



COMMITTEE FOR MINERAL RESERVES  
INTERNATIONAL REPORTING STANDARDS



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# **The Modifying Factors**

## **WORKSHOP**

**Ulaan Baatar 17 October 2014**

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**Chairman**

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

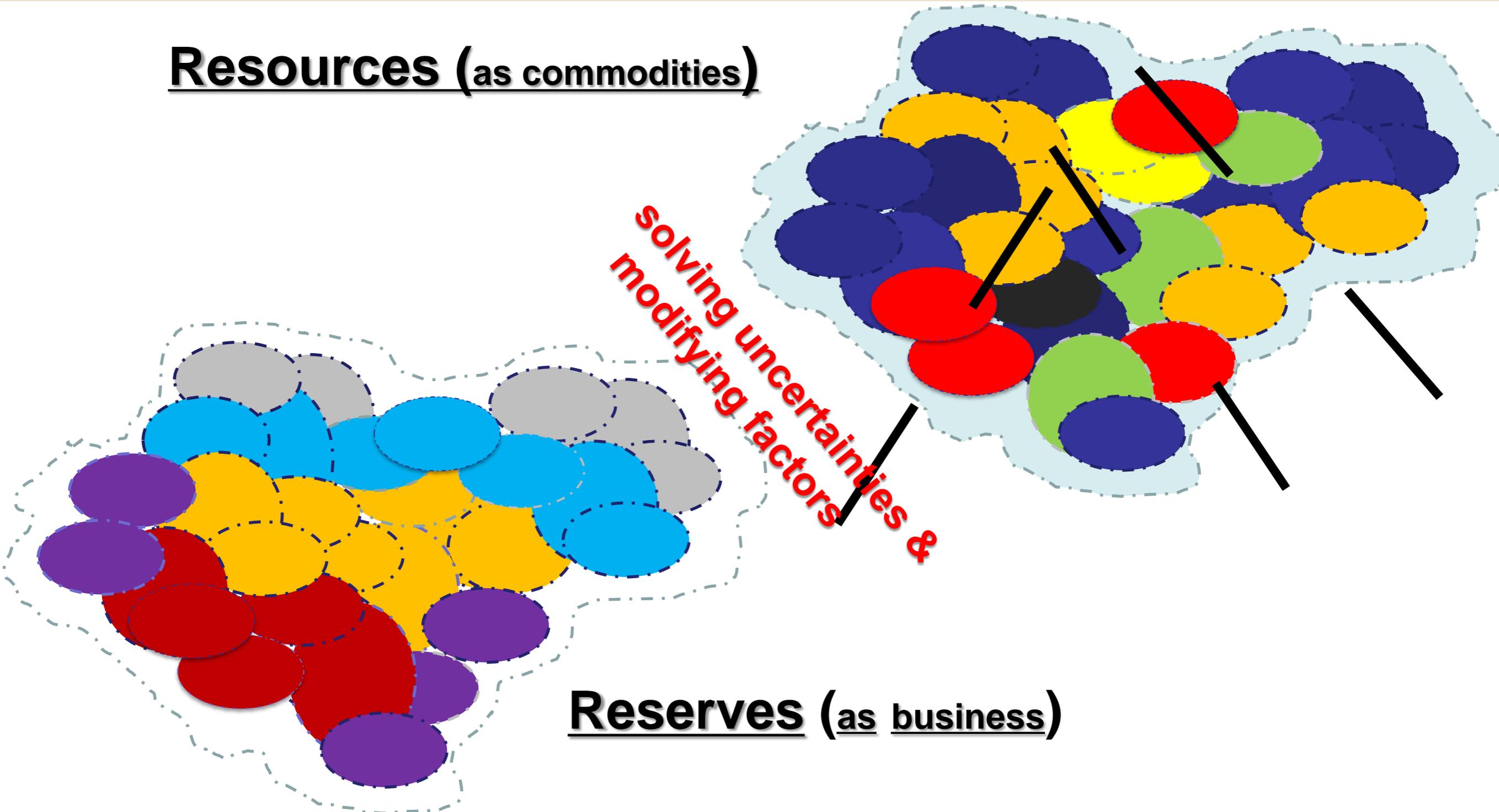
In looking for “**Why**” *we will try to answer on the modifying factors’ ability to set up metrics that allows us to assure the technical and economic extraction of mineral resources.*

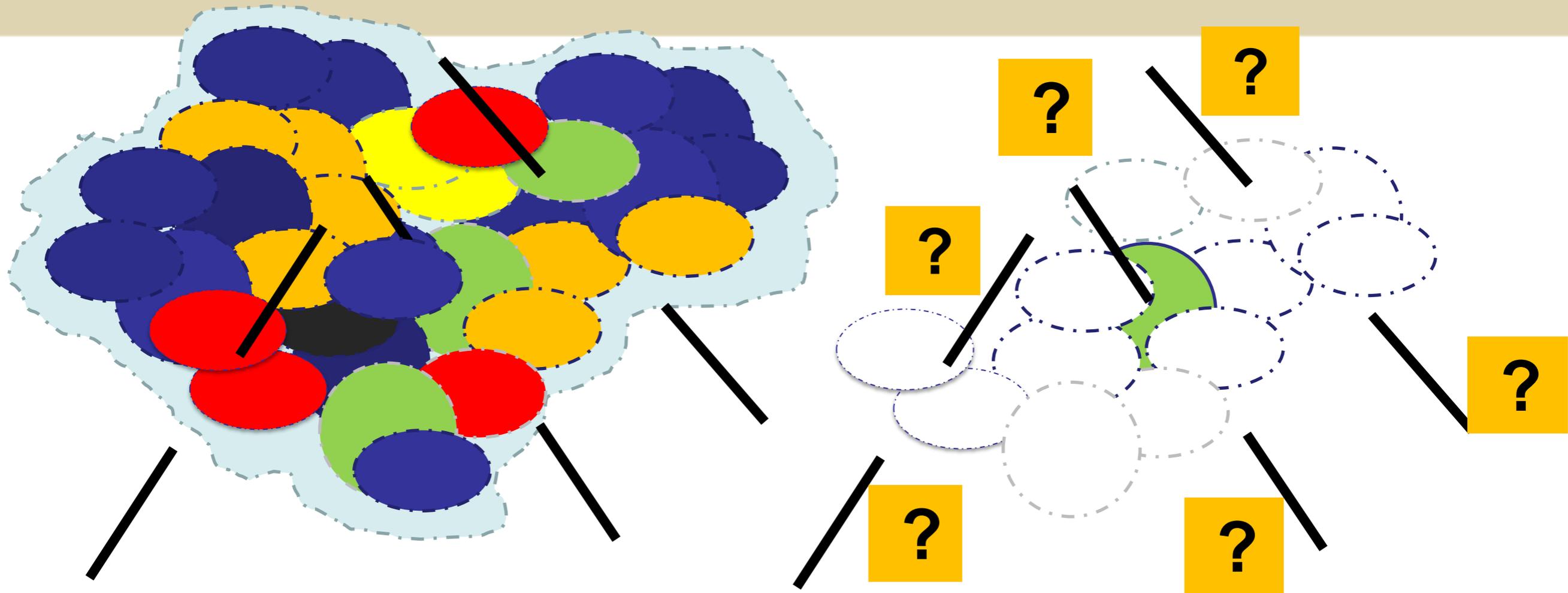
In looking for “**How**” *we will try to answer on the modifying factors’ capacity to discriminate mineral reserves from mineral resources.*

## Resources (as commodities)

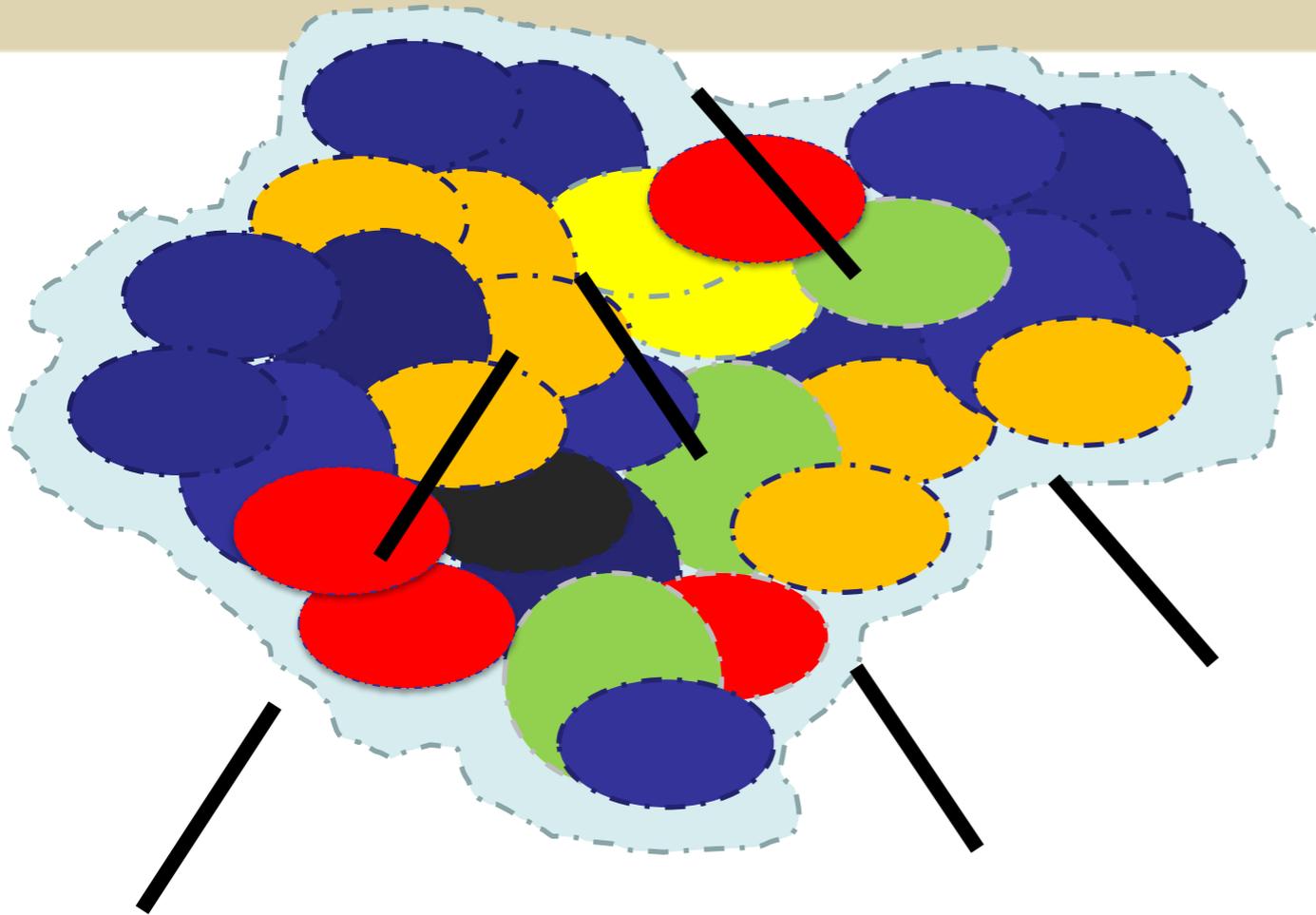
*Solving uncertainties & modifying factors*

## Reserves (as business)



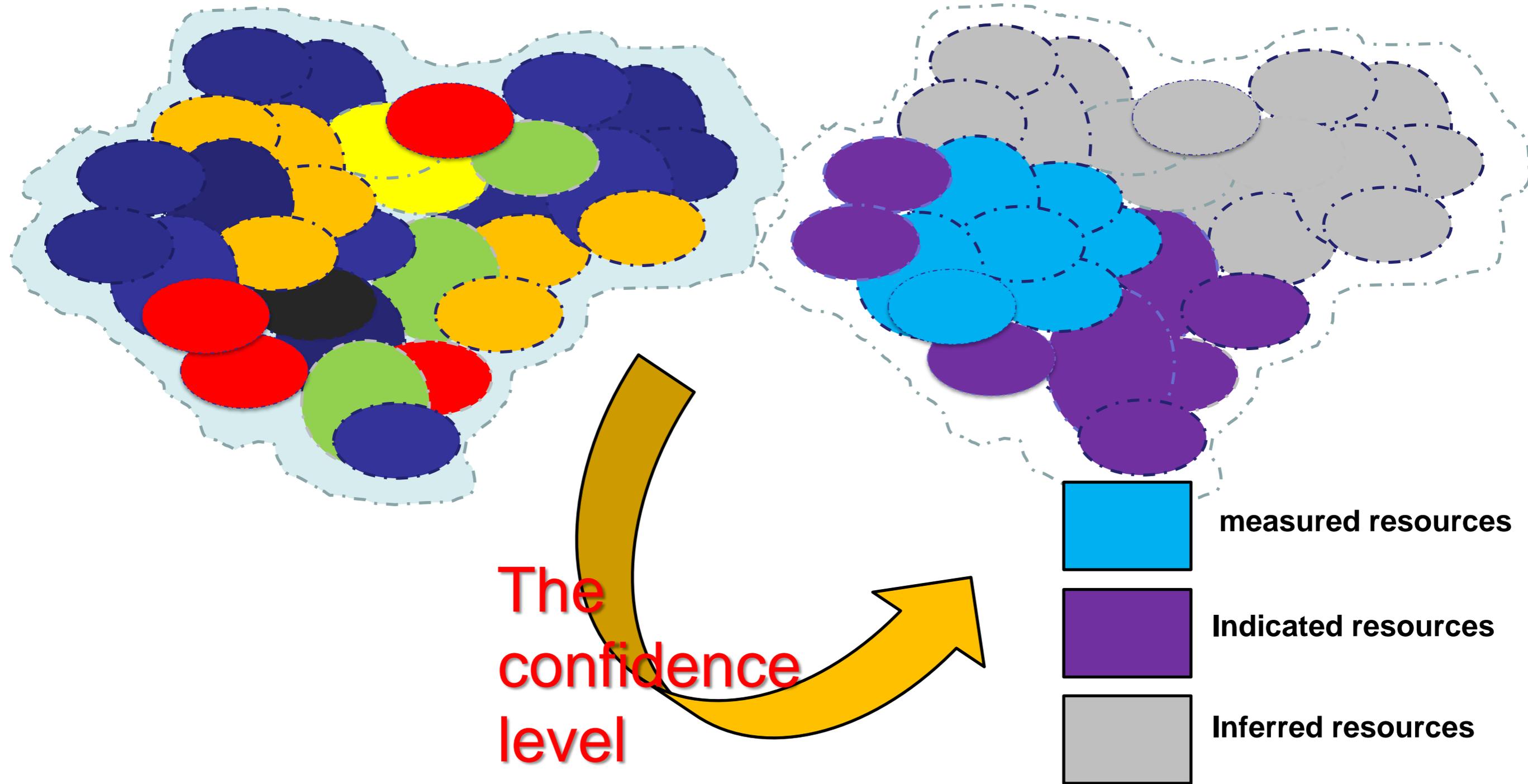


*The mineral resource estimation consists in assigning different attributes and values (grades, density, contaminants, others) to block-ore-tonnages of a mineral deposit. These values or estimates are generated calculating the influence or weight of each sample positioned inside and outside the block-ore-tonnage.*

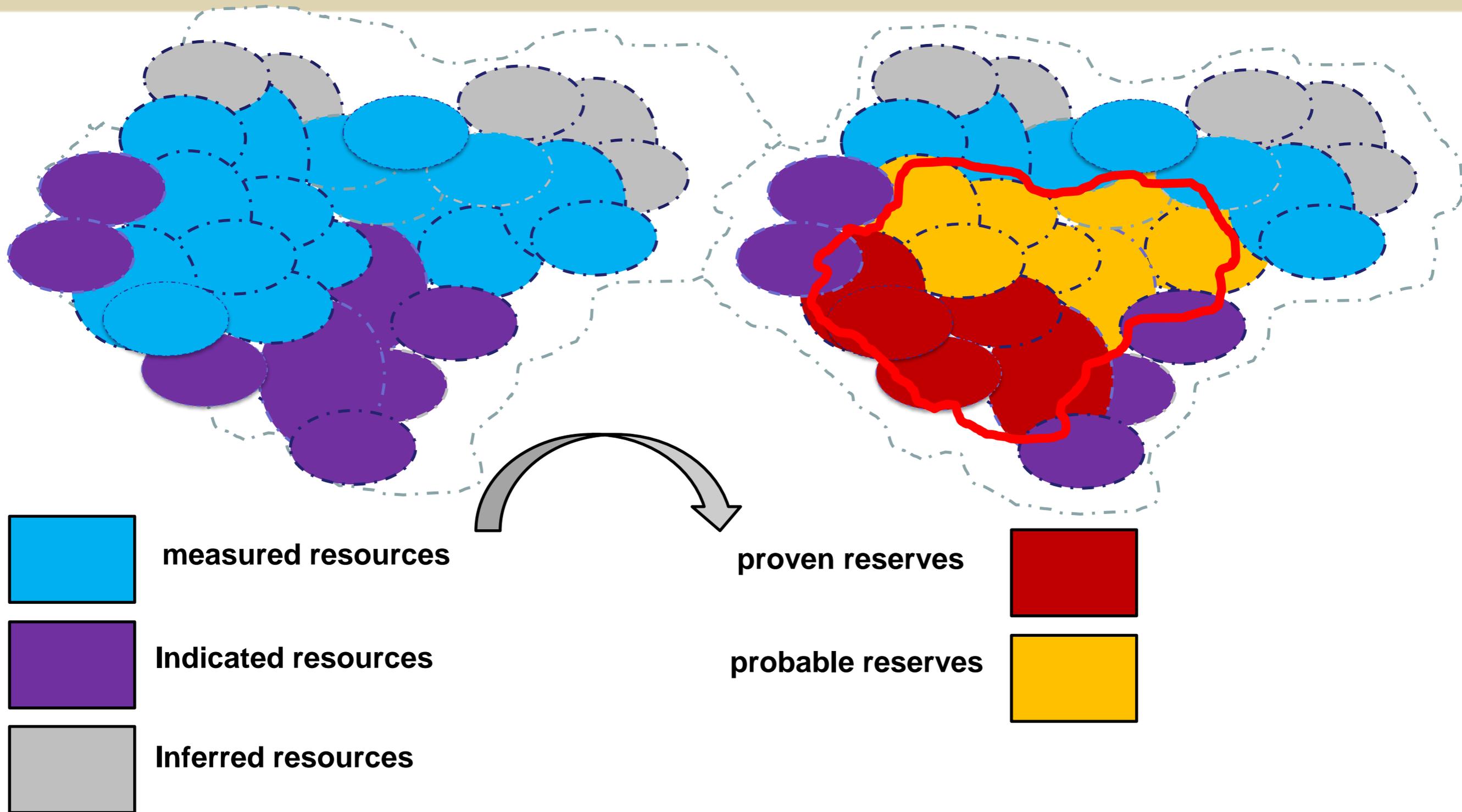


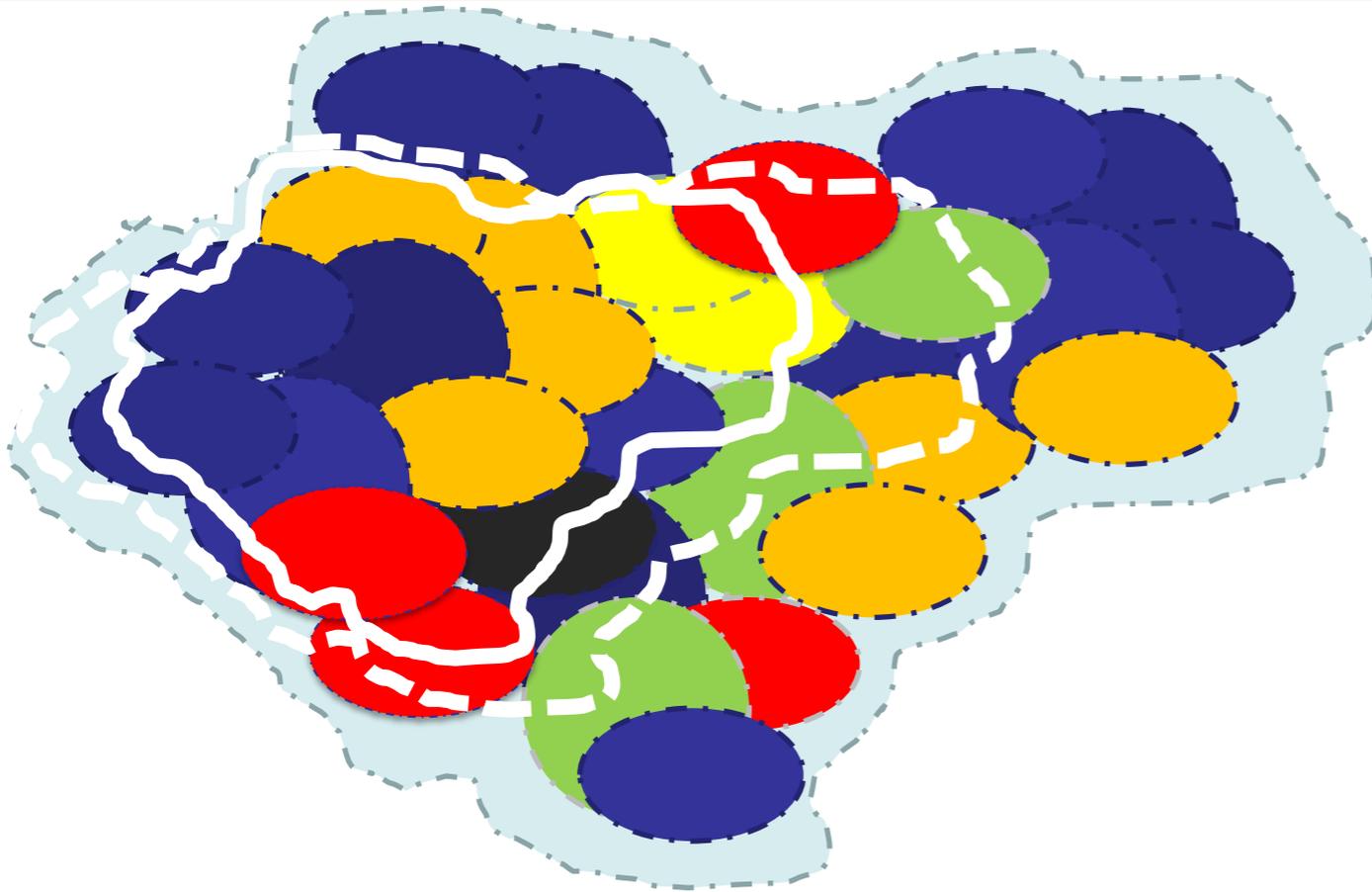
| ATTRIBUTE                     |                |                     |
|-------------------------------|----------------|---------------------|
| Block ore-tonnage coordinates | LOCAL ESTIMATE | CONFIDENCE CATEGORY |
| X1, y1, z1                    |                |                     |
| X1, y6, z4                    |                |                     |
| .....                         |                |                     |
| X4, y2, z1                    |                |                     |
| .....                         |                |                     |
| X6, y6, z8                    |                |                     |

*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.*



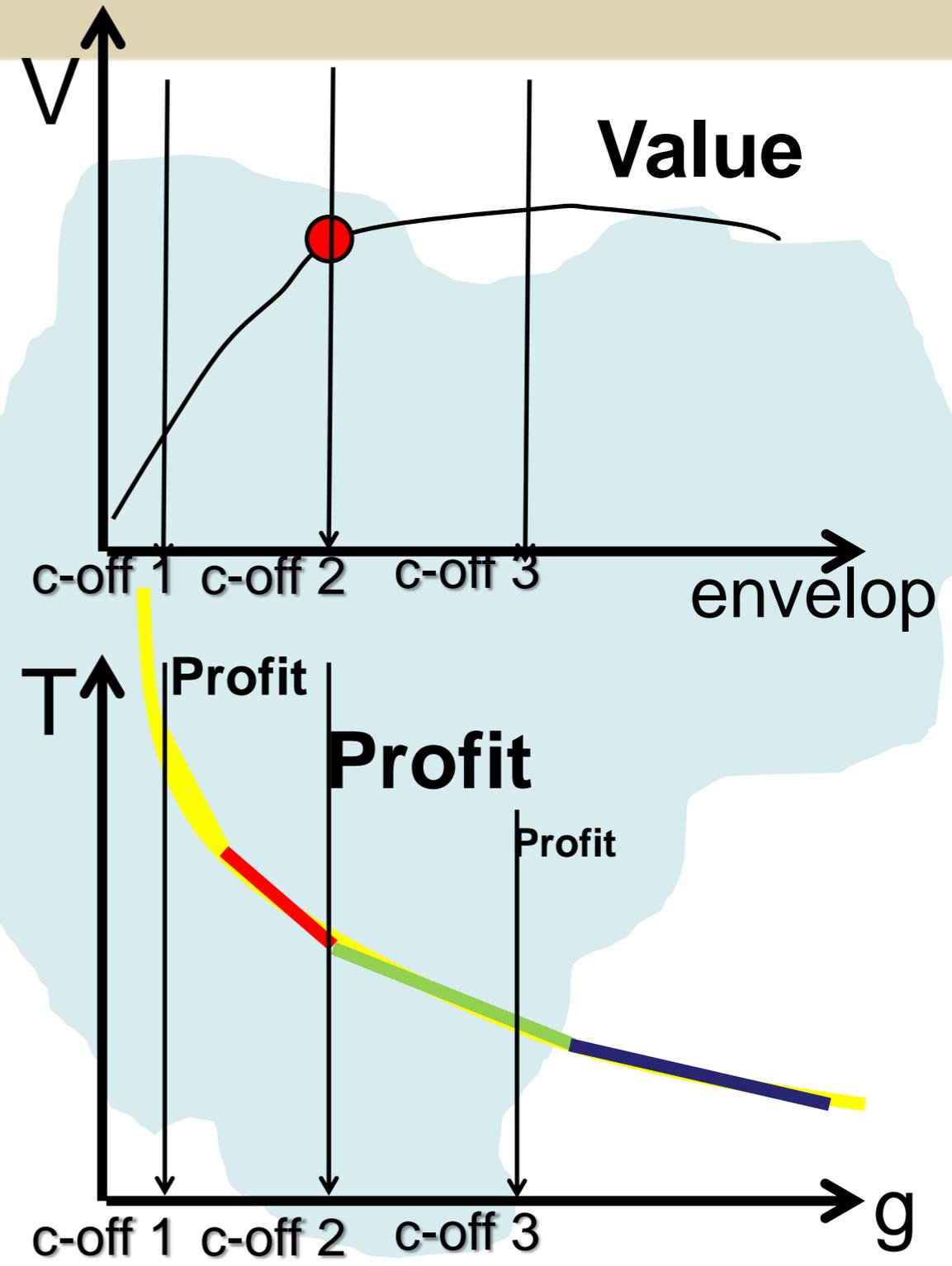
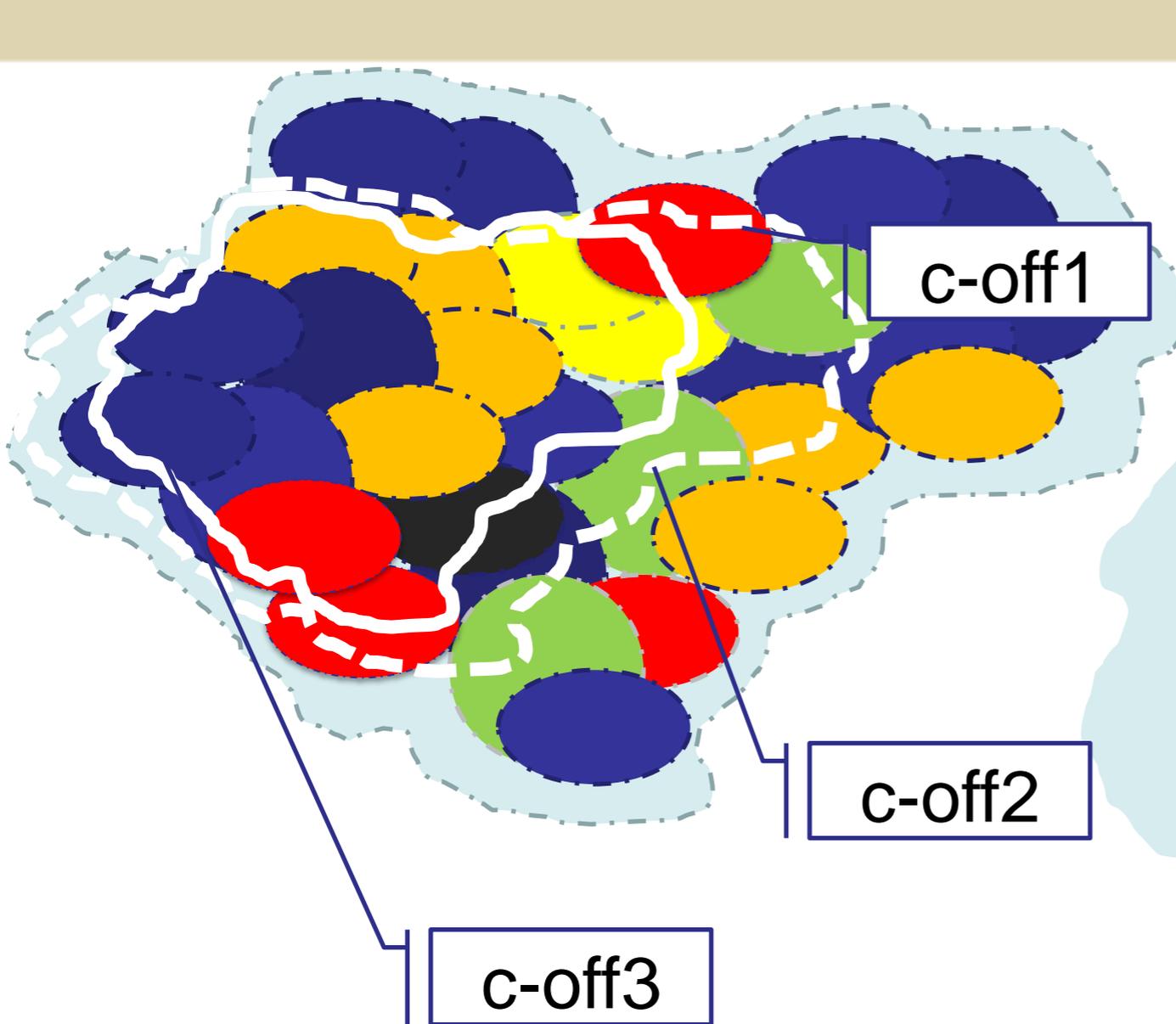
# HOW TO CONVERT RESOURCES TO RESERVES

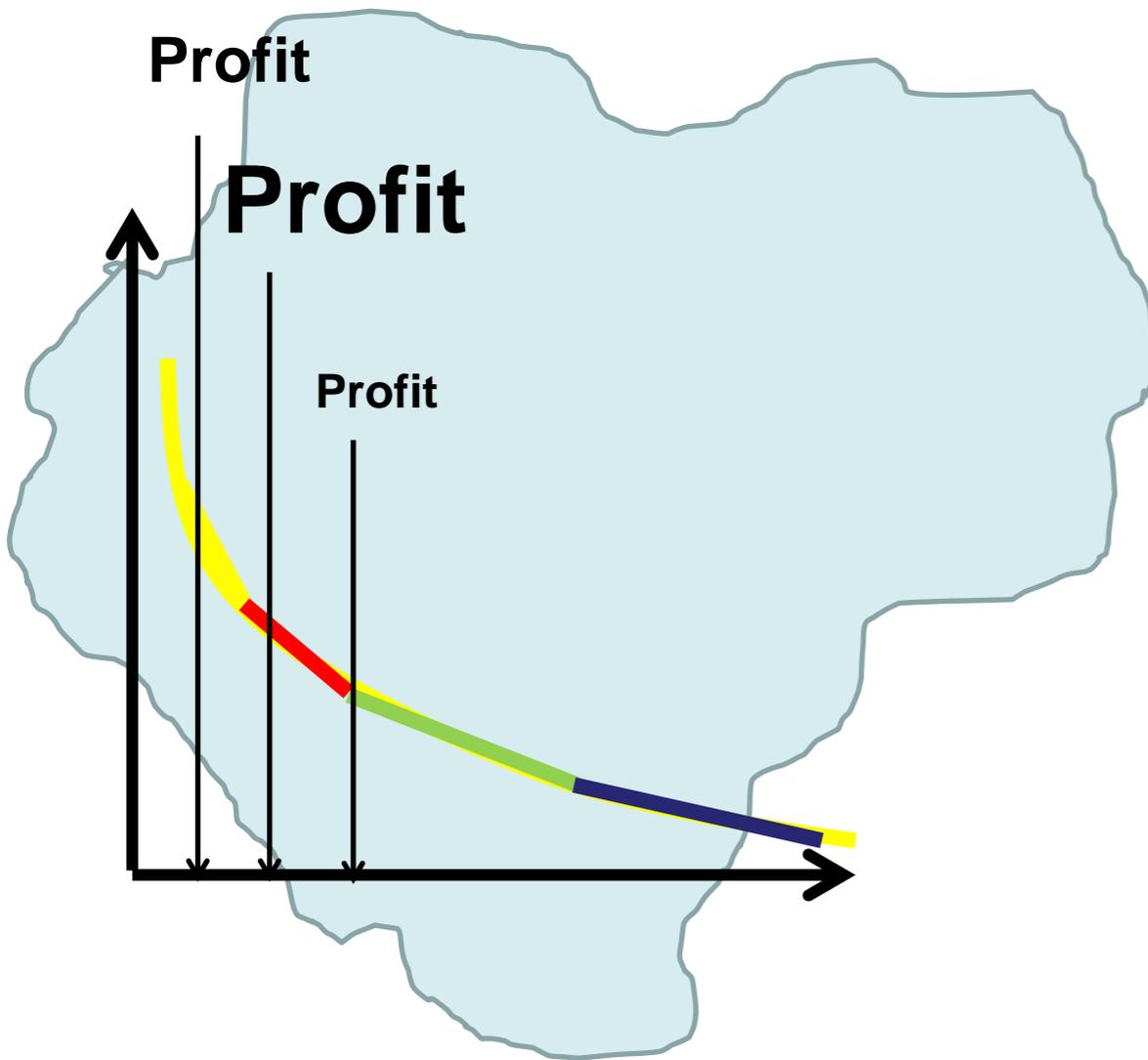




*To convert ore commodities into a mine business we need to draw an envelop where ore tonnages, ore grades, and other ore attributes allows generation of the maximum economic value at a minimum risk.*

*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).*





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

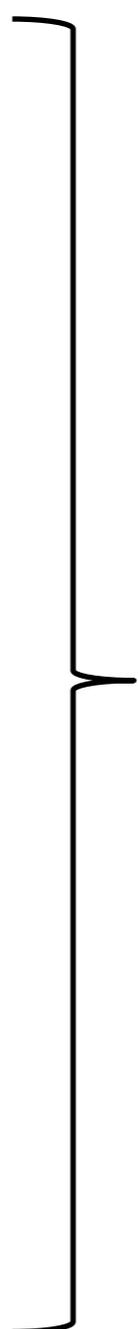
### operating return

- cost of capital
- discount rate
- net present value

## Social Parameters

### social licences

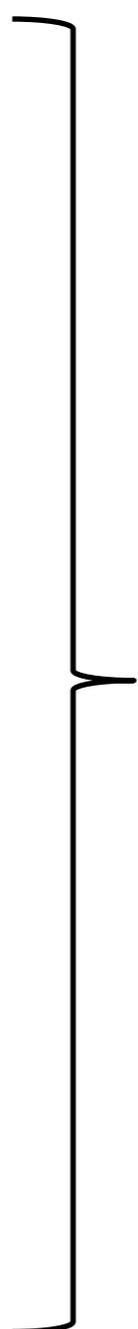
- communities agreements
- environmental permits

**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 [US\$/ton]**

## operating income per unit-grade

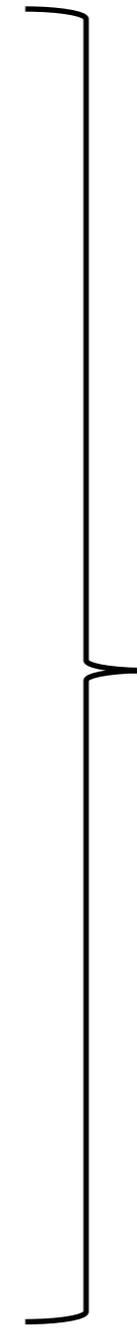
metal prices  
value of metal unit  
metallurgical recovery



b [US\$/ton]

## operating return

cost of capital  
discount rate  
net present value

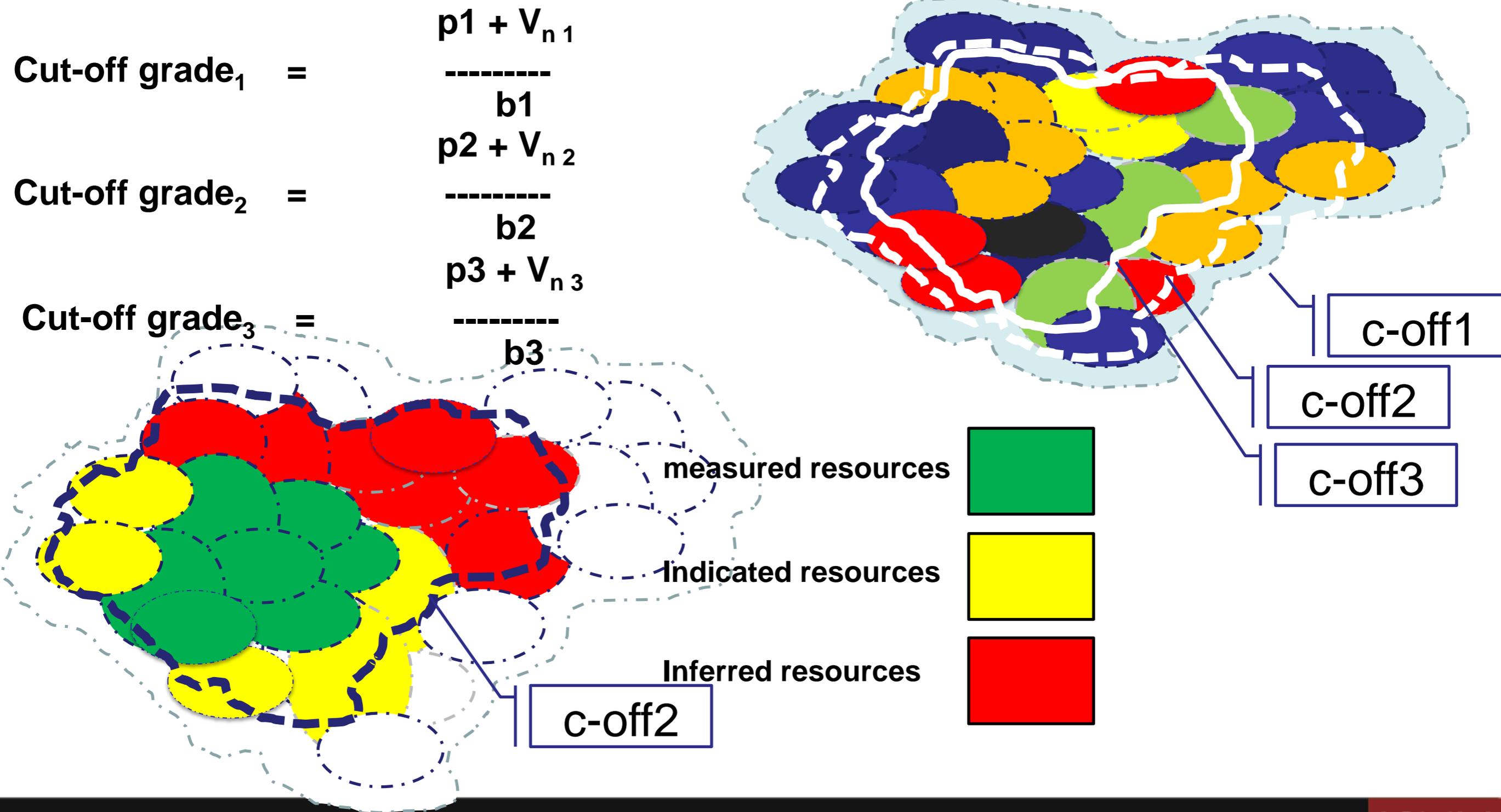


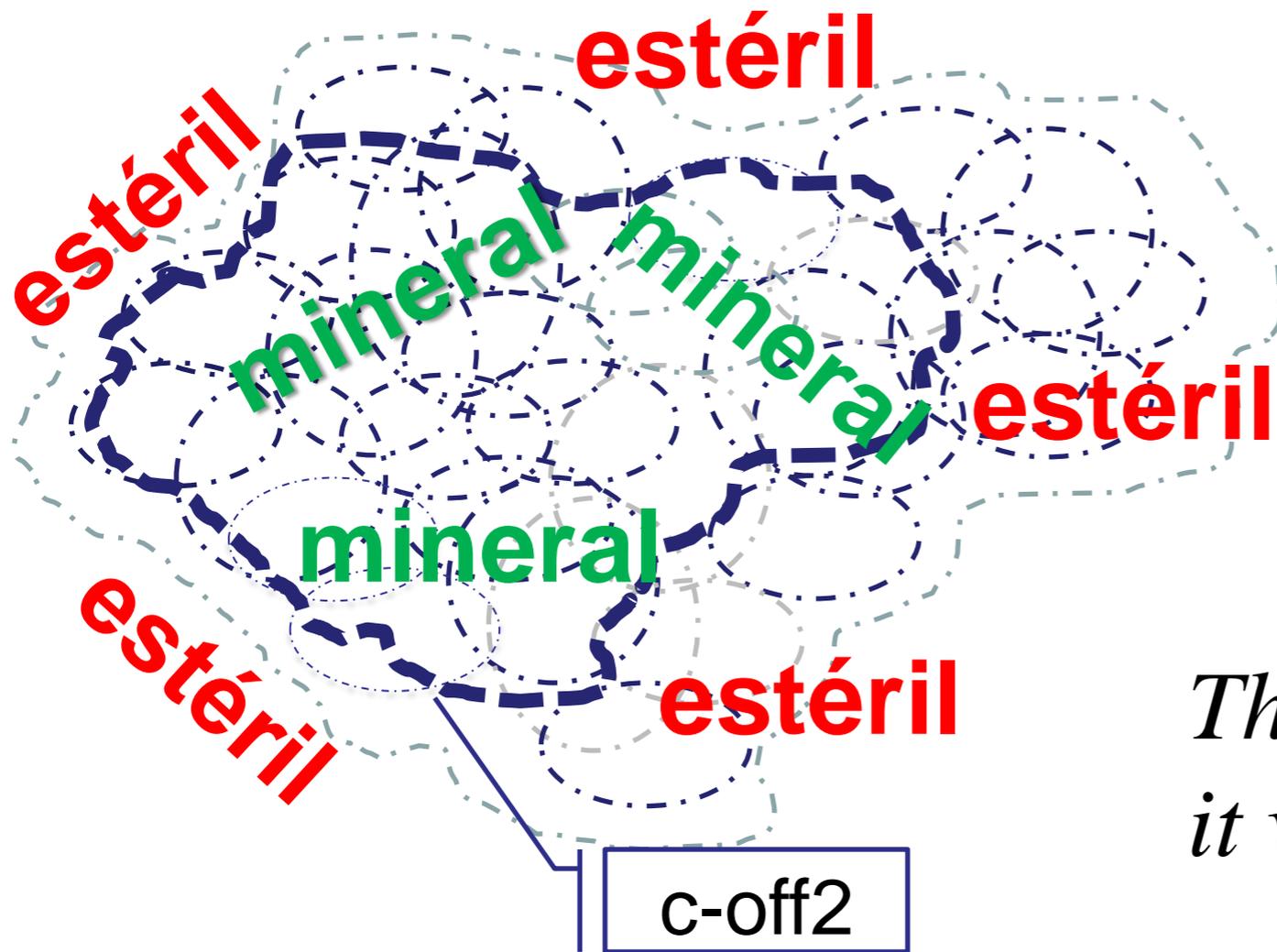
V [US\$/ton]

# A CUT OFF GRADE RELATION

$$\text{Cut -off grade} = \frac{p + V_{f(\text{NPV}, n)}}{b}$$

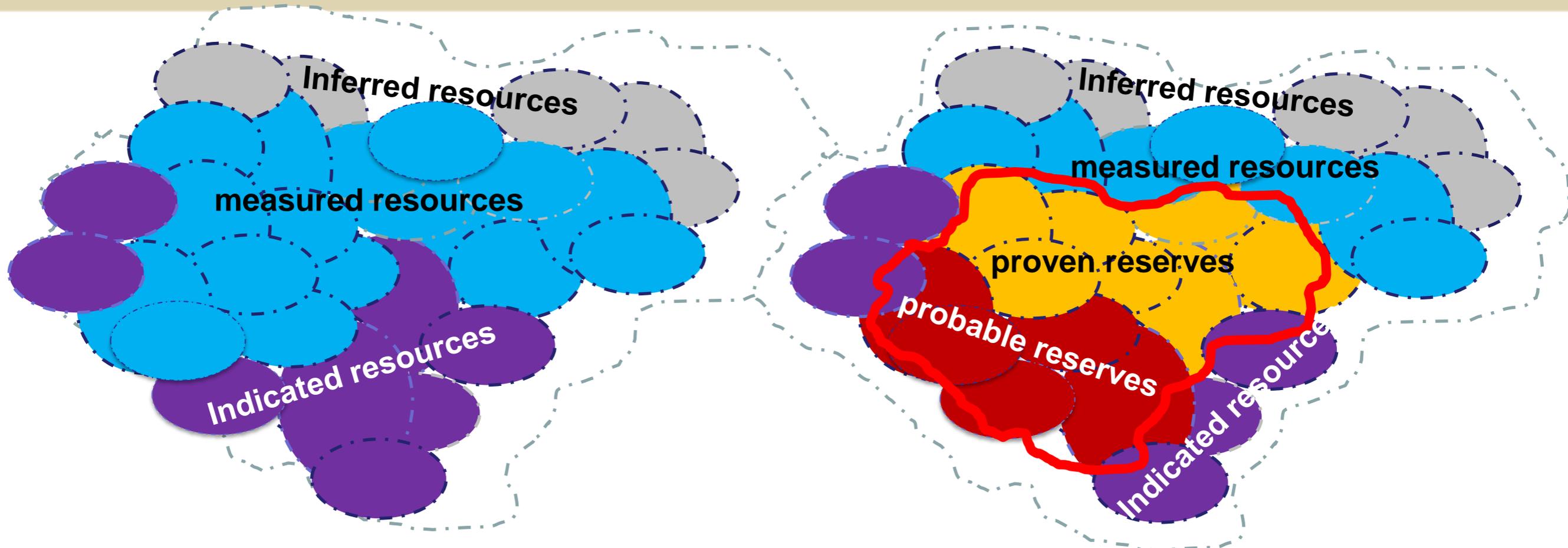
# THE BOUNDARIES GENERATION





*The envelop is dynamic :  
it varies through time.*

# FROM RESOURCES TO RESERVES



measured resources



Indicated resources



Inferred resources



**modifying factors**

proven reserves



probable reserves

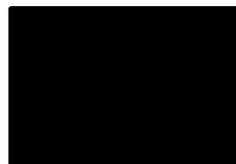


*The lowest metal prices lead to extract the highest metal grades and to establish the first mining phases*

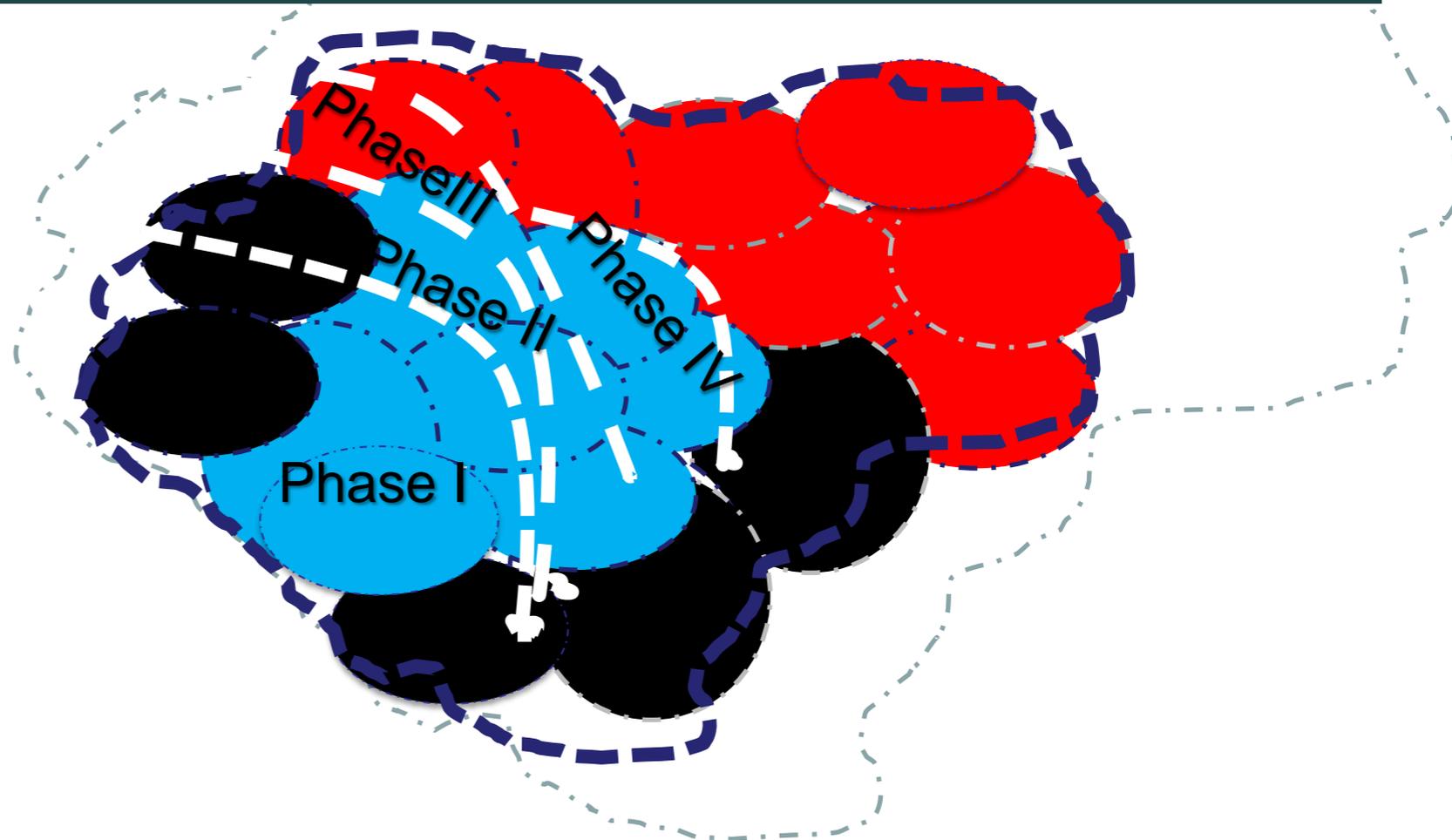
Proven reserves



Probable reserves



Inferred resources



*The modifying factors incorporates technical, economic, financial and social-community parameters to convert mineral resources into mineral reserves. They convert commodities into business.*