Mining Solutions with Satellite Imagery

GeoEye®
Elevating Insight

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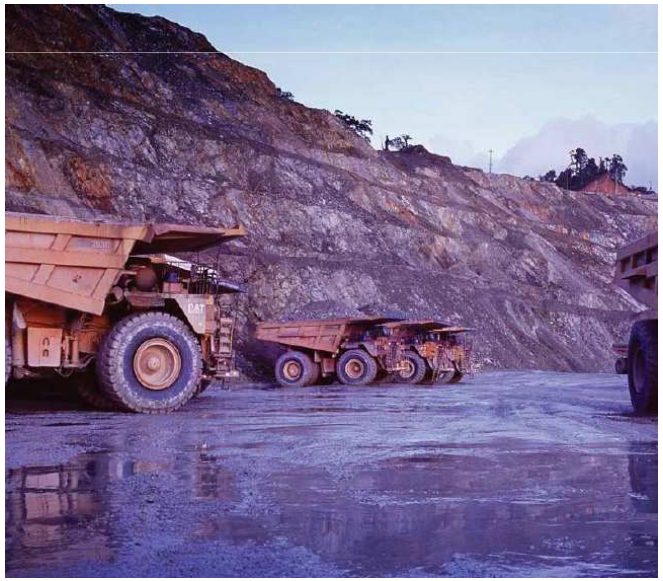
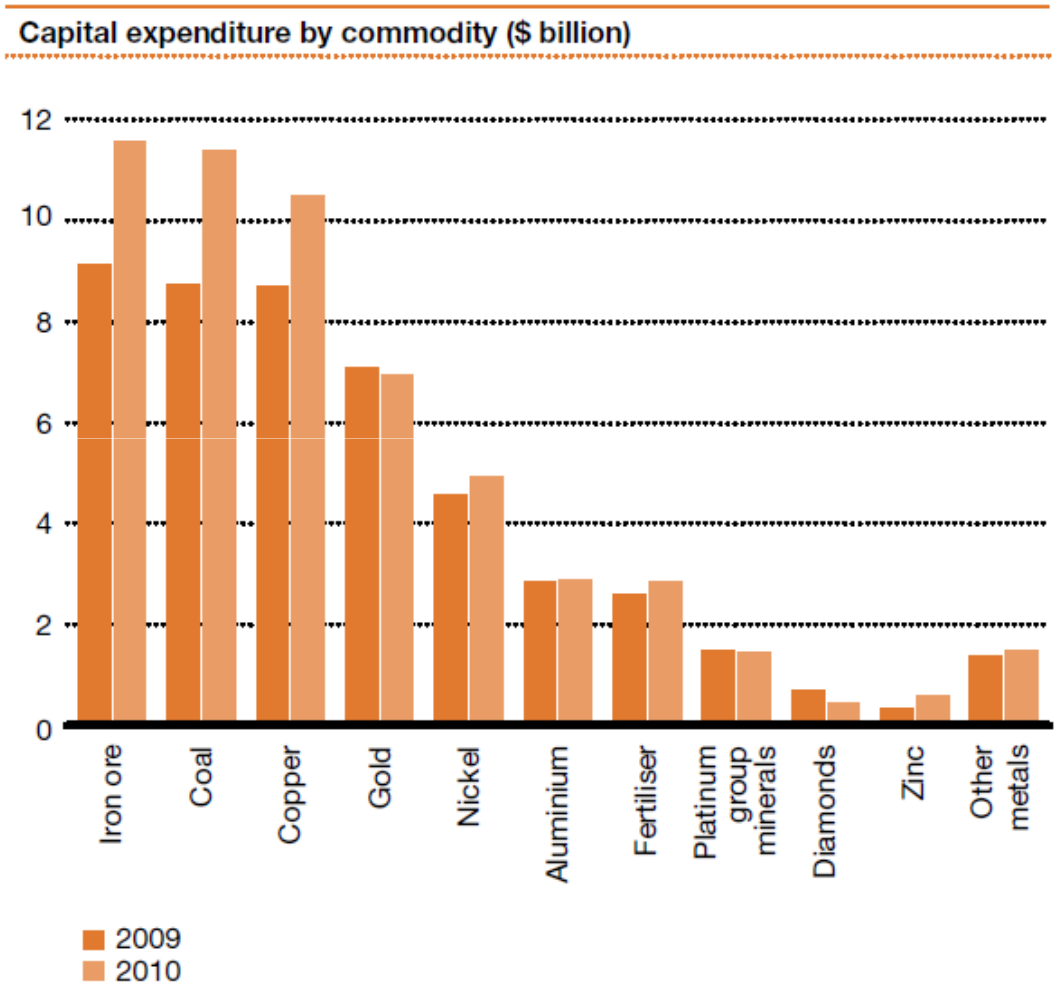
Mining Industry Trends

- Demand continues to be stoked by strong growth in emerging markets.
- Supply is increasingly constrained -more complex and in remote, unfamiliar territory.
- Increase in cost base of the industry
- The Top 40 mining companies have more than $300 billion of capital programs with over $120 billion planned for 2012.
- Investment in new supply is increasingly focused on emerging markets
- Customers and governments enter the industry



Source: PwC Analysis

Capital Expenditure by Commodity



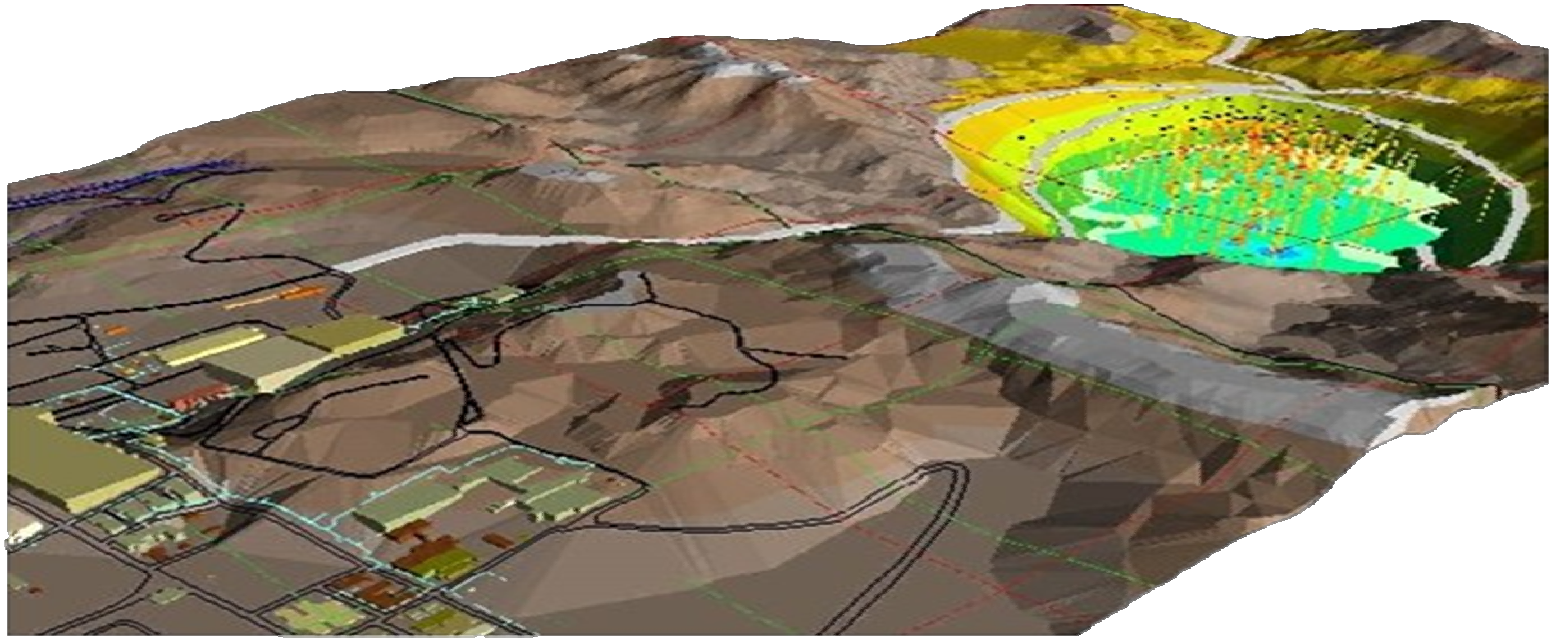
Source: PwC analysis.

Markets Served & Solutions

- New Project Development (Accelerated Delivery & Reduce Cost)
- Asset/Site Monitoring (Volumetric Analysis)
- Regulatory/Environmental Compliance (Reduce exposure to external conditions)

New Project Development

In the planning stages as in day to day operations of a mine, **satellite imagery** can be used as an easily updatable platform/base layer for ever-changing vector data and resource management



New Project Development

Feature extraction for mine planning

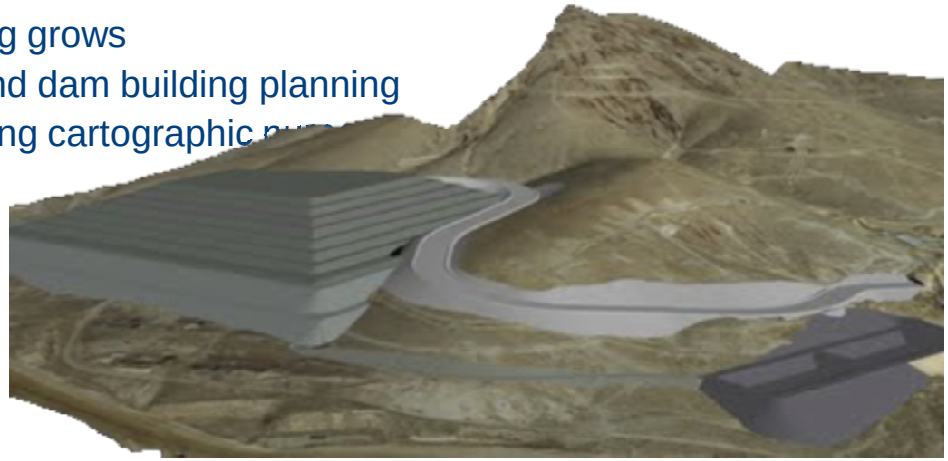
Use of **satellite imagery** substitutes for traditional survey techniques to accurately survey and map future mine locations.

Using the traditional methods of survey can be difficult due to the remote and sometimes dangerous or inaccessible locations of many mines.

Through the use of GeoEye's highly accurate stereo and ortho-rectified imagery, comparably accurate surveys and mapping results can be attained and minimizes the problems of local subcontracting for such work.

Other samples of imagery applications in the mine planning process:

- Mine site design
- Asset management
- Infrastructure planning
- Stockpile positioning planning
- Waste dump sites locations planning
- Expansion planning and strategy as site building grows
- Water resources management and mapping, and dam building planning
- Road network mapping and other vector digitizing cartographic
- Audit surveys

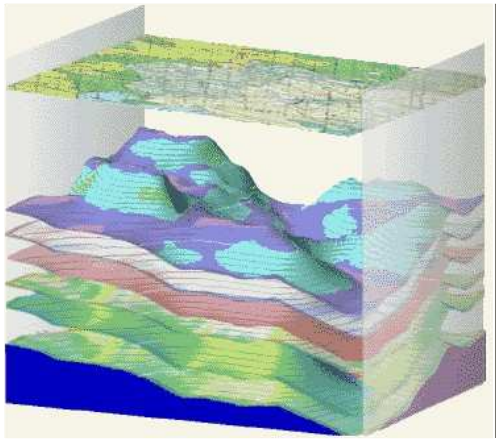


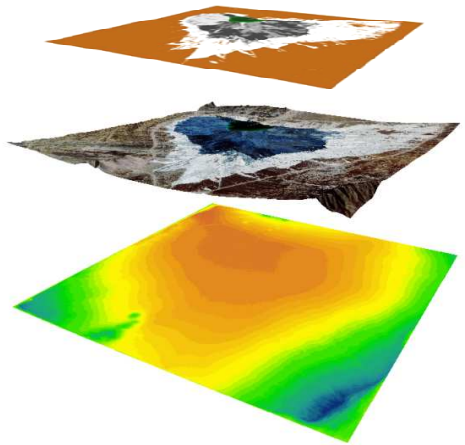
New Project Development

Global geological exploration/investigation strategies

Properly interpreted **satellite imagery** can save corporations millions in unnecessary exploration and development efforts and at the same time provide geologic clues to the discovery of reserves.

- Conceptual methodologies use current knowledge about the ore-body formation to identify those areas which are most likely to contain significant mineralization and map the geology and the faults and fractures that localize ore deposits
- Empirical methodologies analyze for spatial relationships between known deposits and surrounding features.
- Identified spatial relationships are quantified and ultimately integrated into a single thematic map which depicts and highlights areas similar to those known to contain significant mineral deposits and prospectively maps can be created
- **Satellite images** are used to interpret both structure and hydrothermal alteration. Digitally processed thematic ratio images can identify deposits of hydrothermal minerals by their spectral signatures; iron minerals and clays





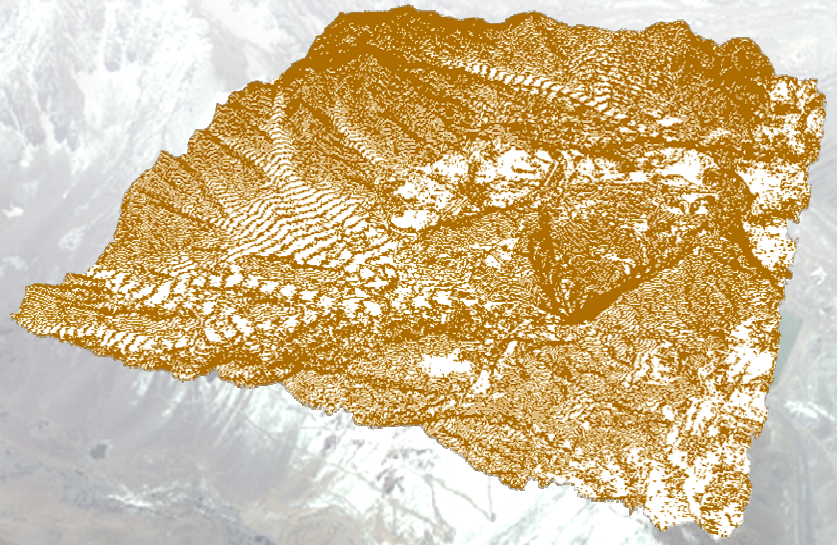
New Project Development

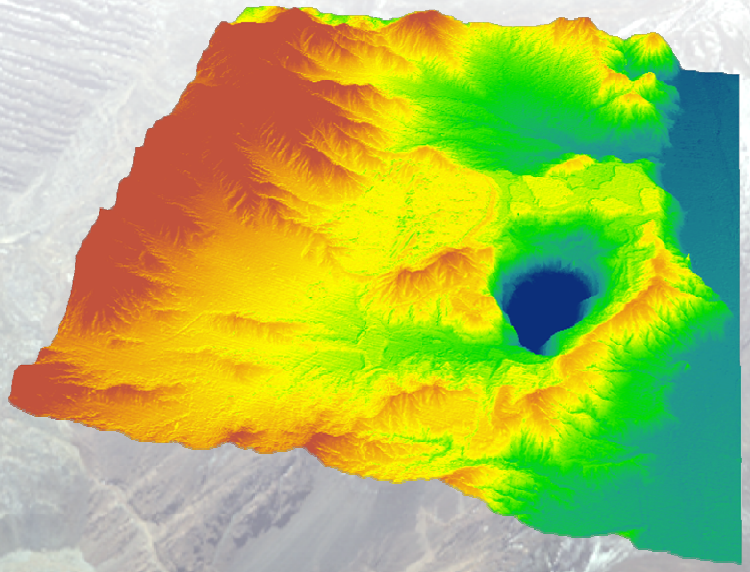
New Project Development

Mine Site Monitoring

GeoEye's high resolution, high accuracy, stereo and Ortho-rectified imagery creates Digital Elevation Models (DEMs) and 3D visualization products to assist in monitoring of mine sites

Use of imagery for change detection is imperative throughout the life cycle of a mine





Monitoring and Change Detection

Feature extraction for change detection

Frequent revisit times and large area coverage capability, **satellite imagery** eliminates much of the ground work study needed in day to day operations

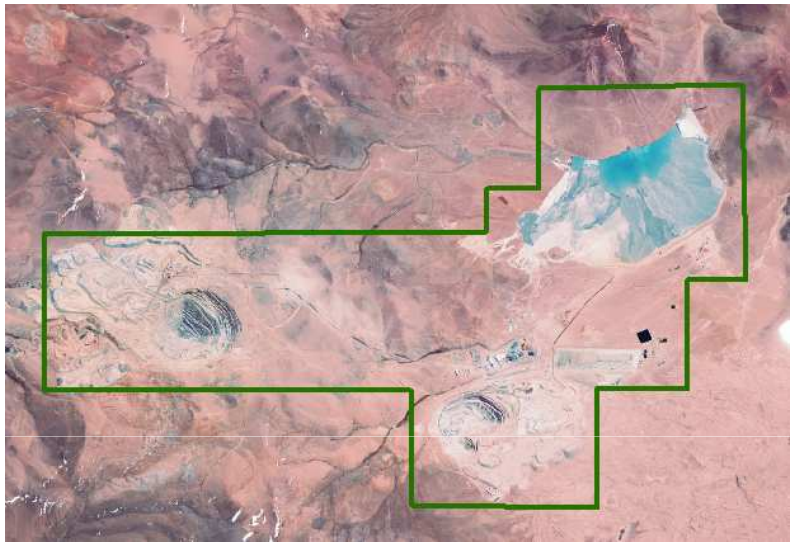
Higher accuracy measurements are possible as imagery collections are more frequent and other derived measurements are more continuous

Advanced feature extraction techniques can be used for day to day operations to perform highly accurate topographic analysis and attain just as accurate linear, angular, area and volumetric measurements

- Stockpile and pit volume measurements
- Water resource/reserve management and quantification
- Mining site infrastructure, road network mapping , asset management , and other vector digitizing purposes
- Regulation and compliance monitoring

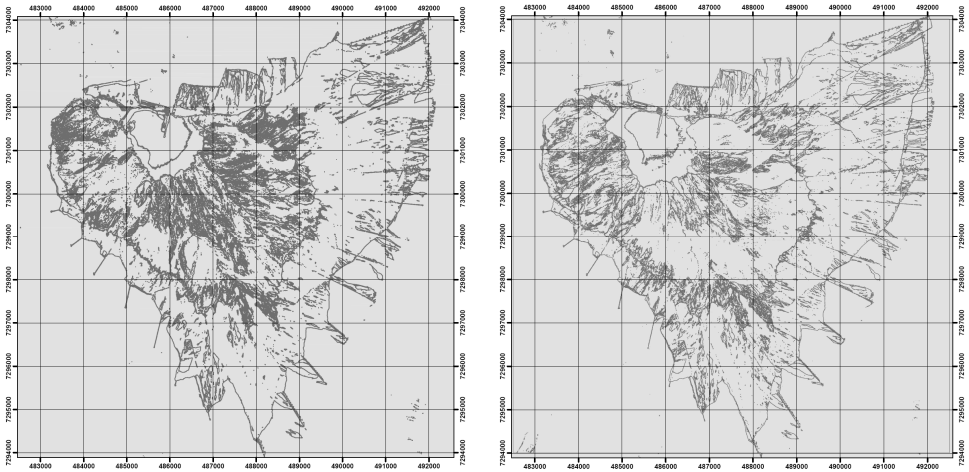
Collahuasi, Chile

0.50 cm collections twice per month



Temporal Change Detection

Ortho-imagery classification vector maps, created using imagery of different dates to detect change in topography and water levels. IKONOS imagery July 7, 2010 and July 16, 2010 – from left to right.



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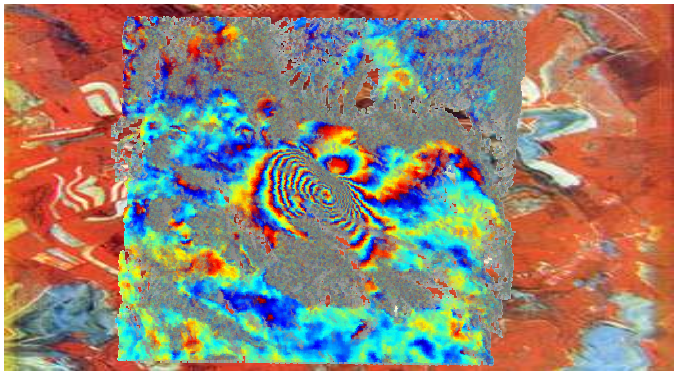
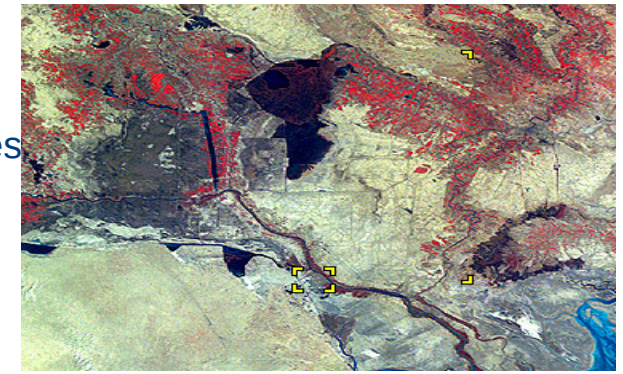
Environmental Monitoring

Environmental impact **monitoring** and vegetation analysis

Multi-temporal satellite imagery, monitoring and analysis of different mine features, such as waste, water bodies, change of land use, reclamation and re-vegetation processes and estimation of pre and post vegetation density cover, can be accurately and properly quantified and documented.

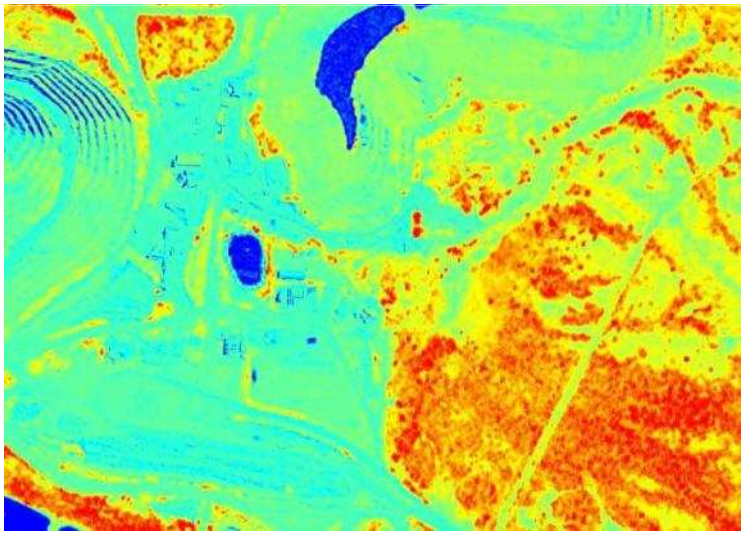
- Early reclamation planning
- Regulation and compliance planning and documentation
- Timely expansion of waste site locations
- Water bodies can be classified into different spectral classes depending on their hydro-chemical properties



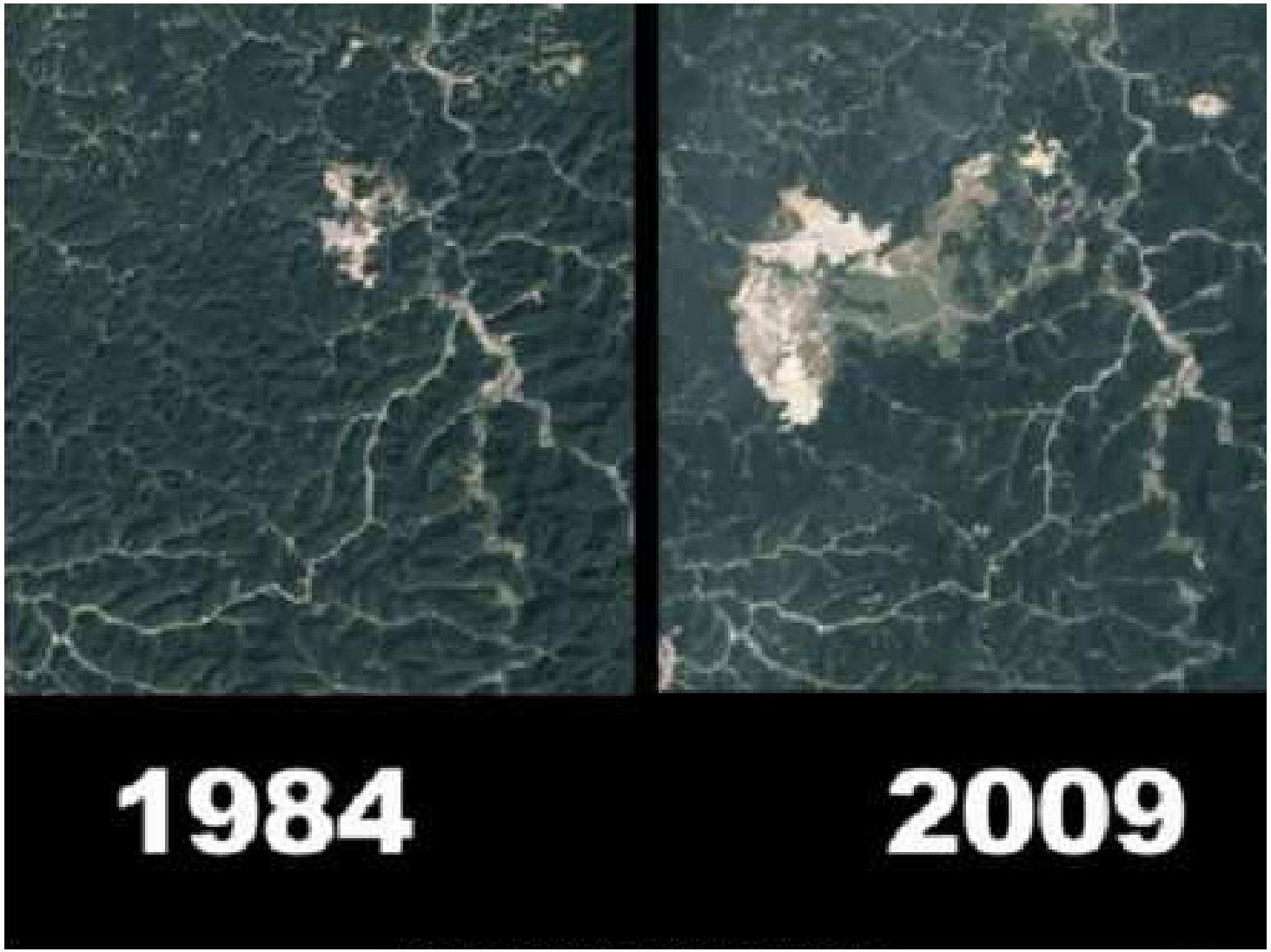


Environmental Monitoring

- Imagery - delivered in digital format,
  - provided both Near Infra-Red & Visible Color bands
- Allows vegetation health assessment on rehabilitated sites

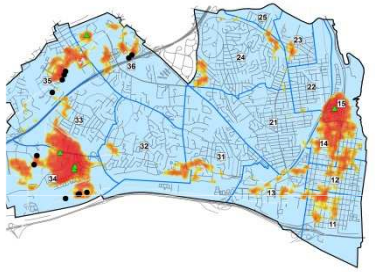


Case study provided by AAM Pty Ltd, a GeoEye partner



What does GeoEye provide?

Geospatial information and insight for decision makers who need a clear understanding of our changing world



Earth Imagery

Geospatial Expertise

Enabling Technology

Protecting Lives, Managing Risk, and Optimizing Resources

GeoEye Constellation

GeoEye-2
2013
0.34m

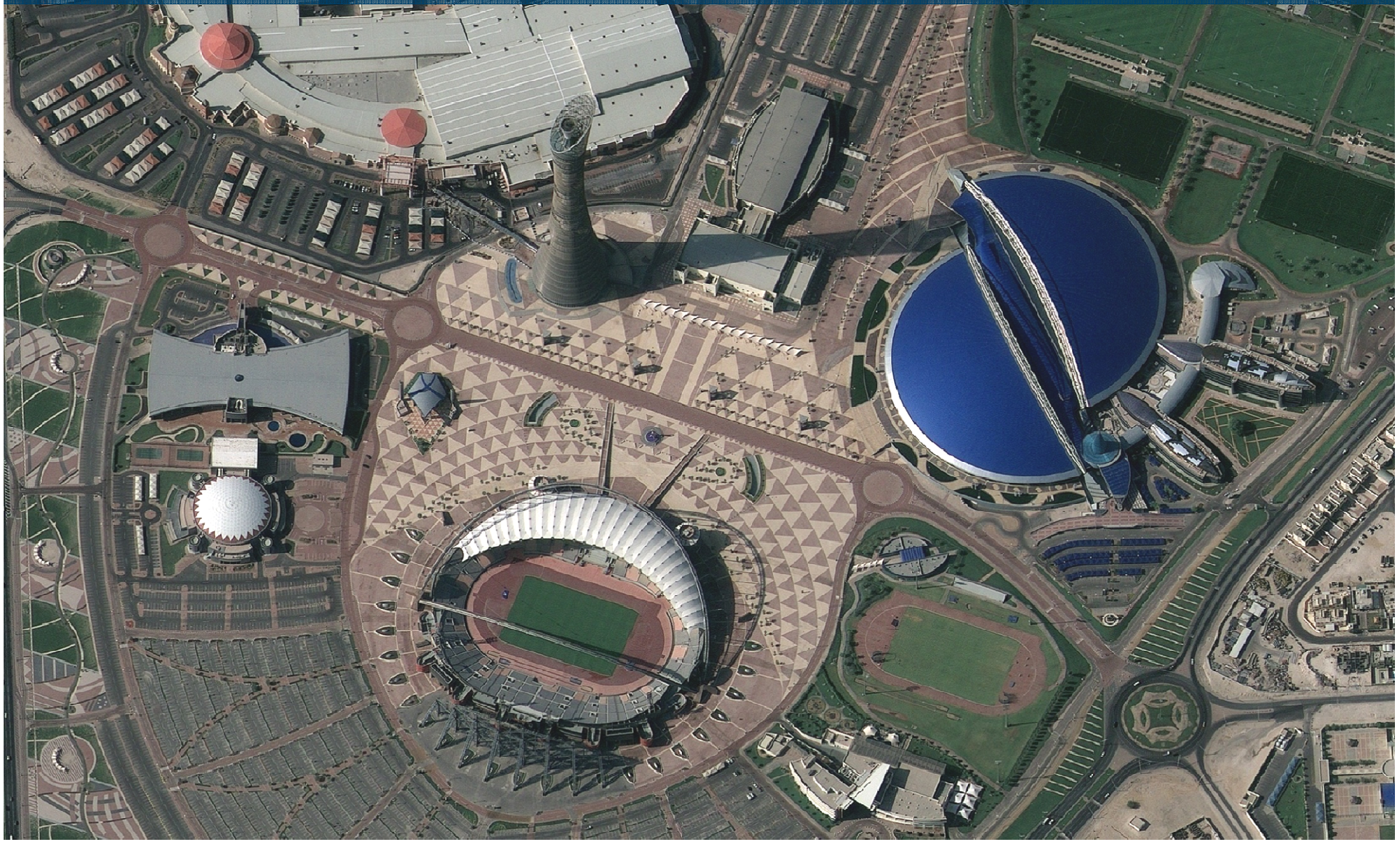
GeoEye-1
Sept. 6, 2008
0.41m

IKONOS
September 1999
0.82m

World's Highest Resolution and Accuracy

Thank You!

GeoEye
Elevating Insight



Top 10 Mining Companies by Value

Top Mining 10 Companies

	Market Cap (USD)
BHP Billiton	178.9 B
Rio Tinto	94.6 B
Vale	60.9 B
Xstrata	48.2 B
Anglo American	43.7 B
Barrick Gold	42.5 B
Glencore	40.7 B
Freeport-McMoRan	38.6 B
Goldcorp	37.9 B
PotashCorp	37.6 B

- All info sourced from http://www.infomine.com/companies-properties/