



Challenges and opportunities in the mining and metallurgical sector

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REMIX Steering Group Meeting

Delphi 16-18/10/2018

The Greek land houses a wide portfolio of minerals with countless uses in industry and daily life; many of them in leading position worldwide



Lignite

*2nd in the EU,
5th worldwide*



Magnesite

*Largest exporter
in Europe*



Perlite

1st worldwide



Laterite

*One of the largest producers
in Europe-key for the national
ferronickel metallurgy*



Bauxite

*Largest producer in Europe-
key for the national
aluminum industry*



Aggregates

*Key for the
cement industry and construction*



Marble

*Global leader in quality,
acquiring market share*



Bentonite

*1st in Europe,
3rd worldwide*



Gypsum / Pozzolan

*Key for the
cement industry*

This variety of minerals is spread across many locations and site types – metallic mines, lignite pits, marble and aggregates quarries

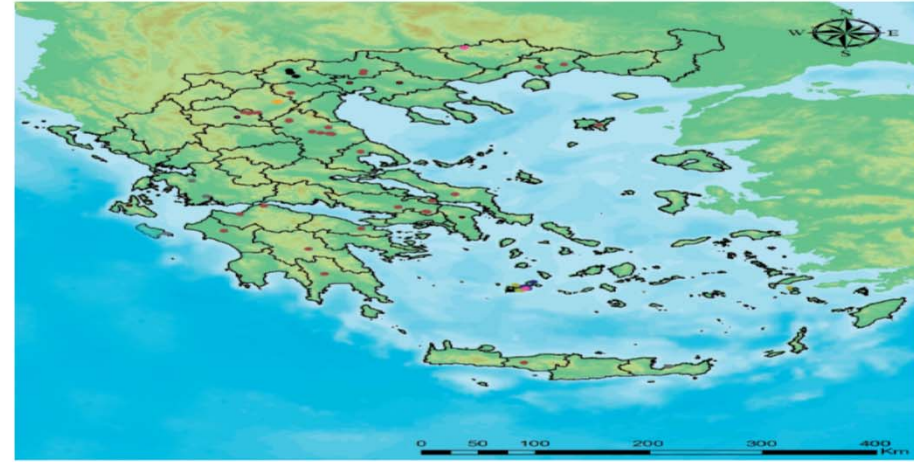


METALLIC AND LIGNITE MINES (2010)



LEGEND: Feldspar // Huntite // Manganese ores // Mixed Sulfides // Magnesite // Ferrous Nickel Ores // Bauxite // Lignite

INDUSTRIAL MINERAL QUARRIES (2010)

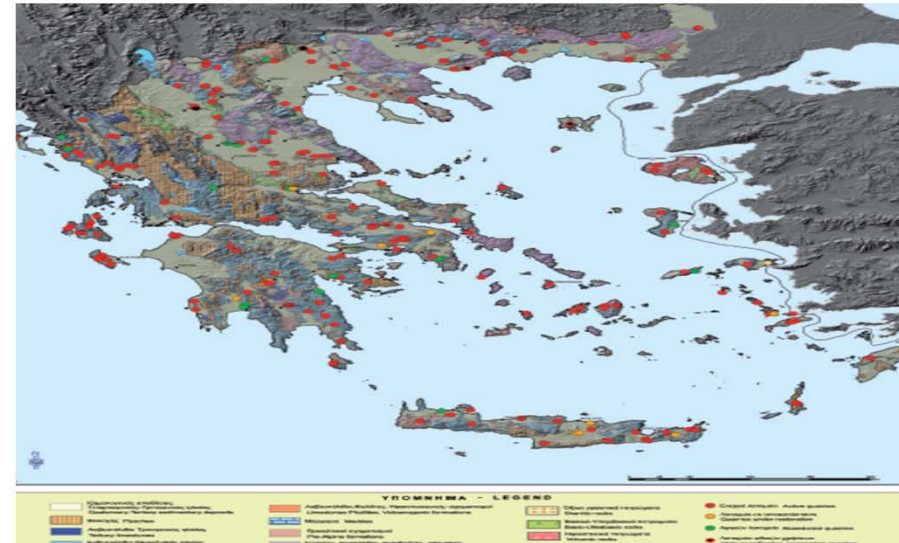


LEGEND: CaCO3 // Pumice // Attapulgite // Quartz // Dolomite - Calcite // Caoline // Pos-solane // Perlite // Betonite // Gypsum // Clays

MAP OF MARBLE EXTRACTIVE ACTIVITIES IN GREECE



WHITE MARBLE



ΥΠΟΜΗΜΑ - LEGEND

Leveraging these resources, Greece has always derived considerable value and competitive advantage through mining activity



Mineral resource centered activity
has traditionally been a key driver
of economic development (through trade and
innovation), employment (in urban centers but
mainly in the periphery), trade, and ultimately
competitive advantage for the Greek economy

Even during the recent economic crisis, the Greek Mining Industry continues to thrive pushing the economy towards sustainable growth



- Accounts for **3% of the Greek GDP**
- Generated a total value of **€1.2 billion in 2014**
- Extracts more than **30 different minerals**, 10 of which in quantities larger than 300,000 tons per year
- **Export value exceeds € 1 billion** – across several countries mainly to Europe
- Constitutes almost **5% of total Greek exports**
- Employs **directly 20,000 individuals and indirectly 80,000 individuals**
- **Top employer** – especially in the Greek periphery – **occupying 4% of the active population**
- **Investments lever** in fixed assets and a magnet for equity investors: **GMEA members are executing approximately €300 mio worth of investments per year**



Growth



Extroversion

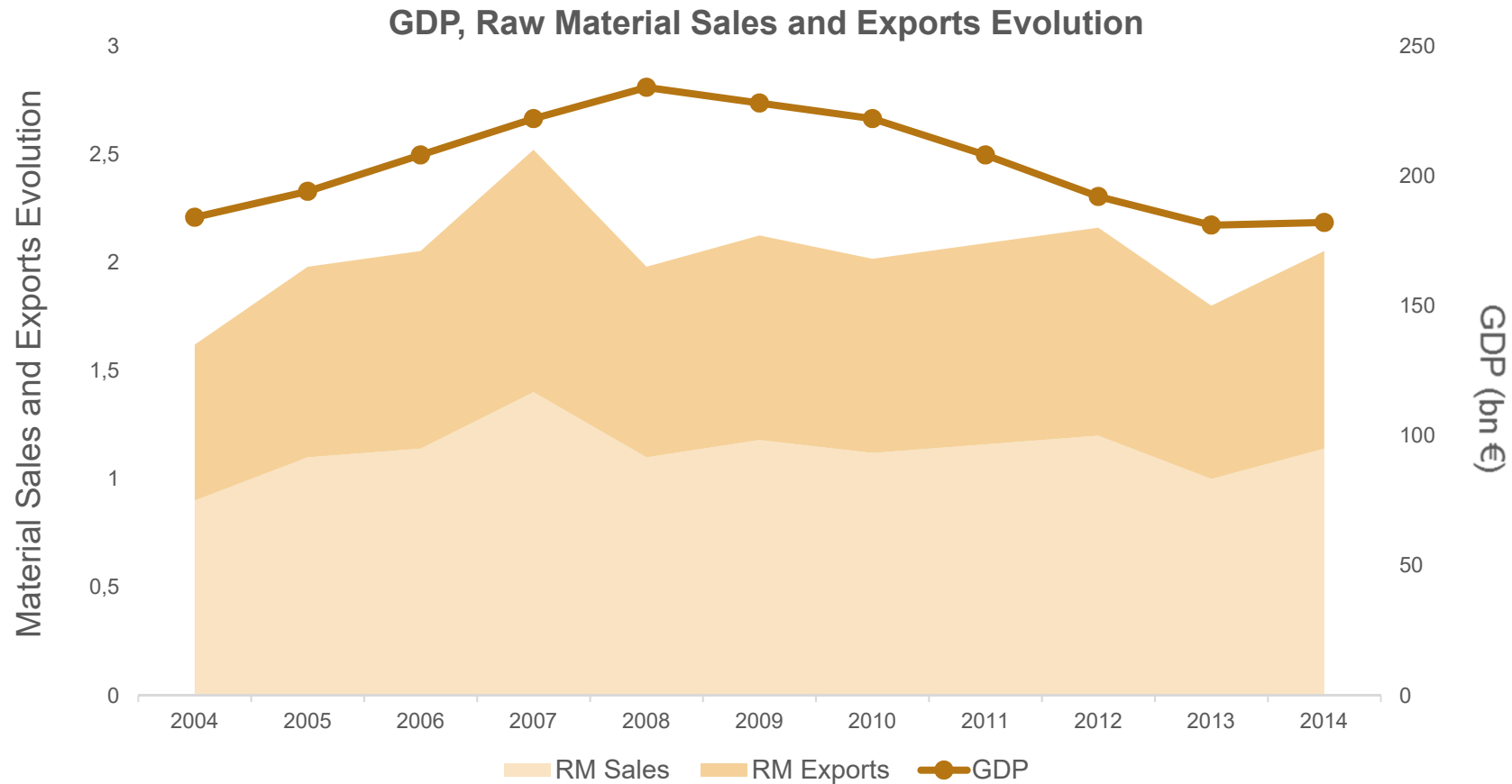


Employment



Investments

The Greek mining industry has weathered effectively the economic crisis thanks to a number of factors



The Greek Mining Industry managed to show resilience during the crisis thanks to the following key four factors: sound risk management practices, extroversion, financial credibility, and responsible operations

The mining industry is a lever of sustainable development and growth...



...but this is not without challenges

Public opinion has also fluctuated but now embraced the industry as a driver of growth and competitiveness



While Greeks are not hopeful for the future, they view the mining industry favorably:

16% of Greeks think that the recovery prospects will improve in the next few months

93% of Greeks think that the government has **not acted towards attracting investments**

86% of Greeks think that the exploitation of mineral resources is **key to economic development**

50% of Greeks think that mining activity favors **job creation**

40% of Greeks think mining activity helps **the local economy and community**

73% of Greeks agree that there is **no political will** to exploit mineral resources

Mining activity causes a temporary, visual disruption on the physical environment



- The majority of extractive activity in Greece concerns aggregates, industrial minerals, energy minerals and sulfur-free metals
- Current rehabilitation projects include the creation of forests, artificial lakes, museums, venue for cultural shows and arable land – **post-mining land use**
- Through the implementation of L998/1979, **more than 65 thousand square kilometers have been rehabilitated** (36% of land under exploitation)
- Since 2007, more than **2.6 mio trees** have been planted
- Additional environmental challenges are created during the extraction and processing of sulfur-containing minerals as well as during lignite combustion for electricity production which are effectively managed using new technologies

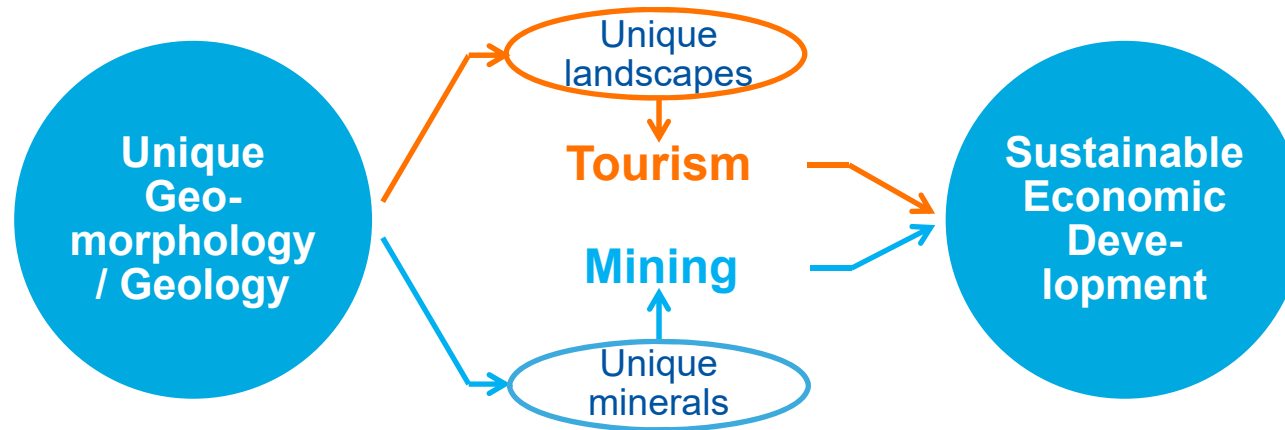


Λατομείο στη Μήλο μετά την αποκατάσταση



Δημιουργία λίμνης στην περιοχή της Πάτρας

A common debate: Tourism and Mining – friends of foes?



Examples of successful mining and tourism symbiosis



Carrara, Ιταλία



Milos Conference Center
George Eliopoulos



Hallstatt, Αυστρία



all the secrets of Milos land.



Lesbos

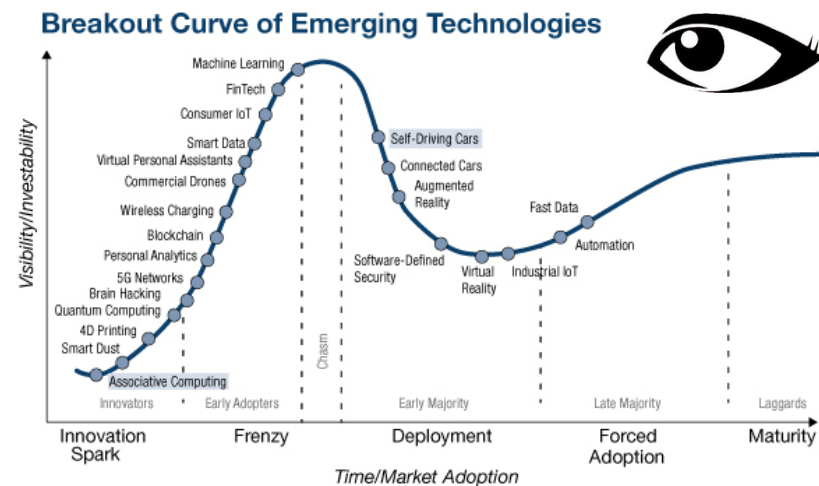


Centuries-old industries, which went through former revolutions
Very few newcomers, little interest from digital giants
Materiality of mining and transforming minerals, physically or chemically,

Threat?

No sign of digital disruption ... yet

- Disruption has its own dynamics
- Visibility momentum may be already late to adapt



Opportunity?

Definitely yes, the question is “how does it serve our vision and strategy”?



Promised capabilities

Cyber-physical systems

Softwares command and control the physical world

Internet of things

Connected objects and sensors measure the world

Cloud computing

Computing power and space are available everywhere

Cognitive computing

Artificial intelligence will outperform the human brain

Big data analytics

The machine can read through a gigantic amount of data

Expectations

Agility

Real-time

Connectivity

Reliability

Predictability

Power Safety

Traceability

Adaptability

Customization

Customer intimacy

Comprehension

Digital mine

Smart factory

End-to-end integration

Three main types of programs:



Industrial and commercial excellence programs: efficiency driven

- Incremental improvements
- Based on identified room for improvement and risk-benefit analysis
- Traditional approach of industrial performance: mining, processing, supply chain, purchasing, etc.



Innovation and strategy: growth driven

- Based on innovation and “megatrends” analysis
- Stage-gate process for risk management
- Leading potentially to radical change and to new business models



Early stage: pilot programs



Mine fleet management *Refractory*

Embedded sensors and IT systems

- *Early detection of issues: predictive maintenance*
- *Operating parameters and real-time supervision by standard KPIs*

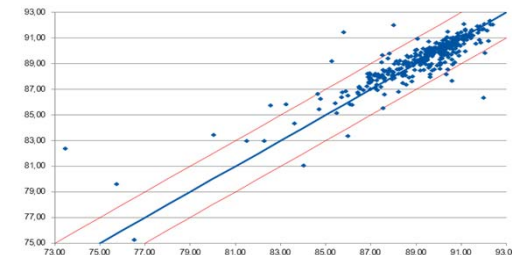


- **Safety**
- **Productivity**

Machine learning *Kaolin*

Prediction of the refined product brightness

- *From easy acquired but indirect data*
- *Using statistical computing and machine learning*



- **Predictability**
- **Avoid loss of material**



Automation in loading and dispatching

Self-loading system, no operator

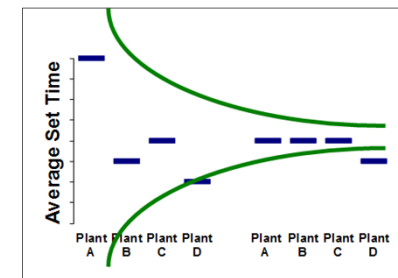
- *Safety rules integrated*
- *Full documentation availability*
- *No manual data entry for drivers*



- **Process stability**
- **Efficiency**
- **Safety**

Quality control Rotary kilns

Quality control performed by fully automated robot (chemistry, mineralogy, particle size), big data treated to ensure quality and traceability from control room



- **Consistency improvement**
- **Benchmark between all kilns**



3D printing

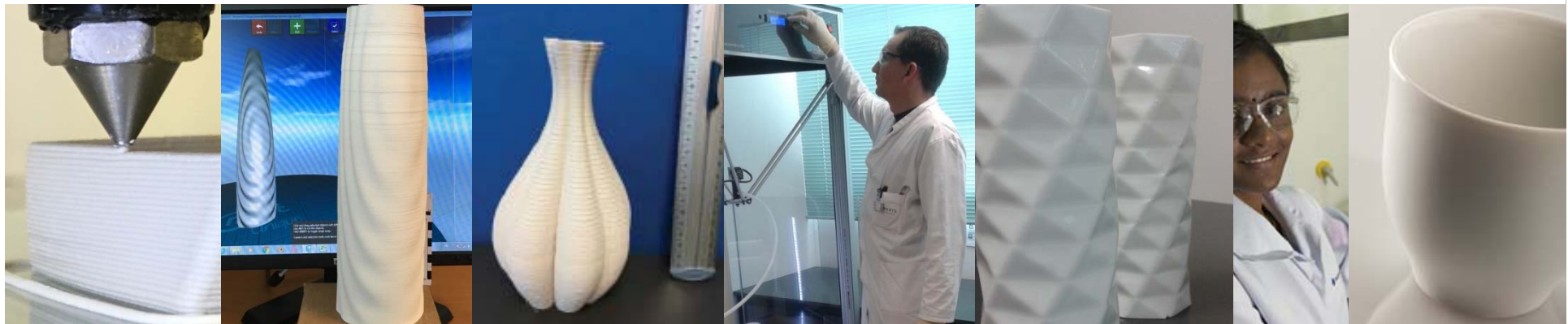


Solutions for tableware and sanitaryware 3D printing - prototypes and short series

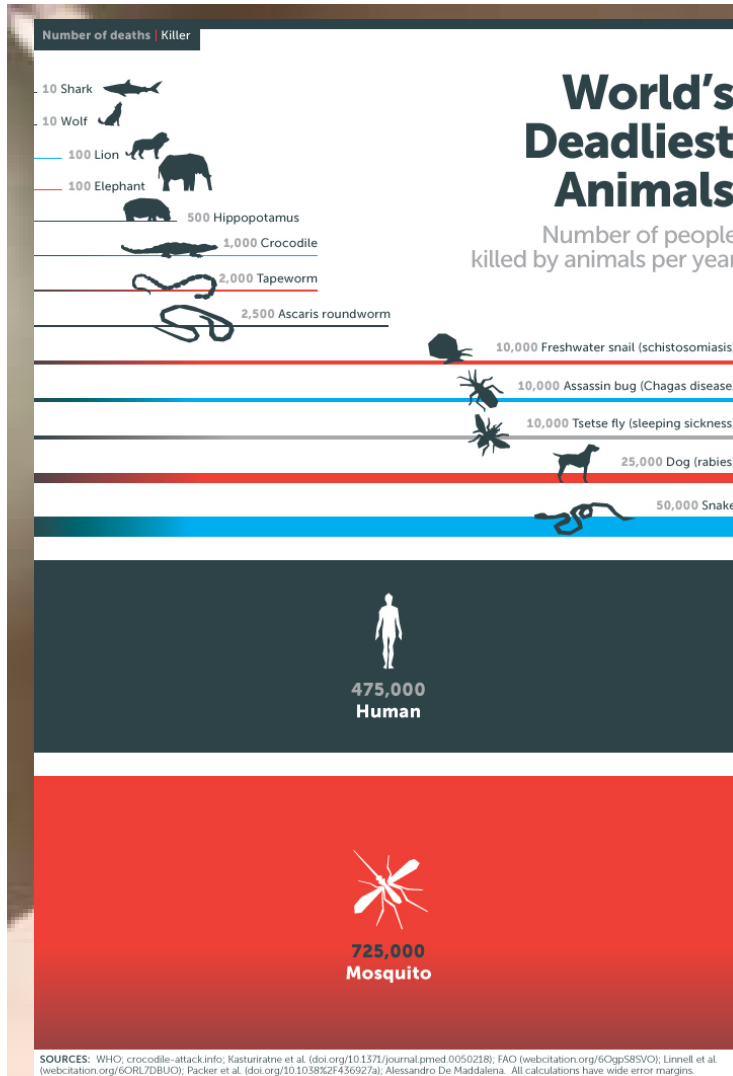
Possible developments in precision casting, special concretes, technical ceramics

- Fast and flexible
- Repeatable
- Waste reduction
- Plastic cartridges recycling

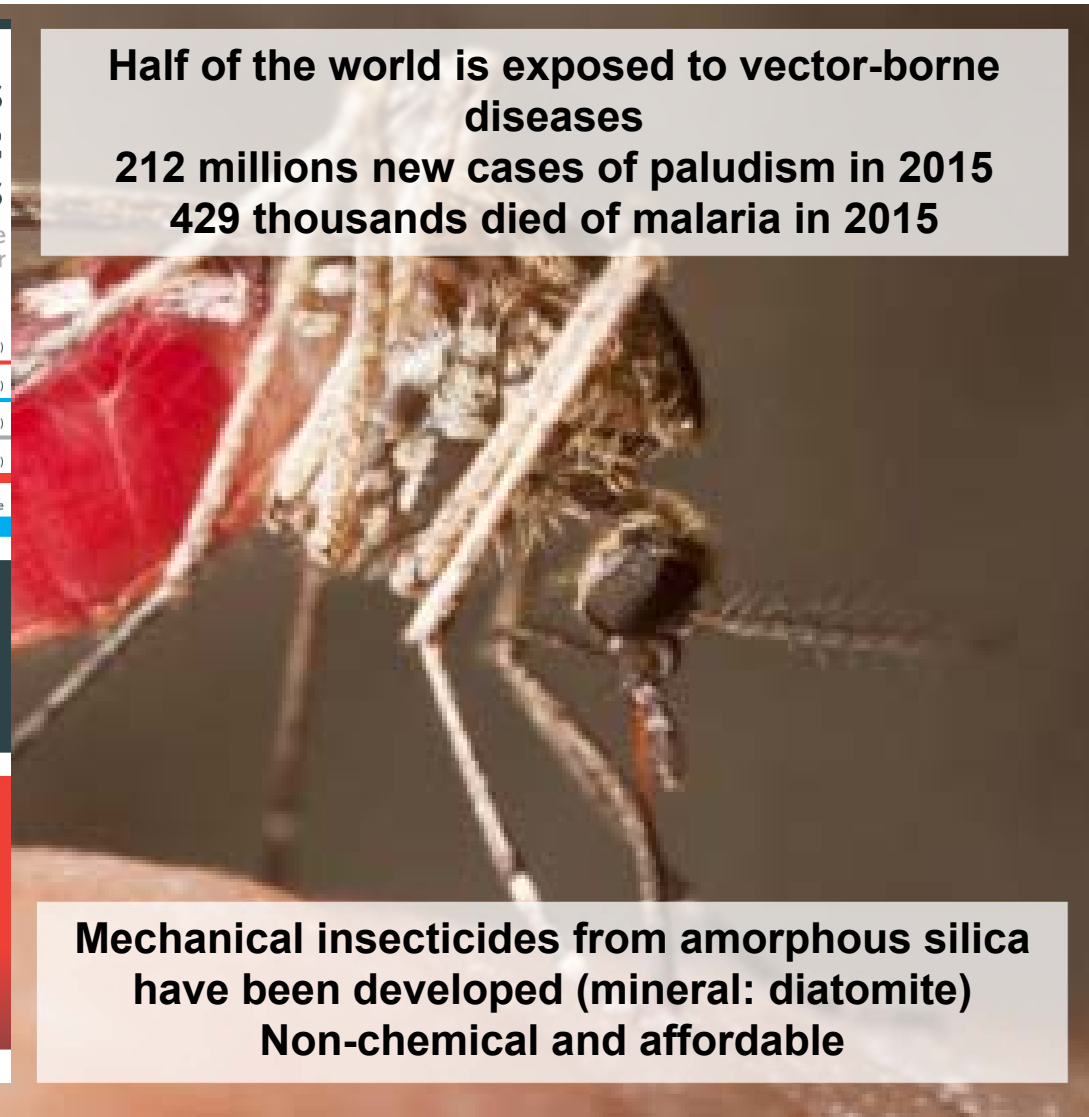
- **Opens a new area of value creation**
- **Revolution of the ceramic industries ?**



The physical world (still) needs physical solutions



Half of the world is exposed to vector-borne diseases
212 millions new cases of paludism in 2015
429 thousands died of malaria in 2015



Mechanical insecticides from amorphous silica have been developed (mineral: diatomite)
Non-chemical and affordable

The physical world (definitely) needs physical solutions



Over 500,000 children under 5 die each year from diarrheal diseases, caused by lack of clean water or adequate sanitation



**Imerys
low cost
water filter
solution for
households**

Capacity: 14 liters
Dimensions (assembled): 25x25x60 cm
Inner box packing size: 28x28x38 cm
Weight in box: 2.4 kgs

ImerPure, a filtration cartridge was developed to clean water at ~ \$0,04 per day and per family



8 million tons of plastics end up in the oceans every year
80% of all litters in the ocean is made of plastic, causing dramatic damages to biodiversity
Only 20 to 30% of plastic waste is recycled (in Europe)



One of the UK's leading plastic recycling companies recycles a wide range of rigid plastics, adding minerals, and resulting in compounds performing as well as original polymers, but from waste materials.

Game changer?



Thank you for your attention!

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