



The Task

- Public reports are issued by owners of mineral assets that concern Exploration Results, Mineral Resources and Mineral Reserves
- This information can influence value in a significant way. There is often a direct correlation between market value and resources/reserves.
- The report must enable the investor or his professional advisers to make a reasoned and balanced judgment


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Acknowledgements

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Examples

- Sale of 25 % of Ashanti Gold Fields to the public
- Privatisation of Zambia Consolidated Copper Mines
- Privatisation of DeBeers Consolidated Diamond Mines
- Sale of 50% of CVRD (Vale) to the public
- Technical Report for Oyu Tolgoi, Mongolia
- Technical Report for Public Listing of Jiangxi Copper


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Considerations

- Mineral commodities are diverse; risk areas vary: grade, tons, deleterious elements
- Stage of development requires different emphasis
- Topics to be covered can be quite broad

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Mineral Commodities are Diverse

- Copper (disseminated, massive veins, porphyry, sediment-hosted, skarns)
- Gold (disseminated, veins)
- Iron Ore (sediment-hosted, skarns)
- Diamonds (pipes, alluvial, marine)
- Potash (brines, bedded salts - sylvite)


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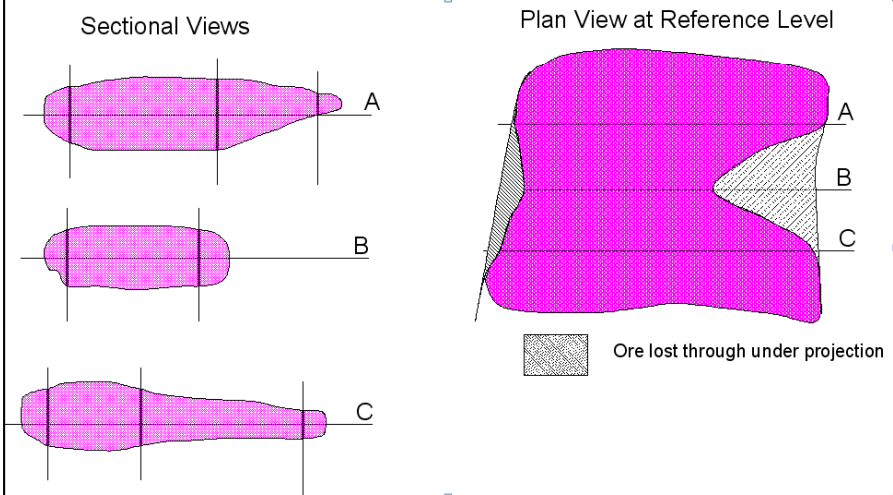
The Topics that Must Be Covered - Geology

- Mapping
- Interpretation on Section and Plan
- How far to project the data?

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 **No guts, No glory**




Sectional Views


Plan View at Reference Level

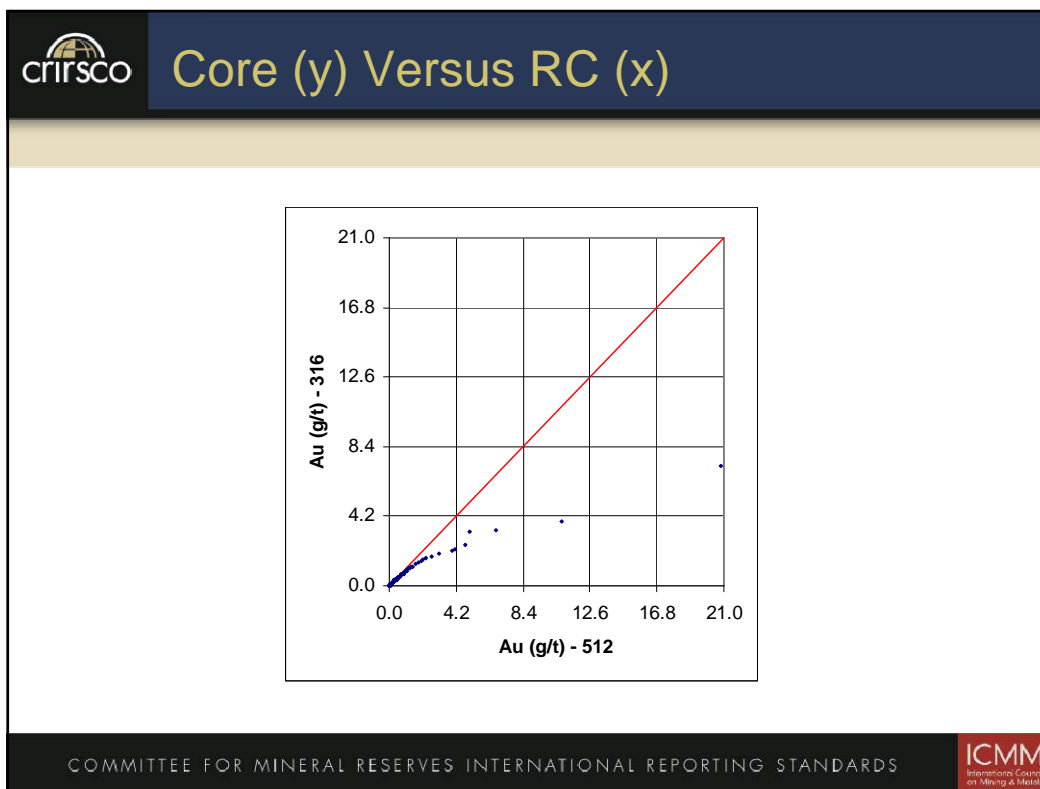
Ore lost through under projection



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 **The Topics to Be Covered – Drilling and Sampling**

- Drill spacing and orientation
- Collar and down-hole surveying
- Size of core
- Use of Reverse Circulation (RC) versus Core
- Sample size
- Splitting and subsampling

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-  Topics to Be Covered - Assaying
- Choice of method (ICP, AA, Gravimetric)
 - Standard reference materials
 - Duplicates, checks, blanks
 - Assurance
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Topics to Be Covered – Resource Estimation

- Domaining
- Dealing with outliers
- Interpolation plans
- Assessment of risk
- Expression of risk – classification (Global, local)
- Opportunities for expansion
- Capability to support mine design


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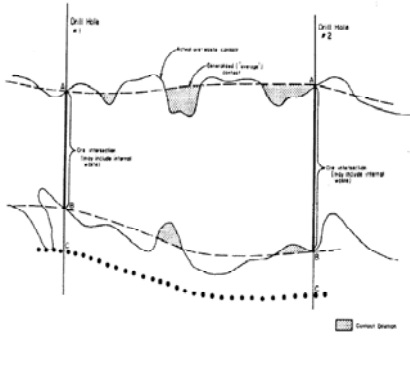

Topics to Be Covered – Mine Planning


- Production rate
- Selective mining unit
- Contact dilution and ore loss
- Slope angles, stope spans
- Ventilation
- Haul Cycles
- Dump stability/trafficability


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 **Contact Dilution and Ore Loss**





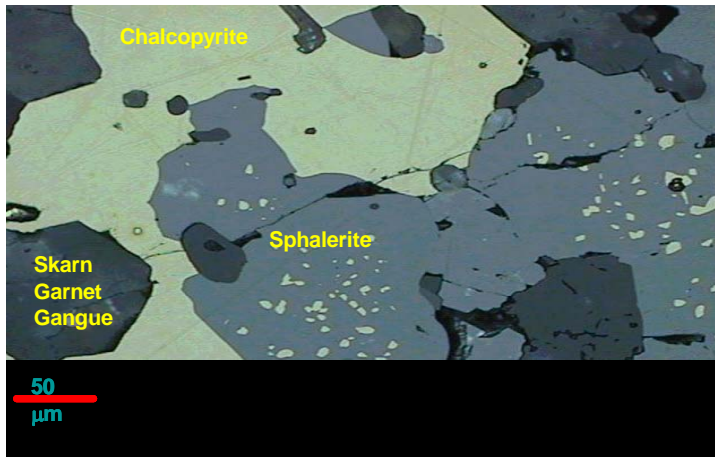
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 **Topics to be Covered - Metallurgy**


- Selection of samples (Are they representative?)
- Hardness
- Flow sheet
- Concentrate quality
- Recovery
- Tailings treatment

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 **Exsolution Blebs of Chalcopyrite in Sphalerite**




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 **Topics to Be Covered – Other Modifying Factors**

- Market
- Permits
- Legal issues – tenure
- Water availability
- Environmental Plan
- Closure Plan



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Topics to be Covered - Economics

- Capital costs (Relation between costs of labor, steel, concrete, price of oil)
- Operating costs (Labor, consumables, maintenance)
- Exchange rates
- Taxes and royalties
- Price forecasts
- Production schedule (Ramp-up, application of technical risk factors)
- Sensitivity Analysis (Risk assessment)


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Conclusions

- Tasks to be covered are diverse in scope
- Stage of property development is key to which tasks are critical (hard information in hand versus ability to make assumptions)
- Opinions are required throughout the process

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Standards

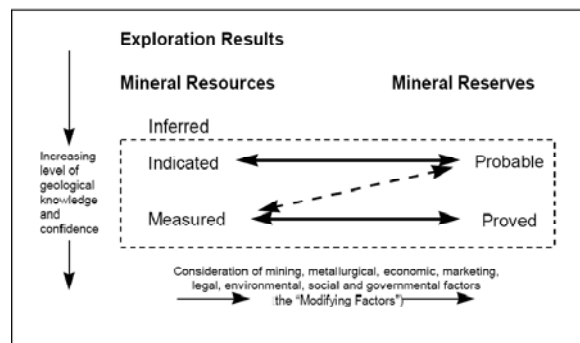
- Detailed standards do not generally exist, except in long-lived districts where repetitive exploration and design are possible (examples Sudbury, Canada; Witwatersrand, South Africa)
- Books and papers provide case studies, (But these must be adapted)
- Many “industry standards” are more guidelines or statements of principles – 100 m grid for porphyry coppers, but could be 50 m to 200 m

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International Council
on Mining & Metals




CRIRSCO Family of Codes For Reporting Exploration Results, Mineral Resources and Mineral Reserves



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Indicated or Inferred Resources? Guidelines from 2006 CRIRSCO Template



- **For Inferred Resources:**

Confidence in the estimate is usually not sufficient to allow the results of the application of technical and economic parameters to be used for detailed planning. For this reason, there is no direct link from an Inferred Resource to any category of Mineral Reserves (see Figure 1).
- **For Indicated Resources**

Mineralisation may be classified as an Indicated Mineral Resource when the nature, quality, amount and distribution of data are such as to allow confident interpretation of the geological framework and to assume continuity of mineralisation.

Confidence in the estimate is sufficient to allow the application of technical and economic parameters, and to enable an evaluation of economic viability.


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Who Can Prepare Reports on Exploration Results, Mineral Resources and Mineral Reserves?

- **Competent Persons!**

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Competent Persons in Chile

- Must have a professional degree in sciences related to the mining industry
- Must be registered with the Comisión Minera
- This is a public register!

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What is a Competent Person? (Reciprocity)


- Must be member/fellow of **recognized professional body** relevant to activity being undertaken and subject to enforceable rules of conduct

**As Interpreted by Canadian (NI43-101)
(Recognized Foreign Association)**

- Professional body admits members based on academic qualifications and experience
- Professional body has power to suspend or expel a member
- Professional body requires compliance with standards of competence and ethics established by the body

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What is a Competent Person?

- Must have a minimum of five years experience relevant to style of mineralization and type of deposit
- It is possible for experience on related deposits to qualify...


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Guidance on Relevance from 2006 CRIRSCO Template

- For example, in estimating Mineral Resources for vein gold mineralisation, **experience in a high-nugget, vein-type mineralisation such as tin, uranium etc. will probably be relevant** whereas experience in massive base metal deposits may not be.
- As a second example, to qualify as a Competent Person in the estimation of Mineral Reserves **for alluvial gold deposits, considerable (probably at least five years) experience in the evaluation and economic extraction of this type of mineralisation would be needed.** This is due to the characteristics of gold in alluvial systems, the particle sizing of the host sediment, and the low grades involved. **Experience with placer deposits containing minerals other than gold may not necessarily provide appropriate relevant experience.**

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Personal Experience: What Does Five Years Provide?

- Opportunity to work on 5 to 10 deposits and to gain experience in ore controls (**not guides**) in an operating environment where resource models are validated through reconciliation with mine production
- Opportunity to observe mining selectivity, contact dilution and ore loss, effectiveness of stope/slope designs
- Opportunity to observe mine/mill reconciliation

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Projects That Went Off The Rails

- Continuity of sedimentary iron formation applied to hydrothermal replacement deposit; contact dilution lowered head grade 10%. **Forecast profit greatly reduced.**
- Inadequate drilling led to inaccurate prediction of top of ore. Ore production ceased for several months while stripping caught up. **Told them to buy a diamond drill, but they bought a haul truck.**
- RC drilling below water table compounded by drilling down high-grade structures led to over-estimation of grade and continuity – **US\$100 million write-off**

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What is a Competent Person?

- Common sense must prevail
 - You need a geologist to prepare reports on exploration results
 - You need a resource estimator to build models of resources
 - You need mining engineers to determine reserves


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Are You Competent? Guidance from 2006 CRIRSCO Template

- As a general guide, persons being called upon to act as Competent Persons **should be clearly satisfied in their own minds that they could face their peers and demonstrate competence in the commodity, type of deposit and situation under consideration.** If doubt exists, the person should either seek opinions from appropriately experienced colleagues or should decline to act as a Competent Person.

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Warning

- You can self-nominate yourself as having relevant experience from other types of deposits, and I have done so
- I usually lived to regret this later
 - Had I seen blast-hole grades at Tintaya, Peru I would have fought harder for more exploration drilling to support Measured and Indicated resources at Antamina in 2000.
 - Unfortunately I did not see Tintaya until 2003

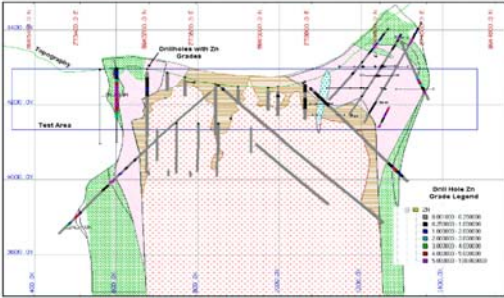
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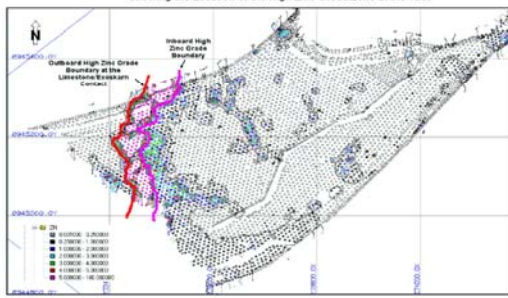


Exploration Drill Spacing is 50 m, but Zinc Orebody is Only 35 m Wide


Vertical Section 20250N DTOK Zn Domain Definition Reference Data




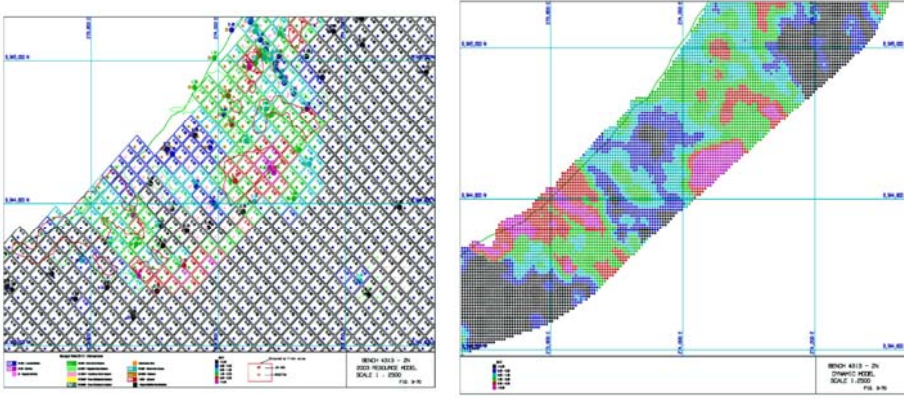
Contoured Blasthole Zinc Grades on the 4223 Bench
Showing the Location of the High Zinc Grade Zone at the Taco





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 **Talus Prevented Drilling and Discovery of High-Grade Structure**




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 **Competent Person's Report**

- Must be transparent, keep audience in mind
 - Neither a comic book or a PhD thesis
 - Clear enough to be summarized in a mining journal
- Must be material
 - Concentrate on key information in Table 1 of the CRIRSCO Template
- Contain clear statements of Resources and Reserves



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Competent Person's Report Best Practices

- Internal and External Audits are the rule, and reports should discuss their outcomes
- If an opinion is borderline, such as classification, state fully the thinking the Competent Person used to make the decision (Pat Stephenson, former Chairman of JORC)
- A summary letter discussing key assessment criteria, resources and reserves statement, risks and opportunities should introduce the report (MRT now Golder Practice)


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Other Observations

- As properties advance through development, it is common for several Competent Persons to author a report
- In general, there will be **lead** Competent Persons who will be Geologists and/or Mining Engineers
- There can be **specialist** Competent Persons who may be metallurgists, environmental engineers, economists, marketing specialists, etc.
- Competent Persons are responsible for the work, even if done by others. Supervision should be close; **QA-QC is required for all steps.**

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Competent Persons in China

- I have come to China for a long time – over 30 years
- I have been fortunate to work on Dexing, Fushun West Open-Pit, Ho Lin He, Ping Shuo
- There are some truly world-class Competent Persons in China, and I hope you will agree that they are the ones to estimate and report Mineral Resources and Reserves

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Thank You

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