

INFAC

INNOVATIVE NON-INVASIVE & FULLY
ACCEPTABLE EXPLORATION TECHNOLOGIES



Moritz Kirsch, Helmholtz Institute Freiberg for Resource Technology
INTMET Clustering Conference, Seville, 23 January 2019

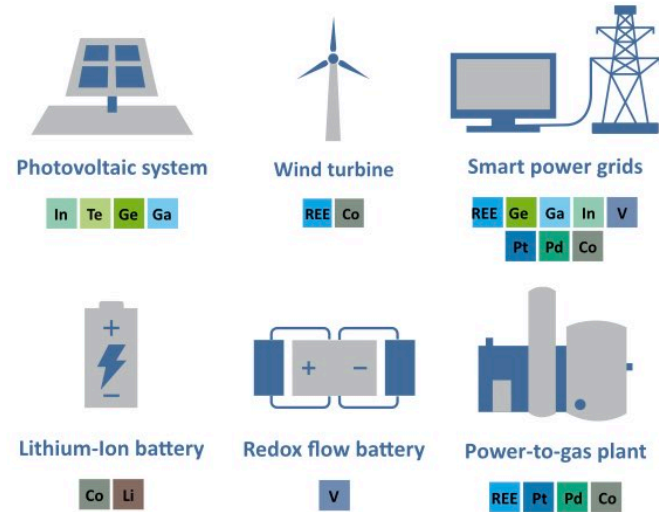
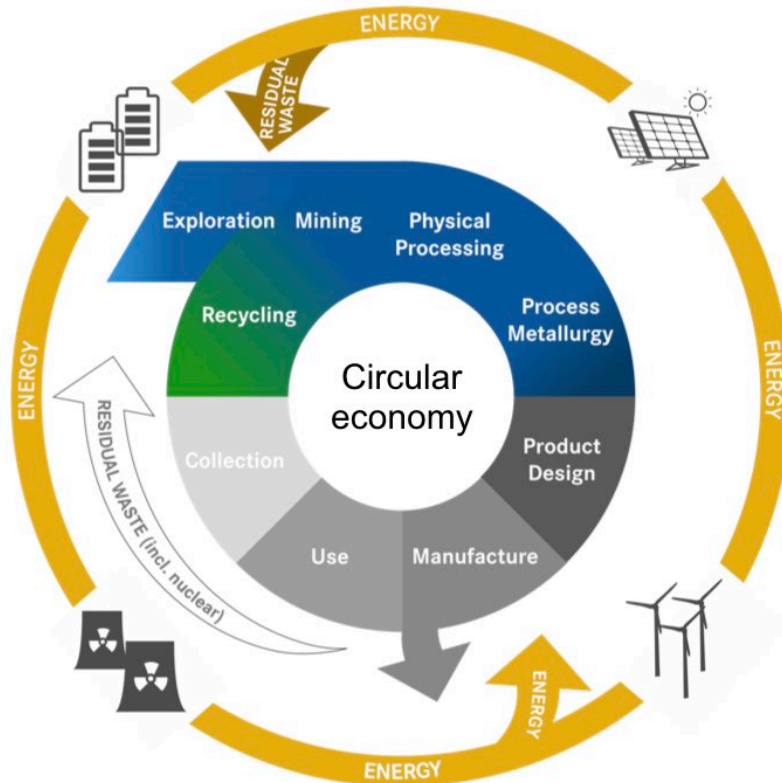
Web: <http://infactproject.eu>
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No 776487.



A NEED FOR RAW MATERIALS

- Rising demand for metallic raw materials and complex metal alloys

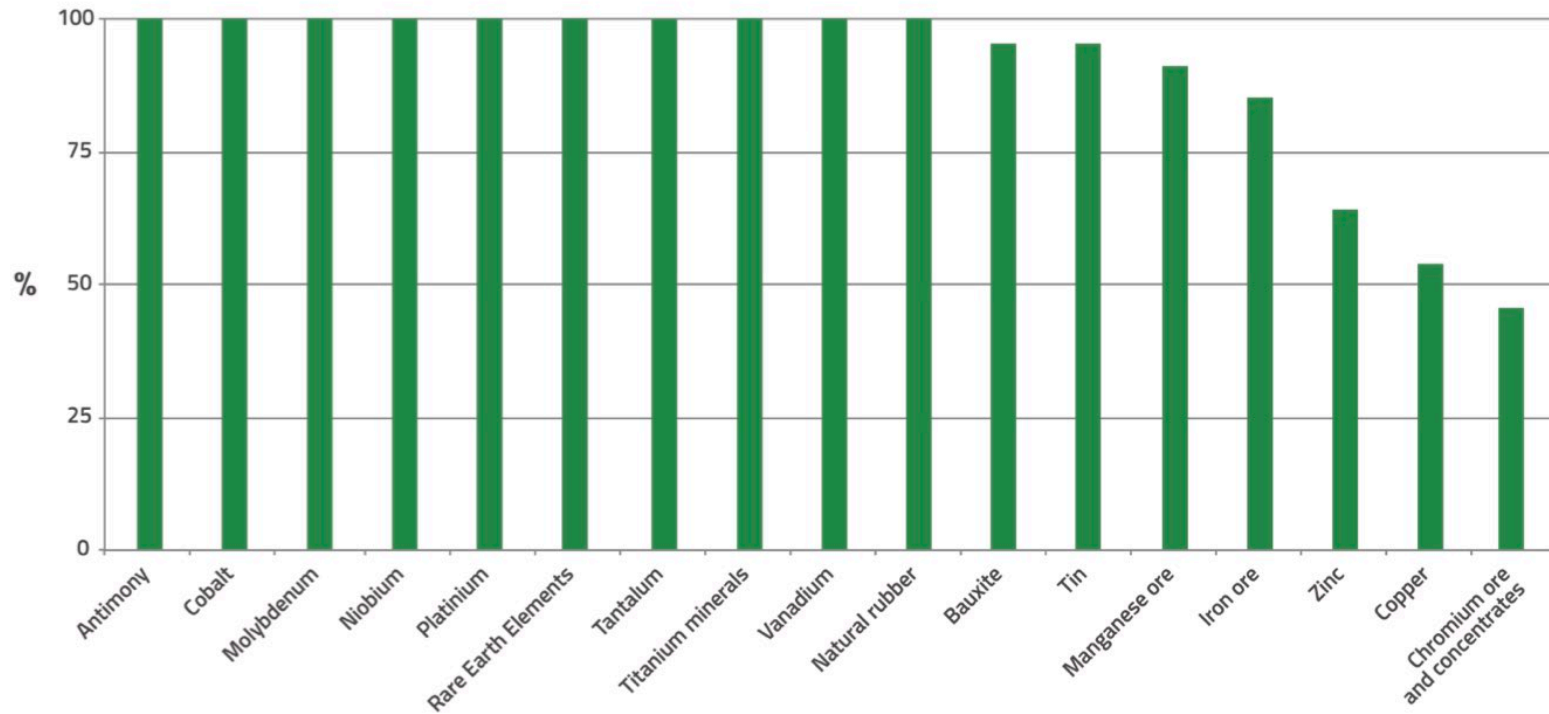


Source: <http://energiesysteme-zukunft.de>

➔ Need to invigorate exploration

DEPENDENCY ON RAW MATERIAL IMPORTS

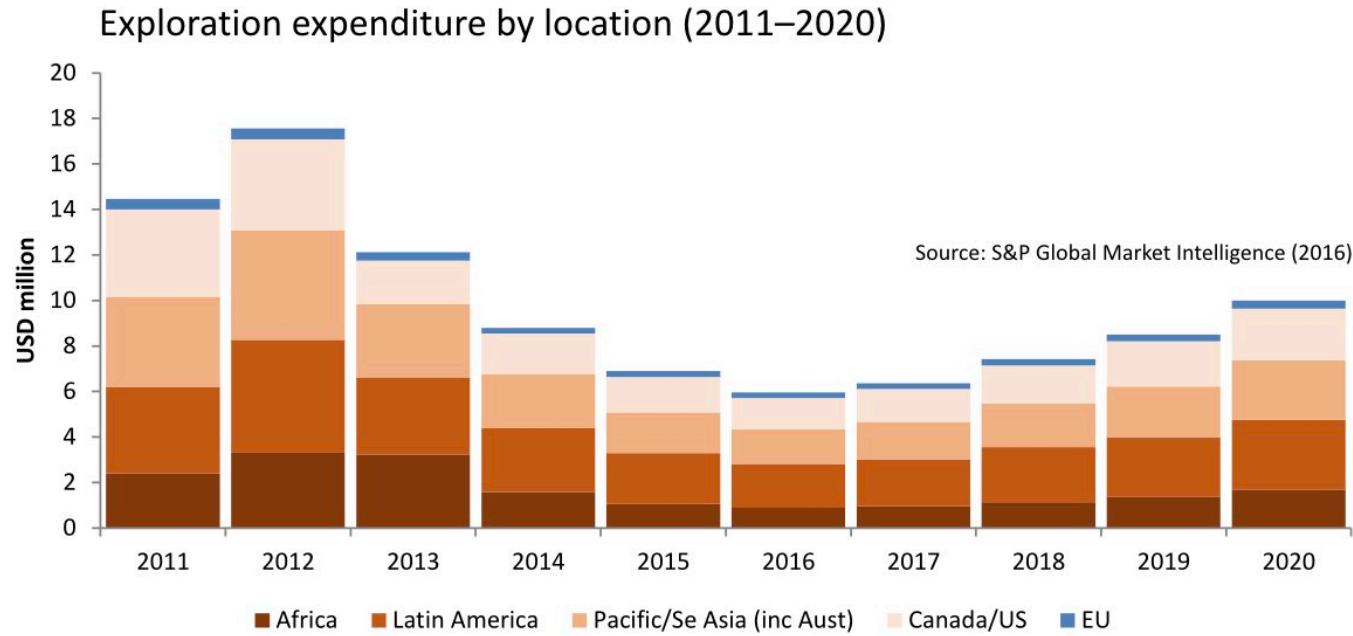
Europe's import dependency for selected raw materials



➔ **Need to reduce import dependency**

Source: JRC analysis based on data from report of the Ad hoc Working Group on defining critical raw materials, 2010, 'Critical raw materials for the EU'.

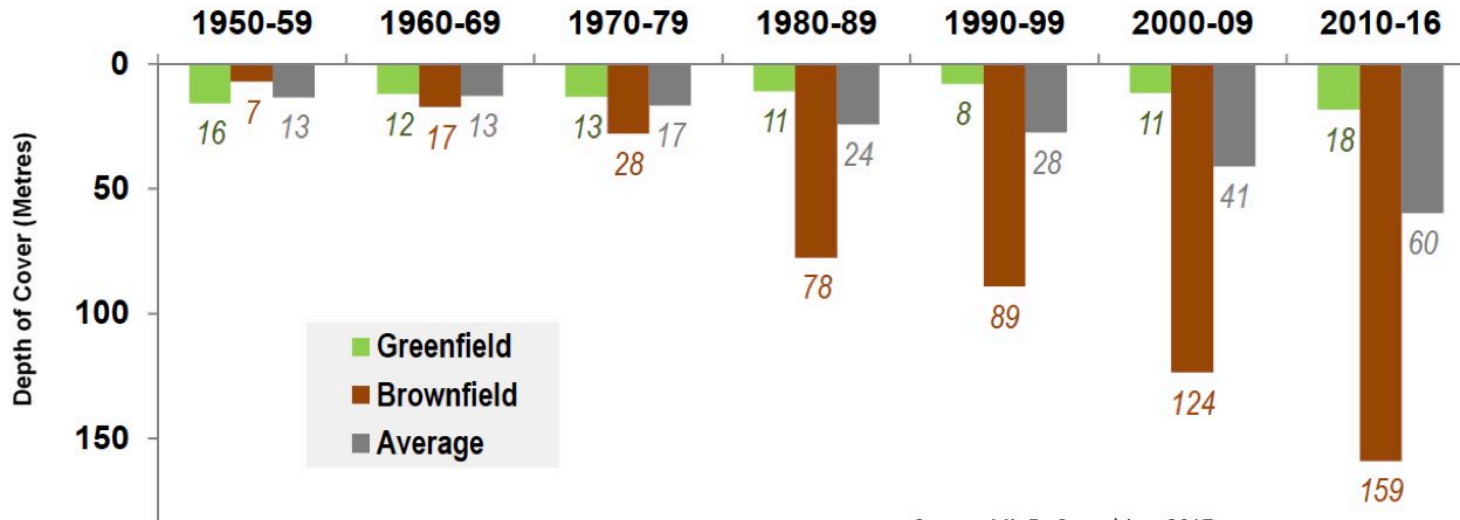
EXPLORATION EXPENDITURE



➔ Need to invigorate exploration in Europe

EXPLORATION CHALLENGE: HIDDEN RESOURCES

Depth of cover for primary gold discoveries in the World 1950–2016

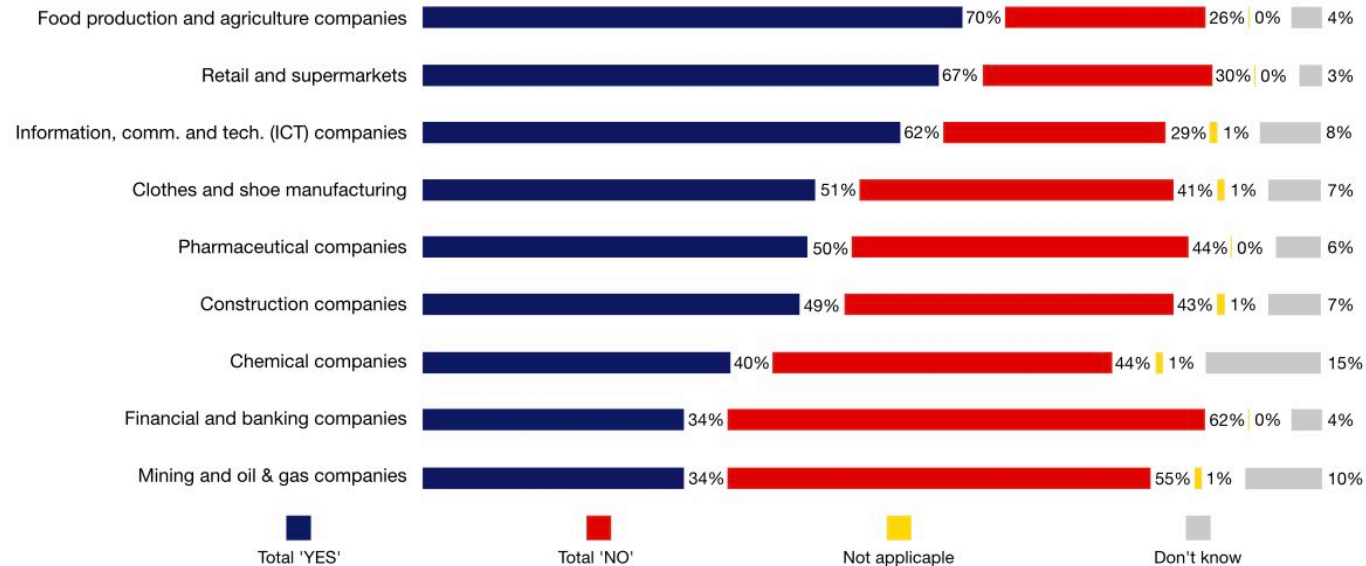


- Surficial deposits have largely been mined, current exploration focusses on mineral deposits located deeper and in more remote locations

➔ Need to develop more efficient, innovative exploration technology

EXPLORATION CHALLENGE: LOW PUBLIC ACCEPTANCE

Q: Do companies make efforts to behave responsibly towards society in our country? Average values for the EU by type of company.



Source: European Commission:
Flash Eurobarometer 363, 2013

➔ **Paradigm shift needed. Focus on non-invasive exploration technology. Social dialogue!**



CHALLENGES FOR THE MINERAL EXPLORATION INDUSTRY



Source: "The State of the Mineral Exploration Industry in Canada", Nadim Kara, 2017

INFACT – IN A NUT-SHELL

- Funding organization: EU/ H2020
- Funding amount: 5.6 Mio €
- Timeframe: Nov 2017 – Oct 2020
- 17 partners from research and academia, industry, state and NGOs from seven countries

Objectives:



Engage society

Develop innovative
exploration technology



PARTNERS

COORDINATOR

HZDR

HELMHOLTZ
ZENTRUM DRESDEN
ROSSENDORF

SOCIAL DIALOGUE & ENVIRONMENT

DIALOGIK
dialogue in digital technology

SYKE



CLAVE

UNIVERSITY OF
EASTERN FINLAND

IMPLEMENTATION & BUSINESS MODEL

Agencia
IDEA

Fraunhofer

TECHNICAL DEVELOPMENT & EXPLORATION

GEOTECH
MINING TECHNOLOGICAL SERVICES

Atalaya
MINING

supracon

srk
exploration

AARHUSGEO

OULU MINING
SCHOOL

CIC



ANGLO
AMERICAN

NON-INVASIVE EXPLORATION TECHNOLOGY

- Contact-less and non-destructive → no damaging of soil and vegetation
- E.g., airborne and remote sensing techniques
- Benefits:
 - Energy efficient
 - Time-saving
 - Safe
 - Low environmental impact
 - Socially acceptable

INNOVATIONS IN NON-INVASIVE EXPLORATION

- **Airborne SQUID-based full tensor magnetic gradiometry**
- **Ground floor EM**
- **Airborne long-wave infrared hyperspectral imaging**
- **Drone-borne sensors (magnetics, hyperspectral, LiDAR, EM, thermal, gravimetry, radiometry)**
- **Extraction of IP data from airborne EM**
- Passive seismic
- Muon tomography
- Gravity gradiometry
- ...

*methods in **bold** will be trialled during INFAC



INFAC – TECHNICAL APPROACH

Establish reference sites



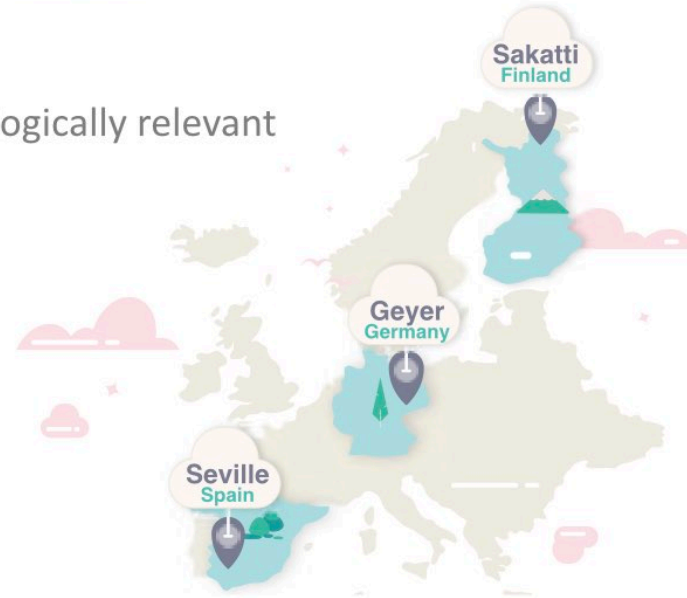
- Geographically and socially representative, geologically relevant
- Existing drillhole database
- Acquisition of state-of-the-art geophysical data



Definition of benchmark targets



Certification



INFAC – TECHNICAL APPROACH

EXPLORATION TEST SITE SERVICES		Technology Applications								Test Site Attributes						Services									
		Multi-system	Magnetics	Radiometrics	Hyperspectral	Gravity gradiometry	Electromagnetics	Airborne IP	Hydrogeology monitoring	Remining	Used for airborne tests	Dense ground data	Surface sources	Shallow sources	Deep sources	Directly-detected sources	Mineral deposit source	Targets undeveloped	Accessible	Suitable local airport	Official test site	Calibration facility	Environmental impact	Social acceptability	Technical certification
Canada	Reid-Mahaffy																								
	Alexandria																								
	Beckenridge																								
	Caber																								
Australia	RJ Smith (Kauring)																								
	Forrestania																								
	Nepean																								
	Carmanah																					EM			
EU	Senssys Sensorik (DE)			Ground systems only																					
	Leicester University (UK)			Ground systems only																					
	Nantes Laboratory (FR)			Ground systems only																					
	Lingby (DK)																					EM			
	San Rossore (IT)			Ground systems only																					
	Minas Rio Tinto							!														v	!	!	!
	Las Cruces																					EM	!	!	!
	Geyer					v																v	!	!	!
	Sakatti							!														v	!	!	!

AEM – Airborne Electromagnetics; AIP – Airborne Induced Polarisation.

- ➔ Caters for multiple technologies
- ➔ Evaluates environmental and social impact



INFACT – SOCIAL APPROACH



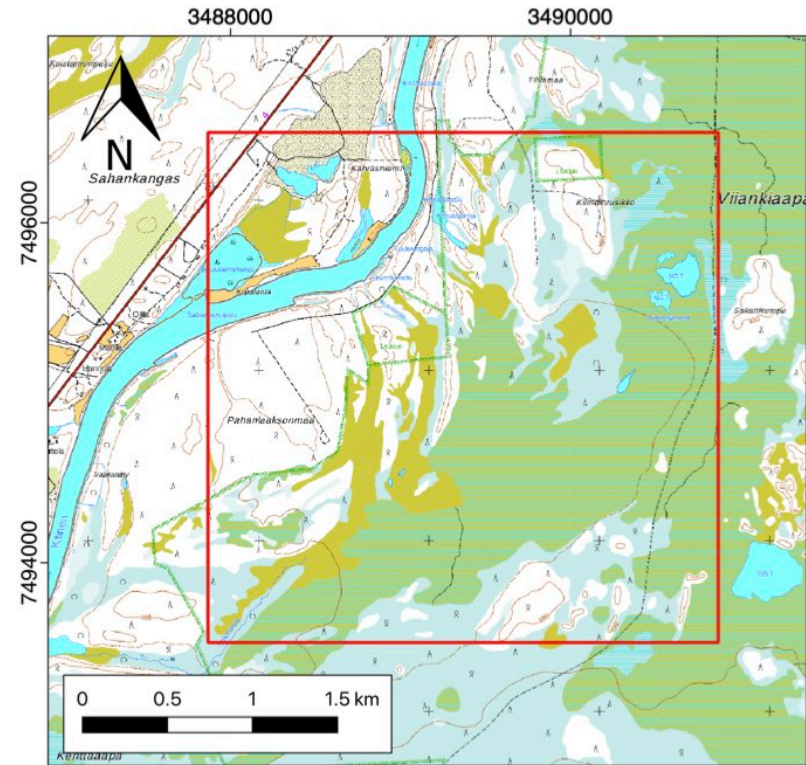
- Stakeholder engagement events
- Interviews with local and regional decision makers
- Roundtable discussions
- Online surveys
- Expert workshops



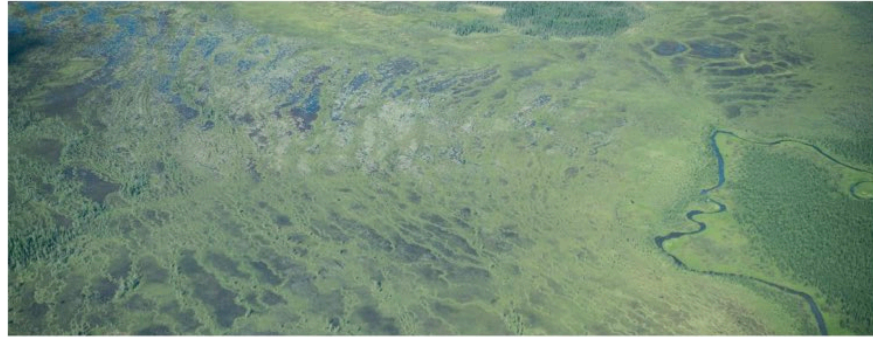
Best practice recommendations

to policy makers, regulatory organisations and the exploration industry

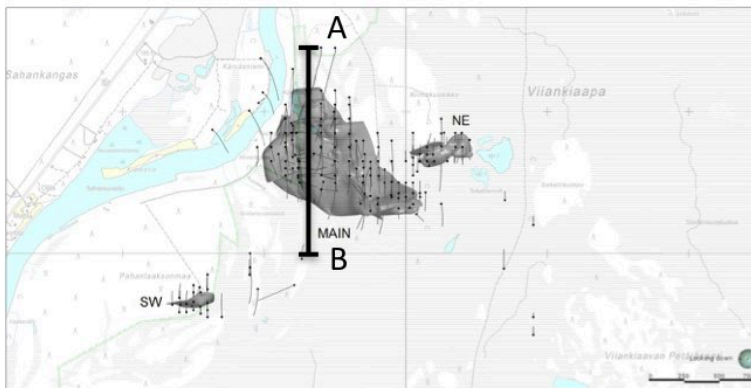
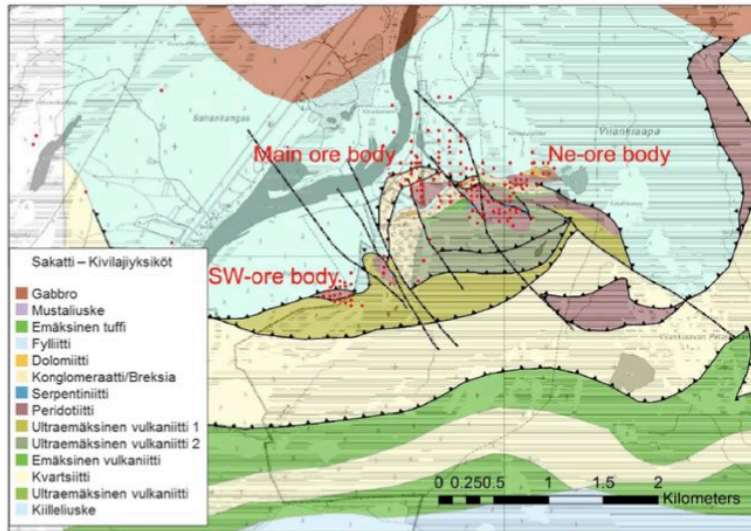
REFERENCE SITE SAKATTI (FINLAND)



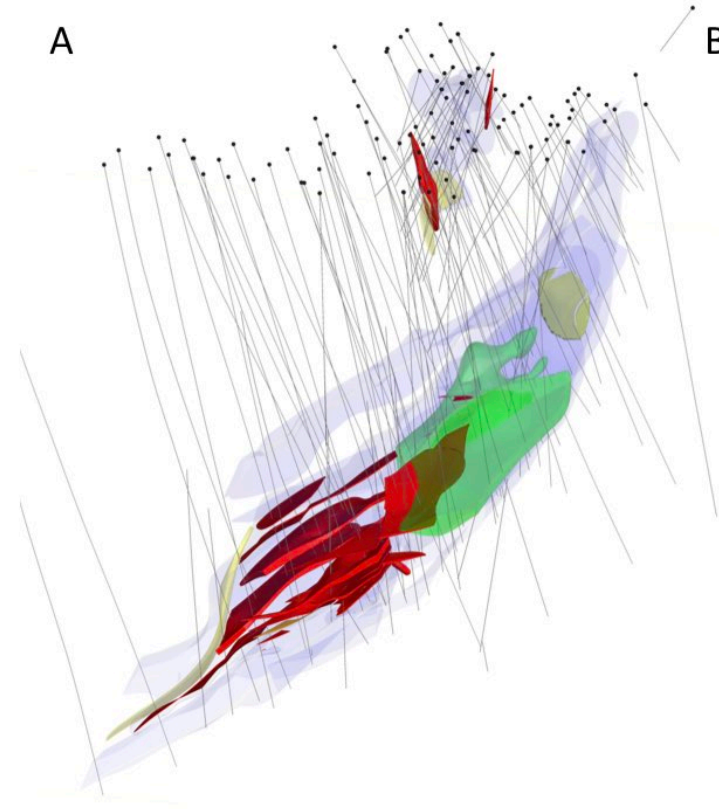
REFERENCE SITE SAKATTI (FINLAND)



REFERENCE SITE SAKATTI (FINLAND)



Geological benchmarking data



Source: AA Sakatti Mining Oy, 2018

REFERENCE SITE SAKATTI (FINLAND)

Data acquisition (state-of the art techniques)



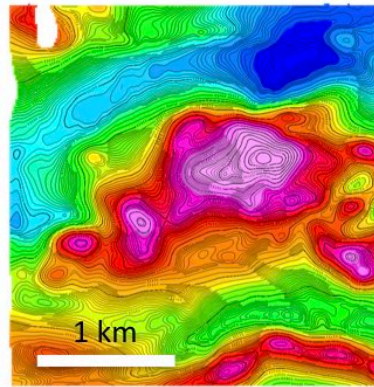
Sakatti site, August 2018



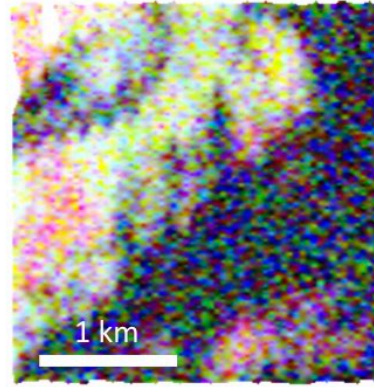
REFERENCE SITE SAKATTI (FINLAND)

Data acquisition (state-of the art techniques)

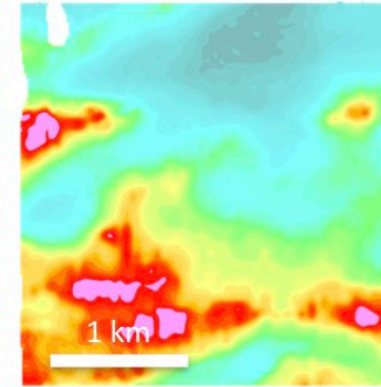
Magnetics (TMI)



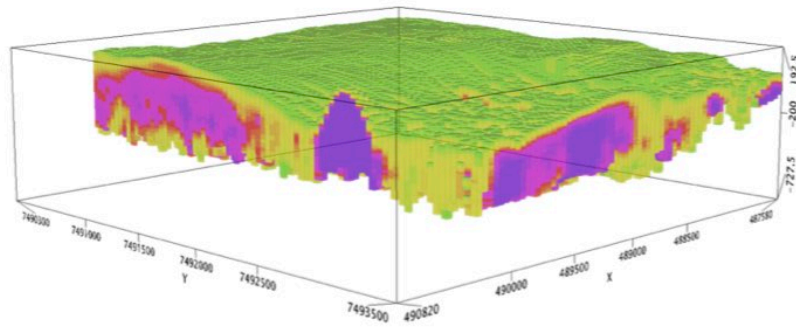
Radiometrics (ternary)



VTEM (dB/dt ET)



VTEM (apparent resistivity)



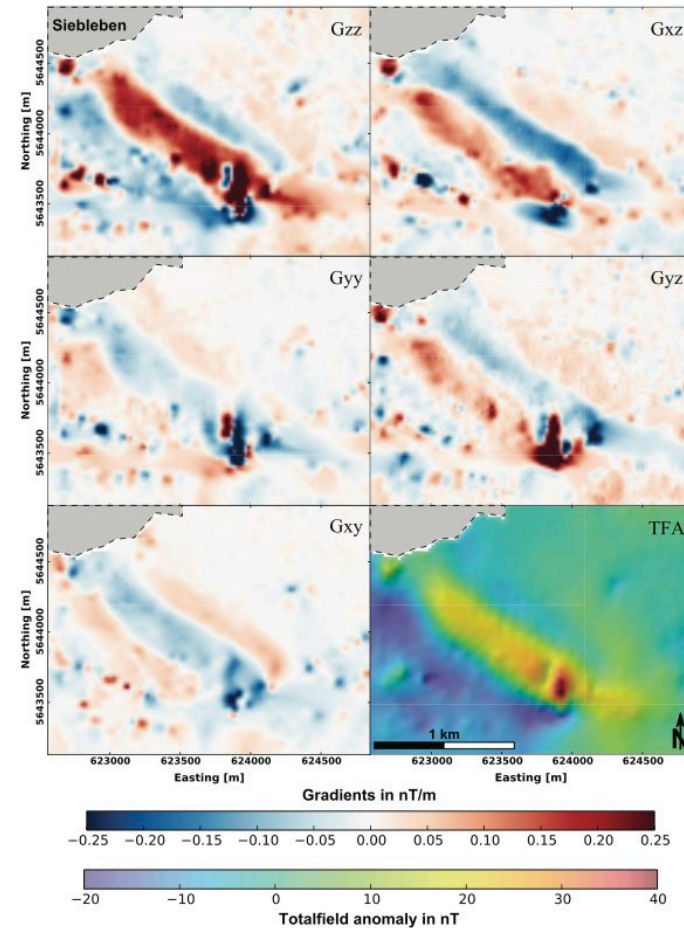
Provides a reference against which emerging exploration technology can be measured

REFERENCE SITE SAKATTI (FINLAND)

Data acquisition (innovative tech)



Sakatti site, August 2018



Source: Queitsch (2017)

STAKEHOLDER ENGAGEMENT ACTIVITIES



Sakatti site, August 2018



Geyer site, August 2018

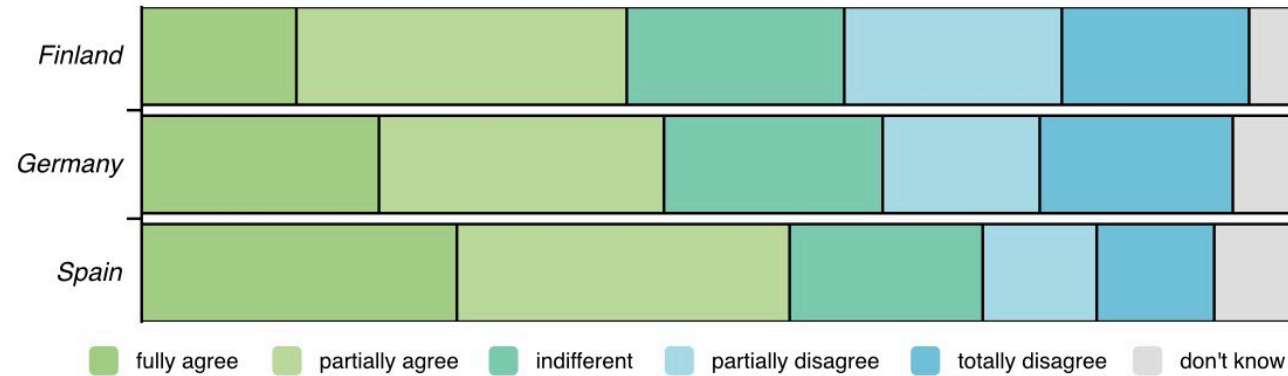


Seville, November 2018

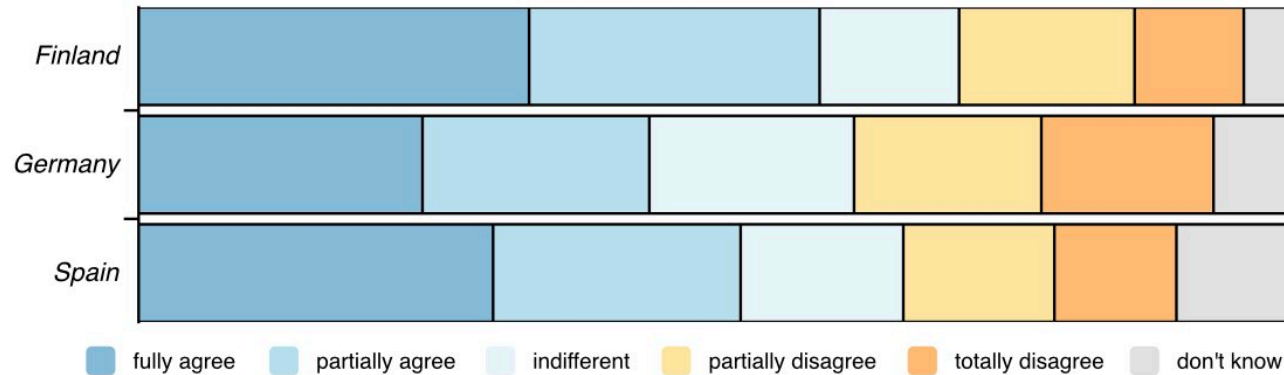
STAKEHOLDER ENGAGEMENT ACTIVITIES

Online
survey

"I trust that the mining industry in Finland/Germany/Spain acts in a fair and responsible manner."

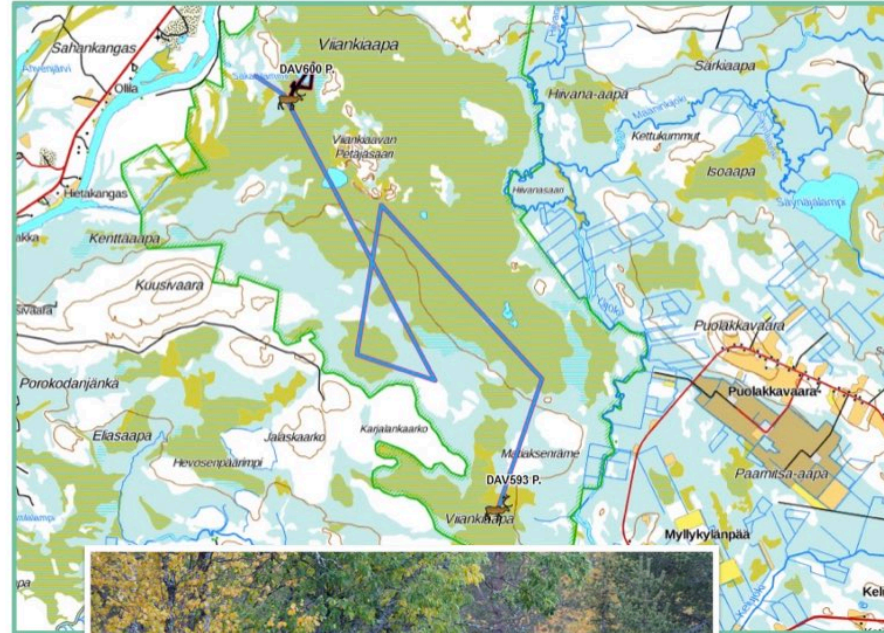
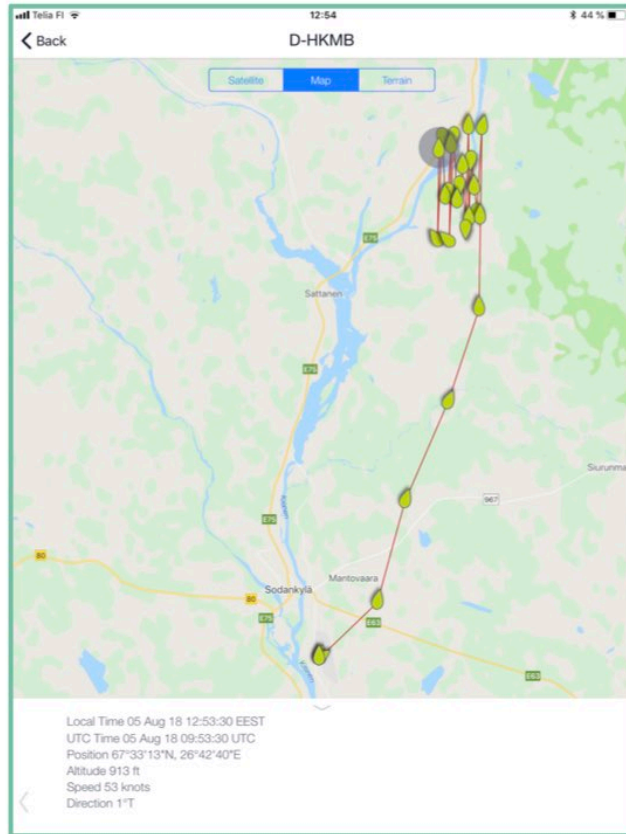


"Drones in action do not bother me"



STAKEHOLDER ENGAGEMENT ACTIVITIES

Flight path vs. reindeer path



THANK YOU FOR YOUR ATTENTION!

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