

## Do you speak ‘tech’?

App, AI, blockchain, IoT, digital assistant, machine learning, robocall, malware. “I Googled that.” “She Skyped him.” “We FaceTimed the grandkids last weekend.” “He Instagrammed the whole time we were at dinner.” Let’s face it -- our vocabulary is changing before our very eyes (and ears).

Remember when you first heard the term ‘Wi-Fi’? Agreed, it would have been tougher for ‘wireless fidelity’ to catch on, but now Wi-Fi has become ubiquitous about anywhere we travel, both as a term and as a technology. It’s now even a basis for decision-making as to where we choose to spend some of our time: “What – no Wi-Fi?” “Their Wi-Fi seems as slow as dial-up to me.” “You charge for Wi-Fi? Seriously?”

For those in our industry for a few years, it may be hard to remember way back when terms like **stope**, **slusher**, **NSR**, and **berm** were new and awkward to us, but at one time they must have been.

You don’t have to be a geek to speak like a geek. The expansion of technology terms as a more sizeable piece of our daily vocabulary is just an expression of the growing reliance and integration of it into our lives, at work and at home. Think you’re not reliant on modern tech? Then you probably never left your smartphone at home when you ran errands. Soon enough these terms will normalize into our everyday lives ... just in time for the next generation of terms to be introduced.

Warning: there is some ‘tech-speak’ in the following. We do hope you enjoy and perhaps learn something from this newsletter. Thanks for reading!

Jeff Rosser (Director – Continuous Improvement), September 2017

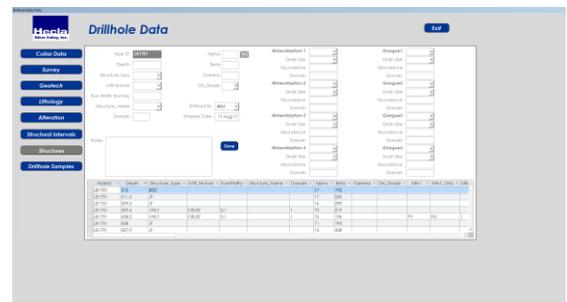


## Field Database for Exploration

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Developed in-house by Hecla staff, this project created a tool now known as Geopolis. A solution was needed to manage drillhole data within these constraints: a) a small-scale exploration project needed to generate as much helpful data as possible from the drilling, b) the drilling project needed to stay within its approved budget, c) the corporate / regional exploration team already uses powerful 3D software for geological modeling, with known capabilities for drillhole data upload, d) any new software tool introduced to help the project needed to be easy to use and support, and e) the amount of staff man-hours available to support the exploration project were limited. The need for this tool, along with the initial concept on how to build it, came from Jonathan Moore, a geologist, with an understanding that when an exploration drilling program kicks off, the clock starts, and there is a very



limited time window for viewing, understanding, learning from, and then adjusting the drilling plan (if needed) based on new data produced from drilling, such as core or rock chips, and the geologist’s initial field logging of the hole. A chance conversation led to the involvement of Gordon Radford, who brought his data management expertise and programming skills to advance and enhance the work started by Jonathan. In its current form, this platform allows for easy input of data collected in the field by the geologist, followed by data upload to the main database (where network connections exist), which can be accessed by the geological modeling software. The result is a quick turnaround of data from its time of collection

to its use within the database. This tool gives the geologist a greater understanding of the area being drilled while the program is underway and while guidance to the drilling program can still be adjusted by new interpretations of the local geology.

### **Where we are using it: Little Baldy project**

**BENEFITS:** Portability is a key feature of Geopolis, in its ability to be accessible in the field, regardless of the remoteness of the site. It also increases its flexibility for use on a variety of future projects of varying scale. Ease of use was built into the platform, making it a simple task to bring a new user up to speed quickly. This platform is a low-cost solution, a critical aspect of its development, built on smart integration of a new user interface with existing software applications. An overriding benefit of Geopolis is its efficiency, in terms of data being entered only once by the user and then made available as part of the overall database once upload is completed.

**PLAN AND PROGRESS:** The tool was developed to solve the needs associated with the Little Baldy project (located in Idaho, north of the Silver Valley). As Geopolis saw more and more use during this initial application, ideas came up on how to improve it, and these potential modifications will be considered and incorporated to make it even more effective in the future.

*Jonathan Moore and Gordon Radford, Corporate*

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## **Remote Vein Miner**

*Produced by Atlas Copco*, this project is developing a new electrically powered mechanized mining machine which uses a large diameter rotating cutter head to fracture rock and direct it onto a conveyor belt where it is handled at the back end of the machine.



### **Where we are considering it: Lucky Friday**

**BENEFITS:** The remote vein miner will help move miners farther back from the working face. It would also eliminate the need for drilling and blasting to excavate the rock it moves, and the current design also has its own onboard rock-bolting system. The remote mechanical miner concept will allow for an improved mining geometry and mining method that will increase ground stability while increasing productivity.

**UPDATED PLAN AND PROGRESS:** Hecla and Atlas Copco have continued to discuss and improve the design of the miner. Testing was done by Colorado School of Mines this summer to evaluate the cutter performance on large rock sample blocks from the mine, and the results are very encouraging. An update to the business case is nearly complete. The project economics will be evaluated during the budget review process in October. If it's a go, Hecla would need to commit in Q4 to spending money on some long-lead components. If the project proceeds, the current timeline puts the first vein miner underground at Lucky Friday for a field trial in early 2020.

*Ralph Barker, Corporate*

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*“The remote mechanical miner concept will allow for an improved mining geometry and mining method that will increase ground stability.”*

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## **Bioleaching**

*Produced by Outotec*, bioleaching uses specially selected and cultured microorganisms (bacteria) to help break down refractory (encapsulating sulfide or organic carbon) minerals in which the desired metals are locked up. This approach is much different from current industry processes that use high temperature and/or high pressure to oxidize these rocks in a much shorter time than could be done by nature.

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*“This technology requires less capital expense...”*

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### **Corporate evaluation for Hosco project, possibly others**

**BENEFITS:** BIOX technology, particularly compared to autoclaves or roasters, requires less capital expense, operates in a variety of climates, requires a low-level skillset to keep it running, requires less money to operate the plant, is less complex to permit, and produces gold at reasonable recovery rates. This process can also allow non-desired materials, such as arsenic, to remain locked up in the rock, making them less able to react after processing.

**UPDATED PLAN AND PROGRESS:** The vendor is currently continuing with test work for Hecla. Recent results show promise.

*Dale Dean, Corporate*



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### **Remote Monitoring of Mobile Equipment**

Sold by Newtrax (ISAAC Instruments mining products), this system allows for onboard data collection and storage of selected machine operating parameters. Each equipped machine, such as a haul truck, loader, drill, etc., has the capability to transmit the data wirelessly to a receiving network which is connected to a central monitoring system with a database. Currently, Casa Berardi periodically downloads machine information manually, about every 3-4 weeks, when the machine receives its regular preventive maintenance. The manually downloaded information is helpful, but it would have more value if it could be accessed more often and more easily, and if it could be automatically reviewed in context with historical data and compared to desired operating ranges.



#### **Where we are considering using it: Casa Berardi (underground)**

**BENEFITS:** Remote monitoring systems provide benefits in multiple dimensions, including machine health, fleet management, operating practices, and other aspects. In terms of machine health, data such as engine oil pressure and engine exhaust temperature can be collected and automatically compared to desired thresholds for performance, identifying possible issues before they become more serious and cause downtime and component damage. Fleet management assistance comes from data collected in the form of 'events' logged by the onboard system. Each event is logged by date and time with readings taken at that moment of specified machine parameters. Time segments can be categorized by summing up the various events, allowing for easier access to real-time status and calculation of business metrics like availability and utilization. Operating practices can be better identified by continuous tracking of machine data while the machine is in use, as it creates records of performance data such as vehicle speed, brake applications, transmission gears used, etc. The bottom-line outcomes from these contributing benefits will include longer component life, higher machine reliability, and lower operating and maintenance costs.

**PLAN AND PROGRESS:** Casa Berardi evaluated potential systems in discussions with multiple vendors. The ISAAC system was selected for field trial underground for a 2-week period that ended in August. In the field trial, one loader and one haul truck were equipped with the system. The test generated much helpful data, and upon review, the CB team has developed an AFE to request funding to purchase 23 systems. It is possible that the machines will be equipped with the new systems by the end of 2017.

*Etienne Jegou, Casa Berardi*

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## Automated Truck Haulage

*Produced by Sandvik*, this technology is an integrated system for remote control and remote supervision of truck haulage activities. The system being installed is called AutoMine (like the tele-remote mucker at Greens Creek), using wireless communication, onboard cameras and a navigation system to keep track of and control unmanned haul trucks. Haulage routes are isolated with barriers to ensure no interactions with personnel or other machines. The truck operator is based remotely, in an office, where a duplicate set of machine controls allow the operator to intervene in truck operation as needed and to operate other remote controls for rock breakers, loading chutes, etc.

### *Where we will be using it: initially at Casa Berardi*

**BENEFITS:** This technology allows continued cycling of haulage trucks with minimal interruption of operation. Time gained by use of unmanned trucks includes that which would otherwise be lost while operators travel to and from the workplace at the ends of shifts as well as time which would be nonproductive during lunch and other breaks. This technology removes operators from the workplace allowing one remote operator to run up to three machines.

**UPDATED PLAN AND PROGRESS:** The Casa Berardi system is nearly complete in its construction phase, with the communication connections and automation controls now being finished on the last two chutes underground. The new mine operations control room awaits the installation of the remote operator's station. The first of two new 40-t haul trucks is on-site (see photo). The system should have its first truck operating autonomously in the 985 drift in November 2017.

*Dave Descoteaux, Casa Berardi*



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## Tele-Remote Mucker

*Produced by Sandvik*, this technology is an integrated system for remote control and remote supervision of loader activities. The system installed is called AutoMine Lite. It uses wireless communication and an onboard cameras / navigation system based on lidar (like radar, but using light rays to sense its surroundings instead of radio waves) to keep track of and control unmanned loaders. The loader operator is based remotely, in an office, where a duplicate set of machine controls allow the operator to intervene in loader operation as needed.

### *Where we are using it: Greens Creek*

**BENEFITS:** One of the biggest benefits of tele-remote mucking is that it will do work in its assigned location while miners are in transit, away from the workplace near the end and start of shift. Getting the mucking done in these 'between shift' periods allows the mining cycle to continue with little interruption, with the miner able to get back to work more quickly breaking more rock. Over time, this will increase the average feet of mining advance achieved per day. The technology will enable one operator at the control station to operate up to three remote muckers; one mucker is in use currently.

**UPDATED PLAN AND PROGRESS:** The Greens Creek mining operation is becoming more and more familiar with the new system and is focused on integrating the tele-remote mucker into its daily mine plan. Targets have been set for the system's usage. The system's backbone, the underground communications network with its many wireless access points, continues to be expanded into additional areas of the mine to support the future deployment of the system per the mine plan. Additional training is being provided in Q3 to technical services team members to give knowledge and skills for adding new travel routes for the tele-remote mucker into its database.

*Bob Weeden, Greens Creek*



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## **Drones**

*Produced by multiple manufacturers.* In the past, the approach to an activity such as determining the amount of material mined from an open pit or delivered to a stockpile or waste dump, etc., generally measured at the end of a month, was by means of a systematic, often tedious, point-by-point collection of location coordinates of selected surface features by surveyors on the ground. Mainstream adoption of GPS technology by mine surveying 20+ years ago made the work less burdensome, but it remained a chore. Infrequent volume calculations involving large areas can be done routinely, at a cost, by aerial photogrammetry, using high-resolution cameras capturing images from airplanes flying programmed routes over target areas.



In today's world, drones have come into use in a variety of industries, including mining. A remotely operated drone's ability to view from a helpful vantage point and collect data about a subject it can 'see' is useful for a mine to have. The drones in use are fitted with a digital camera which can be programmed to collect images of target objects. Real examples of this type of use in Hecla include overflight of ore stockpiles to calculate their contained tonnages, overflight of tailings dam expansions under construction to assess level of completeness vs. design, overflight of impoundments to assess their current level of filled vs. unfilled capacity (see photo from San Sebastian), and other applications. Not yet a use within Hecla, but one that has some examples in the industry, is the use of a drone underground. A fixed camera underground can be helpful to a degree, but a drone can provide video footage from a range of beneficial viewpoints for certain purposes – if you can keep it from crashing into countless obstacles and you have enough light to illuminate what you need to see.

***Where we are using them: San Sebastian (open pit), Casa Berardi (open pit), Lucky Friday (surface work)***

**BENEFITS:** These tasks of collecting volume data, providing regular or intermittent surveillance or status checks, whether large or small in scale, can now be accomplished by airborne camera-equipped drones whose resulting images can be downloaded and location-referenced to existing survey data with resulting meaningful data as outputs. Drones with the ability to be remotely operated as well as pre-programmed, along with the usefulness of accompanying software that translates images into geo-located 3-D surfaces for computation of volumes, will help accomplish future projects that, in the past, have tied up an inordinate amount of surveying and engineering time. Drones will allow for additional data to be collected, more often, with higher accuracy, providing cost savings and allowing man-hours to be devoted to other priority projects.

**PLAN AND PROGRESS:** The use of drones at Hecla mines, and Hecla projects that may become mines, will continue, with their expanded application certain as confidence is gained from their use over time. A future issue of this newsletter will contain a feature article on drone use in Hecla.

*Alberto Ramos, San Sebastian; Gabriel Caya, Casa Berardi; Wes Johnson, Lucky Friday*

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## Coming Up / Contact

*Please direct any corrections for this issue and suggestions for future issues or other feedback related to technological innovation in Hecla to Jeff Rosser at the Coeur d'Alene Corporate office at 208.769.4100.*



*Don't feel left out.* This is the second issue of this newsletter and we plan to create and issue a new one in the middle month of each quarter: February, May, August, and November. Although we would like to mention every single one of the company's technology projects within each issue, the newsletter would be too long and would take too much of your time to read. Our list of topics for upcoming issues remains a long one, with updates on projects like Casa Berardi – mine operations control center, Greens Creek – ruggedized underground tablets, Lucky Friday – guided haul truck control, San Sebastian – drone use for aerial mapping, Greens Creek – paperless pre-shift inspections, what does it take to make a 'wireless' underground mine, and more. Future issues will include articles on projects underway or upcoming in direct operations as well as support functions throughout Hecla.

*Thank you and acknowledgments.* I would like to thank all the project key contacts whom I have pestered (and will continue to pester for future updates) for their time in gathering and sharing information on their projects. We will be in touch – keep up the wonderful work in advancing these valuable tech projects!

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*Hecla Mining Company is not only the largest and one of the lowest-cost U.S. silver producers, and the third largest U.S. producer of both zinc and lead, but also a growing gold producer. Hecla owns and operates four mines on district-sized land packages in mining-friendly North American jurisdictions: Greens Creek in Alaska, one of the largest and highest-margin primary silver mines in the world; the newly revitalized Lucky Friday silver mine in North Idaho; the San Sebastian silver-gold mine near Durango, Mexico; and the Casa Berardi gold mine in Quebec. In addition to its diversified silver and gold operating and cash-flow generating base, Hecla has a number of exploration properties and pre-development projects in seven world-class silver and gold mining districts in the U.S., Canada, and Mexico.*

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### Cautionary Statements Regarding Forward Looking Statements

Statements made or information provided in this newsletter that are not historical facts are "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995 and "forward-looking information" within the meaning of Canadian securities laws. Words such as "may", "will", "should", "expects", "intends", "projects", "believes", "estimates", "targets", "anticipates" and similar expressions are used to identify these forward-looking statements. Such forward-looking statements or forward-looking information include statements or information regarding estimates of silver production for 2017 on a consolidated basis and at each of the Greens Creek, Lucky Friday and San Sebastian mines, annual gold production for 2017 at Casa Berardi, and second quarter 2017 production. Other forward-looking statements include timing and expected benefits of implementing various innovations. The material factors or assumptions used to develop such forward-looking statements or forward-looking information include that the Company's plans for development and production will proceed as expected and will not require revision as a result of risks or uncertainties, whether known, unknown or unanticipated, to which the Company's operations are subject. Forward-looking statements involve a number of risks and uncertainties that could cause actual results to differ materially from those projected, anticipated, expected or implied. These risks and uncertainties include, but are not limited to, metals price volatility, volatility of metals production and costs, litigation, regulatory and environmental risks, operating risks, project development risks, political risks, labor issues, ability to raise financing and exploration risks and results. Refer to the Company's Form 10K and 10-Q reports for a more detailed discussion of factors that may impact expected future results. The Company undertakes no obligation and has no intention of updating forward-looking statements other than as may be required by law.