How Emerging Digital and Geoscience Technologies are Revolutionizing Mining by Enabling ‘Differential Blasting’

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Technologies are Revolutionizing Mining by Enabling ‘Differential Blasting’

As the global economy shifts to renewable energy, increasing electrification of transportation and battery storage, demand for base metals will drive mining to new levels of demand and ultimately growth. Studies predict strong demand for open-cast mined metals such as Copper, Nickel, Zinc, Cobalt, and Lithium. This demand for these metals is expected to far outweigh the ongoing reduction in thermal Coal production.

But, efficiently meeting this demand – and capitalizing on the enormous growth potential in the global mining industry – will not be a slam-dunk for mine operators. Studies show that the mining industry has seen productivity steadily decline since 1999. At the same time, mining companies have largely failed to leverage the dramatic advances in emerging digital technology and artificial intelligence (AI) to improve their processes, productivity, or profits.

For mining companies, this opportunity comes from leveraging powerful new technologies to visualize the subsurface, and understand their benches. Because while geologic knowledge exists, detailed subsurface insights have not been timely enough to improve drilling and blasting outcomes. Of the entire mine production process, improving these drill and blast operations offers the highest value creation opportunity for the mining industry on a global basis.

This white paper examines the breakthrough technologies, deep industry experience and fresh new thinking and that DataCloud has brought together to enable mining companies to address these challenges and fully capitalize on the industry’s emerging growth opportunities.

Combining World-Class Technology and Mining Industry Expertise

DataCloud has assembled a best-in-class group of experts from the technology industry and top-tier institutions such as UC Berkeley, Cambridge and Stanford, who have deep expertise in geoscience and blast-wave analysis. By bringing together leaders in both mining and technology, we are solving many of the problems that have challenged the mining industry for decades.

First among those mining industry challenges is improving drill and blast outcomes. This represents the highest value creation opportunity for mining operators. To help mining companies solve these challenges and capitalize on the huge opportunities, DataCloud has built real-time geoscience solutions that provide the subsurface characterization data required to optimize differential blasting plans. These DataCloud geoscience solutions are based on advanced digital and artificial intelligence technologies such as cloud computing, neural networks, machine learning, advanced visualization, and IoT sensor systems.
Fragmentation Optimization: Key Driver of DataCloud’s Technology

A key driver of DataCloud’s breakthrough technology solutions is the concept of fragmentation optimization. The fragmentation optimization approach offers radical improvements in mine productivity and profitability through fragmentation optimization. With fragmentation optimization, ore bodies are blasted in such a way that the ore itself is finely fragmented while waste material is coarsely fragmented, allowing for efficient, simple size sorting. Fragmentation optimization is a specific solution for lower grade mining operations, however all mines can benefit from this fragmentation optimization. Reducing the fragment size variance can improve “digability,” reduce secondary breakage, and increase mill throughput.

The most critical element of fragmentation profile optimization is differential blasting. Studies show mine NPV can be increased by almost 10% by differential blasting alone. In differential blasting, blast-hole burden and spacing are configured based on a pre-drill geologic model of the bench, which is developed from appraisal holes and enhanced using a proprietary, patented geophysical imaging technology designed specifically for mine bench characterization. While the blast-holes are being drilled, DataCloud collects high resolution SWD (Seismic While Drilling) and formation imaging data. This data is integrated with MWD (Measurement While Drilling) data in real-time to create a high resolution, centimeter scale geologic and mechanical model of the bench. Using this model the blast engineer can estimate spatially variable fragmentation distribution and optimization results for different blast parameters.

DataCloud has also developed a proprietary blast design module that solves for the vertical distribution of explosive energy, detonation velocity, and stemming/spacing parameters for each drill-hole as a function of depth.

Fragmentation optimization is a game-changer for mining companies that today face myriad challenges, including declining mine productivity and global competition. DataCloud is leading the way in leveraging its breakthrough geoscience technology to help its mining clients to improve productivity, profitability and safety, while lessening the environmental impact of their operations.

Fragmentation optimization is at the core of how DataCloud is helping its clients to master the subsurface and “Know the Rock.”

Please contact us to learn more.
Sensors to Characterize the Bench
DataCloud’s technology team is based in Silicon Valley, right in the heart of the latest advances in innovative digital technology, including sensors. These new sensors are essential to DataCloud’s advanced mining technology solutions. Historically, high quality, precise measurements were expensive and slow, interrupting the mining process and requiring additional specialized crews at the mine. DataCloud sensors are designed with the following guiding principles:

> **Keep off the critical path**; all measurements are made without slowing down or stopping the mining process.
> **Don’t add people to the bench**; DataCloud’s sensors are either autonomous or can be deployed by staff doing existing tasks on the bench
> **Use the latest generation of sensor technology**; wherever possible we use the same technology as your smart phone – cheaper, smaller and faster!

Cutting-Edge Solutions That Drive Significant Value, in Real-Time
DataCloud has developed breakthrough geosciences technology solutions that enable mining operators to maximize data measurement and analytics, and subsurface visualization, delivering a radical improvement in drill and blast productivity. Our exclusive suite of geosciences-related solutions includes:

**MinePortal (“Earth Model” Geoscience Data Platform)**
The MinePortal is a real-time “Earth Model” platform for real-time management and analyzing of the geosciences data generated by DataCloud’s sensor, measurement and seismic technologies. This **cloud-based platform allows for integration of the exploration drill data, block models, and latest grade control measures** into a single seamless cloud based platform with an intuitive user interface. It can be accessed from a browser or mobile devices. By analyzing all of this critical data in real-time, the mine operator can make better, faster drilling and blasting decisions that materially improve productivity.

**RHINO™ SWD (Geoscience IoT Logging Tool)**
DataCloud’s RHINO™ seismic-while-drilling (SWD) logging tool is an Internet of Things (IoT) sensor package that measures a variety of previously unavailable rock properties in real-time. RHINO™ sensors are deployed on drills and collect these measurements along every 1-centimeter of drilled blast hole, far exceeding the resolution possible with conventional MWD technology. Blast-critical subsurface information measured by this revolutionary tool includes uniaxial compressive strength, density, and numerous acoustic properties. Such high resolution information also enables accurate detection of faults, fractures, and joint spacing, in addition to many grade indicators and direct ore measurements. The compact RHINO™ sensor package can be installed in minutes and is configured to be “plug and play” ready within DataCloud’s MinePortal™ platform. By providing such high definition rock mass properties in real-time, the RHINO™ IoT sensors enable intelligent blast design, and improve fragmentation and ore body definition, in profound ways that have not previously been available to the mining industry.

**DigitalGeology™ (3-D Image Interpretation of Blast Critical Rock Features)**
Datacloud’s new DigitalGeology™ solution is a turnkey image processing
and interpretation suite that provides mine site geologists and engineers an intuitive method of understanding fracture networks and block size distributions in their rock. It makes use of powerful cloud computing capabilities, sophisticated processing algorithms, and artificial intelligence to quantify key geological parameters and optimize blast planning. DigitalGeology™ identifies fractures, joint sets, spacing, and discontinuity distributions, all of which together make it possible to tailor burden and spacing to actual rock properties, rather than assuming a consistent, uniform grid for blast hole patterns. From third-party or DataCloud collected image data, DigitalGeology™ enables you to develop a complete 3D joint and spacing model in a defined study area and predict how a blast pattern will respond to explosive energy and detonation sequencing.

**RockMaster SWI (Surface Wave Imaging)**

To optimize blast-hole configuration, DataCloud offers its Surface Wave Imaging (SWI) solution. SWI seismic techniques can quickly and efficiently provide a shear velocity image of the bench prior to drilling. Shear wave velocity can be used to directly calculate optimum blast hole spacing to help ensure a desired fragmentation profile is delivered. Passive seismic sensors used for SWI can also be used for blast vibration monitoring to develop better peak particle velocity (PPV) calculations for future blast design. This technology is also well suited to imaging subsurface voids such as karsts and old workings, thereby eliminating the need for expensive proof drilling operations.

**RockMaster BHI (Blast Hole Imaging)**

Another DataCloud proprietary technology solution involves the digital imaging of blast holes during the traditional “dipping” process. Without adding additional tasks, our Blast Hole Imaging (BHI) solution captures high resolution, oriented 360° blast hole images, and analyzes the images to identify joint (fracture) density, block size, orientation and dip, which are used as direct inputs to “blastability” indexes. These measurements take advantage of the dramatic improvements in the size, cost and reliability of today’s wireless sensors.

Sensors are deployed autonomously and are enabled by the latest IoT protocols. Compared to what has previously existed in the industry, these new imaging sensors can be equated to upgrading a 1990’s cell phone to the latest smartphone technology.
Owning the Future

Given the growing demand, and emergence of innovative technologies that enable mining companies to fulfill that demand, the future is now for the global mining industry. DataCloud is committed to creating powerful new geoscience technologies and leveraging breakthrough blasting techniques that empower mine operators to fully capitalize on these historic growth opportunities.

DataCloud helps operators conduct the cleanest, most efficient mineral extraction possible, dramatically improving mine performance and productivity. Crucially, this also reduces the environmental impact of mining operations and improves safety. By mastering the subsurface, DataCloud enables mining companies to transform their economics and own the future.

About DataCloud

Founded in 2016, DataCloud builds advanced technology solutions that help mining companies to master the subsurface so they can transform their economics and own the future. DataCloud enables mining operators to make better, more profitable decisions – faster. Our integrated technology and analytics platform enables mining companies to process massive volumes of drilling and geosciences data and create real-time, actionable insights that dramatically improve their processes, performance and productivity. DataCloud’s mission: Keep our clients ahead of the game – and the competition. DataCloud is committed to helping you lessen your environmental impact, while minimizing risk, improving compliance and increasing safety. With DataCloud, you can maximize your production goals and make real gains on the environmental and safety fronts. For more information, visit www.DataCloud.com.
About the Author
Daniel Palmer is the Chief Operating Officer of DataCloud. Daniel spent over 20 years working for Schlumberger across the globe in a wide range of roles, including operations, management, strategy and sales and marketing. Daniel’s deep expertise in oilfield technology and subsurface resource characterization is instrumental in helping DataCloud design the disruptive, cutting edge and efficient software tools the company is building for its mining clients.