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RESOURCE ESTIMATE REVIEW STEPS

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International codes such as JORC, NI 43-101 and SAMREC are all based on the notion of transparency together with professional aptitude and experience of the competent persons undertaking the work. These codes are not prescriptive; however they do describe a series of guidelines which professionals must adhere to and they are supported by the possibility of professional censure by the various bodies administering the codes. These guidelines are all aimed at defining the precision and accuracy of the data and to ensure the most appropriate methodologies are used to estimate tonnages and grade which underpin for the majority of investments into a mining venture.

RPMGlobal are committed to improving knowledge sets of all mining investors so they have an understanding of the principles of Resource and Reserve estimation which generate the inputs into valuation models. To help foster mining knowledge, RPMGlobal plans to circulate a series of newsletters which outline the steps generally undertaken to review a project, and the reasons, benefits and possible consequences. The first of this series will focus on the exploration data which underpins a resource estimate and the steps taken to review and ensure its accuracy.

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Exploration Data, what is it?

A resource estimate (calculation of total tonnes and grade within a deposit) is generally underpinned by a clear understanding of the geometry, orientation and controls of mineralization and set of assays with assigned 3D spatial locations. This exploration data (set of assays) is formed through variable exploration techniques. Typical methods include geologic mapping, diamond drilling from surface or underground, surface trench samples, underground channel sampling, reverse circulation and reverse air blast drilling.

These techniques are performed using a variety of equipment types, which result in varying types of samples being recovered. Samples include drill core (Figure 1), rock chips, hammer cut and sawed rock. Due to the varying sample types and equipment, sample quality and recovery varies. The quality of the sample and the amount of sample recovered though these methods have a direct relationship to the accuracy of the sample and as such the quality and accuracy of the resource estimate.

Why is Exploration Data Important?

The international codes utilized by the international mining community (JORC, NI 43 -101, etc.) stipulate that the samples which underpin an estimate must be taken in such a way that they are representative of the interval from which they are taken. As discussed, a variety of methods which vary in quality can be used to recover the samples; however, every technique has an inherent sample error range and bias which cannot be eliminated. This inherent error can be further amplified if inappropriate equipment, drilling procedures or sampling techniques are employed while collecting, handling and preparing the sample and then determining the grade (assaying) of the samples. The key is to minimize this inherit error. By using well-constructed, methodical procedures, and regularly auditing their use, human caused bias can be minimized.

In understanding how sample bias can affect a resource estimate, and why is it is critical to any investment decision, one must understand the context of the samples. Whether it is drill hole, trench or channel samples, by volume, these samples commonly constitute less than 1/100,000,000th of the total deposit volume. Then considering that these samples are the only numeric factual information utilised to calculate the total tonnes and grade of a deposit, one can get a sense of the critical importance of sample quality and the accuracy of this data. The spatial interpretation, as well as the grade and location of the assays form the only basis for geologists to make assumptions about the variability of the grade and the geological orientation of the mineralization. If the assays are biased (too high or too low) then these assumptions will be fundamentally flawed and will result in an inaccurate resource estimate. A poor estimate will ultimately decrease the confidence in investment decisions and will, in fact, result in unexpected outcomes. As such, RPM places great importance on ensuring that minimal sample bias occurred and that the data utilized in its resource and reserve estimates are factual and suitable for investment decisions.

Reviewing Exploration Data

Due to the importance of exploration data, when RPMGlobal reviews projects, we undertake a series of steps to ensure the data is factual, appropriate and that assays are representative of the underlying geology of the deposit. These steps can be separated into two phases:

- Database Verification - This phase of the data review focuses on verifying the spatial location of the exploration data, confirming appropriate techniques were used to collect and assay the samples, and confirming consistency between various datasets. Basically phase ensures the data came from where is has been recorded and coming from and appropriate methods were employed to derive it.

- Quality Assurance and Quality Control -When exploration data is collected, QAQC samples are utilized to test various sample bias and errors during the drilling and sampling and ensure correct sample preparation and assaying procedures utilized. These samples include duplicate samples (from individual intervals), known grade material (Standard Reference Materials), and blank (barren) samples. Effectively, these samples enable a review of the precision and accuracy of the assay data and prove the samples are representative of the sampled intervals. Such assurances are required by the various international codes. Various other types of QAQC methods can be employed for a project. These include twin holes (holes located adjacent to existing holes to confirm the validity of information collected from the existing hole), independent re-samples, and external duplicate sample checks to a second or third laboratory.

Next is a brief description of the Database Verification steps generally undertaken by RPMGlobal during a review of a project. Due to the importance and complexity of a QAQC program, a description of QAQC procedures will form the subject of a separate newsletter.

Database Verification

When reviewing project data RPMGlobal generally completes the following steps:

- Review of procedure – This review includes an analysis of drilling, sampling and assaying procedures to ensure correct procedure were used which will minimize sample bias. RPM utilizes its experience with each technique to ensure that the appropriate level of care was undertaken.

- Hard Copy data review – When each bit of data is collected during exploration, a hard copy record is taken. Whether it be a drillers report (records location, depth and angle of hole), sample submission sheet (by the company to the assay laboratory), official assay certificates (supplied by laboratory, states assay results) or company documentation. These documents should be preserved, available and consistent with the digital database.

- Comparison of Database with plans and cross sections – Hard copy cross-section, plans etc. should be available when reviewing a resource. These plans and section maps are compared to the digital database to ensure consistency.

• Onsite Review – Whilst onsite, a series of reviews are undertaken to ensure the consistency of the geology and mineralization with the digital data. Independent sampling may be completed.

These steps are undertaken to ensure appropriate techniques are utilized to collect the data, that no inconsistencies are found between datasets supplied to RPMGlobal and that the appropriate documentation is supplied to support the statutory reporting of the Mineral Resource. An important step in this process is the review of actual material on site, the geological characteristics of the rocks and the records held by the company. Without these reviews and appropriate documentation, RPM may conclude that the dataset cannot be verified to sufficient certainty to enable reporting under the various International Codes commonly used.

What Happens When Database Verification "Fails"?

Upon completion of the database verification steps, if it is considered that material issues exist or insufficient documentation is supplied, then further exploration work is generally required to confirm the dataset or replicate the questionable data. Material issues could include the following;

- Insufficient data is available to confirm the procedures,
- The sample locations cannot be verified, or
- There are material inconsistencies which cannot be resolved between the datasets and geological characteristics of the mineralization.

RPMGlobal highlights that these reviews are a mixture of being subjective and prescriptive and they rely heavily on the experience and understanding of the reviewer based on the style of mineralization and the type of data upon which they are reviewing. For example, data from Chinese exploration teams is vastly different from that which is obtained from Australian companies. Without a detailed undertaking of the procedures and standards which are required and followed, misinterpretations are highly likely to occur. As such, when completing these reviews, RPMGlobal utilises a team of experienced local personnel in addition to international expatriate Competent Persons (as defined by international codes) who have sufficient experience to ensure accurate reviews.

A "failure" during the database verification phase review could be caused by a number of reasons, including poor record keeping, falsification of data or poor exploration techniques; however, essentially it means the data cannot be verified to the standard required under the international codes for inclusion in a Mineral Resource estimate. Unless the issues can be resolved through further review of documentation, it will always be the recommendation to undertake further drilling or re-sampling.

RPMGlobal highlights that inaccuracies in exploration data will mean that the resource estimate is fundamentally flawed. This presents a significant risk to mining investment and is inconsistent with the requirements of the JORC Code and other international codes.

Conclusions

Exploration data is factual information which is utilized to derive the estimates of resource estimates. These estimates form the basis for all investment decisions and as such ensuring the accuracy and precision of the data is critical in any review or due diligence prior to any investment decision. RPMGlobal places great importance in exploration data in any review of a project, whether it be a greenfield or operational asset.

IMPROVING PROJECT VALUE USING SPECIALISED SOFTWARE

A summary of the Berau Coal Case Study

PT Berau Coal (PTBC) Mining Project located in East Kalimantan, is one of Indo-nesia's largest thermal coal producers. Using open pit mining methods their cur-rent production is approximately 25 million tonnes of Run of Mine coal per annum with plans to increase. RPMGlobal was commissioned to undertake a life of mine (LOM) planning study covering multiple pit operations with differing geological char-acteristics. The study was focused on achieving the best economic outcome whilst optimizing deposit utilization.

The LOM study evaluated the design of all mining areas within the Berau Coal concessions. This case study focuses on just one pit. To determine the best mining scenario, a series of strategic schedules were gen-erated and analysed using an economic model. The pit was divided into mining blocks and evaluated against the geologi-cal model to determine the quantity of waste and coal within each block. This was used to populate the reserve data-base in XPAC, RPMGlobal's mine scheduling software. The software was also used to optimize waste placement. The option chosen were dependent on the direction of mining, the availability of in-pit and ex-pit dumping capacity, maximizing re-source utilization and minimizing average haul distances. Detailed analysis of the original pit and dump designs revealed there was insuffi-cient dump capacity to handle the waste production at several points during the schedule. This prevented complete ex-traction of the mineable reserves and re-sulted in a longer average haul distance.

To increase the capacity of the ex-pit dumps, recommendations were made to relocate a workshop and the ex-pit dump was re-designed. The pit was also rede-signed to reduce the strip ratio, resulting in a pit layout that would accommodate earlier in-pit dumping. XPAC was also used for scheduling the new design to identify the strategy that optimized waste placement whilst consid-ering factors such as; seam pit floor, strip-ping ratio, mining and dumping directions and starting in-pit dumping earlier. The revised pit and dump designs ensured that adequate dumping capacity was available throughout the schedule, allow-ing all mineable coal to be extracted. There was also a significant reduction in average haul distance.

To demonstrate the potential economic viability of the project, XERAS, RPMGlobal's financial modeling software was used to evaluate each scenario. An economic model was developed using costing data, coal pricing, and project physicals, consid-ering all haulage costs. The revised pit and dump design with a reduced average stripping ratio and a mine life of 10 years generated a 10% improvement in NPV.

Outcomes

The mine planning process performed by RPMGlobal focused on achieving the best economic outcome while optimizing de-posit utilization. By utilizing the strength of its scheduling software across the whole concession, RPMGlobal was able to identify the potential for a greater improvement in overall project value.