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Rare earth elements in China: Policies and narratives of reinventing an industry

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ABSTRACT

After top producer China decided in 2010 to tighten its export quotas for rare earth elements (REE), major customers feared being cut off from the valuable metals. The trade dispute intensified when the EU, the USA, and Japan brought the case before the WTO. The export controls raise questions about China's intentions and strategies. This article argues that China's export policy should not be viewed in isolation. The export controls are embedded in a greater transformation of the strategic REE industry. Beijing promotes a broad set of policies, including industry reorganization, resource conservation, and environmental protection. Next, the article examines three narratives that may be constitutive of the Chinese policy. Findings indicate that the geopolitical narrative, which sees natural resources as instruments of power politics, can be only partly attributed to China's REE policies. The major driving motives are domestic concerns for resource conservation and environmental protection, as well as the development of competitive downstream industries.

Global production and consumption of rare earth elements

Rare earth elements (REE) are, contrary to the name, relatively abundant in the earth's crust. This group of 17 metals is commonly divided into light REE (LREE) and heavy REE (HREE).[1] The LREE cerium is nearly as abundant as copper. Lanthanum and neodymium are quite common as well. HREE such as dysprosium and terbium are less common, but even the rarest ones occur more often than gold and silver. Only natural promethium does not exist on the earth (Webelements, 2011).

Because of the low ore grade of most REE deposits and the complexity of separation, extraction is profitable in only a few locations, mostly as a by-product of mining another metal (Gupta and Krishnamurthy, 2005). There are currently 110 million tons of global REE reserves, with valuable deposits distributed over the globe. Half of these reserves are located in China; Russia accounts for 17.3 percent of global reserves and the United States for 11.8 percent. Sizeable deposits are also found in Brazil, India, Australia, Canada, and Greenland. The most commonly mined rare earth minerals are bastnäsite, monazite, and xenotime, with an average rare earth oxide (REO) content of 75, 65, and 61 percent, respectively.

Despite their global distribution, REE are mined mainly in China. China produced 95,000 t REE in 2011, down from 129,000 t in 2009. China's share of global production decreased from 95 percent in 2009 to 86 percent in 2012 (Tse, 2013). China has a near monopoly on the production of REE minerals, concentrates, and metals (Levkowitz and Beauchamp-Mustafaga, 2010).

REE are essential raw materials for a range of products. Thanks to innovations in the latter half of the 20th century, global production has tripled since 1985. One fifth of REE being mined is currently used for permanent magnets, 8 percent for phosphors, 19 percent for chemical catalysts, 20 percent for alloys, 13 percent for polishing, and 8 percent for glass (Kingsnorth, 2012). These products have end-use applications in electronics, environmental and energy technology, metallurgy, military technology and many other fields (Grasso, 2012).

For instance, neodymium-iron-boron permanent magnets (NdFeB) make possible compact computer hard drives and highly efficient generators and engines in wind turbines and electric vehicles. REE used in magnetostrictive materials allow ultra-sensitive sonars for military applications. REE-based phosphors are used in making more efficient and stable energy-saving bulbs. Although employed in only small quantities, REE significantly improve product performance (BGS (British Geological Service), 2011).

In 2011, 68 percent of the REE mined in China was used in the country. Japan and North East Asia consumed 16 percent, the USA 10 percent, and others 6 percent. China dominates all immediate

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[1] REE have similar physicochemical characteristics. They include the lanthanides plus yttrium and scandium. Lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium and gadolinium are referred to as LREE or the cerium group. Terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, and yttrium are referred to as HREE or the yttrium group. Chinese sources also distinguish europium, gadolinium, terbium, and dysprosium as middle rare earths.

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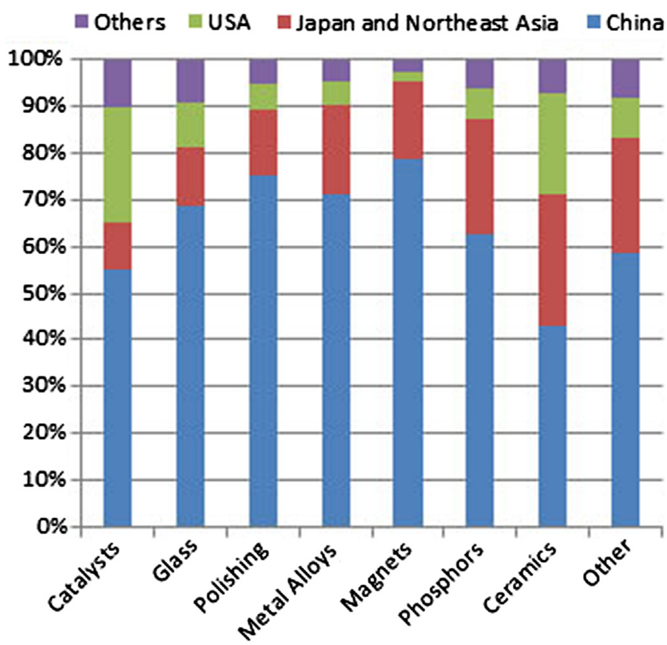

Fig. 1. consumption of REE elements by country, various downstream industries. *Source*: Kingsnorth, 2012.

downstream industries in terms of quantity (see Fig. 1) (Kingsnorth, 2012). However, its downstream industries focus on low-end products, whereas foreign industries, Japanese in particular, dominate the high-end segment.

Research interest

Due to the Chinese near monopoly on REE production and processing, downstream production around the global is critically dependent on Chinese supply. This is becoming problematic since China is less and less interested in exporting its REE, and has been decreasing its exports. Its 2010 decision to cut the REE export quota by another 40 percent triggered serious concerns among its major customers, the European Union (EU), Japan and the USA, who requested consultations within the World Trade Organization (WTO) in March 2012 (WTO, 2012).

These trade tensions are emerging in the context of growing disquiet over instable resource supply in the West. Rising resource prices, a discourse of impending scarcity, environmental degradation, and political decisions in source countries have led many importing countries to put resource supply at the top of the agenda and formulate raw material strategies. The REE symbolize the new concern for a whole range of critical raw materials (DOE, 2011; European Commission, 2010). Why is China controlling its exports? Understanding the intentions behind China's political choices is central to Western economies and governments, as they will have to rely on China for supplies for several critical raw materials at least for some time.

The concern for critical raw materials is nothing new. "Criticality studies," centering on the identification of critical materials and risks, echo similar issues in the 1970s and 1980s (Buijs and Siverers, 2011; Buijs et al., 2012). A limitation of these approaches is that they analyze critical materials mainly from the angle of affordable and undisrupted supply for the importing countries, sidelining the efforts made by originating countries for resource and environmental protection and social policies.

Several OECD and WTO studies on the adoption of export controls for raw materials in various countries argue that export barriers to raw materials lead to adverse economic impacts. They found that resource conservation and environmental protection are frequent source-country explanations for applying export controls (OECD, 2010; Fliess and Mård, 2012; Ruta and Venables, 2012). Many studies deal with China's REE export controls and their impacts on Western downstream industries (see for example Massari and Ruberti, 2013; Humphries, 2012; Morrison and Tang, 2012; Levkowitz and Beauchamp-Mustafaga, 2010; Grasso, 2012).

This perspective, although important, underemphasizes the Chinese regulation of the REE industry beyond the actual export controls. Some Western authors have examined the Chinese REE industry more thoroughly, and there are many Chinese analyses of the domestic situation (Hurst, 2010; Seaman, 2010; Öko-Institut, 2011; Su, 2009; Wang, 2011a). This article seeks to contribute to these analyses by providing an up-to-date and in-depth view of the political actors, current regulatory measures, and domestic narratives in China's REE industry. This perspective links into the literature on industry policy and regulation in China, which looks into the intentions and instruments of government intervention in China's strategic industries (Hsueh, 2011).

First, I show that China's policies extend well beyond export regulation, involving industry reorganization, resource conservation, and environmental protection as well. The country's mining industries in general are currently in a process of transformation (Tse, 2012). Second, to answer the research question about the intentions behind Beijing's REE policy, I bring in three narratives that may be constitutive of this transformation. The assumption is that these narratives provide the contexts in which the central government formulates its interests and decides on policies. Therefore, the empirical analysis and discussion of these narratives focuses on textual statements of the central government and other relevant stakeholders, including experts participating in policy-making, industry leaders, local government represents, and media reports. The findings indicate that the geopolitical narrative is partially spread in Chinese society, but informs policy only to a limited degree (Hao and Liu, 2011). Domestic dynamics – including resource conservation, environmental protection, and development of downstream industries – dominate discourse and policy. As the focus here is on Chinese domestic politics, I do not consider the development of REE mines, policies, or downstream industries outside China and China's interaction with consumer states.

Changing REE politics in China

A resource giant in chaos

China's economic modernization is a history of rampant resource extraction. China now ranks first in the world in the production and consumption of various resources, among them coal and iron ore (USGS, 2012). The Chinese REE era began when the country's biggest mine at Baiyun E'bo in the Autonomous Region of Inner Mongolia started production in 1959, and three refining factories began production in the early 1960s. However, production was expensive and the quality lagged behind leading producers, the USA in particular. The "National Conference for the Promotion of Rare Earth Application" in 1975 noted that China's backward REE industry "even had to import flints," which use mischmetal (Cui and Liang, 1975, no pagination). Chemist Xu Guangxian's invention of a cheaper method for separating single REE enabled Chinese separation plants to achieve high-quality production capacity of 10,000 t in the early 1980s (Wang, 2011a; Shuai, 2011).

By the mid-1990s, China surpassed the USA as the world largest producer of REE (USGS, 2002) (see Fig. 2). Due to environmental problems with several spills from a waste pipeline and cheap