The importance of geology and mineral deposit education and collaboration in Europe:

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ISTerre, Université de Grenoble

Focus on “upstream” part of the minerals chain: exploration

Four main topics
1. Mineral resources research – does it help find new ore deposits?
2. Industry-academia divide
3. Public perception of the minerals industry
4. ERA-MIN, EODI and other European programs
Between 2000 and 2050, more copper (iron ore, zirconium, etc) will have to be produced than from the origin of mankind.....
Between 2000 and 2040, more copper (iron ore, zirconium, etc) will have to be produced than from the origin of mankind ..... 

The alarmist view: one new Escondida will have to be found every 5 years – we will never do this; we must drastically curtail our copper consumption and radically change our lifestyle

The neutral view: to must curtail our copper consumption, improve recycling/substitution and drastically improve our exploration methods and mining technology so as to exploit hidden or lower quality deposits

The optimistic view: in each 40-year period since the industrial revolution, we have produced more copper than from the origin of mankind. We did it then (through improvement in methods and technology) and we will do it in the future.

...... but to do this will require new investment and new research
A VACUUM CURRENTLY EXISTS IN ORE DEPOSITS RESEARCH

(a) **In universities, geological surveys, museums**
Ore deposits research is at a low ebb due to low metals prices in the last decade, a lack of hiring in the field, and no support from funding agencies.

(b) **Industry**
Most research centres in major mineral exploration companies, which were active and fruitful (e.g. De Beers, Inco, BHP, Newmont), have been closed in past decades. Nothing has taken their place.

(c) **School of Mines** “is a term used for many engineering schools established in the 18th and 19th centuries that originally focused on mining engineering and applied science. Most no longer primarily teach mining-related subjects, although some have retained the name”

Wikipedia

Can new ore deposits be found without top-level research involving academia-industry collaboration?
Examples of industry-academia research that contributed to the discoveries of ore deposits

1) the development of the porphyry zonation model in the early 1970s, directly contributed to many discoveries throughout the world
2) the development of the volcanological facies model for komatiite NiS deposits in the 1970s
3) an understanding of regolith evolution and its impact on gold geochemical dispersion in the 1980s which directly contributed to discoveries of concealed deposits in Australia and West Africa

...and some specific examples

4) Olympic Dam, Australia
5) Oyu Tolgoi, Mongolia
6) Submarine Cu-Au and REE deposits
Olympic Dam, South Australia

• the 5th largest Au, 6th largest Cu and largest U ore body in the world
• $863 billion current value ≈ GNP of Switzerland or total Greek debt
• a new type of deposit (IOCG – iron-oxide copper gold)
• buried under >300 m of sedimentary cover

Found in 1975 by Western Mining Corporation, a medium-sized company, using good exploration practices:
- >50% of WMC’s cash went into exploration where it achieved unparalleled success.
- “the exploration genius was Roy Woodall, who attracted some of the best young PhDs in Australia and encouraged them to go abroad and bring back new ideas” (Ralph, AIMM Bulletin, 2011)
- the target was point-pointed using a combination of geological reasoning, national 3D maps and geophysical data
Oyu Tolgoi, Mongolia

• an enormous Cu-Au deposit discovered in the 1980’s
• an example of the new deposits needed to satisfy growing demand
Japan’s Agency for Marine-Earth Science and Technology ... discovers ... vast underwater reserves of rare earth minerals scattered across the Pacific.

Based on:
• IODP drilling
• Research by marine geologists
The depths of the ocean are not a desert .... A characteristic trait of abyssal ecosystems is the high number of rare species (Census of Marine Life http://comlmaps.org/)

Comment: Sea is 2/3 of earth let us not disturb it for our narrow benifits otherwise earth existence will be in danger.  Anurag chaurasia,ICAR,India
Lapland (Fe)
Skellefte - Pyhäsalmi (Cu, Zn, Au, Ni, Co)
Bergslagen (Fe, Zn)
Foresudetic basin (Cu, Co, Pt, Re)
Carpathians (Pb, Zn, Au)
Balkans (Cu, Au, Sn)
Irish (Zn)
Iberian Pyrite Belt (Cu, Zn, Sn)

MAIN MINERAL DEPOSITS OF EUROPE
AND KEY METALLOGENIC PROVINCES

Mineinfo – producing mines
Average yearly investments forecasts in non-ferrous mineral exploration by regions - constant US$/km² ($ value on 31/12/07, corrected by the change in the CPI index)


Source: P. Christmann 2009
Contrary to prevailing opinion, the potential for finding and mining minerals in Europe is high. Current activity in Ireland, Scandinavia and eastern Europe shows that the application of modern exploration methods can find new deposits even in old mining areas. From its geological makeup Europe is sure to contain undiscovered mineral deposits.

**New mines in old European mining districts**

Garpenberg Zn-Pb-Ag, Sweden

Background – a new modern headframe over a newly discovered deposit; foreground a 13th century headframe.

Sites or renewed exploration in eastern Germany

from Rod Allen and Gregor Borg
Mineral exploration and mining in Europe

Contrary to prevailing opinion, the potential for finding and mining minerals in Europe is high. Current activity in Ireland, Scandinavia and eastern Europe shows that *the application of modern exploration methods can find new deposits even in old mining areas*. From its geological makeup *Europe is sure to contain undiscovered mineral deposits*; but *to find them requires new investment, and a change in public perception*.

**New mines in old European mining districts**

Background – a new modern headframe over a newly discovered deposit; foreground a 13th century headframe

Sites or renewed exploration in eastern Germany

*from Rod Allen and Gregor Borg*
Public Perception of the Minerals Industry

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**Phracon**

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*Is a quest ingredient of: Ninja Job Quest*
The Australian Government will use emergency powers to declare a marine park off the Territory coast to stop a multibillion-dollar undersea mining project (Mn from Groote Eylandt; Feb 2012).

Bulgaria becomes second state to impose ban on shale-gas exploration
Government in Sofia makes a U-turn after nationwide protests

Greeks protest against gold mining plan

Thought worth protecting ... workers harvest lavender flowers on a farm in Bulgaria.
• Spanish ecologists recommended that the Aquablanca mine should be sited 40 km away from the deposit, in order to preserve the habitat of a rare plant

• The area occupied by mines in mineral-rich Ontario is the same as that covered by parking lots in the city of Toronto

• 200 people turned up for 3 positions offered by our scientific drilling project in South Africa; they wanted us to open a mine
Digging Deep - Social Benefits of Mining in South Australia

Written by: Government of South Australia (Social Inclusion Initiative)

The mining industry is delivering great benefits for South Australia by bolstering the economy and providing thousands of local employment opportunities both directly and indirectly.

Equally as important as these economic benefits, but far less acknowledged, are the social benefits from mining for South Australia. These benefits include:

- Training for the economically disadvantaged
- Employment of local people
- Aboriginal employment
- Mentoring of Aboriginal employees and/or businesses
- Sourcing goods and services from local business
- Community Trust or funding of community services or infrastructure
- Sponsorship of local events and services
- Student Scholarships or work experience
Welcome to
The More You Dig
it all starts with mining

The More You Dig is a non-profit campaign created by the Northwest Mining Association aimed at educating you about the importance of mining in your daily life and the US economy.

Read More
New avenues of research should involve:

- fundamental and applied science designed to improve our knowledge of how ore deposits form and how new ones can be found
- social science research aimed at changing public perception of the minerals industry

“Ore miles” “Consume Local, Avoid Global”

- Is it reasonable to renounce Kenyan green beans while consuming Congo coltan?
- Aitik mine in northern Sweden – one of the most efficient in the world
- the Dannemora mine in Sweden will sell 33% Fe ore to Germany in the face of competition from 65% Brazilian ore
- Sandvik buys Austrian tungsten mine
- security of supply of metals for European industry; balance of payments ...
- while exportation of jobs and wealth to third-world countries may be defendable (as a form of foreign aid), exporting pollution is not

Social Science Research and Education
- use modern, environment-oriented arguments

Where will this be done?
RESEARCH AT MINES

Mines is a global leader in research and the advancement of technology. Led by our world-class faculty, the research conducted at Mines enhances the educational experience of our graduates. Students have the opportunity to actively participate in research at every level of their education.

Our research spans many highly relevant areas with a specific focus on energy and environmental stewardship. Our first-rate facilities and partnerships with industry, national laboratories, other universities, funding agencies and international institutions

Centres of Mineral Resource Research
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Centres of Mineral Resource Research

Program One - Location
Researchers in Program One work across a range of scales from continent and location of major ore deposits. In particular, we focus on the relationship Program 1 also hosts one of the best equipped and most productive melt in

Program Two - Formation
Program Two research mechanisms of ore genesis. We are developing p hydrothermal and magmatic phenomena fundamental to high-grade ore form

Program Three - Discovery
Program Three addresses the need to develop techniques for the acquisition in the discovery of Australia's deep-earth resources. Read More....

Program Four - Recovery
A research initiative focused on investigating the fundamental relationships recovery. The project involves collaboration with the Julius Kruttschnitt Min and processing attributes that can be embodied into ore body models, whic

- research and teaching, both fundamental and applied
- strong outreach activities
- close collaboration between universities, government agencies and industry
- co-funded by state and industry
European Centres of Mineral Resources Research (based on papers published in top journals)
Future Mineral Resources Research in Europe

New instruments: ERA-MIN (and also EIP, ETP-SMR): promotion of all parts of the metals chain; includes working groups on minerals research and on collaboration & education.

EODI – European Ore Deposits Initiative: focus on mineral exploration and the formation of ore deposits

Important goals are to

• coordinate the now-scattered research undertaken in Europe – individuals in universities, teams in universities and geological surveys

• encourage interaction between academia and industry

• serious thought should be given to the establishment of a European Centre of Mineral Science Research
Identification of the scientific and technical challenges to be addressed by future research in both its fundamental and applied aspects.

The roadmap will be fed by the outcomes of five working groups gathering experts from industry, academia, research centres, funding agencies.

- Primary resources
- Secondary resources
- Substitution
- Public policy support
- Mineral intelligence
- Teaching and education, cooperation
European Ore deposits Initiative

52 geologists from universities, surveys and industry in 12 countries

The aims are:
- To assure that research and teaching about the origin, distribution and exploration for ore deposits forms a integral part of European raw materials initiatives
- To facilitate cooperation between research teams in European universities, geological surveys and industry
- To promote teaching on ore deposits by setting up a Europe-wide network and by organizing short courses and field schools
- To foster interaction between academia and industry
- To inform decision makers and the general public about the nature of the minerals industry in Europe and the potential for domestic mineral production.

Next meeting in Madrid 30-31 August
Conclusions

1. The start of the metals chain is the discovery of ore deposits; research on ore deposits and exploration techniques will be required to assure future supply.

2. Mining in Europe is not inconceivable and in many respects advantageous; but ....

3. Public perception of the metals industry must be addressed.

To do this requires coordinated academic-industry research at a European level.