Global trends in the industrial minerals industry

Challenges & opportunities

Mike O’Driscoll,
Editor, Industrial Minerals

Investment Opportunities in Saudi Industrial Minerals
9 March 2009, Jeddah, organised by the Saudi Geological Survey
Global trends in the industrial minerals industry: challenges & opportunities
Mike O'Driscolm, IM, Investment Opportunities in Saudi Industrial Minerals,
9 March 2009, Jeddah

Industrial Minerals
Metal Bulletin Ltd, UK

Since 1967, delivering premium information on news and trends in global supply and demand of industrial minerals

From mine to market: global non-metallic minerals intelligence
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Mike O’Driscoll, IM, Investment Opportunities in Saudi Industrial Minerals, 9 March 2009, Jeddah

IM ONLINE LAUNCHED MARCH 2009

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- weekly e-mailed news summary
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- content searchable & news alerts customised by market sector
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UPCOMING EVENTS 2009

MagMin 2009
The international conference for global, supply, processing, markets and R&D in magnesia minerals and products
10-12 May 2009
Hotel Okura, Amsterdam, The Netherlands
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Outline

1. The importance of industrial minerals
2. Trends & challenges
3. Opportunities
4. Summary & Conclusions

Think “Saudi Potential”
1. The importance of industrial minerals
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1. The importance of industrial minerals

**Industrial minerals in your kitchen**

- Glass/glasses/light bulbs: silica sand, limestone, soda ash, borates, feldspar, lithium
- Ceramic tiles/mugs/plates etc.: kaolin, feldspar, talc, wollastonite, borates, alumina, zirconia
- Paint: TiO₂, kaolin, mica, talc, wollastonite, GCC, silica
- Plastic white goods: talc, GCC, kaolin, mica, wollastonite, flame retardants (ATH, Mg(OH)₂)
- Wooden flooring: treatment materials- borates, chromite
- Drinking water: treatment materials- lime, zeolites
- Wine/beer: diatomite, perlite filters
- Salt: salt
- Sugar: lime in processing
- Detergents/soap: borates, soda ash, phosphates
- Surfaces: marble, granite
- Books: kaolin, talc, GCC, lime, TiO₂ in paper
- Oven glass: petalite, borates
- Heating elements: fused magnesia
- Wallboard/plaster: gypsum, flame retardants
- Metal pots/cutlery: mineral fluxes & refractories in smelting
1. The importance of industrial minerals

Our world is made of them

A CAR contains up to 100-150 kg of minerals and more than a tonne of metals

50% of PAINT is made of minerals

CERAMICS contain up to 100% minerals

1 km of HIGHWAY requires 30,000 tonnes of minerals

GLASS contains up to 100% minerals

A family HOUSE contains up to 400 tonnes of minerals

1. The importance of industrial minerals

Fundamentals: industry is market driven

“Without a market, an industrial mineral deposit is merely a geological curiosity”
1. The importance of industrial minerals

Fundamentals: industry is market driven

Main consuming markets

- Abrasives
- Absorbents
- Agricultural
- Cement
- Ceramics
- Chemicals
- Construction
- Oil well drilling
- Electronics
- Filtration
- Foundry
- Glass
- Metallurgy
- Paint
- Pigments
- Paper
- Plastics
- Refractories
- Flame retardants
- Welding
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1. The importance of industrial minerals
   Fundamentals: industry is market driven

Ceramics
Chemicals
Glass
Paints
Plastics
Paper
Refractories
1. The importance of industrial minerals

Fundamentals: industry is market driven

Market geography

- Growing populations, eg. China, Asia
- Developing regions, eg. China, India, SEA, eastern/central Europe, Russia
- Hotspots of specific industry activity, eg. oil/gas in Nigeria/Vietnam; steel/ceramics in Middle East; insulation in eastern Europe and Russia

New/growth market application

- Environmental
- New energy alternatives
- Nanotechnology
- Plastics
- CO2 capture
1. The importance of industrial minerals

Fundamentals: Mine to market supply chain

- supply sector
- logistics sector
- consuming market sector
1. The importance of industrial minerals

Fundamentals: Mine to market supply chain

**SUPPLY**
- exploration
- mineral finance
- plant engineering
- mining
- processing

**LOGISTICS**
- trading
- port handling
- mineral inspection
- freight
- warehousing/distribution

**MARKET**
- direct market mineral consumer
- intermediate market mineral consumer
- end market mineral consumer

**DEMAND**
1. The importance of industrial minerals

Fundamentals: Mine to market supply chain

Mineral to end use market

Mineral
↓
Intermed. min. product
↓
Intermediate market
↓
End use market(s)
↓

ilmenite
↓
TiO₂ white pigment
↓
paint
↓
avtomobiles/construction
↓

bauxite
↓
calcined alumina
↓
refractory brick
↓
steelmaker
↓
construction/ships
1. The importance of industrial minerals

Fundamentals: main characteristics

• Deposits quite dispersed

• Long-term commitment necessary

• Complex marketing, and market and product R&D

• Wide range of applications using different grades

• Pricing not set by an exchange – between buyer & seller; host of influencing factors; generally low value, high volume

• Sophisticated, and often high cost processing required

• Logistics a significant part of delivered price

• Essential to maintain working co-operation with end users
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2. Trends & challenges

• Regulation

• Globalisation

• China

• Strategic focus

• Environment

• Economic recession

• Emerging markets
2. Trends & challenges

Regulation

EU - REACH

Registration, Evaluation, Authorisation of Chemicals

Chief principles:
- Promoting responsible care
  - Leaving initiative to Industry
  - Introducing risk assessment and risk based management

Why important to minerals industry?
- Industry supports the principle of responsible care
- REACH offers opportunity to harmonize assessment of chemicals and products in EU
- Determines assessment methodology & database for all major environmental policies
2. Trends & challenges

Regulation – REACH scope

<table>
<thead>
<tr>
<th>INPUT</th>
<th>PRODUCTION</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ores/Concentrates°</td>
<td>Production Intermediates</td>
<td>Massive Metals, Minerals metal and mineral compounds</td>
</tr>
<tr>
<td>° No Registration (if not chemically modified)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* No Registration (if information in hand)</td>
<td>Registration</td>
<td>Registration</td>
</tr>
<tr>
<td>Recovery</td>
<td>Waste</td>
<td>Out of Scope</td>
</tr>
</tbody>
</table>

°° No Registration (if not chemically modified)
### 2. Trends & challenges

#### Regulation – REACH scope

<table>
<thead>
<tr>
<th>Mineral, Ore or Ore Concentrate Processing Step</th>
<th>Chemical Modification ?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical/Mechanised Sorting</td>
<td>No</td>
</tr>
<tr>
<td>Magnetic/Electrostatic Separation (e.g., iron ore, mineral sands)</td>
<td>No</td>
</tr>
<tr>
<td>Gravity or Dense Medium Separation (e.g., gold, iron ore, coal, lead)</td>
<td>No</td>
</tr>
<tr>
<td>Preferential Crushing, Grinding or Milling</td>
<td>No</td>
</tr>
<tr>
<td>Screening, Hydrocycloning or Classification</td>
<td>No</td>
</tr>
<tr>
<td>Agglomeration or Froth Flotation (e.g., Cu, Ni, Pb, Sn, mineral sands)</td>
<td>No</td>
</tr>
<tr>
<td>Thickening &amp; Filtration (e.g., copper, lead, zinc)</td>
<td>No</td>
</tr>
<tr>
<td>Drying (or calcination that results in removal of water &amp; impurities only)</td>
<td>No</td>
</tr>
<tr>
<td>Pelletising by granulation only</td>
<td>No</td>
</tr>
<tr>
<td>Leaching/Washing Processes to remove impurities</td>
<td>No</td>
</tr>
<tr>
<td>Leaching processes to extract the value-mineral</td>
<td>Yes</td>
</tr>
<tr>
<td>Pelletising with sintering</td>
<td>Yes</td>
</tr>
<tr>
<td>Ion-Exchange, Solvent Extraction or Electro-winning</td>
<td>Yes</td>
</tr>
<tr>
<td>Pressure Digestion in aqueous NaOH</td>
<td>Yes</td>
</tr>
<tr>
<td>Sintering, Roasting &amp; Smelting</td>
<td>Yes</td>
</tr>
<tr>
<td>Calcination involving changes to the chemical structure (e.g., CO2 release)</td>
<td>Yes</td>
</tr>
<tr>
<td>Precipitation and gas precipitation</td>
<td>Yes</td>
</tr>
</tbody>
</table>
2. Trends & challenges

Regulation – REACH

• Pre-registration deadline 1 December 2008

• No pre-registration = companies not allowed to produce or import minerals/materials not pre-registered

• EU may make example of breaches of REACH

• Continuing confusion and debate amongst industry over REACH implementation, especially “definitions”
2. Trends & challenges

Regulation – access to resources restricted

Forecasts for 2030

- Global population >8bn.
- Practically all of the growth will be in developing, regions dominated by the young, particularly in urban areas
- More than 60% will be urban population. 80% in Europe and North America
- Increasing challenge to access mineral resources
2. Trends & challenges

Globalisation, M&A

Main drivers
• securing mineral resources
• access to markets
• synergies & economies of scale in production & freight
• move away from state ownership

Response
• M&A activity in supply and market sector
• increasing interest from private equity sector
• competition to secure natural resources worldwide
2. Trends & challenges
Globalisation, M&A
2. Trends & challenges

Globalisation, M&A

M&A ACTIVITY BY MINERAL
2007 – 2008

Clays, magnesium compounds and lime most active mineral targets

Source: Company press releases, Mergermarket, Mergerstat, Capital IQ

BMO Capital Markets 2009
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9 March 2009, Jeddah

2. Trends & challenges
Globalisation, M&A

M&A ACTIVITY BY GEOGRAPHY AND BUYER TYPE
2007 – 2008

Non-US buyers and strategic buyers most active

Source: Company press releases, Mergenmarket, Mergerstat, Capital IQ
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2. Trends & challenges

Globalisation, M&A

<table>
<thead>
<tr>
<th>Target</th>
<th>Mineral</th>
<th>Buyer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idwala, South Africa</td>
<td>lime, GCC</td>
<td>Ethos/Old Mutual, South Africa</td>
</tr>
<tr>
<td>Molycorp, USA</td>
<td>rare earths</td>
<td>RCF/Pegasus/Goldman Sachs/Traxys</td>
</tr>
<tr>
<td>US Silica, USA</td>
<td>silica</td>
<td>Golden Gate Capital, USA</td>
</tr>
<tr>
<td>Magnesita, Brazil</td>
<td>magnesia</td>
<td>GP Investments/Gavea, Brazil</td>
</tr>
<tr>
<td>KaMin, USA</td>
<td>kaolin</td>
<td>IMin Partners, USA</td>
</tr>
<tr>
<td>Prince Minerals, USA/UK</td>
<td>pigments, Zr</td>
<td>Palladium Equity, USA</td>
</tr>
<tr>
<td>Almatis, Germany</td>
<td>aluminas</td>
<td>Dubai International Capital, Dubai</td>
</tr>
<tr>
<td>Mondo Minerals, Finland</td>
<td>talc</td>
<td>Hg Capital, UK</td>
</tr>
<tr>
<td>QMAG, Australia</td>
<td>magnesia</td>
<td>Resource Capital Funds, USA</td>
</tr>
<tr>
<td>NYCO, USA</td>
<td>wollastonite</td>
<td>Resource Capital Funds, USA</td>
</tr>
<tr>
<td>Talison Minerals, Australia</td>
<td>lithium, tantalum</td>
<td>Resource Capital Funds, USA</td>
</tr>
</tbody>
</table>
# 2. Trends & challenges

**Globalisation, M&A**

Strategic buys – recent examples

<table>
<thead>
<tr>
<th>Target</th>
<th>Mineral</th>
<th>Buyer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rio Tinto Minerals, world</td>
<td>talc, borates</td>
<td>????</td>
</tr>
<tr>
<td>Potasio RC, Argentina</td>
<td>potash</td>
<td>Vale, Brazil</td>
</tr>
<tr>
<td>Zemex IM, USA</td>
<td>feldspar, mica</td>
<td>Imerys, France</td>
</tr>
<tr>
<td>LWB, USA/Germany/China</td>
<td>dolomite, refractories</td>
<td>Magnesita, Brazil</td>
</tr>
<tr>
<td>Keliber, Finland</td>
<td>lithium</td>
<td>Nordic Mining, Norway</td>
</tr>
<tr>
<td>Calmag, Turkey</td>
<td>magnesite</td>
<td>Bomex, Serbia</td>
</tr>
<tr>
<td>Slovmag, Slovakia</td>
<td>magnesite</td>
<td>Magnezit, Russia</td>
</tr>
<tr>
<td>UCM, UK/USA</td>
<td>fused mag, fused zirconia</td>
<td>Imerys, France</td>
</tr>
<tr>
<td>Minco, USA</td>
<td>fused magnesia</td>
<td>Penoles, Mexico</td>
</tr>
<tr>
<td>Franklin Industrial Minerals</td>
<td>limestone, GCC</td>
<td>Lhoist, Belgium</td>
</tr>
<tr>
<td>Linden Mining, Guyana</td>
<td>bauxite</td>
<td>Bosai Minerals, China</td>
</tr>
<tr>
<td>General Chemical, USA</td>
<td>soda ash</td>
<td>Tata Chemicals, India</td>
</tr>
<tr>
<td>Searles Valley Min., USA</td>
<td>soda ash, borates</td>
<td>Nirma, India</td>
</tr>
<tr>
<td>Oglebay Norton, USA</td>
<td>limestone, Si-sands</td>
<td>Carmeuse, Belgium</td>
</tr>
</tbody>
</table>
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2. Trends & challenges
Globalisation, M&A

Consuming market sector

**Steel**
Mittal/Arcelor; Tata/Corus

**Paint**
Akzo Nobel/ICI; PPG/Sigma Kalon

**Paper**
NewPage/Stora Enso; Domtar/Weyerheuser

**Brewing**
Interbrew/Ambev; Carlsberg-
Heineken/Scottish & Newcastle
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2. Trends & challenges
China Factor – 1980s-2000s

• 1980s-late 1990s dominated supply
• magnesia, barite, graphite, bauxite, talc, fused alumina, silicon carbide
• faced antidumping legislation
• 1994: export licence system, prices up
• 1990s: exported processed minerals; dissolution of SOE; privatisation
• 2000s: increased foreign investment for both resources & end use; increased exports of end products
• 2003-04: economy soars; prices rise; power, fuel, freight shortages
2. Trends & challenges

China Factor – 2006

Early 2006: a leading trader commented:

“I feel that once the Chinese government is introducing a new tax to curb the export of minerals, obviously they do not worry about the competitiveness of Chinese minerals in the international market any more.”
Early 2006: a leading trader commented:

“The overseas buyer will either be forced to pay a significantly higher price for Chinese minerals or buy from an alternative source.”
2. Trends & challenges

China Factor – 2006-present

- Domestic demand priority
- Exports curbed: VAT rebate ended, licence fee & tax rises; smuggling curb
- Resource & processing capacity investment; streamlining supply base
- Incentive to secure world resources
- Antipollution legislation; plant closures
- Olympic Games ban impact
- Fuel/power costs & availability
- Depletion of quality resources
- Poor mine planning/extraction

= higher prices + export supply shortage
August 2008: a western producer & consumer stated:

“At the end of 2009 we should be independent regarding supply of [Chinese] DBM and FM.”

“A similar strategy should be the base for any serious producer of magnesia based refractory products.”
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2. Trends & challenges

Strategic focus on raw material resources

• Companies/countries targeting “strategic” mineral resources

• Minerals in short supply: eg. magnesia, bauxite, aluminosilicates, barite, frac sand, graphite, fluorspar

• Minerals for new/growth markets: eg. lithium, rare earths, graphite, potash, phosphate

• EU Raw Materials Initiative: - fairer access to supply outside EU
  - improvement of mining within EU
  - increasing recycling

• USGS Minerals Program: Minerals at risk and for emerging technologies
2. Trends & challenges

Environment

• **Sustainable Development:**
  - resource efficiency
  - responsible mining
  - conservation of resources & environment

• **Carbon footprint:**
  - reduction of CO2 emissions in extraction, processing, & freight of minerals
  - need to quantify these values
2. Trends & challenges

Economic recession

- Late 2008: financial crisis – economic recession
- Market slowdown in 2009; trading stalled Q109

Construction → Steel → Refractory demand → Mineral demand
Automobiles → Glass → Cement

- Production cut-backs: eg. - Vale, 470,000 tpa kaolin
  - Kaolin AD 10% workforce layoff
  - Rio Tinto Alcan, 105,000 tpa alumina
  - QMAG, 30% plant capacity
  - Metso, Sandvik cut jobs

- New projects & capacity expansions concern
2. Trends & challenges

Economic recession

2009: Global steel industry expected to contract 7-8%

Middle East steel market expected to drop 35% to 9m. tonnes
2. Trends & challenges

Economic recession

Mineral prices falling

Recent headlines from Mineral PriceWatch on www.indmin.com

“Lithium prices facing pressures” 05 March 2009
“Borates prices follow glass fall” 04 March 2009
“Chinese alumina prices fading” 03 March 2009
“US building mineral prices hit” 02 March 2009
“Bentonite prices could erode” 27 February 2009
“Fluorspar market slows 15%” 26 February 2009
“Rare earths prices continue fall” 24 February 2009
“Chromite prices “hard to judge”” 23 February 2009
“Downturn softens graphite prices” 19 February 2009
2. Trends & challenges

Economic recession

But not all doom & gloom!

Recent headlines from Mineral PriceWatch on www.indmin.com

“Iodine prices up 20% in 2009” 06 March 2009
“Sales fall but potash prices firm” 03 March 2009
“UCM drops magnesia fuel charges” 02 March 2009
“PCC prices buck general trend” 20 February 2009
“Drilling grade barytes prices edge up” 05 March 2009
“Kyanite & mullite prices steady” 26 February 2009
“Chinese salt prices holding up” 25 February 2009

• Fuel and freight costs down; freight availability up
• IMs generally better equipped to survive recessions
3. Trends Opportunities

Emerging markets & opportunities

**Construction:**
- steel, glass, ceramics, paints, plastics
  - BRIC, ME, Eastern Europe market growth
  - Govt. initiatives eg. China, USA

**Environment:**
- improving CO2 footprint by using minerals; sequestration
  - antipollution applications (eg. FGD, waste/water treatment)

**Energy:**
- oil & gas drilling (eg. Brazil, SE Asia); OFM shortage
  - alternative/new power sources (eg. Li-ion batteries, fuel cells); insulation market (Russia, E. Europe)

**Fertilisers:**
- demand from food shortages; biofuel market

**Specialities:**
- eg. technical ceramics, functional fillers, nanotechnology

“Replacing” Chinese supply:
- customers seeking alternatives sources

**Time of positioning:**
- PEG in favourable position
  - time to secure resources/supply
3. Opportunities

Saudi Arabia

- Diversification from oil & gas; 8th Development Plan 2005-09, 7.9% growth in mining sector
- $11,900m. to 2020
- Extraction, processing, & logistics
- New Mining Code in 2004 more attractive to foreign investment
3. Opportunities

Saudi Arabia

Construction, glass, ceramics, cement, mineral wool

- as raw material components
  - Basalt
  - Bauxite
  - Kaolin
  - Diatomite
  - Dolomite
  - Feldspar
  - Gypsum
  - Limestone
  - Nepheline syenite
  - Pozzolans
  - Silica sand
  - Zeolite
3. Opportunities

Saudi Arabia

Steel, metallurgy, IOP

- as fluxes, conditioners, binders

Bauxite
Bentonite
Dolomite
Fluorspar
Limestone
Magnesite
Olivine
Wollastonite
3. Opportunities

Saudi Arabia

Refractories for steel, non-ferrous, glass, cement, lime, petrochem.

- as raw material components

Bauxite
Chromite
Dolomite
Graphite
Kaolin
Kyanite
Limestone
Magnesite
Olivine
Refractory clays
Zirconia
3. Opportunities

Saudi Arabia

**Environment**

- as functional ingredients in FGD,
- waste/water treatment, filtration, CO2 sequestration

Bentonite
Diatomite
Dolomite
Garnet
Limestone
Magnesite
Olivine
Silica sand
Zeolite
3. Opportunities

Saudi Arabia

Energy

- functional ingredients in batteries, fuel cells, oil/gas drilling

Barite
Bentonite
Bauxite
Graphite
Magnetite
Silica sand
Zirconia
3. Opportunities

Saudi Arabia

Fertilisers

- as raw material components

Bentonite
Phosphate
Magnesite
Sulphur
Talc
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3. Opportunities

Saudi Arabia

Speciality

- as functional ingredients in plastics,
rubber, technical ceramics, mobile phones

GCC
Mg(OH)2
Rare earths
Speciality silicas
Zirconia
3. Opportunities

Saudi Arabia

Spotlight: Rare earths

25% new technologies use RE

Military. High strength alloys, laser guided missiles, SONAR, RADAR, blast glass, etc.

Medical. MRIs, Xrays, contrast agents, lasers

Automotive. Hybrid batteries, catalysts, small electric motors, glass, anti-lock brakes

Computer. Hard drives, color screens, speakers, memory chips

Phosphors. Compact florescent bulbs, color screens

Glass. Polishing, strengthening, coloring, micro lenses

Oil. Fluid cracking catalysts
3. Opportunities

Saudi Arabia

Spotlight: Rare earths

• China
  - 95% REO production
  - 90% reserves
  - reducing RE exports
  - starting RE stockpile
  - domestic consumption growing, 28% p.a.
  - actively seeking resources outside China

• World demand
  - Present: 124,000 REO tpa
  - by 2014: 170-190,000 tpa
  - China demand: 120,000 tpa
  - China exports 25,000 tpa
  - ROW demand: 45,000 tpa
  - shortage of Dy, Tb, Y
3. Opportunities

Saudi Arabia

Spotlight: Magnesite

- During 1980-90s China dominated magnesia exports

3. Opportunities

Saudi Arabia

Spotlight: Magnesite

- During 1980-90s China dominated magnesia exports

3. Opportunities

Saudi Arabia

Spotlight: Magnesite

- During 1980-90s China dominated magnesia exports
3. Opportunities

Saudi Arabia

Spotlight: Magnesite

- Western producers diversified from DBM or exited
- 2000s saw China govt. policy of export reduction, and focus on domestic markets, conserve raw materials, export finished products, eg. refractories
- Resulting in magnesia supply shortages, rising prices, consumers scrabbling to secure future supply
- Encouraged producers outside China to expand/emerge
3. Opportunities
West response to China magnesite shortage

- Baymag CCM, DBM, FM
- Mag de Rubian CCM
- Magnezit CCM, DBM, FM
- MMMS CCM
- Bommag DBM, FM
- Kumus DBM, FM
- DSP CCM
- Magnezit DBM, FM
- Quintermina CCM, DBM, FM
- Zarghat? CCM, DBM, FM
- Peneoles CCM, FM
- Qmag CCM, DBM, FM
- Magnesita DBM
- RHI-Jinding DBM
  Tata Ref. DBM
3. Opportunities

**Saudi Arabia – Spotlight: magnesite**

- **Steel bright spots: China, India, South Korea, ME**
- **Non-refractory market opportunities**

**Environmental Specialities**

- CCM/Mg(OH)2

**Agrimarkets**

- CCM

**Hydrometallurgy**

- Ni laterite processing

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*Global trends in the industrial minerals industry: challenges & opportunities*

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4. Summary & conclusions

- **Learn & respect the fundamentals of IMs**
- **Analyse challenges and market demand**
- **Opportunities arise: China, environment, new tech.**
- **This is a time for positioning, securing resources; 2010**
- **IMs generally more resilient in recessions**
- **Saudi Arabia has resources, energy, potential**
- **Strategic focus: RE, magnesite, bauxite, OFM, speciality min.**
4. Summary & conclusions

Thank you for your kind attention