FALL SUMMIT 2020

Extraordinary Discovery Stories

ABSTRACTS

Data integration for successful brownfield exploration: The example of the Candelaria Mine, Chile

Paula Brunetto
Senior geologist, Lundin Mining

The Candelaria Mine is the largest known IOCG deposit in Chile and is located in the Punta del Cobre District in the Atacama Region of Northern Chile. As of June 30, 2020, Candelaria's total Measured and Indicated Mineral Resources were estimated to be 1,179.3 Mt at 0.64% Cu. The Candelaria Mine Complex consists of a large open pit mine, with northern and southern underground extensions, as well as the Santos and Alcaparrosa underground mines. The Candelaria open pit mine commenced production in 1992, after a successful exploration discovery led by Phelps Dodge in 1987 using geophysical and geological data.

The geology of the Punta del Cobre district is characterized by a Lower Cretaceous Punta del Cobre Fm, which hosts most of the copper mineralization in the district. The Punta del Cobre Fm is dominated by andesites and tuff, overlain by limestones and sandstones from the Abundancia and the Nantoco Formations, of the Chanarcillo Group. Like other IOCG deposits, the mineralization in Candelaria has a strong structural component, associated with NNW structures and a massive magnetic breccia. A non- typical IOCG feature is copper mineralized "manto" horizon hosted within a tuff unit from the Punta del Cobre District. The Abundancia Formation also hosts mineralization dominantly in skarns.

By December 31, 2013, after 20 years of operation, the remaining contained copper in the mine Measured and Indicated Mineral Resources stood at 2.7 Mt , and the expected life of the mine for the Santos and Alcaparrosa mines was only until 2017 (Lundin Mining Corporation, October 6, 2014 Technical Report). Lundin Mining Corporation purchased the Candelaria Mine Complex in 2014, recognizing the immense resource growth potential in the underground mines, and suspecting that aggressive exploration programs could further increase the resources within the extensive claim package. These expectations have been more than surpassed, and in the six years since Lundin's purchase, the Mineral Resource estimate has grown in contained copper by 4.8 Mt, to 7.5 Mt (Lundin Mining Corporation, September 8, 2020 Press release), approaching a threefold growth in size.

Significant early Mineral Resource growth was achieved by integrating numerous individual

Resource Block Models, which were fragmented historically. Additionally, a comprehensive District 3D GOCAD Model was developed to allow data integration and target prioritization based on previous data and new geophysical surveys, which have demonstrated to be effective tools to discriminate the magnetic breccia and the mineralized manto. The discovery of "La Espanola," located 4 km SW of the Candelaria Pit, resulted from integrating historical drilling data and regional geophysical surveys.

From 0 to 3M oz in 3 years: The extraordinary Lynx gold deposit

Alexandria Marcotte
VP Project Coordination, Osisko Mining

In December 2016 Osisko Mining Incorporated drilled a reconnaissance hole 600 metres from the known Windfall gold deposit in an unexplored area. What resulted was nothing short of extraordinary: the discovery of the Lynx gold deposit, arguably the richest portion of the Windfall system. Located in the Urban-Barry Greenstone belt beside the Windfall deposit (discovered in 2004), the Lynx gold deposit has grown to almost 3 million ounces Au (indicated + inferred) in three years and continues to expand with the current drill program. What makes the Lynx deposit so extraordinary is its incredible growth in ounces and grade in such a short time, its geological predictability, and its location. Key drivers for the successful discovery and definition of Lynx include Osisko's philosophies of drilling, courage, and patience.

Review of orogenic mineral systems and mineral prospectivity mapping in the Swayze greenstone belt, Ontario, Canada

Francisca Maepa
PhD Candidate, Laurentian University

Mineral exploration targeting has significantly evolved in the last decade with new applications such as spatial predictive analytics. However, traditional mineral prospectivity mapping remains focused on deposit-scale analysis of mineralization controls in well-explored regions. There is a need for a scale-integrated exploration targeting methods that reviews processes responsible for distributing mineralization from regional to deposit scales. By recognizing key ingredients in a mineral system, geoscience predictor maps can be used to map expressions of ore forming processes for the purpose of mineral prospectivity mapping. Furthermore, machine learning algorithms can be used to not only predict new prospective sites, but to give insights on the predictor variables with the best spatial correlations with mineralization processes. A deep neural network model was built and used to analyze multi-dimensional geoscience data and map mineral prospectivity in the Swayze greenstone belt in Ontario Canada. The results indicate that the deep learning model obtained >80% prediction accuracies with less than 0.2 % model error. In addition, a

variance-based feature importance analysis obtained from the deep neural network model indicated that the most influential layers were maps showing proximity to conductive features derived from electromagnetic data, regional scale magnetic worms, distances from first order large-scale high strain zones, distances from third-order local scale faults, and lithological contacts. The results highlight that mineralization processes can be mapped at various scales of the mineral system and used to generate an effective exploration targeting tool. Deep learning models are powerful machine learning tools that can be applied in mineral prospectivity mapping perform well in mapping gold prospectivity and can suggest valuable predictor maps that best map mineralization processes.

Geochemical Exploration Discovery Stories: Programs contributing to significant mineral district discoveries

Mary Doherty
Exploration Geochemist and Adjunct Professor, Colorado School of Mines

Stories. Be they our life stories, our successes and failures, intentions, or dreams, recounting and telling of our stories is an important aspect of technical work. Many explorationists spend a career exploring and yet rarely achieve the goal, a mineral deposit discovery. This talk will focus on the value of geochemical exploration in making mineral discoveries, and we will probe the commonalities in these remarkable discoveries of diamond, nickel, and gold districts. The four cases described involve exposed mineralization, targets covered by glacial till or deeply weathered terrain, and discoveries of new districts with mineralization. The four stories have in common a team of at least two. Firstly, leadership. Leaders with a committed plan and financial support for a program, in some cases persevering through company and budget changes; leadership that shows tenacity is a key ingredient. The second partner in these remarkable discoveries: the field geologist or team. These technical field geologists applied diligent, grinding consistency, passionate commitment, attention to technical detail and, in several cases, improved or new geochemical technology. Geochemical exploration was applied over vast regions, with sample programs costing in the range of $200-1000/sample, and up to a decade in field work to make the discovery. These are stories of remarkable partners in exploration.