



EXPLORATION DRILLING: CANADA AND INTERNATIONAL

MIKE DUFFY, 13MAY2015
CIM CONFERENCE MONTREAL

Atlas Copco

Agenda

Drilling Exploration Basics 6:00

- The Exploration Business 2:40
- What is Core Drilling 1:50
- Components 1:40

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- Geology of the Earth
- Mineral Deposits
- Australia, China
- Africa, North America
- Deep Sea

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Atlas Copco AB 4:00

- Overview
- Hole Drilling Applications
- Industry Challenges
- Commitment to Society

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Comparison to Space Exploration 3:00

- Drills Big and Small
- Why is AC interested in SE

Final Comments

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- World's Deepest Bore Hole

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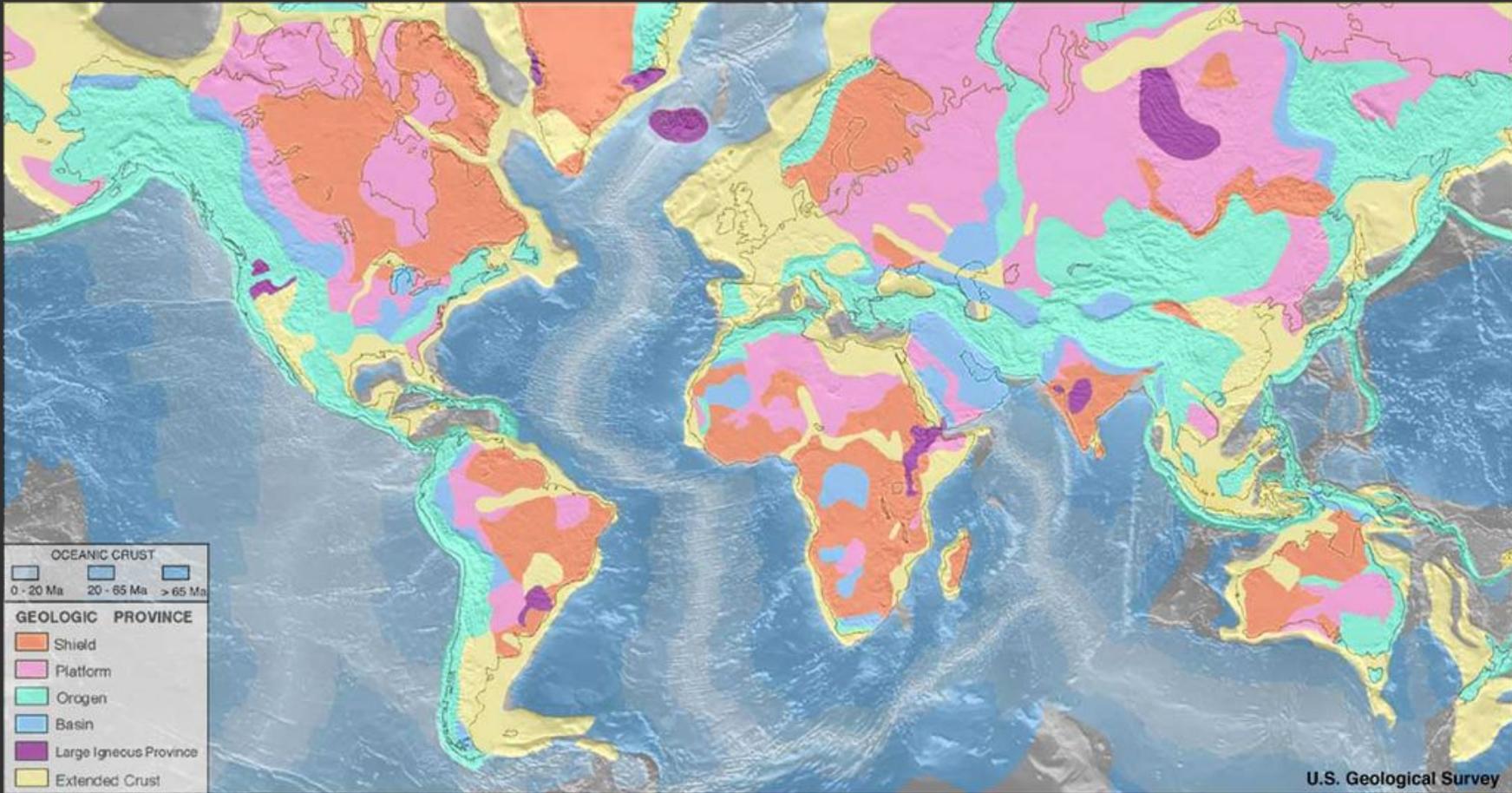
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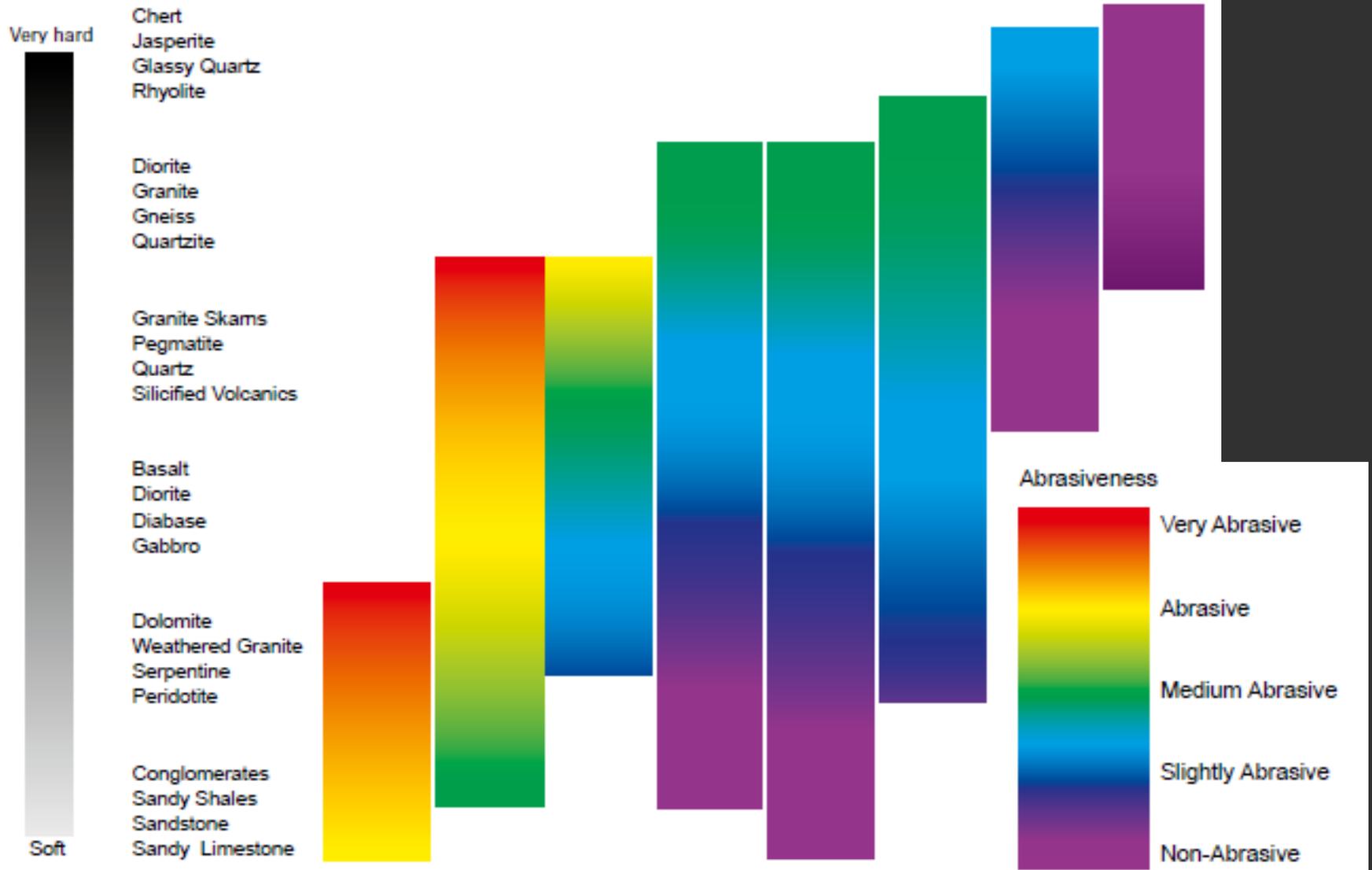
Final Comments

Drilling Exploration Basics

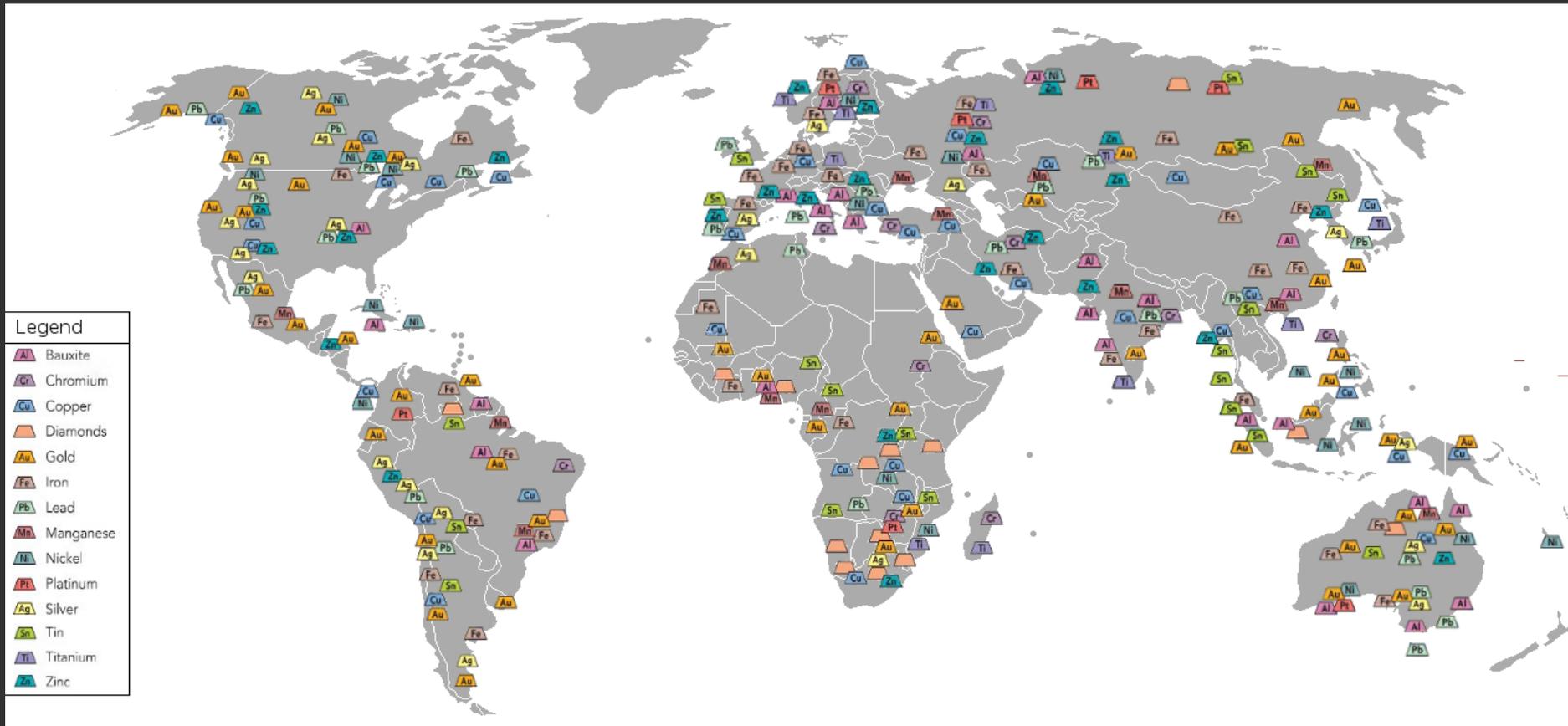
Where in the World

Geology of the Earth



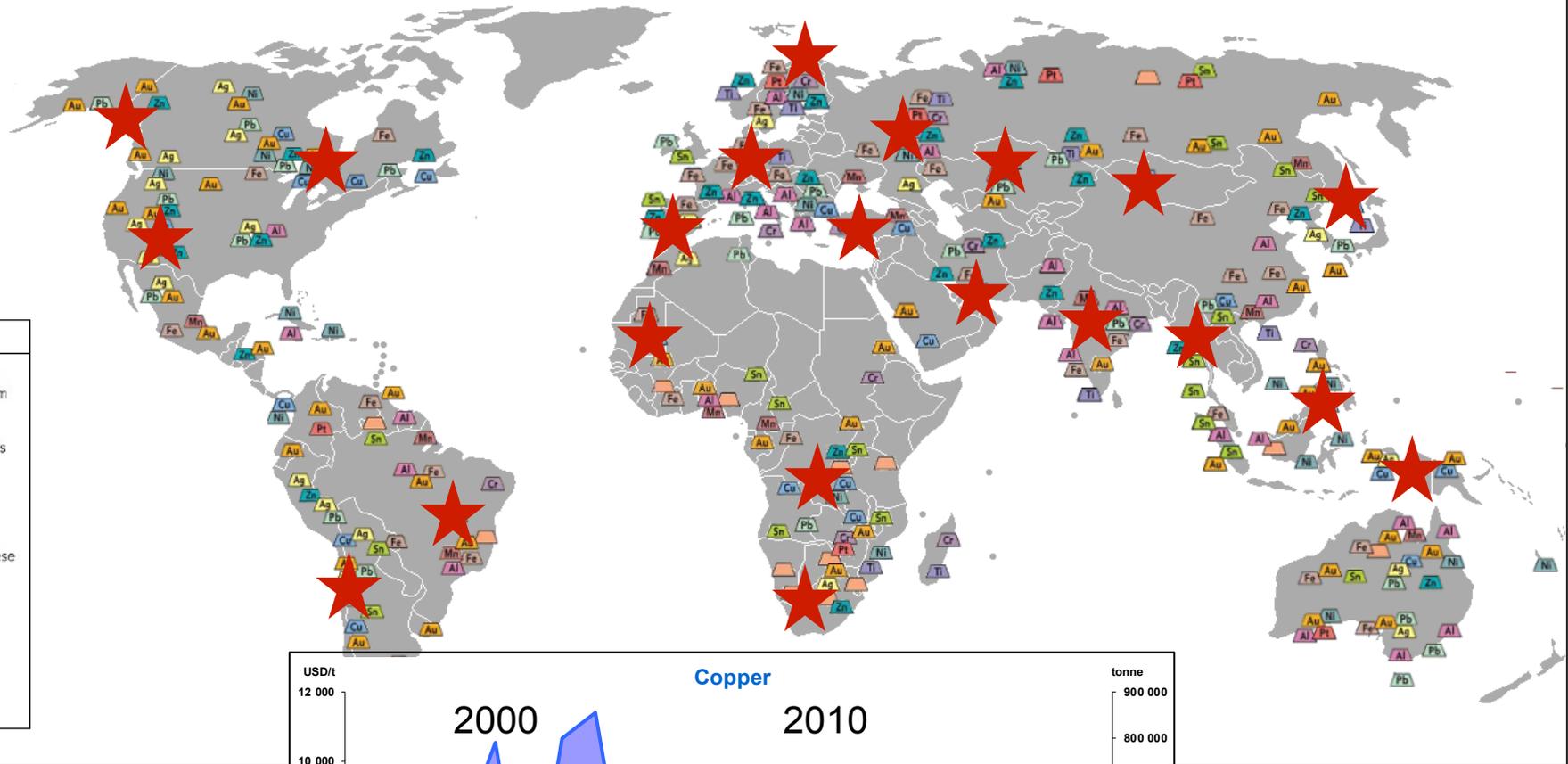


Mineral Deposits

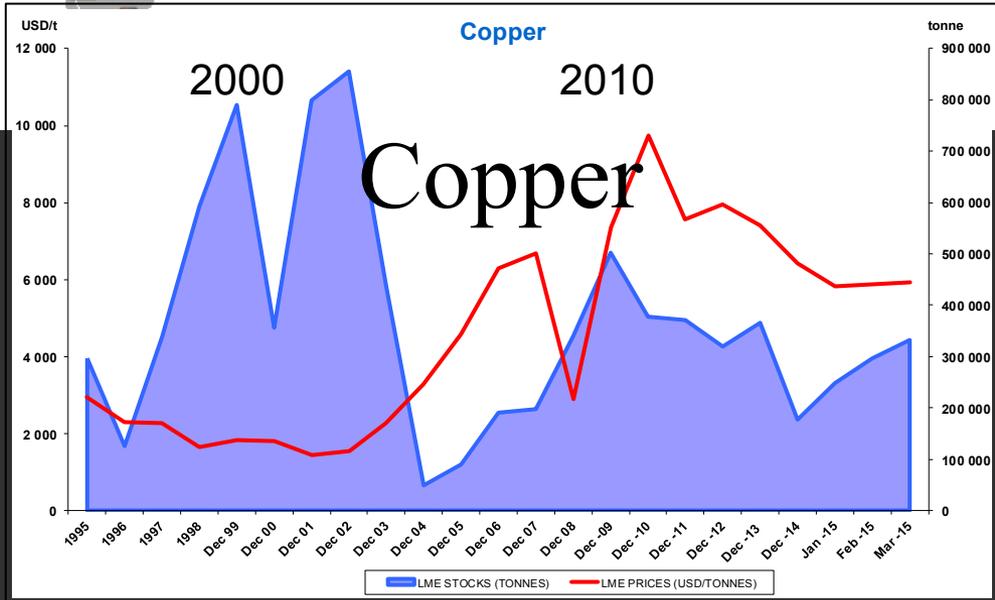


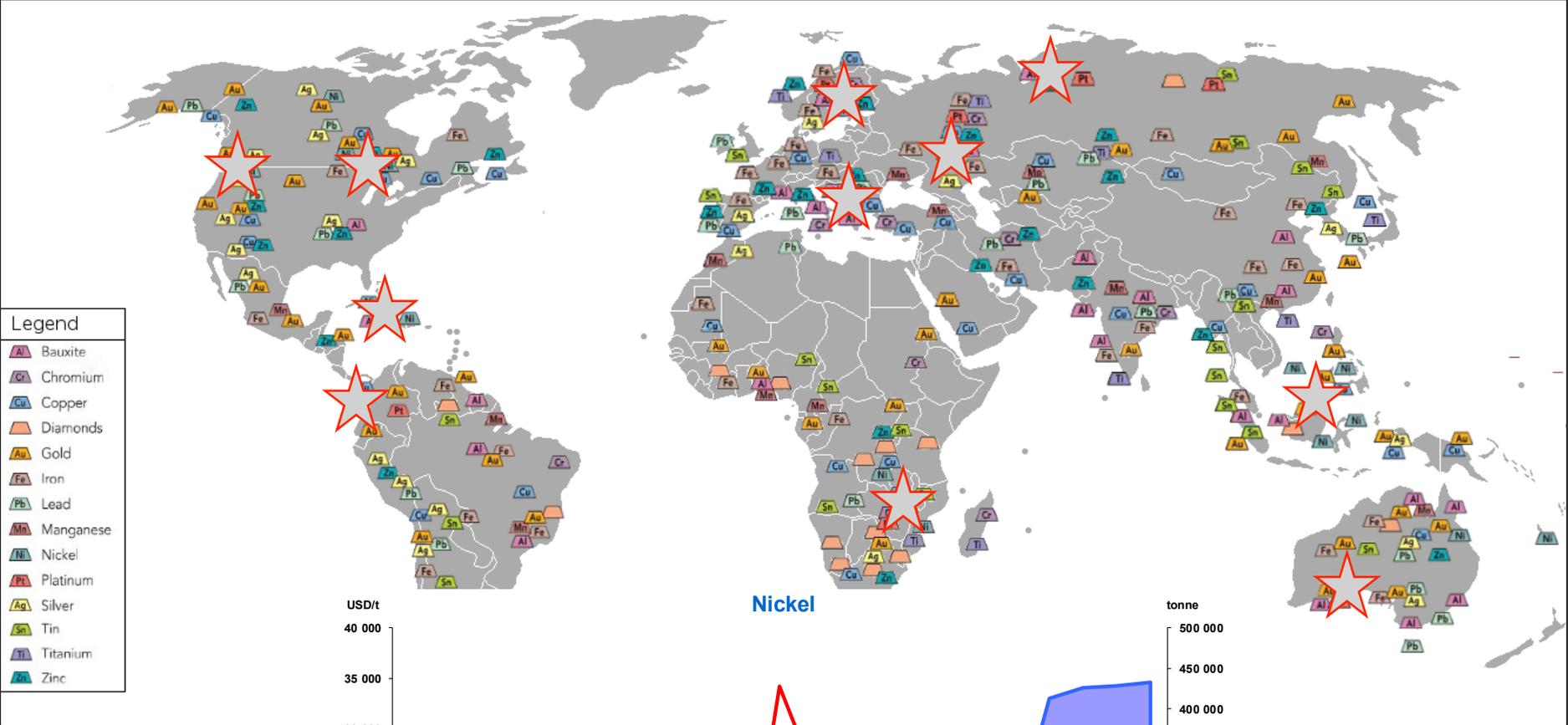
http://commons.wikimedia.org/wiki/File:Simplified_world_mining_map_2.png

JANUARY 2009

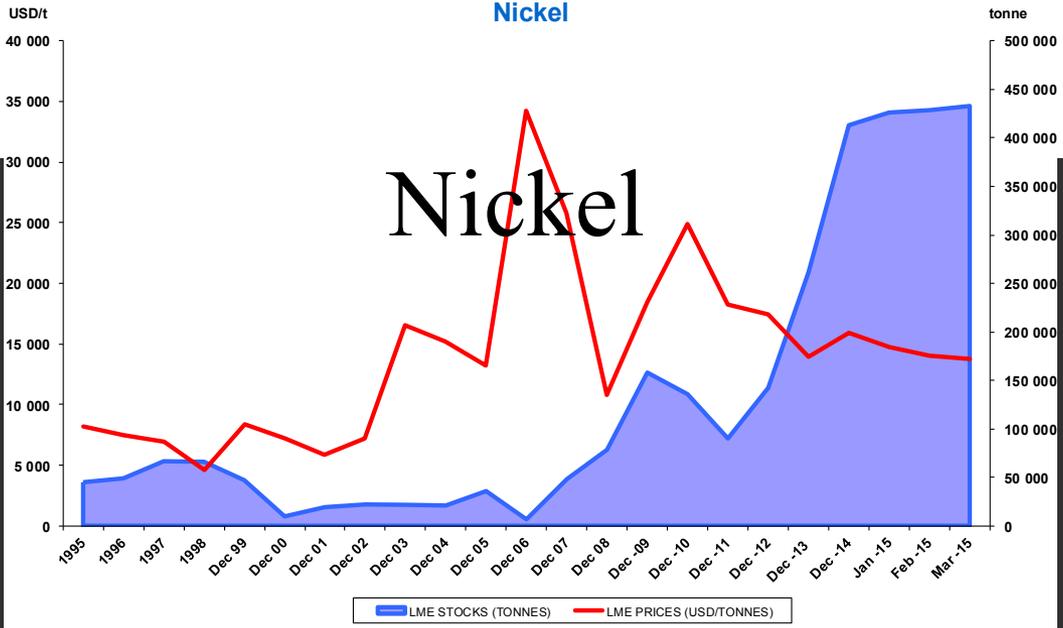


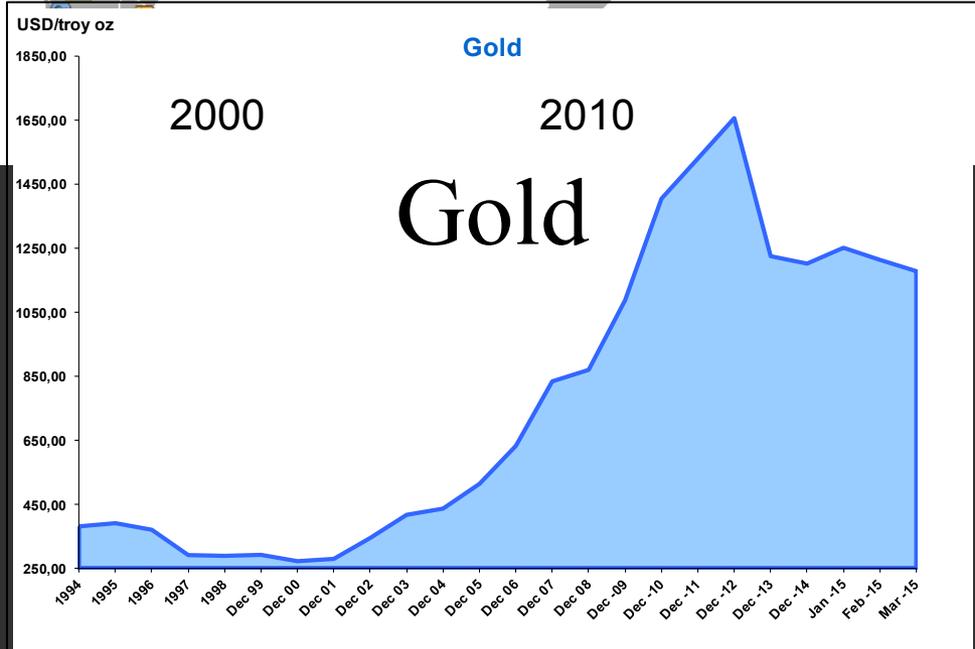
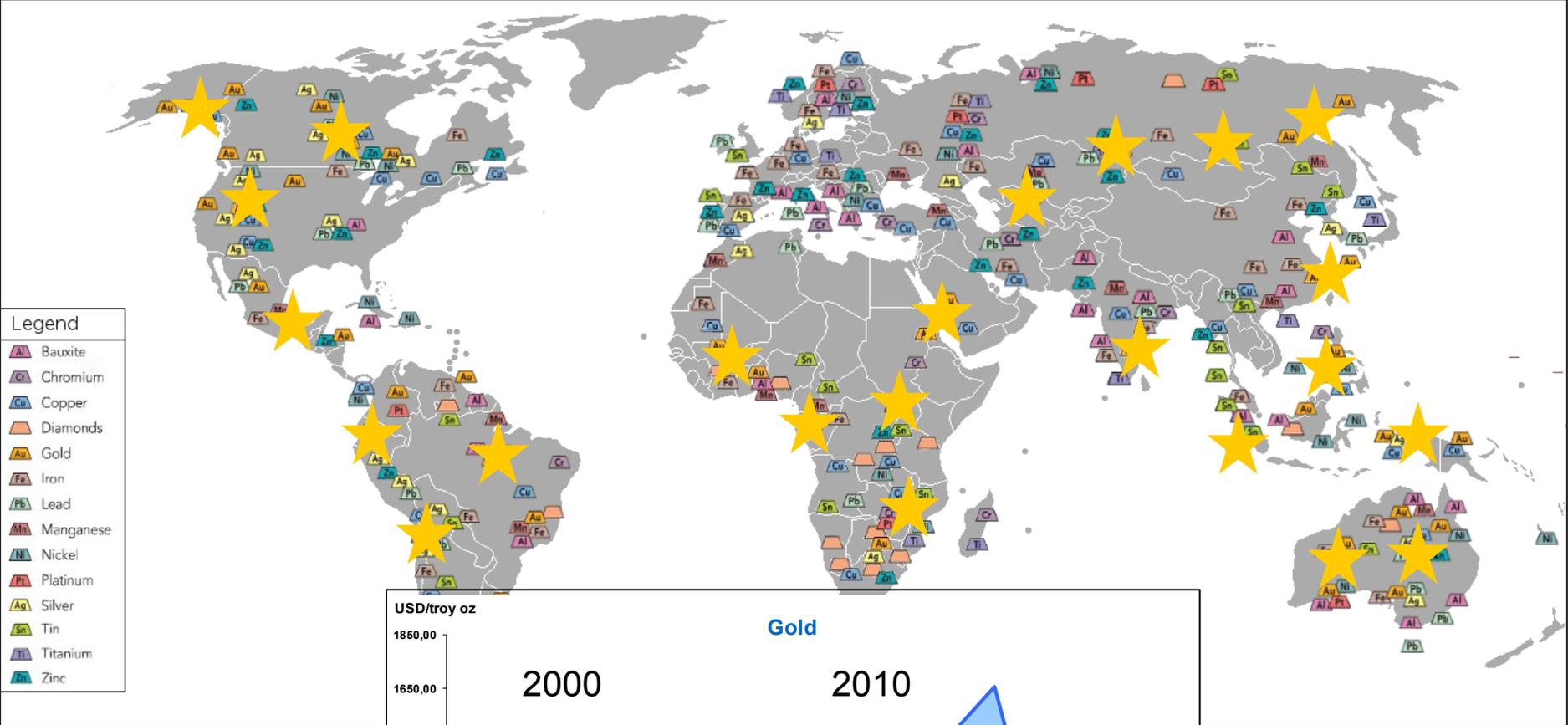
- Legend**
-  Bauxite
 -  Chromium
 -  Copper
 -  Diamonds
 -  Gold
 -  Iron
 -  Lead
 -  Manganese
 -  Nickel
 -  Platinum
 -  Silver
 -  Tin
 -  Titanium
 -  Zinc

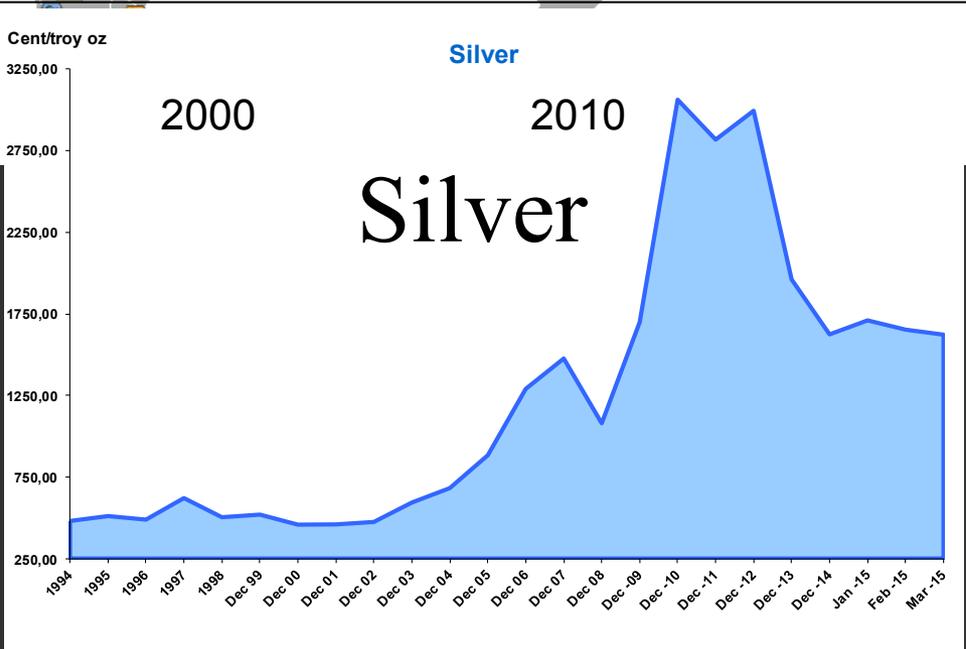
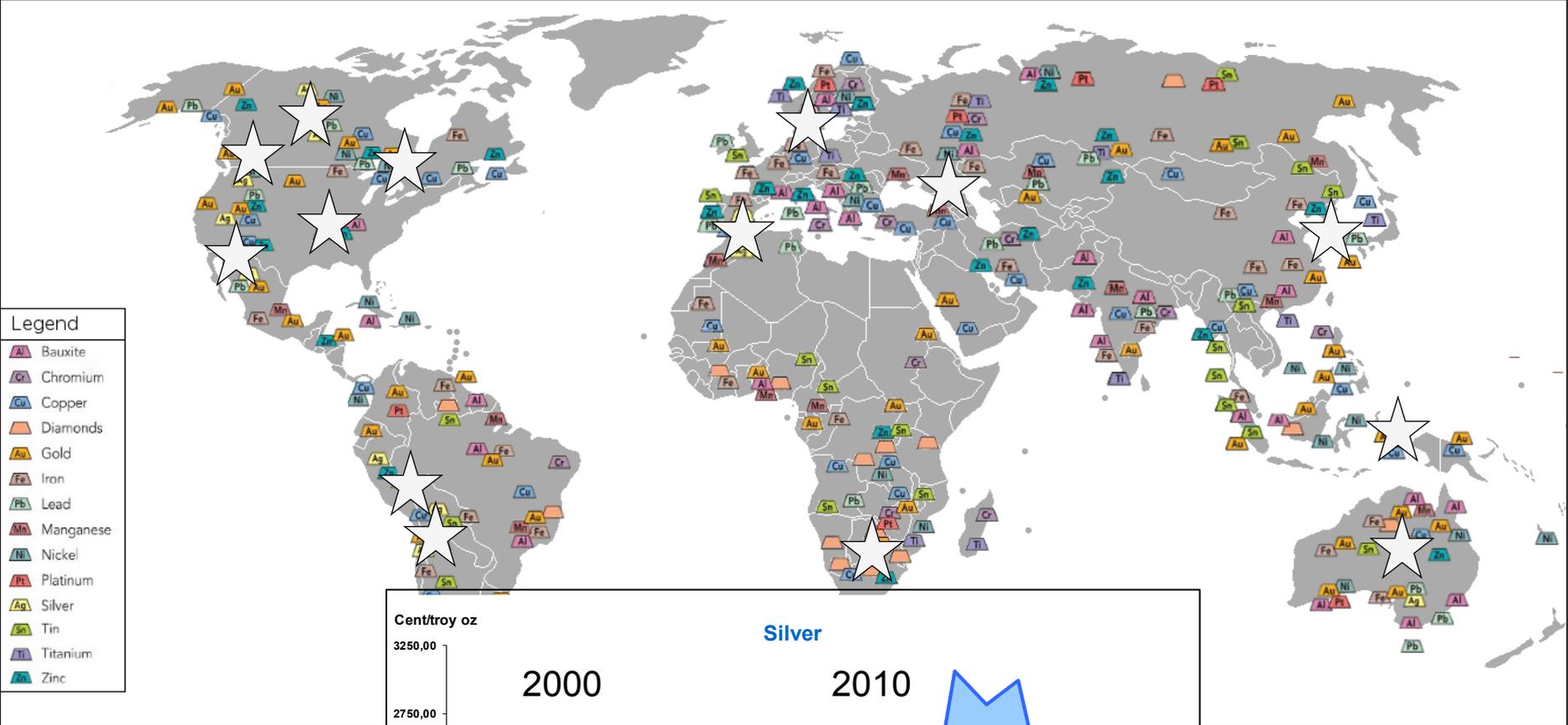


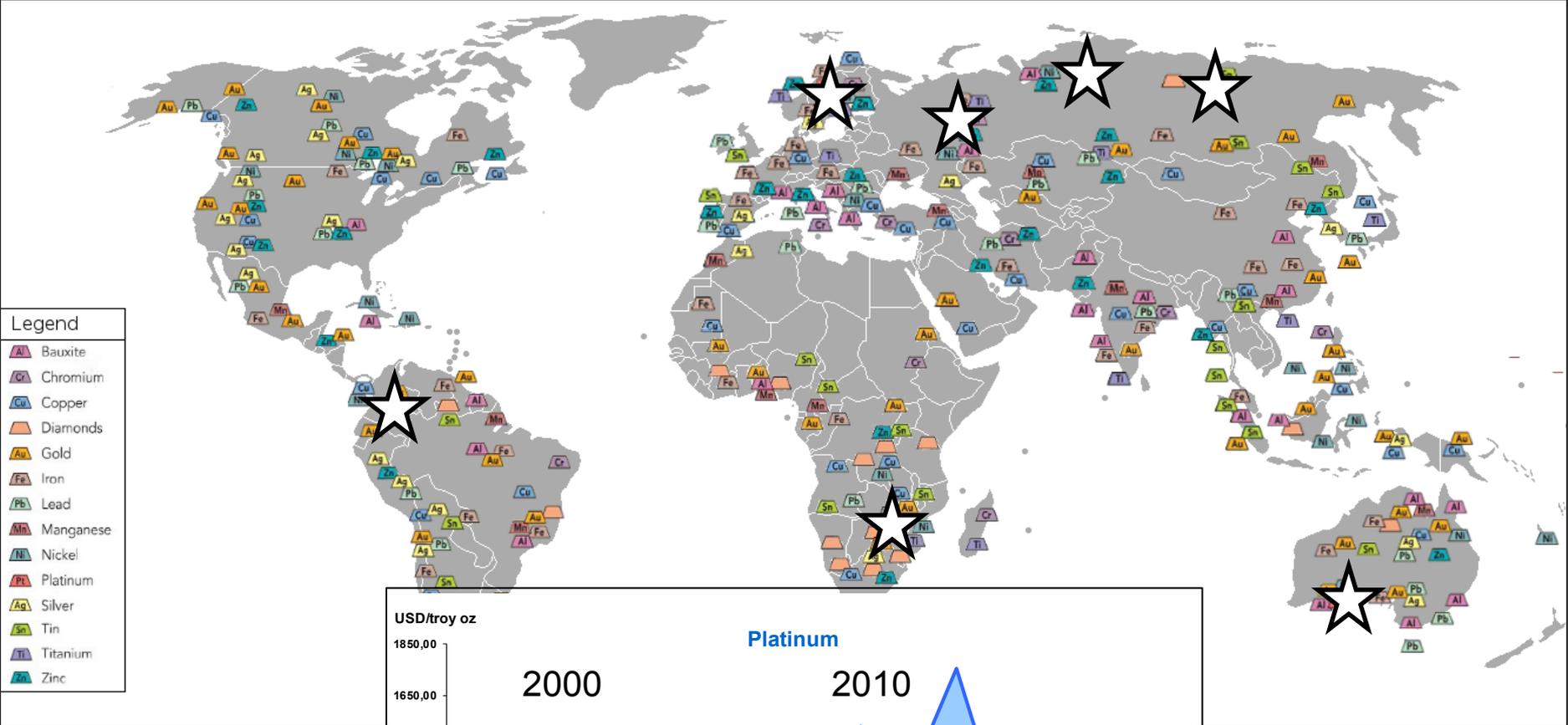


Nickel

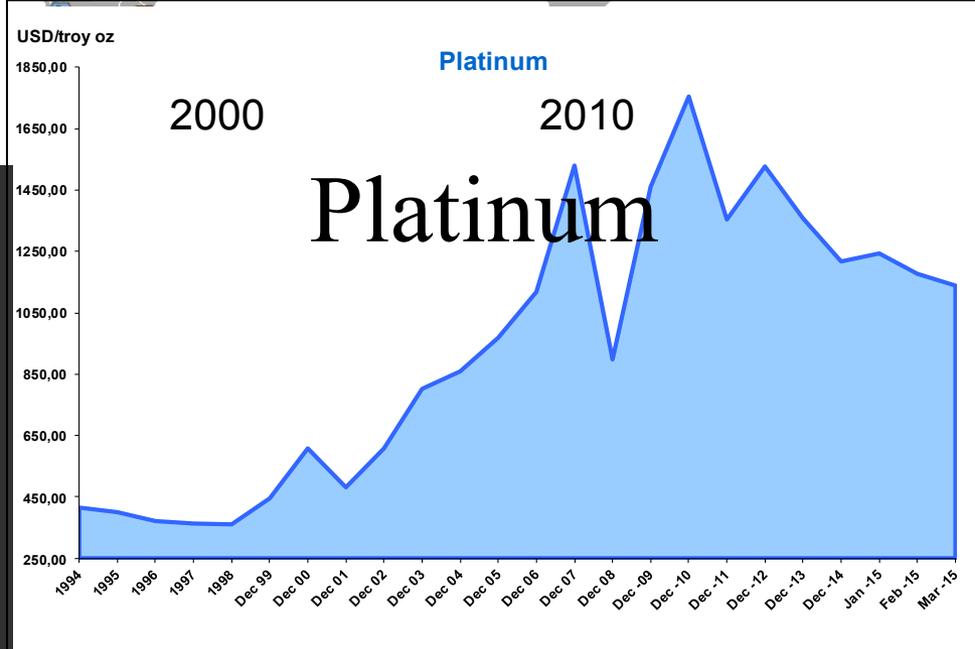








- Legend**
- ▲ Bauxite
 - ▲ Chromium
 - ▲ Copper
 - ▲ Diamonds
 - ▲ Gold
 - ▲ Iron
 - ▲ Lead
 - ▲ Manganese
 - ▲ Nickel
 - ▲ Platinum
 - ▲ Silver
 - ▲ Tin
 - ▲ Titanium
 - ▲ Zinc



Where are diamonds found?

 
Top diamond mining countries:
 Botswana
 Russia
 South Africa
 Angola
 Namibia
 Australia
 Democratic Republic of Congo
 Canada (coming soon)

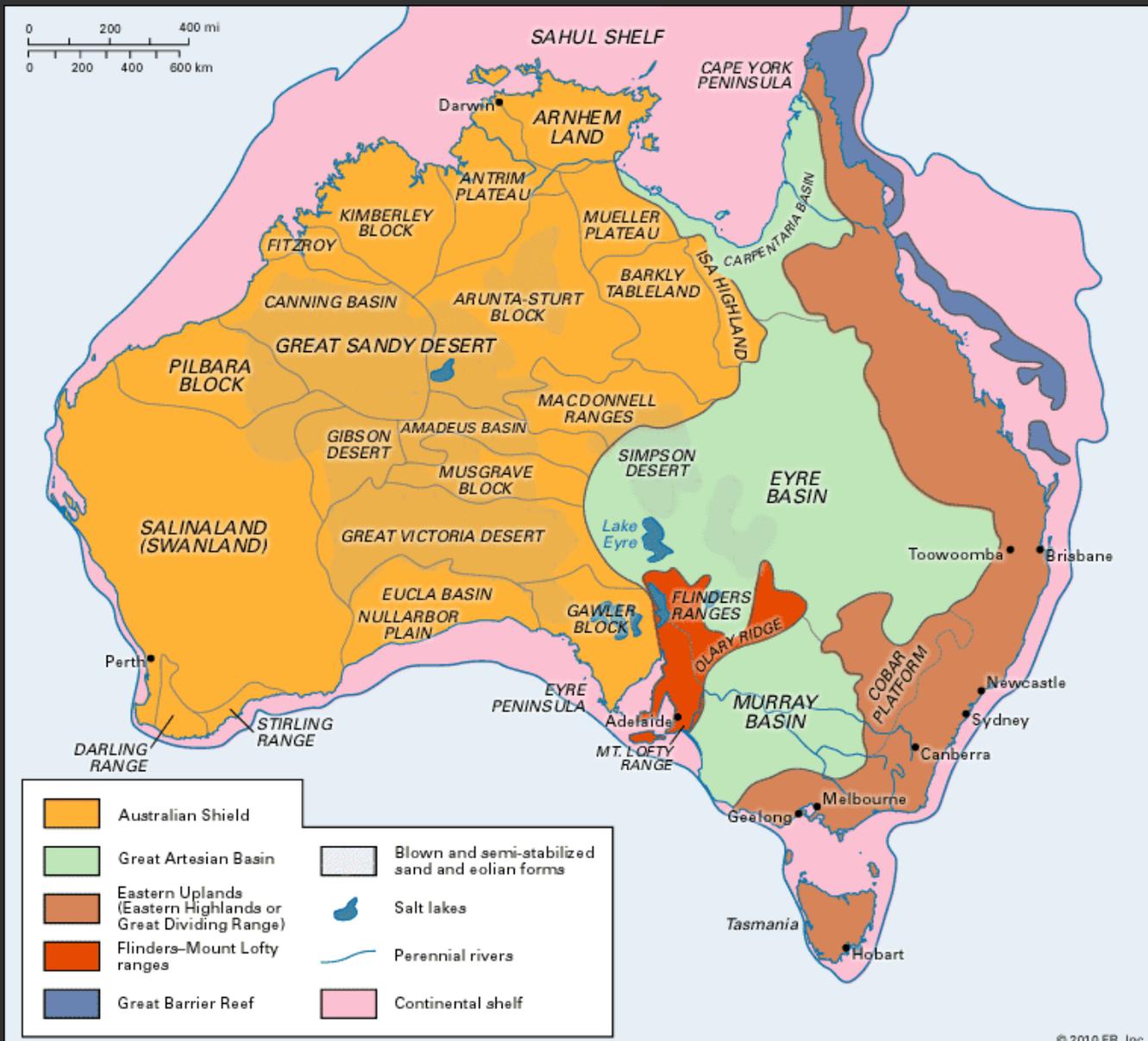
 
Diamonds are also mined in these countries:
 Brazil
 Guyana
 Venezuela
 Guinea
 Sierra Leone
 Liberia
 Ivory Coast
 Ghana
 Central African Republic
 Tanzania
 China
 Indonesia
 Zimbabwe
 India


Traditional diamond cutting centres:
 New York, U.S.A
 Antwerp, Belgium
 Tel Aviv, Israel
 Mumbai, India
 Johannesburg, South Africa

Other countries where diamonds are cut:

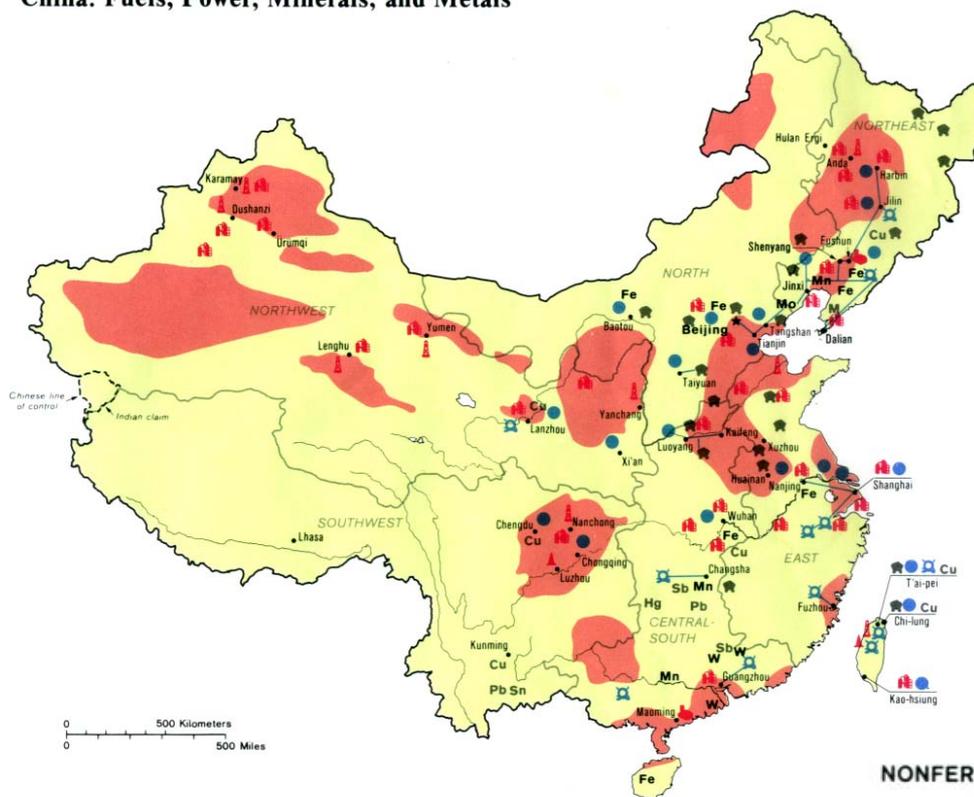
Australia	Malta	
Botswana	Mauritius	
Brazil	Namibia	
China	Netherlands	
Dominican Rep.	North Korea	
Germany	Philippines	
Great Britain	Portugal	
Haiti	Puerto Rico	Taiwan
Hong Kong	Russia	Tanzania
Indonesia	South Africa	Thailand
Japan	South Korea	Tunisia
Malaysia	Sri Lanka	Vietnam

Australia, China



Australia: physiographic regions. Map/Still. Britannica Online for Kids. Web. 21 Mar. 2015

China: Fuels, Power, Minerals, and Metals



0 500 Kilometers
0 500 Miles

FUELS	ELECTRIC POWER	NONFERROUS	FERROUS AND FERROALLOY
Petroleum refinery	Thermal plant	Sb Antimony	Fe Iron ore
Shale oil refinery	Hydro plant	Cu Copper	Mn Manganese
Oilfield	Transmission line	Pb Lead and zinc	Mo Molybdenum
Gasfield		M Magnesite	W Tungsten
Oil basin		Hg Mercury	
Major coal mine		Sn Tin	
		— Economic region boundary	

NONFERROUS

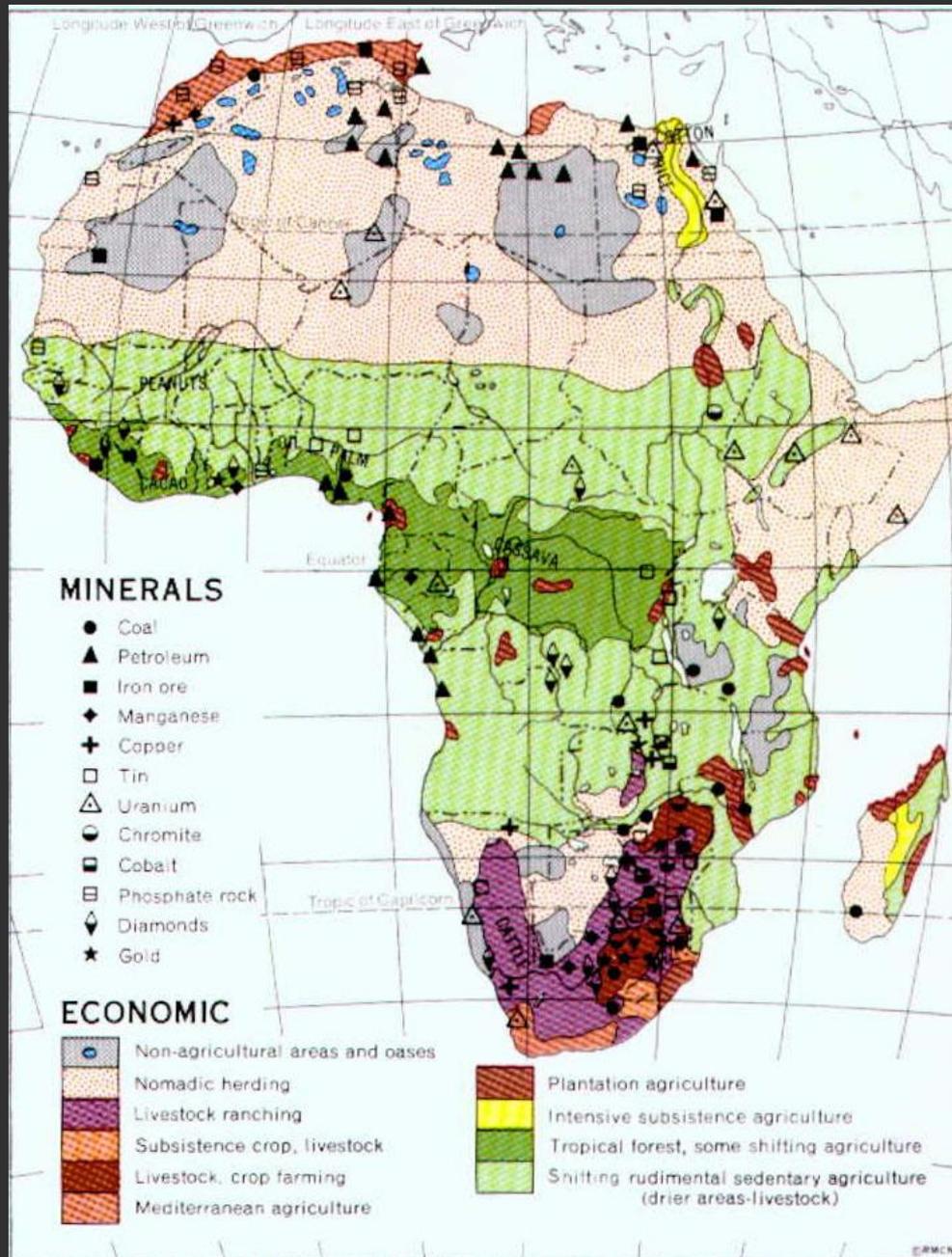
Sb Antimony
Cu Copper
Pb Lead and zinc
M Magnesite
Hg Mercury
Sn Tin

FERROUS AND FERROALLOY

Fe Iron ore
Mn Manganese
Mo Molybdenum
W Tungsten

<http://www.chinatouristmaps.com/china-maps/maps-of-resources.html>

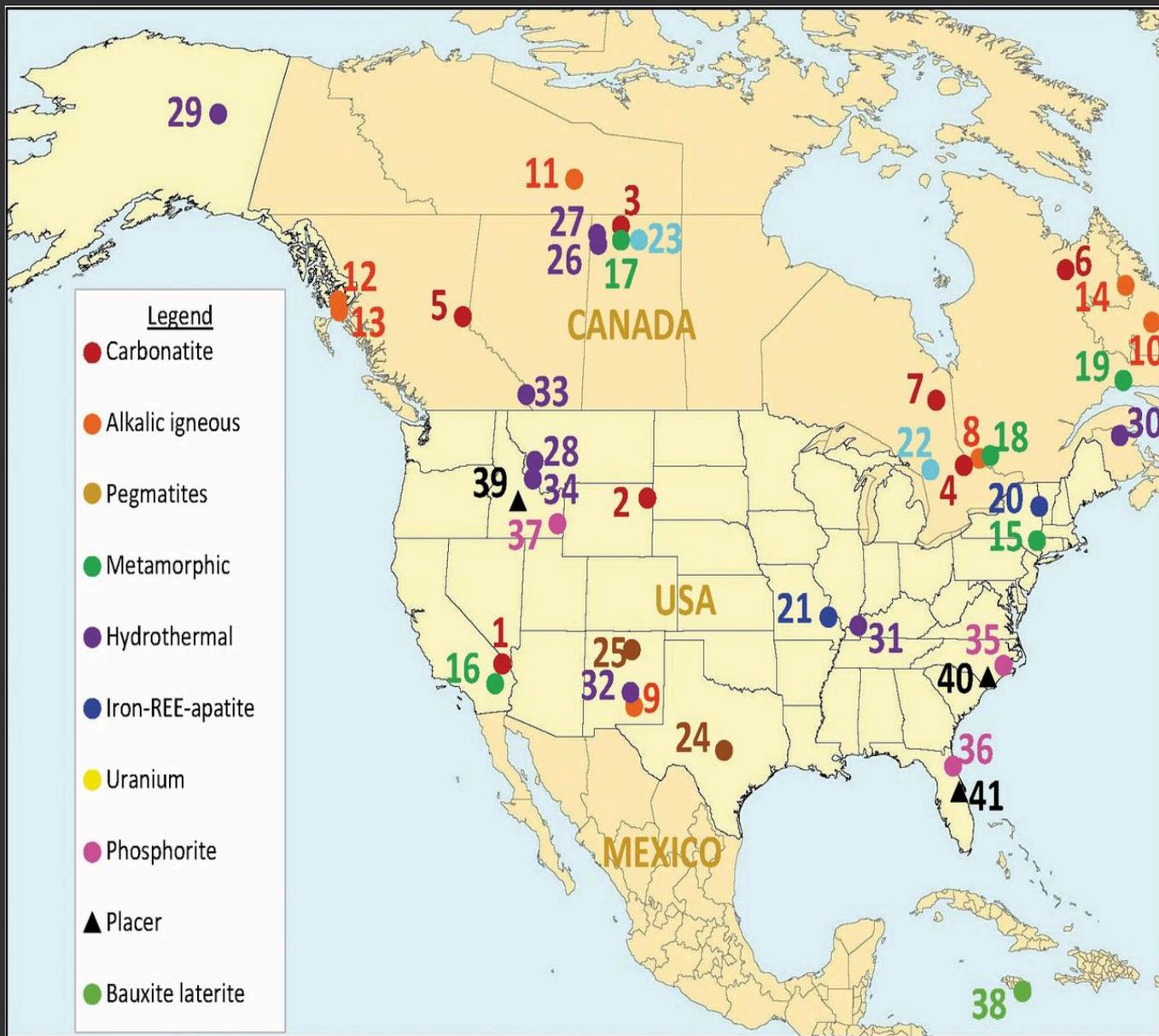
Africa, North America



North America



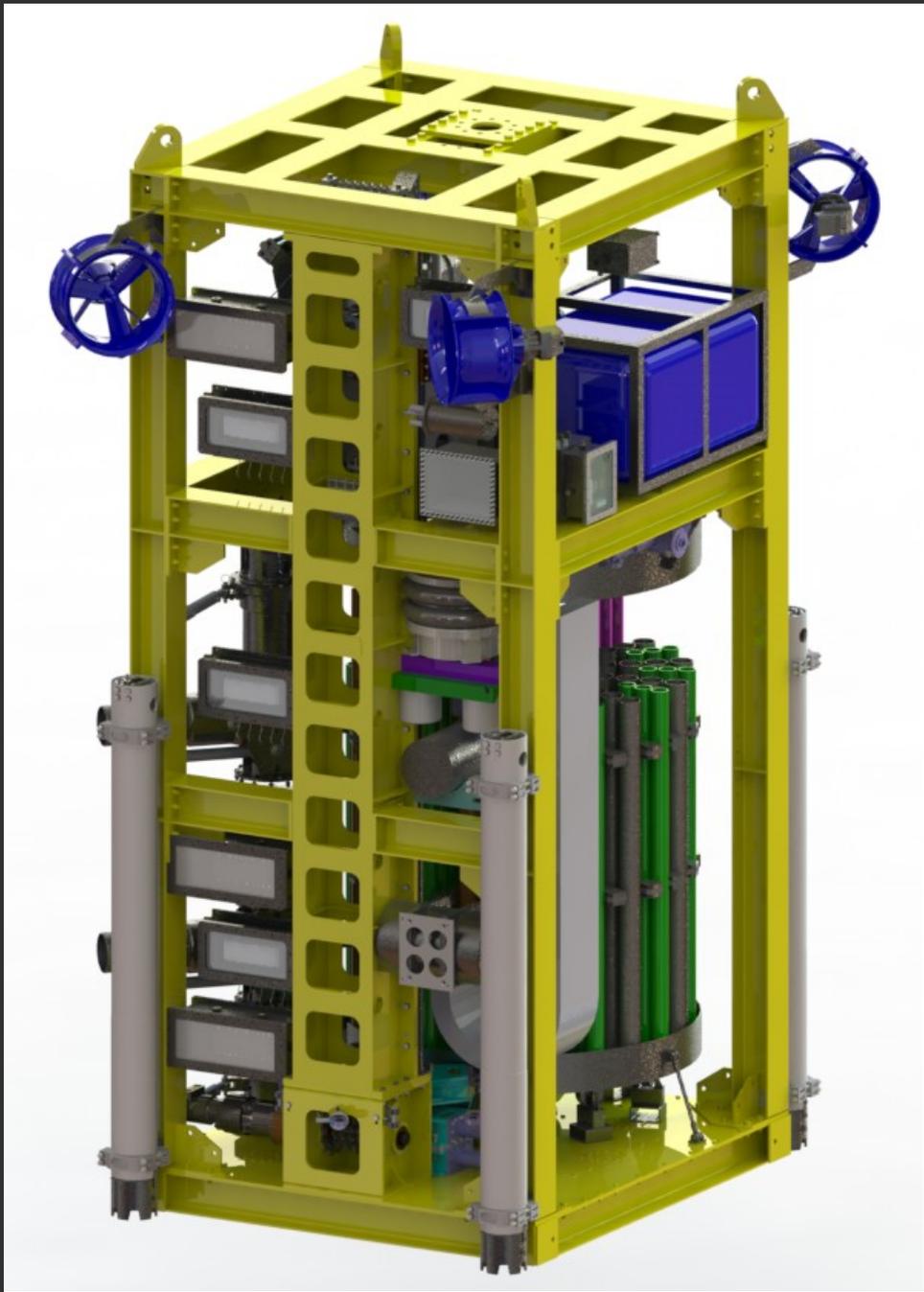
North America: physiographic regions. Map/Still. Britannica Online for Kids. Web. 21 Mar. 2015



Rare Earth Mining and Exploration in North America, Mariano and Mariano

<http://elements.geoscienceworld.org/content/8/5/369.abstract>

Deep Sea



World's Deepest Bore Hole

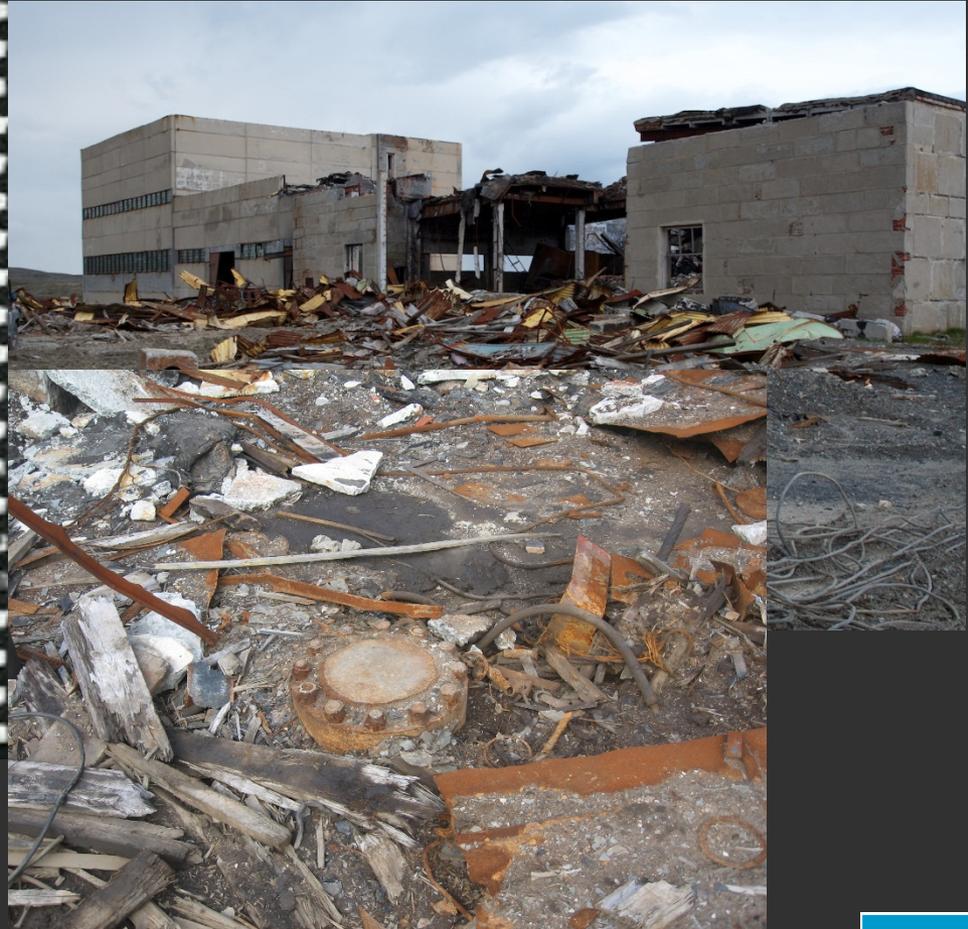


Started May 1970

Goal 15000 meters deep

Maximum depth of 12.3 km reached
in 1989, drilling stopped in 1992 due
to high temperatures





Atlas Copco AB

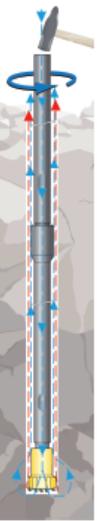


Overview

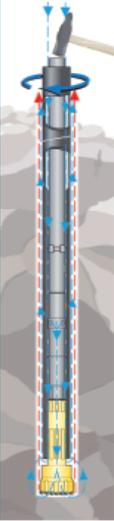
Hole Drilling Applications

10 DRILLING METHODS WITH SECOROC ROCK DRILLING TOOLS

TOPHAMMER DRILLING



COPROD DRILLING



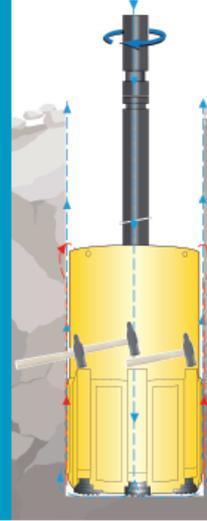
DOWN-THE-HOLE DRILLING



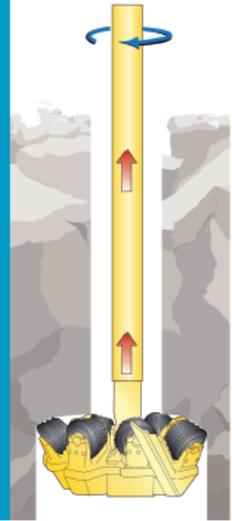
REVERSE CIRCULATION DRILLING



CLUSTER DRILLING



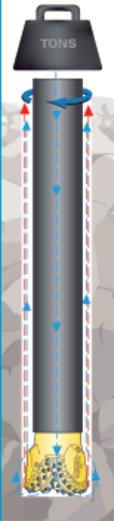
RAISEBORING



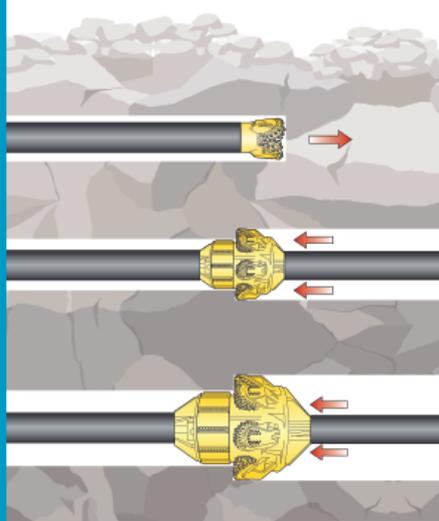
CORE DRILLING



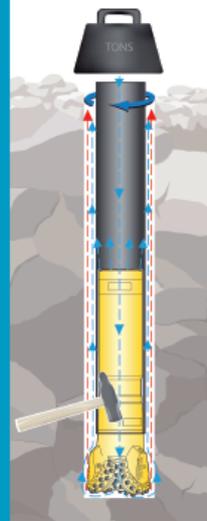
ROTARY DRILLING



HORIZONTAL DIRECTIONAL DRILLING



PERCUSSION ASSISTED ROTARY DRILLING



--- CUTTINGS

--- AIR FLOW*

*CORE DRILLING - WATER FLOW



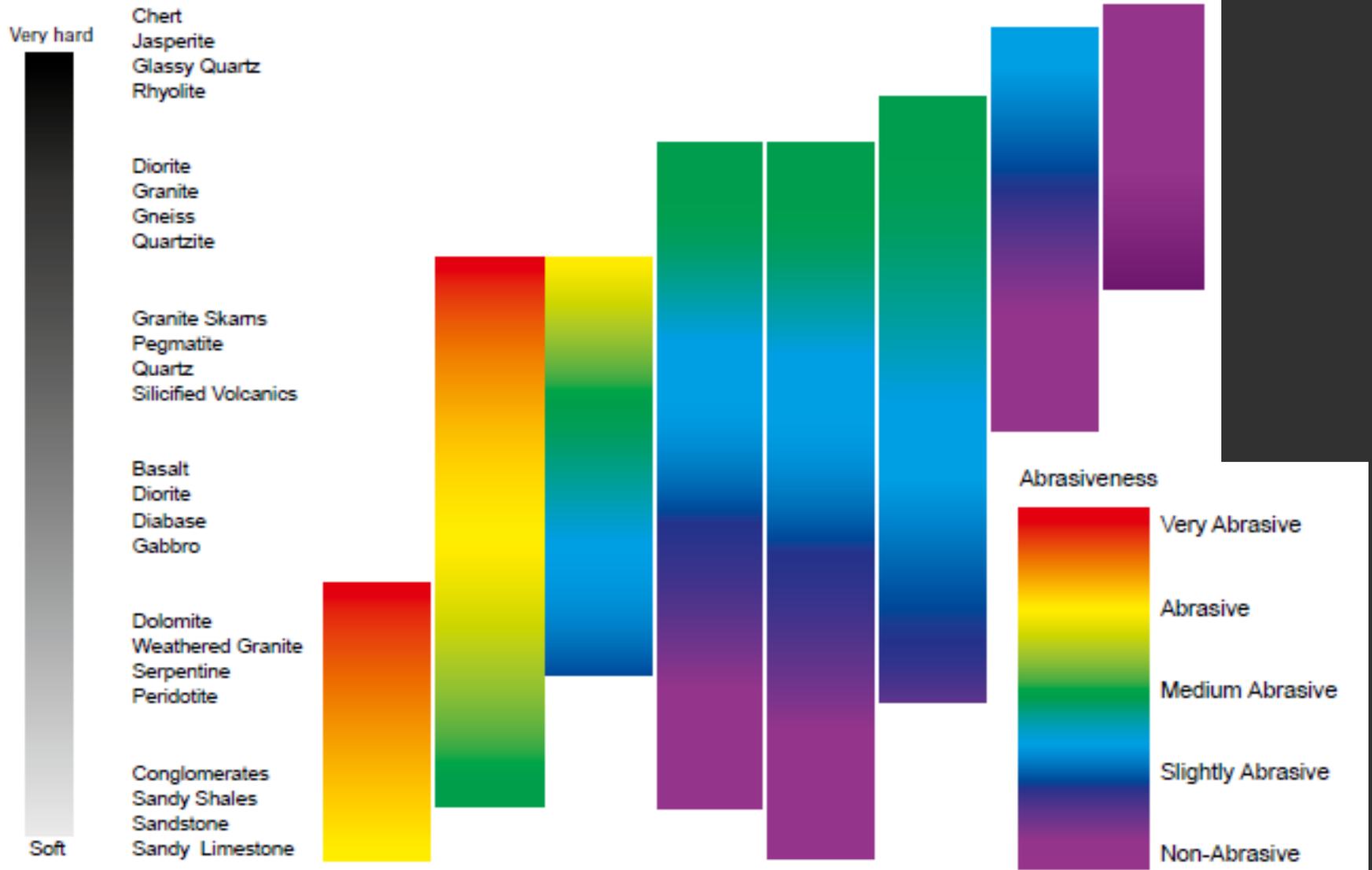
North Bay Ontario

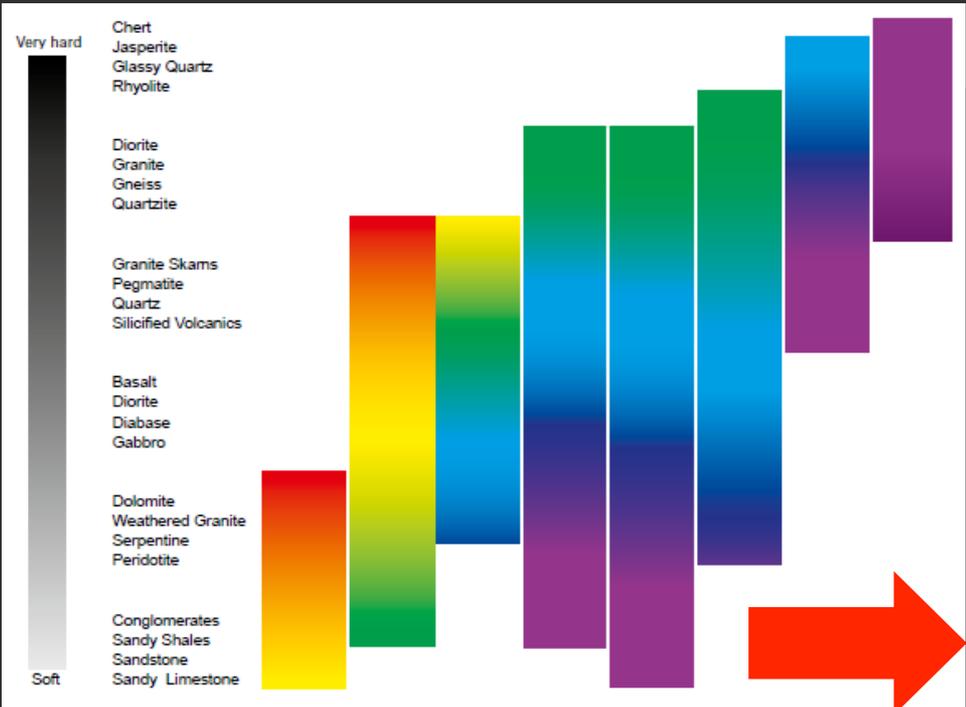


Core Drilling Bits

Simulated field tests have shown that our Trocon line of core drilling bits will outperform in the toughest of drilling conditions.







Channel flushing (CF)

- Standard profile - general purpose design
- Suitable for a broad range of formations.



Extended channel flushing (ECF)

- Preferable in competent and semi-broken rock
- Suitable for mixed formations containing broken and competent zones.



Wedge (pie shaped)

- Superior flushing capability
- Improved productivity
- Preferable in abrasive or broken rock.



Torpedo "V"

- High performance "free cutting" bit
- High productivity
- Suitable for hard/competent formations.



Turbo

- High productivity
- Suitable for competent formations.



Face discharge (FD)

- Designed to minimize flushing of core sample
- Suitable for broken/granular formations.

Industry Challenges

Commitment to Society



WATER FOR ALL – 30 YEARS OF EMPLOYEE COMMITMENT

In 2014, the Atlas Copco Group's main community engagement initiative *Water for All* celebrated 30 years. It was founded in 1984 by Atlas Copco employees and supports projects that give people in need access to clean drinking water. By the end of 2014, the initiative had representation in more than 35 countries, with more under way. All local chapters are initiated and run by Atlas Copco employees who also contribute to the same through donations, often via their salaries. All donations are doubled by the company. Since the start, *Water for All* has provided access to clean drinking water to more than 1.5 million people.

More information:
www.water4all.org



Atlas Copco Annual Report 2014



Comparison to Space Exploration

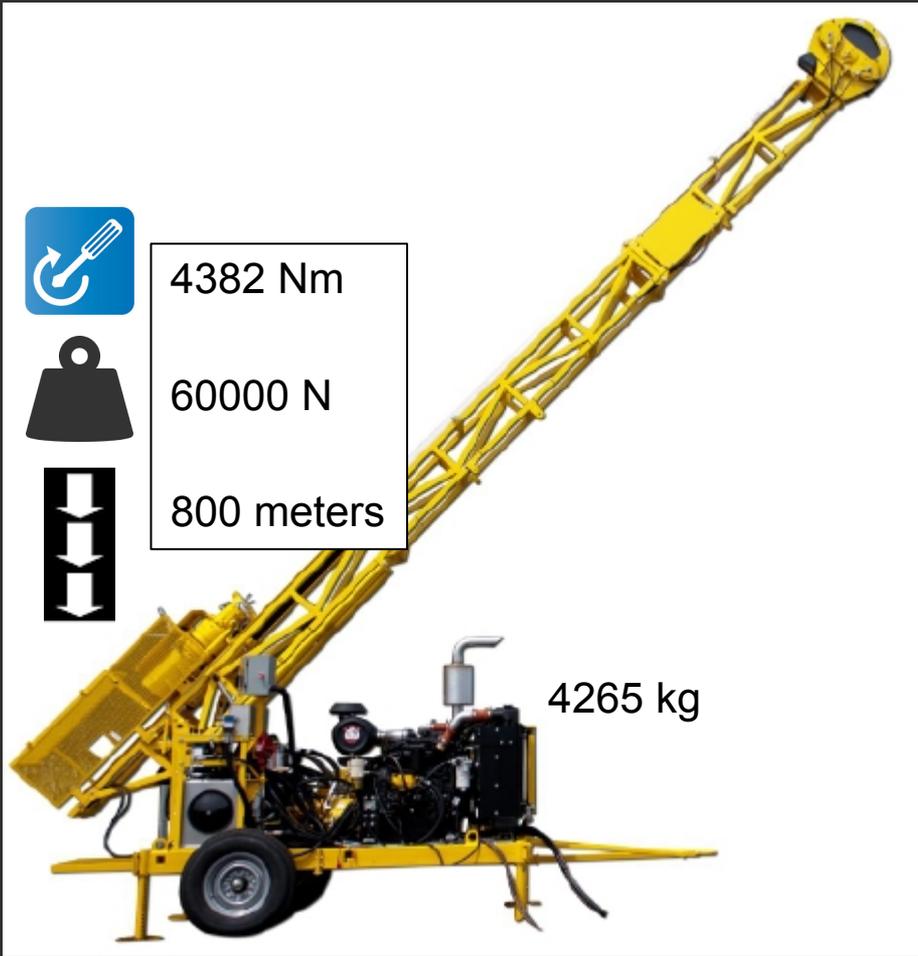
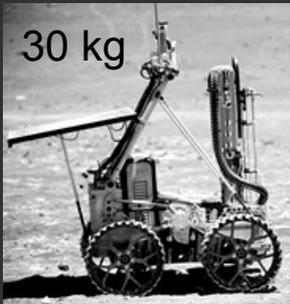
Drills Big and Small



20 Nm
200 N
4 meters



4382 Nm
60000 N
800 meters



Why get involved?

When do we as a company get involved?

- Directly profitable (direct sales)?

When do we as a company get involved?

- Directly profitable?
- Indirectly profitable (PR, technology incubation)?

When do we as a company get involved?

- Directly profitable?
- Indirectly profitable?
- Contributes to the common good (employees)?

When do we as a company get involved?

- Directly profitable?
- Indirectly profitable?
- Contributes to the common good?
- Contributes to the common good (everyone)?

When do we as a company get involved?

- Directly profitable?
- Indirectly profitable?
- Contributes to the common good?
- Contributes to the common good?
- More?

When do we as a company get involved?

- Directly profitable?
- Indirectly profitable?
- Does it contribute to the common good?
- Does it contribute to the common good?
- More?

“I just wish the world was twice as big
and half of it was still unexplored.”

[David Attenborough](#)

Final Comments

“A blade of grass is a commonplace on Earth;
it would be a miracle on Mars.”

Carl Sagan, *Pale Blue Dot: A Vision of the Human Future in Space*

The logo for Atlas Copco, featuring the company name in a blue, italicized serif font. The text is centered within a white rectangular frame that has two thick blue horizontal bars at the top and bottom.

Atlas Copco

Questions