



ELIOS 2 IN ACTION | MINING

MINING DRONES: ELIOS 2 CREATES PHOTOGRAMMETRIC MODELS OF A GOLD MINE PREVIOUSLY IMPOSSIBLE TO INSPECT

THE USE OF DRONES IN THE MINING INDUSTRY IS QUITE POPULAR FOR MAPPING OPEN PITS BUT WHEN IT COMES TO EXPLORING UNDERGROUND, FLYING DRONES IS A TRUE CHALLENGE. ELIOS 2 HAS GOT YOU COVERED WITH MINING APPLICATIONS AND OFFERS A STATE OF THE ART SOLUTION, BRINGING PHOTOGRAMMETRIC CAPABILITIES INTO THE DARK, GPS-DENIED ENTRAILS OF THE EARTH.

BENEFITS IN A NUTSHELL

SAFETY

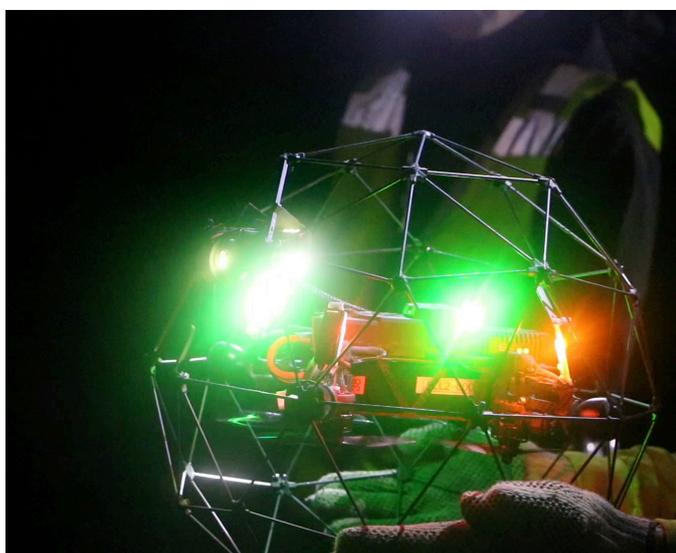
Visual data of excavation sites allowed for safety assessments previously impossible to collect, enabling unprecedented access within no-go-zones without exposing worker to hazards underground.

HIGH QUALITY DATA

High definition 4K video and high quality images provided insight for operations, engineering, survey, and safety departments, which were then utilized in the ongoing development of the stope.

EASE OF USE

Stabilization and a robust caged design allowed for complete, thorough inspections within the mine without worrying about crashing during the inspections.



“How the drone flies, how it stays stable in flight and can lock its distance, how it’s able to access confined areas, the image quality, the new oblique lighting—the Elios 2 checks nearly every single box for what we need to conduct **underground inspections in mines.**”

- Matt Mackinnon, Owner of UAS Inc.

Using data from the Elios 2, Mackinnon and the Flyability team were able to create a 3D photogrammetric model of the large volume left behind after removing the ore vein, called a “stope” in the mining industry. The visual data is needed to help mining personnel make informed decisions related to the current state and condition of the stope, to identify any loose material that poses a threat to remotely operated equipment and mine personnel, and aid in the identification of any remaining ore and geotechnical areas of interest.

INTRODUCTION

For three days Flyability’s Elios 2, a drone created specifically for **confined space inspections**, was put to the test at Barrick Gold Corporation’s Golden Sunlight Mine in Whitehall, Montana.

Matt Mackinnon, founder and president of Unmanned Aerial Services, Inc., which specializes in underground inspections, acted as an advisor to Flyability in the creation of the Elios 2. Matt’s goal at the Golden Sunlight mine was to demonstrate what the Elios 2 could do to support mining operations and add an increased level of safety and access to visual information.

The results? In brief, all of his expectations were surpassed.

[Download the dataset](#)

CUSTOMER NEEDS

After a blast, loose material as big as a small car can be left hanging inside of a stope. It’s not uncommon for these big rocks to become dislodged, resulting in the material tumbling down without warning, potentially damaging the equipment operating inside of the stope, and presenting a significant safety hazard for anyone in the area.

It can be impossible to know the visual condition inside of a stope, since traditional inspection methods are limited to lowering a camera from above (if a borehole is available), or inserting a camera on a pole into the area, which only allows for very limited access to the stope.

The lack of knowledge about the stability of a stope is not only dangerous for the miners, but can also leave expensive equipment vulnerable to shifting material. Muckers, which are large, remote-controlled machines designed to move rock and debris in mines, cost upwards of one million dollars each, and can be destroyed when operating inside of the stope due to lack of data about the stope's condition.

In addition to endangering miners and equipment, the lack of visual data for the interior of a stope can lead to losses for a mining operation in the form of accidentally leaving behind ore simply because you don't know it's there, or from dilution caused by waste material sloughing into the ore.

In order to ensure the safety of mining personnel, to protect expensive equipment, and to avoid losing ore, the Barrick Gold Corporation wanted to gather enough visual data from the Elios 2's flights to create a detailed 3D photogrammetric map of a stope.

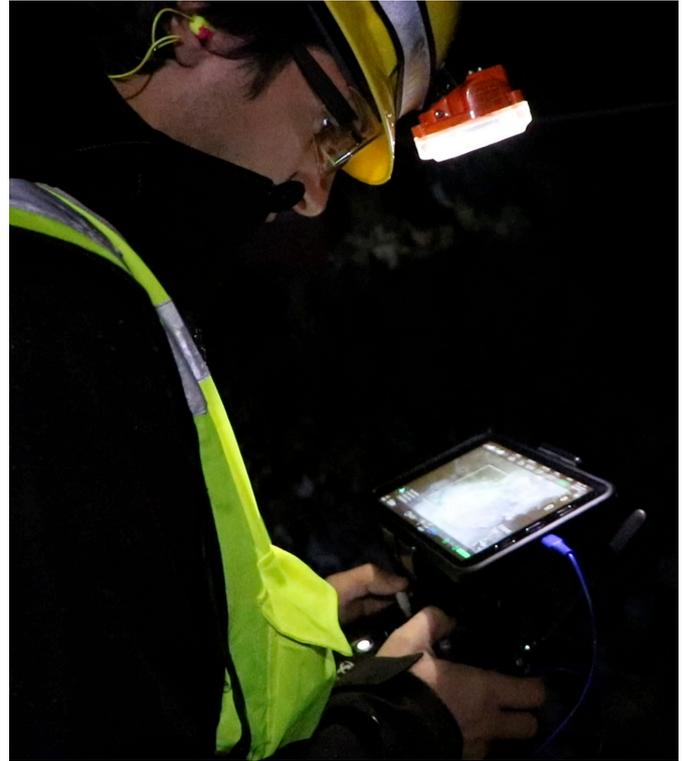
Collecting high quality visual data could help the Barrick team determine whether there had been overbreak or loose materials along the edge of the excavation, and identify fractures in the rocks and other geological features to help them understand where and how collapses might occur.

SOLUTION

The Elios 2 was used to complete several inspections at a handful of different stopes within the Golden Sunlight Mine.

Ryan Turner, a geotechnical engineer for Barrick, oversaw these inspection missions along with

Matt Mackinnon of UAS Inc. and members of the



Flyability team.

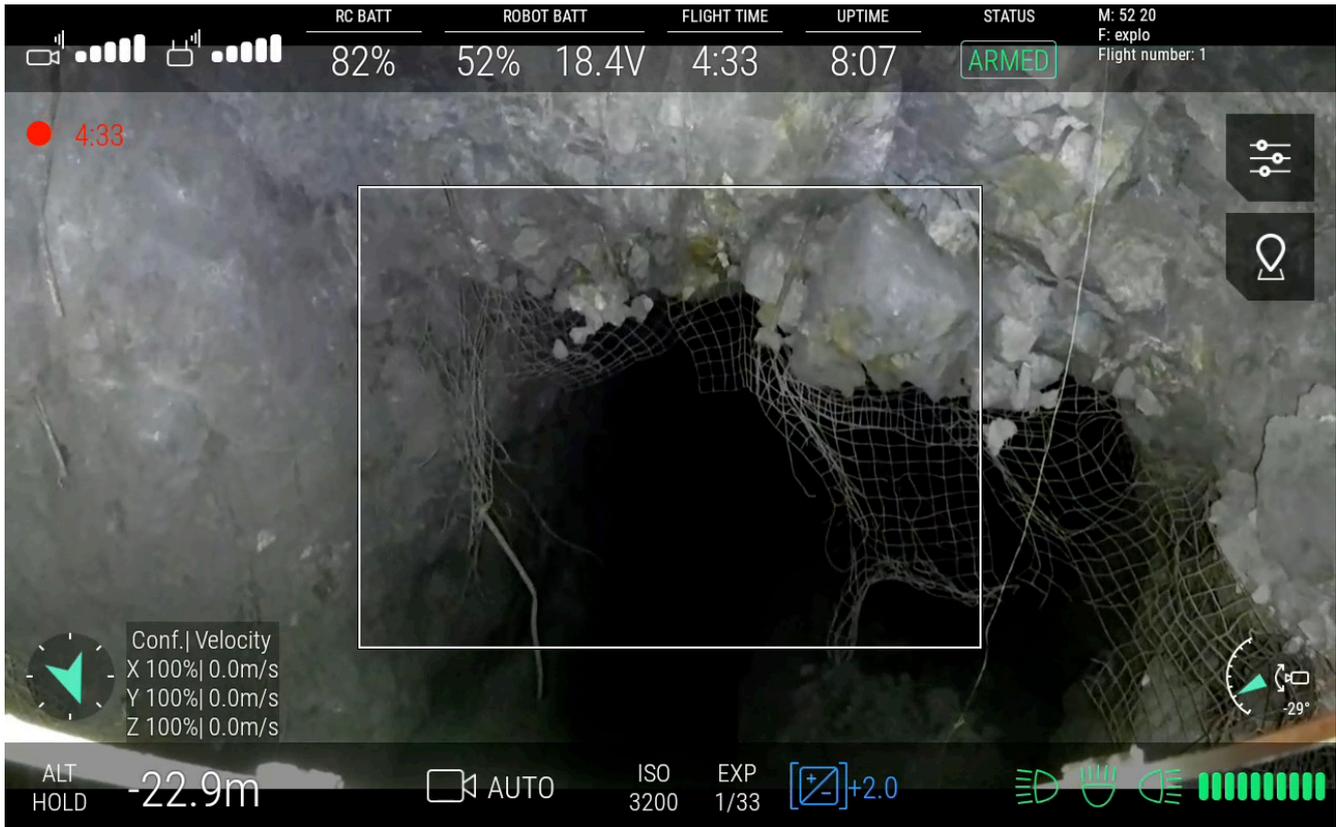
“Here's something you can take off the shelf and fly underground in one of the harshest environments that we work in. You can capture quality footage with the Elios 2. It's safe to interact with, and it has a nice cage that protects it from hurting people, objects, or itself.”

- Ryan Turner, Geotechnical Engineer for the Barrick Gold Corporation

RESULTS

The Elios 2's inspection flights were very successful, with the drone navigating both in very large spaces (10 x 30 x 100 m) and confined shafts with less than 3m diameter.

The powerful lighting system provided sufficient illumination to navigate through the largest spaces, and the protective cage proved useful when the drone collided into hanging metallic wires and ground support bolts—without causing any damage. It collected data that was much more accurate and comprehensive than ever collected before through physical inspection, or any other method. The Elios 2 was able to fly steadily along the body



of ore on the floor of the stope and reveal how much material had been mixed into the ore. It also allowed a close view of the geologic structures within the stope that were releasing material, with sharp, high quality images that provided all the data required for Turner to conduct stability analyses and risk assessments for the area.

“With the Elios 2 we were able to see where the structures were releasing material. The imagery looked really good.”

- Ryan Turner, Geotechnical Engineer for the Barrick Gold Corporation

The Elios 2 also collected important visual data on the position of large boulders that had been released to lower levels within the stope, and showed the actual condition of loose material directly above where the muckers operated, which helped Turner determine if mine personnel and equipment were at risk.

Download Pix4D photogrammetric model project

An important aspect of the Elios 2 that stood out to Turner and his team was how easy it was to fly, and how stable it was while in flight, allowing them to carefully scan an entire wall while performing an inspection.

During these inspection missions two different Barrick employees flew the Elios 2, a geologist and a mucker operator. Neither had any prior experience flying a drone. In each case, they were simply handed the remote control and started flying. They both found that they were able to control the Elios 2 with no problems, and reported that it was easy to fly despite never having flown before.

In talking about the success of the Elios 2 inspections, Turner emphasized how unique it was to encounter a drone that was easy to fly and that could also be flown underground in the harsh conditions presented by a mining operation, noting that most of their previous attempts to use drones for inspections ended in the drone crashing and being lost within the excavation site.

In comparison, five Elios 2 drones were flown over three days at the Barrick Golden Sunlight

Mine, and none were lost.

“Here is a drone you can hand out to someone who’s never used it and they’ll be successful with it.”

- Ryan Turner, Geotechnical Engineer for the Barrick Gold Corporation

PHOTOGRAMMETRIC MAPPING—IN TESTING AND DEVELOPMENT

In addition to the visual data transmitted and analyzed through the Elios 2’s live feed, enough data was collected over four different flights to create a **3D photogrammetric model** of the upper part of one of the gold mine’s stopes.

These models provide important snapshots of the complete condition of an excavation site at a specific moment in time, as well as revealing the full volume of a given stope.

Geotechnical engineers like Turner can use photogrammetric maps to get insights into before/after conditions for a site and to capture the 3D orientation of geologic structures. For example, if



a site has been blasted and there’s concern that this might have impacted an adjacent stope, a before/after comparison using photogrammetric maps can identify how rocks have moved and shifted and help guide decision making about how to proceed. The 3D orientations of geological structures can be used to complete stability analyses for the site to determine if any of the material will deform and possibly fail.

Inspectors can click specific points within these photogrammetric models to see the original images and look for geological features. If there is a fracture in the rocks that an inspector would like to see up close to determine whether it might crack further, he can click that point on the map and look at a detailed photograph of the area in question. Using the 3D photogrammetric models, the locations and 3D orientations of the geological features can be mapped and used for geological and engineering designs.

CONCLUSION

With the Elios 2, the Barrick Gold Corporation and Unmanned Aerial Services, Inc. can now fly into areas of mines that could not previously be accessed in a safe manner and get crucial visual data to guide their decision making.

3D photogrammetric models created with data collected by the Elios 2 will allow geology and engineering personnel at Barrick to visually complete ore control to maximize outputs from their mining efforts, and to conduct stope reconciliation and hazard identification to reduce risks. It will also help them keep their equipment and personnel safe, and potentially save millions in terms of lost production, ore dilution, and damage to equipment.

Download Pix4D photogrammetric model project

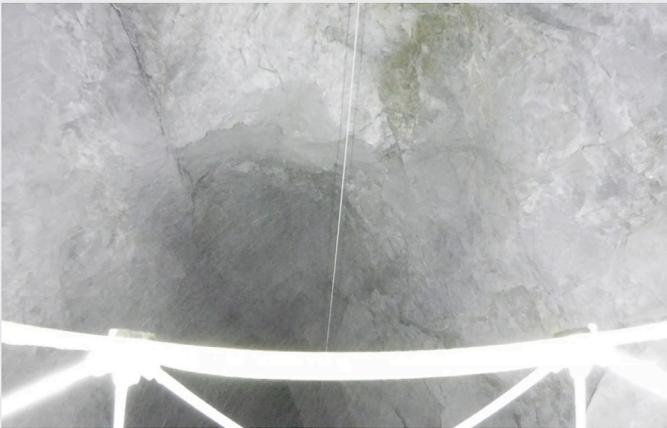
MINING PICTURES TAKEN BY ELIOS 2



Broken welding on the catwalk of a mill



Entering a ventilation raise



Inside a ventilation raise



Fault line in a stope



Fault line in a stope



Stope wall close up

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TIME – COSTS – SAFETY

Flyability builds **safe drones for the inspection of inaccessible, confined, and complex places**. Focusing on the Energy, Oil & Gas, Chemicals & Maritime industries, Flyability enables end-users to save time, costs and reduce risks during visual inspections.