Case study: Dynamic updating of a geological model for enhanced in-situ reconciliation

ONÇA-PUMA LATERITIC NICKEL MINE, PARÁ STATE-BRAZIL

THE PROJECT:

The Onça-Puma lateritic nickel mine is located in the northern Amazonian State of Pará, Brazil. Brazilian miner Vale, is the world’s largest iron ore and nickel producer.

Vale’s Master Geologist, Dr. Valter Oliveira, first began testing Leapfrog at Onça-Puma in 2012. He had read papers on the value of implicit modelling and wanted to improve their modelling of the complex lateritic geology and introduce dynamic modelling to contribute to better in-situ reconciliation. Reconciliation is a scientific and objective method to compare predictions to actual production.

The introduction of Leapfrog allowed the geologists to develop a model that more accurately reflected reality and that could be dynamically updated for timely decision making, saving time and investment. The better reflection of reality meant that the blocks mined were more accurately classified, helping to improve the in-situ reconciliation.

SITUATION:

The Onça and Puma nickel deposits have developed from layered mafic-ultramafic complexes intruding Pre-Cambrian basement rocks of the Brazilian Shield. Supergene and residual concentrations of nickel have developed along the elongated hills of Onça and Puma. Nickel laterites are a residual form of mineralisation derived from a process of uplift, weathering, and secondary enrichment of the host ultramafic rocks. Through processes of leaching and chemical exchange over several millions of years, concentrations of nickel, cobalt, and iron are formed in varying quantities through the laterite profile. Lateritic mineralisation is controlled by a combination of bedrock rock type, geomorphological history, structure, and climatic conditions. The laterisation process is predominantly vertical and gives a complex shape to the contact between limonite and saprolite.
Understanding these profiles and mapping boulders is essential for operational cost control. This modelling process, identifying the soft and hard ore, the waste and the boulders is important to get right. Poor performance of in-situ reconciliation is expensive and time consuming and doesn’t enable good forward planning.

Modelling these highly complex shapes by hand was impossible as it produced square geometry that didn’t reflect the intricate variances of nature and reality. Manual approaches were also extremely time consuming and had been taking the Onça-Puma geologists a month to complete. This manual wireframing also didn’t allow time for regular updating with new information from the geological mapping. In fact, due to the time consuming nature of manual updating it couldn’t even be completed in six months.

Commented Valter Oliveira, “These inconsistencies with data were added to the final result, increasing the difference between planned and realised.”

Results of explicit modelling approach. With this approach we need to split the limonite, saprolite and chacedone in two. This is very different from ‘reality’.
Unlike traditional modelling, the Leapfrog model is produced as a continuous shape that highlights artifacts and domaining deficiencies. Leapfrog can model any narrow geological unit which folds, curves or branches from one another with ease and can export separate hanging-wall and foot-wall surfaces. It can model with minimum and maximum thickness and generate realistic geological domains that pinch-out at excluded segments.

This direct from data modelling obviates the need for time consuming wire framing and also gives the geologist more time to think about the geology.
Modelling at Onça-Puma is based on two types of data, long term data from drilling and short term data from face mapping. Bringing these different types of data together is complex but Dr Oliveira had the idea to transform the mapping data into horizontal drillholes so it could be successfully integrated with the long term data and modelled.
Commented Dr Oliveira, "This new approach to updating is very fast. It only takes a few hours and results in a good and current representation of ‘reality’. We can even update daily. For us the overriding benefit of using Leapfrog is gaining more time. Before Leapfrog it took us months to update our models."

Leapfrog’s Latin American Technical Director, Ignacio Torresi and Business Development Geologist Marcelo Freitas spent a week at the mine site in the Amazon to advise and optimise the processes used for geological modelling. Commented Ignacio, "The advances in modelling that Leapfrog helped achieve mean that blocks can be flagged for the correct processes. Onça-Puma staff now have a more precise model."

International Codes for public reporting are becoming clearer about defining the expectations of shareholders who invest in mining companies, including trends to more clearly define requirements for performance of mine operations. The reconciliation process, comparing actual production with predictions, will increasingly become the benchmark by which a mining company’s performance is judged.

The local Brazilian Leapfrog team worked closely with the Vale team to help fine-tune the model and provided advice and high-level orientation. Said Ignacio, "It was great to work closely with Valter and the Vale team on this project and get a better understanding of their unique requirements. We’ll continue to work closely and keep them informed about the latest advances to improve their geological modelling."
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Vale, Master Geologist, Dr. Valter Oliveira

OUTCOME

Being able to bring the long and short term data together meant that models could be updated with the new information from the pit face on a daily basis. Leapfrog was able to reflect both the long term and short term data, providing a model that was fit for purpose and that could be relied on.

“Increasingly mining is getting more complex with lower grade. The margin for error from geological modelling needs to be minimal,” says Dr Valter Oliveira.

The dynamic nature of mining requires rapid data collection and evaluation so that decisions can be made in a timely manner to capitalise on opportunity and avoid costly delay. As commodity prices fall and resources become more scarce there will be even more focus on improving efficiencies and saving costs.

Commented Leapfrog’s Managing Director, Shaun Maloney, “The ability to rapidly introduce new information to Onça-Puma’s modelling process ensures problems and opportunities are quickly identified and reported. Reconciling from the resource through to delivery of a mineral product adds value during development of a mining project. Leapfrog helps contribute to a robust in-situ reconciliation system that enables the total mining operation to be seen in context.”

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