XPLOREIQ CASE STUDY: NORTH AMERICAN PALLADIUM PARTNERS WITH SGS

Increasing Life of Mine with Machine Learning Algorithms

SGS

INTRODUCTION

ABOUT NORTH AMERICAN PALLADIUM (NAP)

NAP is a leading Canadian palladium producer, operating the Lac des Iles Mine northwest of Thunder Bay, Ontario. With 25 years in operation, NAP's strategy is to be a low-cost, long-life, sustainable producer. As of January 2019, NAP has had seven consecutive quarters of production growth, revenue generation and significant, positive cash flow.

Lac des Iles is one of the largest producing palladium mines in Canada, with plans of reaching 12,000 tonnes per day from underground resources in 2021. Currently, Measured and Indicated Resources are estimated at 72.9Mt at 2.14 g/t Pd for 5 million ounces of contained palladium (Oct 2018).

EXPLORATION STRATEGY

NAP's exploration strategy for Lac des Iles consists of 3 pillars:

- Reserves replacement through extension and conversion drilling adjacent to the principal mining areas,
- Resource additions from underground and surface targets on other parts of the property,
- Delineation of new mineral resources on other intrusions and properties in the immediate vicinity of the mill.

SGS COLLABORATION

SGS' XploreIQ methodology complements its suite of project lifecycle services. It delivers in-depth knowledge of the project and exploration targets by combining NAP's historical data with SGS's geoscience expertise and machine learning algorithms. This unique combination allowed SGS to add value to NAP's exploration and mine development strategy by developing a highly targeted drill program. This collaboration has led to a successful campaign that helps NAP to optimize the ore body potentially leading to an extension of life of mine (LOM).

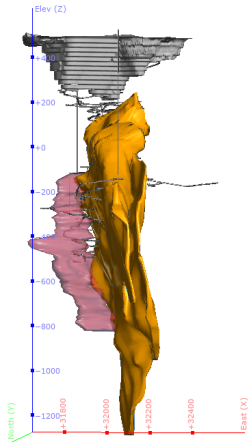
LAC DES ILES C-ZONE DESCRIPTION

In 2018, exploration drilling intercepted a new Pd rich zone (C-Zone). This zone consists of two mineralized trends, including a north-south trend parallel to the central Offset Zone and a southwest-striking trend. The southwest trend generally follows the western contact between the intrusion and the basement rocks and the Southeastern domain of the Offset Zone. Palladium mineralization in the C-Zone is hosted within geological units (Leuco GABVt and Qtz Diorite) that are compositionally distinctive from those that host the Offset Zone resources (Pyroxenite, GAB-Vt and Norite). C-Zone is still an exploration stage target; with encouraging results reported in June 2019. Example results included 74.9 m with 2.93 g/t Pd, including 19.2m with 6.38 g/t Pd and 5.0m with 9.00 g/t Pd (hole 19-520).

LEGEND

Offset Zone

C-Zone =



SGS' PROJECT SCOPE AND RESULTS

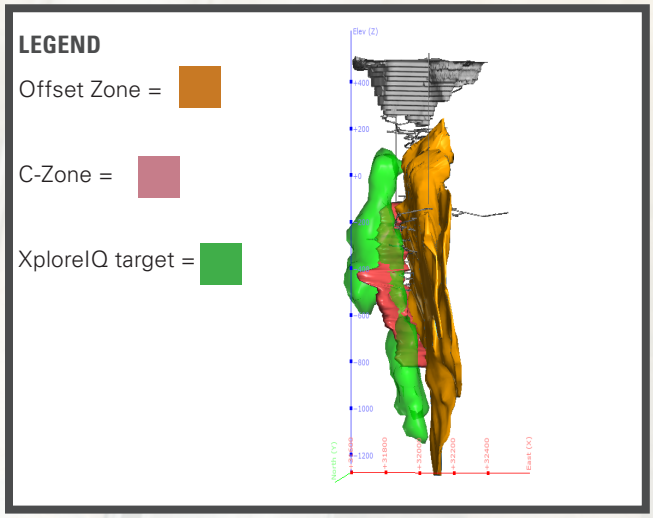
SGS Geological Services was engaged by NAP over the course of eight months in 2016-17 to generate underground and surface near mine exploration targets around Lac de Iles C-Zone. SGS used its methodology developed during the Integra Gold Rush Challenge (XploreIQ), which it won in 2016, to develop two passes of targeting through a combination of its data science capabilities, machine learning tools and algorithms, and geological / PGE deposit knowledge to generate a series of algorithm-generated and weight of evidence (WoE) targets. The C-Zone is directly linked with one of the major high priority targets generated through XploreIQ.

XploreIQ, the SGS machine learning methodology and toolkit, focuses on exploration targeting and mineralization vector creation using historical and current data. The methodology "cleans" and prepares the data to be analysed by multiple types of ML algorithms and creates prospectivity maps that are used to generate 2D or 3D targets. Information is stored and analysed in the form of block models of different sizes, depending on the area of the target zone. Targeting was done in two stages for NAP to improve the level of precision. In the first pass, SGS applied a 25mX25mX25m block model. The second pass focused on areas of interest defined via the first pass and used a smaller 5mX5mX10m block model.

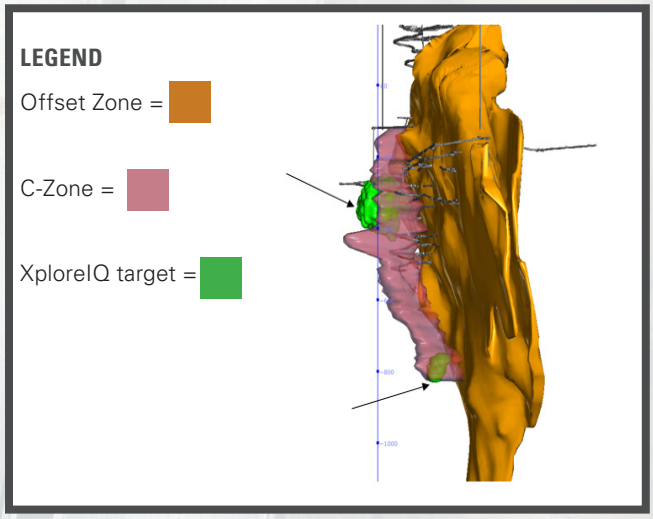
RESULTS

SGS XploreIQ successfully generated drill-ready exploration targets for NAP through two-tiered ML-enabled modelling. Using these targets, NAP has refined and prioritised its near-mine drilling programme as part of its 2018-19 exploration campaign, which has led to a major palladium discovery. This discovery has the potential to extend the life of mine and optimise the ore body value.

PHASE ONE TARGETING & RESULTS



PHASE TWO TARGETING & RESULTS



XPLOREIQ

As new high-quality minerals deposits discoveries become more challenging, and as exploration and mining companies are required to be more efficient with their exploration spending, it is paramount to be more precise with targeting to create an optimal drill campaign. Especially beneficial to deposits with high data density related to historical production or historical exploration work, our XploreIQ toolkit can help you determine further potential for mineral resource expansion (at depth and/or within mine site area). to quantify the risk and increase the return on your exploration investment. Using XploreIQ as part of your exploration program, you can optimize and focus your spend to realize higher and quicker returns, better evaluate and manage risks and maximise your chances of new discoveries.

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WHEN YOU NEED TO BE SURE

SGS