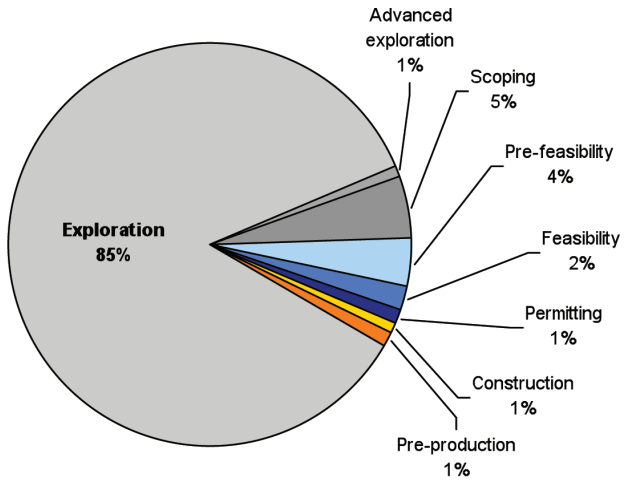

Figure 2. Junior sector project status'. Source: Company reports and websites, SFA (Oxford)

market conditions began to improve and financing for the mining sector is now becoming more readily available, as indicated on the exchanges.

New mining issues on the Alternative Investment Market (AIM) were recorded in Q4'09 for the first time since Q3'08, according to Ernst & Young's Mining Eye report. Encouragingly, this continued in Q1'10. Latest data (for Q1'10) show that total mining issues have risen by 65% since Q4'08 and funds raised have increased by a corresponding £48 million. The mining sector now accounts for more than 20% of total funds raised on AIM. This is a marked improvement on the 2008 low of 15.5% in Q3, when the full impact of the global financial crisis was being felt. Similarly, new mining listings on the Toronto Stock Exchange have increased sharply in Q1'10 with 43 new listings recorded for the quarter (C$3 billion raised), compared with just over 100 listings for 2009 (C$22 billion) as a whole.

Project characteristics

A total of 6.8 moz of PGM reserves have been delineated for the peer group. This includes two projects in Canada and one in Finland. Inclusive of reserves, 71 moz of PGM resources are reported for the peer group cumulatively, with platinum accounting for 15.7 moz and palladium for 40 moz. The distribution by country is shown in Figure 3. With 86% of the peer group being at exploration stage (including advanced exploration), only 20% of projects have resources defined at this time.

Total resources for projects in the US are more than double those reported for existing mines (Stillwater, East Boulder). Conversely, Canadian project resources equate to one-quarter of those delineated by established miners, including Xstrata and Vale, despite the fact that half of the peer group that have issued resource statements are located here. The same is true of Russia, where Norilsk's resources are more than 40 times as large as total Russian project resources.

Figure 4 highlights that the largest projects tend to be lower grade. The Nokomis project in the US, owned by Duluth Metals, is the largest project in terms of resource volume. The project comprises more than 820 mt of ore and 17.7 moz of PGMs. The scale of the deposit offsets the relatively low PGM content of ore (weighted average <0.7 g/t for indicated and inferred resources). Also in the US, PolyMet's NorthMet project has measured, indicated and inferred resources totalling almost 520 mt, but with a weighted average resource grade of 0.42 g/t, it comprises 7 moz of PGMs.

The highest grade projects are Noront Resources' Eagle One (5.5 g/t) and Wallbridge Mining's Broken Hammer (3.8 g/t), both located in Canada. Eagle One has indicated and inferred resources totalling 2.9 mt, while Broken Hammer has inferred resources of just 0.3 mt.

With the exception of Brazil, resources in all regions are more palladium-rich than platinum. Canada and Russia, which together account for 28% of total PGM resources, have the lowest platinum to palladium ratios (Pt:Pd) at 0.33:1 and 0.24:1 respectively. The four projects in the US (44% of total resources collectively) have an average ratio of 0.39:1. Largo Resources' Maracás project (Brazil) is focused on a vanadium-rich titaniferous magnetite deposit, unique in the peer group. The Pt:Pd ratio at Maracás is much higher at >2:1, though the grade of the project is very low at just 0.3 g/t.

In contrast to South Africa and Zimbabwe, a much smaller proportion of deposits could be considered PGM-rich in the rest of the world. That is, PGMs occur as the major constituent with few by-product metals. SFA estimates that PGM-rich projects represent less than one quarter of the peer group. Several projects yield PGMs as a co-product of other base and precious metals, but PGMs more frequently occur as by-products. Figure 5 shows that typical co-/by-products include nickel and copper and, to a lesser extent, cobalt and silver.

For those projects that have resources delineated, 70% are more copper-rich than nickel, as shown in Figure 6. Weighted average values for the peer group are ~0.5% copper and ~0.4% nickel. Noront Resources' Eagle One project comprises the highest concentrations of base metals, while Jien Canada Mining's Nunavik project and Wallbridge Mining's Broken Hammer project both comprise ore with at least 1% copper. The Maracás project and Platina Resources' Skaergaard project (Greenland) appear to be devoid of these base metals.

Economic importance of by-product credits

Co- or by-products such as nickel and copper are important economic considerations in the evaluation of PGM deposits. During periods of depressed PGM prices it is advantageous to own a diverse deposit, with a spread of metals providing a useful buffer to cash flow. The

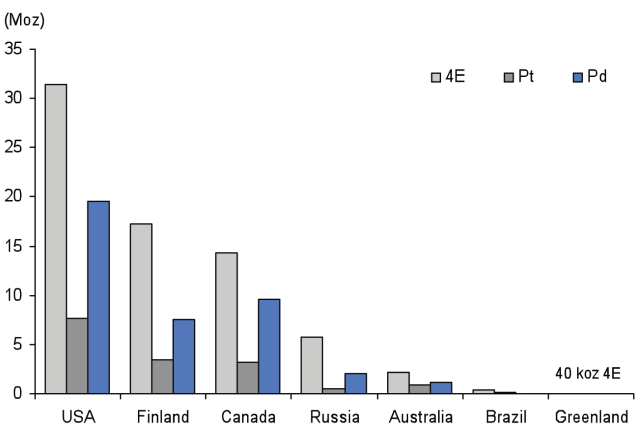

Figure 3. PGM resources (inclusive of reserves) by region. Source: Company reports and websites, SFA (Oxford). No resources have been delineated for Guyana

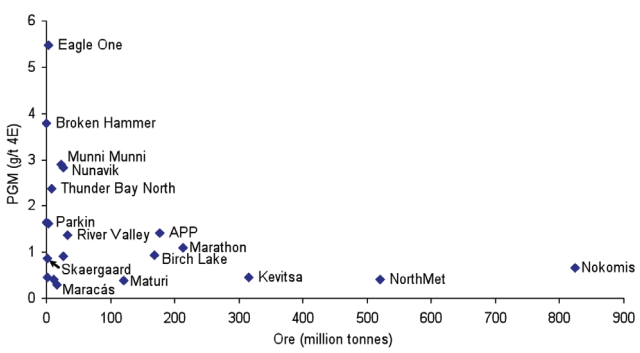

Figure 4. Comparison of resource size and PGM grade. Source: Company reports and websites, SFA (Oxford)

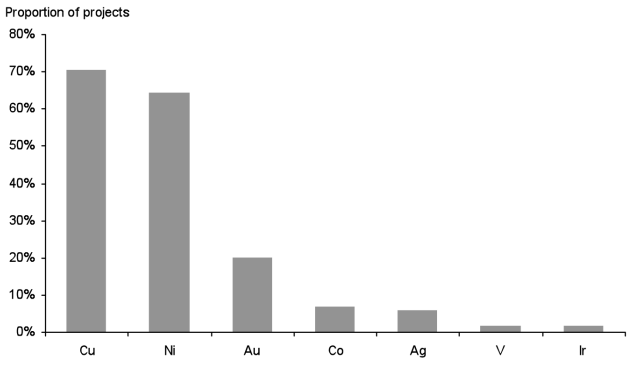

Figure 5. Co-/by-product associations. Source: Company reports and websites, SFA (Oxford)

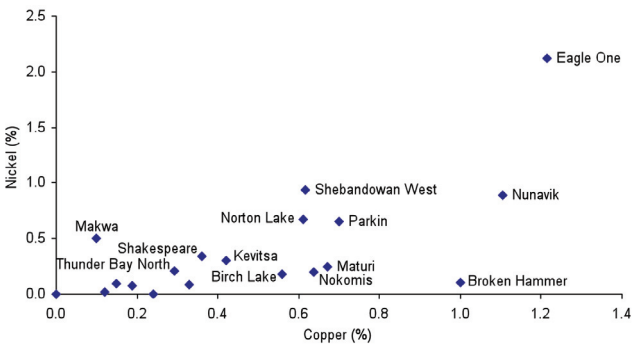

Figure 6. Comparison of nickel and copper contents. Source: Company reports and websites, SFA (Oxford)

following charts highlight that Canadian and Russian-based producers (copper and nickel producers with by-product PGMs) achieved net cash margins (on a 4E basis) that were up to four times higher than the weighted average for South African operations in 2009. Canadian operations proved most profitable, achieving net cash margins of $1 123/4E oz compared with $311/4E oz for the most profitable Bushveld reef (Merensky) and by-product credits of more

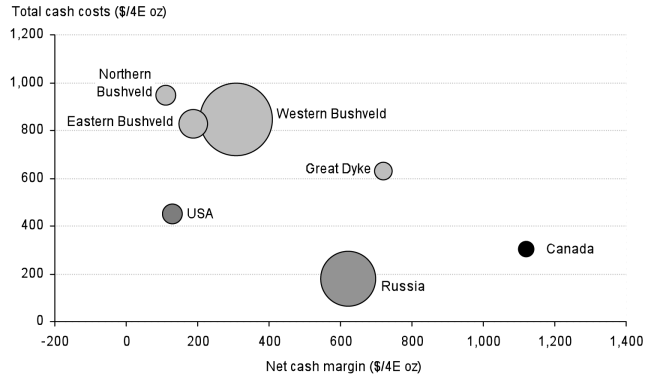

Figure 7. Regional cost and margin analysis–2009. Source: SFA (Oxford). NB. Bubble size represents PGM (4E) production in ounces

than $600/4E oz. Combined with lower cash costs (weighted average total cash costs for South African mines were between 20% and 74% higher than those achieved elsewhere in 2009), this gives miners in other regions a substantial advantage on the net cash margin curve. Both Canada and Russia therefore achieved negative net cash costs in 2009.

Note that SFA presents costs on a calendar year basis. A number of producers have differing financial year-end dates, therefore average metal prices realized and the exchange rates in each financial reporting period can vary markedly. In order to provide a like-for-like comparison, SFA's cost database converts to calendar years those producers that do not report on a December year-end. A full methodology statement is included at the end of this paper. See Figures 7 and 8.

Regional barriers to production

Like those in Africa, PGM miners in the rest of the world are also subject to various political, social or environmental challenges. Mining operations in Russia can be subject to bureaucratic red tape and the legal framework is not clear.

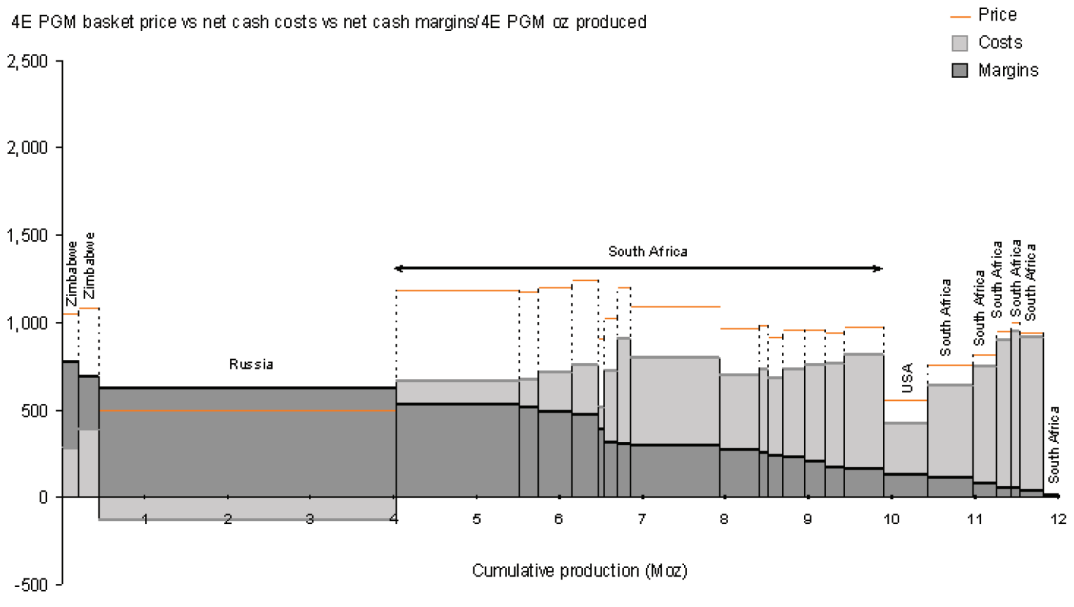

Figure 8. Production performance curve 2009. Source: SFA (Oxford)

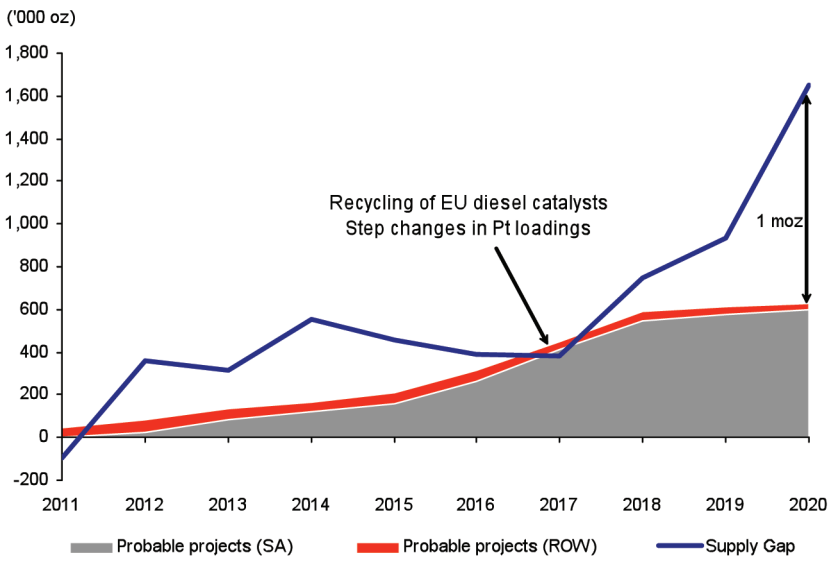

Figure 9. Platinum supply gap and potential production from projects. Source: SFA (Oxford)

Strategic resource exclusion law, enacted in April 2008, restricts foreign company ownership in strategic fields (500 000 tonnes for copper, 4.6 million ounces for gold), while the mining of PGMs and nickel is off limits altogether for non-Russian companies.

However, since the Russian financial crisis, privatizations, rising foreign investment and high commodity prices have helped to improve the fortunes of the Russian resources sector. Although mining areas are typically remote (Kamchatka and Kola Peninsula), there is a legacy of nickel, copper, PGMs and industrial minerals mining in these areas and they are therefore largely self-sufficient in terms of transport and power infrastructure.

In Europe, the chief threat to mining is environmental legislation, which is very much geared towards targeting point sources of pollution (mining and other industries). Such restrictions not only delay project start-ups, but also can adversely affect on the economics of a mining operation. Whereas some of the most advanced mining technology was pioneered in Europe, aimed at improving operational and environmental practices, this technology is being exported to all parts of the world. Regional advantages include the increased security of raw material supply and relatively minimal risk of political upset.

North America is an attractive target for establishing a mining operation, given its political security and logistical advantages. The region has a long history of mining in many areas and, being one of the wealthiest continents, infrastructure is both extensively developed and well maintained to support mining activities. Access to capital markets (Toronto) is an important factor for junior miners, while the business climate is export-orientated with attractive tax incentives. The process for obtaining the relevant mining and development permits is more streamlined in this region than in newer mining countries. However, like in Europe, environmental concerns are becoming an increasingly important factor (and stumbling block) in mine planning decisions.

The supply gap

Given that 95% of the junior peer group are at pre-feasibility stage or earlier with their projects, only a small number of companies have issued indicative or detailed mine plans. These include URSA Major Minerals, Marathon PGM Corporation and Largo Resources. URSA's Shakespeare project was suspended in October 2008, but preproduction activities recommenced in early 2010. An updated technical report for the Marathon project, for which mining permits are being obtained, was released at the beginning of this year.

Annual PGM production that is likely to derive from global junior projects in the short to medium term equates to about 280 koz, including up to 50 koz of platinum and up to 200 koz of palladium. Putting this into context with the platinum market, primary supply is projected to peak at 6.8 moz in 2015 and thereafter fall back below 6 moz by 2020 as existing mine shafts deplete. Combined with a strong platinum demand pull in most end-use sectors, a structural supply gap emerges from 2012, as illustrated in Figure 9. Incorporating planned production from probable projects in South Africa and the rest of the world, a supply shortfall of 1 moz exists by 2020. However, of the 100-plus junior projects analysed, few are in a position where production would be feasible within the next ten years.

Conclusions

The global junior sector has delineated almost 7 moz of reserves and 64 moz of PGM resources in seven countries. Established miners in the same regions have staked out about 330 moz of PGMs. Projects outside of Africa tend to be low grade (in terms of PGM content), with the weighted average grade for the peer group being less than 1 g/t. Therefore, co-/by-product associations are important for economic viability. Base metals are key constituents for more than 60% of the projects analysed, with PGMs occurring as by-products.

A long-term fundamental deficit in the platinum market combined with the easing of liquidity in the capital markets should see junior sector activity begin to accelerate. Already a number of PGM projects that were suspended in 2008/09 are once again gaining traction in response to the rebound in commodity prices. However, analysis of the current peer group highlights that potential new platinum production from projects outside of Africa, at least in the medium term, is not likely to be substantial given that 95% of projects are at prefeasibility stage or earlier.

Cost and margin methodology

SFA's regional PGM industry benchmarking and cost modelling evaluate the total cash costs per refined 4E PGM oz (i.e. Pt, Pd, Rh and Au) of the main PGM-producing regions in South Africa, North America, Zimbabwe and Russia, covering more than 90% of global primary production. Our cost and margin profiles present a regional view of the PGM industry as a whole, and give an insight into the cost characteristics and profit dynamics of its various regions.

Cost profiles are consistently based on cash costs and exclude capital, financing and depreciation/amortization charges in order to provide a coherent, like-for-like framework for comparison. The basic cost measures primarily reflect physical production costs and include other cash costs incurred, which are mostly corporate overheads, marketing and royalties. Finally, costs are also calculated net of the credits arising from the sale of co-products and by-products (net TCC/4E oz). The volumes of platinum, palladium and rhodium, the most significant of the platinum-group metals, and gold are aggregated as the principal components of output, and cost assessments are therefore expressed in US dollars as total cash costs per 4E oz (US$ TCC/4E oz).

Mines that do not have PGMs as their primary output but are substantial PGM producers have also been included in SFA's analysis. These include Norilsk, Vale and Xstrata. The costs of these producers have been adjusted to reflect the proportion of their revenues due to 4E as a share of total producer revenues. This ratio is also applied to the base metal credit calculations which compute net total cash costs and margins per 4E oz.

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Samantha Trickey is a supply analyst whose work involves the evaluation of PGM mines and future potential projects worldwide. She has undertaken numerous comparative analysis studies of the South African and global junior PGM sectors. Her work encompasses project and company financial valuations and strategic analysis, cost and margin benchmarking, sensitivity analysis, geographic risk assessment and comprehensive resource evaluation. Samantha gained an honours degree in geology from Royal Holloway and she holds a Masters degree from the Camborne School of Mines where she specialised in mining geology and worked in association with the British Geological Survey. Samantha worked as a Precious Metals Market Consultant at CRU International prior to joining SFA (Oxford).