

SRK's Technical Assistance Program to the Mining Industry. A Case Study on the Aitik Mine, Sweden



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SRK has recognised that the mining industry has struggled with low commodity prices in the last five years and this has heightened awareness of reducing costs and working efficiently for our clients, at a time when investment has been difficult to justify. In their annual review of the mineral sector, Deloitte identified several key factors that might stimulate growth and help the industry to turn the corner and move out of the current downturn in the foreseeable future. For the industry to regain momentum, a strong foundation for the "coming" up cycle is required.

The need to reduce costs and increase productivity is paramount for the industry and several key factors still need to be addressed, including:

- determine how to ride out the current downturn and how to accelerate resurgence from the bottom of the cycle;
- increase mining efficiency from the current cycle by adopting innovative technologies and work practices;
- achieve better productivity from current and future operations by focussing on operational excellence;
- embrace new ideas and ensure staff are properly trained.

SRK has led the way at a number of

mining operations helping to establish a foundation of best practice mine geology by implementing new approaches that result in improved productivity at reduced risk. Innovation is not solely focused on "best practise" but also incorporates devising new, improved practices relevant to the needs of each individual mining operation. SRK's worldwide experience has shown that companies who invest in training their team, implement new technologies and improve their systems have reduced costs whilst simultaneously driving up production and reducing risk to the project (both technical and financial). SRK provides access to these systems, practices and training through a program of embedded technical assistance at the mine site.

On Site and Accessible

Traditionally the consultant makes a brief visit to the mine site and identifies a number of areas for improvement and then leaves a hefty report of recommendations for the client to implement. However, the skills and capacity required to implement the findings are



Grade control drilling, Chile.



Mr Peter Gleeson Corporate Consultant SRK UK.

often lacking in remote sites, especially amongst junior to mid-tier miners.

To overcome this problem, SRK offers an alternative to traditional consulting which allows us to work closer to the pit face and become part of the client's team by offering extended mine-based technical assistance. This approach allows sufficient one-on-one time between miner and consultant to implement changes and provide rigorous training.

By embedding an SRK consultant for extended periods within a mining operation, a mutual two way relationship is built between the consultant and miner. This approach has been found to strengthen the trust and flexibility between the two parties, ensuring the development of relevant, pragmatic and robust technical solutions, designed with on-site buy-in and then successfully implemented. The client benefits by having an experienced geologist guiding and mentoring their team at a cost which compares with hiring similarly skilled permanent staff but with much greater flexibility around rotas and overall period of engagement. Most importantly, the aim is to become

an integrated part of the mine team and to deliver quality outcomes in production timeframes, with the ultimate aim of reducing risk and cost in all areas of mine geology and grade control.

Experience

The site based professionals used by SRK have a strong background in the production environment in addition to their extensive consulting experience. Typical mine geology skills that can be brought to the mine include, but are not limited to:

- Pit and underground mapping
- Grade control implementation
- Reconciliation studies
- Supervision and implementation of QA/QC programs
- Resource estimation
- Resource domain modelling
- Supervision of drilling programs
- General mine geology
- Project management
- Database management and implementation
- Near mine exploration

In addition to the individual consultant allocated to the project, the client will also have rapid access to SRK's specialists in the wider engineering and processing aspects of managing and planning the mine, who can be called upon at any time to provide additional advice.

Training

The provision of high level technical expertise is only the beginning. SRK emphasise the need for the transference of key skills to the site personnel. This is the cornerstone of the assistance program. The SRK program also brings advanced mining software solutions (in a broad range of mining software) and links to a range of mining engineering, metallurgical, hydrogeological, geotechnical and environmental services that cover the entire scope of mining activities from exploration to production.

In addition to extended mine site technical assistance SRK also offers a number of mine specific short courses in:

- Structural geology / mapping
- Resource domaining
- Resource estimation
- QA/QC



Pit mapping, Burkina Faso.

These courses have been designed in conjunction with industry partners and combine theory with a strong emphasis on hands-on practical workshops with exercises designed to give the geologist a pragmatic skill set and the confidence to perform these functions by themselves. These courses are run either at the mine or from a central location in country.

Benefits of Mine Site Technical Assistance

The benefits of this approach compared to traditional consulting are:

- Extended exposure to highly experienced personnel;
- Mentoring and training of mine staff in all aspects of mine geology;
- Direct outcomes for management that improve mine efficiencies;

- Reduced risk by improving understanding of geological controls on mineralisation and improving sampling and estimation practices;
- Lower costs through improved work practices;
- Contemporary and industry standard work practices moulded to the mines particular needs.

SRK have several case studies that demonstrate a definitive, positive outcome for a participating mine, including cost saving by not processing low grade material, definition of additional reserves and improved reconciliation. These outcomes can add several millions of dollars in value, far outweighing the relatively small cost of using SRK's operational assistance. ►

To date SRK UK have provided mine site technical assistance to a number of clients, including:

- Nordgold. Bissa Gold Operations, Burkina Faso
- Nordgold. Lefa Gold Operations, Guinea.
- Nordgold. Taparko Gold operations, Burkina Faso
- African Minerals, Tonkolili Iron ore project, Sierra Leone.
- Pan African Minerals Limited, Tambao manganese project, Burkina Faso
- Boliden. Aitik Mine. Sweden
- Newcrest. Bonikro gold mine, Cote D'Ivoire.

The on-going nature of many of these programs enables the consultant to develop an intimate knowledge of the mine, the deposit and its production issues. As a result, in several cases, SRK has been invited to return to a mine after a significant change in staff, to ensure continuity of experience and the transfer of knowledge which would otherwise be reduced or lost, which has no doubt been hugely advantageous.

A Case Study. Aitik Mine, Sweden.

SRK were involved in mine site assistance at Boliden's Aitik copper mine in north Sweden. Aitik is one of the largest open pit mines in Europe. The deposit was discovered in the late 1930's and has been in production since 1968. The mine is a large poly-deformed porphyry system that has undergone many



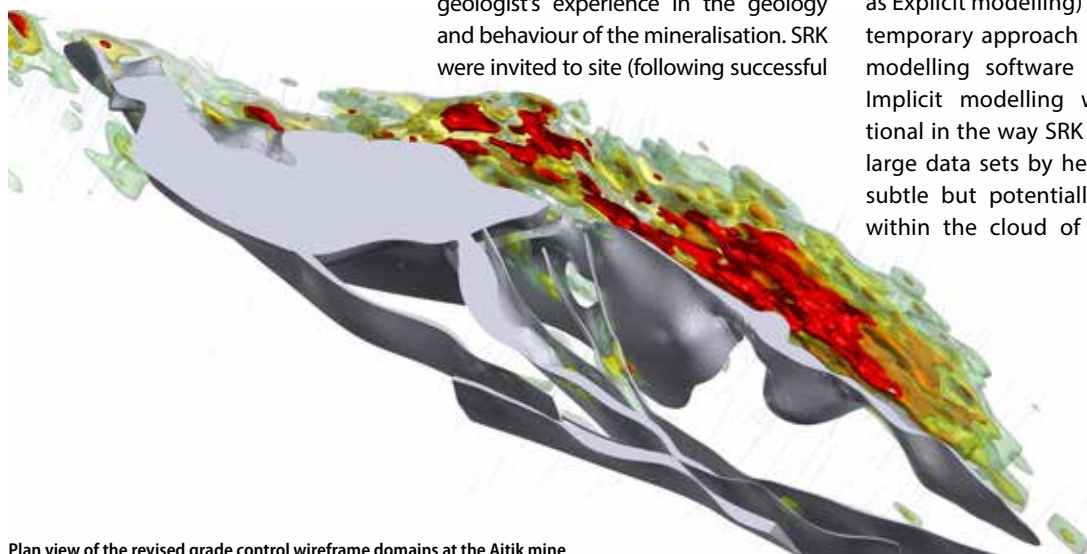
Boliden's Aitik Open Pit Operation, Sweden.

stages of alteration. The mine's current production rate is over 36 Mt per annum, giving 67kt of copper metal. Over the past twenty years the mine had been producing and updating its Mineral Resource and grade control models using a combination of traditional CAD based systems.

The problem was that Aitik (like many large mines) was inundated with huge amounts of data collected on a daily basis. Boliden needed to be able to visualise, analyse and interrogate this data in a timeframe that is consistent with the operational pace of the mine. This was not being achieved with their legacy systems. Updates of the resource and grade control wireframes were requiring several months per year to complete, comprising extensive digitisation and modelling. Although time consuming, the manual process did result in progressively more accurate models, incorporating the mine geologist's experience in the geology and behaviour of the mineralisation. SRK were invited to site (following successful

modelling and mine site technical programs at other Boliden projects) to see if it would be possible to reduce the timeframes and geologist-hours required to produce robust and accurate resource and grade control domain models. The assistance program resulted in providing equally high-quality models in a time frame of one week, compared to the 6 to 8 weeks by previous methods. In addition to the decreased timeframes, (in the opinion of SRK and Boliden), the accuracy and repeatability of the models was also improved.

SRK mentored the mine geology department through the process. Key to the success was the implementation of advanced modelling software and techniques. This involved moving away from a traditional sectional approach of manually digitising lines and manual linking them to form wireframe solids (a process often termed as Explicit modelling) to the more contemporary approach of using Implicit modelling software (Leapfrog Geo). Implicit modelling was transformational in the way SRK dealt with these large data sets by helping to identify subtle but potentially critical trends within the cloud of data. Once the



Plan view of the revised grade control wireframe domains at the Aitik mine

trends were identified, implicit modelling helped SRK to rapidly build models that integrated and honoured all data from a wide variety of sources. Boliden required a system that could build and refine models as part of an on-going and iterative process, rather than relying on periodic updates that were often out of date by the time the model was completed.

The improved approach was more than just implementation of new software. It also enabled increased geological input and therefore improved control on the domaining. Importantly, the process of implicit geological modelling did not use an automatic 'hands off' approach, rather all stages of the process were guided and controlled by the geologists.

Boliden recognised an opportunity for operational improvements in the way they handle their vast data sets and approached SRK to assist them to develop a grade control modelling process that could rapidly update the grade control domains as new production data became available. The steps adopted by SRK in this approach were:

1. To confirm the main controls on the geometry of the mineralisation. In addition to the main trend SRK identified several smaller but important trends. This resulted in a composite structural trend to guide the modelling process;
2. The model was further refined by constraining it within the mineralised biotite –gneiss unit;
3. Finally to fine tune the model SRK undertook a sensitivity analysis. Varying a range of parameters to verify the interpolant settings that best reflected the observed grade trends and geological continuity. The process was set up to account for multiple elements indepen-

dently to account for subtle changes in metal trends that result from multiple mineralisation phases and preferential re-mobilisation of certain elements. Also the modelling created a series of wireframes at a range of different cut off grades allowing for future flexibility in the operational cut off grade, which would be highly time consuming and therefore impractical using traditional modelling methods.

In a short space of time, SRK implemented and trained the mine geology team in a grade control workflow that accurately reflected the orebody and was easily updatable and auditable. In addition it enabled the production team to deliver results in a fraction of the time normally allocated to the process. The downstream effects were that the process improved short term mine planning by enabling rapid, consistent grade control modelling and provided the mine geologists with more time to focus on other key tasks such as mapping, logging, understanding and interpreting the geology and mineralisation better.

The process resulted in significantly improved operational efficiencies and a far more cost effective use of time for geological staff. The new domain models and approach were used in subsequent grade control domaining. All

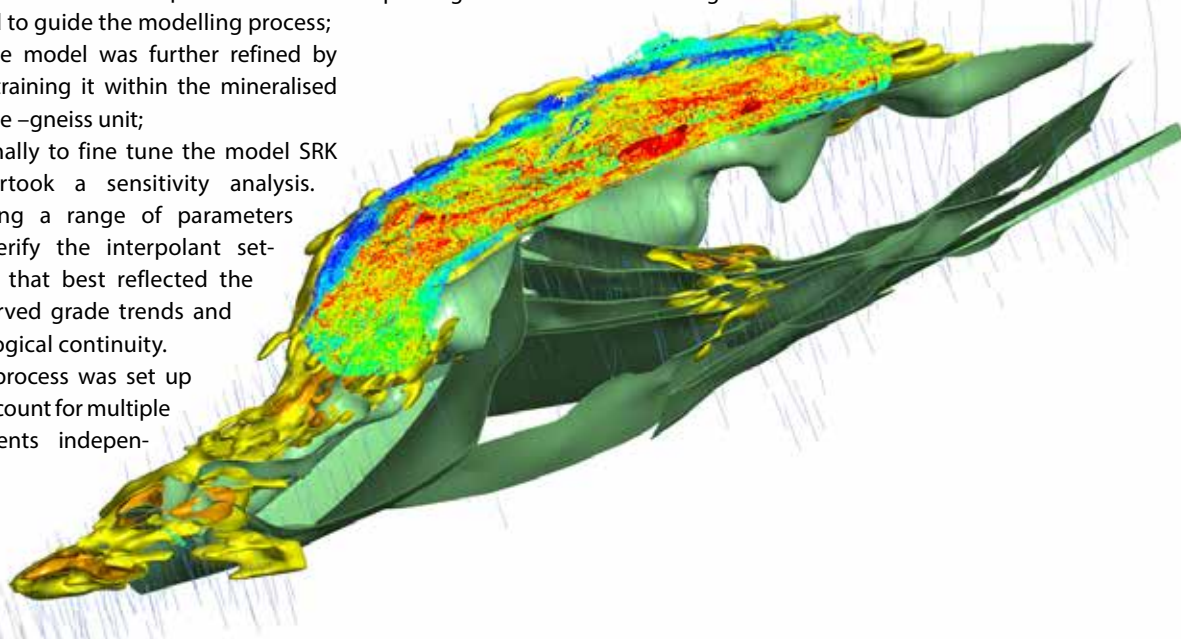
models were validated and honoured the known geology. The new approach often allowed updated resource estimates to be available within a few days of sampling and logging data being received. Therefore, in comparison to the original, time consuming approach, the mine could react operationally almost immediately to any changes to the geological model, rather than having to wait for months.

Summary

Embedded mine site operational assistance goes a long way to addressing the needs for operational excellence, combined with a long term commitment to people and training outlined in the introduction to this article.

The development of this non-traditional approach to consulting is already having direct and demonstrable benefits for mining operations in Scandinavia, West Africa and elsewhere. It is a highly cost effective approach that brings the latest technology, methodologies and mentoring to remote mine sites that may not always have access to professional staff with the right skills. It ameliorates the high costs associated with traditional consulting rates that are often not sustainable and discourage extended site visits. ●

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Plan view of the revised grade control domains and footwall diorite (green) at the Aitik mine.