CERAMIC RAW MATERIALS IN SPAIN

Manuel Regueiro y González-Barros
Geological Survey of Spain
Value of the production of mineral raw materials

Metallic: 51%
Industrial minerals and rocks: 14%
Energetic: 27%
Aggregates: 8%

Total: 1.000.000 M€ (2014)
WORLD PRODUCTION OF MINERAL RAW MATERIALS

World GDP and mineral production – 1992 to 2010

- **Total value of metallic mineral production – 1992=100**
- **World GDP (PPP, current prices) – 1992=100**

% WORLD PRODUCTION OF MINERAL RAW MATERIALS OF THE UE 28
TRENDS IN THE RAW MATERIALS MARKET IN ADDED VALUE
RESOURCES AND INNOVATION WAVES

Waves of Innovation

1st wave
- Iron
- Water power
- Mechanisation
- Textiles
- Commerce

2nd wave
- Steam power
- Railroad
- Steel
- Cotton

3rd wave
- Electricity
- Chemicals
- Internal combustion engine

4th wave
- Petrochemicals
- Electronics
- Aviation
- Space

5th wave
- Sustainability
- Radical resource productivity
- Whole system design
- Biomimicry
- Green chemistry
- Industrial ecology
- Renewable energy
- Green nanotechnology

6th wave
- Digital Networks
- Biotechnology
- Software Information technology

1785 1845 1900 1950 1990 2020
## EUROPEAN PRODUCTION (EU30) OF CERAMIC RAW MATERIALS 2013 (t)

<table>
<thead>
<tr>
<th>Material</th>
<th>Production (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BENTONITE + FULLER EARTHS (26.8% of the world)</td>
<td>3,579,895</td>
</tr>
<tr>
<td>DIATOMITE</td>
<td>401,872</td>
</tr>
<tr>
<td>FELDSPAR</td>
<td>16,419,420</td>
</tr>
<tr>
<td>KAOLIN (26.6% of the world)</td>
<td>9,433,354</td>
</tr>
<tr>
<td>LITHIUM</td>
<td>19,940</td>
</tr>
<tr>
<td>MAGNESITE (29.7% of the world)</td>
<td>5,003,587</td>
</tr>
<tr>
<td>ALUMINIUM SILICATES</td>
<td>68,000</td>
</tr>
<tr>
<td>TALC (16.2% of the world)</td>
<td>1,146,608</td>
</tr>
<tr>
<td>BORATES</td>
<td>1,800,000</td>
</tr>
<tr>
<td>NEPHELINE SYENITE</td>
<td>320,000</td>
</tr>
<tr>
<td>WOLLASTONITE</td>
<td>28,738</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>38,221,414</strong></td>
</tr>
</tbody>
</table>


## Added Value in the Production of Minerals in Europe

### Construction

<table>
<thead>
<tr>
<th>Use</th>
<th>Added Value (M€)</th>
<th>Employment</th>
<th>Mineral Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>16 336</td>
<td>375 400</td>
<td>100%</td>
</tr>
<tr>
<td>Ceramic Tiles</td>
<td>4 253</td>
<td>94 900</td>
<td>100%</td>
</tr>
<tr>
<td>Bricks and Roof Tiles</td>
<td>3 891</td>
<td>78 300</td>
<td>100%</td>
</tr>
<tr>
<td>Concrete</td>
<td>10 515</td>
<td>256 600</td>
<td>100%</td>
</tr>
<tr>
<td>Cement, Lime, Gypsum</td>
<td>8 717</td>
<td>77 700</td>
<td>100%</td>
</tr>
<tr>
<td>Natural Stone</td>
<td>5 492</td>
<td>189 300</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Other Sectors

<table>
<thead>
<tr>
<th>Use</th>
<th>Added Value (M€)</th>
<th>Employment</th>
<th>Mineral Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber</td>
<td>17 057</td>
<td>359 400</td>
<td>Up to 50%</td>
</tr>
<tr>
<td>Plastic</td>
<td>55 534</td>
<td>1 310 400</td>
<td>Up to 50%</td>
</tr>
<tr>
<td>Paint</td>
<td>10 601</td>
<td>179 400</td>
<td>Up to 70%</td>
</tr>
<tr>
<td>Paper</td>
<td>17 429</td>
<td>223 800</td>
<td>Up to 30%</td>
</tr>
<tr>
<td>Other Ceramics</td>
<td>6 514</td>
<td>199 100</td>
<td>100%</td>
</tr>
<tr>
<td>Chemical Products</td>
<td>64 928</td>
<td>584 500</td>
<td>Variable</td>
</tr>
<tr>
<td>Pharmaceutical Products</td>
<td>6 818</td>
<td>66 700</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>228 085</strong></td>
<td><strong>3 995 500</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Table: Evolution of Main Figures of the Spanish Ceramic Industries 2007-2015

<table>
<thead>
<tr>
<th>Category</th>
<th>Companies</th>
<th>Employees</th>
<th>Production Value (M€)</th>
<th>Production</th>
<th>Companies</th>
<th>Employees</th>
<th>Production Value (M€)</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor &amp; wall tiles</td>
<td>245</td>
<td>26000</td>
<td>3596</td>
<td>651 Mm²</td>
<td>190⁰</td>
<td>14500</td>
<td>3075</td>
<td>440 Mm²</td>
</tr>
<tr>
<td>Frits, glazes</td>
<td>25</td>
<td>3754</td>
<td>1097</td>
<td>750,000 t</td>
<td>25⁰</td>
<td>3610</td>
<td>1195</td>
<td>817,000 t</td>
</tr>
<tr>
<td>Bricks &amp; roofing tiles</td>
<td>430</td>
<td>14140</td>
<td>1505</td>
<td>28,800,000 t</td>
<td>200</td>
<td>5600</td>
<td>210</td>
<td>3,900,000</td>
</tr>
<tr>
<td>Raw materials</td>
<td>140</td>
<td>4500</td>
<td>500</td>
<td>50,000,000 t</td>
<td>80⁰</td>
<td>2100⁰</td>
<td>86,4⁰</td>
<td>8,643,603 t</td>
</tr>
<tr>
<td>Giftware</td>
<td>50</td>
<td>4000</td>
<td>200</td>
<td>N.A</td>
<td>25⁰</td>
<td>1500⁰</td>
<td>90⁰</td>
<td>N.A</td>
</tr>
<tr>
<td>Technical Ceramics</td>
<td>20</td>
<td>3200</td>
<td>130</td>
<td>N.A</td>
<td>10⁰</td>
<td>1500⁰</td>
<td>50⁰</td>
<td>N.A</td>
</tr>
<tr>
<td>Refractories</td>
<td>55</td>
<td>1800</td>
<td>244</td>
<td>510,000 t</td>
<td>29⁰</td>
<td>1506</td>
<td>308</td>
<td>553,000*</td>
</tr>
<tr>
<td>Tableware</td>
<td>6</td>
<td>650</td>
<td>33</td>
<td>32 M pcs</td>
<td>3⁰</td>
<td>300</td>
<td>15⁰</td>
<td>15 M pcs⁰</td>
</tr>
<tr>
<td>Sanitary</td>
<td>6</td>
<td>3950</td>
<td>210</td>
<td>8 M pcs</td>
<td>6⁰</td>
<td>4000</td>
<td>290⁰</td>
<td>7 M pcs⁰</td>
</tr>
<tr>
<td>Pottery</td>
<td>950</td>
<td>16000</td>
<td>30</td>
<td>N.A</td>
<td>350</td>
<td>5000</td>
<td>12</td>
<td>NA</td>
</tr>
<tr>
<td>Total</td>
<td>2607</td>
<td>95450</td>
<td>11564</td>
<td></td>
<td>918</td>
<td>39616</td>
<td>5331,4</td>
<td></td>
</tr>
</tbody>
</table>

*Sources: Hyspalit, Ascer, Anfre, Anffecc*

*2014 ⁰=IGME estimates*

**No companies 2007**

- Pottery: 6
- Sanitary: 6
- Tableware: 55
- Refractories: 20
- Technical Ceramics: 50
- Giftware: 140
- Raw materials: 25
- Bricks & roofing tiles: 430
- Frits, glazes: 245
- Floor & wall tiles: 950

**No companies 2015**

- Pottery: 6
- Sanitary: 3
- Tableware: 29
- Refractories: 10
- Technical Ceramics: 25
- Giftware: 80
- Raw materials: 200
- Bricks & roofing tiles: 190
- Frits, glazes: 25
- Floor & wall tiles: 350

**Employees 2007**

- Pottery: 3950
- Sanitary: 650
- Tableware: 1800
- Refractories: 3200
- Technical Ceramics: 4000
- Giftware: 4500
- Raw materials: 14140
- Bricks & roofing tiles: 3754
- Frits, glazes: 26000

**Employees 2015**

- Pottery: 5000
- Sanitary: 300
- Tableware: 1506
- Refractories: 1500
- Technical Ceramics: 1500
- Giftware: 2100
- Raw materials: 5600
- Bricks & roofing tiles: 3610
- Frits, glazes: 14500
- Floor & wall tiles: 16000
- Exports rise, Spanish market upwards, recovery since 2011
- 2\textsuperscript{nd} world exporter (13\% of the world market)
Similar growth buy smaller companies in Spain (73,2 M€ versus 120 M€)

Source: KPMG
• **Classification**
  – Plastic raw materials or clays
  – Non-plastic raw materials (melting agents, refractories, etc.)

• **Clays**
  – Ball clays, red clays and kaolin.
    • Red clays by carbonate content: high, medium and negligible.

• **Tile bodies**
  – Composition
    • Red clays (red products when fired)
    • Refractory clays (white when fired)
  – Typology
    • Porous wall tiles bodies
      – Red clays with high carbonate content
    • Stoneware tiles
      – Red tiles bodies: mixture of red clays with high iron content, low carbonates and variable plasticity and other raw materials such as silica sand, feldspar, talc, etc.
      – White ware bodies: refractory clays and kaolin, calcium carbonate, dolomite, silica sand and feldspar
      – Single fired tiles bodies: refractory clays, feldspar, silica, kaolin and talc
    • Porcelain tiles:
      – White ware bodies with 50% feldspar
    • Rustic tiles
• Bricks and roof tiles bodies
  – A great deal of carbonate and non-carbonate clays
• Sanitary ware and tableware bodies
  – Refractory clays, feldspar, kaolin and silica
• Frits and glazes
  – A great variety of raw materials
• Refractories
  – Dolomite, magnesite, dunite, flint clays, SiC (domestic);
    chromite, bauxite, alumina, zircon, andalusite and graphite
    (imported).
• Glass
  – Vitrifiers
    • Silica sand, boric acid, ulexite, phosphoric anhydride
  – Fusing agents
    • Sodium carbonate, sodium sulphate, potassium carbonate,
      lithium oxide, calcium carbonate, dolomite, barite.
  – Stabilisers
    • Feldspar, kaolin, lead oxide, smithsonite
  – Minor components
    • Fluorite
<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaolin</td>
<td>486.428</td>
<td>333.779</td>
<td>270.298</td>
<td>310.993</td>
<td>384.179</td>
<td>402.251</td>
<td>410.717</td>
<td>344.414</td>
</tr>
<tr>
<td>Feldspar</td>
<td>683.134</td>
<td>632.120</td>
<td>597.496</td>
<td>691.894</td>
<td>662.418</td>
<td>530.238</td>
<td>592.908</td>
<td>533.328</td>
</tr>
<tr>
<td>Lithium (lepidolite)</td>
<td>10.326</td>
<td>9.342</td>
<td>4.270</td>
<td>7.824</td>
<td>8.000</td>
<td>8.000</td>
<td>8.000</td>
<td>8.000</td>
</tr>
<tr>
<td>Raw magnesite(MgO)</td>
<td>195.089</td>
<td>186.076</td>
<td>390.311</td>
<td>462.959</td>
<td>577.725</td>
<td>649.977</td>
<td>836.269</td>
<td>679.348</td>
</tr>
<tr>
<td>Iron oxides</td>
<td>123.287</td>
<td>112.218</td>
<td>45.520</td>
<td>29.808</td>
<td>92.122</td>
<td>70.618</td>
<td>71.948</td>
<td>70.270</td>
</tr>
<tr>
<td>Industrial silica sand</td>
<td>5.081.522</td>
<td>4.000.000</td>
<td>3.310.794</td>
<td>3.700.611</td>
<td>3.727.954</td>
<td>3.546.559</td>
<td>3.230.000</td>
<td>3.260.000</td>
</tr>
<tr>
<td>Talc</td>
<td>78.042</td>
<td>59.299</td>
<td>47.218</td>
<td>51.897</td>
<td>11.957</td>
<td>8.857</td>
<td>0</td>
<td>Mine closed</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>3.000.000</td>
<td>3.000.000</td>
<td>3.000.000</td>
<td>3.000.000</td>
<td>3.000.000</td>
<td>3.000.000</td>
<td>2.500.000</td>
<td>3.000.000</td>
</tr>
<tr>
<td>Dolomite</td>
<td>1.333.773</td>
<td>1.200.000</td>
<td>1.190.376</td>
<td>1.209.000</td>
<td>907.000</td>
<td>739.000</td>
<td>892.439</td>
<td>1.454.644</td>
</tr>
<tr>
<td>Dunite</td>
<td>1.379.395</td>
<td>1.358.562</td>
<td>1.660.555</td>
<td>1.469.999</td>
<td>1.237.209</td>
<td>870.542</td>
<td>796.103</td>
<td>676.471</td>
</tr>
<tr>
<td>TOTAL</td>
<td>58.373.003</td>
<td>46.277.404</td>
<td>23.813.747</td>
<td>23.122.235</td>
<td>19.869.935</td>
<td>18.108.559</td>
<td>16.646.748</td>
<td>17.837.635</td>
</tr>
</tbody>
</table>

Source: Ministry of Industry, Energy & Tourism. 2014
# Production of Ceramic Raw Materials in Spain (t)

<table>
<thead>
<tr>
<th>Material</th>
<th>Tiles</th>
<th>Fine Ceramics</th>
<th>Refractories</th>
<th>Exports</th>
<th>Pigmements</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaolin</td>
<td>147.010</td>
<td>228.551</td>
<td>18.715</td>
<td>34.996</td>
<td></td>
<td>429.272</td>
</tr>
<tr>
<td>Feldspar</td>
<td>31.000</td>
<td>204.688</td>
<td>514</td>
<td>19.768</td>
<td></td>
<td>255.970</td>
</tr>
<tr>
<td>Iron oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tripoli</td>
<td></td>
<td>3.125</td>
<td></td>
<td></td>
<td></td>
<td>3.125</td>
</tr>
<tr>
<td>Red clay</td>
<td>3,435.754</td>
<td>3,023.462</td>
<td>500</td>
<td></td>
<td></td>
<td>6,459.716</td>
</tr>
<tr>
<td>Silica sand</td>
<td>40.104</td>
<td>288.365</td>
<td>5.015</td>
<td></td>
<td></td>
<td>333.484</td>
</tr>
<tr>
<td>Limestone</td>
<td>138.763</td>
<td>4.500</td>
<td></td>
<td></td>
<td></td>
<td>143.263</td>
</tr>
<tr>
<td>Chalk</td>
<td></td>
<td>12.300</td>
<td></td>
<td>4.425</td>
<td></td>
<td>16.725</td>
</tr>
<tr>
<td>Dolomite</td>
<td>7.256</td>
<td>214.413</td>
<td>255.363</td>
<td></td>
<td></td>
<td>477.032</td>
</tr>
<tr>
<td>Slate</td>
<td>8.399</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.399</td>
</tr>
<tr>
<td>Dunite</td>
<td></td>
<td>12.615</td>
<td></td>
<td></td>
<td></td>
<td>12.615</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8,643,603</td>
</tr>
</tbody>
</table>

Source: Ministry of Industry, Energy & Tourism. 2014
Uses: floor tiles white bodies and porcelain tiles. Also in glazes, engobes and bodies for tableware, porcelain and sanitary ware.

Production: 600,000 t/a

Consumption: 800,000 t/a. 20M€.

- Domestic (75%)
- Imports (25%). Ukraine, UK, Germany & France

Main companies:
- Aragón Minero.
- Minera Sabater.
- Intrasa.
- Portome.
- Minera Capilla.
- Aro
- Afrp
- B y b

Ball clay atomizers
Uses: Bricks and roof tiles, ceramic tiles

Total consumption: 7.8 Mt (2014)

- Bricks and roof tiles (3.9 Mt production. Sales 210M€. 2014.)
  - Toledo (16%), Barcelona (9%) y Valencia (8%). Alicante (6%), Jaén (5%) y La Rioja (5%). 33% in the Mediterranean zone (from Girona to Murcia). 29% Central Spain (Madrid, Castilla-La Mancha, Castilla-León & Aragón).
  - 200 companies. 5600 staff (300 in quarries)
  - 60% of the companies (almost 80% of production) are affiliated to a national association HISPALYT

- Ceramic tiles (Turnover 2890 M€ 2014)
  - Valencia Community: Villar del Arzobispo, San Juan de Moró, Alcora, Chulilla. Galve (Teruel).
  - WBB España & 15 minor companies.

- Cement (1.6 Mt. 2014)
<table>
<thead>
<tr>
<th>Year</th>
<th>Red clays (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>47,0</td>
</tr>
<tr>
<td>2007</td>
<td>45,0</td>
</tr>
<tr>
<td>2008</td>
<td>30,0</td>
</tr>
<tr>
<td>2009</td>
<td>13,2</td>
</tr>
<tr>
<td>2010</td>
<td>12,1</td>
</tr>
<tr>
<td>2011</td>
<td>9,2</td>
</tr>
<tr>
<td>2012</td>
<td>8,2</td>
</tr>
<tr>
<td>2013</td>
<td>7,3</td>
</tr>
<tr>
<td>2014</td>
<td>7,7</td>
</tr>
</tbody>
</table>
- Production: 429,272 tpa
- Almost 50% (200,000 tpa) of the national kaolin production is consumed by the domestic ceramic industry (88%) and internationally (12%)
- Main consuming sectors: sanitary ware, tableware, glazes, engobes, white ware bodies for floor and wall tiles and grog for rustic or natural stoneware.
- Main national deposits: Guadalajara, Lugo, La Coruña and Valencia.
- Estimated reserves: > 100 Mt
- Main players: Caobar, Sibelco Minerales, Cavisa, Caolines Lapiedra, Sicamar, SAMCA (Caolina y Sica), Kaosa, Arcichamotas, Arcillas & Feldespatos Río Pirón, Syca, etc.
PRINCIPALES YACIMIENTOS ESPAÑOLES DE CAOLÍN Y ARCILLAS ESPECIALES
GCC

- Production: 2.5 Mtpa. 1.2 tpa micronized, 1.3 tpa other
- Deposits in Tarragona, Almería.
- Main players:
  - OMYA-CLARIANA. World leader with plants in L’Arboc (Tarragona), Purchena (Almería), Belchite (Zaragoza) & Darro (Granada).
  - REVERTE, S.A. Spanish leader with micronizing plants in Castellet i la Gornal (Barcelona) & Albox (Almería).
  - MARCAEL, subsidiary of Provençale. Plant in Arboleas (Almería).

DOLOMITE

- Production all uses: 1.5 Mt. 40 kt dolosinter.
- Deposits in Cantabria, Castellón, Málaga, Granada.
- Main players:
  - GRUPO CALCINOR main Spanish producer, > 1.5 Mtpa, plants and quarries in Guipúzcoa, Cantabria, Castellón, Sevilla & Madrid. Raw dolomite 300,000 t for glass, chemistry, fertilizers, etc. Dolomitic lime 200,000 t for steel works. Sinter dolomite for refractories.
  - PRODOMASA: 500,000 t in Coín (Málaga) raw dolomite. Several grain sizes and uses
  - SIBELCO HISPANIA: 30,000 tpa in Durcal (Granada).
  - DOLOMÍAS DE ARAGÓN in Morés y Sabiñán (Zaragoza): 40,000 tpa calcined dolomite & sinter dolomite for steel works and raw dolomite for glass and other uses.
Spain is the 2º world producer of celestine and only European producer
1 quarry in Escuzar (Granada)
Production 90,000 t/a
Solvay Minerales SA.
Plant of 35,000 t/a of strontium carbonate in Cartagena: Química del Estroncio SA.
Main current uses: ceramics, pyrotechnics, paints, catalysts, metallurgy, electronics and medicine.
- Production: 600kt. 200kt feldspar, 300kt feldspathic sands, 100kt kaolin by-product.
- Imports 1,23Mt. Turkey (75%), Italy (19%), Germany (4%)
- Apparent consumption: 1 587 694 t
- National resources: 600 Mt
IRON PIGMENTS

- PROMINDSA, main producer, Santa Rosa mine in Tierga (Zaragoza), excellent and internationally recognised pigments for ceramics. 13.570 tpa
- Other small producers in Córdoba y Granada. 4.000 tpa for pigments
Production of raw magnesite 643 kt.
170 000t caustic magnesite. 70 kt sinter magnesite.
Magnesite for refractories: 150 kt

**Magnesitas Navarras**
- Open cast mine. Eugui (Navarra)
- Resources 20 Mt
- 180 kt plant in Zubiri. 90 kt caustic magnesite & 70 kt sinter magnesite.
- New mine project in Borobia (Soria)

**Magnesitas de Rubian**
- Mine in Vila de Mouros (Lugo). 90 000 t
- Plant in Monte Castelo. 70 kt caustic magnesite
TALC

- Production: 8000t in 2012, now all closed
- Deposits in Leon & Málaga
- Talcs de Luzenac (Rio Tinto plc)
- Puebla de Lillo closed in 2009
- Malaga closed

TALC IMPORTS THROUGH THE CASTELLON PORT

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>t</th>
<th>M€</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUSTRIA</td>
<td>290.960</td>
<td>138.206,00</td>
</tr>
<tr>
<td>BELGIUM</td>
<td>96.249</td>
<td>64.060,38</td>
</tr>
<tr>
<td>FRANCE</td>
<td>875.835</td>
<td>156.697,41</td>
</tr>
<tr>
<td>ITALY</td>
<td>5.000</td>
<td>5.220,00</td>
</tr>
<tr>
<td>LUXEMBOURG</td>
<td>596.000</td>
<td>235.420,00</td>
</tr>
<tr>
<td>THE NETHERLAND</td>
<td>245.650</td>
<td>120.368,49</td>
</tr>
<tr>
<td>PAKISTAN</td>
<td>267.000</td>
<td>34.937,65</td>
</tr>
<tr>
<td>POLONIA</td>
<td>4.875</td>
<td>3.200,00</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>53.950</td>
<td>15.456,95</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2.435.519</td>
<td>773.566,89</td>
</tr>
</tbody>
</table>

Map showing the location of deposits and production sites for talc.
- **Production:** 3,26 Mt. More than 20 operations in Spain
- **Types:**
  - Silica sands: 70%
  - By product of feldspathic sands: 23%
  - By product of kaolin production: 5%
  - Sandstones and quartzites operations: 2%
  - Quartz quarries
- **Reserves > 500 Mt**
- **Main players:**
  - Sibelco Hispania S.A. Main producer with many operations Arija (Burgos), Arcos de la Frontera (Cádiz), Río Deva (Teruel & Valencia), Higuueruelas (Valencia).
  - Other producers of silica sands: Echave, Montorio, Asirosa, etc.
  - Micronized silica (300 000 t/a): Sibelco Hispania, Molcasa, Caobar, Euroarce, Sílices Gilarranz, Mario Pilato.
  - Silica from kaolinite sands: Caobar, WBB España, S.A. Sicamar, Sica, etc.
  - Silica from feldspathic sands: Incusa. Arcillas y Feldespato de Río Pirón.
  - Silica from sandstones: Sílices La Cuesta in Asturias & Silices de Boñar in León.
  - Quartz: Erimsa & Ferroatlantica main producers.
<table>
<thead>
<tr>
<th>NAME</th>
<th>LOCATION</th>
<th>OWNER</th>
<th>MINERALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROYECTO BOROBIA*</td>
<td>BOROBIA (SORIA)</td>
<td>MAGNESITAS DE NAVARRA, S.A.</td>
<td>MAGNESITE</td>
</tr>
<tr>
<td>INVESTIGACIÓN MINA TRES ARROYOS</td>
<td>ALBURQUERQUE (BADAJOZ)</td>
<td>IMERYS CERAMICS SPAIN, S.A</td>
<td>LITHIUM</td>
</tr>
<tr>
<td>P.I. PANCRUDO</td>
<td>ALPEÑÉS, PANCRUDO, ALCORISA &amp; BERGE (TERUEL)</td>
<td>IMERYS CERAMICS SPAIN, S.A</td>
<td>CLAYS</td>
</tr>
</tbody>
</table>

* Already in operation
Increase on quality requirements

Reduction on size of raw materials. Continual reduction on the under 30 µm reject

Important investments on R&D in the field of minerals treatment and quality control

Mineral supply companies have experienced a considerable increase in turnover: Outsourcing
Aftermath of the crisis: 70% minerals production drop

Mining is a primary sector: slow recover

Spain will still be leader in exported minerals with high quality

The raw materials initiative: an opportunity for R&D
- Improve access to resources
- Improve legislation
- Development of best practices
- Improve geological surveys networks
- Research, innovate, recycle, turn Green

Some resources in Spain in international hands

Some national production groups go international

Still some opportunities to find new resources

The Spanish Geological Survey (www.igme.es) leading provider of mineral information
Ceramics in Spain slowly recovering thanks to exports, technology specialization, design and excellent raw materials.

Innovations in the ceramic tile sector in Spain

- **DECORATION**
  - Inkjet technology
  - Laser ablation

- **LASER THERMAL TREATMENT**

- **BACTERICIDAL TILE**

- **AIR CLEANING**

- **BIOCLIMATIC ARCHITECTURE**
  - PCM (phase change materials) ceramic tiles. Accumulate energy and returns it to when needed

- **THERMAL TILES**
  - Warm tiles: designed to generate heat applying a voltage difference to a conductive glaze

- **SMART SURFACE SYSTEMS**
  - Tiles that detect the presence of humans and activate devices that regulate traffic lights at pedestrian crossings, serve as interactive games for children, improve accessibility and safety in given spaces, etc

- **PHOTOLUMINESCENT TILES**
  - Tiles covered with a fluorescent pigment incorporated into a glaze composition

- **ANTI-ELECTROSTATIC TILES**
  - Glaze composition that generates surface electric conduction, adapted to stoneware and porcelain tile bodies

- **ANTI-SLIP TILES**

- **ECOLOGICAL TILES (Green production)**

- **PHOTOVOLTAIC TILE**
  - Thin films integrated into the ceramic tile itself, which allow solar energy to be transformed into electricity
GRAZIE MILLE