Mineral Resources of Afghanistan

Driver for Regional Economic Development

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http://www.mom.gov.af

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Afghanistan has complex geology.

Northern part belongs to Eurasia.

The south is made up of accreted fragments of Gondwana Land.

Each block is separated by deep seated faults.

There were different geological activity in each zone which resulted in formation of very rich mineral assemblages.

Coal and oil/gas are found on the Eurasian plate or its margin.
Holocene & Pleistocene
Cretaceous
Permian
Triassic
Jurassic
Pcm
Status of Geological Studies

- No recent systematic and detailed geologic studies have been conducted
- Most interpretations are based on 30-40 years old Soviet geological and exploration findings and recent reevaluations of data
- In spite of many hurdles, world class deposits of iron, copper, molybdenum, nickel, gold, lithium and other minerals are known to exist in Afghanistan
- In 2010 the AGS assessed 286 billion dollars worth of mineral resources in Afghanistan
- A data center with initial storage capacity of 92 TB has been established at the AGS for storage/dissemination of geoinformation
## AGS Assessed Resources in 2010

<table>
<thead>
<tr>
<th>Area</th>
<th>Resources</th>
<th>Price per unit</th>
<th>Total in situ value $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sya Dara Iron</td>
<td>500 million ton</td>
<td>$160</td>
<td>80 billion</td>
</tr>
<tr>
<td>Bamiyan Granite</td>
<td>36 billion m³</td>
<td>$5 /m³</td>
<td>180 billion</td>
</tr>
<tr>
<td>Zenda Jan Limestone</td>
<td>1.5 billion ton</td>
<td>$4/ton</td>
<td>6 billion</td>
</tr>
<tr>
<td>Takhar Gypsum</td>
<td>2 billion tons</td>
<td>$10/ton</td>
<td>20 billion</td>
</tr>
<tr>
<td><strong>Total, $</strong></td>
<td></td>
<td></td>
<td><strong>286 billion</strong></td>
</tr>
</tbody>
</table>
Areas Identified for Mineral Potential

- Recent USGS/AGS joint evaluation of Afghanistan mineral resources identified large areas of mineral potential for a diverse range of mineral commodities. These are included in the following set of slides.

- The preliminary In Situ Gross value of mineral resources is estimated at trillions of dollars.
Mineral Resources

- Li, Be, precious stones, and rare metals in the pegmatite fields of NE Afghanistan
- Porphyry Cu with Mo and Au in central, southern, and western Afghanistan.
  - Potential for discovery of 60 million ton additional copper is probable
- Rare Earth Elements (REE) and Nb in southern Afghanistan
- Lead and zinc in central Afghanistan
- Gold in the north, and southern regions (the price of gold is 1700/oz)
- Lithium (Li) in salars of central, SW, and western Afghanistan
- Oil and gas in the north, potential for gigantic discoveries exists
- Coal in Central Afghanistan
Iron deposits occur along a line from Badakhshan to Herat.

Extends several hundred km (from borders of Tajikistan to Iran).

Resources are estimated at billions of tons of high quality iron containing a very attractive mixture of elements, Mo, Ti, and V, in some areas.
Hajigak and Sya Dara Iron
Hajigak 2B, Sya Dara 500M tons
A View of Hajigak from Space
Chromite, Talk-Magnesite
Carbonatites with REE and Nb
## REE Prices and Production

### Price $/Kg

<table>
<thead>
<tr>
<th>Rare Earth Oxide</th>
<th>Mt Weld Distribution</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Q1 2011</th>
<th>Q2 2011</th>
<th>17-oct-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanthanum Oxide</td>
<td>25.50%</td>
<td>8.71</td>
<td>4.88</td>
<td>22.4</td>
<td>75.87</td>
<td>135.02</td>
<td>80</td>
</tr>
<tr>
<td>Cerium Oxide</td>
<td>46.74%</td>
<td>4.56</td>
<td>3.88</td>
<td>21.6</td>
<td>77.52</td>
<td>138.29</td>
<td>72</td>
</tr>
<tr>
<td>Neodymium Oxide</td>
<td>18.50%</td>
<td>31.9</td>
<td>9.12</td>
<td>49.5</td>
<td>130.23</td>
<td>256.15</td>
<td>265</td>
</tr>
<tr>
<td>Praseodymium Oxide</td>
<td>5.32%</td>
<td>29.48</td>
<td>18.03</td>
<td>48</td>
<td>119.65</td>
<td>220.08</td>
<td>220</td>
</tr>
<tr>
<td>Samarium Oxide</td>
<td>2.27%</td>
<td>5.2</td>
<td>3.4</td>
<td>14.4</td>
<td>72.75</td>
<td>125.6</td>
<td>110</td>
</tr>
<tr>
<td>Dysprosium Oxide</td>
<td>0.12%</td>
<td>118.49</td>
<td>115.6</td>
<td>231.6</td>
<td>412.9</td>
<td>921.2</td>
<td>2300</td>
</tr>
<tr>
<td>Europium Oxide</td>
<td>0.44%</td>
<td>481.92</td>
<td>492.9</td>
<td>559.8</td>
<td>719.2</td>
<td>1830</td>
<td>3800</td>
</tr>
<tr>
<td>Terbium Oxide</td>
<td>0.07%</td>
<td>720.77</td>
<td>361.6</td>
<td>557.8</td>
<td>717.6</td>
<td>1659.2</td>
<td>3220</td>
</tr>
<tr>
<td>Av. Mt Weld Composition</td>
<td></td>
<td>14.87</td>
<td>10.32</td>
<td>31.35</td>
<td>92.84</td>
<td>173.2</td>
<td>140.64</td>
</tr>
</tbody>
</table>

### World REE Production, 1000 tons

<table>
<thead>
<tr>
<th>Country</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>119</td>
<td>120</td>
</tr>
<tr>
<td>India</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.73</td>
<td>0.73</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Thailand</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Australia</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>USA</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Others</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>123</td>
<td>124</td>
</tr>
</tbody>
</table>
Ore Geochemistry and Resources

Geochemistry

![Map with contour lines and sample sites](image)

Sample sites:
- 2010 collection
- 2011 collection
- Landing zone 2009
- Landing zone Aug. 2010
- Landing zone Feb. 2011
- Soviet "ores"

Elevation contours:
- 20 meter contour
- 100 meter contour

Elevation Value:
- High: 1334
- Low: 800

Distance scale:
- Miles: 0, 1, 2
- Kilometers: 0, 1, 2
## Resources Estimates

### Khanneshin Resources Calculation

<table>
<thead>
<tr>
<th>Area</th>
<th>LREE Grade</th>
<th>MT REE Before Dilution REE</th>
<th>MTREEE after Dilution REE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concordant Veins and Seams (Dikes)</td>
<td>2.775</td>
<td>6.058</td>
<td>0.606</td>
</tr>
<tr>
<td>Discordant Veins and Seams (Dikes)</td>
<td>3.282</td>
<td>-</td>
<td>0.507</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>-</td>
<td>1.113</td>
</tr>
</tbody>
</table>

### Areas of Enrichment

<table>
<thead>
<tr>
<th>Areas of Enrichment</th>
<th>REE Grade</th>
<th>Mt before 1/10 dilution</th>
<th>Mt before 1/10 dilution</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW Zone</td>
<td>2.775</td>
<td>5.807</td>
<td>0.581</td>
</tr>
<tr>
<td>Within Zone of Enrichment</td>
<td>2.775</td>
<td>5.966</td>
<td>0.597</td>
</tr>
<tr>
<td>Total Remote Sensing</td>
<td></td>
<td></td>
<td>1.178</td>
</tr>
</tbody>
</table>
Remote Sensing Data
Sedimentary Copper

Aynak Copper
Major Porphyry Cu-Mo Discovery
Cu-Mo Mineralization
Tin and Tungsten

Legend
- Red: Prospective
- Orange: Favorable
- Yellow: Permissive
- Gray: Non-permissive
Bauxite (Aluminum)
Barite
Lead and Zinc
Volcanogenic Massive Sulfide
Graphite Disseminated
Graphite Microcrystalline
Pegmatites with Nb, Ta, Be and Li
Lithium in Salars
Li in Ghazni Salars

Nawar Lithium Salar

Scale 1:1,000,000
Marble
Afghan Marble Varieties

- 34 Colors
- 40 varieties
- Billion tons Resources
Bamyan Granite

32 B m³
**Limestone and Marl for Cement**

<table>
<thead>
<tr>
<th>Chemical Composition</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaCO₃</td>
<td>97.25</td>
</tr>
<tr>
<td>SiO₂</td>
<td>0.65</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>1.27</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.88</td>
</tr>
<tr>
<td>CaO</td>
<td>56</td>
</tr>
<tr>
<td>Mg</td>
<td>0.25</td>
</tr>
<tr>
<td>SO₃</td>
<td>0</td>
</tr>
</tbody>
</table>

**Aybak**
Sand and Gravel
Oil, Gas, Coal, Lignite, and Peat
Oil and Gas Resources

- Two proven basin
  - Afghan-Tajik Basin
  - Amu Darya Basin
- Three potential Basins
  - Katawaz Basin
  - Helmand Basin
  - Herat Basin
- Most of these basins are filled with several Km of sediments an ideal geological setting for hydrocarbon generation
Estimates have increased the oil resources by 23 times and more than tripled the natural gas resources.

Undiscovered gas reserves range from 3.58 to 36.46 trillion cubic feet (cf) with a mean of 15.69 trillion cf.

Undiscovered oil reserves range from 391 million barrels to 3.56 billion barrels with a mean of 1.60 billion barrels.

Undiscovered liquid gas condensate reserves range from 126 million barrels to 1.33 billion barrels with a mean of 562 million barrels.
监督世界一流的阿扬克铜矿开采合同，资本支出，50亿美元，35公里东南于喀布尔。生产将在2年内开始。该项目将为国家带来数亿美元的收益。

世界一流的哈吉加克铁矿，288亿美元，原地价值，20000个就业岗位，130公里西于喀布尔。招标工作正在进行。在哈吉加克附近还有几个其他前景较好的矿床，可延长其生产和量。

Syada铁矿，140公里西于哈吉加克，500百万吨估计资源。

阿穆达里河的金矿。

北方阿富汗的石油和天然气开发。

评估潜在的地区，用于辉铜矿、金、钼和水泥原料。
Large Mining Projects Require

- Railroad and highways for export of ore, ore concentrate or final metal products (copper, steel, construction materials, and import of machinery and equipment)
- Access roads
- Power supply (hydro, coal fired, or gas fired)
- Water supply (for industrial and domestic needs)
- Community development projects: hospitals, schools, shopping centres, etc
- Most of the coal, iron, and other mineral reserves occur in Central Afghanistan
MAJOR ROAD DEVELOPMENTS

Completed Major Roads

Planned Road Construction

Ongoing Road Construction
MAJOR RAIL DEVELOPMENTS

Existing Rail

Proposed Rail (Asian Development Bank)

Proposed Rail (Aynak)

Hajigak Iron Ore

Aynak Copper

Proposed Rail to Charbahar
REGIONAL RAIL NETWORKS
Baseline Power Needs

- To develop the vast mineral resources of Afghanistan, tremendous amounts of electric power is needed.

- A chemical plant cannot afford to have power interruptions, because forced startup and shutdowns can result in enormous product losses, considerable financial losses and significant environmental pollution.

- A stable and reliable base-load power supply is needed.

- The coal resources of Central Afghanistan or the natural gas from Amu-Darya Basin can be used as a reliable fuel source for large electric generation plants to meet the need of the mining projects. In addition, it would create thousands of additional jobs.

- More exploration is needed to commercialize these resources.
ELECTRIC POWER LINES

Northern Electrical Power Lines
Regulatory Framework

- Guarantee of tenure from exploration to exploitation
- Royalty regime in line with international standards
- Simplified licensing process
- Guaranteed profit repatriation
- Clear and transparent dispute resolution mechanisms
- Commitment to transparency in awarding contracts (EITI)
Mineral and HC Bid Prioritization

Bids are prioritized based on:

1. Technical capacity
2. Financial strength
3. Revenue to the government
4. Level of Socio-economic benefit to the people
5. Dimension of newly built infrastructures
6. Stringency of socio-environmental commitments
According to the law, companies that are engaged in a mining contract with the government of Afghanistan, pay the following taxes:

- Royalty from the gross product
- Surface usage fee
- Income Tax around 20%
Duration of Mining Contracts

- 30 years for large projects
  - Can be extended every five years until reserves completely exhausted
- 10 years for small mines
  - Can be extended every five years
Security of Investment

- The Constitution and the Minerals Law of Afghanistan provide the following:
- The government guaranties that the private investment is not nationalized
Thanks