

Reconciliation Harder than it Looks!

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Agenda

1. What is Reconciliation?
2. Uses
3. Approach
4. Examples
5. Conclusion



What is Reconciliation?

Reconciliation involves the collection of tonnage, grade (quality) and contained metal (product) data from disparate and hopefully independent sources.

These data may be compared by means of ratios, to relate short term (ore control) model to ore reserves depleted and to relate material *received* at mill (measured by the mill) to material *delivered* to mill.

- *Paraphrasing Parker 2012.*

Usage

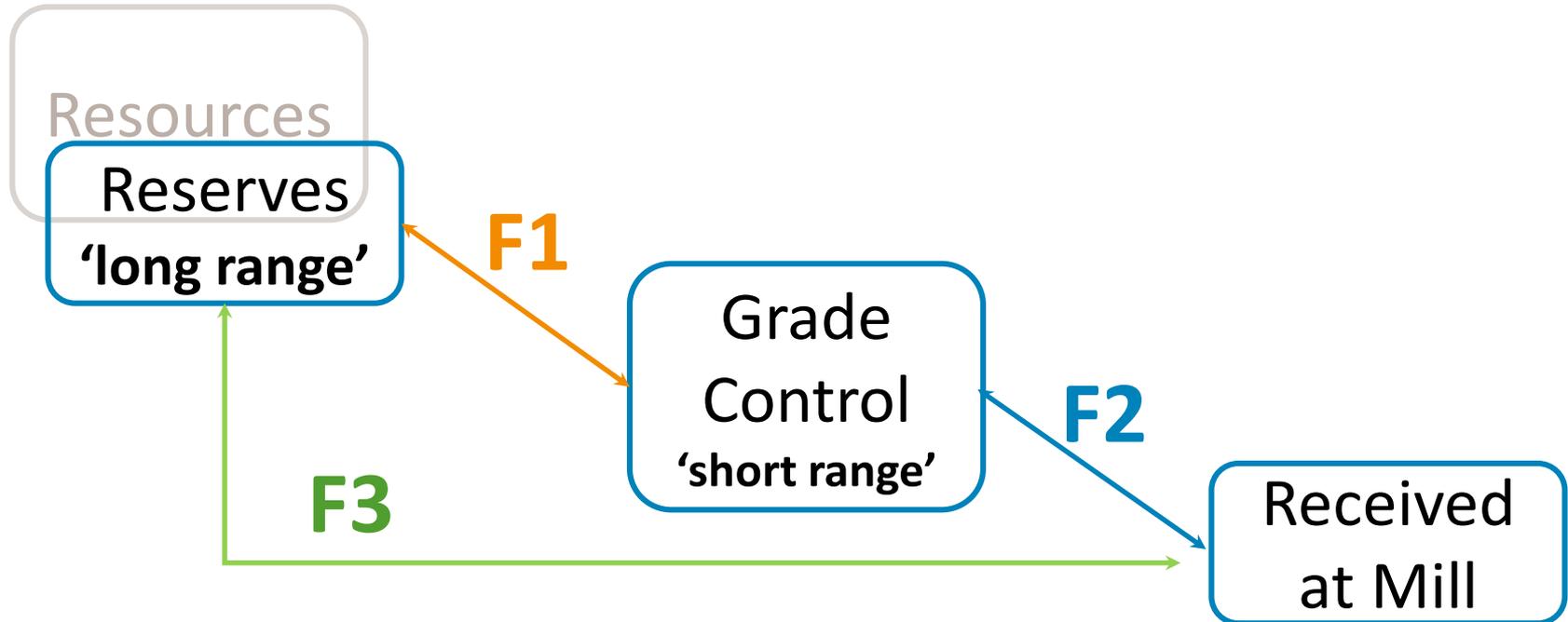
- Measuring project success
- Measuring operational improvement or the scope for improvements in the mining value chain
- Calibrating resource and reserve classification
- Preparing for the next reserve
- *And scapegoat hunting (all too often)*



“Bite-sized Chunks”

- Reduce reconciliation to a series of depletions in model tonnages, grades and metal content. Often expressed as factors (Parker, 2012)
 - F1 factor usually relates short term (grade control) model to ore reserves depleted
 - F2 factor usually relates received at mill (measured by the mill) to delivered to mill production
 - F3 factor is $F1 * F2$ and is a measure of a mine's ability to recover the tonnage, grade and metal content estimated in ore reserves

Two stages of reconciliation



Time Periods

- Depending on production volumes and resource uncertainty, the practical time periods for reconciliation may be shorter or longer
 - Weekly or monthly for high volume, low variance commodities
 - Quarterly or annually for lower volume, high variance commodities

Reserve to Ore Control (F1)

- Sampling issues
- Geometric uncertainty
- Change of Support ('internal dilution')
- Preconceived ideas
- *Insufficient data*
- Oversmoothing
- Conditional bias
- Mined/Not Planned & Planned/Not Mined

Ore Control to Delivered to mill to (F2)

- Sampling issues
- Unplanned dilution
- Stockpile movements

Volume / Bulk Density / Tonnage (F1)

- Pay attention to measurement and estimation of:
 - Wireframing volumes
 - Moisture content
 - Potential voids

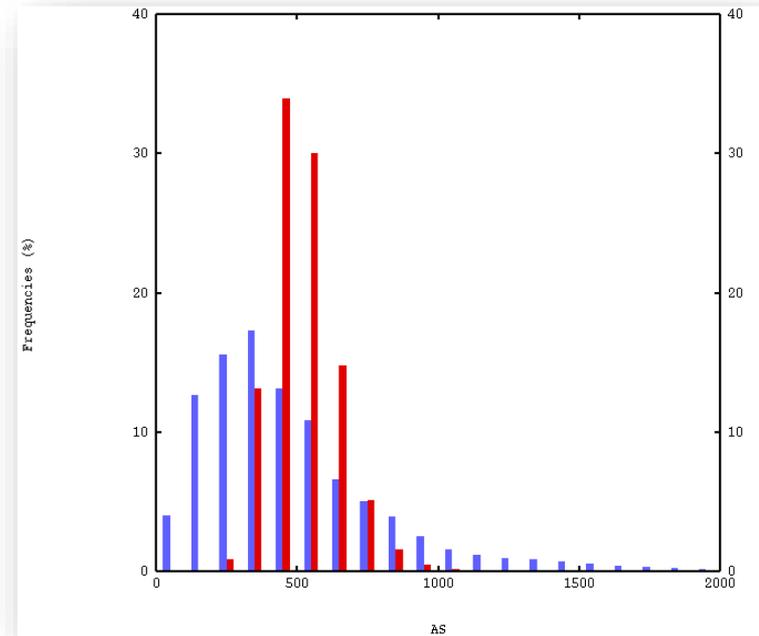
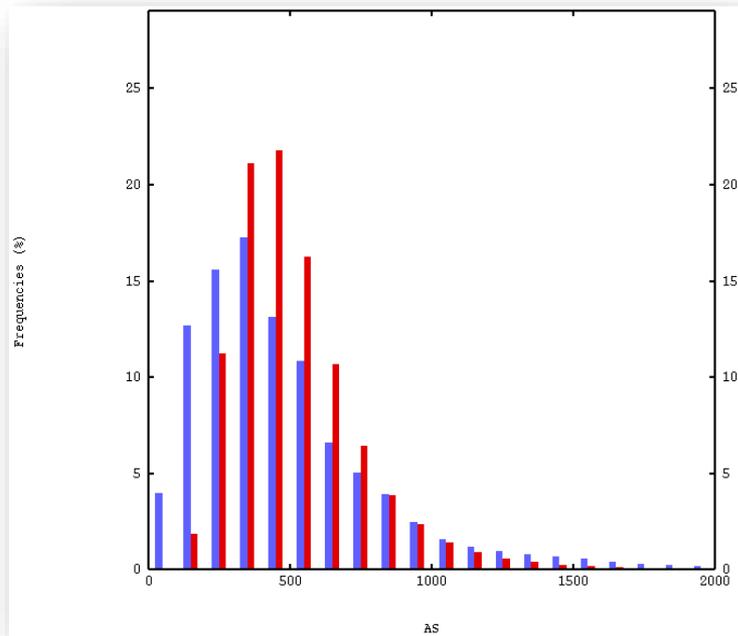


Sampling (applies to F1 & F2)

- Sampling
 - The challenge of obtaining a meaningful, unbiased sample from heterogeneous materials haunts estimation and reconciliation.
 - In situ sampling (F1)
 - Broken ore sampling (F2)
 - Methods and Equipment
 - People

Change of Support ('Internal dilution')

Selective mining unit assumptions can affect reconciliation
30x30x15 smu's versus 100x100x15 panels



Selective Mining

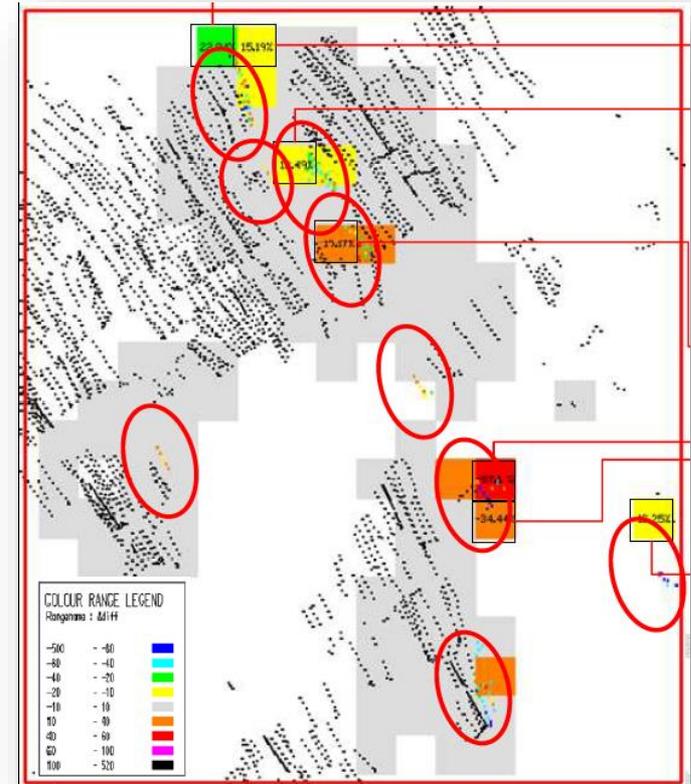
- Planning for selective mining on the basis of a theoretical grade tonnage curve is meaningless, unless the higher grade material can be identified and extracted

People and Sampling (F1 & F2)

- Sampling is
 - Fundamental to the process
 - Boring
 - Arduous
 - Sometimes hazardous
- Often entrusted to persons who are comparatively
 - Junior
 - Under-trained
 - Under-appreciated
- Little wonder the results can be
 - Inaccurate
 - Misleading

Visualizations of Reconciliation

- Reconciliation maps help isolate regions where assumptions or estimates cause systematic deviations between reserves and ore control
- Future improvements depend on identifying causes of deviations



Sometimes the soft issues are hard...

- People...

Resource / Reserve / Mill Accounting

- Involve
 - Multidisciplinary team activities
 - Numerous 'moving parts'
 - A high level of uncertainty
 - Significant assumptions
- Disagreements and misunderstandings can occur....

The Human Factor

Nobody wants to be the weakest link...

- Pride
- Fear

- Bonuses are at stake

Dealing with Personalities / Conflict resolution

- Communicate
- Be objective (as one can)
- Be diplomatic
- Respect other disciplines
- Put yourself in the shoes of others

What else can go wrong?

- Examples...

Anecdote 1

- Underground channel samples from a gold deposit
 - In bags
 - Transported from a series of shafts on a truck
 - 60 km later, arrive at laboratory
 - Systematically upended and subsampled
 - Biased towards the fine end of particle size distribution...
 - With positively biased grade results.

Anecdote 2

- Process plant sampling
 - Collected on day and night shifts
 - Day shift – supervised
 - Low variance, systematic time periods represented
 - Night shift – unsupervised
 - High variance, haphazard timing
- The differences are only apparent when the data is split into night and day shifts....
- If measurements are not made accurately, they are likely misleading

Reconciliation and Project Success

- Small variations in predicted versus actual metal recovery can be significant because
 - Profit margins in many mining projects are low
 - Unexpected grade shortfalls of only a few per cent can have several times more impact on profit

Conclusions

- Reconciliation requires attention to technical as well as human aspects
- Sampling data is critical
- Small deviations in estimation and assumptions have serious implications for profitability

Reference

- Parker, H. M. 2012 Reconciliation principles for the mining industry. Pages 160-176 *in* Mining Technology 2012 VOL 121 NO 3. The Australasian Institute of Mining and Metallurgy. Published by Maney on behalf of the Institute of Materials, Minerals and Mining and The AusIMM

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