



Exploration

CMD 20 November 2013

Jonas Wiik
Exploration Director
Boliden Mines

 **BOLIDEN**

Exploration

Mines

Smelters

Recycling

What we do

Why we do it

How we do it



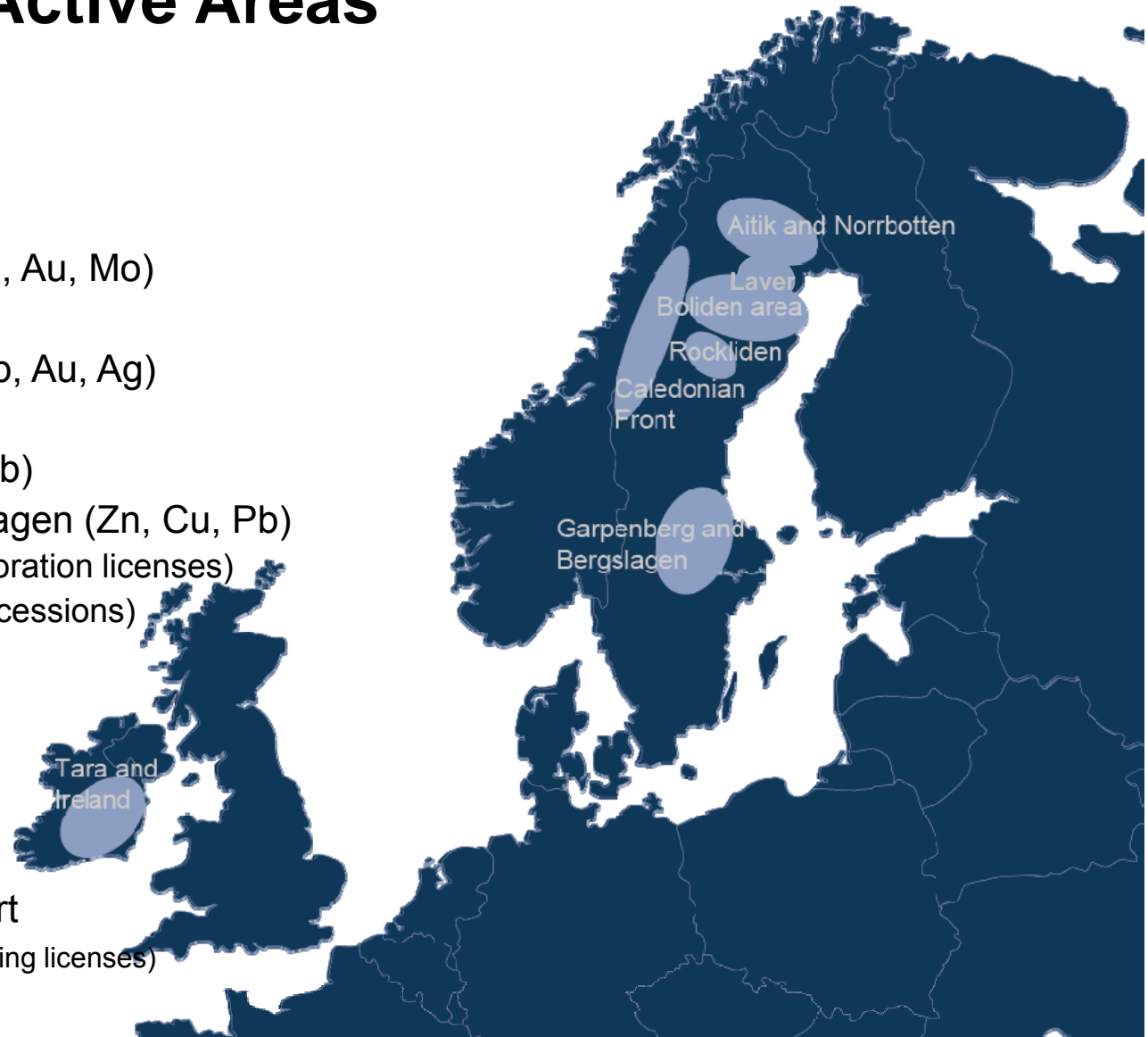
Exploration - Active Areas

Sweden:

- Aitik and Norrbotten (Cu, Au, Mo)
- Laver (Cu, Au)
- Boliden area (Zn, Cu, Pb, Au, Ag)
- Rockliden (Cu, Zn, Ag)
- Caledonian Front (Zn, Pb)
- Garpenberg and Bergslagen (Zn, Cu, Pb)
 - 3.000 km² (~ 170 exploration licenses)
 - 60 km² (90 mining concessions)

Ireland:

- Meath (Tara area)
- Limerick
- Tullamore
- Strokestown & Slievedart
 - 2.800 km² (~90 prospecting licenses)





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Exploration Organisation Sweden

Head of Exploration
  Jonas Wiik

Near Mine Exploration
  Mie Munck

Field Exploration North
  Pia Fagerström

Field Exploration South
  Ann Allen

Exploration Technology
  Bertil Sandström

Exploration Geology R&D
  Rodney Allen
  Benny Mattsson

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  Alexandra Berglund	  Oakley Turner
  Fredrik von Weisz	  Annika Wasström
  David Dreijng-Carol	  Maartje Van Dijk
  Susanne Holmen Fröberg	  Åsa Erifeldt
  Paulina Nordfeldt	  Peter Karlsson
  Annett Uhlmann	  Jonas Lasskogen
  Eva Lundquist	  Anthony Lawther
  Roger Nordin	  Martin Lindfors









  Joachim Albrecht	  Anders Zettergren
  Mohsen Banaie Fard	  Holger Paulick
  Anders Gren	  Juhani Nylander
  Sebastian Knipfer	  Henrik Johansson
  Erik Nordfeldt	

  Sebastian Wareing
  Jan-Olov Ost
  Hein Raat
  Peter Lindholm
  Joakim Lundqvist

Instrument Development

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  Jonny Olofsson

Geophysics

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  Adriana Berbesi-Stenfeldt
  Mikko Mali
  Katri Vaittinen

Core Archive

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  Fredrik Linder-Nordberg	  Constanze Kreiss
  Ulla-Britt Lundström	

  Mac Fjellerud Persson	  Jarkko Lamminen
  Tobias Hermansson	  Ditte Kilsgaard-Møller
  Nils Jansson	  Kristofer Lundqvist

Geophysical Surveys

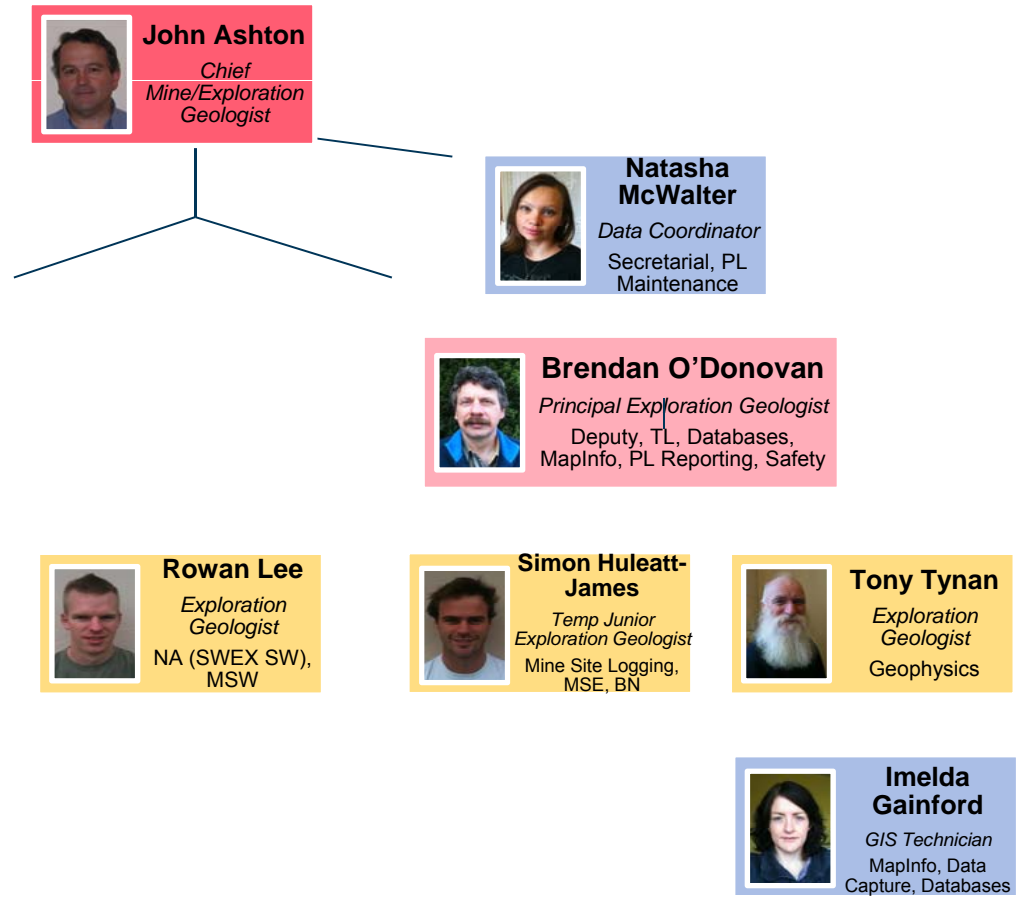
  Dan Dahlberg	  Lars Sjölund	  Mats-Ove Johansson
  Anders Marklund	  Kenneth Persson	  Mikko Pekkanen
		

Geodata/Tenement Management

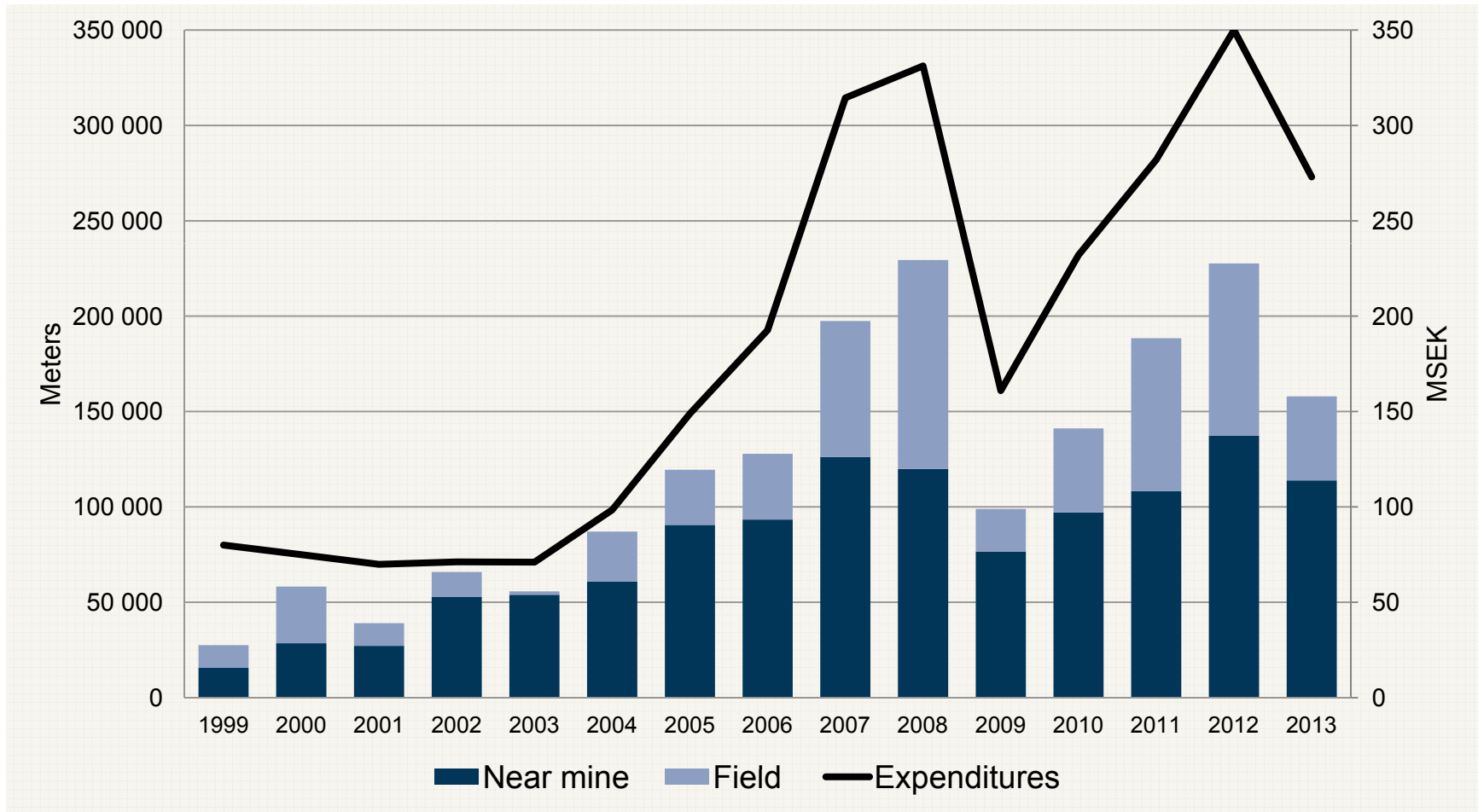
  Kirsi Ronkainen	  Monica Johansson
  Roberto Andersson	  Hanna Söderberg
  Christine Bodén	  Fredrik Vikström
  Agnetha Steinwall	  Henrik Aslund
  Linnea Hisved	



Exploration Organisation Ireland

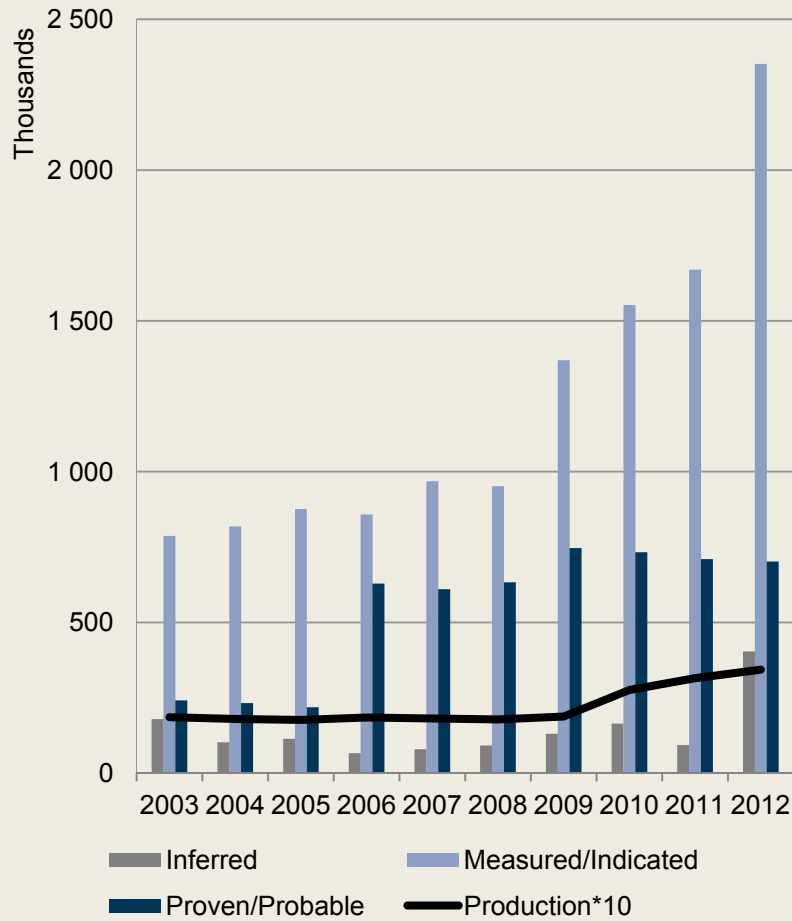


Core drilling & exploration expenditures 1999-2013

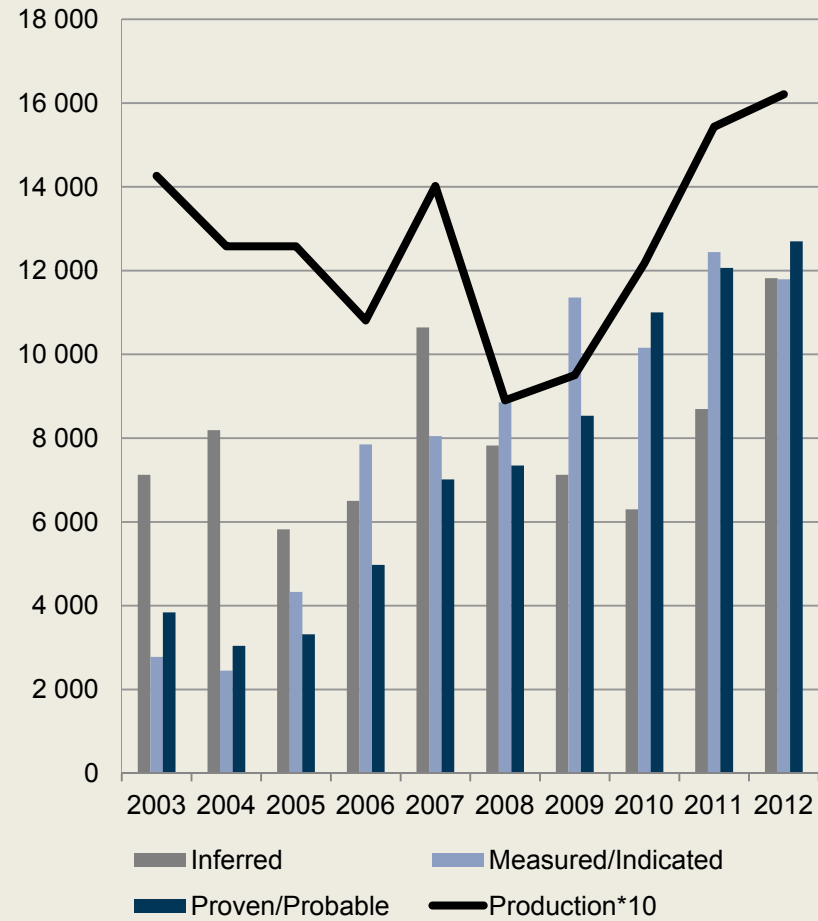


Aitik & Boliden area – 2012

Aitik

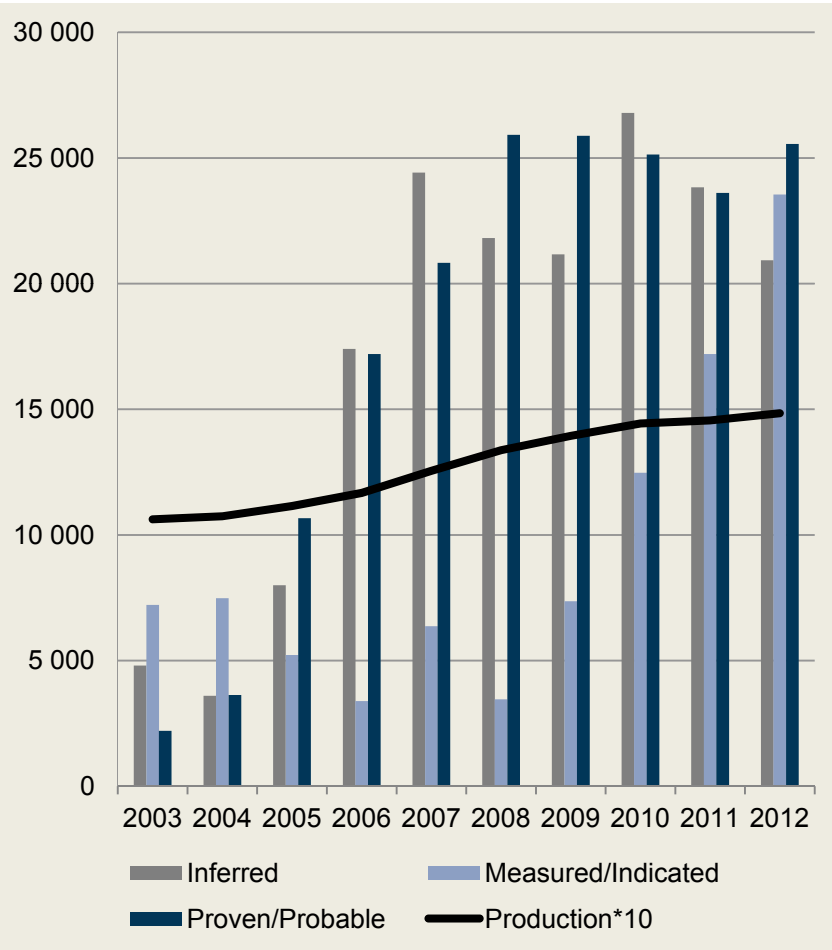


Boliden Area

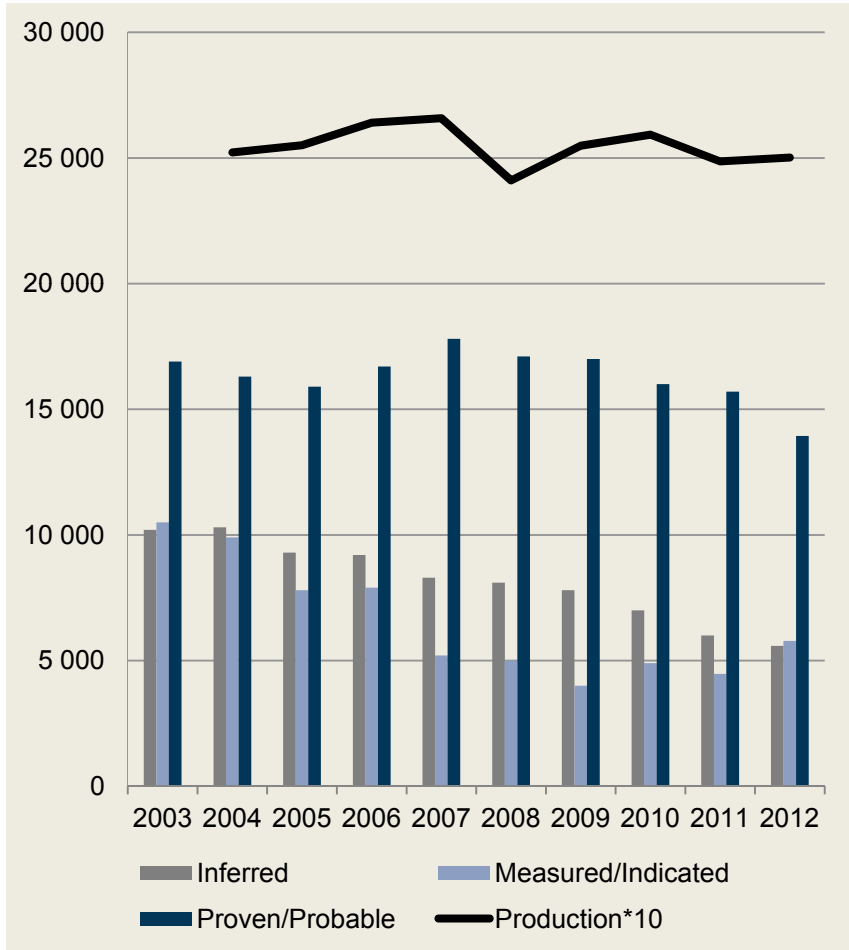


Garpenberg & Tara – 2012

Garpenberg

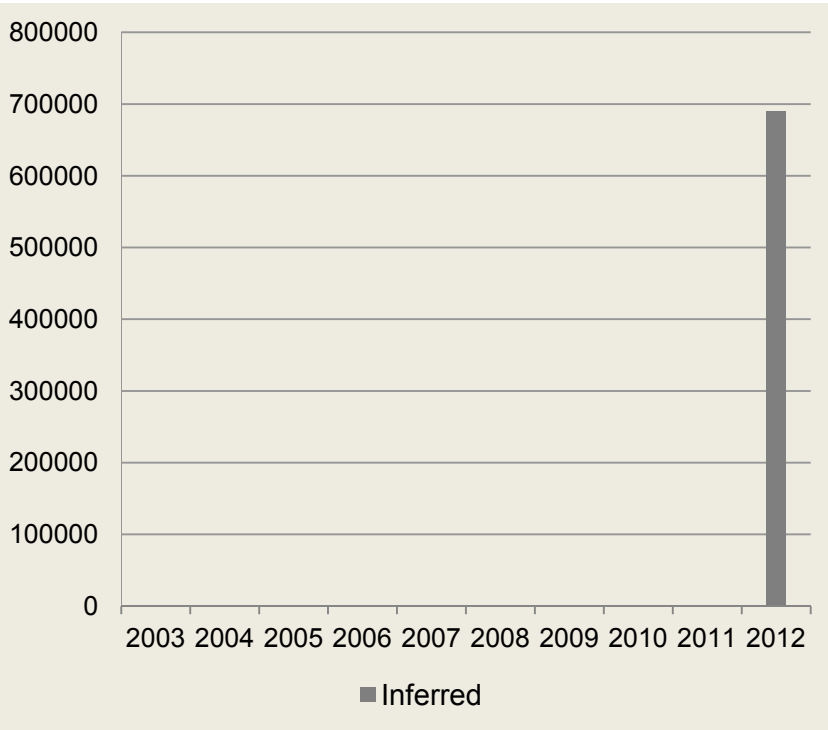


Tara



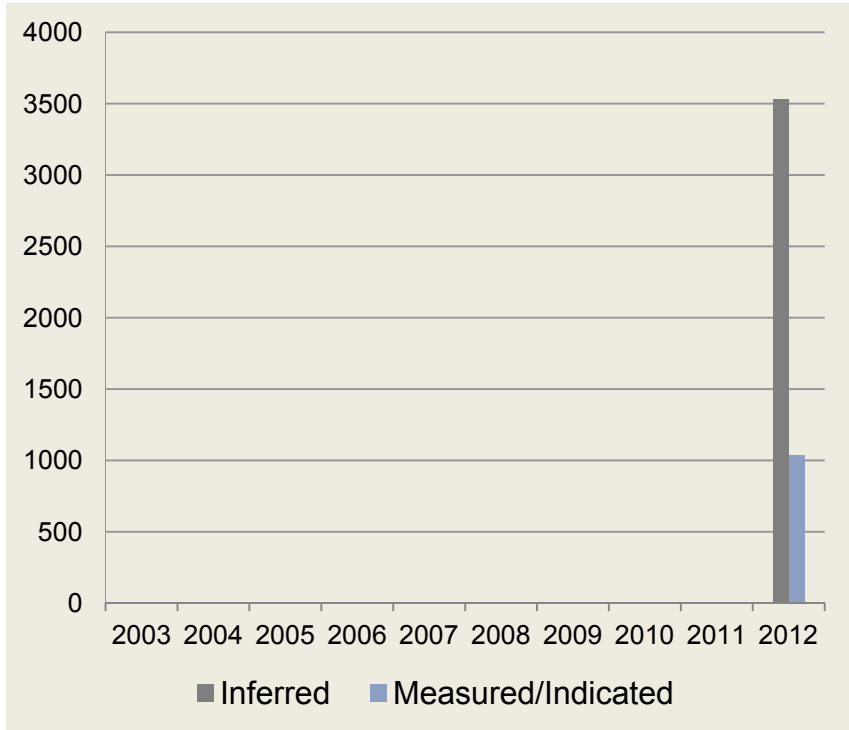
Added resources in 2012 – Laver & Rockliden

Laver



- New inferred mineral resource
- On-going exploration
- On-going conceptual study

Rockliden



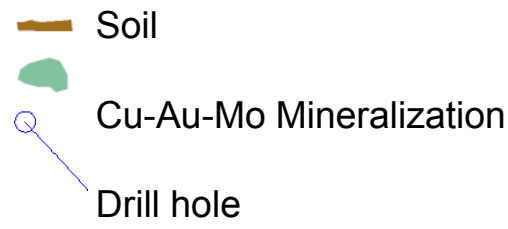
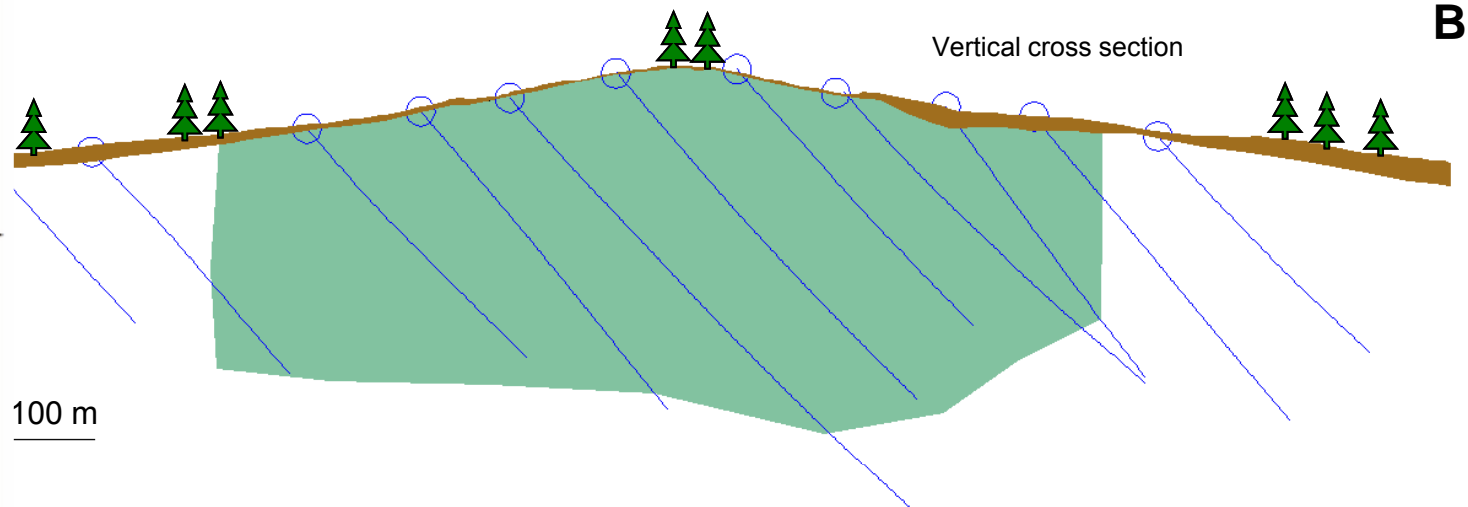
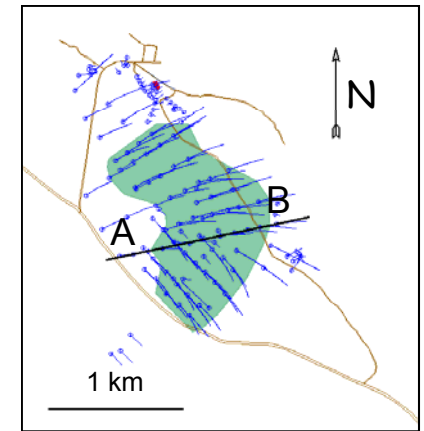
- New inferred and indicated mineral resource
- On-going exploration
- On-going conceptual study



Laver Update 2013

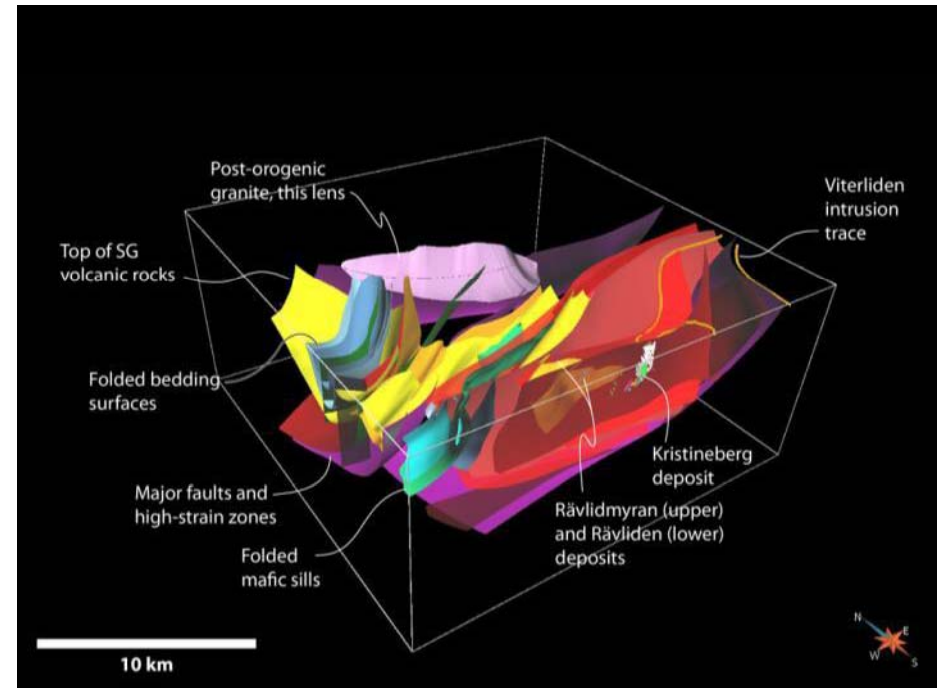
- Diamond drilling
- Field mapping
- Airborne and ground geophysical surveys
- On-going conceptual study

Horizontal view

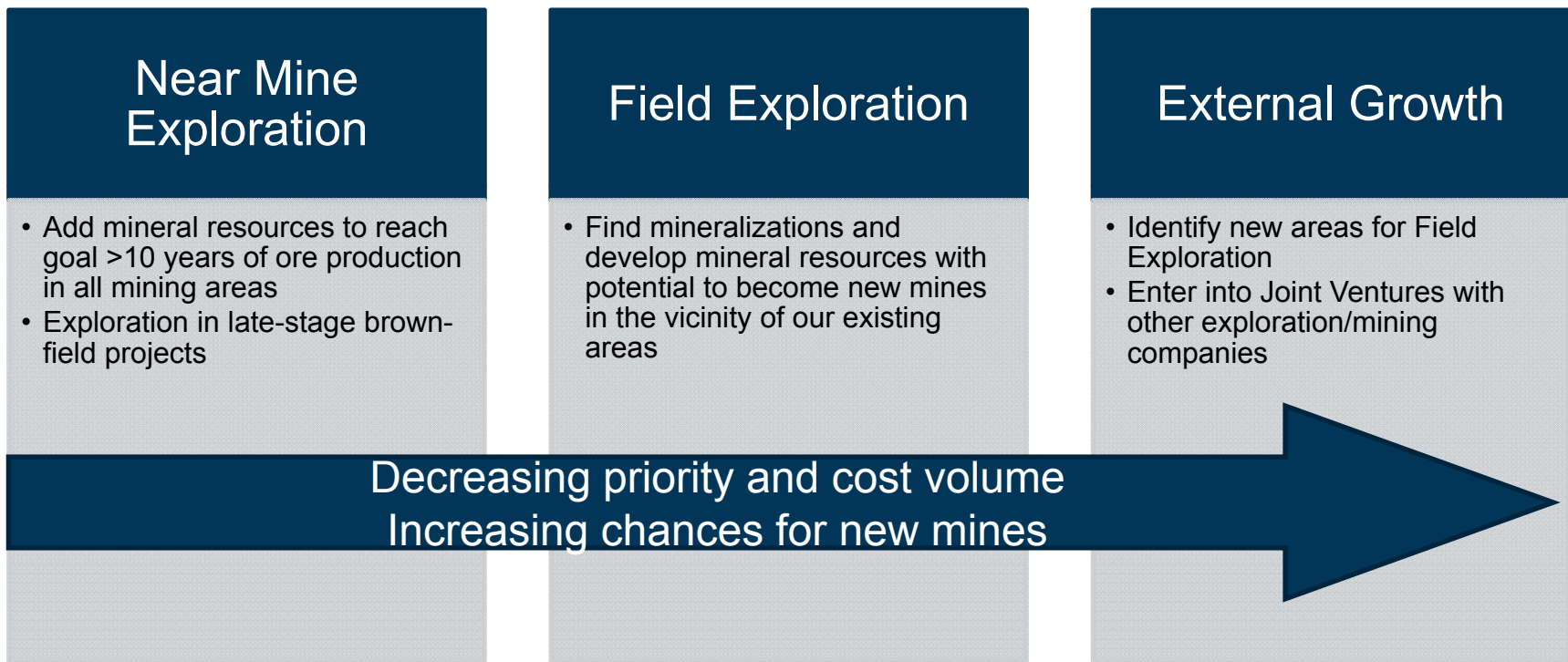


Exploration

- Goal of 10-year production lifespan at each mining area
- Near Mine and Field exploration
- Track record in finding deposits
 - ~45 different deposits discovered
- Zinc, copper and precious metals
- Long tradition in developing geophysical instruments
- Over 30 active projects
- Latest major discovery – Laver



Exploration strategy



Exploration

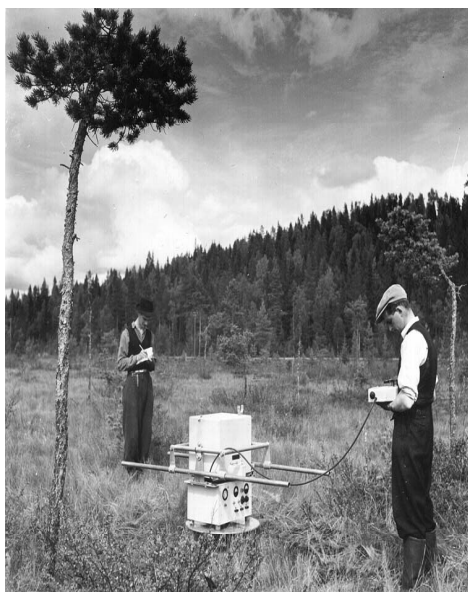
Key factors in successful exploration

- Safety Culture
- Geological and geophysical expertise
- Access to areas of land and cooperation with land owners and stake holders
- Best practice methods and tools
- Long term planning



How we work

Geophysical ground surveying



1936



1965



2010

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How we work - Geophysical instruments used and *developed* by Boliden

- 1918 Equipotential method
- 1923 *Two-frame method*
- 1936 *Boliden gravimeter*
- 1945 *Slingram (HLEM) 3600Hz*
- 1950 *Airborne EM* - and magnetic survey
- 1950 Worden gravimeter
- 1969 Hetona Downhole 3-comp MAG
- 1970 *VLF-E E-field 30 kHz local transmitter*
- 1970 *IP Induced polarisation*
- 1980 *BHEM Downhole 3-comp EM*
- 1980 TEM Transient-EM
- 1980 *Airborne MEM*
- 1980 *Downhole Radar*
- 1984 *MAG Magnetic method*
- 1986 *EM3 Ground-EM 3-comp*
- 1986 *BHIP Downhole-IP*
- 1990 Scintrex Gravimeter CG3
- 1990 Ground Penetrating Radar
- 1992 *BHMAG Downhole 3-comp MAG*
- 1995 *EM3 Ground-EM 3-comp with GPS*
- 1995 *Downhole 3-comp MAG on drillrod*
- 1996 *Downhole 3-comp EM on drillrod*
- 1998 GEM Magnetometers GSM-19
- 1999 *Downhole 3-comp EM/MAG on drillrod*
- 2002 *EM3-4 frequencies GPS-synchronized*
- 2003 *IP GPS-synchronized ground system*
- 2004 *4 frequency downhole 3-comp EM*
- 2004 *MAG Ground magnetic instrument (GPS)*
- 2009 Scintrex Gravimeter CG5
- 2010 *Portable IP-transmitter (GPS)*



How we work

Mapping / Sampling / Logging

In order to understand the origin of the rocks and where mineralization can be expected to be found, samples are sent to a laboratory for analysis.

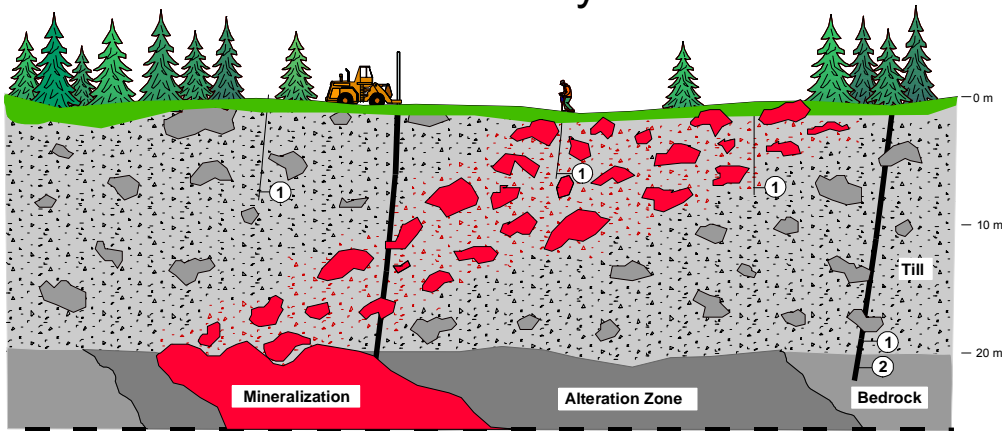


The study of rocks enables geologists to make better predictions as to where mineralization could be found.

How we work

Geochemistry and Drilling

Geochemistry



— Drilling with tractor-mounted drill
— Sampling with handheld drill

① Till sampling
② Bedrock sampling

Sampling and assaying the soil and top bedrock in the search of mineral deposits

Drilling



In the end of the day drilling is needed to test anomalies, verify models and delineation of mineral deposits

Zooming in to targets



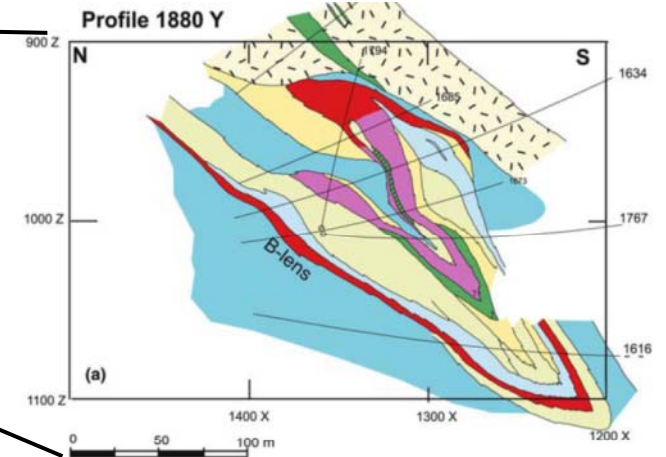
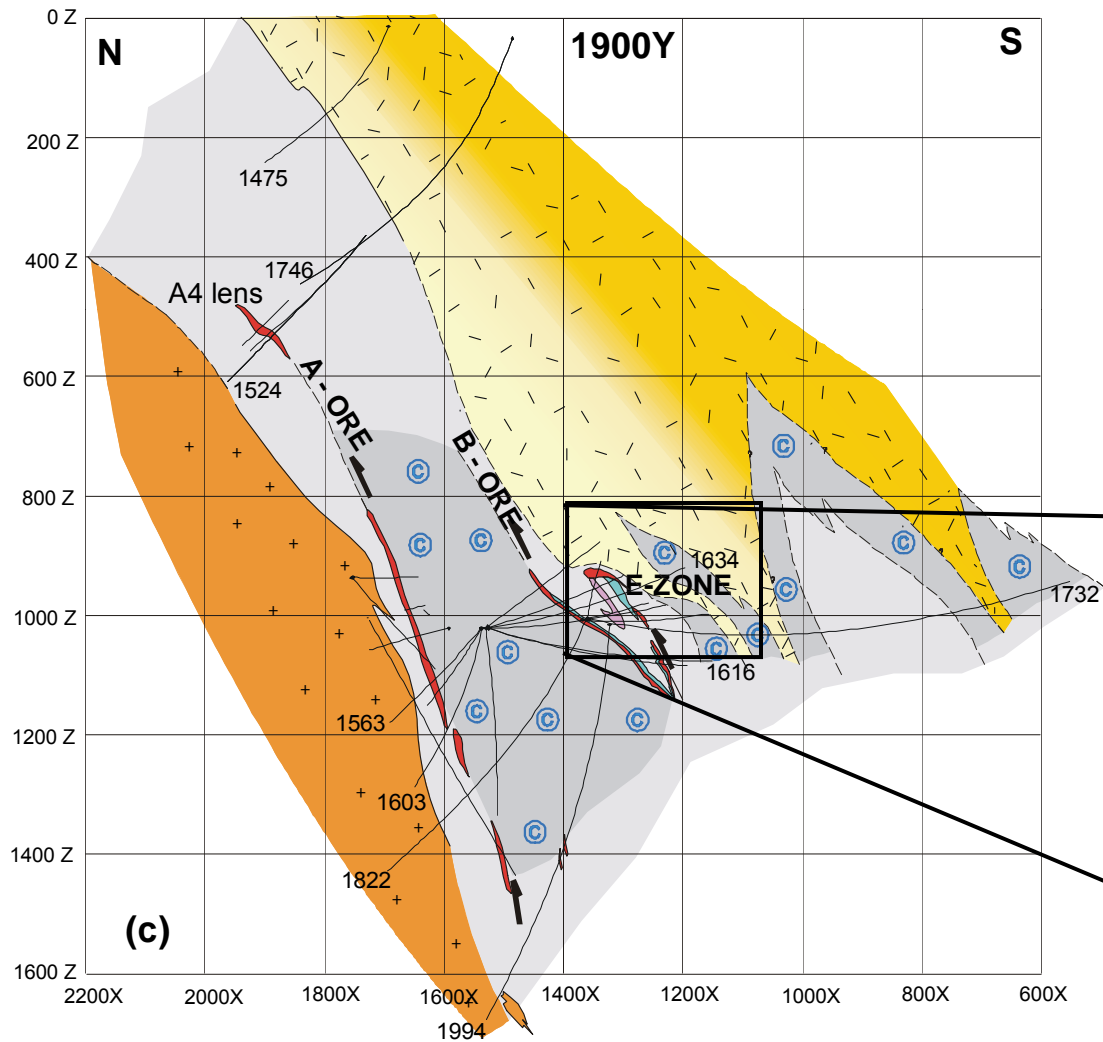


How we work - Core archive

- Core archive – different warehouses containing in total ~1,800 km of drill core
- Photographing – all cores photographed and digitally stored
- Sample preparation – Sawing and packing of drill core before sending off samples to laboratories

How we work

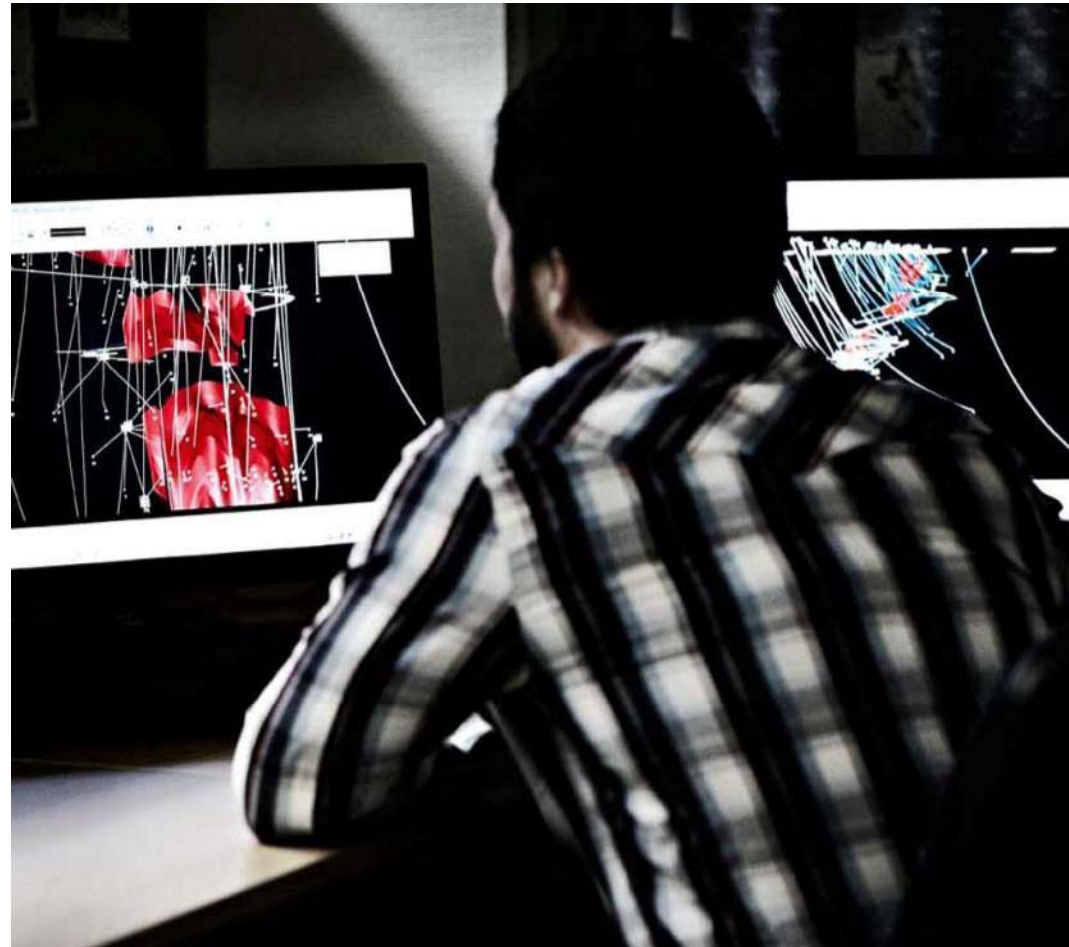
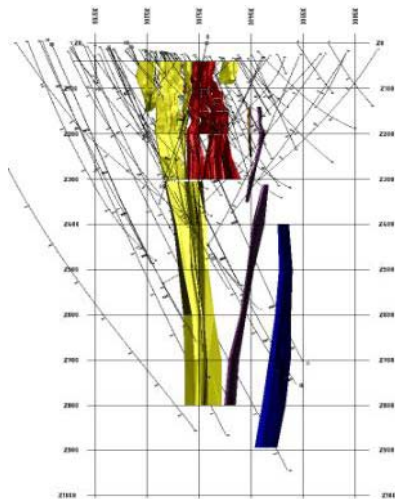
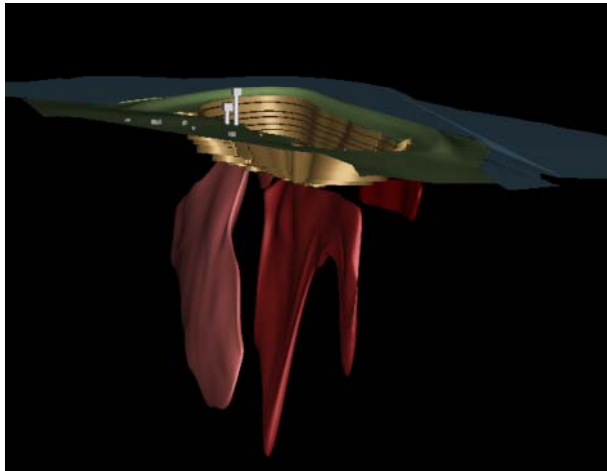
Interpretation, geophysical/geological modelling and delineation



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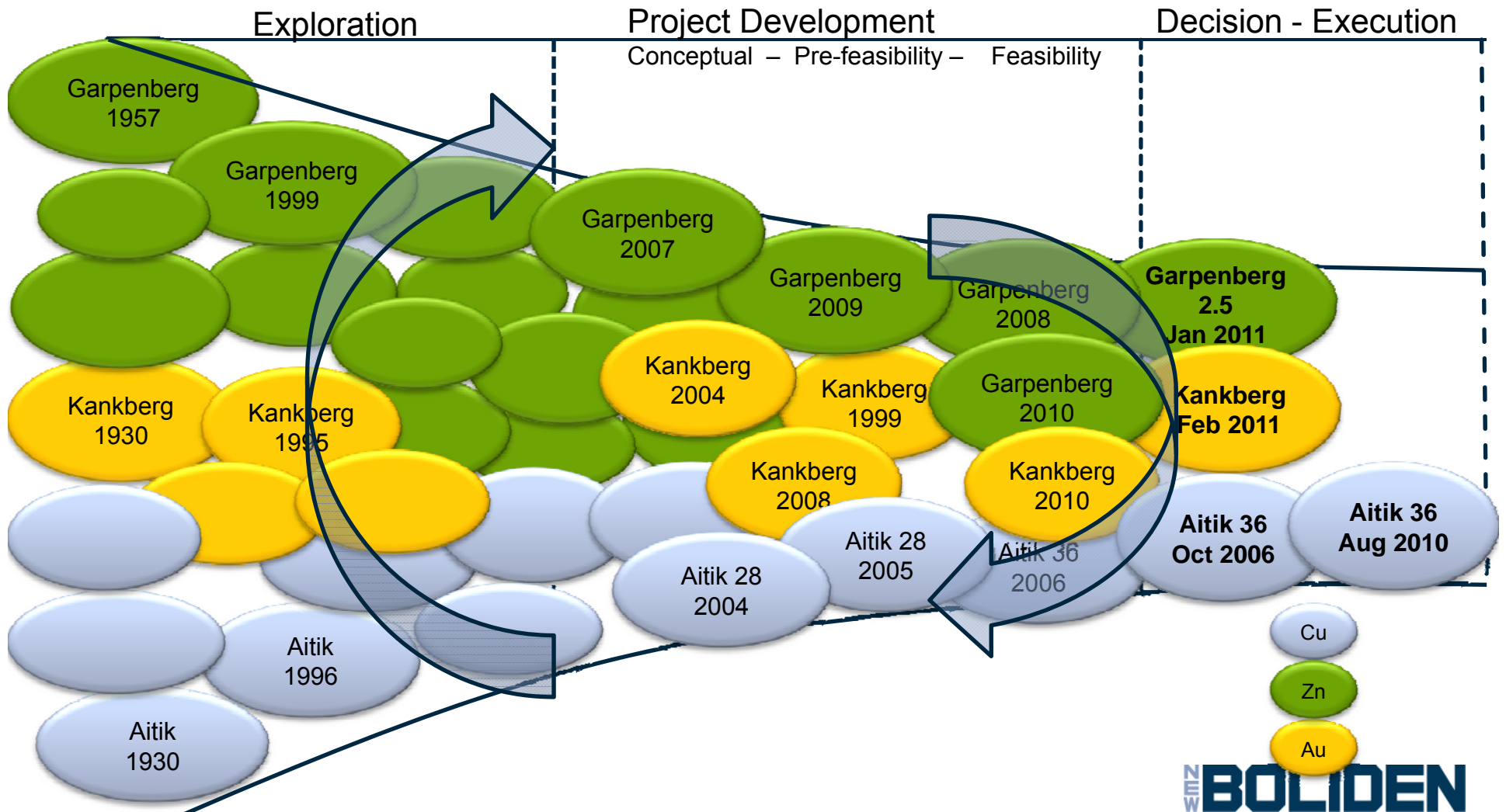
How we work

3D modelling and Resource Estimation



Exploration

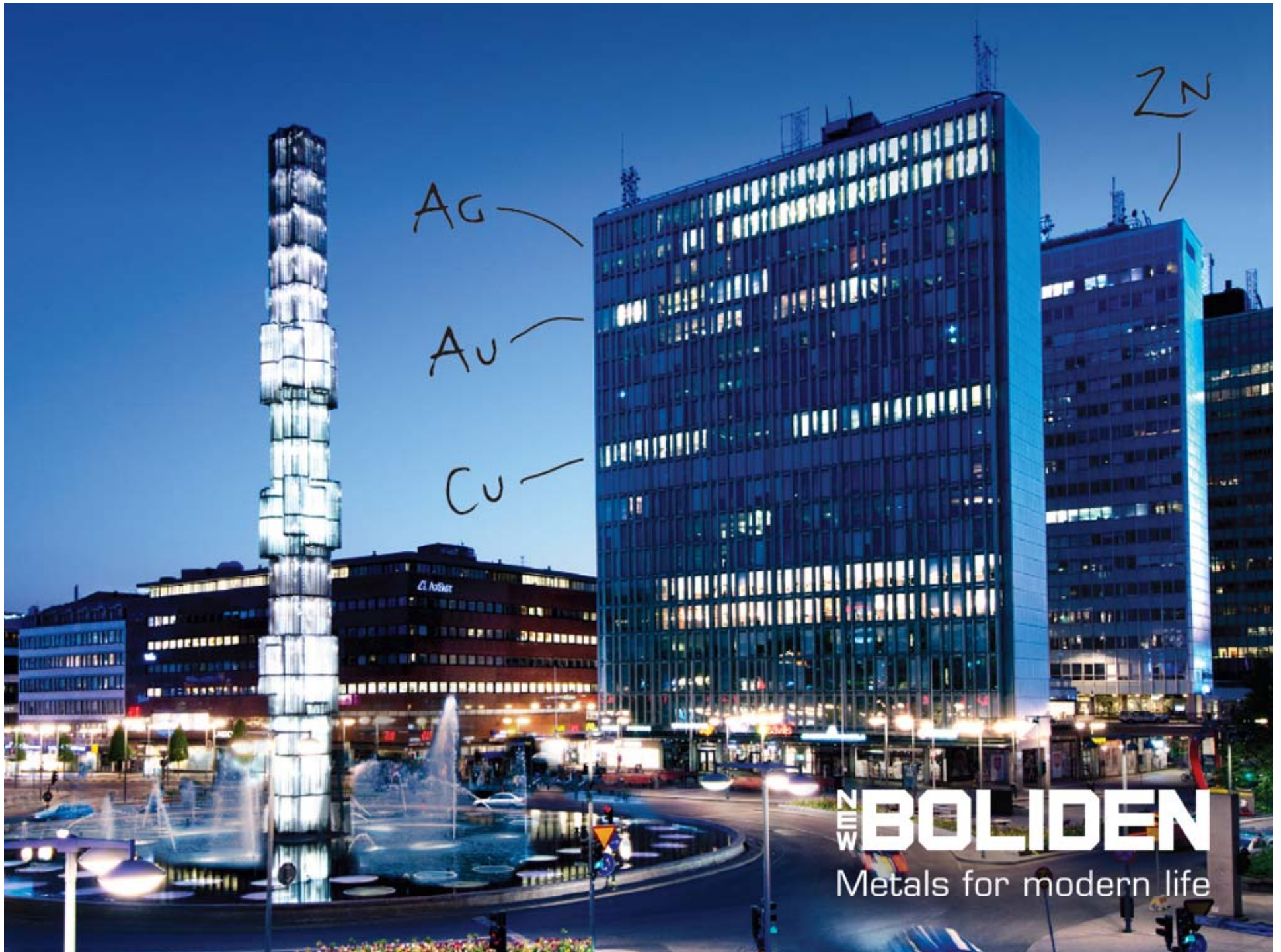
Organic growth



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Ag

Au

Cu

Zn

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