26 Common Flaws Encountered in Mineral Resource Estimation

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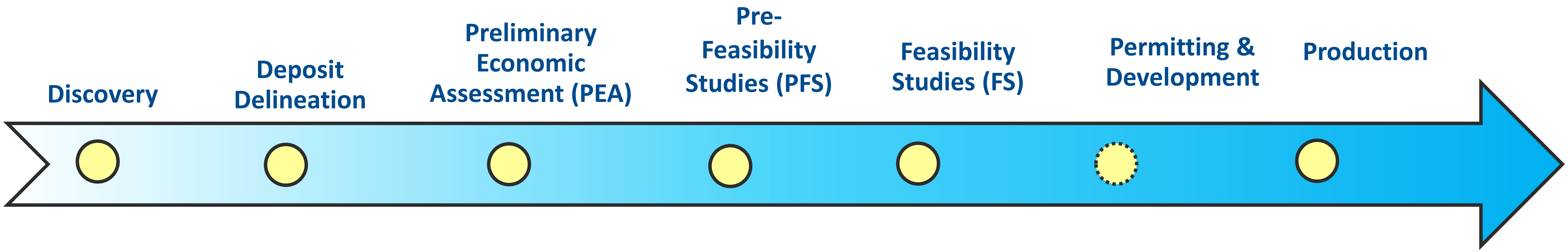
- All discussions and opinions discussed in this presentation are those of the authors only.

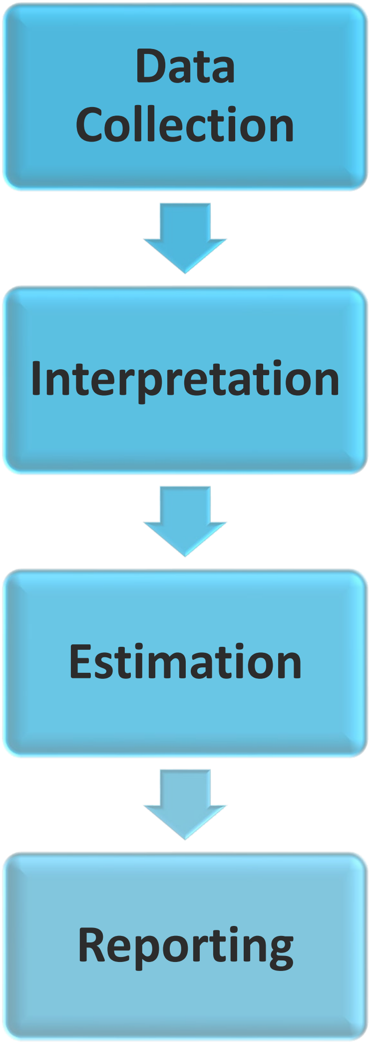
INTRODUCTION

Mineral Resources and the Mining Cycle



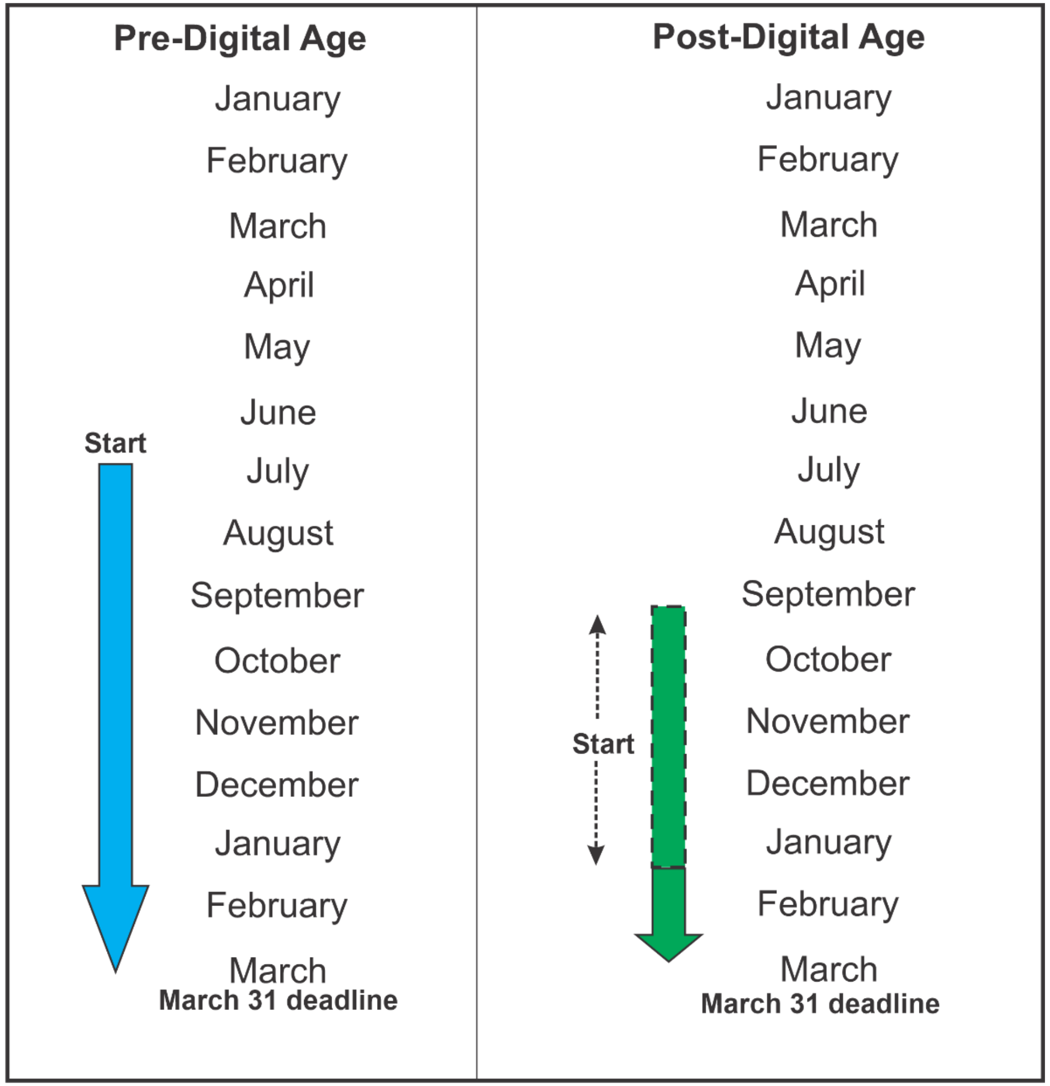
- Mineral Resources are prepared at various stages in the mining cycle.
- In all cases, the purpose of a Mineral Resource is to prepare an estimate of the three-dimensional location, size, shape, geometries, rock density, and metal grades of a mineral deposit from which more detailed studies can be completed.
- The underlying fundamental concept of a Mineral Resource is that the material will ultimately be considered as feedstock in a mining and processing operation at some point in the future.

Mineral Resource Estimation Workflow



- Over the span of several decades, SLR has had the opportunity to participate in or review **well over 900** Mineral Resource estimates spanning many deposit types throughout the globe.
- Generally, Mineral Resource estimates follow a similar workflow that begins with data collection and concludes with reporting of the results.
- While each Mineral Resource estimate has its unique characteristics, SLR has observed some consistent errors in the preparation of Mineral Resource estimates.

MOST COMMON ERROR



- Not enough time allotted for Mineral Resource and Mineral Reserve estimation.
- Experience has taught that there are often unexpected surprises that crop up during the estimation process.
- These surprises all require extra time to address in an adequate manner.
- Best advice: Start the process early.

Agenda

- A detailed discussion of each of the flaws or errors listed above will require more time than is allotted for this presentation.
- Consequently, only a selection of the following more serious flaws will be discussed in this presentation.
- Additional discussions to follow.

Common Errors

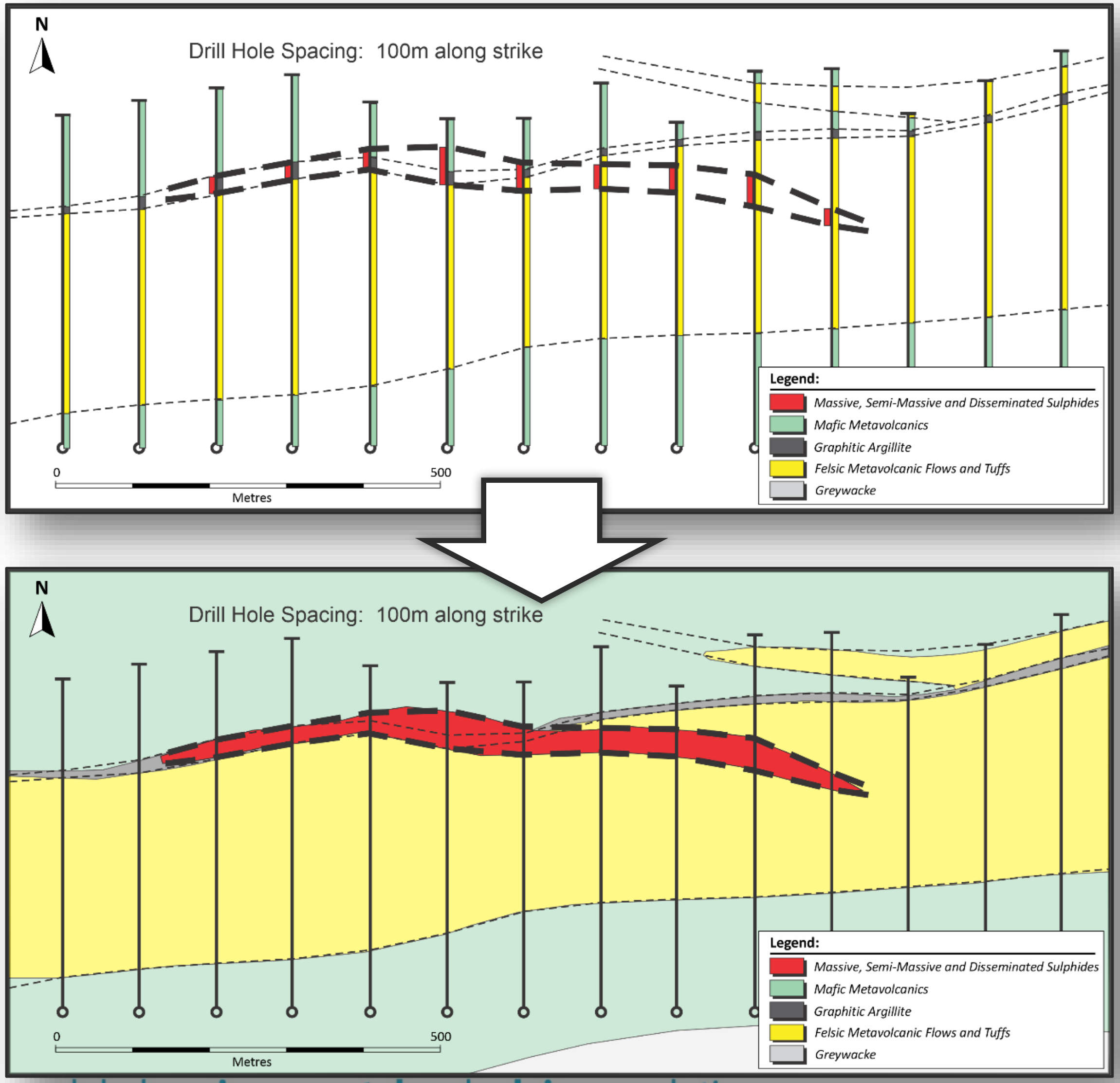
1. **Data Collection (Database Quality):**
   1. **Insufficient drilling**
   2. **Insufficient sampling (null values)**
   3. **Data errors and poor database quality**
   4. Inappropriate assaying method (TCu vs ASCu, CNAu, NiT)
   5. Insufficient density measurements
   6. Poor understanding of spline methods
2. **Interpretation and Wireframing:**
   1. Poor (or no) snapping to drill holes
   2. **Using broad/loosely constrained mineralization wireframes**
   3. Using too low of a mineralization threshold for wireframing
   4. Incorrect interpretations
   5. Interpretation from too widely spaced drill hole information
   6. **Incorrect use of an interpolant to create a mineralized domain volume**
   7. Ignoring/not modelling post mineralization intrusions when volumetrically significant
   8. Aggressive/deep oxide surfaces for heap leach projects
   9. Unconstrained compositing

Common Errors

3. **Estimation:**
    1. **Inappropriate treatment of high grades**
    2. **Poor selection of estimation parameters**
    3. Poor search ellipse orientations
    4. **Poor variography**
    5. **Over-smoothing the estimated grades**
4. **Reporting:**
    1. **No Constraining Surfaces or Volumes**
    2. **Cut Off Grade is incorrect due to incorrect parameter selection**
    3. **Minimum width does not meet the RPEEE requirement**
    4. Bad coding of as-mined volumes / inappropriate inclusion of remnant material
    5. Running Whittle or other software incorrectly to define resource pit shells
    6. Running Deswick or other optimization software incorrectly to define underground resource panels

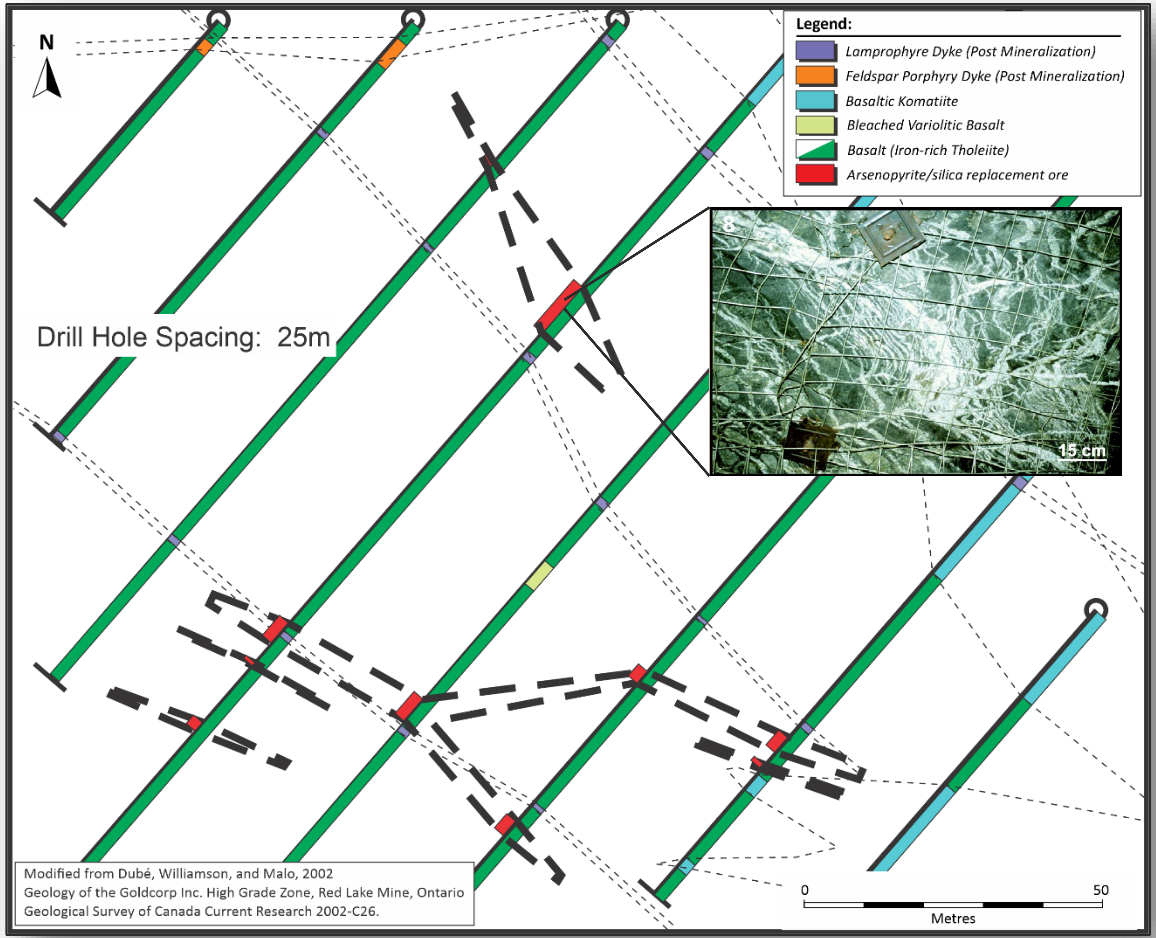
DATA COLLECTION AND QUALITY

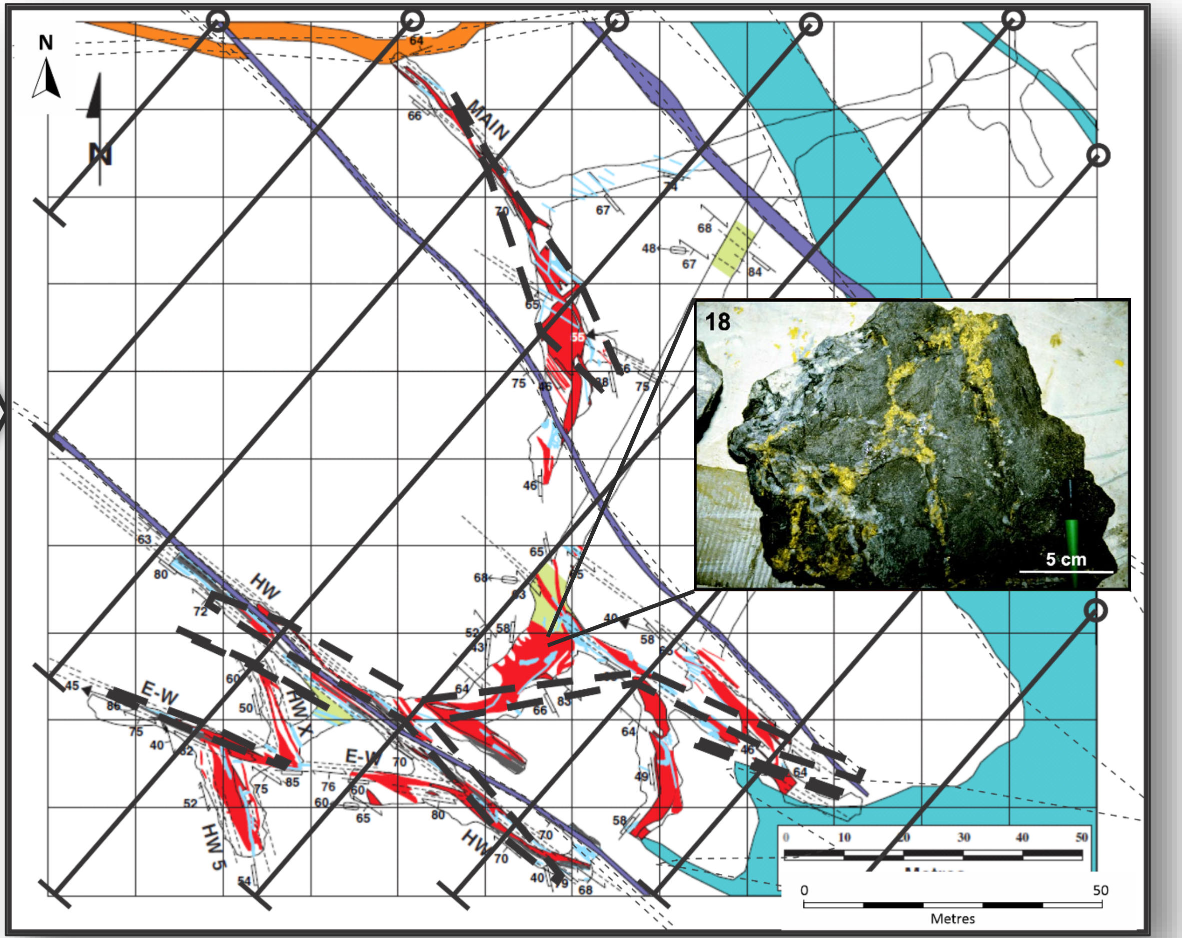
Drilling Density – Simple SPATIAL Continuities



- Drill hole information used for Mineral Resource estimation is required for two purposes: 1) to outline and define the geological continuity (“the structure”), and 2) to define the continuity of the grades.
- For mineral deposits with relatively simple spatial geometries, outlining the continuity of the geology and mineralization can be done using relatively widely spaced drilling.
- Unfortunately, not all mineral deposits have simple spatial geometries……

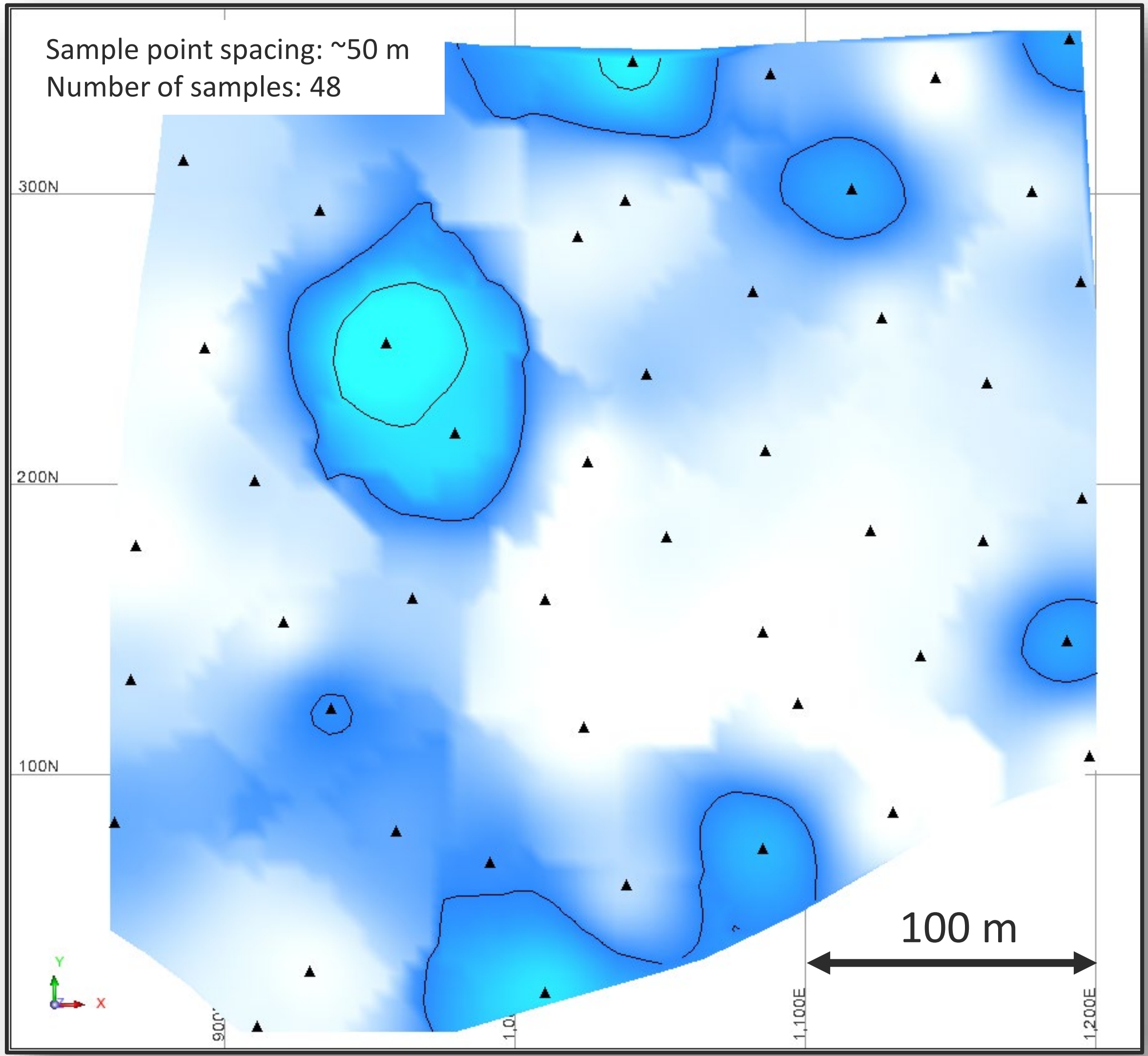
Drilling Density – Complex SPATIAL Continuities





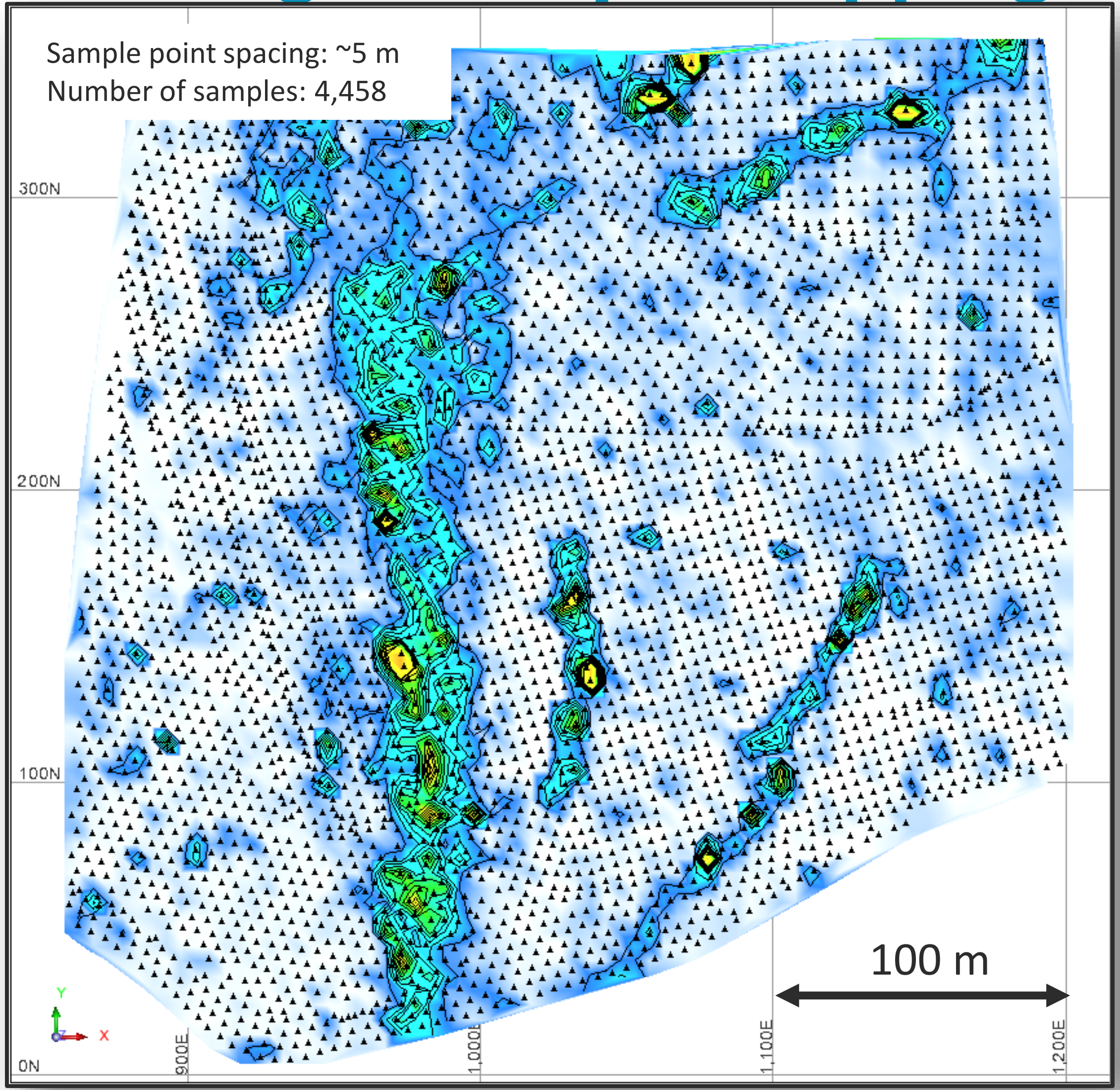
- Many mineral deposits have complex geology and mineralization geometries. A higher density of sample (DDH) information is required to allow the accurate interpretation of the geology and mineralization.
- Unfortunately, the determination of the optimum drill hole spacing requires foreknowledge which is not available. The judgement and experience of the geological team is often the only source of information for determining an optimum drill hole spacing.
- **When in doubt: Drill more!**

Drilling Density – Mapping the GRADE Continuity



- After the spatial continuity of the geology and mineralization has been defined, drill hole sample information is then required to determine the distribution and continuities of the grades (or values) of the mineralization **within** the wireframe model.
- The objective at this stage is to collect sufficient sample information to be able to describe the three dimensional location, shape and concentration (grade) of the metal values.
- The process typically begins with collection of sample information at a relatively wide spacing.

Drilling Density – Mapping the GRADE Continuity



- The continuity of the geometries and distribution of metal values in mineral deposits are often complex affairs.
- Industry experience has shown that collection of samples at a close spacing is often required to provide an improved understanding of the geometries and the grade distribution.
- This detailed information is critical for reducing the uncertainties of tonnage and grade estimates.
- **When in doubt: Drill more!**

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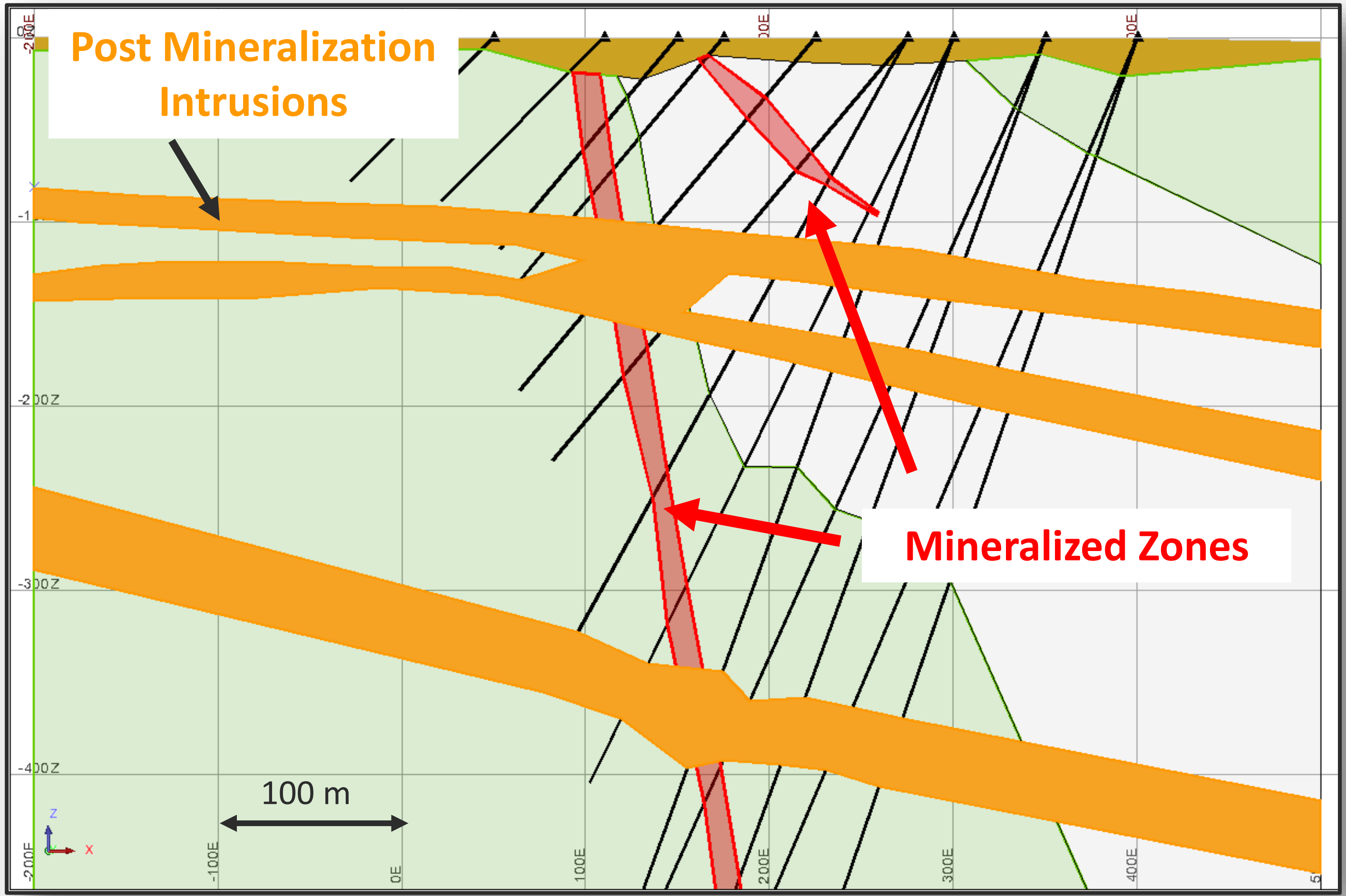
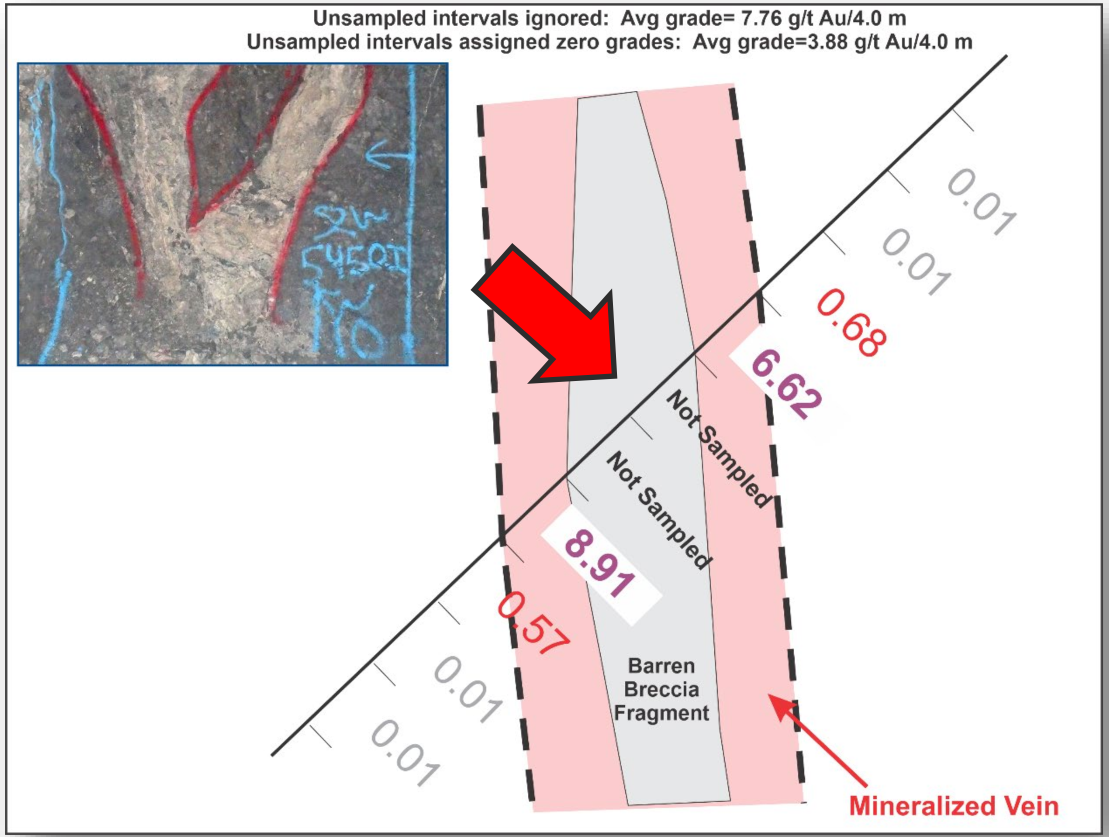
Drilling Density – Post Mineralization Features



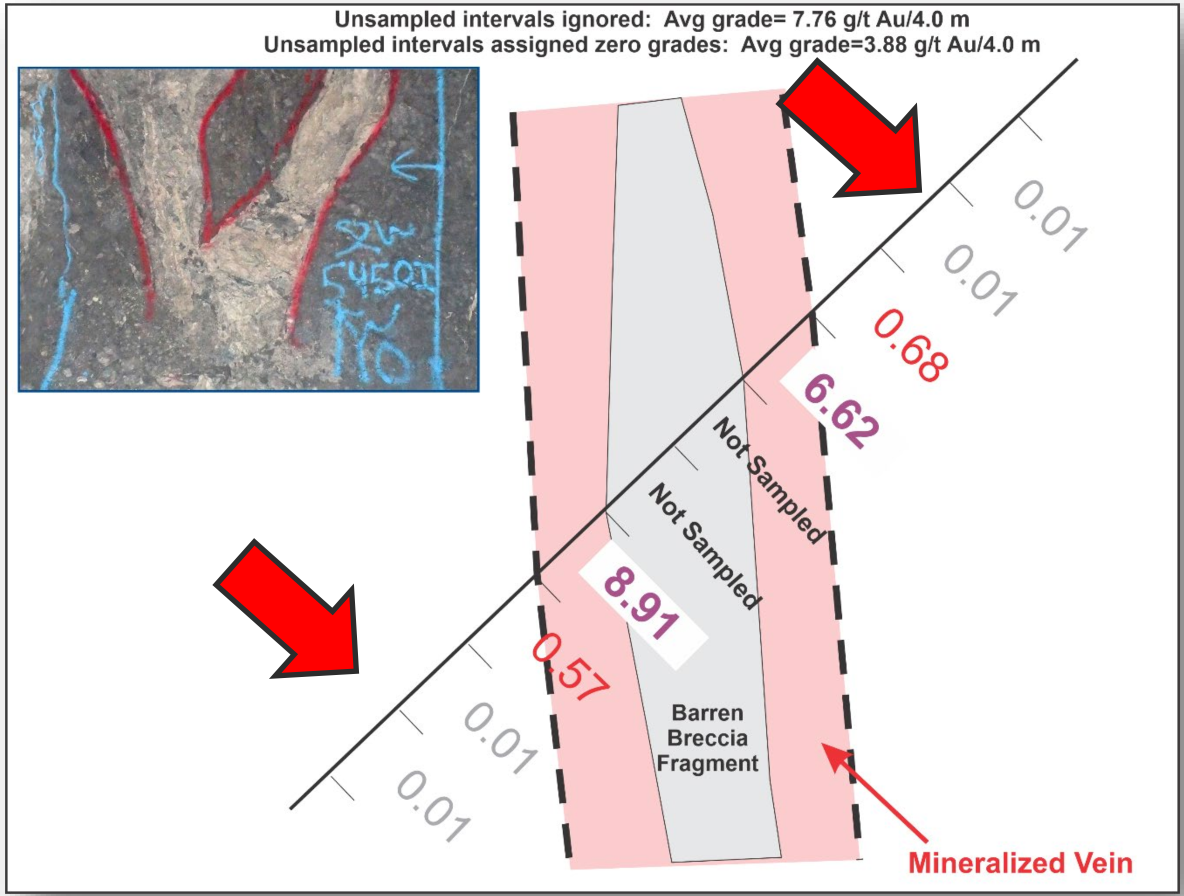
- The geometries of mineral deposits can also be affected by post mineralization effects such as faulting, intrusions, or folding.
- Collection of sample information at a sufficient density is required to improve the confidence of the interpretations.
- The density of the sample spacing will depend on the spatial complexity of the mineralization.

Unsampled Intervals (Null Values)



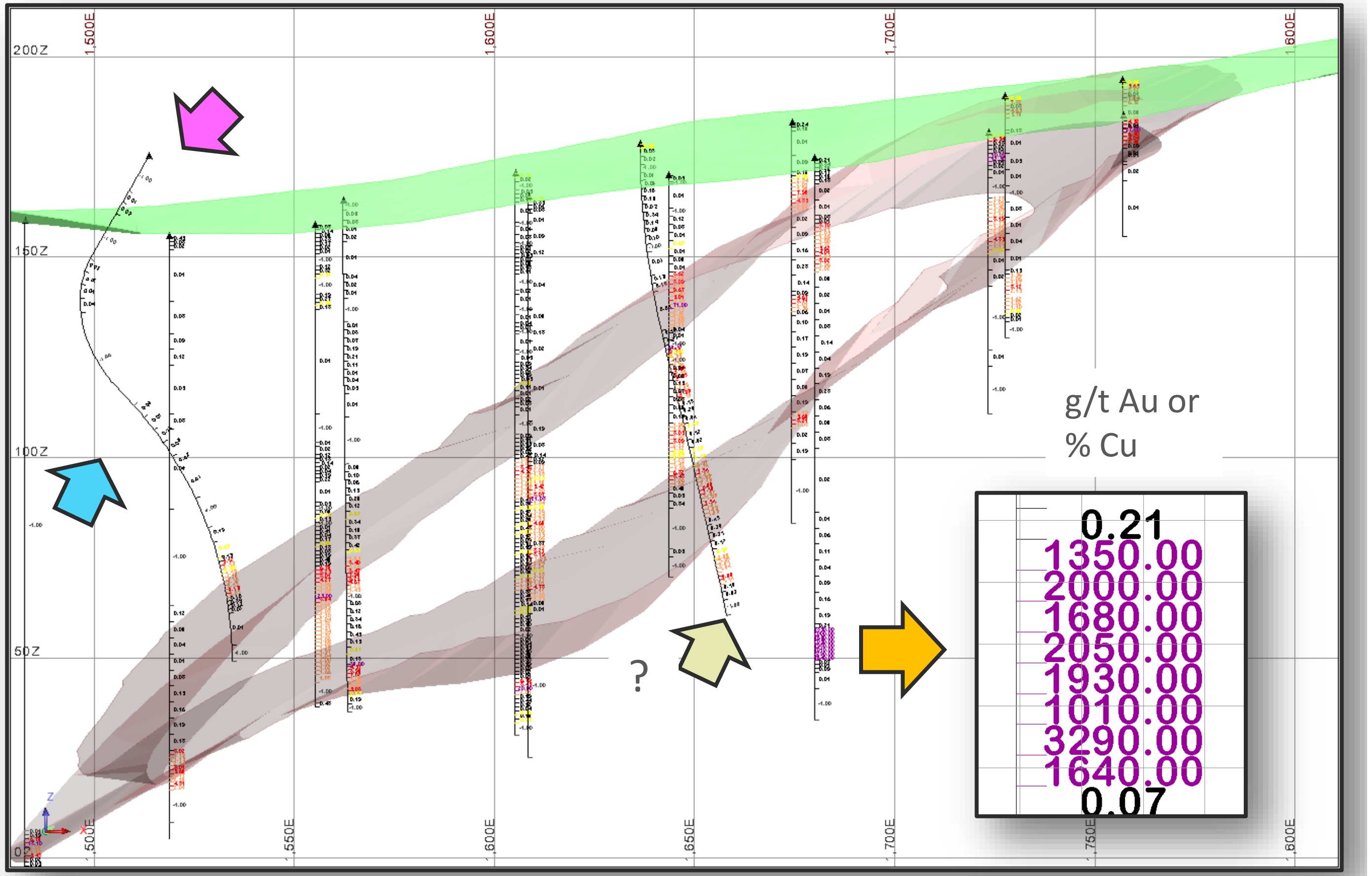
- In some cases, gaps in the sample information of the mineralized zone may be present resulting from the core logging geologist's estimation that the interval(s) in question are not likely to contain potentially economic concentrations of metal based upon visual examination. In many cases, this judgement has proven correct.
- These unsampled intervals are recorded in the drill hole databases as no sample taken ("null values").
- This poses a major challenge for grade estimation, as null values are often treated as ignored (blanks). Adjacent sample values are used to estimate the intervening grades leading to a poor Mineral Resource estimate.
- Experience has taught that best results are obtained when full sample coverage of the mineralized zones is achieved. Where this is not possible, insert zero values for the unsampled intervals prior to estimation of grades.

Sampling Wall Rocks (Null Values)



- An important step at the drill hole logging and sampling stage is to ensure that sufficient samples are taken for assaying along the hangingwall and footwall contacts.
- This provides full confidence that the limits of the mineralization have been defined by assaying.
- It also allows the Mineral Resource practitioner to clearly identify the mineralized intervals.
- Assay information for the wall rocks permit the construction of dilution models with confidence.
- It is good practice to collect samples along the wall rocks.

Data Errors / Database Quality



- The accuracy of the drill hole and sample information in a database is critical for preparation of a reliable Mineral Resource estimate, and all subsequent work that relies upon it.
- GIGO applies!
- Despite the database validation routines offered in many software packages, material errors can still be present for which the checking routines are not designed to find.
- All data errors should be corrected before a Mineral Resource estimate is prepared.
- **Practitioners are reminded that they are ultimately responsible for all aspects of a Mineral Resource estimate.**

INTERPRETATION

Wireframe Interpretations

Source: Harper and Manns,
CIM Bulletin Vol 80, no 907, November 1984

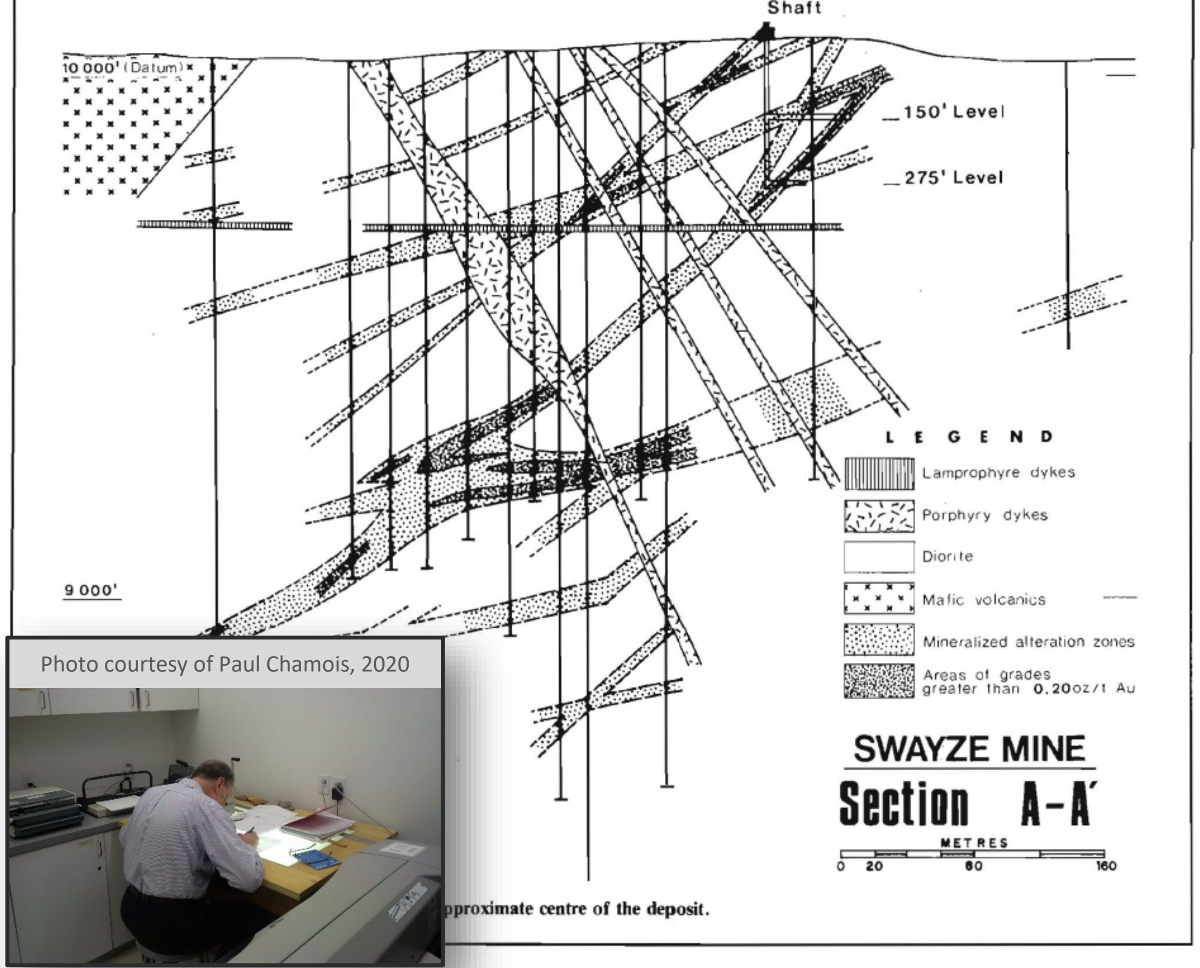
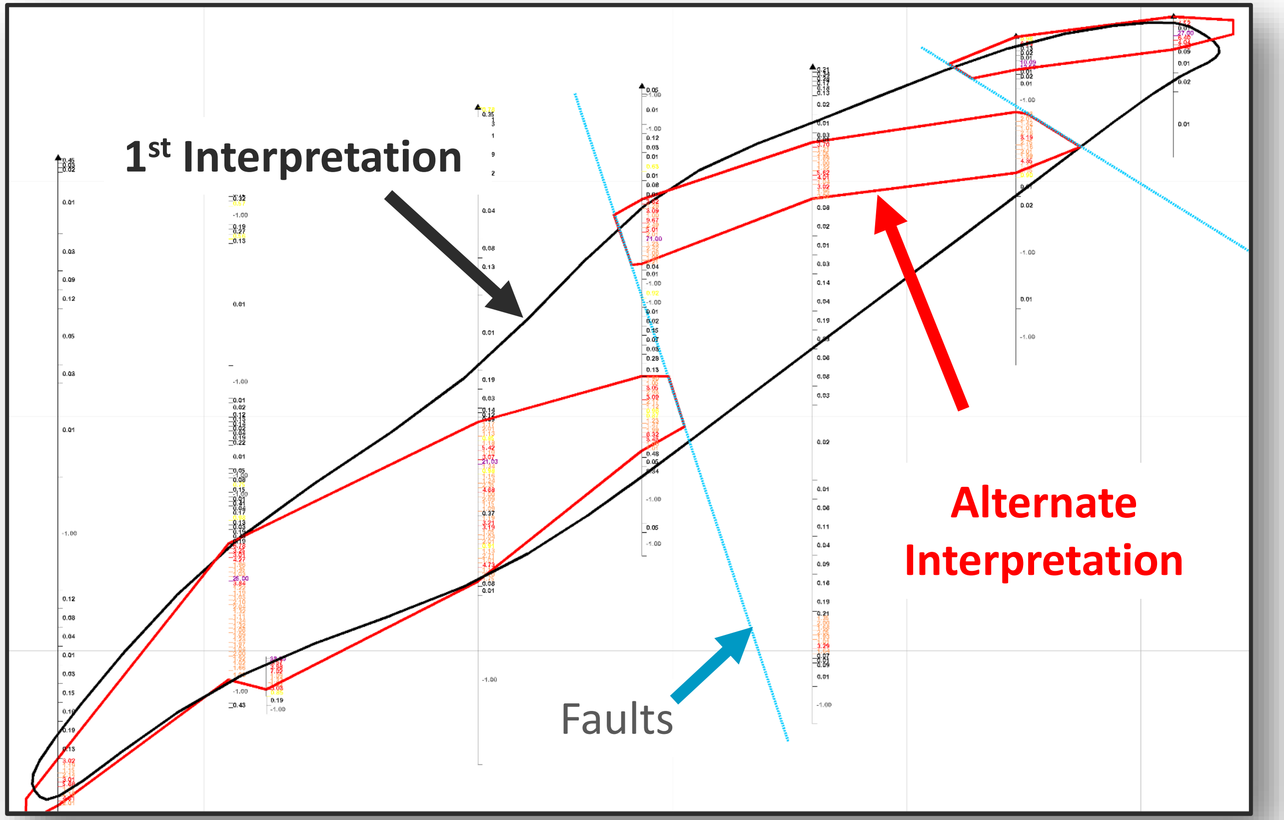


Photo courtesy of Paul Chamois, 2020

- Interpretation of lithology, alteration, and mineralization information collected from drill holes and other methods has long been an integral part of the Mineral Resource estimation process.
- Although modern-day interpretations are largely completed using computer-aided methods, the fundamental concepts remain unchanged.
- For all practical purposes in a mining operation, the purpose of a mineralization wireframe is to create a three-dimensional model of the mineralized material that has potential for being extracted and processed at a profit.

Mineralization Wireframes

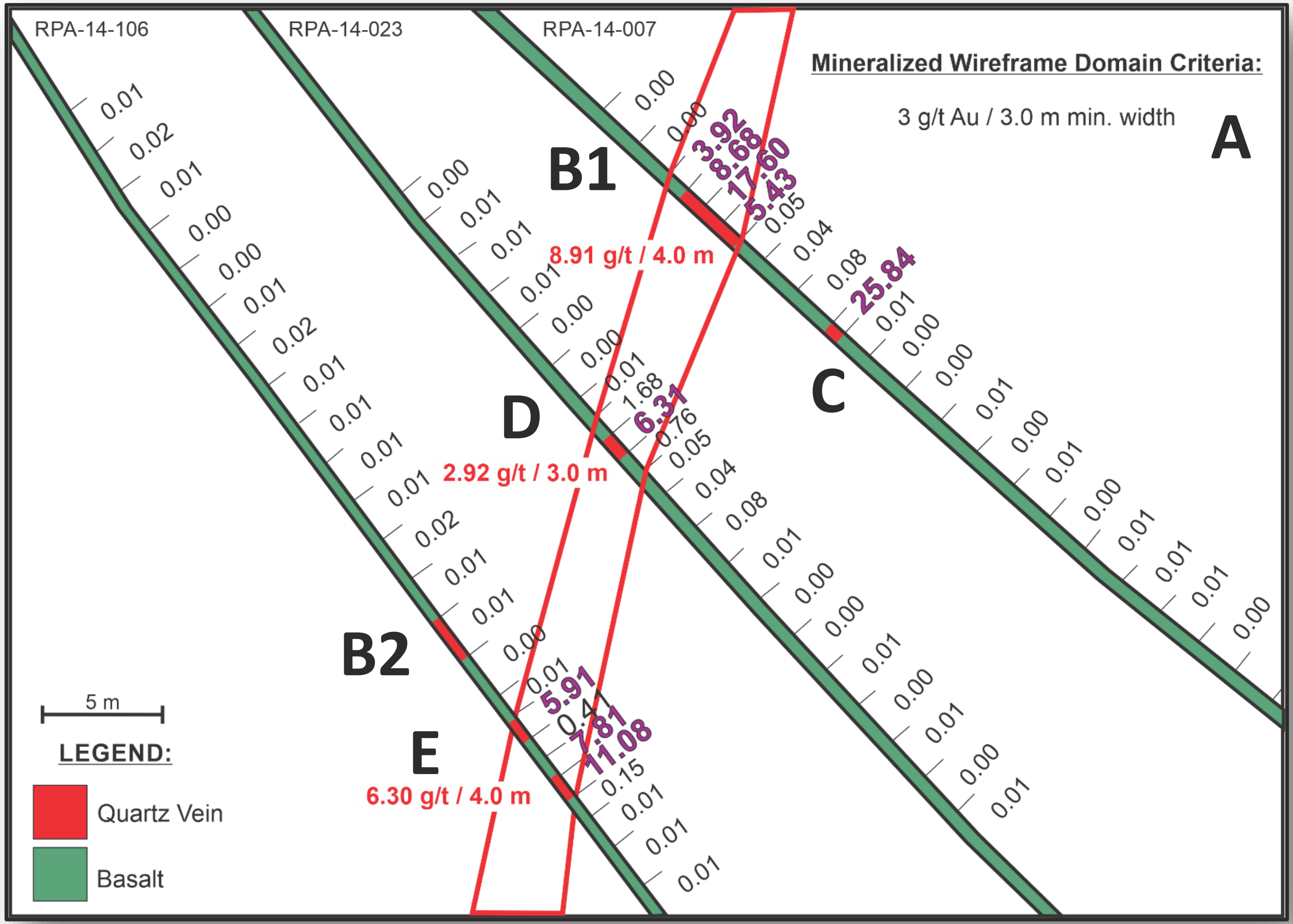


- Mineralization wireframes are prepared by **<u>INTERPRETATION</u>** of the continuity of the mineralized intervals between drill holes.
- In many cases, alternate interpretations may be possible. These may have significant impacts on the Mineral Resource estimate.
- Mineral deposits are not always well-behaved tabular sheets. Knowledge of the deposit type and expertise of the Practitioner is critical.

Mineralization Wireframes

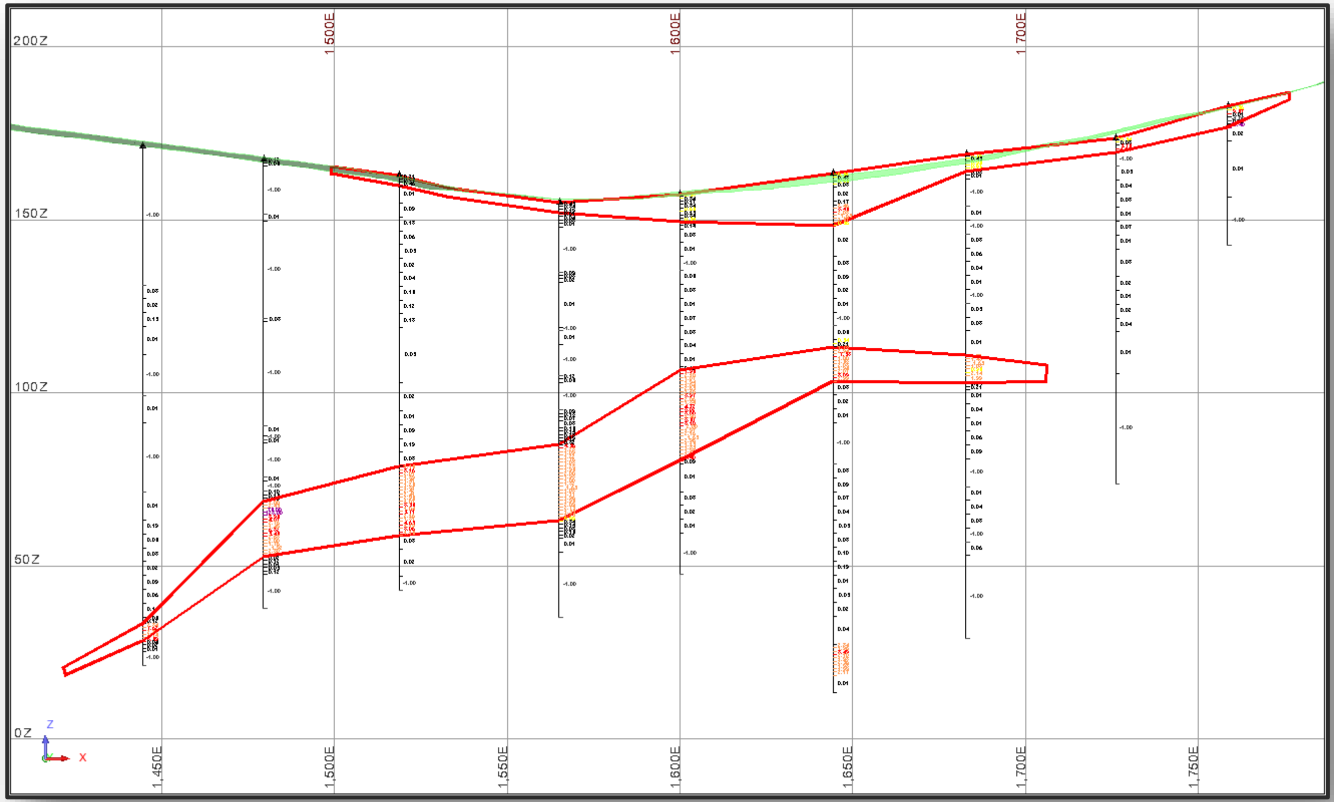
- Suggested criteria for creating mineralization wireframes provided in Chapter 5.4 of the Canadian Institute of Mining and Metallurgy 2019 Mineral Resource and Mineral Reserve Best Practices Guidelines include:
  - Spatial density and distribution of sample information,
  - Pertinent geological features such as lithology and structure,
  - Spatial distribution and continuity of the mineralization,
  - Continuity and distribution of the grade of the mineralization,
  - Nature of the boundaries (e.g. sharp or gradational),
  - Anticipated economic limits of extraction (such as a grade, grade equivalent or value parameter) and processing scenario under consideration, and
  - Anticipated mining rate.

Mineralization Wireframe Fundamental Concepts



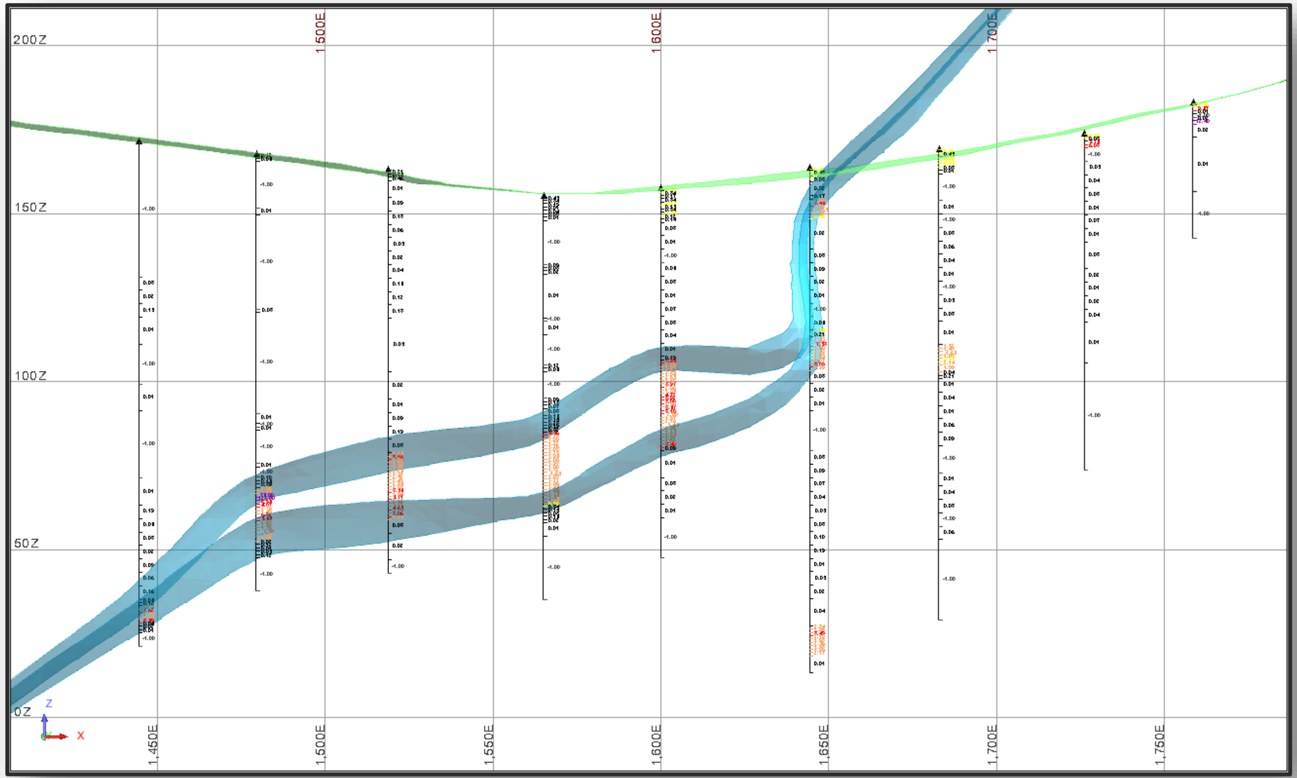
- While the specific criteria for creating mineralized wireframe interpretations is deposit specific, the fundamental concepts remain unchanged over time:
  - Appropriate cut-off grade and minimum width criteria (A),
  - Relationship of geology with grade (B1,B2),
  - Geological continuity (C),
  - Modelling of minimum width (D), and
  - Internal dilution (E).
- These time-tested and proven principles have been traditionally applied when creating explicit mineralization wireframe models.

Explicit Wireframe Models



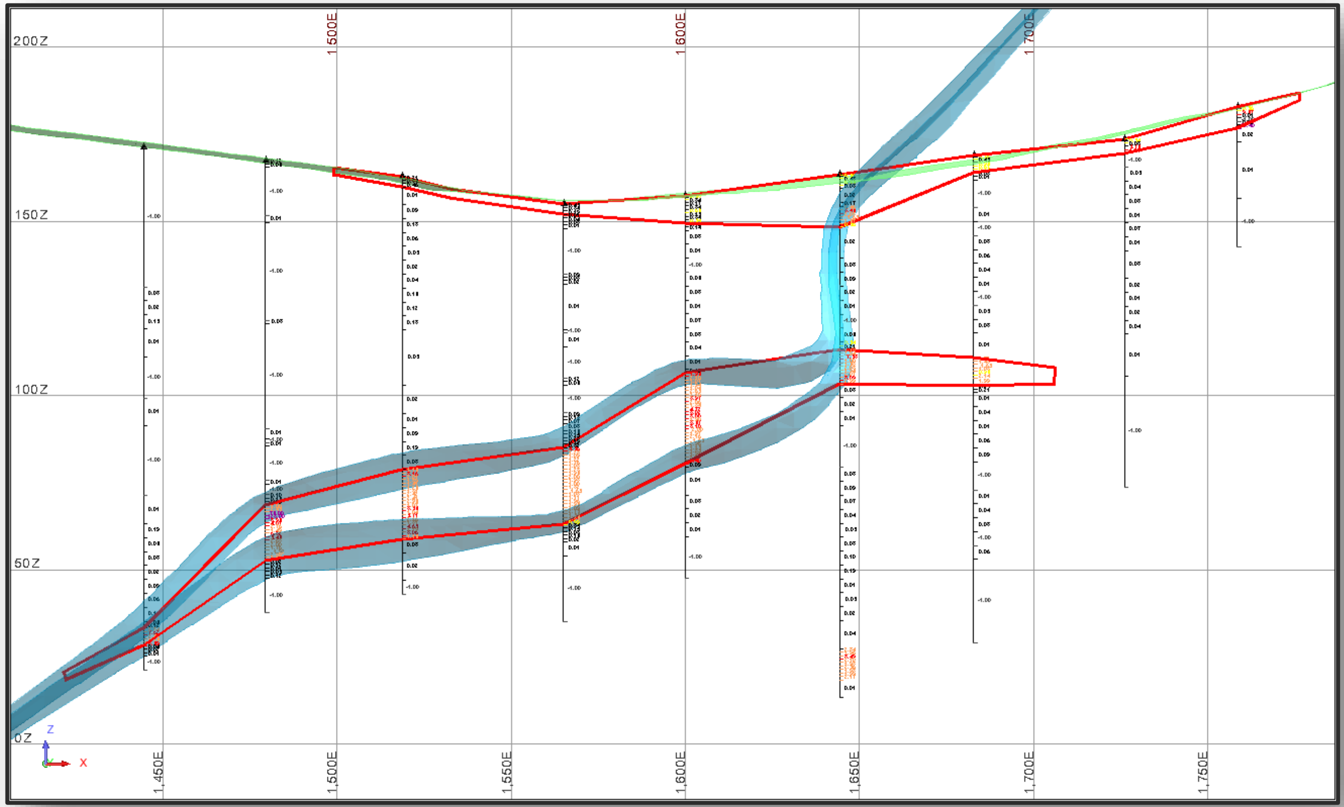
- The traditional principles of wireframe modelling were adapted and adopted for use in preparation of computer-assisted Mineral Resource estimates.
- The workflow required that Practitioners create interpretations by manually digitizing strings/polylines onto a computer screen. These were then used to create three dimensional models.
- This workflow is now referred to as explicit modelling.

Implicit Wireframe Models



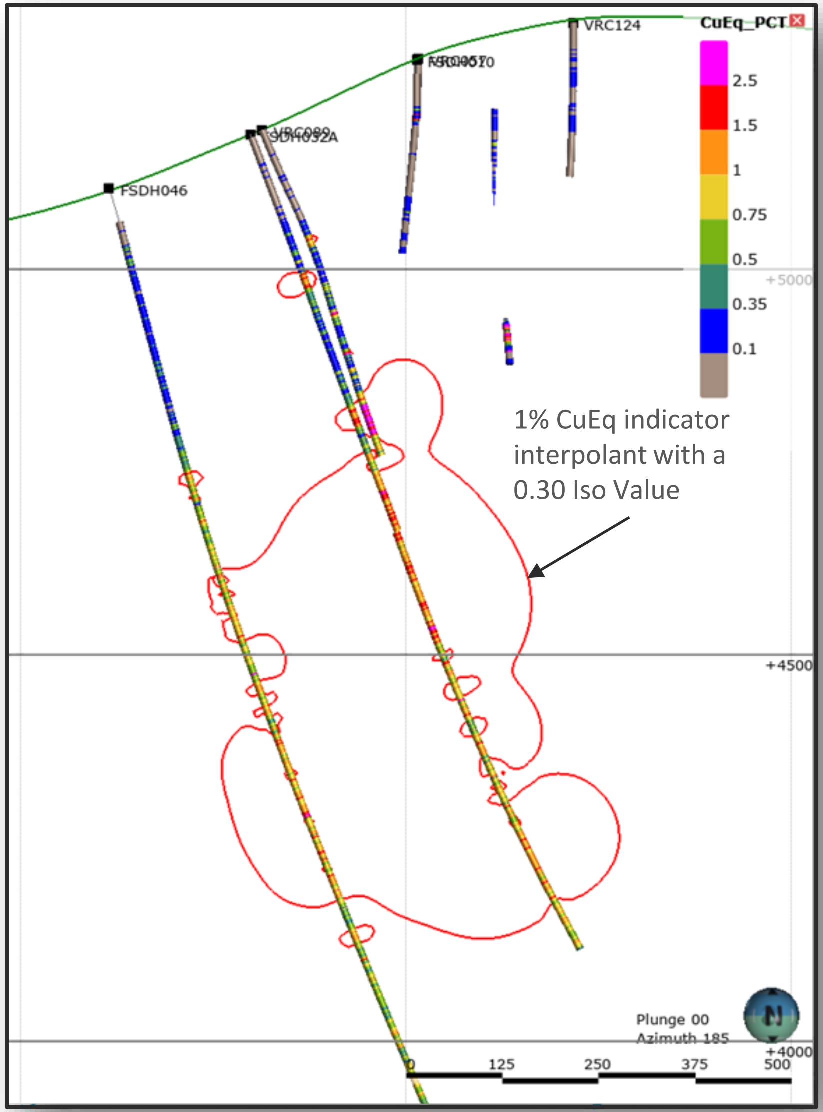
- Advances in computer technology has enabled creation of more sophisticated programs that no longer rely solely upon digitized strings to create three dimensional volumes.
- Rather, the software programs create three dimensional models in response to criteria supplied by the Practitioner.
- This approach is referred to as implicit modelling.
- Many choices of work flows are available for creation of implicit models.
- In all cases, Practitioners must ensure that the results are reasonable and make sense.

Explicit vs Implicit Wireframe Models



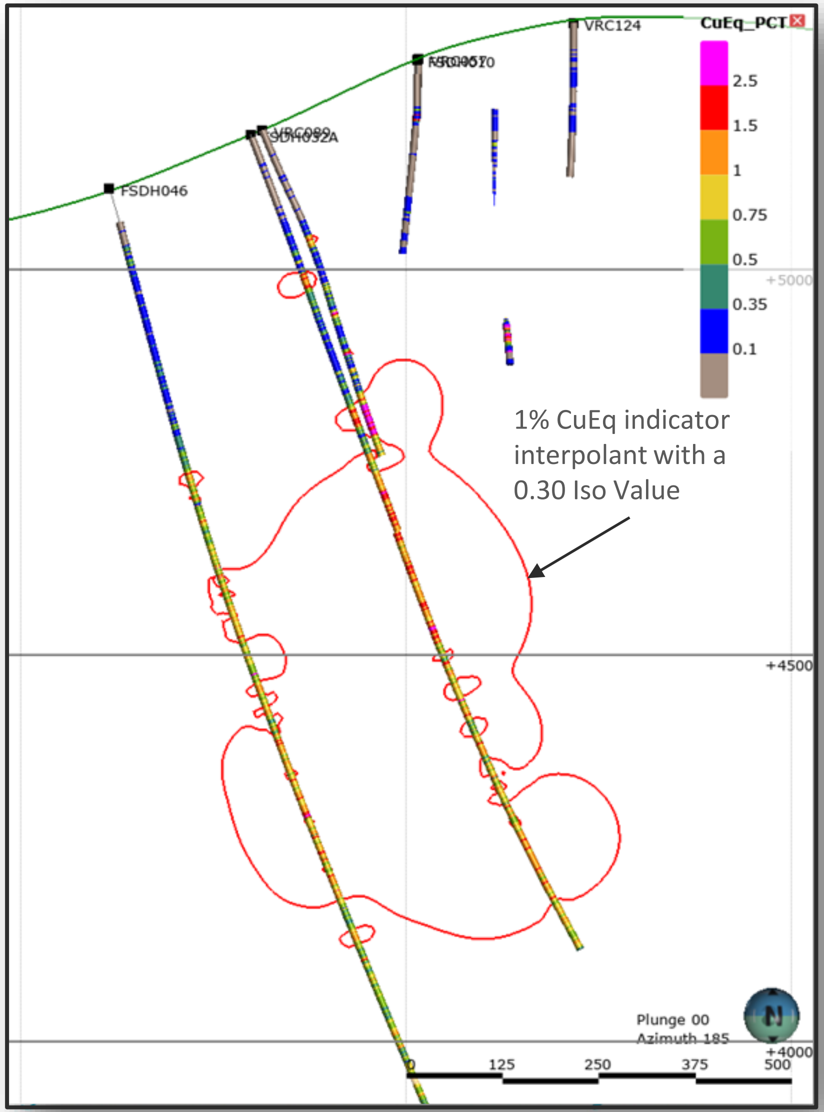
- While explicit modelling approaches appear to be slower, their key advantage is the requirement of the Practitioner to exercise thought and judgement when preparing a three dimensional interpretation.
- Implicit models can offer the advantage of speed and the ability to deal with complex situations in a timely manner.
- Experience has shown that the quality of the results are often a function of the Practitioners knowledge, proficiency, and the time spent to create and refine the wireframes.
- **Practitioners are reminded that they are ultimately responsible for all aspects of their Mineral Resource estimate.**

Indicator Mineralization Wireframes



- One workflow available is the use of indicators as criteria for creation of implicit wireframe models.
- In this approach, a numeric threshold (often a metal grade or value) is selected as one of the wireframing criteria.
- Wireframe models are then created from the list of criteria.
- Experience has shown that Practitioners often fail to understand that the resulting shapes and volumes do not necessarily represent what can be achieved during a mining operation.

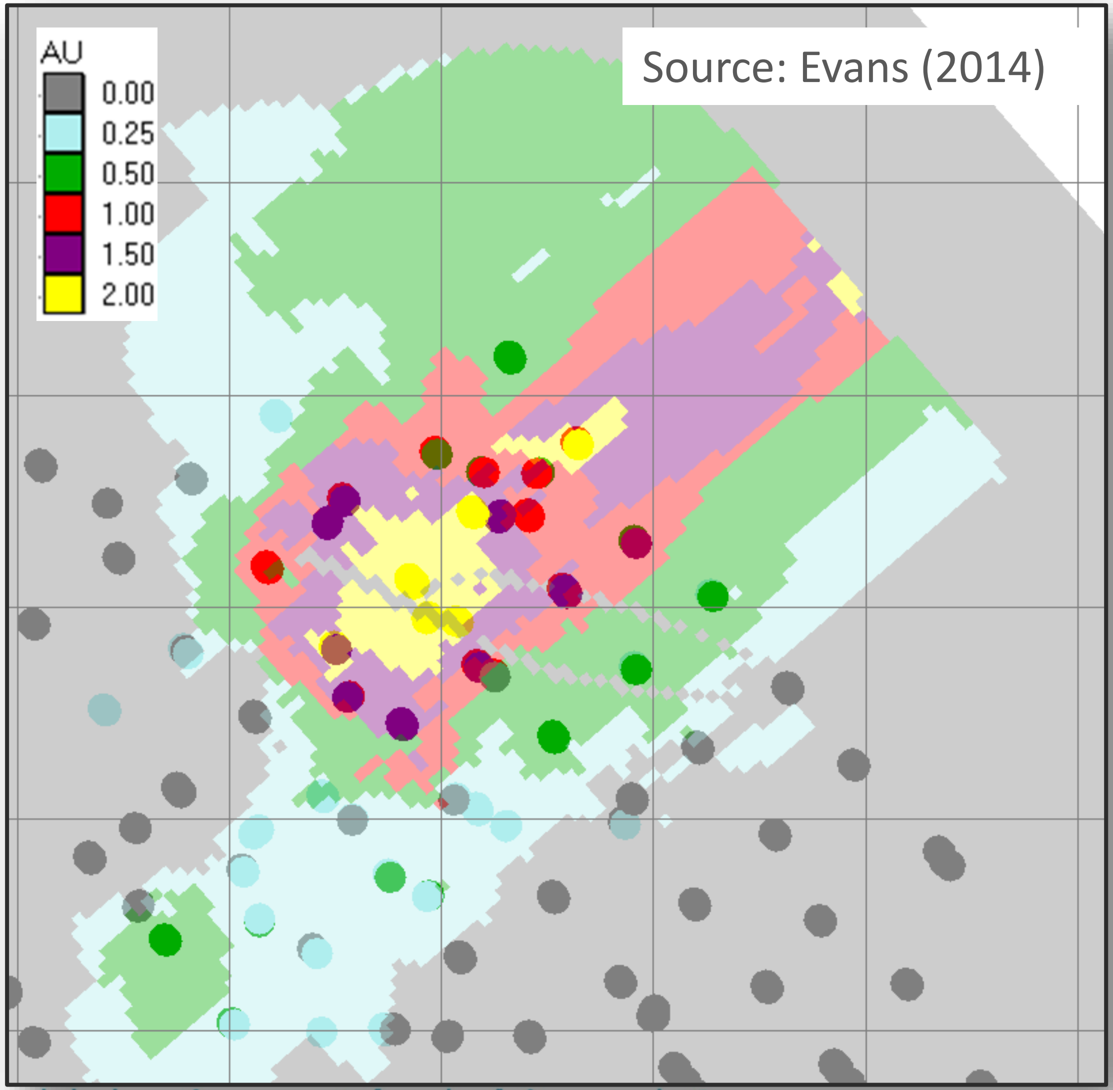
Indicator Mineralization Wireframes



- Workflows involving interpolants or indicator interpolants have a place in a geologist’s toolbox.
- They can be of great use in trend analysis and can help **guide** manually controlled methods of interpretation when combined with other tools such as trend surfaces and/or economic composites.
- It is important for practitioners to take the time to understand the limitations of interpolants and the impact of changing various interpolant parameters as they can produce various artefacts.
- An interpolant is constructing a volume based on specific rules and instructions, not knowledge – it cannot exercise judgement. It cannot re-draw itself with a mining method in mind.

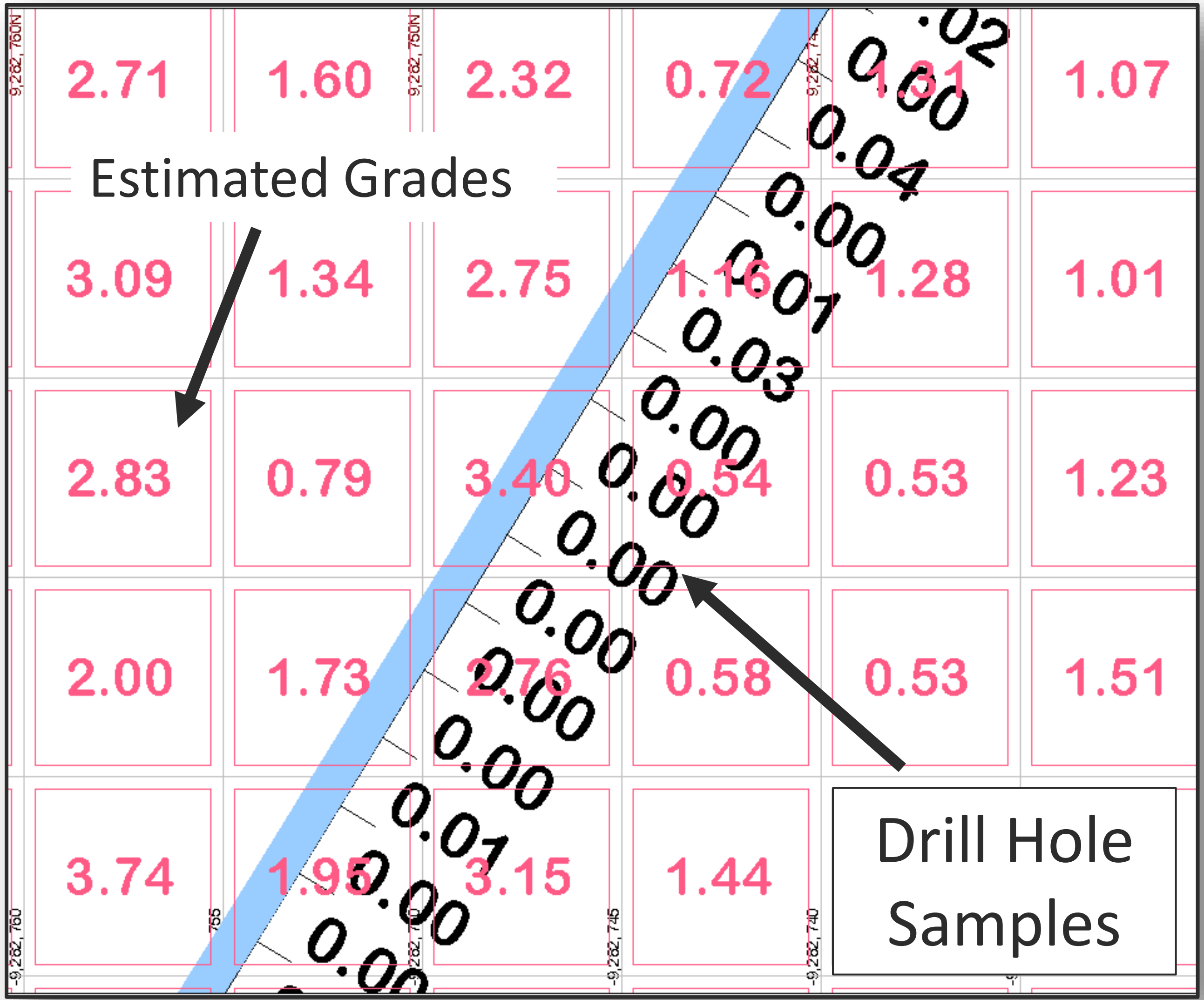
ESTIMATION

Impact of Poorly Constructed Mineralization Wireframes



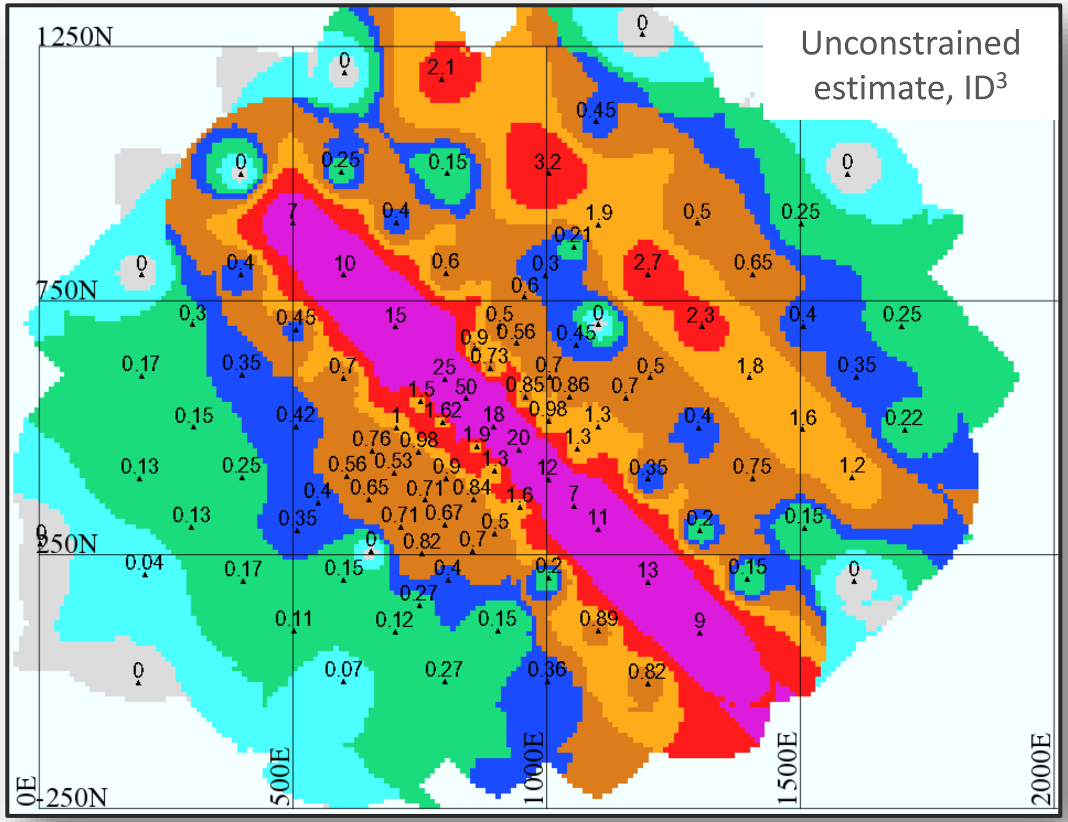
- Significant estimation errors can result for those cases where the mineralization wireframes have been constructed using an inappropriate grade (or value) threshold.
- Estimation errors can occur when the mineralization wireframes are drawn too broadly and do not provide sufficient limits on grade estimation.
- This often results in high grades being applied in areas with little to no sampling information.
- This is known as grade smearing.

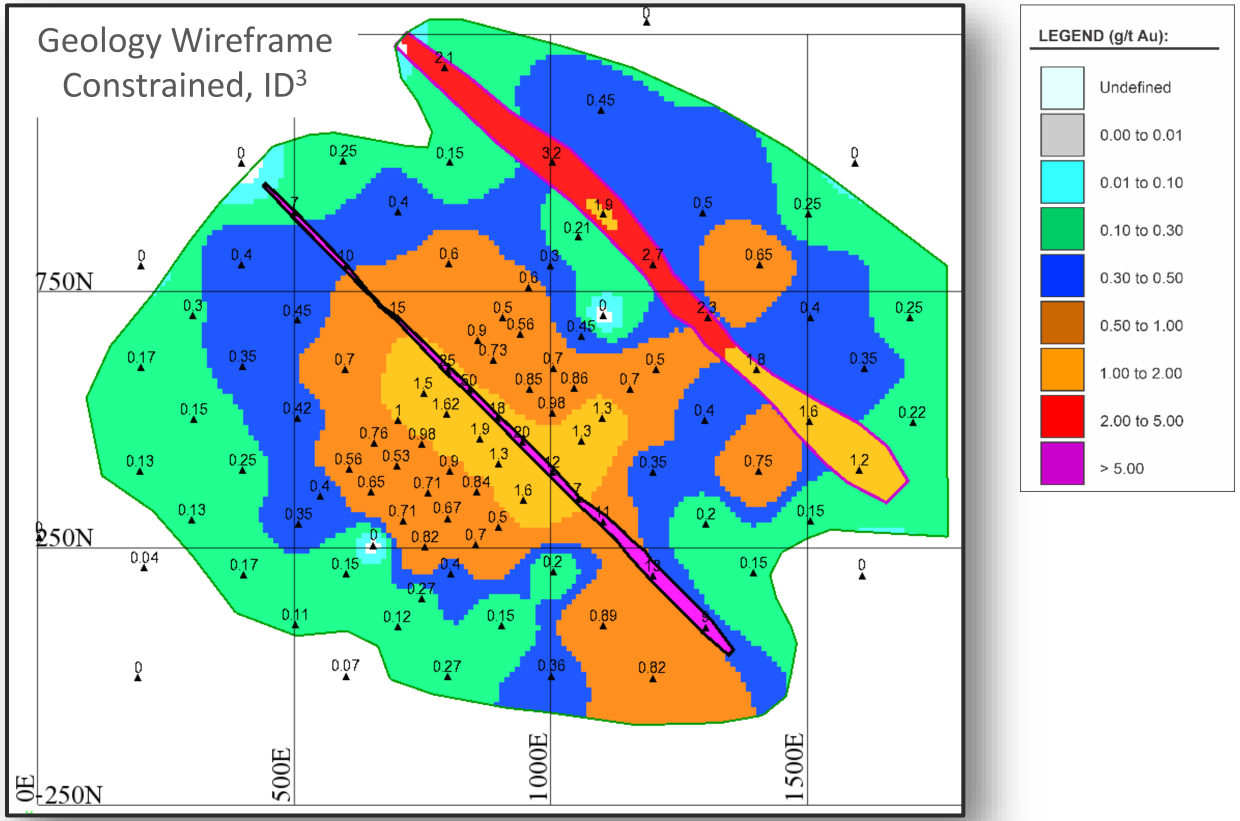
Impact of Poorly Constructed Mineralization Wireframes



- Due to the workflows applied, significant smearing of block model grades can also occur in areas where sample information is available.
- Such grade smearing results in block grades that bear little resemblance to the informing drill hole samples, resulting in material over-estimation of the Mineral Resource.

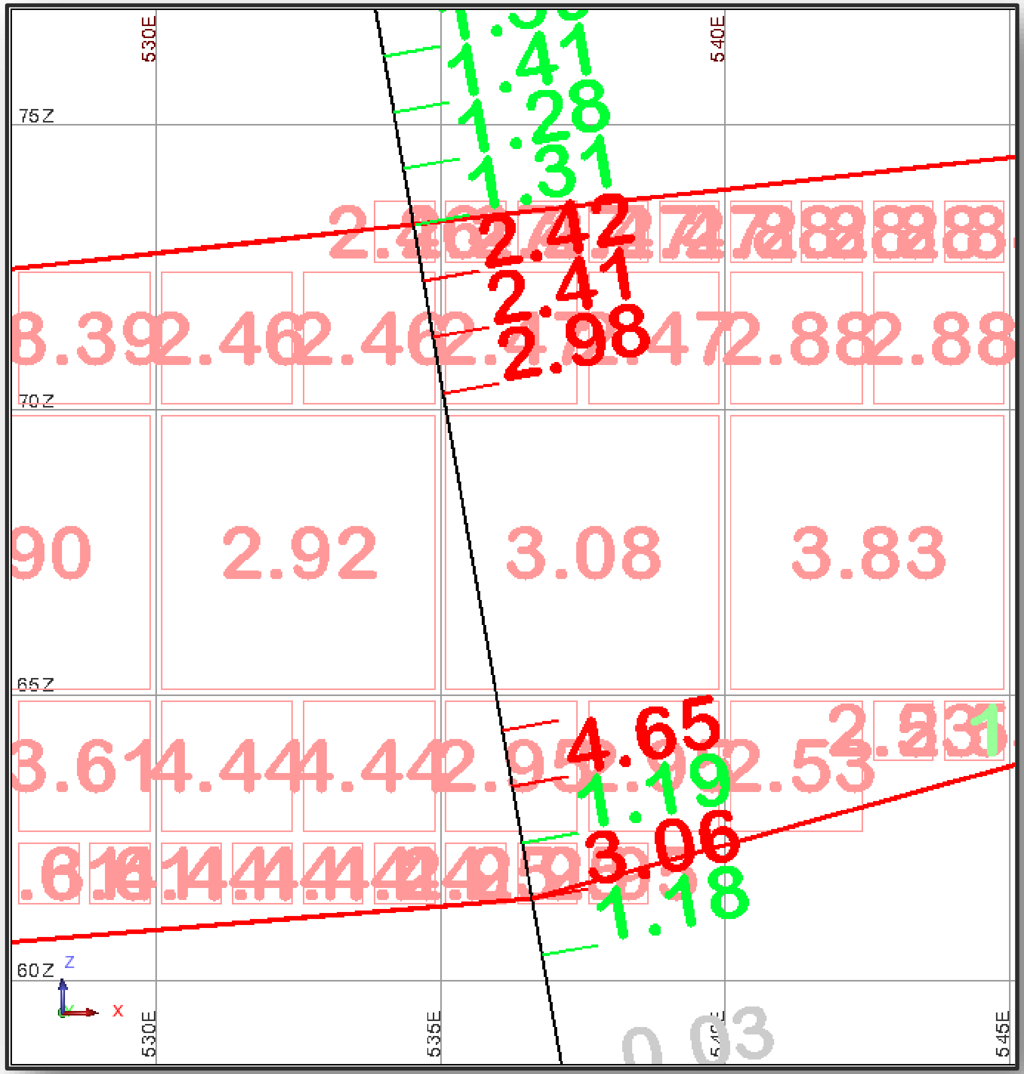
Impact of Poorly Constructed Mineralization Wireframes





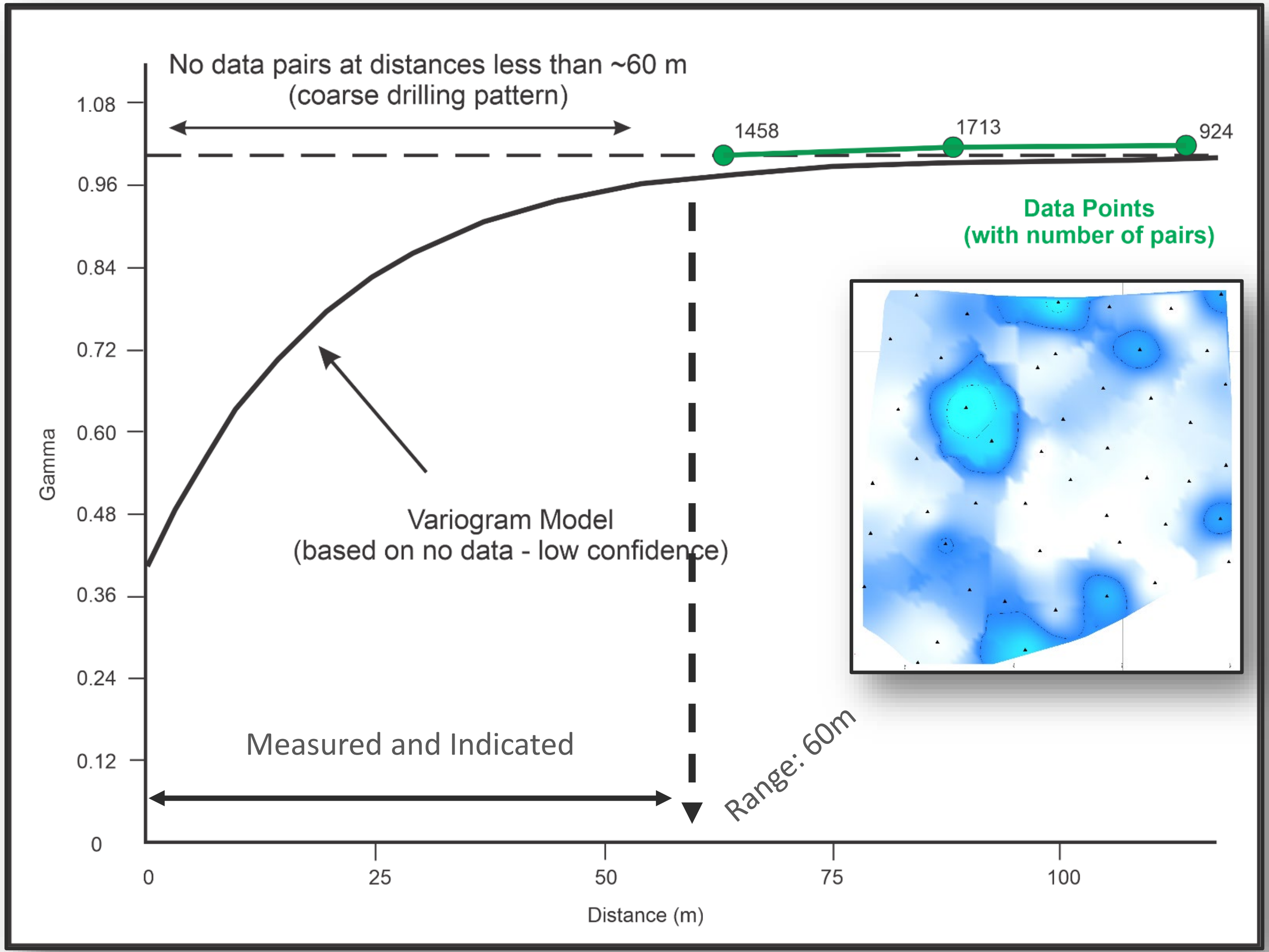
- This grade smearing can be avoided by careful construction of mineralized wireframes that are reasonable reflections of either the geological boundaries, or economic limits (cut-off grade or value).

Grade Smearing - Null Values



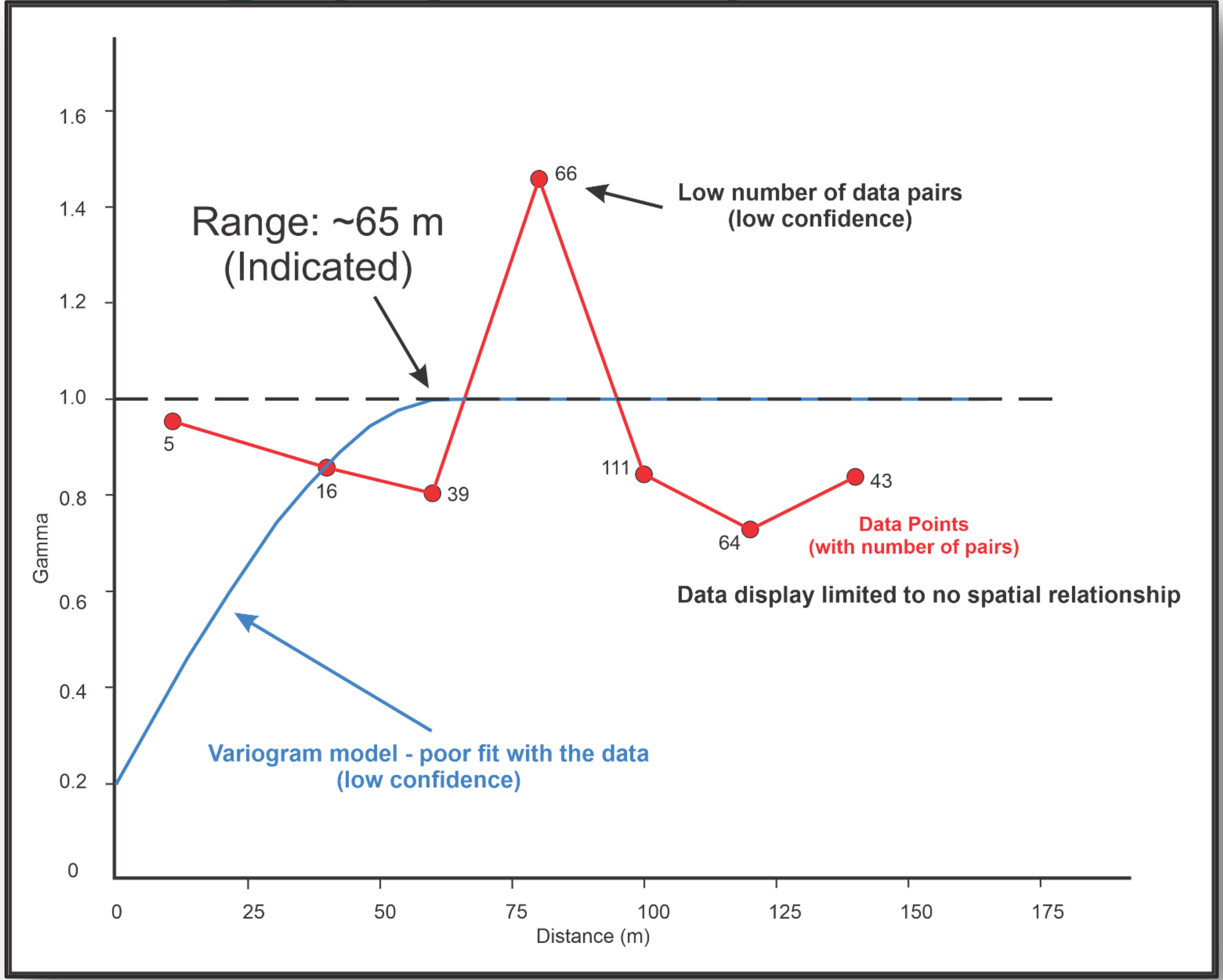
- Incomplete sampling within a mineralized interval is a significant cause of grade smearing.
- A common reason that samples are not taken in a mineralized interval is because the logging geologist observes that the material is clearly not mineralized.
- Intervals of no sampling are ignored by the grade interpolation algorithms.
- The resulting estimated grades are often not reflective of the true grade of those intervals.
- Continuous samples should be taken across the entire width of the mineralized interval (along with some wall rocks).

Variography – Example #1 Bad Practice



- Variogram models are constructed from drill hole and sample information.
- The first parts of the variogram model (i.e. the shorter sample spacings) have the most impact upon the grade estimation.
- If the variogram model is created from inappropriately spaced sample information, the resulting estimated grades will be less accurate.
- Mineral Resource classification categories will also be affected….

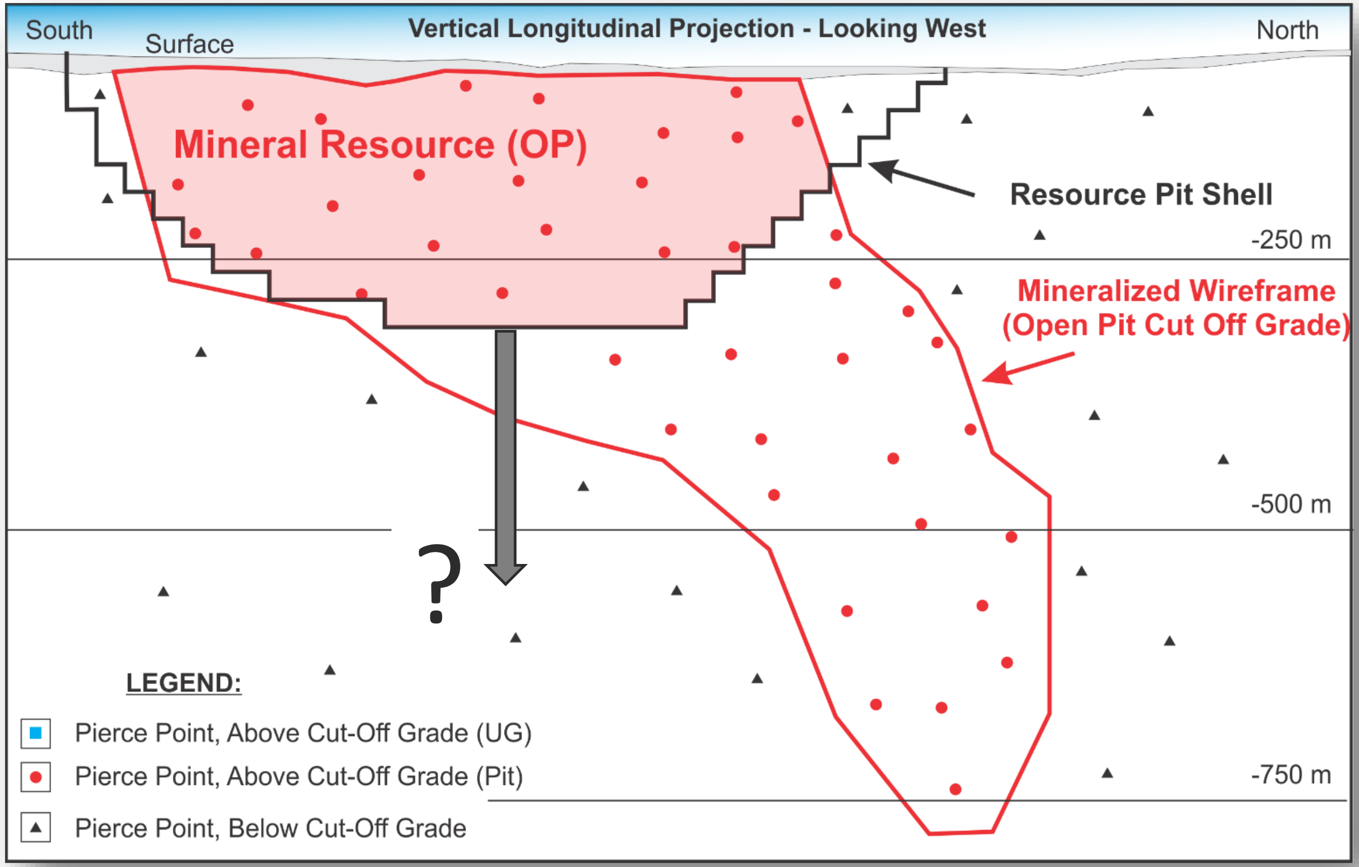
Variography – Example #2 Bad Practice



- If the variogram models do not realistically honor the informing data, or are poor fits with the data, then any derivations from those models (such as the classification distance) may not accurately represent the data distribution.
- GIGO (Garbage In, Garbage Out) applies.
- Obtaining sufficient density of sample information and understanding the grade distributions are the most important considerations when creating variogram models and using them for estimation.

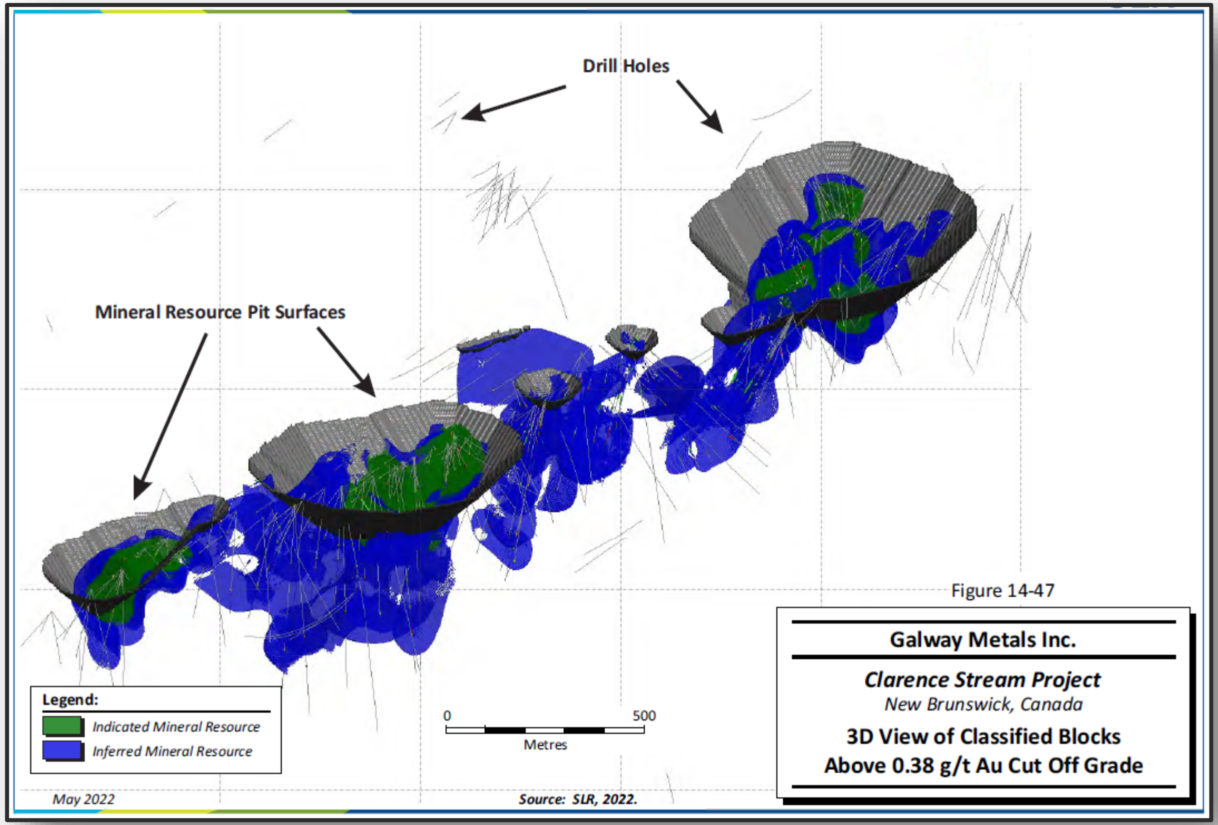
REPORTING

Mineral Resource Reporting – Open Pit Settings



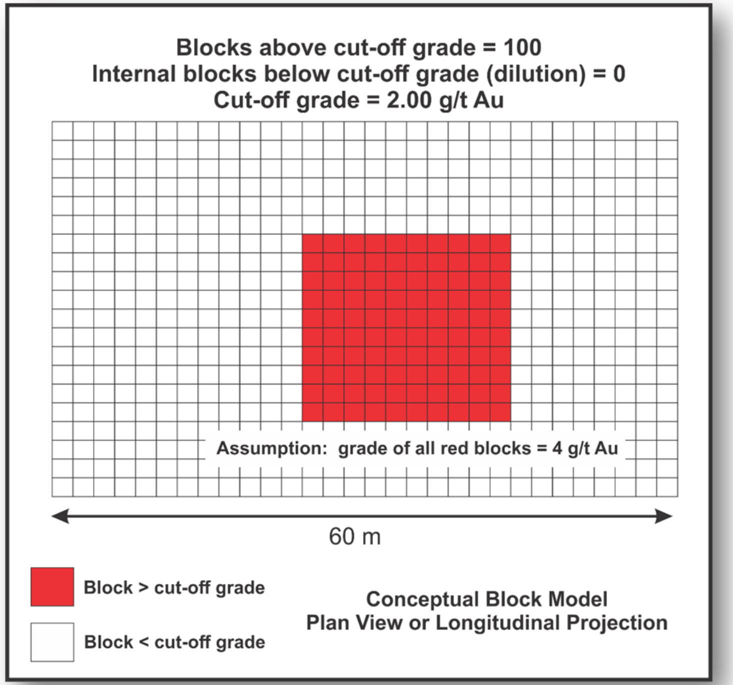
- Mineral deposits are found at a variety of burial depths.
- Typically, the strike and depth extents of a mineral deposit are outlined by drilling programs. This information is then used to prepare a Mineral Resource estimate.
- For those deposits where the mineralization is present close to surface, open pit mining methods may be appropriate.
- But all open pit mines have a depth limit.

Mineral Resource Reporting – Open Pit Settings



- The challenge for preparing a Mineral Resource estimate is to determine where this limit is located.
- Mineral Resource statements that are simple tallies of all blocks within a model that are above a cut-off grade are often not correct.
- The most common solution is to develop a preliminary surface that describes a volume which satisfies the technical and economic requirements for an open pit mine.
- This surface then becomes one of the criteria used in preparation of the Mineral Resource statement.

UG Mineral Resource Reporting - Checkerboard Effect



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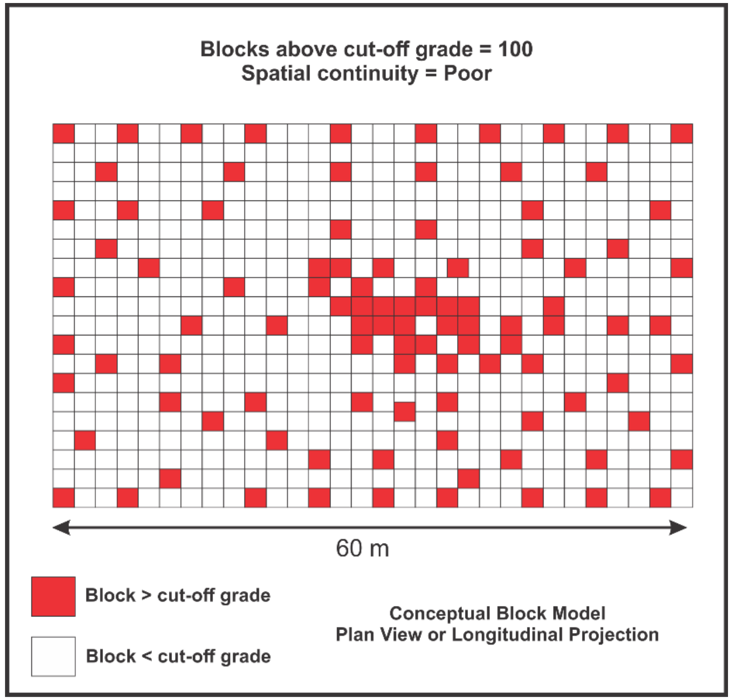
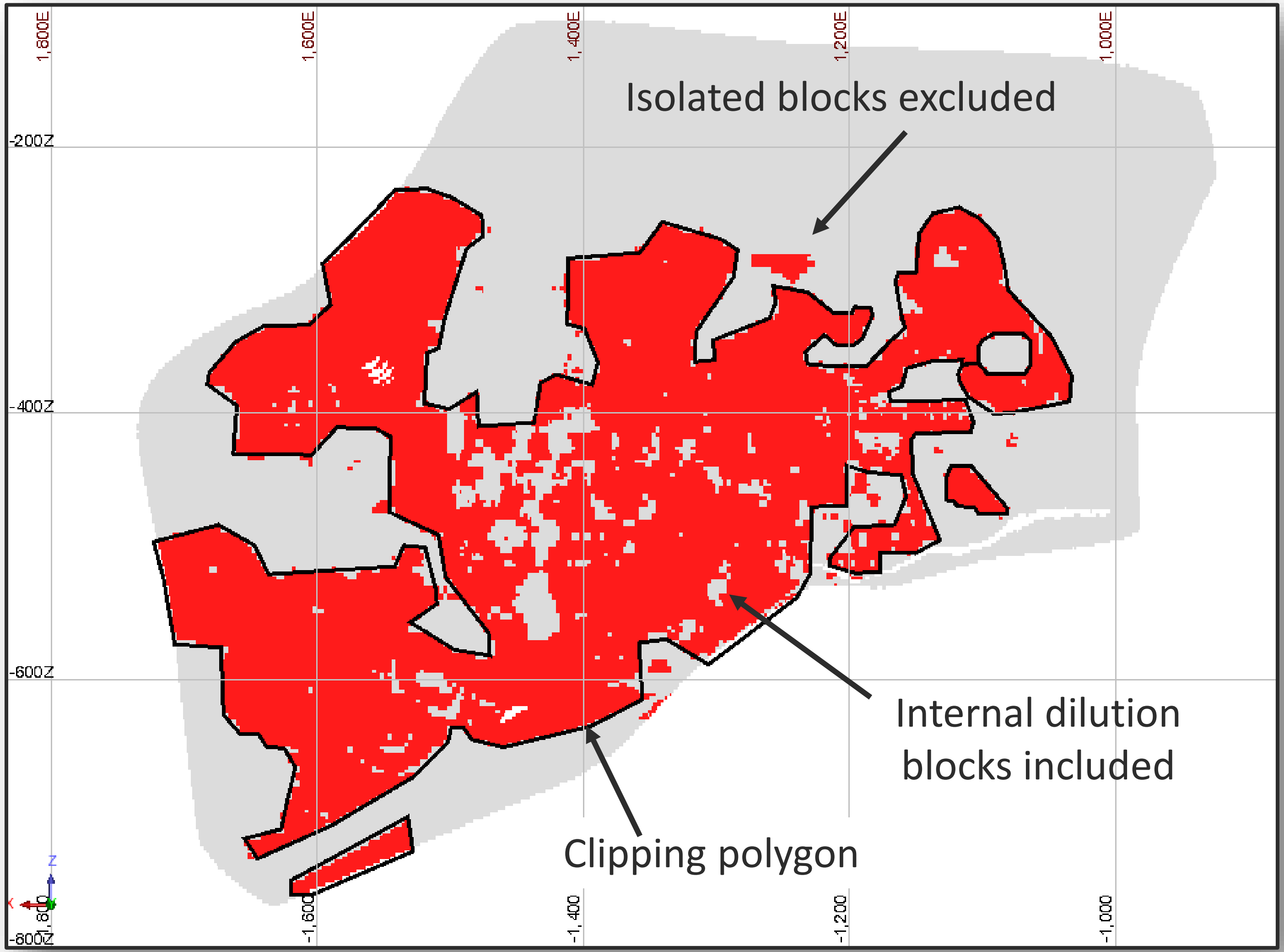


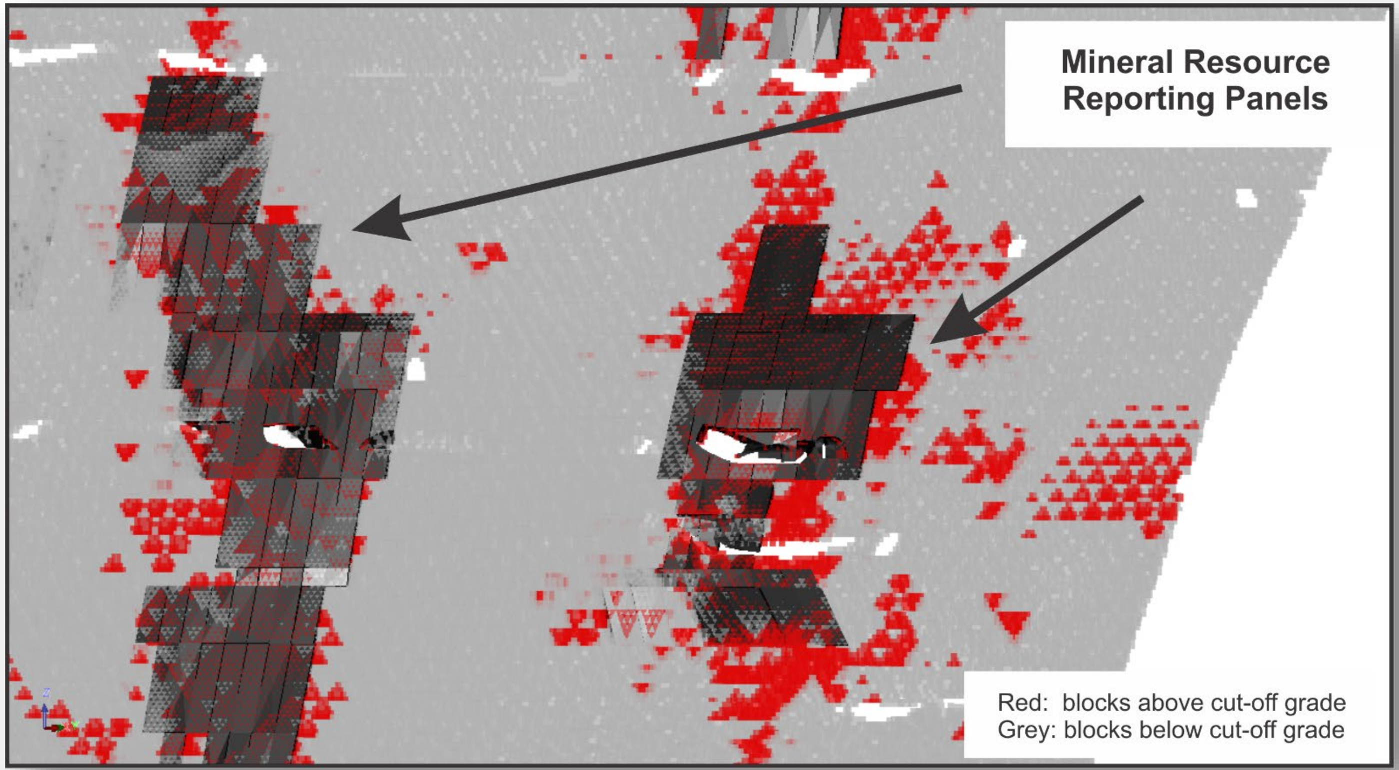
- A common approach in the digital age is to report all blocks above a cut-off grade (i.e. using a "block cut-off").
- This approach can have unintended results as the spatial continuity of the above cut-off grade blocks are not considered. The spatial continuity of any internal dilution blocks are not considered either.
- We refer to this condition as "The Checkerboard Effect".

Solutions – Clipping Polygons



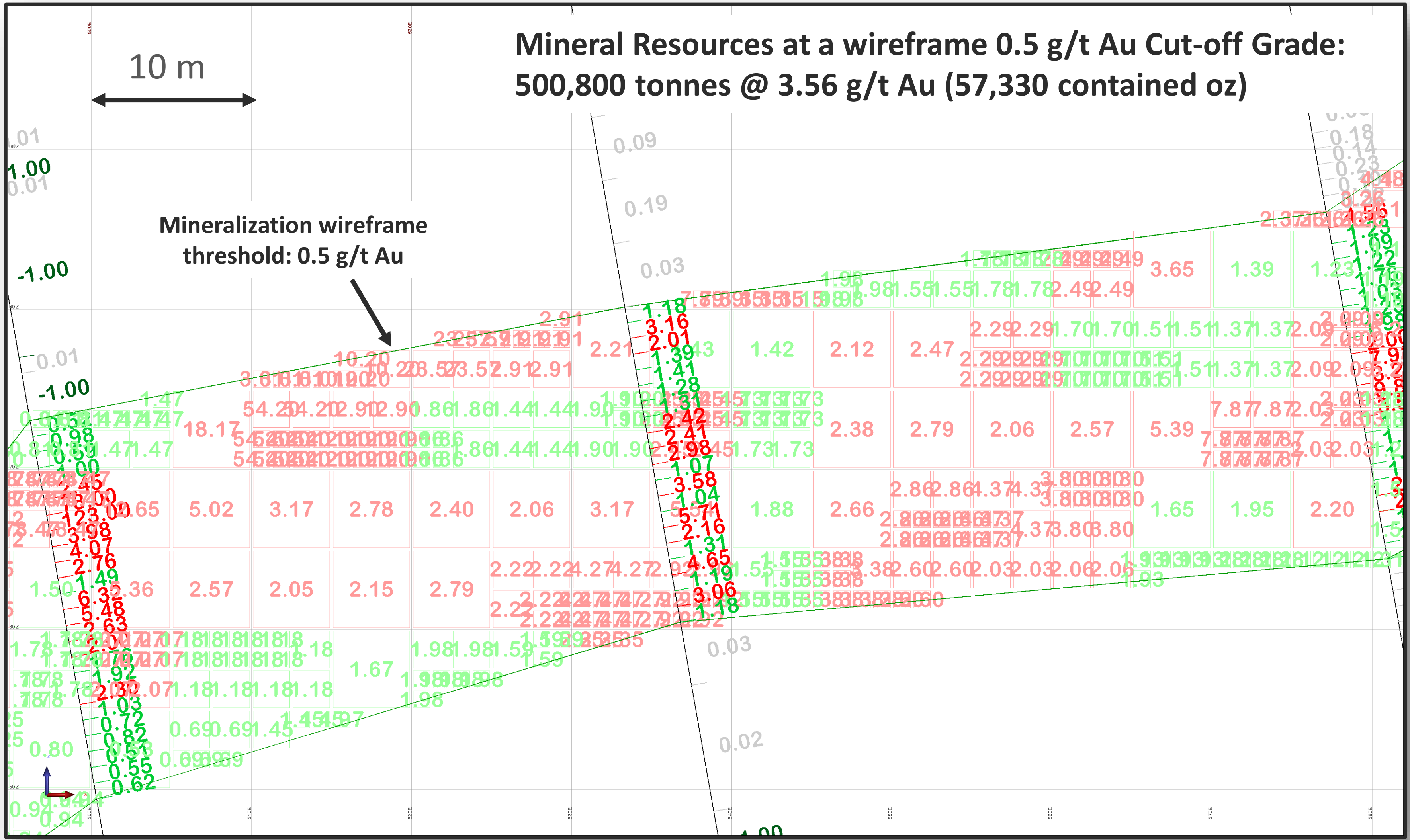
- Manual methods clipping polygons are effective for dealing with a small number of cases, say less than 20.
- The Mineral Resource statement would then be a summation of all of the block tonnes and grade contained within the clipping polygon.
- Alternative methods are required to deal with larger number of cases.

Solutions – Report blocks inside reporting panels



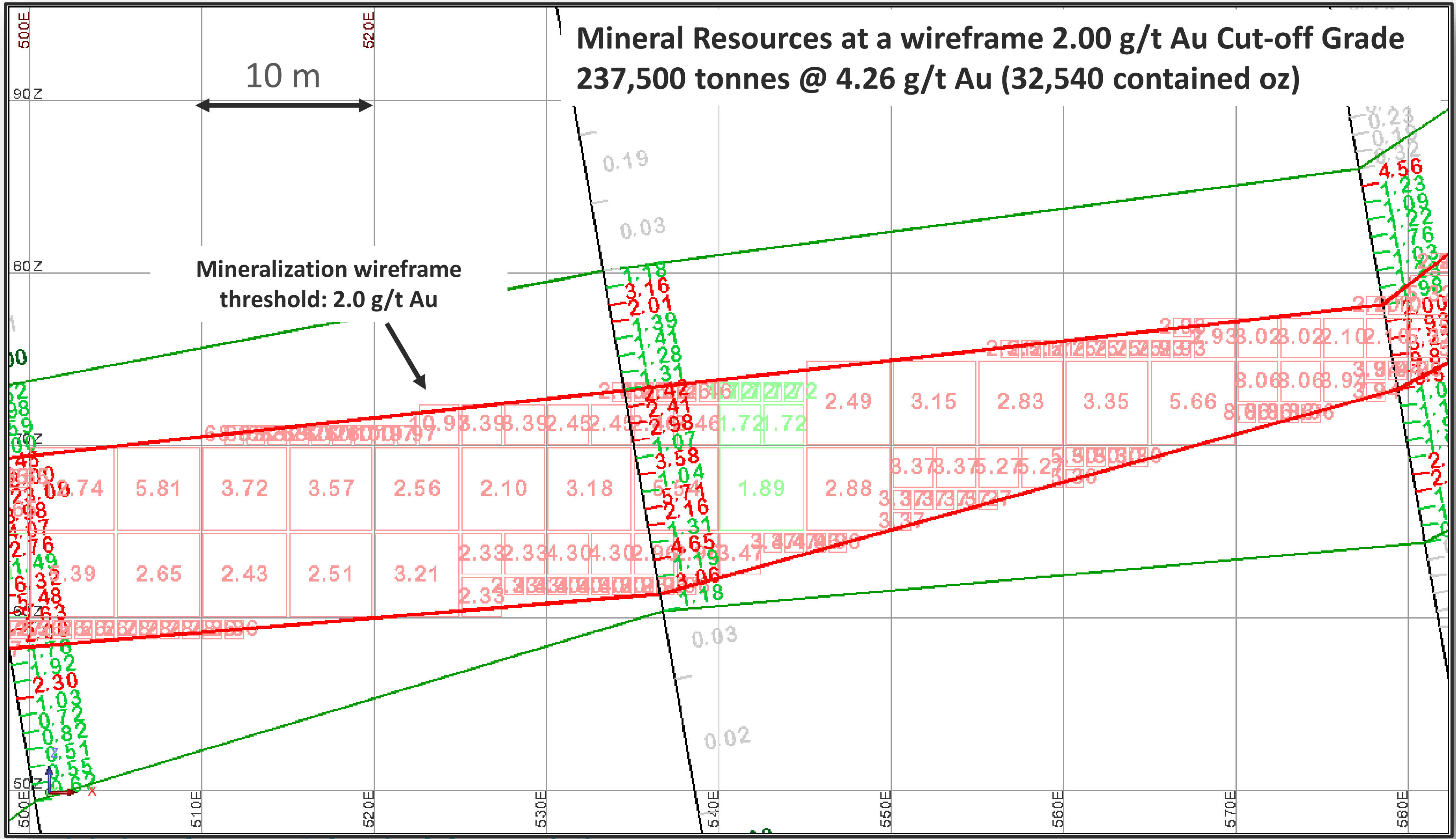
- Another common solution in use is the creation of reporting volumes generated by computer software programs.
- The parameters selected as inputs for creation of these panels can be chosen to comply with the RPEEE requirement of the CIM Definition Standards for Mineral Resources.
- The Mineral Resource statement would then be a summation of all of the block tonnes and grade contained within the reporting panels.

Incorrect Reporting - Cut-off Grade



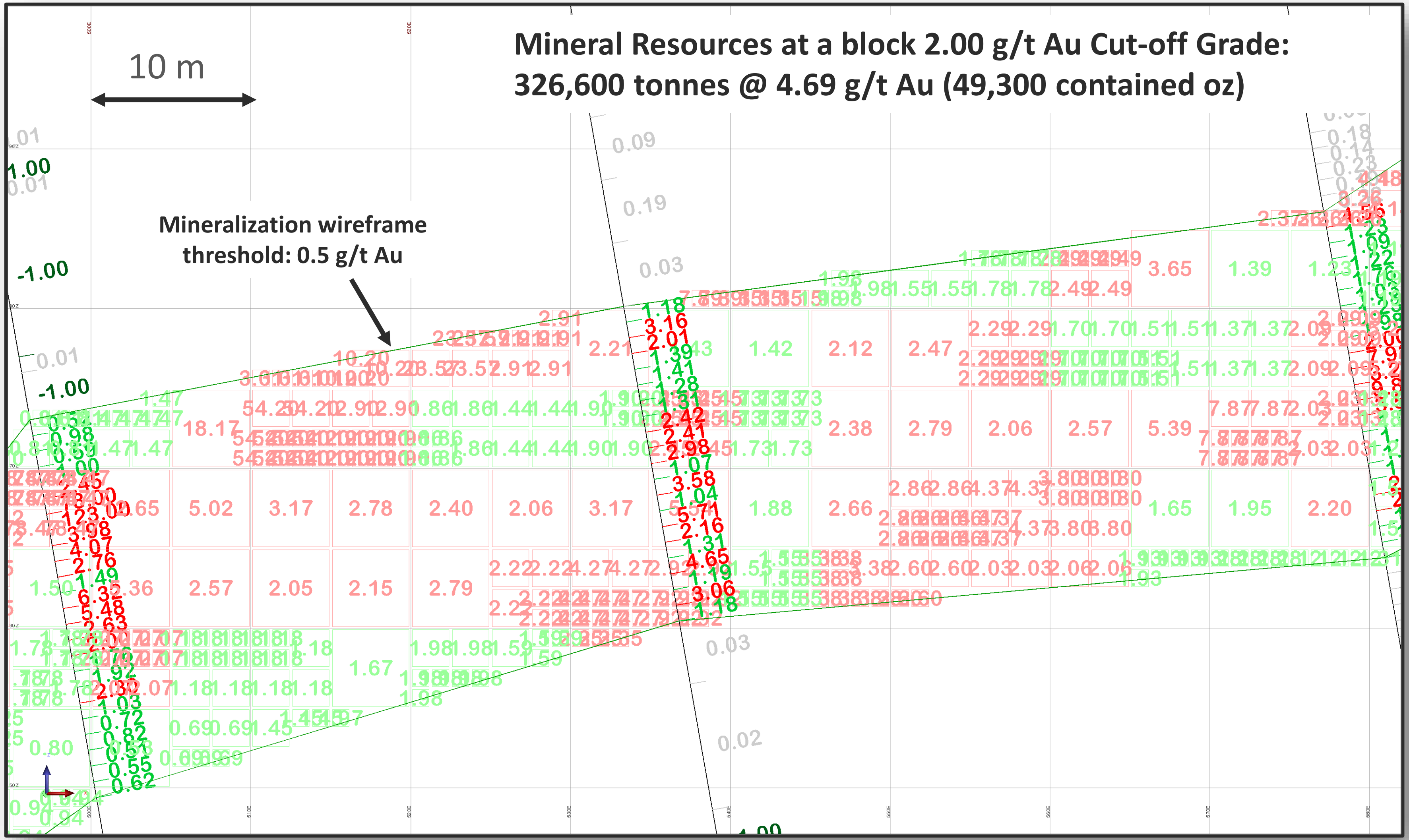
- Selection of an appropriate cut-off grade (or value) for reporting of Mineral Resource estimates is a critical item for meeting the “RPEEE” requirements.
- Selecting an incorrect cut-off grade (or value) can result in a material mis-representation of the tonnage and grade.

Incorrect Reporting - Cut-off Grade



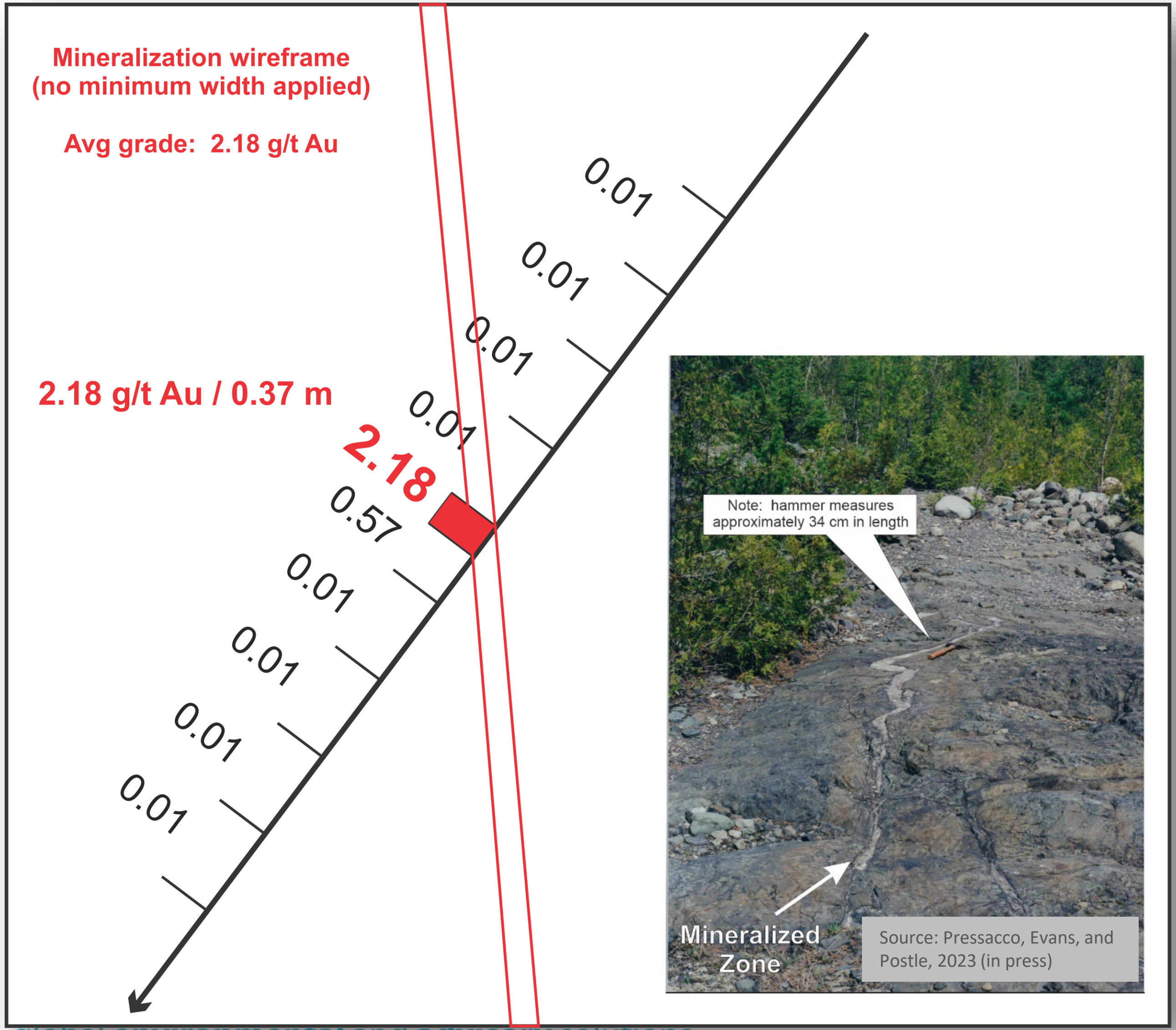
- Reporting thresholds (cut-off grades or values) should reflect the economic criteria of RPEEE.
- Combined with proper wireframe construction, the results should be a reasonable reflection of what could be mined.

Incorrect Reporting - Cut-off Grade



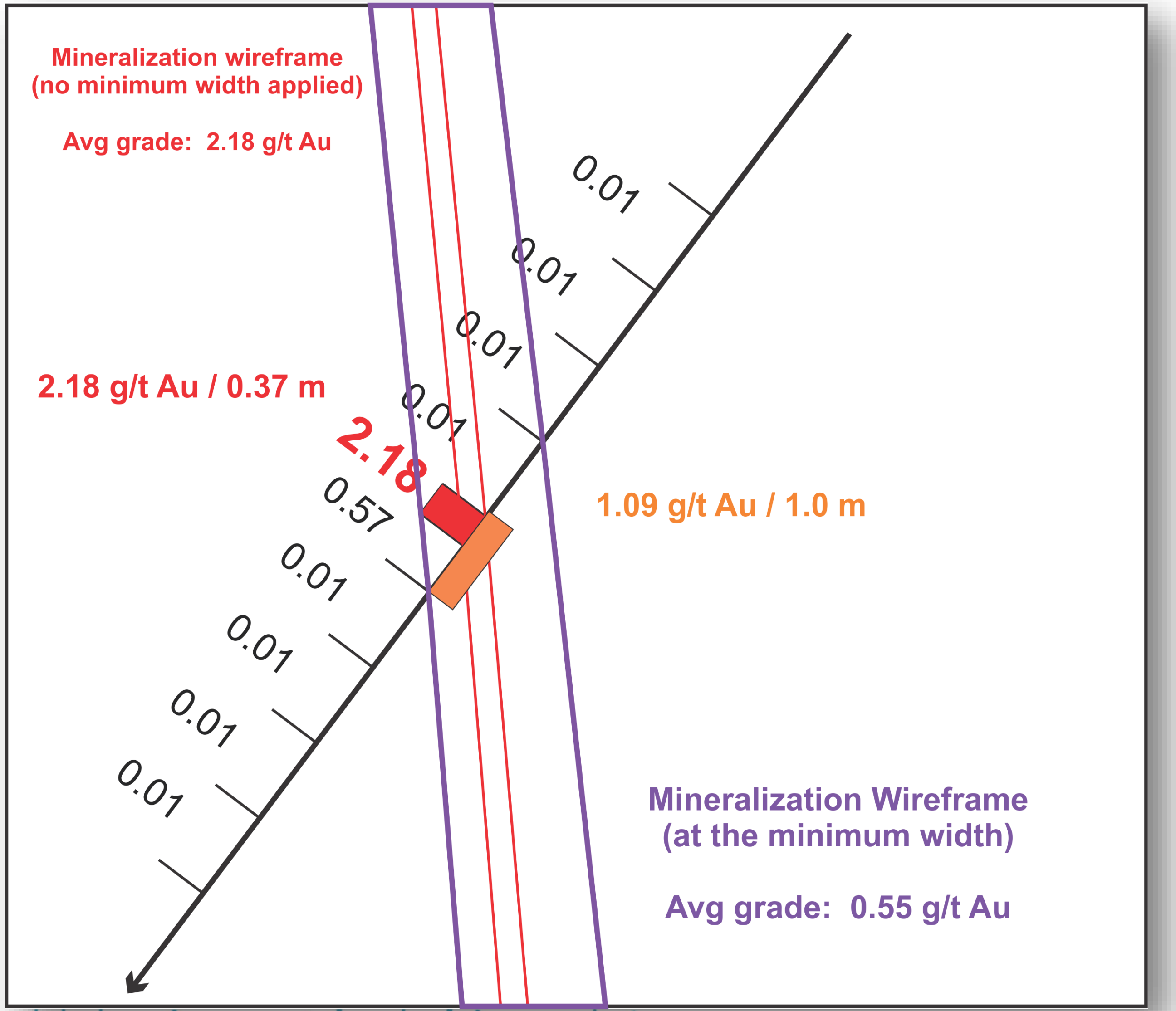
- Use of incorrect wireframing approaches,
- combined with incorrect reporting criteria often results in misleading estimates.

Minimum Widths



- In some cases, Mineral Resource models are prepared using mineralization wireframes that are drawn without consideration of the minimum mining widths of the contemplated underground mining method.
- While the selection of the estimation workflows resides with the Qualified Person, care should be taken to avoid preparing Mineral Resource statements in these situations.
- In many cases, the tonnage and grade statements from these workflows are mis-understood by the target audience.

Minimum Widths



- Although solutions are available to prepare Mineral Resource statements using a minimum width criteria, in our experience, the creation of a Mineral Resource wireframe using the minimum width criteria at the early stages is more time and cost efficient.
- We recommend "snapping" the wireframes to the sample intervals, as the distribution of the mineralization within any given sample is not homogenous.
- The assay value for a sample is the **average grade** of the materials within the sampled interval.

CONCLUSIONS

Conclusions

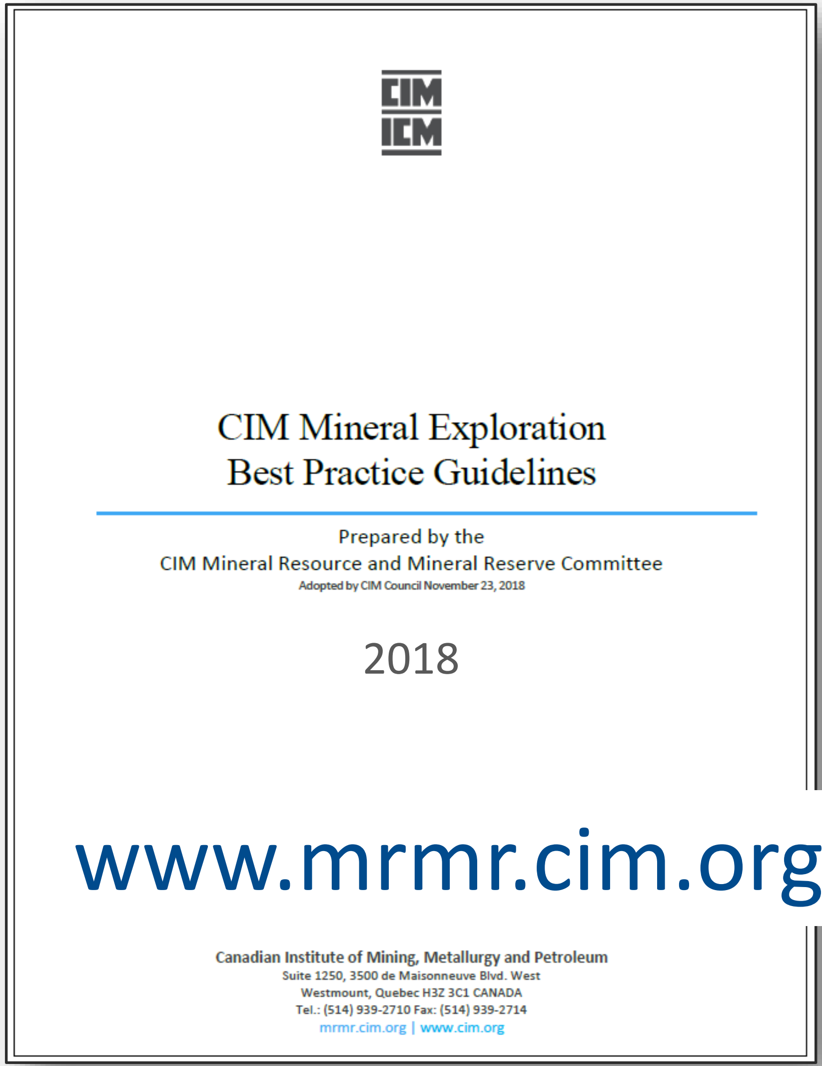
- A fatal flaw for a Mineral Resource is rarely the result of a single item. More often, fatal flaws are the result of several individual flaws all acting together.
- Errors committed at the early stages of the estimation process continue to cascade through the subsequent workflow and impact upon subsequent steps, leading to a flawed Mineral Resource estimate.
- Attention to detail and adherence to high quality standards throughout the estimation process is required. GIGO applies!
- All flaws ultimately are a result of the level of knowledge or expertise by the Practitioner.
- **Practitioners preparing Mineral Resource estimates are ultimately responsible for all aspects of their work.**

Top Five Most Serious Flaws - 2023

1. Not enough time allotted for Mineral Resource and Mineral Reserve estimation.
2. No RPEEE (lack of minimum widths, constraining surfaces or volumes).
3. Poor mineralization wireframe interpretations.
4. Lack of sufficient drill hole information (spacing too wide).
5. Insufficient sample coverage (null values).

ADDITIONAL GUIDANCE

CIM Best Practice Guidelines



CIM Mineral Exploration
Best Practice Guidelines

Prepared by the
CIM Mineral Resource and Mineral Reserve Committee
Adopted by CIM Council November 23, 2018

2018

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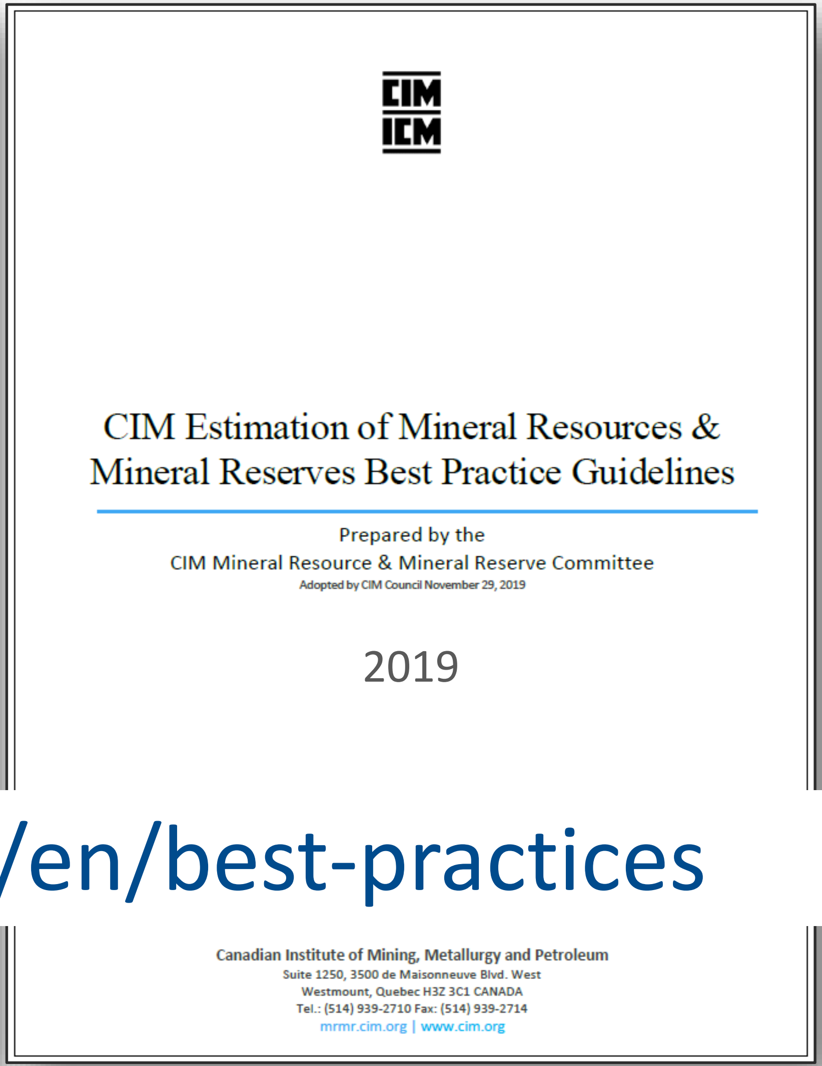

CIM Estimation of Mineral Resources & Mineral Reserves Best Practice Guidelines

Prepared by the
CIM Mineral Resource & Mineral Reserve Committee
Adopted by CIM Council November 29, 2019

2019

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www.mrmr.cim.org/en/best-practices

- Copies of the Best Practices Guidelines are available **at no cost** from the CIM website.

CIM Journal Article – Checkerboard Effect

The checkerboard effect and mineral resource reporting of underground mineral resources

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https://doi.org/10.1080/19236026.2021.1902203

ABSTRACT The goal of a Mineral Resource statement is to estimate the in-situ tonnage and grade that might reasonably be expected to be extracted using the contemplated mining methods. Despite the transition by the mining industry to the use of computer-aided methods for preparing Mineral Resource estimates, the fundamental realities of complying with the CIM Definition Standards requirement of "Reasonable Prospects for Eventual Economic Extraction" (RPEEE) have not changed. Computer-aided block modeling can result in an irregular, patchwork of blocks above and below cutoff grade, termed the checkerboard effect. In such cases, for underground mining methods, strict application of a block cutoff grade does not consider the impact of any internal dilution blocks that may be present, while also potentially including blocks above cutoff grade that may not have sufficient spatial continuity. Considering the block dimensions relative to the selectivity of the potential underground mining method, this can result in material errors in Mineral Resource statements. The impact of the checkerboard effect varies from deposit to deposit. While several techniques are currently employed by Mineral Resource practitioners to ensure compliance with the RPEEE requirement of a Mineral Resource, practitioners are encouraged to develop additional methods and techniques that provide reasonable results.

KEYWORDS Block model, Checkerboard effect, Constraining surfaces, Constraining volumes, Internal dilution, Mineral resources, Reasonable prospects, Underground mining method

RÉSUMÉ Le but d'un énoncé des ressources minérales consiste à estimer le tonnage et la teneur in situ qui pourraient raisonnablement être extraits à l'aide des méthodes d'extraction envisagées. Malgré la transition de l'industrie minière vers l'utilisation de méthodes assistées par ordinateur pour la préparation des estimations des ressources minérales, les réalités fondamentales du respect de l'exigence des normes de définition de l'ICM concernant les perspectives raisonnables d'extraction économique éventuelle (RPEEE, de l'anglais *Reasonable Prospects for Eventual Economic Extraction*) n'ont pas changé. La modélisation de blocs assistée par ordinateur peut donner lieu à un patchwork irrégulier de blocs au-dessus et en dessous du seuil de teneur limite appelé effet de damier. Dans de tels cas, pour les méthodes d'exploitation souterraine, l'application stricte d'une teneur limite de bloc ne tient pas compte de l'impact des blocs de dilution interne qui peuvent être présents, tout en incluant potentiellement des blocs au-dessus de la teneur limite qui peuvent ne pas avoir une continuité spatiale suffisante. Compte tenu des dimensions des blocs par rapport à la sélectivité de la méthode d'extraction souterraine potentielle, cela peut entraîner des erreurs importantes dans les énoncés des ressources minérales. L'impact de l'effet damier varie d'un dépôt à l'autre. Bien que plusieurs techniques soient actuellement utilisées par les praticiens des ressources minérales pour assurer la conformité à l'exigence de la RPEEE d'une ressource minérale, les praticiens sont encouragés à élaborer d'autres méthodes et techniques qui fournissent des résultats raisonnables.

MOTS-CLÉS dilution interne, effet de damier, méthode d'extraction souterraine, modèle de bloc, perspectives raisonnables, ressources minérales, surfaces de contrainte, volumes de contrainte

- A discussion on sources of "The Checkerboard Effect" and suggested solutions can be found in an article published in the CIM Journal, Volume 12, Issue 2 (April, 2021).
- Copies of the article are available to CIM members at:

  www.cim.org/library/cim-journal/

CIM Journal Article – Historical Geoscientific Data

Considerations for using historical geoscientific information in mineral resource estimation

R. Pressacco, L. Evans, and W. E. Roscoe
SLR Consulting (Canada) Limited, Toronto, Canada

https://doi.org/10.1080/19236026.2022.2045458

ABSTRACT In many cases, mineralization discovered by prior owners of a mineral property may have been considered to be too low grade to be of potential economic interest at that time. Changes in market conditions over time often warrant a review of the economic potential of historical exploration results. Therefore, any available historical geoscientific information can be of great value because it can save the cost and time required to completely replicate the historical data. As qualified persons (QPs) are ultimately responsible for all data used to prepare a mineral resource estimate, they bear the obligation of carrying out appropriate due diligence and validation of all information and historical work prior to their use for estimation. The task of assigning acceptance criteria rests upon the QP. Considering the wide range of possible scenarios, a detailed listing of acceptance criteria is far beyond the scope of this paper. Generally speaking, the acceptance criteria for using historical data will by necessity vary on a case-by-case basis. In all cases, the QPs are encouraged to fully document the criteria used to establish the acceptance criteria. This paper discusses some of the various actions that QPs may consider for validating historical data.

KEYWORDS Data validation, Geoscientific data, Historical data, Mineral resources

RÉSUMÉ Dans de nombreux cas, la minéralisation découverte par des propriétaires antérieurs d'une propriété minérale peut avoir été jugé trop faible pour présenter un intérêt économique potentiel à ce moment-là. Les conditions au fil du temps justifient souvent un examen du potentiel économique des résultats de l'exploration historique et, par conséquent, toute information géoscientifique historique disponible peut être d'une grande valeur, car elle permet d'économiser le coût et le temps nécessaires pour reproduire complètement les données historiques. Étant donné que les personnes qualifiées (PQ) sont ultimement responsables de toutes les données utilisées pour préparer une estimation des ressources minérales, elles ont l'obligation de faire preuve de diligence raisonnable et de valider tous les renseignements et travaux historiques avant de les utiliser pour l'estimation. L'attribution des critères d'acceptation relève de la PQ. Compte tenu du large éventail de scénarios possibles, une liste détaillée des critères d'acceptation dépasse de loin la portée du présent document. En règle générale, les critères d'acceptation pour l'utilisation de données historiques varieront nécessairement au cas par cas. Dans tous les cas, les PQ sont encouragées à documenter pleinement les critères utilisés pour établir les critères d'acceptation. Le présent document traite de certaines des diverses mesures que les PQ peuvent envisager pour valider les données historiques.

MOTS-CLÉS données géoscientifiques, données historiques, ressources minérales, validation des données

- A discussion on the use of historical geoscientific data in Mineral Resource estimation can be found in an article published in the CIM Journal, Volume 13, Issue 2 (April, 2022).
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CIM Journal Article – "Reasonable Prospects"

CIM JOURNAL
https://doi.org/10.1080/19236026.2022.2148594

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GEOLOGY

"Reasonable prospects" in mineral resource estimation and reporting

R. Pressacco, L. Evans, and J. Postle

SLR Consulting (Canada) Ltd., Toronto, Canada

ABSTRACT

A fundamental component of the Definition Standards for Mineral Resources is the requirement that the material have "reasonable prospects for eventual economic extraction" (RPEEE). The first adoption of the RPEEE requirement by a widespread group was in 1997 as part of the Denver Accord meeting and has since become an international standard. Mineral resource statements are prepared for mineral properties that are at various stages in the mining cycle, from the discovery stage through to the production stage. The confidence level of information available for the development of the input parameters for the technical and economic components of RPEEE varies greatly among stages. Consequently, the RPEEE assumptions may evolve with the stage of the mineral property as well. The economic aspects of RPEEE are commonly achieved by selecting appropriate input parameters for establishing a cut-off grade. The technical aspects can include consideration of such items as minimum widths, spatial continuity, and the application of appropriate constraining surfaces and volumes. In all cases, the responsibility of ensuring that the mineral resource statements are prepared in accordance with the requirements of the Canadian Institute of Mining, Metallurgy and Petroleum Definition Standards ultimately resides with the qualified person.

RÉSUMÉ

Une composante fondamentale des Normes de définition des ressources minérales est l'exigence selon laquelle la matière doit avoir des « perspectives raisonnables d'extraction rentable à terme » (RPEEE, de l'anglais *reasonable prospects for eventual economic extraction*). La première adoption de l'exigence RPEEE par un groupe très répandu a eu lieu en 1997 dans le cadre de l'Accord de Denver et est devenue depuis une norme internationale. Les relevés des ressources minérales sont préparés pour les propriétés minérales qui en sont à diverses étapes du cycle minier, de la découverte à la production. Le niveau de confiance de l'information disponible pour l'élaboration des paramètres d'entrée pour les composantes techniques et économiques de RPEEE varie considérablement entre les étapes. Par conséquent, les hypothèses de RPEEE peuvent évoluer avec l'étape de la propriété minérale ausse. Les aspects économiques des RPEEE sont généralement obtenus en sélectionnant les paramètres d'entrée appropriés pour établir la teneur de coupure. Les aspects techniques peuvent inclure la prise en compte d'éléments tels que les largeurs minimales, la continuité spatiale et l'application de surfaces et de volumes contraignants appropriés. Dans tous les cas, il incombe à la personne qualifiée de veiller à ce que les énoncés sur les ressources minérales soient préparés conformément aux exigences des Normes de définitions de l'Institut canadien des mines, de la métallurgie et du pétrole.

KEYWORDS
Cut-off grade, Definition standards, Mineral resources, Minimum widths, Open pit surfaces, Potentially mineable shapes, Reasonable prospects, Spatial continuity

MOTS-CLÉS
continuité spatiale, formes potentiellement exploitables, largeurs minimales, normes de définitions, perspectives raisonnables, ressources minérales, surfaces à ciel ouvert teneur de coupure

- A discussion on "Reasonable Prospects for Eventual Economic Extraction" in Mineral Resource estimation and reporting can be found in an article published in the CIM Journal, Volume 14 (2023).
- Copies of the article are available to CIM members at:

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