Mine Shift

Coherence: The 'Always On' Monitoring Solution For Decision Makers

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Introducing 'Coherence'

Across our Mine Shift series so far, we've explored the potential of earth observation satellites to provide risk information to better protect sites around the world through the precise measurement of ground displacement.

We've analysed the events leading up to the Williamson Diamond Mine and showed how ground movement had a potentially influential role in compromising the site's structural integrity.

We've also looked at how Synthetic Aperture Radar (SAR) technology can be used to better predict outcomes of potential tailings dams breaches, such as in the instance of the Jagersfontein disaster in 2022.

There is another use of SAR technology that can provide key insights for investors and industry watchers -but it is often underutilized.

It's called Coherence – a process that uses images taken by SAR satellites days apart to create detailed, near-real time snapshots of activity in and around a site of interest at regular intervals, anywhere in the world.

For analysts and investors, Coherence data can be applied to tracking trends in a mine's production output by assessing patterns of activity.
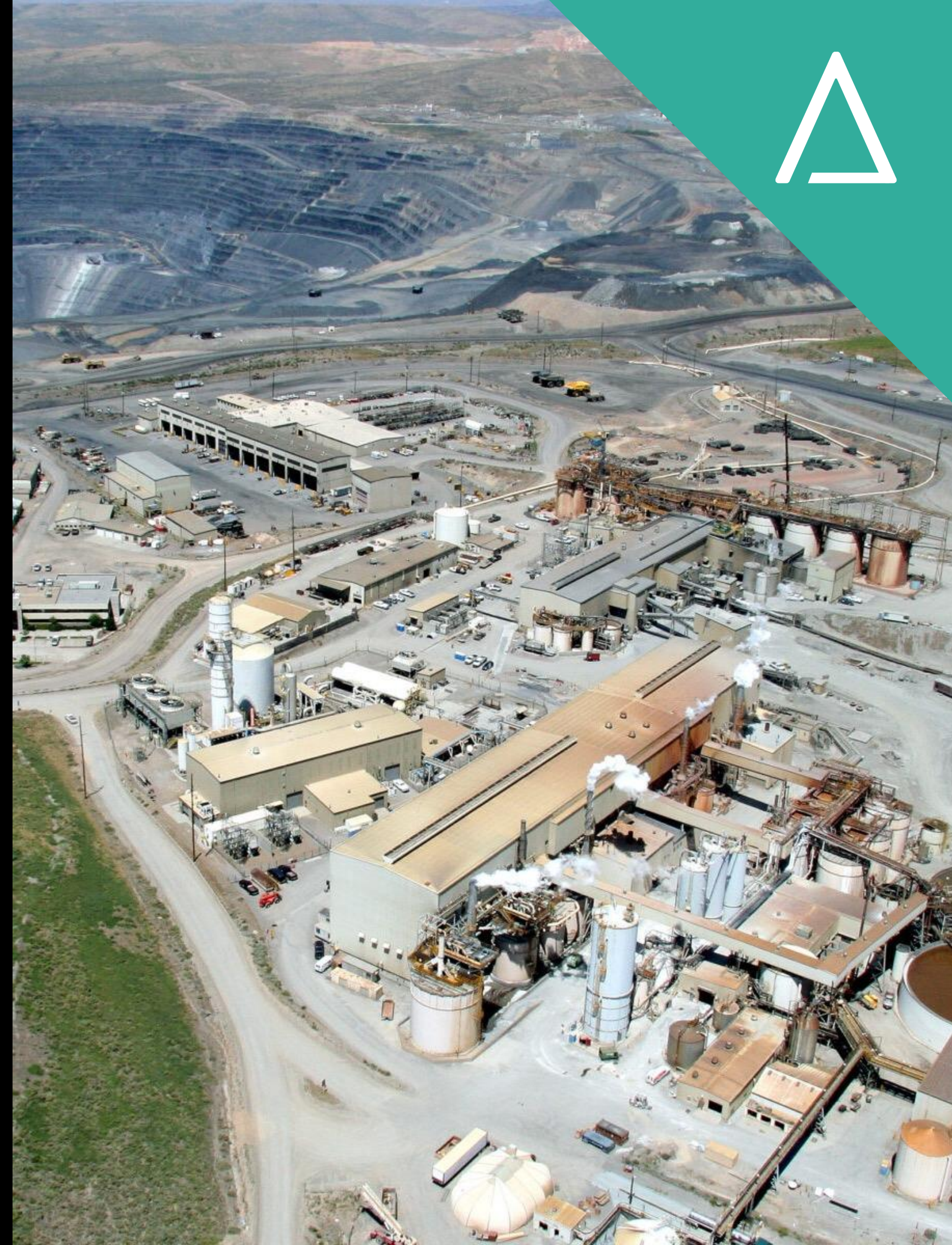
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Geospatial finance – coherence is confidence

Traditionally, coherence has been used mainly to support decision makers directly responsible for monitoring the operational and maintenance strategies of large scale, high value assets – such as active and inactive mines.

Today, though, it's finding new and transformative uses in non-traditional industries where confidence in decision making is crucial – such as commodities trading.

In a world where markets are increasingly susceptible to long and short-term volatilities - such as weather, geopolitical events, and economic uncertainties - analysts and investors are using Coherence to provide valuable, near-real time insight to reduce their risk and support more informed, more confident investment decisions faster.

And here's how.

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Geospatial finance – coherence is confidence

CATALYST simplifies access to this seemingly complex source of intelligence, known as Coherence Change Detection. This automated processing technique works though signal comparisons over features of interest with many repeat observations.

Satellites can capture images over specific areas at set intervals using the exact same parameters. When changes on the ground occur, they are reflected in the signal and produce a coherence value ranging from 0 to 1. Low values (close to 0) indicate "low or loss" of coherence, thus a change on the ground, while the opposite (close to 1) "high or no loss" indicate less change.

These are highly sensitive measurements capable of identifying changes within each pixel in the SAR imagery, making it possible to detect even the most subtle changes, like the presence or absence of cars in parking lots, or vegetation changes and landform differences in and around mine sites.

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Geospatial finance – coherence is confidence

More pertinent for analysts and investors, this sensitivity can even be applied to tracking trends in the mine's production output by noting changes in patterns for excavation and excess material generation with each new acquisition.

What's more, there's no need for specialist teams to view or process raw satellite images. Through CATALYST INSIGHTS, Coherence and pattern of life information is at the fingertips of any decision maker wanting more visibility across their investments.

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The value of this analysis

The intent of our analysis, and indeed of earth observation in general, is to highlight how it can be used to support more informed, faster decision making. In the context of geospatial finance, generating this type of alternative data to augment a specific hypothesis related to trading certain stocks or commodities creates exciting new possibilities.

Using SAR based coherence measurements in traditional, non-geoscience industries – such as financial services is innovative and promising. Traditional monitoring of large, global asset portfolios play a key role in investment decisions, but they have their limitations, including operational costs, time, and resource required.

Earth observation harnesses the power of satellites to conduct regular monitoring of critical sites, with near-real time data delivery, which is perfect for augmenting with existing strategies to enhance the quality of decisions.

Businesses who have already embedded this technology into their workflows are now better equipped than ever to monitor their portfolios and enhance their investment strategies.

Not only does this improve existing process, but it also reduces costs and improves efficiency.

C A T A L Y S T

Unlocking patterns in coherence data – sample mines

To show it in action, we've selected some examples of mine sites around the world to generate examples of the information that's contained in the coherence.

1. Nevada's Gold Strike Mine produced over 3.3 million troy ounces of Gold in 2021 and is the world's largest active gold mine.

2. Wharf Mine, located in South Dakota, is an active open pit gold and silver mine.

3. Homestake Mine, also in South Dakota, has been inactive since 2002 – it produced more than forty million troy ounces of gold over its 124-year lifespan.

Gold Strike Mine, NV
Status: Active

Wharf Mine, SD
Status: Active

Homestake Mine
Status: Inactive

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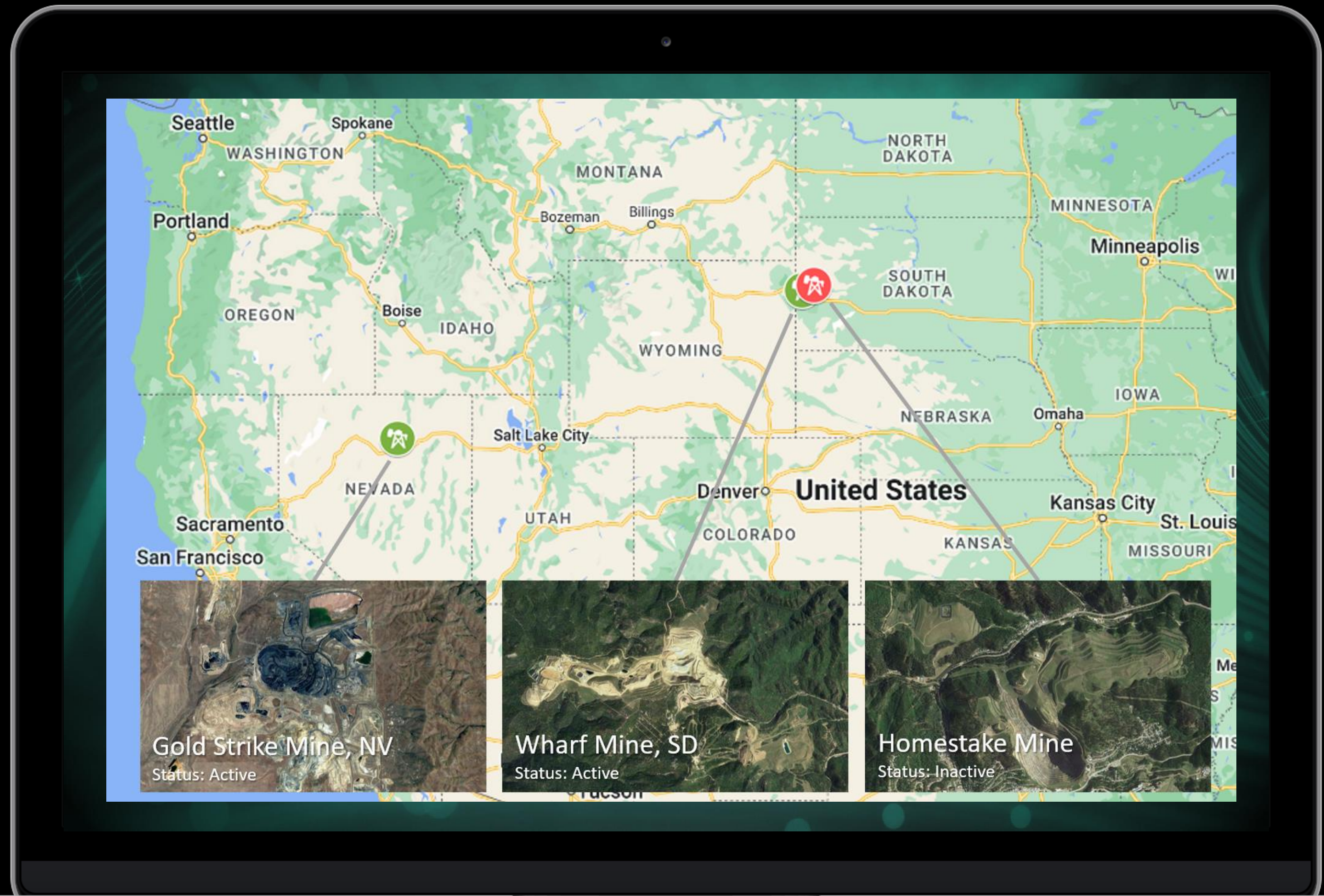
Long term change analysis - elevation changes analysis (15-year period)

To augment the analysis and confirm the levels of activity, we compared globally available elevation layers over the three sites over a 15-year period.

The active mines (Goldstrike and Wharf Mines) show large elevation changes, owing to the excavation of and deposits of material that continues.
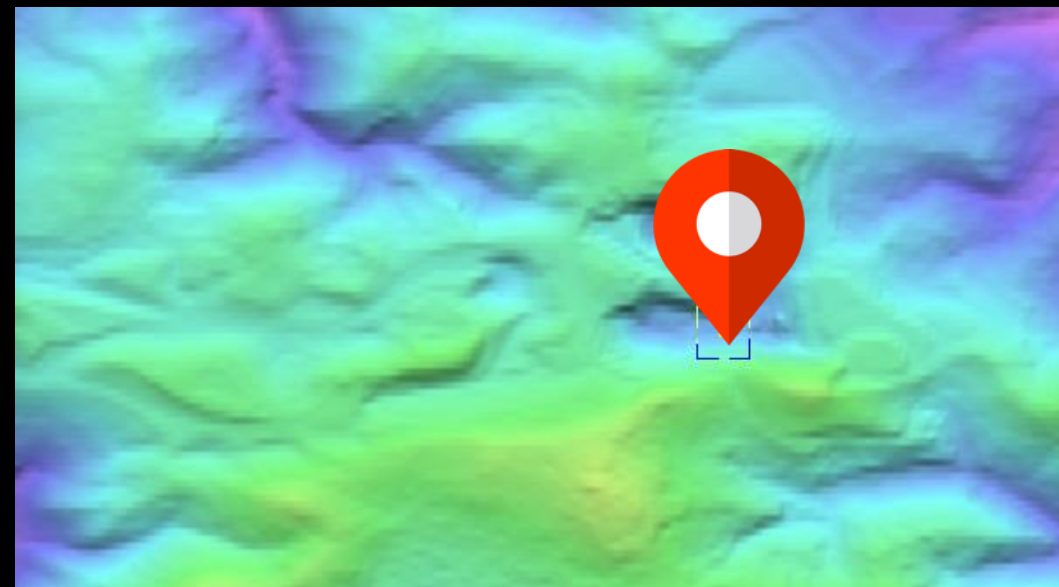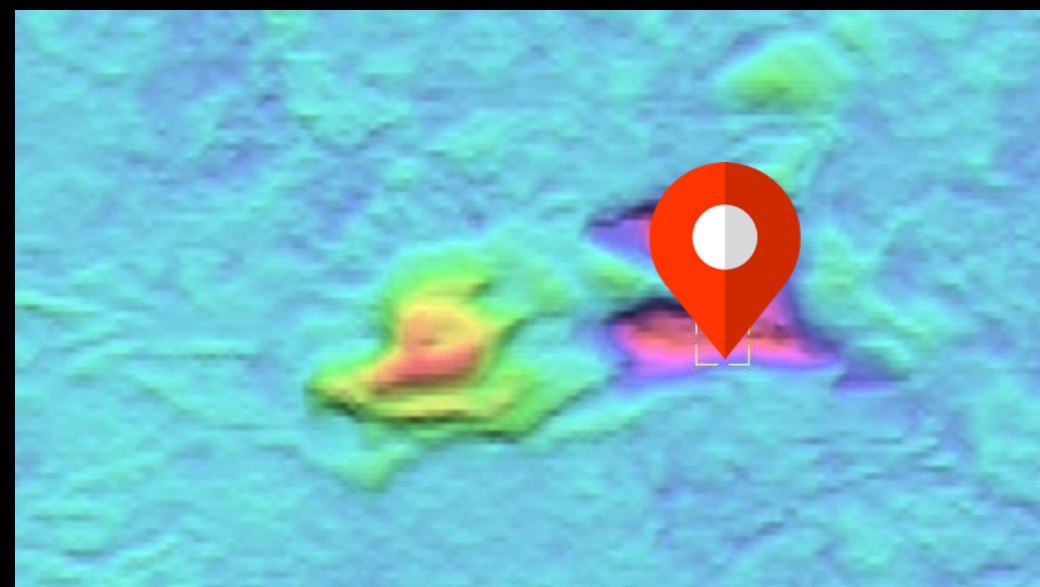
Wharf Mine, South Dakota
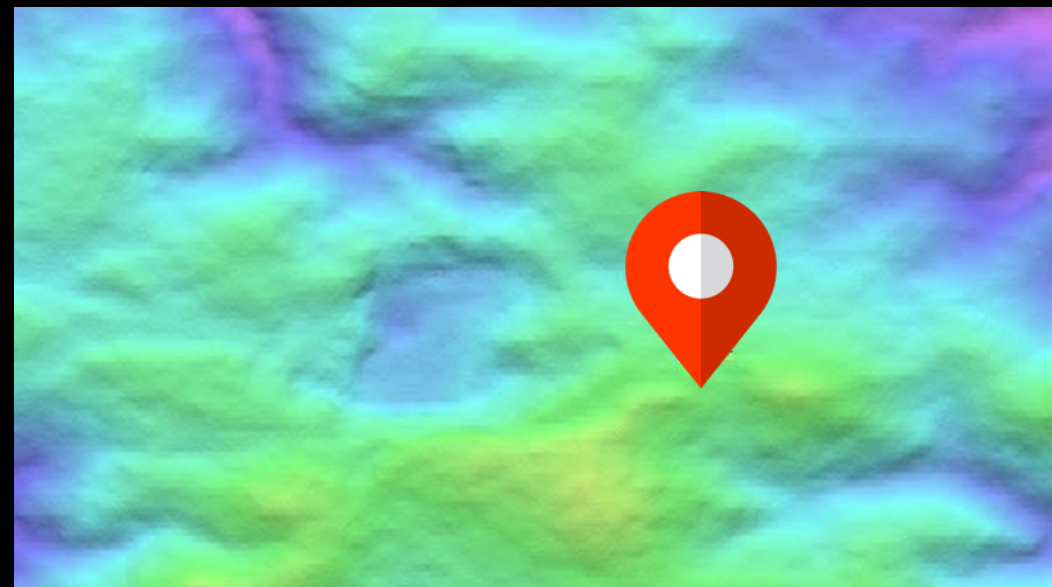
2000

Elevation Value at cursor:
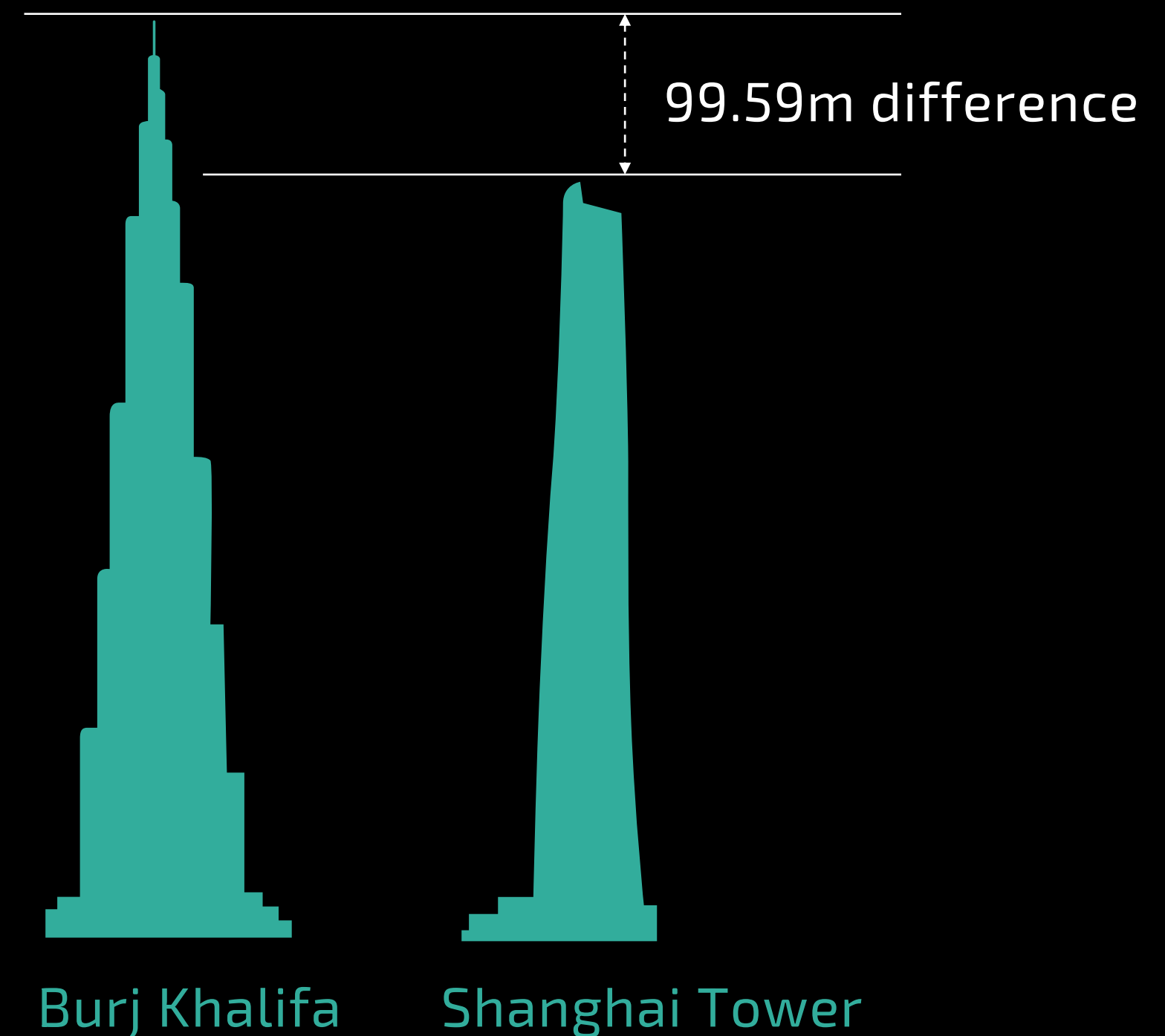1950 m above Mean Sea Level (2000)

2015

Elevation Value at cursor:
1850 m above Mean Sea Level (2015)

Elevation difference

Elevation Value at cursor:
-99.59 m (Digital Elevation Model change)

99.59m difference

Burj Khalifa   Shanghai Tower

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Long term change analysis - elevation changes analysis (15-year period)

The inactive mine (Homestake) elevation changes confirm that there has been little / no excavation over the 15-year period with only small elevation changes (see below) mainly due to small variations in the accuracy of the Digital Elevation Models. This is confirmed by the fact that the Homestake Mine has been inactive since 2002.
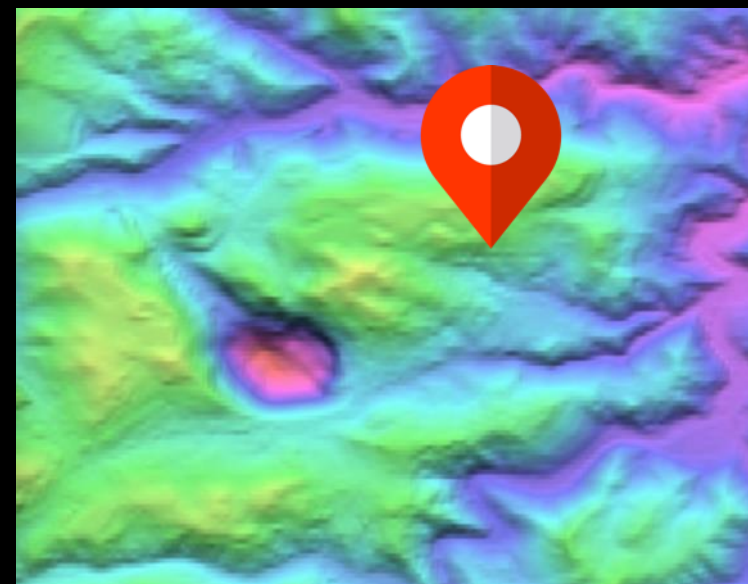
Homestake Mine, South Dakota
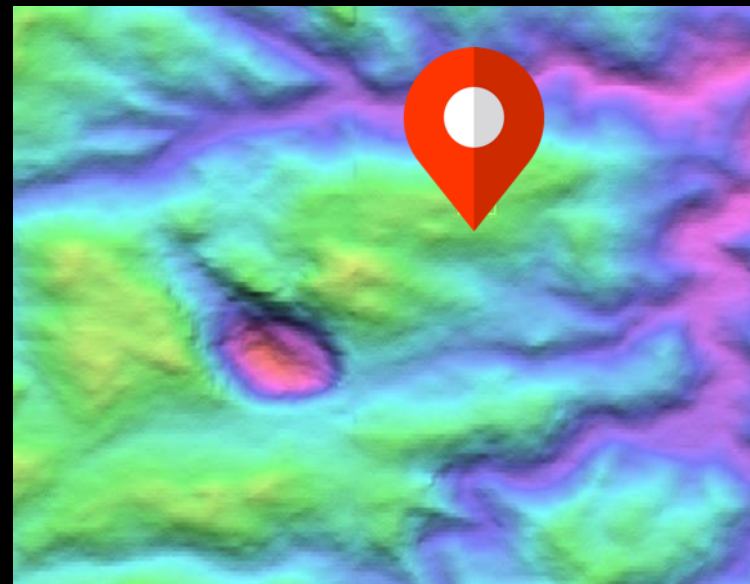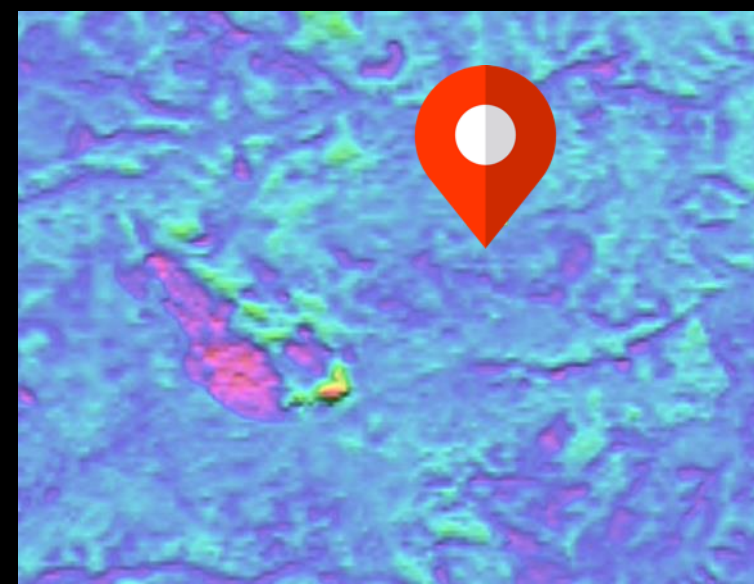

2000

Elevation Value at cursor: 1662 m above Mean Sea Level (2000)
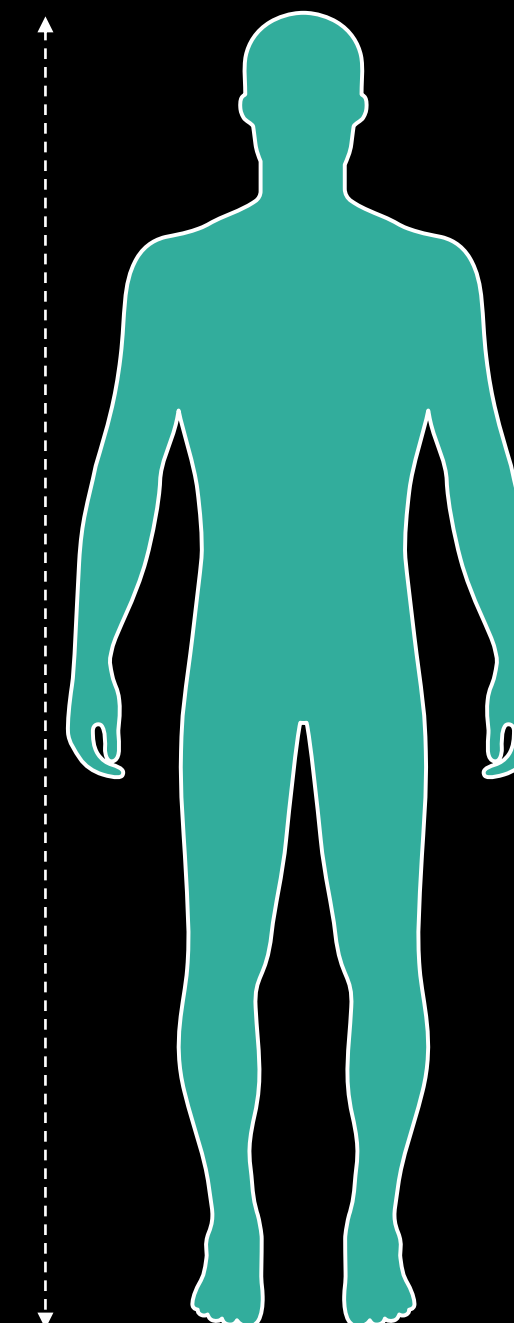

2015

Elevation Value at cursor: 1664 m above Mean Sea Level (2015)

Elevation difference

Elevation Value at cursor: 1.74 m (Digital Elevation Model change)

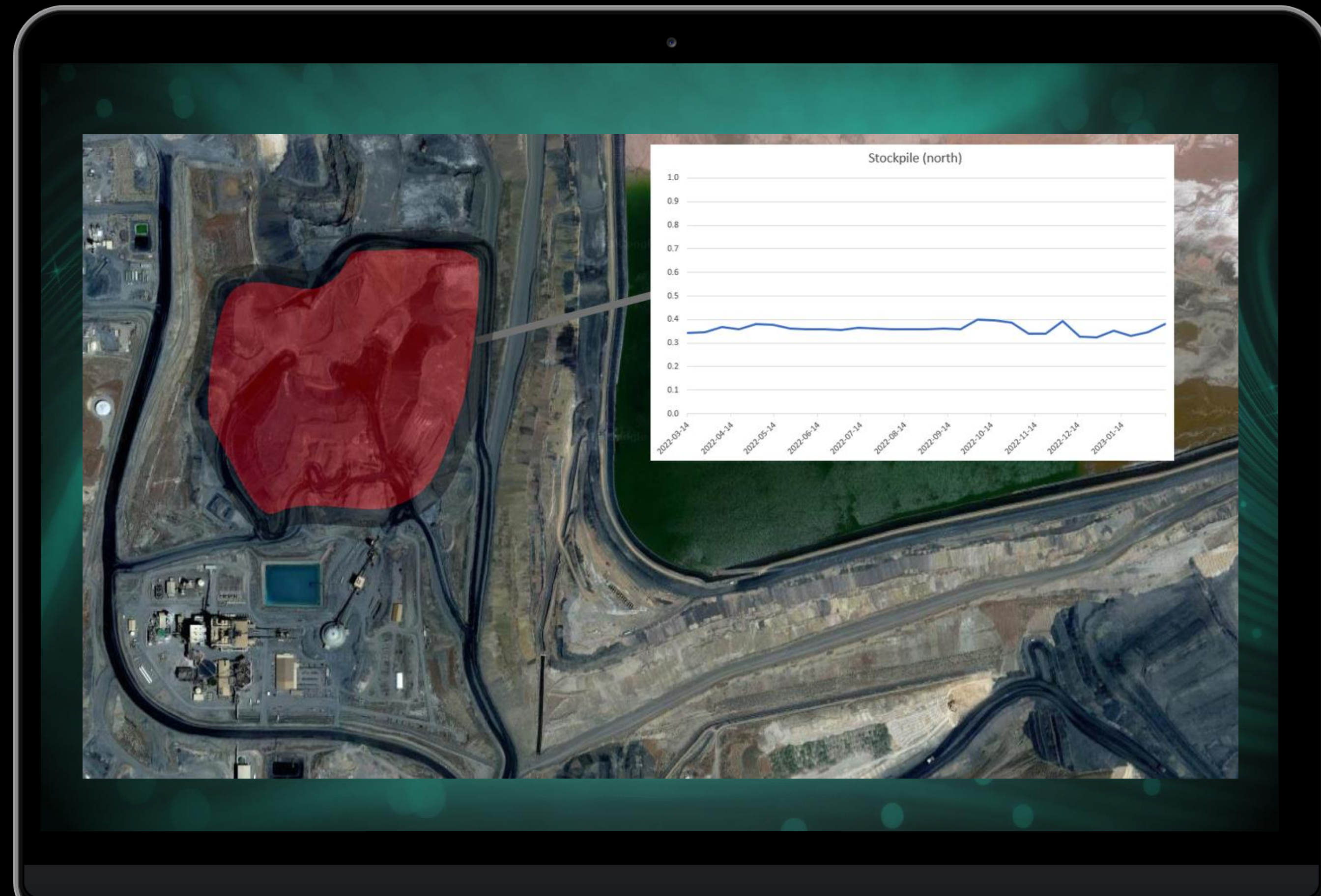1.74m average height of a man

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Active monitoring of activity – 1 year coherence based analysis

Our team analysed each of these sites over a 12-month period, with measurements taken every 12 days using Sentinel-1 SAR imagery. All processing was done using CATALYST algorithms which include advanced image processing capability which is highly modular, automated and deployed to the cloud.

To assess activity levels, different types of features were selected within the mine sites. Examples are described in more detail below.

Sample area 1:
Stockpile (Northern Sector), Nevada Gold Mine.

High activity: The coherence over the measured (red polygon) shows low overall coherence indicating constant changes throughout the observation period. This area is used as a staging location to process material thus rapid changes are observed.
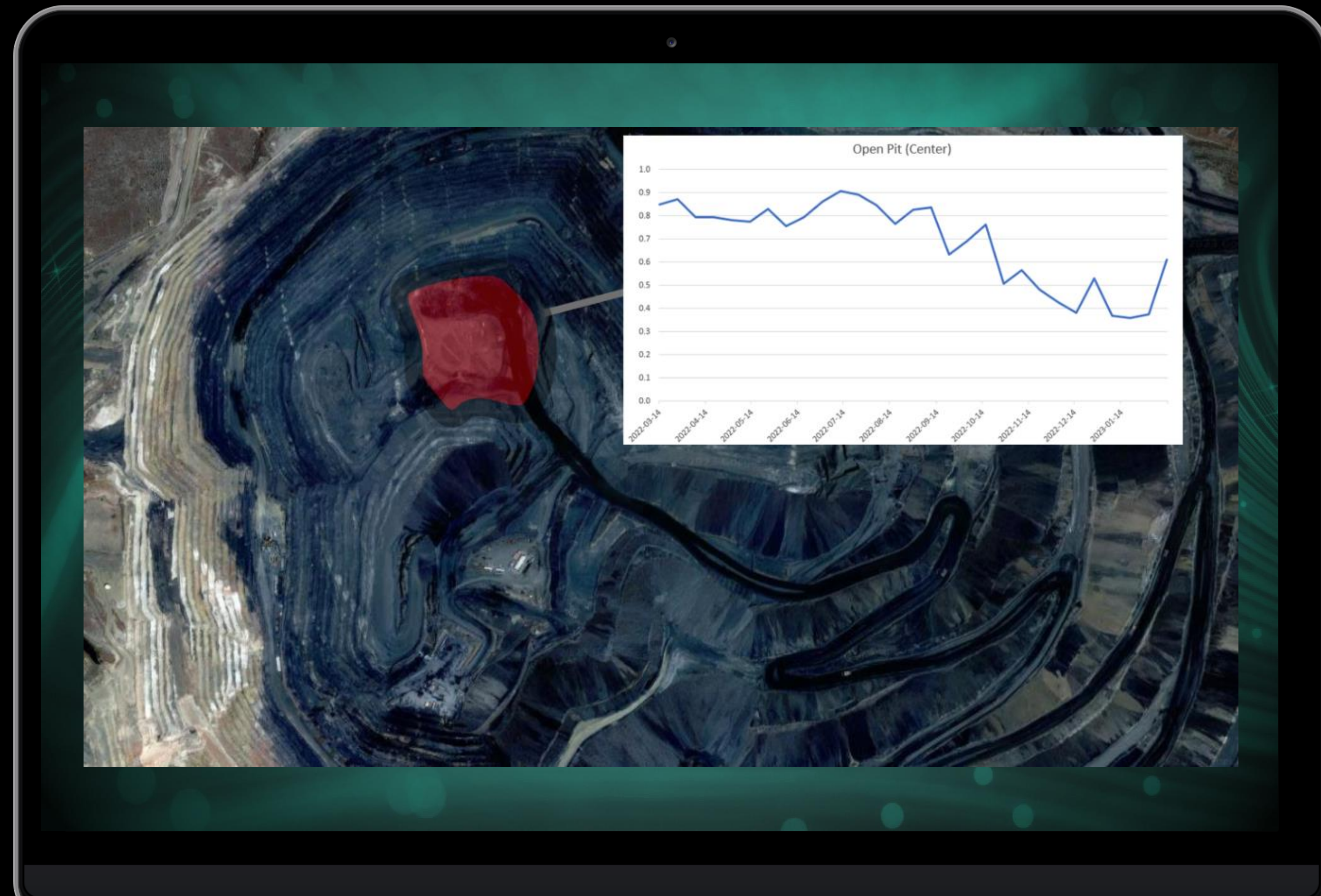

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To assess activity levels, different types of features were selected within the mine sites. Examples are described in more detail below.

Sample area 2:
Open pit (Center), Nevada Gold Mine

Activity noted: The coherence over the measured (red polygon) shows higher coherence overall, and notably a pattern emerges (drop in coherence) mid-way through the timespan, indicating activity and likely new material being blasted in the bottom of the open pit.

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# Active monitoring of activity – 1 year coherence based analysis

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To assess activity levels, different types of features were selected within the mine sites. Examples are described in more detail below.

Sample area 3:
Open pit (North and West Walls), Nevada Gold Mine

North Wall: Little / no activity noted: The coherence over the measured (red polygon) shows higher coherence overall indicating little change and remains stable over time. This indicates no changes are present – it is likely that expansion of the mine to the north is unlikely based on this analysis.

West Wall: Activity noted: The coherence over the measured area is low over the time series indicating consistent changes, which could be an indication that blasting and continued expansion of the mine towards the west is likely.

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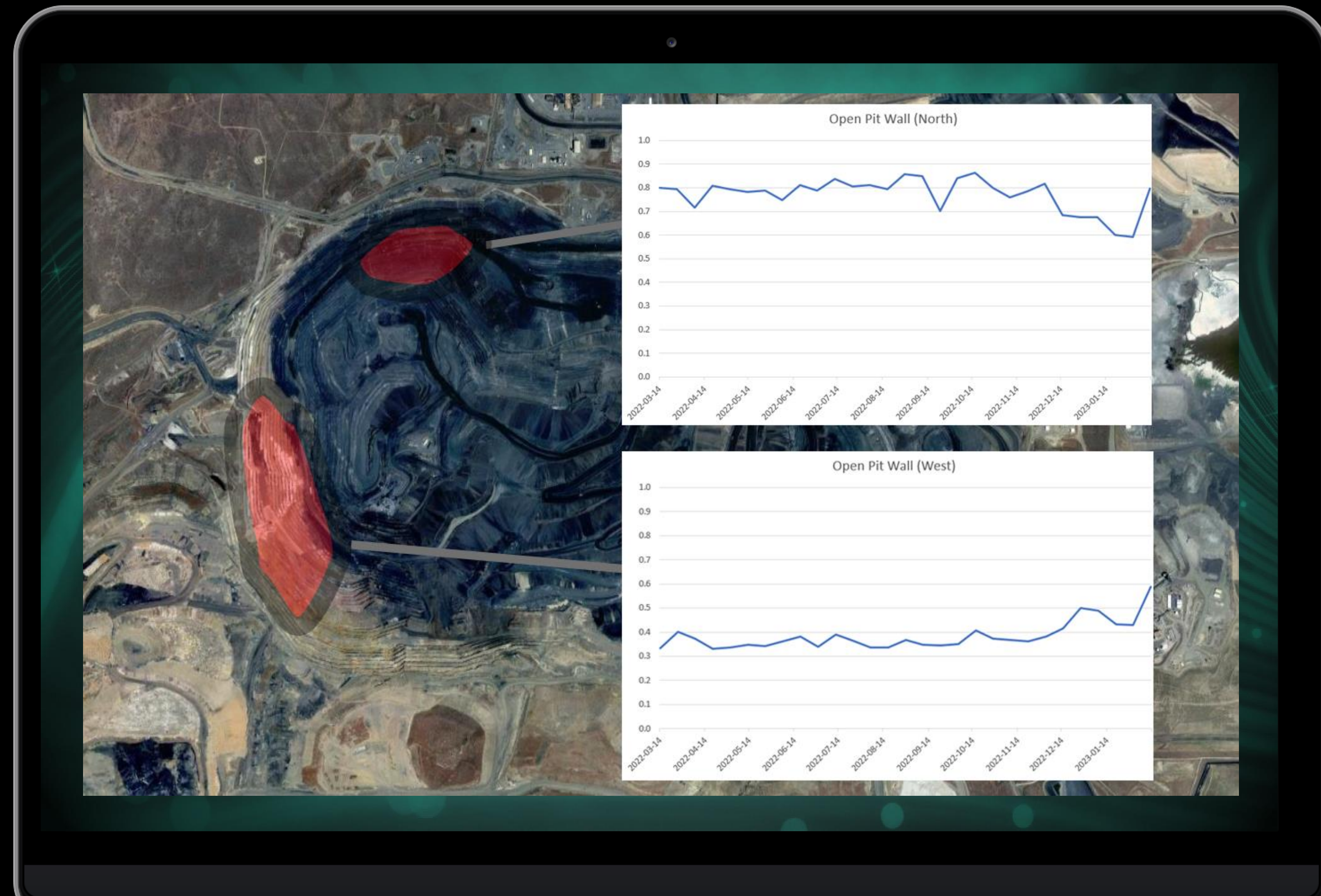
This Is Technology With Transformative Potential

And not just for industries like financial services. Its power is in its relevance for almost any industry, anywhere in the world.

With Coherence, there's confidence every day in knowing even the slightest change in activity is detectable. Alerts, immediate.

For health and safety teams, it informs more timely and appropriate protocols to better protect staff. For maintenance teams, it helps shape more effective resource management and planning strategies. Especially preventative measures to avoid major catastrophes.

While for the communities existing alongside these massive, dominating sites, it means greater levels of peace and comfort knowing there is an always ready, always alert system in place monitoring potential threats to their homes and families.

Similarly, while sudden shifts in activity are critical,

Coherence's monitoring of consistent, expected output is equally valuable.

Monitoring production levels, personnel activity, and on-the-ground traffic movements means greater levels of oversight at decision-makers' fingertips.

With extreme volatilities seen across the world in industries such as energy, imagine the commercial, market, and operational potential in knowing how active coal mines are at any moment, anywhere in the world. Or how active a oil drilling operations are. How regular on-shore wind farms are active.
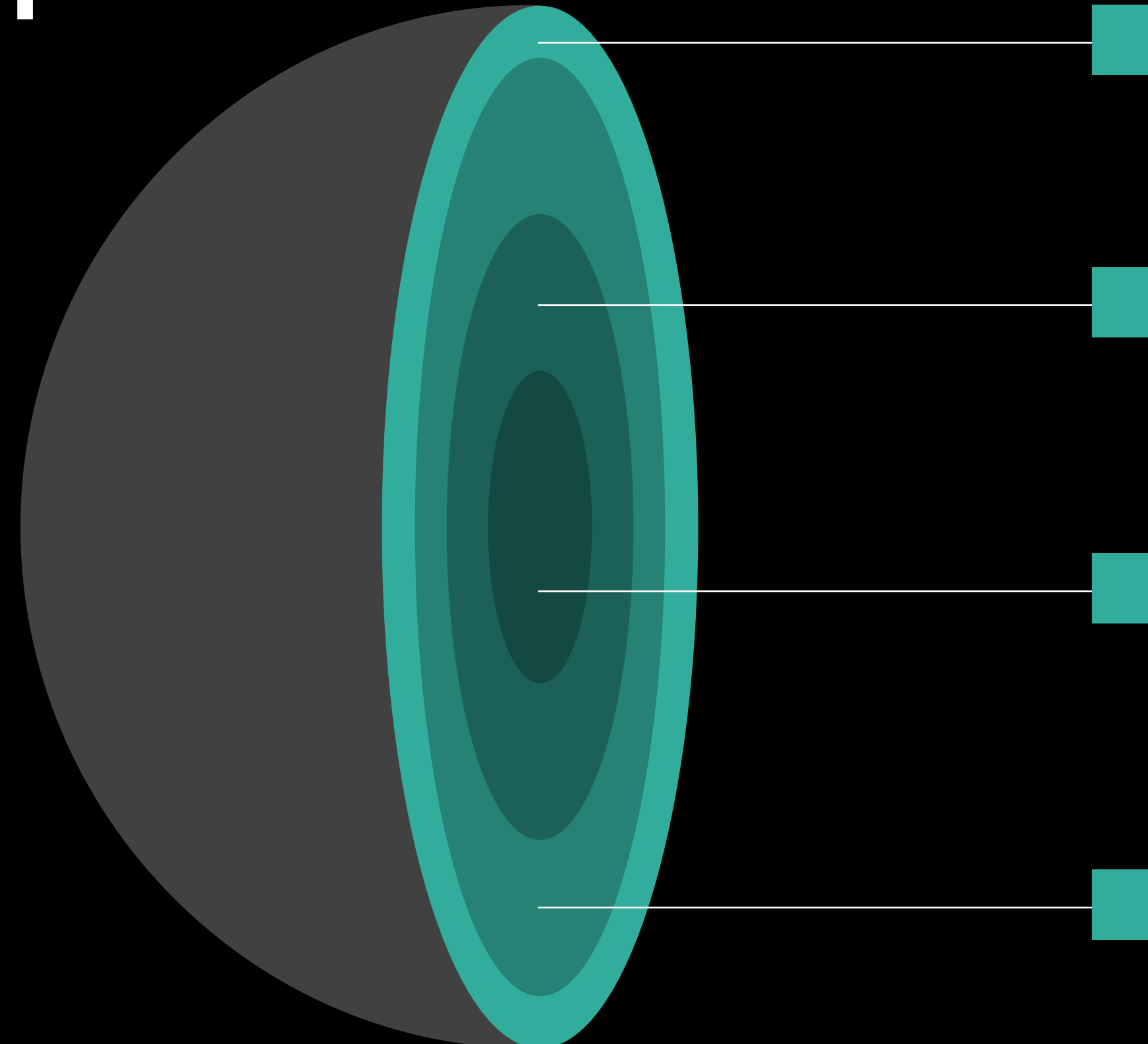
And the good news is - this isn't science simply to benefit geospatial experts.

Coherence is for today's decision makers.
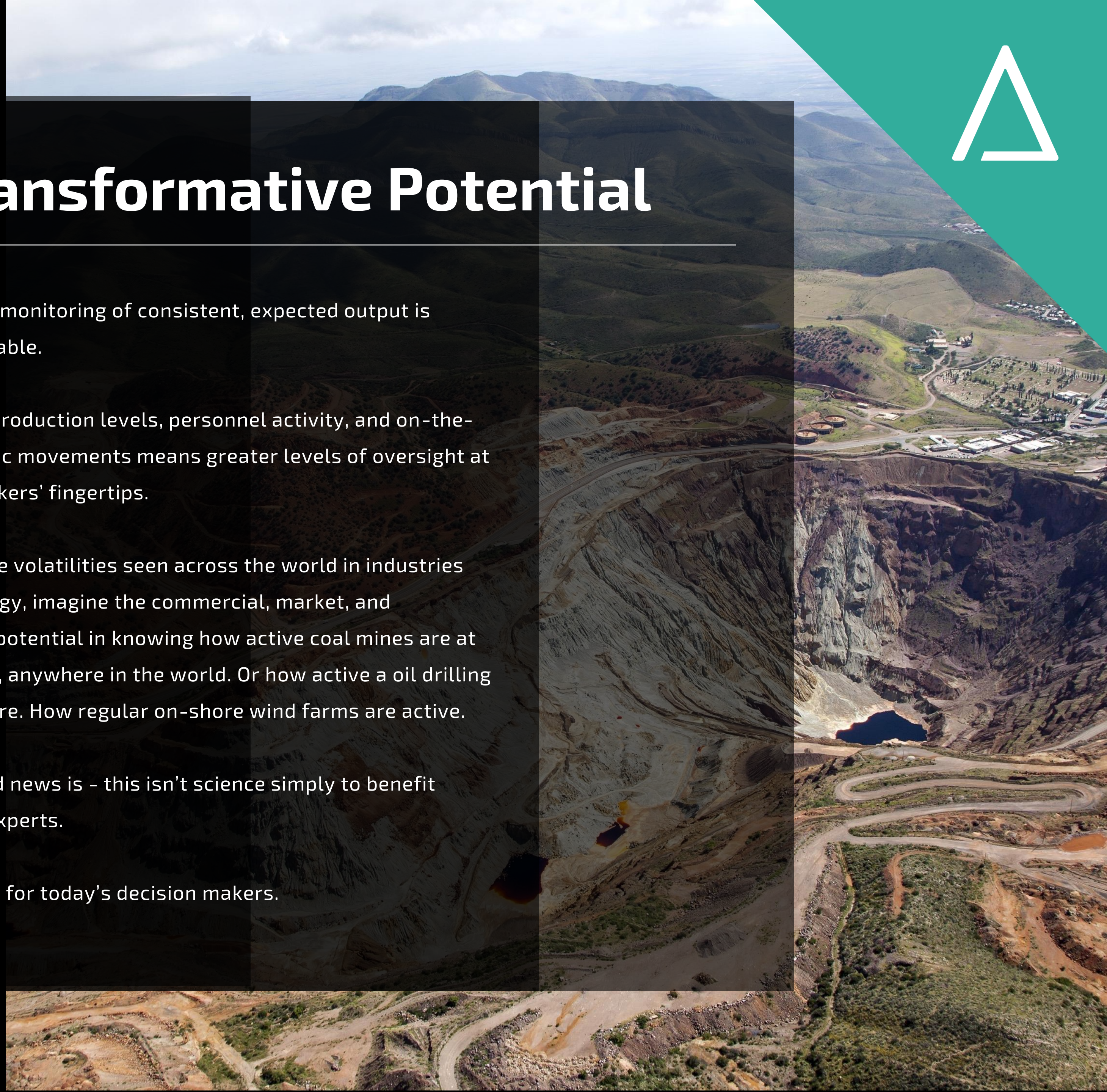
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Discover what CATALYST can do for you

Earth observation and analytics is no longer a tool for the specialists. Thanks to our cloud-based innovations.

CATALYST solutions are available to all businesses, teams, and decision makers.

CATALYST INSIGHTS delivers critical actionable data in a format that is easy to understand for the business community. With cloud enabled workflows.

CATALYST can provide sector wide historical and continued monitoring data within hours – providing a critical edge in accessing this new source of alternative data.

**Discover what they can do for you.
Get in touch with our team today.**

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