

CREATING VALUE IN AN UNCERTAIN WORLD

How to proactively manage risks and pursue opportunity while addressing global challenges

EXPLORE & DISCOVER
QUARTERLY NEWSLETTER





03

FROM THE CORNER OFFICE

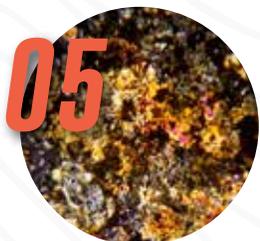
Creating Value In An Uncertain World



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CREATING VALUE

In An Uncertain World



BRIAN LENTZ
Vice President

Responsible exploration and development of Earth's resources has never been more critical to human life and well-being. Mining of metals, minerals and energy enabled the industrial revolution and elevated much of the world's population out of poverty into the prosperous, thriving economies we know today. However, the continuity and future success of global societies will depend on our ability to find and utilize these critical materials without compromising the sustainability of our planet's natural systems.

Today's risk environment is, in many ways ignorant of industry, sector, nationality or locale. The vulnerability and disruption of manmade systems like globalized supply chains, or natural systems like our Earth's climate, pose risks for business and value creation that span the globe. Modern business and community leaders must chart a course amidst conditions that are increasingly interconnected, interdependent, and rapidly changing.

Major drivers of complex global changes like population growth, urbanization, and technological advancement can strain our societal institutions. These conditions are presenting novel challenges to the viability of historically sound business models and pushing proven strategic frameworks towards obsolescence. These new challenges to growth stimulate competition and present new frontiers for the best innovators and entrepreneurs.

In this issue we explore strategic minerals that are critical for renewable energy and modern tech. As highlighted in previous issues, strategic minerals are essential components of our daily life and an increasingly important building block of our modern society. We also take a look through the microscope at how valuable and important petrography and ore microscopy methods are for finding and classifying ore deposits. Furthermore, we discuss our continued focus on key fundamentals of Big Rock; our growth culture, specialized team and sustainability. Stay tuned throughout 2019 as we embark on an exciting path to explore and discover into the future.

Cheers!



DATA SPEAKS LOUDLY:

A growing awareness of globalized risks

3 OUT OF **5**

2018 GLOBAL RANKING OF **ENVIRONMENTAL RISKS**
IN TERMS OF LIKELIHOOD & IMPACT

READ REPORT



WORLD ECONOMIC FORUM RISK REPORT:

Climate change dominates the strategic risk landscape of top global business leaders



LEADERSHIP IMPERATIVE:

Complex challenges demand bold action

70%

PERCENTAGE OF AMERICANS

WHO BELIEVE GLOBAL WARMING IS HAPPENING OUTNUMBER THOSE WHO DON'T BY A 5 TO 1 RATIO.

READ REPORT



YALE PROGRAM ON CLIMATE CHANGE COMMUNICATION

Percentage of Americans who think global warming is happening is **up 7%** from 2015.



INNOVATIVE COMMUNICATION:

Sustainability as a tool for value creation

95%

OF TOP GLOBAL 250 COMPANIES

ISSUE A SUSTAINABILITY REPORT AS A CORPORATE BEST PRACTICE.

READ REPORT



ERNST & YOUNG

Sustainability reporting has emerged as a competitive advantage for 21st-century business.



RISING TO MEET THE CHALLENGE | *Tech Demand Presents Opportunity*

Environmental-related risks are top of mind for many business leaders. A lack of mitigation and adaptation to climate change is one of the strongest headwinds to growth. The impacts on economies and communities are no longer an abstraction of the future but a here-and-present reality. Therefore, the case for cleaner, more sustainable forms of energy gets stronger by the day and presents an optimistic outlook for the strategic minerals needed in the emergent renewables sector and other new technologies.



**BIG ROCK'S
BOTTOM
LINE**

The renewable energy sector is a key growth opportunity for our business and we have made a strategic decision to develop capacity and expertise in this area. Big Rock is actively involved in numerous projects that explore and develop critical mineral commodities while also supporting new renewable energy projects with our geologic expertise and boots-on-the-ground services.

TECHNOLOGY GLOBALIZATION IN FOCUS | *iPhone case study*

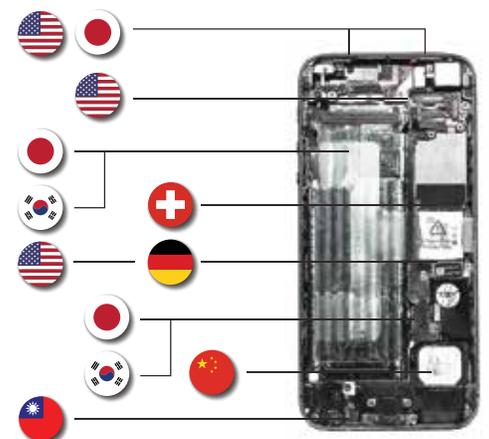
Part of our business development strategy is taking a high-level view of industries and sectors that rely heavily on strategic minerals we're exploring for. It's no secret that technology companies make up a massive portion of the global economy, and their products such as the iPhone contain a tremendous number of specialized components.

By breaking down the iPhone into its constituent components we can identify where in the supply chain certain manufacturers are positioned, and then evaluate the nature of their sourcing and pricing. This level of analysis also helps us track the flow of capital investment to various projects and forecast the fluctuating demand for commodities based on regional scarcity or abundance.

7
COUNTRIES

15+
MANUFACTURERS

60+
MINERALS



Sources: <https://www.visualcapitalist.com/bull-case-every-energy-metal-2019/>
<https://www.eurasiagroup.net/issues/top-risks-for-2019>



AN APPEAL FOR PETROGRAPHY

AUBREY LEE
Senior Geologist

Consider this fact – many university geology departments no longer offer optical mineralogy and petrography courses. In fact, teaching the fine art of ore microscopy in the classroom went the way of cursive and wood shop long ago. The good news is, one must look no further than the minerals industry to find the study of rocks in thin section alive and well.

Any mining geologist will agree that the most challenging mineral assemblages to classify are those related to the formation, alteration, and weathering of an ore deposit. Petrographers collect a variety of data from thin sections including primary and secondary mineralization, alteration, structure, and textures related to these events. These criteria are essential to constructing paragenesis, mineralization timing, and deformational events. Petrography can help to build a regional alteration and structural framework and reveal mineral zonation pathfinders to target a deposit. Finally, petrographic work is a requisite first step to selecting samples for more advanced analytical methods such as laser ablation (LA-ICP-MS), SIMS, or synchrotron-based studies.

While the common rock-forming minerals – a small subset of the mineral kingdom – provide criteria for rock-classification, the accessory mineral species must be equally regarded. Since ore deposits are generated through various physiochemical reactions, identifying all products of these reactions is key to elucidating their conditions of formation. Hand sample and drill core analysis relies on the naked eye and is often supplemented with very expensive analytical techniques. At relatively low-cost, one can adhere a 30 micron-thick slice of rock to a microscope slide and reveal a wealth of information to boost exploration.

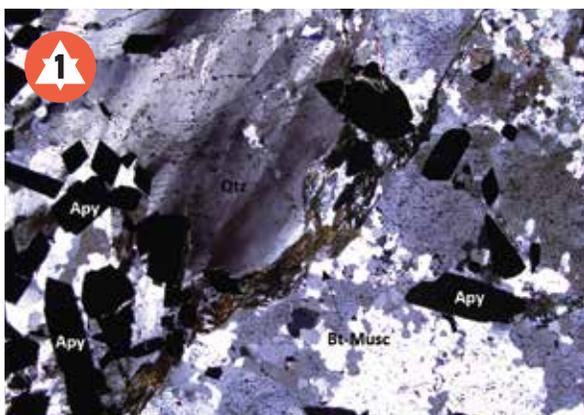


Fig. 1: Trans_photomicrograph: Photomicrograph image of quartz-rich rock showing quartz deformation textures, muscovite alteration, and arsenopyrite mineralization. 4x magnification. Cross-polarized transmitted light. Qtz = quartz. Bt-Musc = biotite and muscovite. Apy = arsenopyrite.

At Big Rock, we use our petrographic microscope to study rocks from a variety of ore deposit types. A typical petrographic microscope passes transmitted light through a slice of rock to highlight the transparent silicate minerals while an ore microscope reflects light off the thin section to illuminate the opaque metallic minerals. Big Rock's scope has both capabilities. This allows us to study whole-rock crystallography and textures as well as metallic ore and accessory minerals.

In conjunction with other exploration tools, we've found that petrography can add great value to an exploration program and is crucial to understanding the formation of an ore deposit. Petrographic study of minerals in thin section is also employed in other industries including manufactured materials like cement and ceramics, and in medicine to image kidney stones and bones. Using microscope technology to analyze rocks and minerals is a proven method to explore and discover future resources.



Fig. 2: Refl_photomicrograph: Photomicrograph image of gold-bearing rock showing multiple metallic minerals in a carbonate matrix with trace gold mineralization. 40x magnification. Plane-polarized reflected light. Ank = ankerite. Py = pyrite. Sph = sphalerite. Au = gold.



A group of Big Rock geologists gather around the microscope to discuss an interesting mineral assemblage.

A STRONG *GROWTH* CULTURE

Human capital drives operational excellence

Big Rock believes a strong growth culture is one that is dedicated to honest and thorough self-assessment with a continuous effort to refine, develop and improve. This isn't just an organizational quality, it is an essential characteristic we look for when recruiting the next generation of explorers. While seeking out talented scientists has been a core objective to building an effective staff, we've been hyper-focused and deliberate about finding the right people that embody our values and help to elevate the team. Valuing our people as unique assets in our company is a core value we are proud to promote at Big Rock.

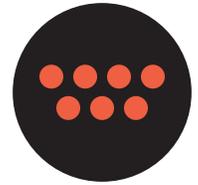
Once we've identified the right people for opportunity with Big Rock, it's important that we get to work building the long-term relationship. Part of this process is finding a mutually-beneficial fit within the company to help maximize an individual's strengths while balancing perspectives and personalities across the team. From a leadership standpoint, the relationship with our staff is built on trust, respect, and commitment from each side to the mission and vision of Big Rock. When new staff join our team, they know they're in a culture that values family, environmental and social responsibility, scientific quality and hard work.

One of the strongest ways we can express our commitment to staff growth is by investing in their well-being and professional development. Whether it's actively placing them on projects that ignite their passions, or opening doors for continuing education opportunities like conferences, trainings and short courses, we believe that if we create value for our team, they will in turn help create exceptional value for our clients.

BY THE NUMBERS



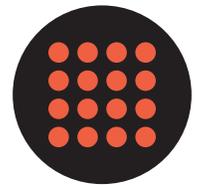
Women comprised 50% of new hires in 2018



7 staff participating at AME Roundup 2019



Female staff on leadership team



16 staff participated in Insights Discovery training



Technical specialists with top-tier safety certification



Staff time spent doing community outreach in 2018

READY TO MAKE THE CLIMB?



Big Rock is continually looking for talented, driven professionals that want to be part of a young, energetic, and growth-minded team. Each person is vital to our collective success and responsible for delivering exceptional results for our clients.

APPLY TODAY



To learn more visit:

BIGROCKEXPLORATION.COM



LIZ ROEPKE

GEOLOGIST

BS in Geology, minor in Math - Univ. of Puget Sound (Cum Laude, '11)
MS in Earth Sciences, Biogeology track - Univ. of Minnesota '18

SPECIALIZATIONS



FIELD MAPPING



SAMPLING PROGRAMS



DATA ANALYSIS



EVALUATIONS & REPORTING



DRILLING PROGRAMS

FIELD EXPERTISE

- Geomicrobiology
- Granite-Greenstone terranes
- Precambrian geology
- Orogenic gold
- Biogeochemistry
- Paleoenvironments
- Environmental geochemistry

HOW I BECAME A *GEO*:

"My family goes camping a lot so I was outdoors a lot as a kid. In the summer during high school, I went on canoe trips with YMCA Camp Widjiwagan (based in Ely, MN) culminating with a 6-week whitewater canoeing trip through the Northwest Territories and Nunavut. When I started college that fall, I took my first Geology class and I think I liked it so much because it helped explain why the different landscapes I had seen look the way they do. . . How rivers and glaciers change a landscape, how it's influenced by the bedrock underneath. . .

*AFTER THAT **ONE CLASS**, I WAS **HOOKED** AND **HAVEN'T LOOKED BACK SINCE.***

A college class in "Mineral Resources and the Environment" sparked my interest in economic geology, and I've always loved working in MN because it has everything from Archaean to Quaternary geology."

MY FAVORITE PROJECT SO FAR:



My research in grad school focused on removing metals from effluent at the Soudan Underground Iron Mine site using native fungi and bacteria. I enjoy thinking about the interactions between biology and geology, especially at small scales.

MY DREAM PROJECT:



My grandfather worked for the Bureau of Mines trying to figure out how to drill on the Moon. It would be really cool to follow up on that and work on a project that studied mining in space. Another (more plausible) dream project would be biomining, using microbes to sequester metals from low-grade ore and waste rock.

WHY BIG ROCK?

*I'm excited to learn and grow with Big Rock on a hard-working team that values **creativity, collaboration, and care for each other** and the environments in which we work.*



GET IN TOUCH:

liz@bigrockexploration.com



Elizabeth Roepke

BIG BERTHA | NATIONAL GEOGRAPHIC



Scientists may have just found the oldest intact Earth rock—on the moon. A study published Thursday in *Earth and Planetary Science Letters* makes the case that one of the rocks collected by Apollo 14 astronauts in 1971 contains a fragment of Earth's ancient crust, dating back more than 4.011 billion years.

It's possible that the fragment formed in a weirdly water-rich pocket of magma deep within the ancient moon. But the study authors think it's likelier that the rock formed within our planet's crust and got jettisoned to the moon by one of the many meteor impacts that bombarded early Earth.

[READ MORE](#)

THE SPACE SNOWMAN | THE NEW YORK TIMES



Ultima Thule, an icy world 4 billion miles from the sun, looks like a big snowman. Planetary scientists have never before seen a close-up of a body like Ultima Thule. It is likely a fragment that coalesced more than 4.5 billion years ago and which has remained in the deep freeze of the solar system's Kuiper belt ever since.

If it is indeed a pristine planetesimal, a building block of the planets, studying it will offer clues to how Earth and its neighbors formed.

[READ MORE](#)

THE DARK SIDE OF THE MOON | FAST COMPANY



On January 2nd, China National Space Administration (CNSA) was able to successfully land its Chang'e-4 spacecraft on the part of the moon that Earth cannot see and no other spacecraft has reached before. The ship was launched in early December and has been orbiting around the space mass for weeks in preparation for the "dark side" landing. According to the state news source Xinhua, the Chang'e-4 successfully landed on the Von Karman crater.

This mission is just one part of China's growing space exploration ambitions. This latest Chang'e-4 mission according to Xinhua intends to "provide firsthand data and clues for the evolution of the moon, earth and solar system."

[READ MORE](#)



SUSTAINABILITY IN PRACTICE

DAN GOETTSCH
Business Development

In light of the theme that runs throughout this newsletter issue, Big Rock is excited to share that “Sustainability In Practice” is our key initiative for 2019. Thus far in our growth, as a company we’ve staked our reputation on a commitment to economic, environmental, and socially responsible business that “does no harm” and creates value for society. Just as we push ourselves to lead our scientific field, we’re seeking to lead by setting a new standard of stakeholder engagement and shared value. Later this year, Big Rock will be publishing its first ever sustainability report to further our transparency and communication with our stakeholders. Listed below are some of the steps we’ve taken to put our values into practice.



ENVIRONMENTAL STEWARDSHIP

We believe in the responsible use of our natural resources, protecting ecosystems, and minimizing our footprint.



HIRE LOCAL, SOURCE LOCAL

We recruit and employ talented and qualified professionals where we work and operate.



WIN-WIN PARTNERSHIPS

We compete to create value but collaborate and partner whenever and wherever possible to better serve clients.



SUPPORT YOUTH & STUDENTS

We create practical and relevant work-learning opportunities for students and young people.



EMPLOYEE WELL-BEING

We support healthy, active lifestyles, economic job security, and strong family support for our staff.



COMMUNITY BUILDING

We spend time in the communities where we work building stakeholder relationships and giving back.

DO YOU HAVE AN
AGGREGATES
PROJECT?

HIRE A BIG ROCK GEO.

Big Rock has expertise in providing geologic services on a variety of sand and gravel projects. With our boots on the ground support you can:

SAVE
TIME



SAVE
MONEY



PRECISE
DATA



CONTACT US FOR A FREE CONSULTATION

SME

2019 ANNUAL
CONFERENCE



SMART MINING

*Resources for a
Connected World*



DENVER, COLORADO

FEBRUARY 24-27, 2019

UNION STATION
RAVEL & TRAIN

UNION STATION

COME MEET WITH OUR TEAM

TORONTO

MARCH 3-6

PDAC

2019

ANY PROJECT, ANYWHERE, ALWAYS READY

The Big Rock Competitive Advantage

Our mission is to provide our clients tailored project solutions through quality scientific investigation. Big Rock's project geologists all have extensive field experience and top-tier safety training. While much of our staff works remotely on active jobsites, we are always building capacity to deploy the necessary technical expertise whenever a client is in need. If your project needs boot-on-the-ground today, we're ready to help.

COMPANY HIGHLIGHTS

30+

TECHNICAL STAFF

15

CORE SERVICES

11

ACTIVE PROJECTS

7

ACTIVE INDUSTRIES

CONTACT US

- Gold
- Copper / Nickel
- Uranium
- Copper
- Gemstones
- Industrial Minerals
- Diamonds
- Rare Earth Elements
- Renewable Energy



GLOBAL HQ

Minneapolis, Minnesota, USA

44° 59' 12" N 93° 15' 29" W

PROJECT FOOTPRINT

LET'S WORK TOGETHER.

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MINERALS ARE THE

FUTURE



To learn more visit:

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