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Pentagon Loses Control of Bombs to China Metal Monopoly

By Peter Robison and Gopal Ratnam - Sep 30, 2010 8:49 AM ET

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Workers handle neodymium ingots before they are crushed at Neo Material Technologies Inc.'s Magnequench Tianjin Co. factory in Tianjin, China. Photographer: Doug Kanter/Bloomberg

A senior manager at a company that churns out metals routinely used in U.S. smart bombs pauses in mid-sentence when his phone rings: a Wall Street stockbroker looking for information. He makes a note to have an assistant call back -- someone who is fluent in English, not just Chinese.

"It's a seller's market now," says [Bai Baosheng](#), 43, puffing a cigarette in his office in Baotou, China, where his company sells bags of powder containing a metallic element known as neodymium, vital in tiny magnets that direct the fins of bombs dropped by U.S. Air Force jets in Afghanistan.

A generation after Chinese leader [Deng Xiaoping](#) made mastering neodymium and 16 other elements known as rare earths a priority, China dominates the market, with far-reaching effects ranging from global trade friction to U.S. job losses and threats to national security.

The U.S. handed its main economic rival power to dictate access to these building blocks of modern weapons by ceding control of prices and supply, according to dozens of interviews with industry executives, congressional leaders and policy experts. China in July reduced rare-earth export quotas for the rest of the year by 72 percent, sending prices up more than sixfold for some elements.

Military officials are only now conducting an inventory of where and how U.S. suppliers use the obscure but essential substances -- including those that silence the whoosh of Boeing Co. helicopter blades, direct Raytheon Co. missiles and target guns in General Dynamics Corp. tanks.

Warning Signs

"The Pentagon has been incredibly negligent," said Peter Leitner, who was a senior strategic trade adviser at the Defense Department from 1986 to 2007. "There are plenty of early warning signs that China will use its leverage over these materials as a weapon."

China may already be flexing its muscles amid a diplomatic spat with its East Asian neighbor Japan. China last week imposed a "de facto" ban on exports to Japan of the metals used in liquid crystal displays and laptop computers, Japanese Economy Minister [Banri Kaieda](#) said Sept. 28. That followed Japan's detention of a Chinese fishing boat captain whose ship collided with two Japanese Coast Guard vessels. Japan later released the man.

No such ban exists, China's Ministry of Commerce spokesman [Chen Rongkai](#) said.

New Factor

"What it does, clearly, is bring a new factor into the consideration of supply of critical materials," said [Dudley Kingsnorth](#), director of Industrial Minerals Co. of Australia, a forecaster in Perth.

The U.S. Congress's investigative arm, the Government

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April 14 (Bloomberg) -- The U.S. military depends on China for the metals required to build smart bombs, night-vision goggles and naval radar, according to a report from the Government Accountability Office. Bloomberg's Lindsey Arent reports. (Source: Bloomberg)

Chart: [In China, No Stone Unturned](#): [Graphic](#)



"Because export quotas are limited, we basically can choose our clients; we are no longer compelled to sell to just about anybody who comes knocking," said Bai Baosheng, who handles investor relations for Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Co. Photographer: Nelson Ching/Bloomberg



Annealed neodymium iron boron magnets sit in a barrel prior to being crushed into powder at Neo Material Technologies Inc.'s Magnequench Tianjin Co. factory in Tianjin, China. Photographer: Doug Kanter/Bloomberg



The research facility at Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Co. Photographer: Nelson Ching/Bloomberg

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Samples of various rare earth compounds are displayed in the showroom at Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Co. Photographer: Nelson Ching/Bloomberg



Motors in missiles like the JDAM might be three times as big without advanced magnets. The JDAM has been used extensively in Iraq and Afghanistan. Photographer: Philip A. McDaniel/U.S. Navy via Bloomberg



An open pit mine in Nevada owned by Molycorp, which plans to mine almost 20,000 tons of rare earths annually by late 2012 but doesn't yet have the capacity to refine the raw elements into metals. Photographer: Jacob Kepler/Bloomberg



Kathy DeFries, co-owner of Excel Machine Technologies and owner of Coco's Canine Cabana, attends to dogs in her doggie daycare facility in Valparaiso, Indiana. The facility occupies a portion of an Excel plant that used to make 80 percent of the rare earth magnets in laser-guided U.S. smart bombs. Photographer: John Zich/Bloomberg



Kathy DeFries, co-owner of Excel Machine Technologies Inc., next to drill presses on Excel's shop floor in Valparaiso, Indiana. Photographer: John Zich/Bloomberg



A quote by former Chinese Leader Deng Xiaoping, which reads, "The Middle East has oil, and China has rare earths" on the wall at Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Co. in China. Photographer: Nelson Ching/Bloomberg



Samarium-cobalt magnets of different strengths, left, and a defense component with mounted magnets are arranged for a photo at the Electron Energy Corp. factory in Landsville, Pennsylvania. Photographer: Gopal Ratnam/Bloomberg

Accountability Office, in April warned of "vulnerabilities" for the military because of the lack of domestic rare-earth supplies. The House of Representatives Armed Services Committee will hold a hearing in October, the same month a Pentagon report on how to secure future supplies of the metals is due.

"The department has long recognized that rare-earth elements are important raw material inputs for many defense systems and that many companies in our base have expressed concern regarding the future availability of the refined products of these elements," Brett Lambert, director of the Pentagon's Office of Industrial Policy, said.

While two rare-earth projects are scheduled to ramp up production by the end of 2012 -- one owned by Molycorp Inc. in California and another by Lynas Corp. in Australia -- the GAO says it may take 15 years to rebuild a U.S. manufacturing supply chain. China makes virtually all the metals refined from rare earths, the agency says. The elements are also needed for hybrid-electric cars and wind turbines, one reason supply may fall short of demand in 2014 even with the new mines, according to Kingsnorth of Imcoa.

Doggy Day Care

Just how far U.S. manufacturing has waned is apparent at a factory in Valparaiso, Indiana, where dogs skitter across a bare concrete shop floor, their nails clicking. This brick plant on Elm Street once made 80 percent of the rare-earth magnets in laser-guided U.S. smart bombs, according to U.S. Senator Evan Bayh, a Democrat from Indiana. In 2003, the plant's owner shifted work to China, costing 230 jobs.

Now the plant houses Coco's Canine Cabana, a doggy day care the current tenants started to supplement sagging income from their machine shop. On most days dogs outnumber the 15 metalworkers, said Kathy DeFries, co-owner of Excel Machine Technologies Inc.

"When things got slow for manufacturing, we had this big empty shop floor," said DeFries, nuzzling a floppy-eared puppy. "It's a great stress reliever."

Expensive to Mine

The rare earths are chemically similar elements, with names such as yttrium and dysprosium. China has the largest share of worldwide reserves, about 36 percent, and the U.S. is second, with 13 percent, the U.S. Geological Survey says. While the elements aren't rare, they're less frequently found in profitable concentrations, expensive for Western producers to extract and often laced with radioactive elements.

China produced 120,000 tons, or 97 percent, of the world's 124,000-ton supply last year, according to the GAO. Half of that came from Baotou, said Kingsnorth. The raw elements have many applications. Neodymium is used by Chinese companies including magnet makers, who sell to U.S. suppliers of defense contractors.

Export Quotas

Export quotas and taxes for overseas buyers that the GAO says can reach 25 percent are pushing up prices of elements even in relatively large supply. For example, the cost of a kilogram of samarium powder, needed for the navigation system of General Dynamics' M1A2 Abrams tank, jumped to \$34 in early September, from \$4.50 in June, according to U.K. researcher Metal Pages Ltd.

The U.S. and the European Union consider Chinese restrictions on a range of raw goods part of a strategy to draw in higher-paying manufacturing jobs by making them cheaper to buy inside China. The export taxes violate World Trade Organization

rules because China pledged to limit them to 84 product categories when it joined the trade group in 2001, said Terence Stewart, managing partner of Washington law firm Stewart &

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Stewart. In 2010, China had taxes on 329, he said.

The U.S. and the EU filed a WTO [complaint](#) over raw materials including bauxite and coke last year. China's commerce minister, [Chen Deming](#), said Aug. 28 that the policies comply with WTO rules.

Some manufacturers in China are lobbying the ministry to back off the latest quotas because a dispute will disrupt the market, said [Constantine Karayannopoulos](#), chief executive officer of Toronto-based Neo Material Technologies Inc., which has rare-earth production facilities in China.

Risk of Trade War

"It was very sudden and didn't give the industry any time to adjust," he said. "This quota action could risk a trade war."

For Western companies, China's policies are creating the real "unobtainium," the fictional mineral fought over in [James Cameron's](#) 2009 film "Avatar."

It's taking as long as 10 weeks to get neodymium magnets, double the previous wait time, said Joe Schrantz, group supply chain manager at Moog Inc. in East Aurora, New York. He said the company buys hundreds of thousands of magnets a year to make motors for cars, trucks and weapons including Raytheon's AMRAAM -- or Advanced Medium-Range Air-to-Air Missile -- and Boeing's Joint Direct Attack Munition, a tail fin kit for making precision-guided "smart" bombs out of ordinary weapons.

Rising Prices

Rising neodymium prices are forcing up the price of magnets, which typically cost between \$2 and \$30 apiece. That's having a "significant" effect on profit, and suppliers say costs will keep going up, Schrantz said. The company is considering buying blocks of raw material and storing it.

"If everybody does that, then it's going to get really crazy," he said.

Neodymium, a silvery metal, is essential in a magnetic alloy [developed](#) separately by engineers at General Motors Co. in Detroit and Sumitomo Special Metals Co. in Japan in the 1980s. The magnets are now in millions of stereo speakers, computer disk drives and motors.

In missiles, they [replace](#) a hydraulic system of pumps and fluids that was costlier and heavier. Motors in weapons like the JDAM might be three times as big without advanced magnets, said Todd Brewster, senior design engineer at Kollmorgen, a unit of Washington-based Danaher Corp. The JDAM has been used extensively in Iraq and Afghanistan.

Hybrid-Electric Motors

A Chinese supplier makes neodymium magnets for hybrid- electric motors the Navy is developing to cut fuel use of Arleigh Burke-class [destroyers](#), according to the GAO. The agency also says Lockheed Martin Corp.'s [SPY-1 radar](#) on Aegis destroyers contains samarium-cobalt magnets that will need to be replaced over 35 years. China is virtually the only supplier of yttrium needed for laser gun sights in the General Dynamics Abrams tank, the U.S. Geological Survey says.

"It's amazing how this issue seems to have caught the country off guard," said U.S. Representative [Mike Coffman](#), a Colorado Republican who was a U.S. Marine Corps infantry officer. He noted that China's capabilities have expanded significantly since 2001, when the U.S. Army canceled plans to buy Chinese-made berets under pressure from Congress. "How ironic is that we were concerned about berets?"

[Jon Kastle](#), a spokesman for Raytheon of Waltham, Massachusetts, said his company hasn't experienced supply shortages. Spokesmen for Bethesda, Maryland-based Lockheed Martin; General Dynamics, of Falls Church, Virginia; and Chicago-based Boeing declined to comment. "There is a particular need to focus on rare-earth minerals," said [Alexis Allen](#), spokeswoman for the Aerospace Industries Association, an Arlington, Virginia-based lobby group for defense contractors. "The Department of Defense should consider many alternatives to reliable access."

Stockpile

One option is to stockpile the metals with allies. Since 1994 the Pentagon has sold off excess raw materials for \$7 billion.

Another is subsidies of U.S. manufacturing. The U.S. House of Representatives approved yesterday a proposal by Representative [Kathy Dahlkemper](#), a Pennsylvania Democrat, that would set up a research and development program at the Department of Energy to help U.S. rare-earth manufacturers such as Molycorp with measures including loan guarantees. To become law the bill, which cleared the House on a 325-98 vote, must have a matching Senate version and be signed by the president. Currently there is no such measure.

While Molycorp plans to mine almost 20,000 tons of rare earths annually by late 2012, it doesn't

yet have the capacity to refine the raw elements into metals.

'No Substitute'

Complicating matters is that even the Pentagon has been unsure of its own needs. Stephen Luckowski, chief of materials manufacturing and prototype technology at the U.S. Army's [Picatinny Arsenal](#) in New Jersey, told participants at a February conference in Cleveland that it took him a month to learn that rare-earth metals are in the nose of the Excalibur missile, and he still wasn't certain of the exact supply route. Luckowski, a metallurgist, was sure the Army needed the rare earths. "That may be a case where you have no substitute," he said.

China's dominance in the materials comes as it scours the planet for resources to feed its economy, which is expanding more than 10 percent this year while the U.S. struggles with an almost 10 percent [unemployment rate](#). The country has been snapping up oilfields, buying copper mines and investing in wind power. China is also expanding its military, developing an aircraft carrier, nuclear-powered submarines and ballistic missiles, the Pentagon [said](#) in an August report.

Deng's Quotation

In the lobby of Bai's company, a unit of state-owned Baotou Iron & Steel Group Co., a now-famous 1992 quotation by Deng is emblazoned in pink marble. It reads: "The Middle East has oil, and China has rare earths." A May interview with Bai is regularly interrupted by calls from stockbrokers, analysts and fund managers looking to learn more about the company.

"Because export quotas are limited, we basically can choose our clients; we are no longer compelled to sell to just about anybody who comes knocking," said Bai, who handles investor relations for Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Co. The [shares](#) have more than doubled in the past year, reaching 72.72 yuan on Sept. 29, giving the company a market value of \$8.8 billion.

The company is especially proud of the samarium-cobalt magnets used in the Shenzhou 7 space capsule that lifted Chinese astronauts into space in 2008. They were developed at the nearby Baotou Research Institute of Rare Earths.

Environmental Costs

The export restrictions compensate for the heavy environmental toll, said Zhang Anwen, vice secretary of the Chinese Society of Rare Earths, a group of researchers in Beijing. "It's unfair for the U.S. to be pointing fingers at China now," he said. "To undo the damage done to the earth, we need to return the vegetation, increase water flow and treat the ground. It's an extremely costly repair."

Deng set China on its path with a 1986 initiative whose goals included acquisition of technology in "exotic materials" such as rare-earth metals, new energy compounds and high-capacity engineering plastics, according to a U.S. House of Representatives committee [report](#).

That year Zhu Weiheng, an electrical engineer at the Chinese Academy of Sciences, wrote a report to Chinese officials suggesting they control exports of rare-earth minerals because of their high value in manufacturing. Zhu had studied at the Massachusetts Institute of Technology in Cambridge, Massachusetts, and in 1965 designed a motor for China's first satellite, the East is Red. Later he spent part of Chinese leader [Mao Zedong's](#) Cultural Revolution under arrest as a suspected spy.

'Real Revolution'

By the early 1980s, Zhu was testing samples of neodymium iron boron, the alloy perfected by engineers at GM and Sumitomo. Two Chinese research institutes also developed it, said Zhu, 91. "It was a real revolution," he said.

In 1990, Zhang Hong, the Chinese academy's deputy director of technology, visited Magnequench, a GM unit in Indiana that used a spinning wheel to quench, or cool, the molten alloy into flakes to make magnets. Five years later, a group including then state-owned San Huan New Materials and Hightech Inc. agreed to buy Magnequench.

The Committee on Foreign Investment in the United States, a cross-agency [board](#) that reviews foreign takeover deals, allowed the purchase partly because the partners [agreed](#) to keep open facilities in the U.S.

Shipped to China

The company opened a new plant in Tianjin in 1998 and shut a former GM operation in Anderson, Indiana, four years later. Magnequench also purchased and later closed the factory in Valparaiso, where Kathy DeFries now boards dogs for \$5 an hour. That plant's tools were shipped to three San Huan operations in China, according to [Shannon Song](#), a Beijing-based executive at Magnequench.

"What they were basically doing was replicating the production lines in China," said Leitner, the

former Pentagon official.

Indiana's [Bayh](#) and [Hillary Clinton](#), now U.S. secretary of state, both cited Magnequench as an example of the U.S. losing jobs and expertise to China. In the 1990s a dozen U.S.-based suppliers of magnets employed 6,000 people. Today there are four, employing 500, said Ed Richardson, vice president of Thomas & Skinner Inc. in Indianapolis, one of the survivors.

Business Decision

The plant closures were a business decision after the technology bust in 2000 hurt sales, Song said. Most of the Valparaiso factory's business came from computer makers; defense was a minor share, she said. In 2001, labor costs in Anderson averaged \$7.32 per kilogram of neodymium powder on top of \$10.07 in direct production overhead, she estimates. In 2003 in Tianjin, labor costs were 16 cents and overhead \$3.20.

"It was a question of letting the ship sink or doing something to cut the operating cost," she said.

Toronto-based AMR Technologies Inc. bought Magnequench in 2005 and renamed the merged company Neo. The company's shares rose to C\$4.92 yesterday from as little as C\$1.05 in early 2009.

San Huan, now known as Beijing Zhong Ke San Huan High-Tech Co., went public in 2000. [Sales](#) have risen more than fourfold, from 371 million yuan that year to 1.6 billion yuan in 2009. The stock has almost tripled in the past year, reaching 17.14 yuan on Sept. 29.

God and Magnets

"God created the universe from nothing and organized it with the help of a magnet," the company declares on its website, in English and Chinese.

Shares of [Aluminum Corp. of China Ltd.](#) rose 18 percent over the past two days in Shanghai trading after its parent announced a plan to invest at least 10 billion yuan (\$1.5 billion) to build a rare earth production base in Jiangxi province with a local partner.

A group of U.S. investors led by Denver-based private equity firm Resource Capital Funds wants to challenge China's dominance by restoring the fortunes of Molycorp, the largest supplier of rare earths for much of the last century. Its mine, west of Las Vegas in California's Mojave Desert, shut eight years ago, under pressure from Chinese competitors and regulatory [scrutiny](#) of wastewater spills.

Molycorp, based near Denver, says it needs \$511 million to refurbish and expand. It raised \$379 million in its July share sale, and has applied for a \$280 million loan guarantee under a U.S. Department of Energy program for "innovative technologies." The shares have almost doubled, closing at \$26.73 yesterday from \$14 in July.

Joshua Trees

Costs of environmental compliance will be steep, Molycorp warns in a filing that says it spent \$3 million last year alone. Beyond a 300-foot-deep open pit, John Benfield, manager of quality assurance, points to a valley sheltering Joshua trees where slurry left after processing ore will be pumped and harden like concrete.

The trees, protected under California law, will be given new homes after their precise positions are measured with compasses. Their bark burns in the desert sun without the right orientation. Even so, only 20 percent of replanted trees survive, Benfield said.

The company will keep processing costs to \$1.26 per pound, half the average in China, by recycling more water and using a single acid to separate elements, said Mark Smith, Molycorp's CEO. Molycorp is also negotiating with potential partners to alloy metals and turn them into neodymium magnets in the U.S., creating as many as 900 jobs.

"It was a very, very strategic move that the Chinese made," he said. "They created a very, very large number of jobs for the citizens of China. We ought to be looking at executing that exact same strategy here in this country."

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