# THE EXPLORATION ISSUE

THE ***WHAT, HOW, AND WHY*** BEHIND OUR ***DRIVE TO DISCOVER***

## IN THIS ISSUE



# EXPLORE & DISCOVER


QUARTERLY NEWSLETTER • ISSUE NO. 6

# BIG ROCK EXPLORATION

We are an international technical consulting company based out of Minneapolis, Minnesota, focused on identifying, exploring and evaluating natural resources.

*METALS ▲ MINERALS ▲ ENERGY*

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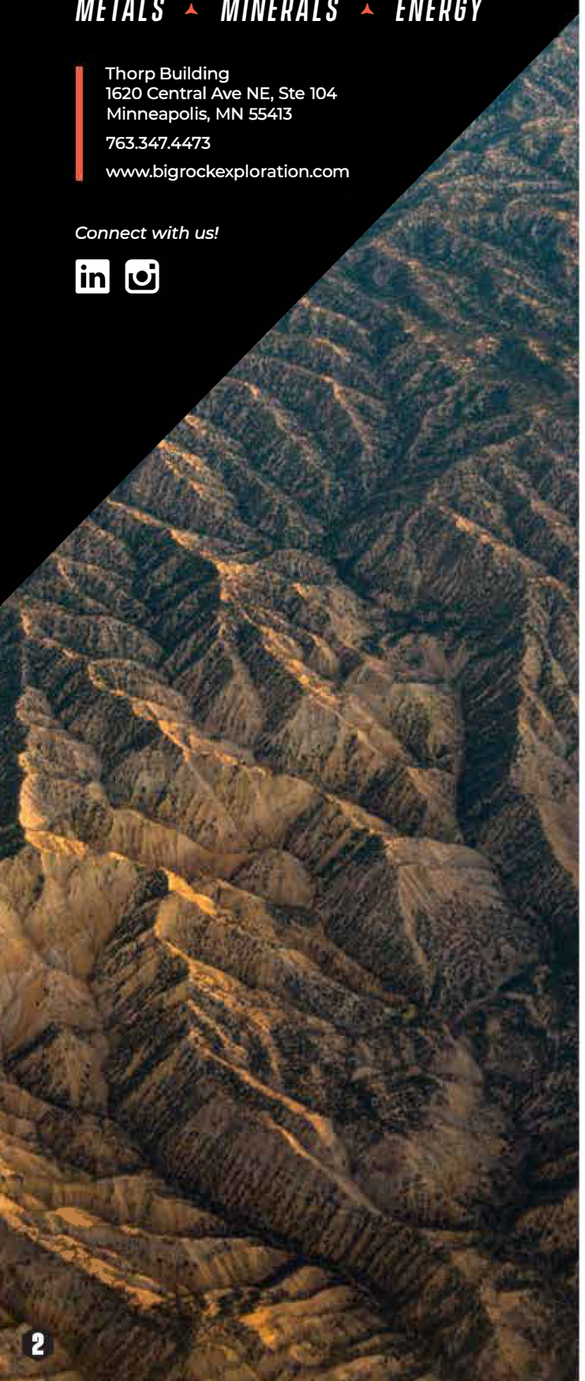
*Connect with us!*





FEATURES



# (*FUN*)DAMENTALS!

## *Summer Brings Welcome Return To Field Geology Projects*

BRANDON ISAKSON
Director of Operations

This is always an exciting time of year for Big Rock. Although the winter months provide ideal conditions for many of our clients' drilling programs, summer is undoubtedly the peak season for field geology work such as mapping and sampling. As the melting snow exposes outcrops and provides better access to field areas, Big Rock is ready to put lots of boots on the ground.

In the busy season ahead, we'll have over 30 technical staff deployed in the field on at least 13 active programs. Our footprint this summer will span a dozen states and provinces, and in the process the team will collectively cover some 55,000 miles of travel in a few short months. Office hours will be sparse and that's just the way we like it. After months of planning, we're looking forward to getting in the field and helping our clients ***explore and discover.***

Cheers,

## NORTH AMERICAN FOOTPRINT

*Keep Up With Just A Few Of Our Staff On June Projects*


**ROGER SCHULZ**
Sr. Data Manager
Hermiston, OR

**LIZ ROEPKE**
Project Geologist
Hibbing, MN

**LEIF JOHNSON**
Senior Geologist
Denver, CO

QUARTERLY
# KUDOS!


GOLD SPONSOR
April 15-17, 2019

READ MORE

APRIL ROCKSTAR
Geologist Marcus Larson

MEET MARCUS

PHOTO OF THE MONTH
Mike Harrigan, Project Geologist

VIEW PHOTO

# GRASSROOTS EXPLORATION:

## *The Art And Science Of Effective Field Geology*

For grassroots exploration programs, the main goal is to identify discrete areas of interest (AOI) with the intent of developing specific drilling targets. Extensive preliminary research is conducted utilizing a variety of sources and methods such as geodatabase compilation of publicly available data, airborne geophysics data, satellite imagery, and identifying other regional AOI based on selective lithologies, structures, alteration types, and other possible mineralization indicators.

Sometimes previous mapping, mining, or exploration efforts can provide clues as to where to begin targeting, but our geologists are encouraged to think independently and "outside the box" to avoid overlooking mineralization indicators that may have been previously missed (or misinterpreted) by other groups. This objective approach is essential to adhering to the scientific method and avoiding common pitfalls in exploration tactics.

When first on the ground, the mapping geologists perform regional reconnaissance mapping and sampling. During this phase, the mapping crews will systematically cover large areas of land. They will sample and document specific lithologies, structures, alteration types, or other areas of possible mineralization, based on preliminary research. However, they will attempt to map and sample throughout all rock types in an effort to develop an unbiased and robust data set with expansive and balanced geographical coverage, including samples that will ultimately provide "background" data.

After blanketing a region with mapping data, the geologists can begin to piece together general geological interpretations and observations. Once sample assay data starts coming back from the labs, the geologists can begin to identify anomalous geochemical signatures and can develop localized AOIs for follow-up investigation. Once discrete localized AOIs are developed, the geologists will return and perform higher-density sampling in conjunction with higher-resolution, detailed mapping.

*" Our geologists are encouraged to think independently and outside the box to avoid overlooking mineralization indicators that may have been previously missed or misinterpreted. "*

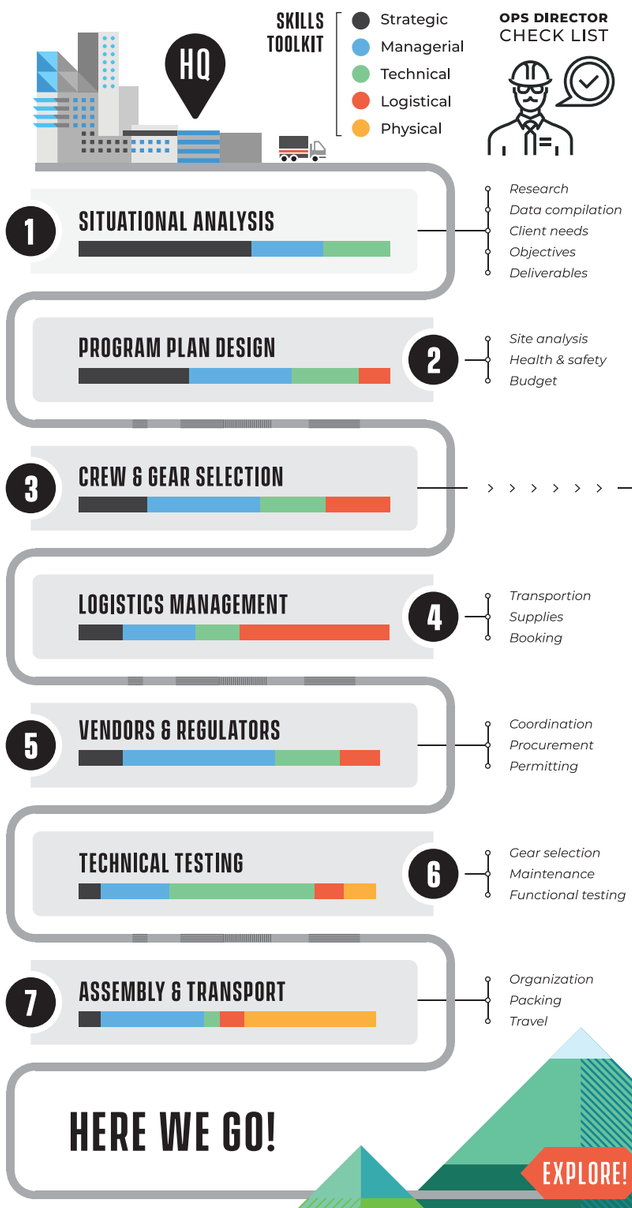
- Brandon Isakson



# MAESTRO OF MOBILITY

In order to execute a successful and efficient exploration program, the Director of Operations must not only be a technical expert, but also a logistical master. Planning, organizing, and moving 16,000 pounds of personnel, supplies, and highly sensitive equipment over thousands of miles from headquarters to remote wilderness job sites is a thing of beauty when executed to precision.

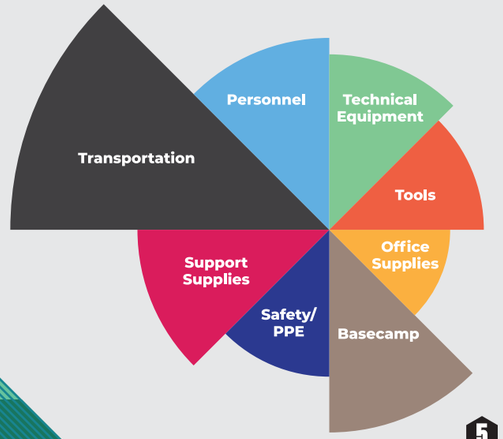
## THE OPERATIONS ORCHESTRATION





## OUTFITTING A FIELD PROGRAM

What Does 16,000 Pounds Of Gear Look Like?



# MINERALS IN THE MIDDLE:

## *U.S., China, And A New Techonomic Cold War?*

BRIAN LENTZ
Vice President

As yet another round of retaliatory tariffs go into effect, the escalating trade war between the U.S. and China is showing no signs of cooling off. The current clash of economic superpowers is a fight for position as the 21st century's epicenter of innovation and global producer of emergent technologies.

Where once the U.S. and China sought a win-win relationship, first-mover advantage in the impending revolution of disruptive technologies like 5G has created a mutually-exclusive endgame with a clear winner and loser. Ceding intellectual supremacy and the right to determine the course of the next century is seen as an unacceptable outcome for each side and therefore undercuts the perceived benefits of cooperation.

Whether looking at China's trillion-dollar Belt and Road Initiative or their consolidation of powerhouse tech companies, President Xi Jinping has sent a clear message. In the realms of big data, advanced weaponry, artificial intelligence, and renewable energy, China has ambitious plans to surpass the United States as the world's next techonomic superpower.

The race to manufacture and bring new technologies to market is dependent on the supply of resource inputs; most critically the supply of minerals. (Previously in Issue No. 5, we highlighted one micro-example of this dependence with the iPhone supply chain case study, which requires 60+ minerals to build.)

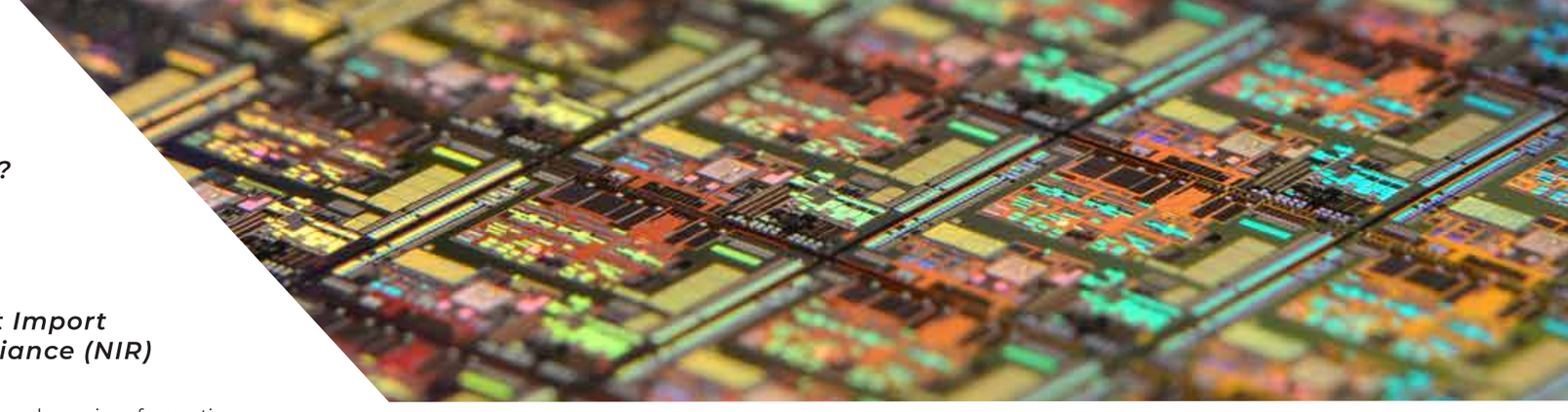
FROM THE BLOG:

### MINERALS ARE THE FUTURE

Examine the iPhone supply chain case study & critical minerals in tech innovation

READ MORE

Unequivocally, minerals make our modern civilization and advanced economy possible. From civil to military, nearly all sectors of the U.S. economy rely on minerals. This important status no doubt makes mineral supplies a foreign policy issue around the world since no single country can domestically supply all of the mineral resources it needs.



### KEY TERM | *Net Import Reliance (NIR)*

The term that describes the dynamic of meeting domestic resource demands through foreign supply is called **net import reliance** (NIR). It measures how much of a country's domestic consumption is fulfilled through imports.

Historically the United States imports its minerals from many countries so it isn't fully reliant on a single country for a mineral resource. However of our major import sources, China is the single largest supplier of mineral commodities for the United States, particularly for those required in all of the advanced technologies previously mentioned.

### U.S. NIR | BY THE NUMBERS

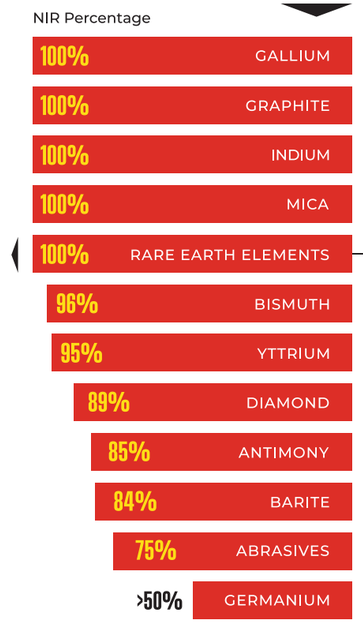
Of the commodities that have a high net import reliance (>50% imported), ***12 of the 26 minerals*** on the list are sourced primarily from China:

CHINA'S GRIP ON RARE EARTHS

**81 PERCENT**
China's share of global REEs production (2018)

**500 PERCENT**
Cost of REEs processing in China over the past 3 decades

NIR Percentage



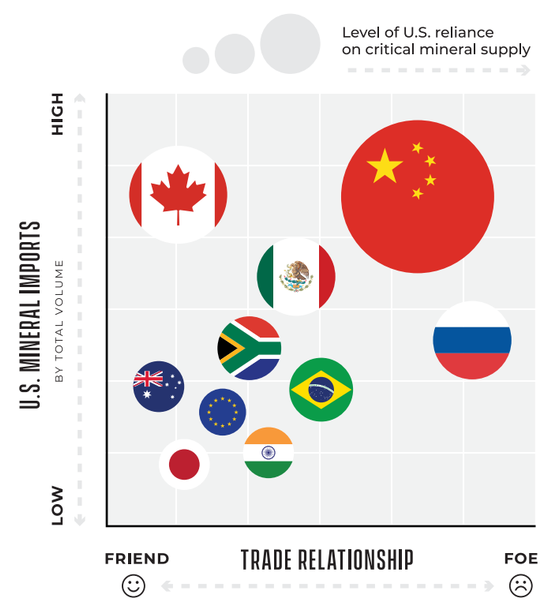

## NIR: A POTENTIAL HEADWIND TO GROWTH & INNOVATION

The NIR dynamic is not unique to just the U.S.. Many other countries are subject to similar constraints of foreign reliance on mineral supply. The European Union, Australia, Japan and others are dealing with NIR challenges. China and the U.S. might be grabbing the media headlines, but the effects are more far reaching than simply a U.S. problem.

The U.S. government has already begun enacting countermeasures to secure reliable supplies from more cooperative partners and increase domestic production of high NIR critical minerals, including Cobalt and REEs. The dynamic geopolitical climate all but forces a more assertive and proactive effort through policy and private capital investment to meet a much larger portion of our domestic needs without heavy reliance on imports; especially those vital to the future innovation.

### HIGH N.I.R. : NOT JUST A RARE EARTH PROBLEM

In 2018, imports made up more than ½ of the U.S. consumption for 48 nonfuel mineral commodities, and the U.S. was 100% net import reliant on 18. Of those, 14 of the 18 were critical minerals.




### KEY U.S. TECH PRODUCERS

with high REEs supply needs

**APPLE**
**Market cap: $827 B**
- Electronics
- Rechargeable batteries

**BOEING**
**Market cap: $197 B**
- Aerospace
- Defense systems
- Commerical aviation

**GENERAL ELECTRIC**
**Market cap: $83 B**
- Renewable energy
- LED lights
- Laser imaging

**SPACE X**
**Valuation: $35 B**
- Advanced rocketry
- Space travel
- Satellite systems

ECONOMIC VALUE OF JUST 4 U.S. FIRMS:
**$1.2 TRILLION**

# EXPLORATORY DRILLING

## EXPLAINED: *What It Is & How It Works In Practice*

Developing an exploration program is a long and time-intensive process with many steps prior to any drilling. After a grassroots exploration program has been conducted with extensive research of geophysics, geochemistry, and surface mapping, there is still a small chance the explorer will have identified a viable target (AOI). In the rare case of finding positive mineralization indicators and potential for a deposit, the next step of the exploration team is to sample the subsurface targets at depth using exploratory core drilling.

With proper land access from the surface owner and permitting from state and federal regulators in place, the exploration team will implement a drilling plan and budget to drill for core samples. Core drilling is done in the later phase of exploration because it is the most expensive step of the operation and therefore only used when there is adequate potential of mineralization.

This direct method uses a diamond core drill bit composed of industrial diamonds that allow it to cut through rock and collect a continuous cylinder of rock core 2-5 inches in diameter. The average depth of an exploration drill hole targeting nonferrous metallic minerals is approximately 1,000 feet, but varies dependent on the geography of the mineral deposit being targeted.

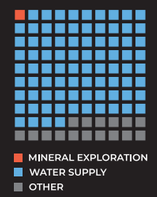
Core drilling is an exercise in technical precision. An exploration team can usually hit 1,000 feet of depth in less than two weeks of drilling time, but sampling may require multiple drill holes depending on the target potential and program budget. Once boring is complete, site reclamation takes place to fill drill holes with local soil materials and clays to return the site to it's natural state with only minor, temporary impacts.

The core is then described in detail and chemically assayed to measure the metal content in the rock. If signs of mineralization are favorable, further drilling will likely follow in order to more thoroughly evaluate the extent and grade of mineralization.

## BIG ROCK'S BOTTOM LINE

Exploration that leads to discovery takes innovative thinking and operational excellence. Big Rock enables our clients' success by providing exceptional value through tailored, turn-key service applying the highest level of technical expertise in the most cost-effective package.

# MN EXPLORATION BY THE NUMBERS




### A TINY FOOTPRINT:

Mineral exploration drill holes make up less than 1% of all drilling in the state.


### SETTING A HIGH BAR:

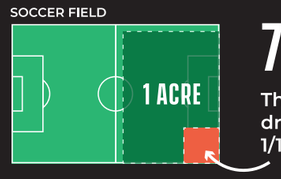
Based on over 50 years of exploration data, only 2.2% of all leased state parcels had drilling completed on them.

**99** PERCENT

### VERY LONG ODDS:

99% of state leases were terminated after 10 years because no discoveries were made.

SOCCER FIELD




### 70' x 70'

The average size of a drill pad is approximately 1/10 of an acre.

### AN OPERATION *WITH* MANY CRITICAL PARTS!

It costs an estimated $100,000 to drill 1,000 feet of drill core ($100 per/ft).

A drilling program costs may include:

- Geologist
- Site selection
- Geophysics
- Labor
- Drilling



MEET TEAM BIG ROCK

# BEN KEUTE | PROJECT GEOLOGIST

**Hometown**: Blaine, MN | **BS in Geology** - Winona State University, '13

FIELD MAPPING | CORE LOGGING | DATA & REPORTS

HOW I BECAME A *GEO*

I've had a love for the outdoors since childhood so I pursued a career that wouldn't keep me stuck behind a desk. At Winona State University I took my first minerology class and immediately got hooked on geoscience. My professional field experience started with major projects in South Dakota's Black Hills determining the deformation style of Proterozoic rocks, and in Southeastern Minnesota performing rock mass rating for sedimentary rocks used in engineering buildings, structures, and mines.

"I DON'T CARE WHAT THE MODEL IS... *I'M FINDING* **GOLD.**"

- BEN KEUTE

FAVORITE PROJECT

## SASKATCHEWAN, CA

58.446°N 108.332°W
**100,000** square kilometers
*'Canadian Shield'*

ATHABASCA BASIN

*FAST* **FACT:** Athabasca Basin currently supplies **20%** of global uranium

FAVORITE HOBBIES WHEN I'M NOT STUDYING ROCKS:

WOOD WORKING | BEER | ROAD TRIPS | SCUBA DIVING

GET IN TOUCH:

ben@bigrockexploration.com
Ben Keute

# SAFETY KNOWS NO SEASON

*Why Sustainability Strategy Should Start With Your Most Vital Resource: Human Capital*

ROB BERGMANN
President

When most people think about the term sustainability, environmental issues like carbon footprint, global warming, and biodiversity loss may come to mind. However, sustainability is about more than 'being green'. It is an increasingly important business strategy that seeks to responsibly balance the needs of people, planet, and profit to achieve long-term success and viability.

No matter an organization's size or measurable impacts, they cannot be sustainable without protecting the safety, health, and well-being of their most vital resource: their workers. Currently workplace health and safety are often acknowledged as a regulatory compliance matter of day-to-day operations, but rarely integrated into a proactive plan for managing risks and improving overall business performance into the future.

By demonstrating a stronger commitment to their human capital, businesses can reduce worker illnesses, injuries and fatalities that lead to numerous costs and residual negative impacts. In turn, worker engagement and satisfaction have been shown to increase due to active participation and cultivation of a culture that prioritizes their well-being. Studies have also shown that engaged employees leads to less turnover, increased productivity, higher work quality, and improved recruitment - all of which have a substantial positive impact on the bottom line.

Big Rock has been an innovator and leader in this effort by not only making safety a cornerstone value of the company, but also integrating it into long-term planning with our "Harm Free" policy. This approach starts with a commitment to continual improvement and acknowledgement that compliance is the floor not the ceiling of our effort. By involving both leadership and staff in the evaluation of policy and protocol, we've been able to identify key opportunities to refine our process over time.

## BIG ROCK: AN INDUSTRY LEADER IN SAFETY

*Benchmarks Ensure Excellence For Our Stakeholders*

HARM FREE POLICY

0 LOST TIME INCIDENTS · SINCE 2010 ·

0 HAZARDS OR CITATIONS · SINCE 2010 ·

★★★★★ m1 OSHA WORKPLACE CERTIFIED 2019

## (UN)SAFE IN THE U.S.A.

**5,147**

workers died on the job in 2017 (all industries combined)

**$200B**

Total economic costs of workplace illnesses, injuries, and fatalities in 2017

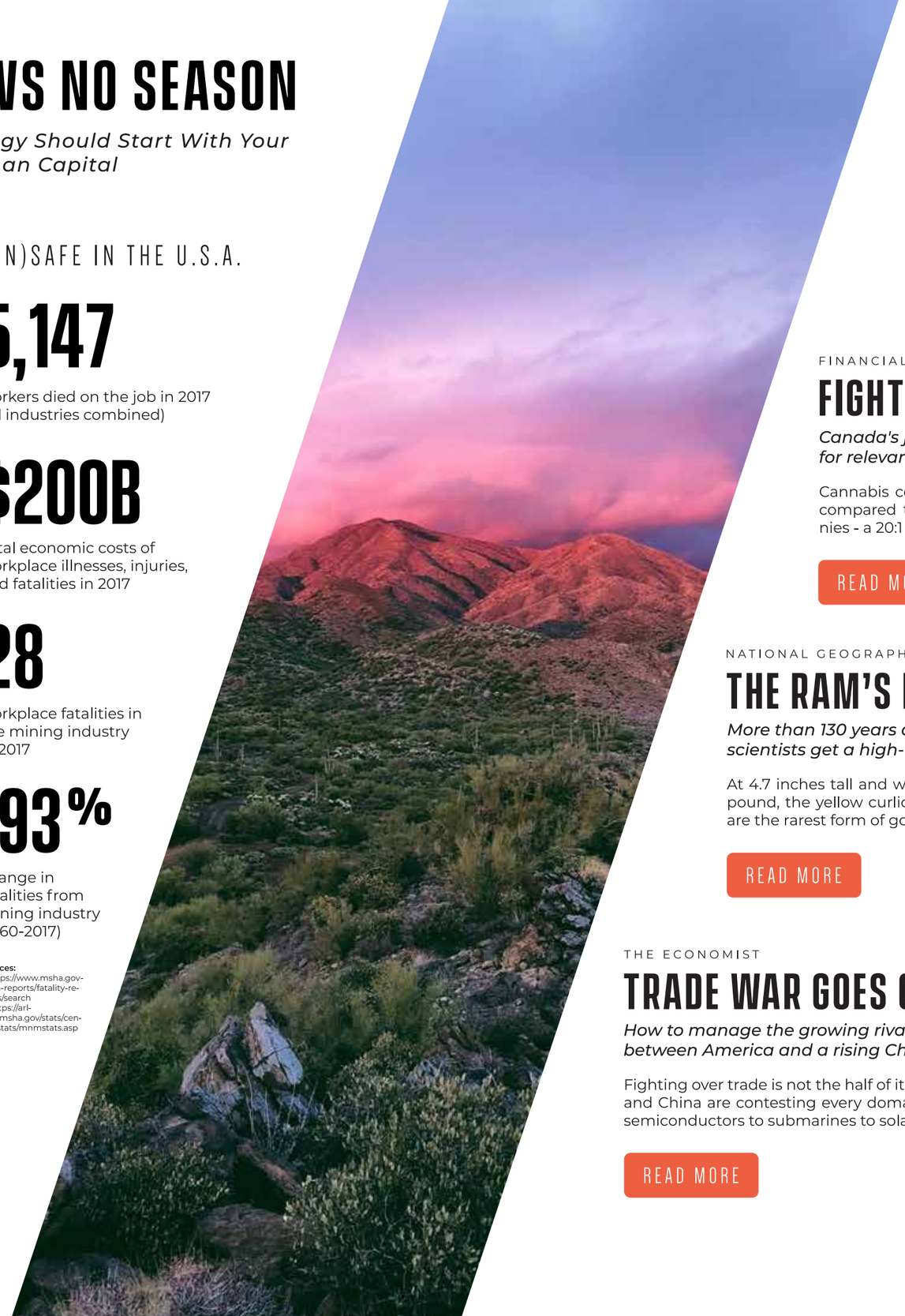
**28**

workplace fatalities in the mining industry in 2017

**-93%**

change in fatalities from mining industry (1960-2017)

**Sources:**
1) https://www.msha.gov-/data-reports/fatality-reports/search
2) https://arl-web.msha.gov/stats/centurystats/mnmstats.asp



# ROCKS IN THE NEWS

FINANCIAL POST

## FIGHTING FOR CASH:

*Canada's junior mining sector struggles for relevance — and capital*

Cannabis companies raised $4 billion in 2018 compared to $217 million by mining companies - a 20:1 difference.

READ MORE

NATIONAL GEOGRAPHIC

## THE RAM'S HORN:

*More than 130 years after it's discovery, scientists get a high-tech look inside*

At 4.7 inches tall and weighing roughly half a pound, the yellow curlicues of precious metal are the rarest form of gold ever found.

READ MORE

Photo credit: Harvard

THE ECONOMIST

## TRADE WAR GOES COLD:

*How to manage the growing rivalry between America and a rising China*

Fighting over trade is not the half of it. The U.S. and China are contesting every domain, from semiconductors to submarines to solar panels.

READ MORE

BIG ROCK

# BRIDGING THE GAP

*Empowering The Next Generation of Explorers*

## WOMEN IN STEM

*A Roundtable Discussion With Big Rock's Female Technical Staff*

**Summer 2019 | Date TBA**

LEARN MORE

## MINNESOTA MINERALS EDUCATION WORKSHOP

*Senior Geologist Leif Johnson Working With The Next Generation of Aspiring Explorers*

**June 18-20th, 2019**

LEARN MORE

## ESRI USER CONFERENCE

*Senior Data Manager Roger Schulz Presenting On Modern Field Mapping With Survey123*

**July 8-12th, 2019**

LEARN MORE

## YMCA PARTNERSHIP HITS 5TH YEAR IN A ROW

*Big Rock Staff Teaching Science At Giraffic Park Kids Camp in Rapid City, SD*

**June 24-26th, 2019**

*Big Rock Sponsoring Twin Cities Prairie Burn Festival To Benefit Local Camps*

**September 14th, 2019**

LEARN MORE



IN THE NEXT ISSUE

# FAIR TRADE MINERALS

*Can Fair Trade Standards Signal A Drive Towards More Sustainable Mineral Production and Sourcing?*

### OVERVIEW

The concept of Fair Trade products and goods is not a new one. Over the past 30 years, it has become an important solution to address social and environmental problems associated with the production and sale of a variety of goods. The Fair Trade concept has now become a certified standard to ensure consumers are getting what they need without supporting child or forced labor practices or sacrificing environmental standards. It is widely recognized and largely supported for goods such as coffee, tea, fruit and vegetables. Other industries are getting pressured for not living up to Fair Trade standards, such as cocoa beans for chocolate production. *But what about minerals?*

### BOTTOM LINE

Minerals are not always meeting sustainable production standards. It's time to demand our minerals be Fair Trade to support production from reliable sources, with adequate labor laws and environmental standards. We can get it cheaper elsewhere, but is it the right thing to do? We think not, and it's time to live up to our ideals of clean energy, social and environmental responsibilities. If products require mineral production that is employing child labor and polluting the environment - it's a problem.

### DIG DEEPER

Keep up with the latest industry insights and examine key topics influencing the future of exploration - with the Big Rock blog!

SUBSCRIBE

# BIG ROCK IN THE FIELD

JUNE 2019

### ON THE HUNT

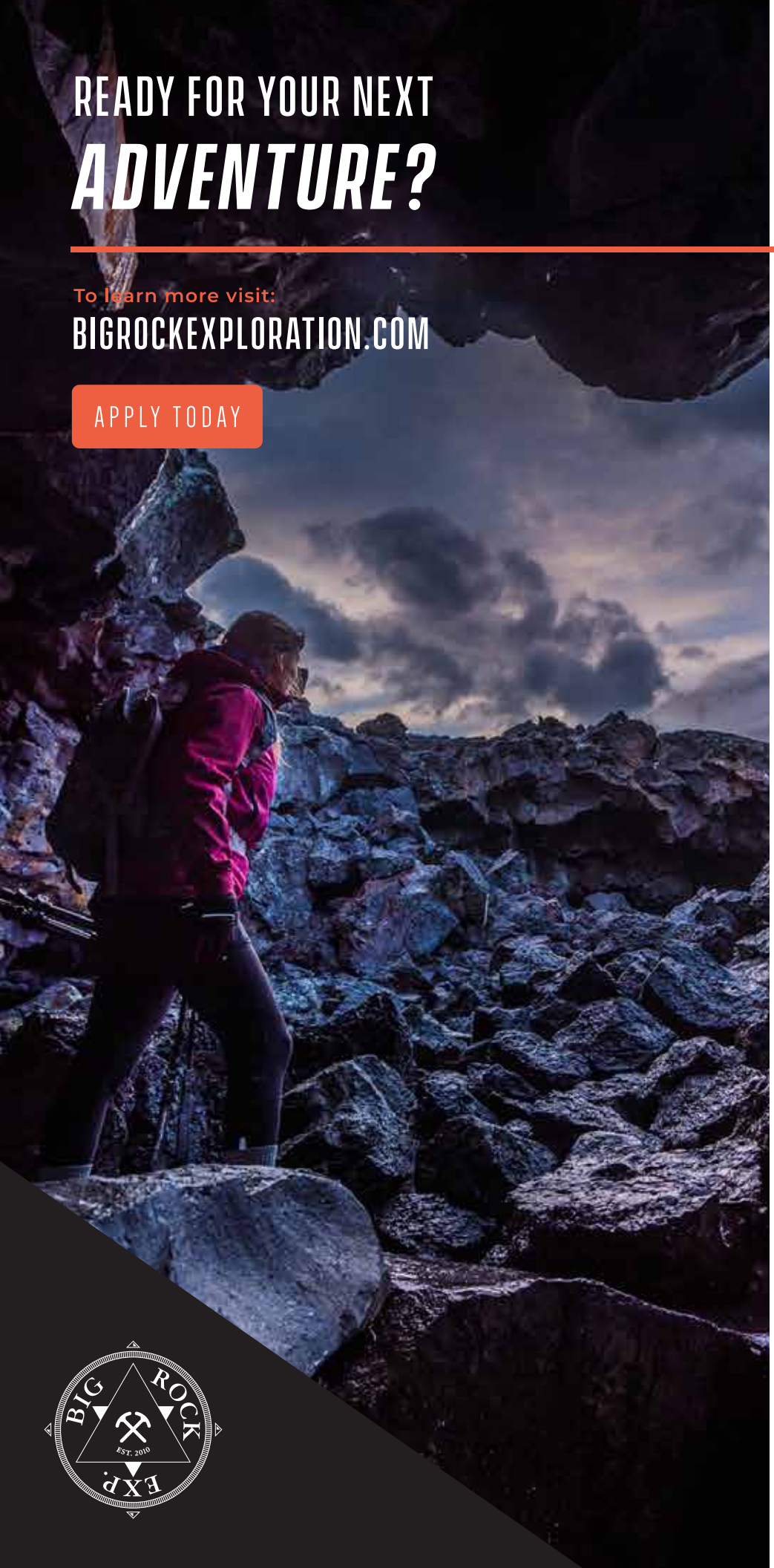
Big Rock geologists Eric Nowariak & Chris Nicosia covering serious ground on a long day of field mapping in the early summer heat.

*(Main below)*

### UNLOCKING CLUES

The Big Rock technical team leaves no stone unturned, literally. With a detective's intuition and a scientist's scrutiny they blanket the area with data to unlock clues hidden for billions of years in the rock below their feet.

*(Right column)*



# READY FOR YOUR NEXT *ADVENTURE?*

To learn more visit:

BIGROCKEXPLORATION.COM

APPLY TODAY

BIG ROCK EXP. EST. 2010

A DAY IN THE LIFE OF AN

# *EXPLORER* SCIENTIST

*FAINT-HEARTED NEED NOT APPLY

## *WILDERNESS TRAVEL REQUIRED*

YOUR OFFICE IS OFFICIALLY *OFF THE GRID*

## *PRIMITIVE* BASECAMP

NO WAKE-UP CALLS! NO COMPLIMENTARY BREAKFAST BUFFET!

**12** HOUR WORK DAYS IN *ALL* CONDITIONS

**-50°F** TO **110°F**

**5,000** FEET CLIMBED PER DAY

**10,000 M** ON FOOT PER DAY

**50** POUNDS OF GEAR & EQUIPMENT