



Is the Platinum Group Minerals in a typical Zimbabwe flotation operation significantly different than typical PGM's in a Bushveld Igneous Complex operation and does it matter?

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design, development and production of mining chemicals and mineral processes

Introduction



- Plants are operated on Fire Assay PGE, and Cu, Ni base metal data.
 - This are keeping the accountants happy.
- Flotation plants operate with Minerals.
 - Is data on elements (fire assay) sufficient for metallurgist?
- No! BUT what is the alternative?



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Automated Scanning Electron Microscope (A-SEM) hardware and application technology (MLA)



Some interesting facts:

- Anglo American Research biggest MLA lab in the world (15 units).
- Betachem is the first mining reagents support company in the world with a MLA lab.
- 30 days to scan a tails sample and then still produce “dodgy” statistical data.



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OK..... MLA is alive and well,
your friendly chemical supplier has a couple and is willing to do
work (to get and hang onto your account.....)

So What?

1. Is the PGM composition in typical Zimbabwe (Great Dyke) operations significantly different to PGM deposits in the Bushveld Igneous Complex? If so, does it matter?
2. Why are PGM's lost to tails in typical Zimbabwe flotation plants and what can be done to reduce this loss?
3. What are the gangue minerals in typical Zimbabwe flotation concentrate and can this be reduced to produce a higher grade concentrate? How ?



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Q: Is the PGM composition in typical Zimbabwe (Great Dyke) operations significantly different to PGM deposits in the Bushveld Igneous Complex?

A: Yes

Q: Does it matter?

Q: Why are PGM's lost to tails in typical Zimbabwe flotation plants and what can be done to reduce this loss?

Why are PGM's lost to tails in typical Zimbabwe flotation plants and what can be done to reduce this loss?

There are 5 reasons why value minerals are lost to tails in a typical flotation operation:

- Too small to float. (For this ore and circuit, the author assumes the cut off size is 10 microns. It is acknowledged that this is an oversimplification.)
- Too large to float. (For this ore and circuit, the author assumes the cut off size to be 150 microns. It is acknowledged that this is an oversimplification.)
- Locked in non-floating gangue. (For this ore and circuit, the author assumes 80% locking as a locked mineral. It is acknowledged that this is an oversimplification.)
- An incorrect process or reagent suite is used to float a value mineral.
- Other reasons, which may include process efficiency.

Why are PGM's lost to tails in typical Zimbabwe flotation plants and what can be done to reduce this loss?

Table 2: Recovery of PGM's for typical Zimbabwe operations. 10 microns assumed to be the limit where flotation losses occur due to "too small to float". 10 to 150 microns assumed to be the well sized particle size range. 80% value mineral and 20% gangue assumed as the limit for liberated.

Recovery	Zim. plant 1	Zim. plant 2	Zim. plant 3	Zim. plant 4	Zim. plant 5
Total minus 10 microns liberated	83	85	94	98	99
Total well sized liberated	85	89	96	97	98
Total locked	74	69	68	70	62
Contribution to recovered PGM's	Zim. plant 1	Zim. plant 2	Zim. plant 3	Zim. plant 4	Zim. plant 5
Total minus 10 microns liberated	13	18	7	13	14
Total well sized liberated	36	33	34	23	34
Total locked	31	29	39	44	32
Total	80	80	80	80	80

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Table 5: Locking (association) of particles in flotation final concentrate classified as locked particles for 5 typical Zimbabwe operations. With what mineral are the PGM's in the concentrate locked?

Locking of PGM recovered to concentrate	Zim. plant 1	Zim. plant 2	Zim. plant 3	Zim. plant 4	Zim. plant 5
Cu Sulphides	22	29	4	9	4
Ni Sulphides	6	9	9	5	5
Fe Sulphides	13	17	10	19	11
Talc and Pyroxene	52	16	58	40	17
Quartz, Feldspar & Olivine	1	4	3	2	61
Amphibole, Chlorites and Mica	1	3	4	3	0
Other minerals	6	20	12	21	2
Total	100	100	100	100	100

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Table 3: PGM recoveries calculated for the 6 PGM groups for well sized (10 to 150 microns) and liberated particles.

Calculated recoveries of well sized liberated particles	Zim. plant 1	Zim. plant 2	Zim. plant 3	Zim. plant 4	Zim. plant 5
Gold	100	100	100	100	100
PGE Alloy	22	19	100	100	100
PGE Sulphide	100	100	100	81	100
PGE Arsenate	100	100	100	100	100
PGE Sulpharsenate	100	100	100	100	100
PGE Telluride	100	86	97	100	93

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To summarise

The two reasons PGM's are lost to the tails of a typical Zimbabwe flotation plant is due to:

- SOME minerals grouped as PGE Alloy and PGE Telluride.
- PGM minerals locked in Talc & Pyroxene (and Pyrrhotite).

Of the two reasons, the non-liberation is by far the biggest reason for PGM losses. **It thus seems fairly unimportant that the Zimbabwe PGM composition is different as compared to other deposits, as the main reason for PGM losses is not the mineral type, but its liberation character.**

With some exceptions, it can thus be concluded that if a PGM mineral is liberated and preferably well sized, it will be recovered in a typical Zimbabwe flotation plant.

The PGM composition is thus less important than the liberation character of the PGM's.

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Q: Is the PGM composition in typical Zimbabwe (Great Dyke) operations significantly different to PGM deposits in the Bushveld Igneous Complex?

A: Yes

Q: Does it matter?

A: No, not really. If a PGM mineral (irrespective of which one it is**) is liberated and preferably well sized, it will be recovered in a typical Zimbabwe flotation plant.

** Not 100% correct. There are some problem minerals....

The main reasons PGM's are lost to the tails of a typical Zimbabwe flotation plant is PGM minerals locked in Talc & Pyroxene.

Conclusion

Q: Is the PGM composition in typical Zimbabwe (Great Dyke) operations significantly different to PGM deposits in the Bushveld Igneous Complex?

A: Yes

Q: Does it matter?

A: No, not really. If a PGM mineral (irrespective of which one it is**) is liberated and preferably well sized, it will be recovered in a typical Zimbabwe flotation plant.

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Q: So what are the issues:

A:

- Liberation of PGM's with the bulk gangue mineral (Talc and Pyroxene).
 - Depressants
 - Frothers
 - (Milling aids)
- Flotation of Pyrrhotite
 - Collectors
- Flotation of some isolated problem PGM minerals.
 - Collectors

Thank you!

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