Overview on China’s Rare Earth Industry Restructuring and Regulation Reform

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1. Major Issues: *Why important?*
2. Rare Earths Industry Restructuring: *How?*
3. Regulation Effects: *What about?*
1 Major Issues
Rare Earth Elements (REEs): 17 elements

Light REEs

Middle REEs

Heavy REEs

15 elements

+ Scandium

Yttrium
Resources dilemma: Dominance of China’s supply

China accounts for less than $\frac{1}{3} \sim \frac{1}{2}$ of rare earths reserves in the world total!

The reserves of China’s REEs sharply decreased from 2003 to 2009 then increased slightly in 2010 and remained at 55,000 tons over last 5 years!

It is forecasted that the reserves of China’s REEs will be depleted in next 20 years!

China started to provide a large amount of REEs to the world since the middle 1980s.
At least 95% of all rare earths output currently originate from China.
Economic impact: Fluctuation of REEs price change

Upside down relationship between REEs export and price fluctuation since 1979 in China
Environmental and ecological Issue

Extensively mining and seriously waste of resources: three major models of REEs mining technologies in the Southern China

1. Pool Leaching
2. Dump Leaching
3. In-situ Leaching
In-situ leaching map of rare earth deposits in weathered crust of Southern China
In-situ leaching solution

Liquid collecting groove by in-situ leaching of rare earth deposits in weathered crust
The ecological destruction of vegetation, soil erosion, waste emissions
Environmental pollution as a result of REEs processing
## Comparisons of three major models of REEs mining technologies in the Southern China

<table>
<thead>
<tr>
<th>Mining Models</th>
<th>Process Flow Chart</th>
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<tbody>
<tr>
<td><strong>Pool Leaching</strong></td>
<td>Topsoil stripping → Extracting ores → Start leaching → Precipitation → Burning → Acid dissolution → Precipitation → Burning → Oxidation of rare earth</td>
</tr>
<tr>
<td><strong>Dump Leaching</strong></td>
<td>Topsoil stripping → Extracting ores → Leaching in tank → Precipitation → Filtering → Burning → Oxidation of rare earth</td>
</tr>
<tr>
<td><strong>In-situ Leaching</strong></td>
<td>Dividing mining field → Tunnels building → Infusion leaching → Purifying → Precipitation → Filtering → Rare earth carbonate</td>
</tr>
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<table>
<thead>
<tr>
<th>Mining Models</th>
<th>Environment Destruction</th>
<th>Applicability</th>
<th>Resource Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool Leaching</td>
<td>Large</td>
<td>General application</td>
<td>Less than 50%</td>
</tr>
<tr>
<td>Dump Leaching</td>
<td>Large</td>
<td>General application</td>
<td>Less than 50%</td>
</tr>
<tr>
<td>In-situ Leaching</td>
<td>Small</td>
<td>The treatment effect is not ideal for the complicated ore body in geological conditions</td>
<td>More than 75%</td>
</tr>
<tr>
<td>Mining Models</td>
<td>Extraction Efficiency</td>
<td>Technology</td>
<td>Production Costs</td>
</tr>
<tr>
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<td>------------------</td>
</tr>
<tr>
<td>Pool Leaching</td>
<td>Low</td>
<td>Simple</td>
<td>High</td>
</tr>
<tr>
<td>Dump Leaching</td>
<td>Low</td>
<td>Simple</td>
<td>High</td>
</tr>
<tr>
<td>In-situ Leaching</td>
<td>More than 70%</td>
<td>Complex</td>
<td>Low</td>
</tr>
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</table>
International trade issue: Export disorder and weak supervision
Trade flows of one very important rare metal – Neodymium

Global demand for rare earth materials such as lanthanum and neodymium was and will be surging as the world’s green energy technology developed and appetite for hybrid cars, wind turbines and ever-faster phones with better screens increased.

2 Rare Earths Industry Restructuring
The Chinese rare earth industry has formed three major bases and two production systems of rare earths, strongly relying on the core area of rare earth resources, including:

- **three Bases:**
  - the north production base of rare earth dominated by Baotou
  - the medium- and heavy- rare earth production base in Jiangxi and other seven provinces in South China;
  - the production base of bastnaesite in Mianning of Sichuan.

- **Two systems:**
  - the northern light rare earths process system
  - the southern medium- and heavy- rare earths producing system

**Geographical distribution of REEs resources in China**
Institutional Conflicts: a ‘double-leadership' (central and local) and the independent line of management on REEs in China
Progress in restructuring

- **National Level:** constructed 6 comprehensive public technology service platforms, a number of high-end materials and devices projects. It is predicted that all rare earths enterprises will be controlled less than 20 within next few years by ways of asset reorganization and merger integration.
- **Regional Level:** some provinces (region) like Inner Mongolia, Guangdong, Jiangxi, Fujian and others have basically completed integrations of rare earth mining, smelting and separation enterprise within their areas and formed large scale enterprise groups of REEs.
- **Enterprise Level:** “1+5” giant state-owned enterprises like Baotou, plus China Minmetals, China Aluminium Corp (also known as Chinalco) and others have intensified structural adjustment and enhanced their industrial scale and comprehensive strength.
Major Impacts

- International trade dispute over China's exports of raw materials since March 2012
- Illegally and unplanned production has occurred frequently over China
- Excess capacity of rare earth smelting and separation is also relatively prominent
- Illegal activities of rare earth production and circulation are difficult to cure as a result of unhealthy laws and regulations
Historic rare earth policy evolution

• Since 1978 China has established the leading group or national office associated with the rare earth industry, though different names were used for different subsidiaries at different stages.
• In the past six-run reforms of government institutions under the State Council, management functions for the rare earth industry have always been reserved.
• Since the mid-1980s three development stages:
  ✓ The first stage (1985 – 1998), taking the policy of ‘open production and open supply’
  ✓ The second stage (1998 -2005), taking the policy of ‘limit low but encourage high quality of rare earths export’
  ✓ The third stage (2005 – present), taking the policy of ‘comprehensive rare earth new deal’
## Current rare earth policies

<table>
<thead>
<tr>
<th>Date</th>
<th>Policy Name</th>
<th>Organization/Committee</th>
<th>Policy Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-2014</td>
<td>(1) Export Quotas</td>
<td>Ministry of Land and Resources (MLR)</td>
<td>Protect and rationally utilize domestic rare earths while mitigating environmental damage</td>
</tr>
<tr>
<td>1980-2014</td>
<td>(2) Environmental Laws: (i.e., Rare Earth Industry Pollutant Discharge Standards)</td>
<td>Ministry of Environmental Protection (MEP)</td>
<td>Coordinate rare earth development and utilization with environmental protection</td>
</tr>
<tr>
<td>2006-2014</td>
<td>(3) Export Licenses</td>
<td>Ministry of Commerce (MOC)</td>
<td>Enhance domestic revenues by limiting joint venture licenses; maintain stricter environmental standards</td>
</tr>
<tr>
<td>2007-2014</td>
<td>(4) Export Duties</td>
<td>Ministry of Commerce (MOC)</td>
<td>Manage and control the variety and quantity of rare earth products leaving China</td>
</tr>
<tr>
<td>2002-2014</td>
<td>(5) Technology for Resources</td>
<td>National Development and Reform Commission (NDRC)</td>
<td>Expand China’s rare earth industry to the more elaborate processing sectors</td>
</tr>
<tr>
<td>2009-2014</td>
<td>(6) Industry Consolidation: (i.e., Plans for Developing the Rare Earth Industry 2009-2015)</td>
<td>Ministry of Land and Resources (MLR)</td>
<td>Establish three rare earth production districts and two production systems; create a unified front for the entire Chinese rare earth industry</td>
</tr>
<tr>
<td>2008-2014</td>
<td>(7) Stockpiling</td>
<td>Rare Earth High-Tech Zone Management Committee</td>
<td>Regulate rare earths pricing and help ensure future supplies</td>
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### China’s REEs Export Quotas in 2009-2014 (metric tons)

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<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Batch</strong></td>
<td>21728.1</td>
<td>22283</td>
<td>14446</td>
<td>21226</td>
<td>15499</td>
<td>15110</td>
</tr>
<tr>
<td><strong>Second Batch</strong></td>
<td>26427</td>
<td>7976</td>
<td>15738</td>
<td>9770</td>
<td>15502</td>
<td>15500</td>
</tr>
<tr>
<td><strong>Supplement</strong></td>
<td>1990</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>50145.1</td>
<td>30259</td>
<td>30184</td>
<td>30996</td>
<td>31001</td>
<td>30610</td>
</tr>
</tbody>
</table>
3 Regulation Effects
Implications for small-scale REEs mining

• The current policy adjustment of rare earth industry in China is a serious challenge to regulate small-scale rare earths mines and is not objectively favourable to the development of private and small-scale rare earths enterprises

• Some extremely impact may be arisen for small-scale REEs mining in China
  ✓ a high pressure situation against illegal rare earths ASMs will be always maintained
  ✓ the formation of large-scale rare earth conglomerates will be accelerated in the near future
  ✓ the management on key sections in whole rare earths industry will be reinforced
  ✓ the Chinese government will actively support technological innovation and the development of rare earths application industry
  ✓ some rare earths laws and regulations will be greatly improved
Regulations that have delivered the restructuring

- Although a series of reforms on the rare earths industry in China have been made over recent years, some regulations that have delivered the restructuring are more or less at work.
- Some new changes and difficulties are as below:
  - the rare earth export quotas seem to be failure
  - the formation of “one plus five” large-scale rare earths groups has been promoting difficultly
  - the new environmental protection verification was developed for all rare earth enterprises
  - the minimum required indicators for three rates of rare earths resources development and utilization was implemented in China

### Indicators of opencast recovery rates of rock ore type REEs mining

<table>
<thead>
<tr>
<th>Ore-body thickness (m)</th>
<th>Mining recovery rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin ore body</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Medium thickness ore body</td>
<td>5 ≤H≤15</td>
</tr>
<tr>
<td>Thick ore body</td>
<td>H ≥ 15</td>
</tr>
</tbody>
</table>
The most recent revision of the Mineral Resources Law of People’s Republic of China started in 2002 but has been progressing slowly. Up to date, this new round of China’s mineral law revision has been in suspense either in the government agenda or academic disputes.

Some changes in mineral resource law revision will be comprehensively amended. It aims to improve the mining by enhancing mineral resource management, implementing a methodical science-based mining strategy, improving the Chinese mining investment environment, and realizing more sustainable development in mining.

The scope of new legislation will include public welfare and commercial mineral explorations and mining production, environmental protection, the marketing, import and export of mineral products.

Other establishments in terms of health and safety, labor and local development will be referenced to related laws and regulations.
Closing Remarks
Significances and Regulations in general

• China has supplied at least 95% demand of REEs to the world just by less than half of its REEs reserves over past decade!
• Future regulation will definitely aim to consolidate, focus, and improve a unified management system for its mineral resources, by establishing a classified and hierarchical management system for mineral resources, a strong mineral resource property system and a comprehensive environmental protection system for all mines around China.
• It also seeks to improve the legal system for mineral resource planning, the reserve management system for mineral resources, the management system for lands designated for mining, the management system for ASM.
Regulations Perspectives in particular with REEs industry

• Although the new draft law for ASM was still under open discussion in 2014, the majority of the above objectives are likely to be fully integrated in the year-end finished revision.
• China will definitely continue to adjust and improve the management system for exploration and mining of REEs resources and for managing mining taxes, fees and economic benefit, and clarify legal responsibilities of all stakeholders towards sustainable development of rare earth minerals industry in China.
• To what content and what parts of provisions should be included in the revised laws and regulations with particular reference to rare earths ASM and potential implementation at local level remain to be looked forward to and observed in the near future.
Thank you!

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