THE GEO COMMUNITY ACTIVITY "EARTH OBSERVATIONS FOR MANAGING MINERAL AND NON-RENEWABLE ENERGY RESOURCES": HISTORY, PRESENT AND FUTURE ACTIVITIES

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Presented by Michael Abrams
Economic and societal importance of minerals

Mining is not everything, but without mining, everything is nothing!

*Max Planck*

The mining and extractive industry plays a significant role in the development of many countries all over the world.

Most sectors, such as construction, chemicals, automotive, aerospace, machinery and equipment sectors that provide e.g. in the EU a total value added of €1´324 billion, and employment for some 30 million people, depend on unimpaired access to raw materials.

A child born today in the United States consumes on average:

- 45 kg of gold
- 212 kg of zinc
- 424 kg of copper
- 389 kg of lead
- 2297 kg of bauxite
- 5795 kg of clays
- 7667 kg of phosphate rock
- 12 614 kg of iron ore
- 14 876 kg of salt
- 17 526 kg of cement
- 18 370 kg of other minerals/metals
- 61 521 gallons (British) of oil
- 239 994 kg of coal
- 494 415 kg of rock, sand, gravel
- 177 829 m³ of natural gas

...during the whole of his life. What gives the total of 1342 632 kg or 1 343 m³ of minerals, metals and fuels. It is more than 17 tons per 1 person/year.

Source: Mineral Information Institute – www.mil.org
Minerals: a global issue...

WHERE THE MINERALS ARE

http://www.mining.com/infographic-where-the-minerals-are-82638/
Mining: a global issue...
Coal and Lignite
a global issue too...

Major Coal Deposits of the World

- Anthracite and Bituminous Coal
- Lignite
"Unused extraction" grows
➢ more waste, water distraction, landscape change…
➢ Land use conflicts
➢ Resource extraction prefers sparsely populated areas as conflicts grow with population density

Source: Mudd 2009, Australia
The intergovernmental Group on Earth Observations, has been established by the Resolution of the Third Earth Observation Summit in February of 2005, in response to calls for action from the 2002 World Summit on Sustainable Development, to develop & implement GEOSS. 104 countries plus the EC are members and there are also 109 participating organisations (e.g. IUGS, EuroGeoSurveys, EARSeL, WB...)

A 10-year implementation plan with bi-annual Work Plans, addressing 8 Societal Benefit Areas (SBAs) + cross-cutting issues.

GEO, the group on Earth Observations, envisions “a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth Observations and information.”
Minerals in GEO

2005 – 2015 10-year WP: Nine Societal Benefit Areas (SBAs)

What about minerals?
2012-2015 revised Work Plan

  – Integration of spaceborne, airborne and ground-based EO datasets into mature stakeholder-oriented EO products to monitor the societal and environmental impacts of the extractive industry over all phases of a project, from exploration to closure
New 2016 – 2025 SBAs

Adopted at GEO XII Plenary, Mexico city, November 2015
CA-06 : EO data for managing mineral and non-renewable energy resources. PoC: S. Chevrel (MinPoI)

GI-10 : EO data and renewable energies. PoC: T. Ranchin (MinesParisTech)
CA-06 overarching proposed activities

• Develop tool sets and information products for the Resource Assessment, Monitoring and Forecasting of Geological Resources (including mineral and fossil resources, raw material and groundwater)

• Develop tool sets for environmental impacts monitoring of mining and processing operations

• Identify and foster implementation of strategic measures for the competitive, reliable and sustainable management of geo-resources exploitation and treatment of re-usuable materials
GEO Community Activity “Earth Observations for Managing Mineral and Non-renewable Energy Resources” (CA-06)

- Global mineral map of the Earth’s surface
  - Australia Geoscience mineral map
  - Global spectral libraries of soils in view of future IS spaceborne missions

- Global GEO community portals

- EO-based integrated products for monitoring environmental and societal impacts:
  - National to regional (e.g. illegal mining, GFOI, GMOS)
  - Local: mine site, SLO...
Minerals lack dedicated EO systems and rely on systems from other SBAs.

The “mineral community” strongly advocates for operational hyperspectral spaceborne missions ensuring a global systematic coverage at no (or marginal) costs and at “decent” spatial resolution:

- Operational, freely available, global coverage
  - *Multispectral* : Sentinel 2 and Landsat TM
  - *Superspectral* : ASTER (failure of SWIR sensors in 2009)
- Operational, commercial, local coverage on request, high acquisition costs
  - *Superspectral* : WV-3
  - *hyperspectral* : airborne VNIR-SWIR, few operational TIR sensors

EO in mineral industry lacks institutional support:

- Mostly deals with private companies
- => EO-based monitoring of illegal mining
Activities for 2017-2019 WP

• Overall plans
  – Generation of a publicly available Global ASTER Geoscience map to be delivered to GEO (2018)
  – Definition of possible product standards for global, public hyperspectral satellite land surface composition
  – Global land surface composition spectral libraries
  – Identification of user community and their requirement, including mineral regulation enforcement

• Activities
  – Global ASTER Geoscience map: challenges, collaborations, network, path for moving forward
  – Global Soil Spectral Library (GSSL)
  – Definition of relevant essential variables...
  – Cross-cutting GEO activities
    • Links with GEO initiatives GI-10 (renewable energies) and GI-18 (SDGs)
    • Illegal mining: links with GFOI, GMOS (GEOBON?)

• Support global user community portals
  • EO Broker Energy
  • MAP-X
e.g. Al-Clays: phengite, muscovite, paragonite, lepidolite, illite, brammalite, montmorillonite, kaolinite, dickite, beidellite

17
Geoscience maps were created

AlOH group composition
White mica chemical gradients (exploration)
Transported versus *in situ* regolith materials.
Productive agricultural soils.
Surface permeability (water catchments).

pH indicator.
From ASTER Geoscience Maps of Australia to ASTER Global Geoscience Maps

Please attend following talk for details

Estimated completion date: 2019
GSSL Global Soil Spectral Library

Global Soil VNIR-SWIR Spectra
Some 20,000 VNIR-SWIR reflectance spectra from 12,509 sites in 92 countries over the 7 continents
45 collaborators from 35 institutions collaborate to the global database

http://www.globalsoilmap.net/

An initiative supported by ESA

https://www.youtube.com/watch?v=1OSNaDrPixE
Mapping Mining to the Sustainable Development Goals: An Atlas
Comprehensive inventory of the non-renewable resources natural capital
ensure equitable return for the resources
future land use planning, conflicts and monitoring evolution over time
Assist in resettlement planning and follow up, spatial distribution of urban sprawl
around mining area and its impacts
Detection of illegal mining and other infrastructure development
Monitoring restoration efforts and progress towards final land use
Monitoring non-mining use areas options such as agricultural crop monitoring
Understanding the cumulative impacts of mining and related infrastructure
Understanding and monitoring the impacts on surface and groundwater resource and
their impacts on crops and aquatic life
Environmental Impact Assessments and Monitoring of changes of crops productivity
Infrastructures design, location and implementation and implications on agriculture
lands
Dust (and other pollution) monitoring and their impacts on crops
Coal self-combustion monitoring
Understanding and monitoring pollution related to mining
Impacts (including predictive) on surface and groundwater
Mapping and monitoring soil contamination
Monitoring marine pollution from inland mining activities
Predictive implementation of inland mining facilities to avoid downstream
contamination transport to shoreline
predictive models for potential leakage and failure of waste disposal facilities
Provision of EO data relevant to a country’s mineral wealth
Provision of EO-based documents/products for Social License to Operate (SLO)
process and responsible mining initiatives
Capacity building in EO
Assist national authorities in developing methodologies to combat illegal mining
and in enforcing regulations
Renewable and non-renewable energy sources together with GI-10
The CA-06 contributors

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- Australia: CSIRO, GSA
- USA: USGS, JPL
- EU: EuroGeoSurveys, ESA
- UK: BGS, Univ. of Nottingham
- Germany: DLR, GFZ
- Japan: AIST, Japan Space Systems
- China: China University of Mining and Technology, RADI
- Israel: Tel Aviv University
- NL: ITC
- More to join?
  - ✓ Oil and gas community
Thank you for your attention

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