

# MINING GEOLOGY

2019

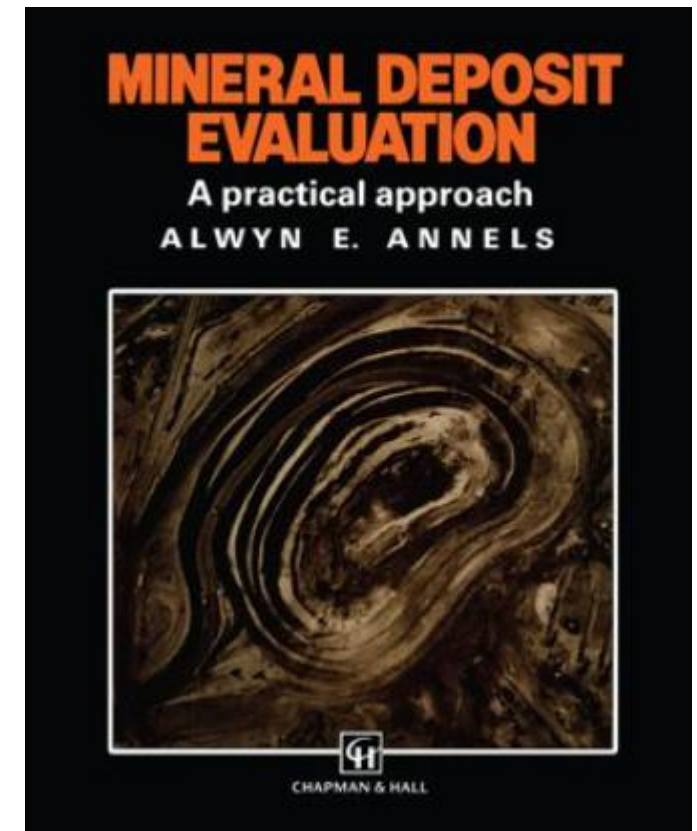


## The Use and Abuse of Metal Equivalents

Presented by Gerry Fahey – CSA Global

# References

- Only one textbook was found that set out the principle clearly



## Definition of metal equivalents

Mineralisation that is comprised of several **metals** of economic value is converted to a single **metal**.

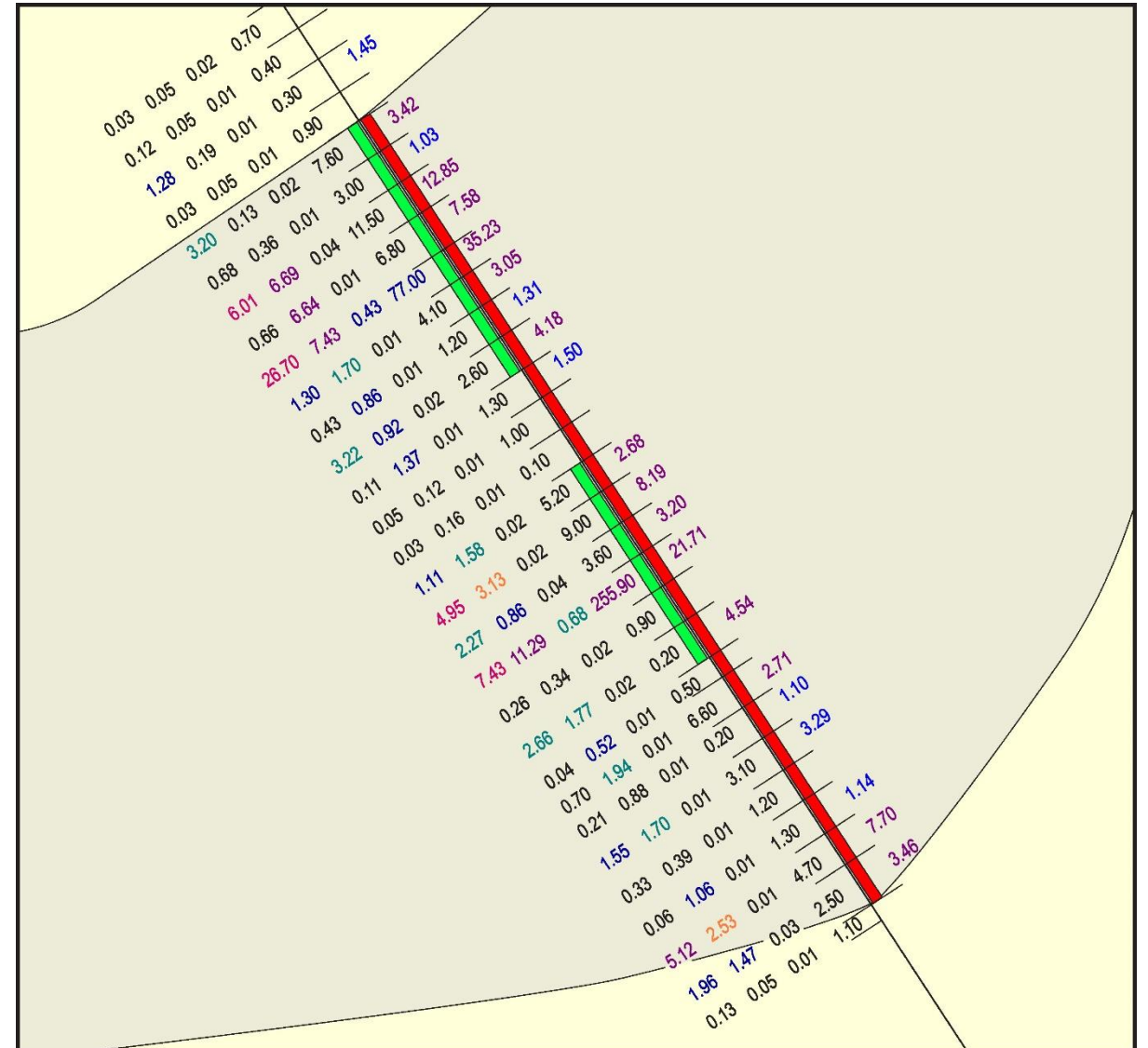
Typically the minor **metals** are converted by formula and added to the grade of the major **metal**.

A similar approach can also be used for **economic industrial minerals**

## Why bother?

*Allows for simpler presentation of many economic grades in terms of a single equivalent*

This example shows four economic metals on the left hand side  
Metal Equivalent value on the right hand side

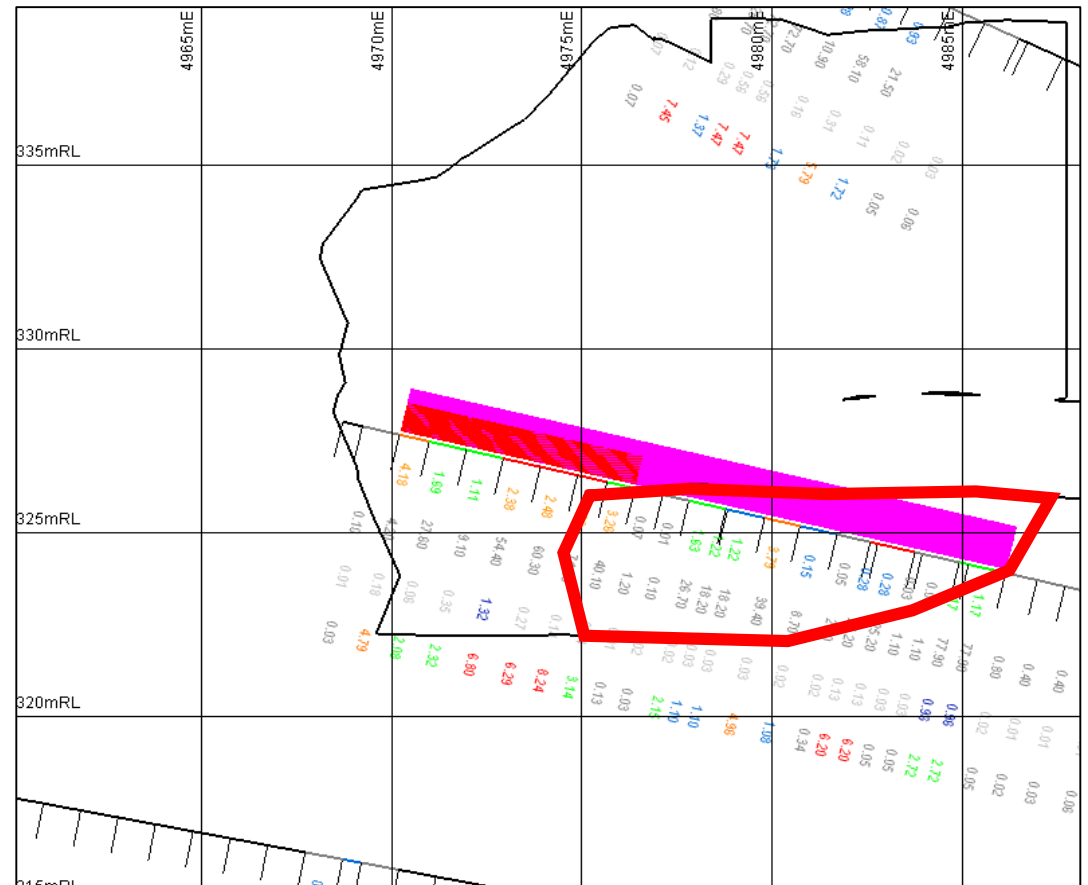


## Why bother?

*Allows for simpler presentation of many economic grades in terms of a single equivalent*

This example shows

1. Red bar: Cu above threshold
2. Pink bar: Cu equivalent above threshold
3. Red line shows improved ore recovery



Au  
Ag  
Pb  
Cu

## Use and abuse of metal equivalents

Examples how to  
calculate metal  
equivalents

Examples showing  
reporting of metal  
equivalents

JORC Code  
reporting

## Calculation of metal equivalent dependent on

- assay data,
- metal/mineral pricing
- and metallurgical recoveries

Examples how to  
calculate metal  
equivalents

## Examples how to calculate metal equivalents

Example 1:

$$\text{CuEq} = (\text{Cu}_{\text{tot}}\% - \text{Cu}_{\text{as}}\%) + ((\text{NSR}_{\text{Mo}} * \text{molybdenum recovery}) / (\text{NSR}_{\text{Cu}} * \text{concentrator copper recovery} * \text{smelter recovery for copper}) * \text{Mo}\%)$$

*Where  $\text{Cu}_{\text{tot}}$  is the total copper grade*

*$\text{Cu}_{\text{as}}$  is the acid soluble copper grade*

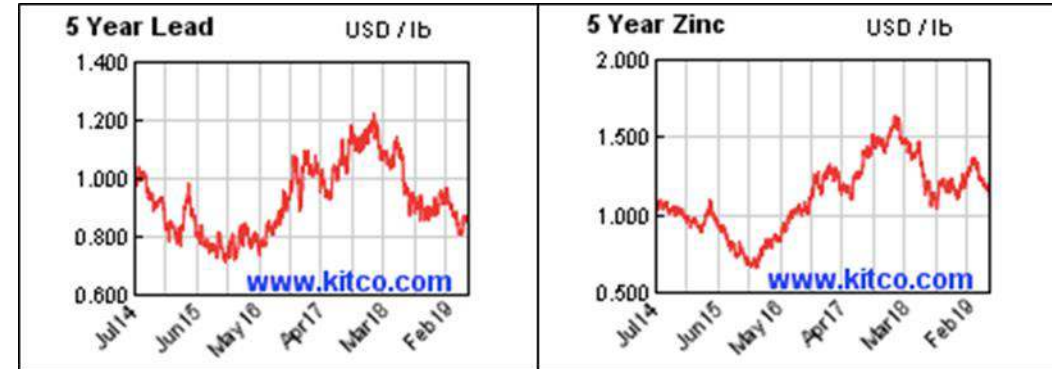
*$\text{NSR}_{\text{Mo}}$  is the net smelter return price for molybdenum*



Examples how to  
calculate metal  
equivalents

Example 2:

$$\text{Zn Eq} = \text{Zn} + (1.81\text{Au}) + (0.95\text{Pb}) + (0.02\text{Ag})$$



	Inputs					
	Realised Price	Unit	Recovery	In Situ Unit price	Unit	Zinc equivalent factor
Zn	2,179	\$/t	92%	20.05	\$/t	1.00
Au	52	\$/g	70%	36.22	\$/g	1.81
Pb	2,537	\$/t	75%	19.03	\$/t	0.95
Ag	0.5	\$/g	65%	0.35	\$/g	0.02

Equation 3, with grades of 0.2% Cu, 0.2 g/t Au, 0.1% Pb and 50 g/t Ag will give a CuEq grade of 1.14%.

$$\text{CuEq} = \text{Cu} + (1.27\text{Au}) + (0.67\text{Pb}) + (0.01\text{Ag})$$

Equation 3:

Example copper equivalent equation

Examples how to  
calculate metal  
equivalents

Example 3:

$$\text{CuEq} = \text{Cu} + (1.27\text{Au}) + (0.67\text{Pb}) + (0.01\text{Ag})$$

Equation with grades of 0.2% Cu, 0.2 g/t Au, 0.1% Pb and 50 g/t Ag will give a CuEq grade of **1.14%**.

**But each contributing grade is at best marginal**

Examples showing  
reporting of metal  
equivalents

Hole	From (m)	To (m)	Length (m) <sup>(2)</sup>	Copper (%)	Gold (g/t)	Silver (g/t)	Zinc (%)	Copper Equivalent (%) <sup>(1)</sup>
DDHXXX	517.00	617.00	100.00	2.51	3.03	52.5	0.41	4.99

## Example 1:

In calculating the CuEq value the company has provided:

- No metallurgical recovery
- Uses spot prices
- There may be lower thresholds to achieve payment for precious metals within the Cu concentrate
- Zn may only be valuable if sold as a separate concentrate

## Example 2:

232 meters of 0.55% copper equivalent (0.47% copper and 0.13 g/t gold)

The calculation: **CuEq = Cu + (0.63Au)**

100% recovery

1t of ore with 1% Cu is worth  $(3 / 0.000453592) / 100 = \$66.14$

1t of ore with 1g/t Au is worth  $(1300 / 31.1035) = \$41.80$

1g/t Au is equivalent to  $41.80 / 66.14 = 0.63\%$  Cu

Therefore  $CuEq = 0.47 + (0.63 * 0.13) = 0.55$

copper and gold (\$3/lb and \$1300/oz respectively)

Examples showing  
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equivalents

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CATEGORY	TONNES	GRADE Gold Equiv. g/t		Au g/t	Cu %	Ag g/t	Pb %	Zn %
Measured	926,000	3.5		0.60	0.41	6.8	0.33	0.57
Indicated	1,068,000	3.1		0.41	0.22	5.1	0.30	0.79
Inferred	1,137,000	2.4		0.33	0.21	5.1	0.28	0.53
<b>TOTAL</b>	<b>3,131,000</b>	<b>3.0</b>		<b>0.44</b>	<b>0.27</b>	<b>5.6</b>	<b>0.30</b>	<b>0.63</b>

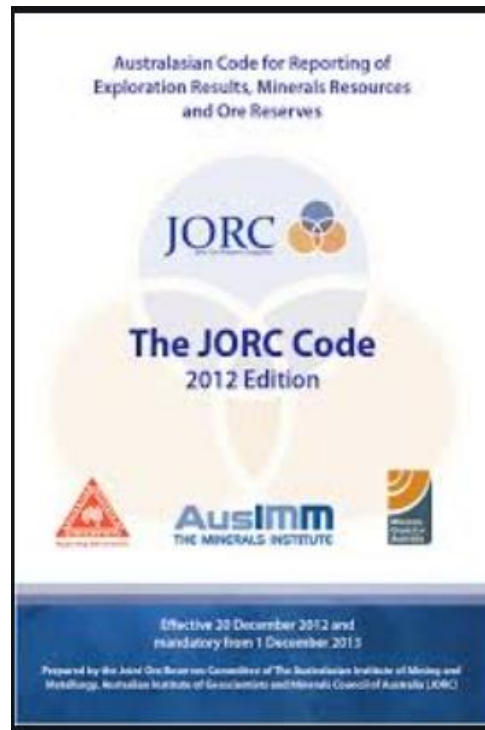
### Example 3:

Company announced a Mineral Resource of approximately 3.0 Mt @ 3.0 g/t gold equivalent without any metallurgical recoveries etc.

## JORC Code reporting

### Clause 50 Report according to the following five bullet points

- individual grades for all the metals in the metal equivalent calculation
- assumed commodity prices for all the metals
- assumed metallurgical recoveries for all metals and how derived
- a clear statement that all elements have a reasonable potential to be sold
- show the calculation formula used



Useful

Internal reporting for operating polymetallic operations

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Somewhat  
Useful

External reporting of results for polymetallic deposits where studies are advanced

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Somewhat  
Unhelpful

External reporting of early stage polymetallic projects

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