GLOBAL UPDATE OF MAGNESITE RESOURCES

IAN WILSON
OSLO, NORWAY
14th MAY 2013

SALUDERE ANA DAMAR MINE, TURKEY
AGENDA

• TYPES OF MAGNESITE
• GLOBAL RESOURCES OF MAGNESITE DEPOSITS
• SPARRY TYPE MAGNESITE DEPOSITS
• CRYPTOCRYSSTALLINE MAGNESITE DEPOSITS
• SUMMARY OF CCM, DBM AND FM OUTPUT
• UPDATE OF VARIOUS COMPANIES/NEW PROJECTS
MAGNESITE TYPES
MAGNESITE CRYSTAL, BRAZIL

ONLY NATURAL MAGNESITE COVERED IN THIS TALK. MgO FROM BRINES AND SEAWATER IMPORTANT SOURCES

BRUCITE

Mg(OH)₂

HYDROMAGNESITE

Mg₅(CO₃)₄(OH)₂·3H₂O

MAGNESITE

MgCO₃

HUNTITE

Mg₃Ca(CO₃)₄

MgO

CO₂
TYPES OF MAGNESITE DEPOSITS

1. MACROCRYSTALLINE OR SPARRY MAGNESITE HOSTED IN CARBONATE ROCKS

2. CRYPOCRYSTALLINE MAGNESITE HOSTED IN ULTRAMAFIC ROCKS (PERIDOTITE-SERPENTINITE)

3. CRYPOCRYSTALLINE MAGNESITE FORMED IN FRESHWATER SEDIMENTS

MACROCRYSTALLINE (OR SPARRY) - LARGE CRYSTALS
CRYPOCRYSTALLINE - SMALL CRYSTALS
CRYSTALLINE SPARRY MAGNESITE (SM)
(Large crystals up to several cms in length)

SUNGRI, North Korea

CEARA, Brazil

SMZ Slovakia

HAICHENG, China
FORMATION OF MAGNESITE IN EASTERN ALPS, AUSTRIA

PERMIAN EVAPORITIC BRINES

\[ \text{Mg}^{2+}, \text{K}^+, \text{Na}^+, \text{Br}, \text{SO}_4^{2-}, \text{Others}^- \]

Permian rifting

MAGNESITE MINERALISATION

WITH DOLOMITE HALOES

SANDSTONE, DOLOMITES, EVAPORITES

PERMOSKYTHIAN

SHALES, CONGLOMERATES

WESTPHALIAN A – C

LIMESTONES

EARLY VISEAN-NAMURIAN

SHALES, SANDSTONES, LIMESTONES

EARLY VISEAN

EARLY VISEAN

EVAPORATION

EARLY VISEAN

PERMIAN EVAPORATION
CRYPTOCRYSTALLINE MAGNESITE (CM)
(Amorphous with crystals 1-10 microns)

XIM Deposit, Kosovo

UZICE, Serbia

MAGNESITE IN SERPENTINITE STOCKWORK, KUMAS,, TURKEY
CRYPTOCRYSTALLINE MAGNESITE FORMATION

- **METEORIC WATER**
- **BELA STENA TYPE** – nodular and layered CM in freshwater sediments
- **STOCKWORK** (10-80m depth)
- **HYDROTHERMAL TYPE**
  - **VEINS**
  - To ~300m in depth
  - Alteration of host rock
- **INfiltration TYPE**
- **KRAUBATH TYPE**
  - In ultramafic olivine rich rocks
  - Serpentinite altered by fluids and Magnesite forms in veins
  - (ALL CM TYPE)

**Chemical Reaction:**

\[ \text{H}_2\text{O} + \text{CO}_2 \]
Dependent on various applications the market is supplied by

- **MACROCRYSTALLINE NATURAL MAGNESIA**  
  low to medium application

- **CRYPTOCRYSTALLINE NATURAL MAGNESIA**  
  low to high application

- **SYNTHETIC MAGNESIA**  
  medium to high application
GLOBAL MAGNESITE RESOURCES
LOCATION OF MAGNESITE DEPOSITS IN THE WORLD

- **Major magnesite deposits >500mt**: Starred locations
- **Other magnesite deposits**: Triangular locations

Country locations: Canada, USA, Colombia, Venezuela, Brazil, Slovakia, Russia, China, North Korea, Kazakhstan, Iran, Pakistan, Nepal, India, Egypt, Saudi Arabia, Zimbabwe, South Africa, Australia, New Zealand.
GLOBAL RESOURCES OF MAGNESITE
13 BILLION TONNES
(Five countries - 70%)

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>MT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUSTRALIA</td>
<td>628</td>
</tr>
<tr>
<td>BRAZIL</td>
<td>862</td>
</tr>
<tr>
<td>CHINA</td>
<td>3,439</td>
</tr>
<tr>
<td>NORTH KOREA</td>
<td>3,000</td>
</tr>
<tr>
<td>RUSSIA</td>
<td>2,745</td>
</tr>
<tr>
<td>SLOVAKIA</td>
<td>1,240</td>
</tr>
<tr>
<td>OTHERS</td>
<td>1,086</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>13,000</strong></td>
</tr>
</tbody>
</table>
MAGNESITE RESOURCES OF 13BT BY TYPE (%)
GLOBAL PRODUCTION
MAGNESIA FROM MAGNESITE
10.7 MT
IN 2012

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Kt</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBM</td>
<td>6,777</td>
</tr>
<tr>
<td>CCM</td>
<td>3,051</td>
</tr>
<tr>
<td>FM</td>
<td>872</td>
</tr>
<tr>
<td>TOTAL</td>
<td>10,700</td>
</tr>
</tbody>
</table>
**MAGNESIA**
10.7 MT
IN 2012

**GRADE** | **MT** | **% CHINA**
--- | --- | ---
DBM | 6.78 | 52
CCM | 3.05 | 49
EFM | 0.87 | 80
TOTAL | 10.70 | 53

CHINA ACCOUNTS FOR 5.70 MT ABOVE

**ASIAN METAL REPORTS OUTPUT FOR 2012 FROM CHINA AS 8.67 MT (ALMOST + 3.0 MT)**

<table>
<thead>
<tr>
<th>%</th>
<th>GRADE</th>
<th>ROW (MT)</th>
<th>CHINA (MT)</th>
<th>TOTAL (MT)</th>
<th>% CHINA</th>
<th>% ROW</th>
</tr>
</thead>
<tbody>
<tr>
<td>53%</td>
<td>DBM</td>
<td>3.27</td>
<td>3.96</td>
<td>7.23</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>35%</td>
<td>CCM</td>
<td>1.55</td>
<td>3.25</td>
<td>4.80</td>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>12%</td>
<td>EFM</td>
<td>0.18</td>
<td>1.46</td>
<td>1.64</td>
<td>89</td>
<td>11</td>
</tr>
<tr>
<td>MT/%</td>
<td></td>
<td>5.00</td>
<td>8.67</td>
<td>13.67</td>
<td>63</td>
<td>37</td>
</tr>
</tbody>
</table>
GLOBAL DBM PRODUCTION ESTIMATES FOR 2012
6.77 MT

CHINA 52% (3.50 MT)
RUSSIA 15%

7.23 MT TOTAL
CHINA 3.96 MT
55% OF TOTAL
GLOBAL CCM PRODUCTION ESTIMATES FOR 2012
3.05 MT

CHINA 49% (1.50 MT)

AUSTRALIA 6%
AUSTRIA 6%
BRAZIL 4%
GREECE 4%
NORTH KOREA 6%
RUSSIA 6%
SPAIN 5%
USA 5%
OTHERS 9%

4.80 MT TOTAL
CHINA 3.25 MT
68% OF TOTAL

ASIAN METAL
亚洲金属网

4.80 MT TOTAL
CHINA 3.25 MT
68% OF TOTAL
MAGNESIA CAPACITY BY TYPE %

- 85%
- 15%

SPARRY CRYPTOCRYSTALLINE

- SPARRY
- CRYPTOCRYSTALLINE
LOCATION OF MAGNESITE DEPOSITS AND RESOURCES
SPARRY MAGNESITE (MACROCRYSTALLLINE)
Look at some deposits and operations
SMZ Jelsava and magnesite deposits, Slovakia
CHEMISTRY OF MAGNESITES

JELSAVA

MgO  42.0%
CaO  2.5%
Fe$_2$O$_3$  3.6%
SiO$_2$  0.3%

MUTNIK

MgO  44.0%
CaO  1.0%
Fe$_2$O$_3$  2.5%
SiO$_2$  1.1%
MAGNETTING OF MAGNESIA

ROTARY KILN

HIGHER MgO – MORE MAGNETIC
88 - 89% MgO
NORTH KOREA

CHINA
NORTH KOREAN AND CHINESE MAGNESITE DEPOSITS WITHIN THE CHINA-KOREA PLATFORM ROCKS ARE BASEMENT PRECAMBRIAN ~1.9 B years
LOCATION OF MAGNESITE DEPOSITS AND MAGNESIA PLANTS

MAGNESITE DEPOSITS

MAGNESIA PLANTS

NORTH KOREA

CHINA

RUSSIA

100km
IN 2011 PRODUCTION OF MAGNESIA WAS 255,000 TONNES WITH 67% CCM, 23% DBM and 10% FM.

IN 2012 OUTPUT IS ESTIMATED BY KMCIG TO HAVE DECREASED BY AROUND 30% TO 178,000 TONNES.

DIFFICULTIES IN SUPPLY OF COAL AND TRANSPORTATION ARE THE MAIN REASONS FOR THIS DECREASE.

OF THE 178,000 MT PRODUCTION IN 2012 APPROXIMATELY 100,000 MT WERE EXPORTED AS follows (MAINLY TO CHINA):

• CCM 60,000 TONNES (60%)
• DBM 25,000 TONNES (25%)
• FM 15,000 TONNES (15%)

(Source; Korean Magnesia Clinker Industry Group and Rocky Wu, Rocky Mountains) Co. Ltd)
DEVELOPMENT OF NAMGYE MAGNESITE DEPOSIT

TOTAL 48 Hectares

LARGE RESOURCE: >100 MT Potential (>70m depth)
# Namgye Magnesite Underground Mine

<table>
<thead>
<tr>
<th>Level</th>
<th>+15m</th>
<th>-30m</th>
<th>-60m</th>
<th>-90m</th>
<th>-90m</th>
</tr>
</thead>
<tbody>
<tr>
<td>MgO</td>
<td>47.8</td>
<td>48.1</td>
<td>47.4</td>
<td>46.6</td>
<td>48.1</td>
</tr>
<tr>
<td>LOI</td>
<td>50.9</td>
<td>49.7</td>
<td>51.2</td>
<td>50.7</td>
<td>50.3</td>
</tr>
<tr>
<td>SiO₂</td>
<td>0.55</td>
<td>1.54</td>
<td>0.33</td>
<td>2.39</td>
<td>1.22</td>
</tr>
<tr>
<td>Magnesite</td>
<td>98.3</td>
<td>94.5</td>
<td>97.1</td>
<td>97.1</td>
<td>97.9%</td>
</tr>
</tbody>
</table>
### CHEMISTRY (XRF) Wt.%

<table>
<thead>
<tr>
<th>Element</th>
<th>Wt.%</th>
</tr>
</thead>
<tbody>
<tr>
<td>MgO</td>
<td>96.1</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>0.35</td>
</tr>
<tr>
<td>SiO₂</td>
<td>1.34</td>
</tr>
<tr>
<td>CaO</td>
<td>1.25</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.54</td>
</tr>
<tr>
<td>LOI</td>
<td>0.39</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>99.97</strong></td>
</tr>
</tbody>
</table>

### MINERALOGY (XRD) Wt.%

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Wt.%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERICLASE</td>
<td>96.2</td>
</tr>
<tr>
<td>MAGNESITE</td>
<td>0.4</td>
</tr>
<tr>
<td>QUARTZ</td>
<td>0.3</td>
</tr>
<tr>
<td>MONTICELLITE</td>
<td>3.2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100.1</strong></td>
</tr>
</tbody>
</table>

**PERICLASE CRYSTALS**

MgO - Octohedra
HAICHENG – DASHIQIAO MAGNESITE BELT
3.4 BD
Special uses in Steel and cement

98% MgO
MagCarb bricks and for ladles

RHI/JINDING UPGRADE QUALITY
RHI/JINDING MAGNESITE GP
DASHIQIAO
$50 Million
100,000 TPA
MEDIUM FEED (ONLY MgO 95)
REMOVE SiO₂
HIGH QUALITY

3.4 BD
Special uses in Steel and cement
BOROBIA AND ZIBETI DEPOSITS PLANNED TO OPEN IN 1ST QUARTER 2014

The average quality of the deposits after (very limited) treatment is:

<table>
<thead>
<tr>
<th>Sintered</th>
<th>Borobia: MgO &gt; 88%, CaO 5%, Fe₂O₃ 3%, SiO₂ 3%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zilbeti: MgO &gt; 65%, CaO 30%, Fe₂O₃ 3%, SiO₂ 0.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Caustic</th>
<th>Borobia: MgO &gt; 90%</th>
</tr>
</thead>
</table>

The economical reserves are:

- Borobia > 50 MTn.
- Zilbetti > 7 MTn.

Source: Nicolas Gangutia, MagMin Presentation, 2011
Personal Communication: May 10th 2013
Washing, heavy media, flotation, briquetting and feed 3 qualities to kiln:

87% MgO, 8% CaO, 2% SiO2, 3% Fe2O3
85% MgO, 9% CaO, 3% SiO2, 3% Fe2O3
65% MgO, 30% CaO, 2% SiO2, 3% Fe2O3

Source: Nicolas Gangutia, MagMin 2011
MAGNESITAS DE RUBIAN - UPDATE

• EXISTING MINE AT IMPENSADA HAS RESERVES OF 12 MT AND JUST 1.5km TO EAST IS SANTALLA DEPOSIT AND ADJACENT AREAS WITH POTENTIAL 20MT
• 200,000 TONNES IS MINED UNDGROUND PER YEAR
• PRODUCTION IS 70,000 TONNES PER YEAR OF CCM
• 75% IS FOR AGRICULTURE, 20% FERTILIZER, 6% OTHERS
• EXPORTS 80% MAINLY TO UK, FRANCE, GERMANY, BELGIUM AND IRELAND.

Source: Eduardo Jimenez Aguirre, General Manager, MGR
MAGNESITAS DE RUBIAN
APPLICATIONS OF MGR PRODUCTS

Animal feed, Fertilizers
Acidity adjustment in agricultural soils
Treatment of soils contaminated by heavy metals

Sewage treatment, Glass
Flame retardant, Rubber
Oil Industry, Gas desulphurization
Paper and paste industries
Sugar refining, Adsorbent of heavy metals
### Typical Analysis of Magnesite Ore

<table>
<thead>
<tr>
<th></th>
<th>MgO</th>
<th>CaO</th>
<th>SiO₂</th>
<th>Al₂O₃</th>
<th>Fe₂O₃</th>
<th>Mn</th>
<th>P₂O₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>43.5</td>
<td>1.5</td>
<td>3.2</td>
<td>0.8</td>
<td>1.4</td>
<td>0.07</td>
<td>0.08</td>
</tr>
</tbody>
</table>

### Typical Analysis of Magnesia Products

<table>
<thead>
<tr>
<th></th>
<th>MgO</th>
<th>CaO</th>
<th>SiO₂</th>
<th>Al₂O₃</th>
<th>Fe₂O₃</th>
<th>Mn</th>
<th>P₂O₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>85.6</td>
<td>2.9</td>
<td>6.5</td>
<td>1.5</td>
<td>2.7</td>
<td>0.04</td>
<td>0.05</td>
</tr>
</tbody>
</table>

### Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Average MgO content (%)</th>
<th>Granulometry (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAGAL G</td>
<td>75</td>
<td>1 - 4 mm</td>
</tr>
<tr>
<td>MAGAL N</td>
<td>83</td>
<td>0 - 1.4 mm</td>
</tr>
<tr>
<td>MAGAL K</td>
<td>83</td>
<td>0.25 - 1.4 mm</td>
</tr>
<tr>
<td>MAGAL P</td>
<td>83</td>
<td>&lt; 360 μ</td>
</tr>
<tr>
<td>MAGAL T</td>
<td>66</td>
<td>&lt; 75 μ</td>
</tr>
<tr>
<td>MAGAL H PLUS</td>
<td>55</td>
<td>variable</td>
</tr>
<tr>
<td>CARBONATO</td>
<td>43</td>
<td>diverses</td>
</tr>
</tbody>
</table>

%MgO GRANULOMETRY

MagMin Conference 2013

MAGNESITAS DE RUBIAN
## Typical chemical composition of deposits (Magnezit Group, Russia)

<table>
<thead>
<tr>
<th></th>
<th>MgO</th>
<th>SiO₂</th>
<th>CaO</th>
<th>Fe₂O₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satka group</td>
<td>44-47</td>
<td>0,6-2,5</td>
<td>0,8-7,0</td>
<td>0,8-1,0</td>
</tr>
<tr>
<td>(Chelyabinsk region), %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nigneangarsk group</td>
<td>47-48</td>
<td>0,25-0,35</td>
<td>0,47-0,55</td>
<td>0,10-0,15</td>
</tr>
<tr>
<td>(Krasnoyarsk Territory), %</td>
<td>high grade</td>
<td>medium grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>46-47</td>
<td>0,35-0,75</td>
<td>0,55-0,70</td>
<td>0,10-0,15</td>
</tr>
</tbody>
</table>

Satka: Raw magnesite is extracted from underground and open-pit mines. The second deposit in Russia (Krasnoyarsk Territory) uses only open-pit mines.
KARAGAI MINE, SATKA

Biggest mine and open cast operations will finish within 3-4 years. The lower part of the deposit will then be underground mining.

DR. DMITRY BORZOV, MagMin 2011
COARSE-GRAINED SPARRY MAGNESITE
Graphite electrodes

Separation of crust and FM in plant

Cooling of FM container

FUSED MAGNESIA PRODUCTION
**MAGNEZIT GROUP TOTAL NEW CAPACITY FROM 2013-2015**

**Total new capacity until 2015, in 1000mt**

<table>
<thead>
<tr>
<th>AREA</th>
<th>PRODUCTS</th>
<th>TYPE OF KIKB</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satka area</td>
<td>CCM</td>
<td>multiple-hearth („Polysius”)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>DBM 94, 95, 97</td>
<td>Shaft kiln („Polysius”) N°1 (Since 2009 works)</td>
<td>50</td>
<td>50</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shaft kiln („Polysius”) N°2</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>FM</td>
<td>Satka old melt plant after upgrade</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Satka new melt plant</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Krasnoyarsk area</td>
<td>CCM</td>
<td>Shaft kiln N°1</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shaft kiln N°2</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>multiple-hearth („Polysius”)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>FM</td>
<td>6 furnaces after upgrade</td>
<td>35</td>
<td>35</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

**Total new capacity:**

<table>
<thead>
<tr>
<th>PRODUCTS</th>
<th>high-grade quality</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCM</td>
<td>(shaft kiln production)</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>DBM</td>
<td>high-grade quality</td>
<td>50</td>
<td>130</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>FM</td>
<td></td>
<td>85</td>
<td>85</td>
<td>150</td>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>
## BRAZIL - RESOURCES (MT) AND PRODUCTION (Kt) OF THREE COMPANIES

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>LOCATION</th>
<th>Resources (MT)</th>
<th>DBM</th>
<th>CCM</th>
<th>EFM</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBAR Nordeste SA</td>
<td>Brumado</td>
<td>80</td>
<td>20</td>
<td>160</td>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>Jucas, Ceara</td>
<td>5</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Magnesita SA</td>
<td>Brumado</td>
<td>830</td>
<td>320</td>
<td>60</td>
<td>34</td>
<td>414</td>
</tr>
<tr>
<td>Magnesium do Brasil</td>
<td>Jucas, Ceara</td>
<td>60</td>
<td>0</td>
<td>80</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>975</strong></td>
<td><strong>340</strong></td>
<td><strong>320</strong></td>
<td><strong>34</strong></td>
<td><strong>694</strong></td>
</tr>
</tbody>
</table>

*Source: Personal communications*
MEDIUM-GRAINED MAGNESITE
4. RIACHO FUNDO - IBAR
5. TORTO - MAG do BRASIL

SPARRY MAGNESITE
1. ALENCOR - PITOMBEIROS - MDB
2. MALHADA VERMELHA - MBD.
3. CABECA DE NEGRO - MDB
MAGNESITE DEPOSITS IN CEARÁ, NE BRAZIL

- CABECA DE NEGRO
- MALHADA VERMELHA
- TORTO DEPOSIT
- ALENCAR
- PITOMBEIROS DEPOSIT
- RIACHO FUNDO DEPOSIT

50 km
The Brazilian based Magnesium do Brasil, owned by the Franck family, sold 50% of its shares to the Roullier Group. The two companies have been commercial partners for a few years.

The company has its own mines with access to quality reserves of raw-material. Located in the northeast of Brazil, there is direct access to two ports allowing easy export to major international markets.

Roullier Group, holds a strong presence in several agro-chemical and industrial activities. The subsidiary TIMAB, brings a strong international sales network, logistical efficiency, complementary global sourcing capabilities, together with strong R&D support.
PITOMBEIROS MAGNESITE MINE

Sparry magnesite with greenish tinges of talc
CABECA DE NEGRO MAGNESITE DEPOSIT IN DOLOMITE

IRON STAINED MAGNESITE

DOLOMITE
MAGNESIUM DO BRASIL PLANT AT TORTO, CEARA, BRAZIL

GERMANO FRANCK AND FIRST KILN FOR MAGNESITE IN CEARA
• LARGE MAGNESITE DEPOSITS WITH 67% IN THE BRUMADO AREA TOTALLING 830 MILLION TONNES

• FURTHER DEPOSITS ARE CONTROLLED BY MAGNESITA
CATIBOABA SINTERING PLANT

PEDRA PRETA SINTERING PLANT

MagMin Conference 2013
PRODUCTION PROCESS

CAPACITIES (tonnes)

- DBM: 320,000
- CCM: 60,000
- EFM: 34,000
M-30 PRODUCTION PROCESS

FLOTATION PROCESS IMPROVES QUALITY OF DBM TO >98% MgO

<table>
<thead>
<tr>
<th>DBM GRADE</th>
<th>M10</th>
<th>M30 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>% MgO</td>
<td>&gt;94</td>
<td>&gt;98</td>
</tr>
<tr>
<td>% SiO2</td>
<td>&lt;1.8</td>
<td>&lt;0.3</td>
</tr>
<tr>
<td>% Fe2O3</td>
<td>&lt;2.9</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>% MnO</td>
<td>&lt;1.0</td>
<td>&lt;0.16</td>
</tr>
<tr>
<td>Bulk Density</td>
<td>&gt;2.98</td>
<td>&gt;3.30</td>
</tr>
</tbody>
</table>
### QUALITY of DBM PRODUCTS - M10 / M30

<table>
<thead>
<tr>
<th>GRADES</th>
<th>SiO2 (%)</th>
<th>Al2O3 (%)</th>
<th>Fe2O3 (%)</th>
<th>MnO (%)</th>
<th>CaO (%)</th>
<th>MgO (%)</th>
<th>BD (g/cm³)</th>
<th>AP (%)</th>
<th>&gt;50mm (%)</th>
<th>&lt;50mm (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-10</td>
<td>Typ.</td>
<td>1.36</td>
<td>0.34</td>
<td>1.95</td>
<td>0.88</td>
<td>0.44</td>
<td>95.04</td>
<td>3.06</td>
<td>12.4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Spec.</td>
<td>&lt;1.8</td>
<td>&lt;0.6</td>
<td>&lt;2.9</td>
<td>&lt;1.0</td>
<td>&lt;0.7</td>
<td>&gt;94.0</td>
<td>&gt;2.98</td>
<td>&lt;15.0</td>
<td></td>
</tr>
<tr>
<td>M-30B</td>
<td>Typ.</td>
<td>0.25</td>
<td>0.08</td>
<td>0.4</td>
<td>0.1</td>
<td>0.91</td>
<td>98.25</td>
<td>3.32</td>
<td>2.4</td>
<td>87.5</td>
</tr>
<tr>
<td></td>
<td>Spec.</td>
<td>&lt;0.3</td>
<td>&lt;0.12</td>
<td>&lt;0.5</td>
<td>&lt;0.16</td>
<td>&lt;0.95</td>
<td>&gt;98.0</td>
<td>&gt;3.30</td>
<td>&lt;3.0</td>
<td></td>
</tr>
</tbody>
</table>

• M10

• M30
## BRUMADO MINE OF IBAR LTDA, BRAZIL, RESOURCES AND PRODUCTION

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>LOCATION</th>
<th>Resources (MT)</th>
<th>DBM</th>
<th>CCM</th>
<th>EFM</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBAR Nordeste SA</td>
<td>Brumado</td>
<td>80</td>
<td>20</td>
<td>160</td>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>Jucas, Ceara</td>
<td>5</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>
IBAR PLANT AT BRUMADO AND MARKETS SERVED

-THIRD ROTARY KILN COMES INTO PRODUCTION IN JULY 2013 AND THE CAPACITY IS ALREADY INCLUDED IN THE PRODUCTION FIGURES

CCM MAINLY FOR ANIMAL FEED AND FERTILIZERS AND SOME INDUSTRIAL USES
CRYPTOCRYSSTALLINE MAGNESITE

Look at some deposits and operations
MANTLE ROCKS ARE MAINLY PERIDOTITE – THESE ARE ALTERED TO SEEPENTINITE WHICH RELEASES FLUIDS THAT CONTAIN MgO AND ACT AS SOURCE FOR MAGNESITE (MAGNESIUM CARBONATE)
New Company name
Kümaş Manyezit Sanayi A.Ş.
(Kümaş Magnesite Corporation).
- Kümaş was acquired by Ülker and Gürmen Groups in June 2012.

- Same management team still working at Kümaş.

- 2011-2012-2013 (PLAN) AND PRODUCTION LEVELS AND EXPANSION OF EFM, CCM AND DBM OUTPUT
LOCATION OF 12 MAGNESITE FIELDS

(Source: KÜMAŞ 2012)
### SUMMARY OF MAGNESITE PRODUCTION

(Source: KÜMAŞ April 2013)

<table>
<thead>
<tr>
<th>MAGNESITE PRODUCTION</th>
<th>Programme</th>
<th>Actual</th>
<th>Programme</th>
<th>Actual</th>
<th>Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>KÜMAŞ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRUDE MAGNESITE</td>
<td>490.000</td>
<td>523.000</td>
<td>549.000</td>
<td>643.000</td>
<td>771.000</td>
</tr>
<tr>
<td>ORE CONCENTRATED</td>
<td>368.000</td>
<td>371.000</td>
<td>385.000</td>
<td>350.000</td>
<td>600.000</td>
</tr>
<tr>
<td><strong>TAVŞANLI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRUDE MAGNESITE</td>
<td>*</td>
<td>22.000</td>
<td>60.000</td>
<td>55.000</td>
<td>138.000</td>
</tr>
<tr>
<td>ORE CONCENTRATED</td>
<td>*</td>
<td>5.000</td>
<td>40.000</td>
<td>42.000</td>
<td>110.000</td>
</tr>
</tbody>
</table>

(*): Tavşanlı Plant acquired by Kümaş in June 2011.

**KÜMAŞ MINES** - NEW BENEFICIATION/CONCENTRATOR INSTALLED IN 2011

**BOMMAG MINES** - NEW CONCENTRATOR INSTALLED IN 2012

**BOMMAG COMPANY WAS ACQUIRED IN JUNE 2011 BY KÜMAŞ**

![Stockwork and Veins](image1.png)

![Hand Selection](image2.png)

![Crushed Stockpile](image3.png)
MAIN SALUDERE ANA DAMAR MINE
SALUDERE PRE-CONCENTRATION PLANT
PLANT SHOWING THREE ROTARY KILNS
MAGNETIC SEPARATION

OPTICAL SEPARATION

FINAL ORE PROCESSING IS CARRIED OUT BY MAGNETIC SEPARATION AND OPTICAL SORTING – THIS SEPARATES MAGNESITE FROM SERPENTINE (LATTER MAGNETIC AND GREENISH IN COLOUR)
### KÜMAŞ AND TAVŞANLI PLANTS

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>KÜMAŞ PLANT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBM-CCM- DBD</td>
<td>180.000</td>
<td>174.000</td>
<td>180.000</td>
<td>152.000</td>
<td>260.000</td>
<td>250.000</td>
</tr>
<tr>
<td>EFM ELECTRO FUSED MAGNESIA</td>
<td>17.500</td>
<td>12.300</td>
<td>17.500</td>
<td>13.500</td>
<td>27.500</td>
<td>21.000</td>
</tr>
<tr>
<td>BOMMAG PLANT, TAVŞANLI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROTARY KILN CCM</td>
<td>11.000</td>
<td>0</td>
<td>20.000</td>
<td>13.000</td>
<td>20.000</td>
<td>18.000</td>
</tr>
<tr>
<td>1.SHAFT KILN CCM</td>
<td>10.000</td>
<td>2.000</td>
<td>10.000</td>
<td>6.000</td>
<td>10.000</td>
<td>10.000</td>
</tr>
<tr>
<td>2.SHAFT KILN CCM</td>
<td>30.000</td>
<td>0</td>
<td>30.000</td>
<td>1.000</td>
<td>30.000</td>
<td>27.000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>248.500</td>
<td>188.300</td>
<td>257.500</td>
<td>185.500</td>
<td>347.500</td>
<td>326.000</td>
</tr>
</tbody>
</table>

### KUTAHAYA PLANT
- NEW ROTARY 80,000 TPY ROTARY KILN IN 2012 – NOW 3 ROTARY KILNS
- FOUR NEW EAF – ELECTRIC ARC FURNACES - END 2012
- FEED FOR EFM BOTH DBM AND CCM

### BOMMAG PLANT
- CCM AND FEED FOR EFM
- BRIQUETTING DBM
BOMMAG PLANT AND MINES DEVELOPMENTS

- SARKIZIK MINE/PROCESSING IN “BOMMAG” MINES
  INTRODUCTION OF OPTICAL SORTER TO REMOVE SERPENTINE
  20-40 mm FEED FOR POLYSIUS SHAFT KILN WITH 96-97 MgO

OLD KILN → CCM → CCM → POLYSIUS SHAFT KILN → GRINDING → BRIQUETTING

CRUSHING SCREENING MAGNETIC SEPARATION

DBM ← ← ←
BRICK AND MONOLITHIC PRODUCTION 2011-2012

(Source: KÜMAŞ April 2012)

<table>
<thead>
<tr>
<th>Fired, Pitch and Resin Bonded</th>
<th>2011 CAPACITY</th>
<th>2012 PROJECTION</th>
<th>2012 CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesia and Dolomite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick Production</td>
<td>93,000</td>
<td>83,000</td>
<td>110,000</td>
</tr>
<tr>
<td>Monolithic Production</td>
<td>50,000</td>
<td>54,000</td>
<td>60,000</td>
</tr>
</tbody>
</table>

SHAPING OF BRICKS

TUNNEL KILN FOR BRICKS
TURKMAG (TRABZON, CIHAN GROUP,) AŞKALE, ERZURUM

WASHINGTON

Approximate scale

0 150 km

AREA OF DEPOSITS

COMMISSIONED IN DECEMBER 2010 – DBM PRODUCTS %MgO 90 to MgO 97
TURKMAG DEPOSITS SHOW VEINS AND STOCKWORKS IN SERPENTINE

MAGNESITE VEIN IN SERPENTINE

CRYPTOCRYSTALLINE
TURK MAG (TRABZON, CIHAN GROUP,) AŞKALE, ERZURUM

STOCKWORK

HAND-PICKING SERPENTINE

DBM CAPACITY 100,000 TPY

VEIN OF MAGNESITE

DBM 93

DBM 94
UPDATE ON SOME PROJECTS
SOME MAGNESITE DEPOSITS OF PAKISTAN AND AFGHANISTAN

CRYPTOCRYSTALLINE MAGNESITE:
- ABBOTABAD
- JALALABAD
- PESHAWAR

SPARRY MAGNESITE:
- KABUL
- ISLAMABAD
- LAHORE
- KARACHI
- QUETTA
- KABUL

Some magnesite deposits of Pakistan and Afghanistan.
PAKISTAN MAGNESITE DEVELOPMENTS

SOUTHERN AREA
CRYPTOCRYSSTALLINE IN SERPENTINE.
LARGE DEPOSITS

NORTHERN AREA
COARSE SPARRY TYPE
ASSOCIATED WITH DOLOMITE
SOME SMALL LOCAL KILNS

NEW PLANT WILL BLEND
BOTH TYPES OF MAGNESITE

MAGNESITE MINE

TRENCHING

SERPENTINITE

MAGNESITE

ROTARY KILN FOR DBM PLANT

NEAR ABBOTTOBAD
DAVAO ORIENTAL, PHILIPPINES MAGNESITE INTEREST IN CHROMITE POTENTIAL OF AREA
- MAGNESITE USED FOR ADDING MgO TO SOIL OF BANANA PLANTATIONS EVERY 4 YEARS
- CRYPOCRYSTALLINE ASSOC. SERPENTINE
- AROUND 40% MgO WITH 15.5% SiO2
- MIX OF MAGNESITE AND CLAY MINERAL
18th February 2013: Globex completed a financing which netted $4,269,150 and immediately started a 50 hole drill program on our talc-magnesite deposit south of Timmins, Ontario. Objective to raise resource to reserve status and other detailed studies

(Ray Zalnieriunas, Globex)
Main activity is the sale of MgO to the Animal health industry for the prevention of grass tetany in dairy cattle - serious often fatal disorder characterized by low levels of magnesium in the Blood serum of cattle.

CAUSMAG has capacity 18,000 TPY and 70% is used for animal health and the rest is used in various industrial applications.

Aditya Jhunjhunwala (Managing Director) reports that present output is 9-10,000 TPY increase to fill capacity within 1-2 years.
• MINES AT THUDDUNGRA – 60,000MTY
• 98% WITHOUT BENEFICIATION
• SOME PHOTOMETRIC SORTING
• CAPACITY OF YOUNG PLANT 18,000 TPY
• CRYPTOCRYSTALINE MAGNESITE,
• LOW BORON LEVELS

Source: Aditya Jhunjhunwala,
MagMin Paper 2011, Madrid
and personal communication
SITUATION IN 2012

1. MURRAY D’ALMEIDA (CHAIRMAN TASMANIA MAGNESITE) AND NEW MANAGING DIRECTOR OF BEACON HILL RESOURCES, ROWAN KARSTEL
2. SLOW DOWN IN LAST YEAR WHILE LAND TENURE ISSUES IN THE “TARKINE” REGION AFFECTING A NUMBER OF MINING COMPANIES - NOW MOSTLY RESOLVED
3. NEW METALLURGICAL TESTING PROPOSED AND EXPECT TO COMPLETE TESTING OF A BULK SAMPLE BY END-2013
4. DETAILED MARKETING REPORT COMPLETED AND FUTURE STRATEGIC PLANS

CURRENT SITUATION MAY 2013

DETAILED DRILLING
HYDROGEOLOGY
METALLURGICAL
CALCINING OPTIONS
BRIDGE BUILT
FEASABILITY STUDY
25MT GRADING
42.4% MgO
## MINERALOGY OF TWO BOREHOLES

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>Quartz</th>
<th>Dolomite</th>
<th>Magnesite</th>
<th>Talc</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-MB08</td>
<td>0.5</td>
<td>0.0</td>
<td>99.1</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>0.4</td>
<td>9.1</td>
<td>90.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>1.9</td>
<td>96.7</td>
<td>0.0</td>
</tr>
<tr>
<td>BH-AR228</td>
<td>2.1</td>
<td>2.3</td>
<td>95.4</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>0.0</td>
<td>99.5</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>0.0</td>
<td>86.6</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>0.6</td>
<td>99.1</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>0.0</td>
<td>99.9</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>15.1</td>
<td>83.8</td>
<td>0.0</td>
</tr>
</tbody>
</table>
- HUANDOT NOW OWNED BY THESSALLY RESOURCES PTY LTD

- WILL BE RENAMED “AUSTRALIAN MAGNESIA PTY LTD”

- CORPORATE RESTRUCTURING AND FUNDING PLANS

- EXPLORATION BY BHP BILLITON IN 1969 AND ADVANCED BY MAGNESIUM INTERNATIONAL IN 2004 – FOCUS ON Mg METAL

- AUSTRALIAN MAGNESIA PTY LTD WILL FIRST DEVELOP:
  - HIGH GRADE RAW MAGNESITE
  - HIGH QUALITY CCM

SOURCE: LORRY HUGHES, MANAGING DIRECTOR, THESSALLY PTY LTD
1. GOOD LOGISTICS

2. PROXIMITY TO DARWIN PORT

3. CLOSE TO RAIL

3. GAS AND MAINS POWER
RESOURCES OF MAGNESITE

- SMALL AREA DOWN TO 50 METRES
- 5.2 MT IDENTIFIED IN SMALL AREA
  - HIGH GRADE
    44.6% MgO, 0.36% Ca, 0.53% Fe, 4.34% AIR
  - LOW GRADE
    42.3% MgO, 0.49% Ca, 0.47% Fe, 8.63% AIR

- RESOURCE HAS THICKNESS OF 80-120 METRES.
- FURTHER EXPLORATION/ASSESSMENT WILL GIVE RESOURCES/RESERVES TO JORC CODE STANDARD

- PREVIOUS ACTIVITY INCLUDED MINING OF 25,000 MT WITH FOLLOWING QUALITY:
  44.8% MgO, 0.35% Ca, 0.37% Fe, 0.08% Al,
  0.31% Si, 3.80% ACID INSOLUBLE RESIDUES (AIR)
CRYPTOCRystalline magnesite from ultra-basic deposit of Kazakhstan
DEVELOPMENTS - NEW PROJECTS - ACQUISITIONS
PLENTY OF RESOURCES / RESERVES AVAILABLE AND
QUALITY BEING IMPROVED THROUGH BENEFICIATION

Sources: O’Driscoll/IM/Industry