The Modifying Factors

WORKSHOP

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The purpose of this presentation is to show why and how the “modifying factors” are the tools to transform mineral resources into mineral reserves.

In looking for “Why” we will try to answer on the modifying factors’ ability to set up metrics that allows us to assure the technical and economic extraction of mineral resources.

In looking for “How” we will try to answer on the modifying factors’ capacity to discriminate mineral reserves from mineral resources.
WHY CONVERT RESOURCES TO RESERVES

Resources (as commodities)

Reserves (as business)

solving uncertainties & modifying factors
The *mineral resource estimation* consists in assigning different attributes and values (grades, density, contaminants, others) to block-ore-tonnages of a mineral deposit. These values or estimates are generated calculating the influence or weight of each sample positioned inside and outside the block-ore-tonnage.
A mineral deposit includes tonnages with different grades and other attributes positioned according to a tri-dimensional systematic grid of ore block-units in which each ore block-unit is estimated and categorized.
RESOURCE CATEGORIZATION

The confidence level

measured resources
Indicated resources
Inferred resources
HOW TO CONVERT RESOURCES TO RESERVES

- Measured resources
- Indicated resources
- Inferred resources
- Proven reserves
- Probable reserves
To convert ore commodities into a mine business we need to draw an envelop where ore tonnages, ore grades, and other ore attributes allows generation of the maximum economic value at a minimum risk.

Ore block-tonnages and ore grades correlate to each other according to a grade–tonnage curve. This curve depicts various grade-tonnage scenarios which provide different economic returns (different business scenarios).
A KEY PARAMETER: THE CUT-OFF GRADE

What scenario grade-tonnage to select??

What is the grade that achieves the maximum economic profit??

The cut-off grade.

The cut-off grade

• technical parameters
• economic parameters
• financial parameters
• social parameters
Technical Parameters
- operating cost
  - mining cost
  - transportation cost
  - processing cost
  - marketing cost

Economic Parameters
- operating income
  - metal prices
  - metal recoveries

Financial Parameters
- operating return
  - cost of capital
  - discount rate
  - net present value

Social Parameters
- social licences
  - communities agreements
  - environmental permits
operating cost

- mining cost
- transportation cost
- processing cost
- marketing cost
- open pit design parameters
- underground design parameters
- transport inside the mine
- transport outside the mine
- transport of ore
- transport of waste
- energy cost
- water cost
- conminution cost (crushing, milling)
- processing cost (leaching, flotation)
- insurances
- freight

$p \text{ [US$/ton]}$
operating income per unit-grade

metal prices
value of metal unit
metallurgical recovery

\[ b \ [\text{US$}/\text{ton}] \]
operating return
  cost of capital
discount rate
net present value

V [US$/ton]
Cut-off grade = $\frac{p + V_f(NPV, n)}{b}$
Cut-off grade_1 = \frac{p_1 + V_{n_1}}{b_1}
Cut-off grade_2 = \frac{p_2 + V_{n_2}}{b_2}
Cut-off grade_3 = \frac{p_3 + V_{n_3}}{b_3}
The envelop is dynamic: it varies through time.
FROM RESOURCES TO RESERVES

measured resources
Indicated resources
Inferred resources

modified factors

measured resources
Indicated resources
Inferred resources
proven reserves
probable reserves
The lowest metal prices lead to extract the highest metal grades and to establish the first mining phases.
The modifying factors incorporates technical, economic, financial and social-community parameters to convert mineral resources into mineral reserves. They convert commodities into business.