THE FUTURE OF GEOLOGY

INDUSTRY LEADING EXPERT'S INSIGHTS

INTO WHAT THE FUTURE MAY LOOK LIKE FOR THE MINING SECTOR

CONTENTS

INTRODUCTION

Geology is an ever-changing and growing field across the globe. Every day, exciting new discoveries are made and advancements are achieved, all of which change the course of the practise. It's interesting to consider what the following years will hold in store and what impacts this will have on society on an international scale.

This Future of Geology eBook has been written to provide a snapshot of the Geology industry, and to offer insights from four industry leading experts into what the future may look like for the global mining sector over the next few years.

GEOLOGY INDUSTRY EXPERTS

As leaders in their respective fields, the following four Geology professionals contributed their own personal opinions and experiences together to create the comprehensive predictions found in the following chapters.

ADAM MCKINNON

Geology Superintendent - Aurelia Metals

With over 10 years' experience, Adam has worked for some of the largest mining and geology companies around Australia, including CBH Resources, KBL Mining and Aurelia Metals. Adam currently works for the Geology Superintendent for Aurelia Metals.

GLENN COIANIZ

Director & Geological Consultant - ExplorIS Pty Ltd

With over 15 years' experience in exploration for precious and base metals and mineral sands deposits. Glenn has worked on numerous base metal and gold deposits in Australia and Papua New Guinea and conducted mineral resource studies on porphyry copper/gold deposits in Australia and epithermal gold deposits in Papua New Guinea.

CHRIS SPURWAY

Principal - Spurway Geological Services

Chris is an Exploration & Geology Manager with over 25 years international and Australian experience covering mining, mineral exploration, resource definition and strategic planning & development, prospect generation with a demonstrated track record of mineral discovery and project development.

BRAD MILLER

Senior Geologist – Ernest Henry Mine

With over 10 years' experience, Brad has worked at various mining operations throughout QLD covering multiple mine geology related roles, focussing on resource definition, near mine exploration and long term planning & development duties. Currently working in the technical services department at Ernest Henry Mine as the Senior Geologist.

01

DATA REFINEMENT

All industries are becoming more sophisticated when it comes collecting, refining and interpreting data. Geology is no different. There is real value to be found in utilising existing data sets in a more meaningful way, which means that this will be a growing focus in the years to come.

At present, mining companies are already collecting vast amounts of data, however they fail to do much with it. Data analysis will be a way forward to optimise what mining companies have already got, however in a more meaningful and insightful way.

02

USE OF TECHNOLOGY

It's no surprise that the rise and growth of technology is and will always have a significant impact on the Geology and Mining industry. It has already become a main staple across the field, and will continue to do so in the years to come.

Australia in particular, has a lot of potential for sizable mines in the future, however a new technique is needed. It is predicted that a technology revolution within Geology will discover the next mine because the current suite of techniques are not producing the results required.

> "The next big progress will be either a technique where Geologists can look underground better to see things more clearly, or it will be a technique that allows Geologists to extract more out of the current technology.

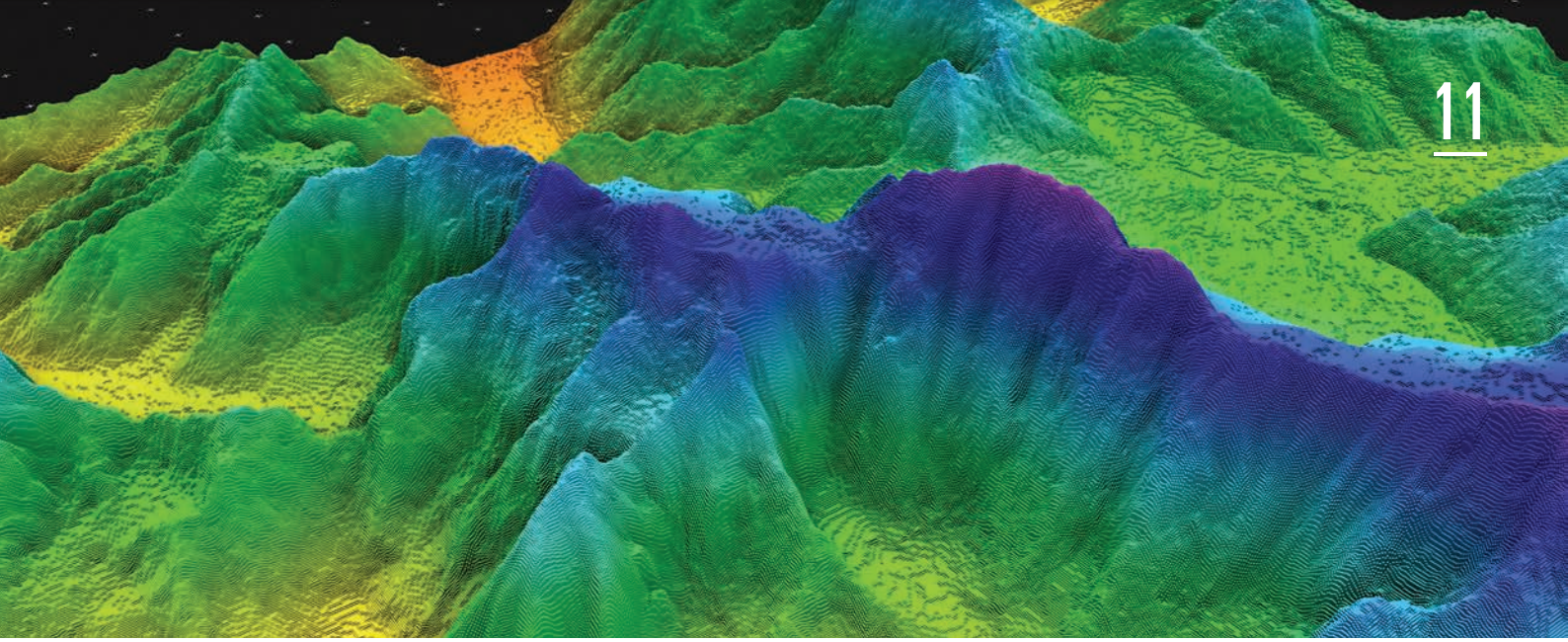
Scanning technology, particularly in this underground space, is therefore a growing area. There's a lot happening currently with scanning geological structures and capturing more data, which is quickly replacing the pen and paper methods with digital recording devices.

Drone technology is making a big impact on Geology when it comes to observational requirements, and this will become more prominent in the next few years.

Especially in early-stage assessment type work, Drones will mean that Geologists won't necessarily need to be physically on the ground, which will improve accessibility and reduce the time and staffing required.

But it's not just flying over mine sites for evaluation; it's the potential for tool and device transport over great distances on a site, too. This is currently being tested in industries like food delivery, and will have future implications for Geology too.

> While Drones weren't specifically developed in a mining scenario, the opportunities to take advantage and adapt to their capabilities will reduce costs and enhance Mining tasks.



Advancements in LIDAR images will also see greater use over the next few years. This involves the use of laser ranging which basically gives Geologists an accurate, 3D representation of rockfaces.

In the past, these surfaces and structures were normally mapped visually, however this technology allows 3D model representation, where Geologists can use a computer to determine where faults are, where the joints are, and where other structures and features are. This is set to become far more prominent over the next decade.

03

SHIFTS IN COMMODITY DEMANDS

Demand for raw materials will always have an impact on Geology and Mining, and these demands change over time based on final product trends.

For example, Smart Devices are driving a greater focus on metals such as cobalt and lithium which is predicted to continue into the future.

Electric cars require six times more copper wiring than more conventional designs, which is increasing the worldwide demand for it. Additionally, the bodies of these vehicles are not crafted from traditional iron, and as a result, manufacturers are looking towards aluminium.

> The trend towards environmentally friendly product alternatives is becoming more prominent every year, and this has a lot of potential to increase exponentially over the next ten years. Commodities and raw materials related to this will be in high demand into the future, and a key indicator of what's on the horizon for Geology.

04 MINING DEPOSITS TOWARD NARROW VEINS

While mining methodology is not predicted to change significantly, the focus on quality over quantity is beginning to become a more accepted practise, particularly in the gold and precious metal industries.

Through the 1990s and 2000s, the industry was preoccupied with large disseminated deposited with larger reserves, even though the cost of production was incredibly high.

During these years, narrow-vein style deposits were vastly overlooked on a global scale, however there will be a significant paradigm shift back towards these deposits in the future.

Unfortunately, Australia has lost that expertise over time, and it has become a rare skillset Internationally as well. This is because there are very few companies that perform narrow-vein mining anymore, except in Peru, Bolivia and parts of North America.

The problem is, the world favoured large-scale mechanised mining, and kept away from cheaper narrow vein hand mining. It's only some countries and some machinery manufacturers that are specifically producing smaller narrower equipment to handle this type of mining.

There is a predicted shift in the future towards more Narrow Vein mining, which will change the landscape of Geology in years to come.

With companies starting to search for higher-margin deposits, it's possible to have a narrow vein mine that produces, for example, 50,000 ounces with a cash cost of $800, versus, for example, a larger lower-grade mine that produces 200,000 ounces with a cash cost of $1400, meaning the profits are the same.

Now that the industry is heading in this direction, manufacturers are trying to adjust their technology to reconfigure it more toward narrow vein mining.

05

GEOLOGIST EDUCATION

Educational institutions are beginning to move towards updating their syllabi to give Geologists who are studying greater access to essential industry skills to help them to be more successful in real-world scenarios.

In the past, Universities typically have come from the more academic approach, only to find that when Geologists enter the field, they didn't have the right operational tools that they needed.

The industry as a whole is providing feedback to help update educational programs to incorporate a more practical aspect for students, in addition to the academic side, and this will continue over the next ten years.

> This will result in the next generation of Geologists to be more prepared for the conditions, technology and workplace environment that they will be immersed in throughout their future careers.

Of course, on-the-job training can never be replaced or effectively replicated in Educational institutions, however this is heading more in the right direction, so that Graduates will be more equipped.

06

GENERAL POPULATION EDUCATION

One of the key issues the Geology Industry has to address far better in the future is educating the general populace about the value of mining.

A lot of people don't want mining to go ahead but still want their cars, mobile phones, and other modern luxuries. Unfortunately, most people don't understand that products like those require raw materials that have to be mined.

Unlike a manufacturing plant, which can be placed anywhere, Geologists can't simply put a gold mine wherever they wish; if the gold is located in a particular spot, then that's where the mine has to be.

Addressing this more appropriately over the next decade will help people to understand the role Geologists play in society and the environment. This will also reduce the growing negativity that the industry is continuing to face.

Teaching the general populace the importance of mining will make it easier to access certain locations to help perform essential tasks. For example, farmers and landowners need to be aware that in order for them to have their tractors, aeroplanes and other machinery that they need to use, Geologists need to have a mine somewhere, even if it's on their property.

Unfortunately, there is a disconnect today between what consumers have and where it comes from. This needs to be addressed not only by the Geologist industry, but by most industries. People need to understand that in order for them to purchase their fresh produce, it has to come from a market garden, which involves clearing land. The same applies to geology and mining. Both sides have to be aware of each other, and there has to be a compromise of coexistence.

07

AUTOMATION AND AI

The use of Automation and Artificial Intelligence in Geology as a whole is inevitable.

It may not necessarily be mechanical or robotic, however from the data analysis side of things, mining processors are heavily involved in this. A lot of processors occur on a daily, weekly, monthly basis. Automating some of these will be the way forward to not only improve efficiency, but also as a way for companies to keep their costs down.

The Industry is just starting on that journey toward exploring the possibilities of automation when it comes to building databases. In the future, when this becomes more established and commonplace, Geologists will be able to spend less time on data entry and more time on technical geology, which is a stronger preference.

08 THE THREAT OF FUNDING

Unfortunately, there is a concern that is threatening the future of Geology and Mining, and that's a shrinking of investment dollars. As an Industry, it's beginning to become difficult to attract large-scale investors to conduct exploration and initiate new projects.

In the previous booming periods, there was an excess of investment funding on a global scale, and unfortunately, the industry abused this somewhat and didn't offer the returns that these investors were aiming for.

This means that investors moved away, and the ones that still remain place an increasing amount of caveats on the funding.

While this is a foreseeable concern, it's an opportunity for the Geology industry to learn from past mistakes, and better manage and reward investment funding on future projects in a more equitable way.

> Additionally, there is a future need to shorten the mining turn-around time from start to finish, to improve the favourability of the industry and attract more investors. As it stands today, an investor expects not to see a return for between 20 and 35 years, which is a significant amount of time.

In the future, Geologists need to cut that down by around half, to make mining a viable option for investors, particularly in first-world countries like Australia.

09

HOW TO ADOPT TO CHANGE

Change is the only constant, and it's clear that the Geology and Mining Industry will be undergoing a wide range of transformation across several facets over the next few years.

It's very important, as Geologists, to be open-minded and embrace 'out of the box' approaches. A lot of what is done currently involves the use of physical pen and paperwork, manual calculations, manual data collection, and so on. However, starting to embrace some of the technology that's around to make the practise easier and more efficient should be welcomed and explored.

Geologists have to be more mindful of social license in the future when working within the community. But even more importantly, Geologists need to keep the level of optimism up and continue to embrace working out in the physical field.

> "At the end of the day, Geologists are not going to find a mine by looking at a screen. These are found by going out and looking at rocks, ground and other stuff outside. Not to say that computers aren't important, but ultimately, mines are found when physically exploring; the industry should never lose touch of this concept.

There is a bright future ahead for the Geology and Mining Industry, and it's exciting to see the changes that will come about over the next few years.

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