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Commissioners D'Amato and Blumenthal, thank you for inviting the U.S. Geological Survey (USGS) to speak today about the status and trends of China's production, consumption, and stockpiling of mineral resources. My name is David Menzie, I am the Chief of the Global Minerals Analysis section at the National Minerals Information Center (NMIC). The NMIC is part of the U.S. Geological Survey, the science agency of the Department of the Interior. Unlike the BLM, or the USDA Forest Service, the USGS does not regulate minerals resources in the United States. Rather, we provide unbiased, peer-reviewed science to those bureaus and to the public to inform decision making.

The USGS maintains a long tradition of Federal leadership in minerals information that predates the creation of the bureau in 1879. Congress first authorized the Treasury Department to collect statistical information on gold and silver mines in the Western United States. This responsibility expanded over time to include all types of minerals. The USGS is authorized to gather international minerals information, as well, and does so in collaboration with our various partners across government, academia, and the private sector.

More information on USGS work on minerals resources is available at minerals.usgs.gov.

China's Mineral Production

China is a prodigious producer of raw and processed mineral commodities as is shown in Table 1 (below). For many of the more than 80 mineral commodities tracked by the USGS, China ranks as the world's leading producer. In a number of cases, China is not only the leading producer, but dominates world production, producing more than 80 percent of such minerals as antimony, magnesium metal, rare earths, and tungsten. In addition, China produces between 50 percent and 80 percent of bismuth, germanium, indium, pig iron, mercury, silicon, fused alumina, barite, cement, fluorspar, natural graphite, lime, magnesium compounds, wollastonite, and natural zeolites.

Although China's production of raw minerals is large, its production of a number of processed minerals is even larger. The result is that China must import additional raw minerals to meet its domestic needs. For example, China produces significant amounts of bauxite but must import bauxite and alumina to achieve its production of aluminum. Similarly, China must import antimony, copper, lead, tungsten, and zinc ores and concentrates to meet its production needs for those metals. Perhaps most significantly, although China is the leading producer of iron ore, it must import nearly one-half of the iron ore that it requires for steel production.

Finally, China is not a significant producer of a number of minerals including chromium, niobium, platinum-group metals, rhenium, and selenium and, is dependent on imports of these minerals.

China's Mineral Consumption

Consumption of many mineral commodities increase as a country's economy develops. Consumption on a per capita basis tends to increase as income per capita increases. Consumption per capita generally plateaus as a country's economy matures (Menzie et al., 2005; Menzie and Tse, 2006).

Table 2 presents data on China's consumption of 10 mineral commodities including aluminum, cadmium, cement, refined copper, refined lead, salt, soda ash, finished steel products, refined tin, and refined zinc. These minerals represent a market basket of construction materials (cement), industrial minerals (salt and soda ash), and metals (copper, lead, steel, tin, and zinc). China's consumption of minerals began to increase in the early 1990s, and accelerated throughout that decade and the first half of the next decade. Since 2005, China's increase in consumption of some minerals has slowed. However, consumption of other minerals has continued unabated.

China's Mineral Policies

China's mineral policies are based in part on a white paper issued by the State Council in 2003. The policies put forth in the paper are based on the premise that the demand for mineral resources will continue to increase during the following 20 years. The paper suggested that China needs to strengthen its efforts in mineral prospecting, exploitation, and management. The paper also states a concern for protecting mineral resources and the implementation of a sustainable development strategy for protecting the country's mineral resources and balancing the exploitation of mineral resources and environmental protection. The Government would encourage investors to explore for bauxite, chromium, cobalt, copper, gold, nickel, oil and gas, platinum-group metals, and sylvite. In addition, the Government would establish a strategic mineral resources system that would include mineral commodities based upon the supply of and demand for individual commodities as well as for commodities for which China faced possible shortages (State Council, China's Policy on Mineral Resources, white paper, December 2003).

In 2008, China's Ministry of Land and Resources issued guidelines for development of the country's mineral resources for the period 2008 to 2015. The Ministry's development plan designated antimony, rare earths, tin, and tungsten as protected mineral commodities; exploration for and production of these mineral commodities was to be strictly controlled. The production of bauxite, germanium, indium, molybdenum vanadium, zirconium, and other minor minerals was required to be in compliance with policies set out in the development guidelines [Ministry of Land and Resources, the country's mineral resources development guidelines (2008-2015), December 31, 2008]. Currently, China issues production quotas for antimony, fluorspar, molybdenum, rare earths, and tungsten. China also maintains export quotas for each of these metals as well as indium.

China's mineral policies, especially those related to rare earth minerals, have become the subject of increased debate. China is rich in rare-earth resources, accounting for about 48% of the world's total rare-earth resources (Cordier, 2011). In addition to raw rare-earth minerals, China produces a variety of processed products including rare-earth metals and chemicals. Since the 1990s, China has become the leading rare-earth producing country in the world, accounting for more than 90% of the world's total output. Over the past decade, countries including France, Italy, Japan, and the United States have depended upon rare earths exported from China. Before 2000, China's rare-earth production exceeded domestic demand; at that time suppliers in China exported significant amounts of rare-earth products to overseas markets. In 2000, China produced 73,000 metric tons (t) of mined rare earths (rare-earth oxide equivalent) and consumed about 19,000 t. During this period, China exported unprocessed rare earths.

However, in the last ten years, Chinese domestic demand for rare earths increased sharply. The country's rare-earth production increased to over 120,000 t; however, domestic rare-earth consumption increased to 87,000 t by 2010. At the same time, the Chinese Government issued measures calling for restricted production, and the government further restricted exportation of rare earths. China no longer exports unprocessed rare earths. In addition, the rare-earth export quota decreased to about 30,000 t in 2010 from 47,000 t in 2000. Chinese statistics indicate that the country's rare-earth production has been over 120,000 t during the past several years.

China's restriction of rare-earth exports has significantly affected the downstream sectors of other countries, especially France, Italy, and Japan which do not have rare-earth resources. In the United States, the re-opening of the Mountain Pass Mine in California in late 2011 is expected to reduce U.S. demand for processed rare earths from China in coming years. In addition, Lynas Corp. Ltd. of Australia completed construction of its Mount Weld Mine in Western Australia in 2010. These two mines can supply a total of about 30,000 t of mined rare-earths during the next couple of years and will reduce the demand for Chinese-produced rare earths. Mountain Pass and Mount Weld, however, contain mainly light rare earths (lanthanum, cerium, praseodymium, neodymium, samarium, and europium). Many electronic products require heavy rare earths (gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium) to perform more efficiently. Currently, China is the only country that can supply significant amounts of both light and heavy rare earth products. At least for the next several years, China will continue to be the major supplier of heavy rare earths.

Mineral Stockpiles

In 2006, the Ministry of Land and Resources announced in its five-year plan to build up strategic reserves of minerals over the following 4 years (Areddy, 2006). In 2007, the Chinese Government announced a strategic reserve for five mineral commodities: cadmium, cobalt, copper, manganese, and petroleum. The strategic reserve was to cover 90 to 180 days of net imports for the country (Tse, 2007). In 2008, the Ministry of Land and Resources added indium, germanium, rare earths, tin, and tungsten to the country's strategic mineral stockpile list [Ministry of Land and Resources, the country's mineral resources development guidelines (2008-2015), December 31, 2008]. In 2009, the Chinese State Council ordered the State Reserve Bureau to stockpile aluminum, copper, indium, lead, and zinc. Beyond these announcements, little is known about the content and operation of China's strategic reserve. In addition to the national mineral stockpiles, the Provincial governments for Jiangxi and Yunnan Provinces have announced their intent to create stockpiles of aluminum, copper, lead, rare earths, tungsten, and zinc in local warehouses to support metal prices in the domestic market (Tse, 2010). In 2010, the government of Nei Mongol (Inner Mongolia) Autonomous Region authorized Baotou Iron and Steel and Rare Earths Corp. to stockpile rare earth concentrates in Baotou (Tse, 2011a).

Competition for Minerals

China's increasing consumption of minerals has been responsible for the majority of the increase in global production and consumption of minerals. This increase has resulted in rising prices of many mineral commodities and an increase in the exploration for and investment in minerals. This has in some cases led to aggressive competitive behavior by companies for mineral projects. In some cases, Chinese companies have benefitted from Chinese Government investments in foreign infrastructure or from loans to foreign governments.

As China's domestic mineral consumption has risen, its large production of many minerals has been increasingly consumed internally and for a number of mineral commodities China has had to depend upon imports of raw minerals, including bauxite, chromium, cobalt, copper, diamond, iron ore, manganese, natural gas, nickel, niobium, oil, platinum-group metals, potash, sulfur, tantalum, and uranium to meet the needs of its domestic processing industries. In recent years, China has also had to import processed minerals such as aluminum, copper, nickel, and zinc.

In order to assure supplies of metals, China has invested significant capital in mineral projects and has purchased or attempted to purchase foreign mineral companies. China's investments have been geographically broad across the globe and have concentrated on fuels and metals. In Africa, China has made significant investments in metals in the Democratic Republic of Congo, South Africa, Zambia, and Zimbabwe. In Asia, China has made significant investments in Afghanistan, Australia, Mongolia, Papua New Guinea, the Philippines, and Vietnam. China has also made significant investments in metals in Canada, Chile, Mexico, and Peru. In terms of mineral commodities, China has sought investments in copper, iron ore, nickel, rare-earth, and zinc projects and in companies with assets in those commodities. Initially, Chinese firms sought to control interests in mineral projects and companies. More recently, Chinese firms have in some cases bought minority shares with agreements to purchase future production.

Implications

If one compares China's per capita mineral consumption in 2010 with that of the United States in 2000, (the last year of domestic consumption data preceding the recent economic downturn) one can form some idea of how far China has increased its consumption. For a few mineral commodities (cement, steel, tin, and zinc), China's 2010 consumption already equals or exceeds that of the United States in 2000. With the exception of tin, these minerals find a significant proportion of their use in the construction sector. For many other commodities (aluminum, copper, lead, salt, soda ash), China's 2010 consumption is less than half of that of the United States in 2000. It would be reasonable to suggest that China's consumption of these minerals is likely to continue increasing for some time to come. These minerals find their uses in a variety of manufactured products (aluminum, copper, and lead) and in industrial chemicals (salt), and glass manufacture (soda ash). The resulting production and consumption is likely to support continued high prices for many mineral commodities, and continued investment in and competition for mineral projects and companies. The increased mineral consumption is also likely to be accompanied by a significant increase in environmental impacts from mining, processing, and consuming the minerals, particularly in the vicinity of these activities.

For the United States a particularly worrying trend is the declining domestic consumption of a number of processed metals (aluminum, copper, lead, finished steel, tin, and zinc), both in terms of absolute consumption and in terms of per capita consumption. The declines in per capita consumption follow decades in which the per capita consumption of many metals was stable. These declines may reflect a decline in U.S. manufacturing of goods that use these metals.

Conclusion

To summarize, Chinese government policies on the production, consumption, and stockpiling of mineral resources have been driven, in part, by the country's rapid economic growth. The changes in its minerals economy have, in turn, significantly affected the global economy and will continue to do so into the future.

This concludes my testimony. I am happy to answer any questions the Commission may have.

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Table 1. "Comparison of China-World Commodity Production"

Commodity	m/p	Production 2010 China	World	Units	China Rank
Bauxite	m	40,000	211,000	thousands of tons	2
Aluminum	p	16,800	41,400	thousands of tons	1
Antimony (Sb content)	m	120	135	thousands of tons	1
Bismuth (Bi content)	m	5.1	7.6	thousands of tons	1
Cadmium	p	5.6	22	thousands of tons	1
Chromium ore (gross weight)	m	200	22,000	thousands of tons	--
Cobalt (Co content)	m	6.2	88	thousands of tons	3
Copper ore (Cu content)	m	1,200	16,000	thousands of tons	3
Copper	p	4,690	19,100	thousands of tons	1
Germanium	p	80	120	thousands of tons	1
Gold	m	345	2,500	thousands of tons	1
Indium	p	300	574	tons	1
Iron Ore (Fe content)	m	332,000	1,290,000	thousands of tons	1
Steel (raw)	p	630,000	1,400,000	thousands of tons	1
Lead ore (Pb content)	m	1,750	4,100	thousands of tons	1
Lead	p	4,200	9,490	thousands of tons	1
Magnesium Metal	p	650	760	thousands of tons	1

Manganese ore (Mn content)	m	2,800	13,000	thousands of tons	1
Molybdenum ore (Mo content)	m	94	234	thousands of tons	1
Nickel (Ni content)	m	77	1,550	thousands of tons	7
Nickel	p	322	1,410	thousands of tons	1
Rare Earth Elements	m	120	130	thousands of tons	1
Silicon	p	4,600	6,900	thousands of tons	1
Silver	m	3	22.2	thousands of tons	3
Tin ore (Sn content)	m	115	261	thousands of tons	1
Tin	p	150	350	thousands of tons	1
Titanium Sponge	m	53	132	thousands of tons	1
Tungsten ore (W content)	m	52	61	thousands of tons	1
Vanadium (V content)	m	23	56	thousands of tons	1
Zinc ore (Zn content)	m	3,500	12,000	thousands of tons	1
Zinc	p	5,160	12,700	thousands of tons	1
Abrasives (mfg)					
Fused Alumina	p	700	1,190	thousands of tons	1
Silica Carbidep	p	455	1010	thousands of tons	1
Barite	m	3,600	6,900	thousands of tons	1
Boron	p	150	3,500	thousands of tons	6
Cement	p	1,800,000	3,300,000	thousands of tons	1

Diatomite	m	450	1,830	thousands of tons	2
Fluorspar	m	3,000	5,400	thousands of tons	1
Garnet	m	470	1,410	thousands of tons	2
Graphite (natural)	m	800	1,100	thousands of tons	1
Gypsum	m	45,000	146,000	thousands of tons	1
Nitrogen	p	42,000	131,000	thousands of tons	1
Phosphate Rock	m	65,000	176,000	thousands of tons	1
Potash	m	3,000	33,000	thousands of tons	4
Salt	p	60,000	270,000	thousands of tons	1
Strontium	m	200	420	thousands of tons	1
Sulfur	p	4,400	68,000	thousands of tons	2
Talc	m	2,300	7,450	thousands of tons	1

Table 2. “Estimated Consumption of Selected Commodities”

Consumption in thousand metric tons

Consumption per capita in kilograms per capita

China	2000		2005		2010		2010
	Consumption	Per capita	Consumption	Per capita	Consumption	Per capita	
Aluminum	3,694.99	2.93	9,058.35	6.97	19,811.00	14.78	5.36
Cadmium	5.08	0.00	10.96	0.01	11.67	0.01	2.29
Cement	592,371.00	470.14	1,047,856.00	806.04	1,867,622.50	1,393.75	3.15
Copper	1,941.40	1.54	3,743.20	2.88	7,594.30	5.67	3.91
Iron and steel	124,278.00	98.63	347,472.00	267.29	575,984.00	429.84	4.63
Lead	648.51	0.51	2,000.61	1.54	4,236.87	3.16	6.53
Salt	30,730.66	24.39	50,177.00	38.60	71,712.00	53.52	2.33
Soda ash	7,481.00	5.94	12,505.50	9.62	18,770.00	14.01	2.51
Tin	39.19	0.03	124.77	0.10	167.83	0.13	4.28
Zinc	1,516.64	1.20	3,253.97	2.50	5,595.03	4.18	3.69
Population (billion)	1.26		1.30		1.34		

United States	2000		2005		2010		2010
	Consumption	Per capita	Consumption	Per capita	Consumption	Per capita	
Aluminum	9,354.65	33.17	8,822.64	29.81	6,843.53	22.08	0.73
Cadmium	2.00	0.01	0.85	0.00	0.47	0.00	0.23
Cement	109,527.00	388.39	128,035.00	432.55	69,500.00	224.19	0.63
Copper	2,728.57	9.68	2,181.19	7.37	1,730.00	5.58	0.63
Iron and steel	120,012.00	425.57	110,307.00	372.66	82,000.00	264.52	0.68
Lead	1,767.70	6.27	1,520.82	5.14	1,500.00	4.84	0.85
Salt	53,905.91	191.16	56,421.00	190.61	55,305.00	178.40	1.03
Soda ash	6,430.00	22.80	6,380.00	21.55	5,220.00	16.84	0.81
Tin	46.11	0.16	51.27	0.17	16.91	0.05	0.37
Zinc	1,278.00	4.53	1,019.28	3.44	901.00	2.91	0.71
Population (billion)	0.282		0.296		0.31		

2011 U.S. NET IMPORT RELIANCE FOR SELECTED NONFUEL MINERAL MATERIALS

Commodity	Percent	Major Import Sources (2007–10)[1]
ARSENIC (trioxide)	100	Morocco, China, Belgium
ASBESTOS	100	Canada, Zimbabwe
BAUXITE and ALUMINA	100	Jamaica, Brazil, Guinea, Australia
CESIUM	100	Canada
FLUORSPAR	100	Mexico, China, South Africa, Mongolia
GRAPHITE (natural)	100	China, Mexico, Canada, Brazil
INDIUM	100	China, Canada, Japan, Belgium
MANGANESE	100	South Africa, Gabon, China, Australia
MICA, sheet (natural)	100	China, Brazil, Belgium, India
NIOBIUM (columbium)	100	Brazil, Canada, Germany, Russia
QUARTZ CRYSTAL (industrial)	100	China, Japan, Russia
RARE EARTHS	100	China, France, Estonia, Japan
RUBIDIUM	100	Canada
SCANDIUM	100	China
STRONTIUM	100	Mexico, Germany
TANTALUM	100	China, Germany, Kazakhstan, Australia
THALLIUM	100	Russia, Germany, Kazakhstan
THORIUM	100	France, India, Canada, United Kingdom
YTTRIUM	100	China, Japan, France, United Kingdom
GALLIUM	99	Germany, Canada, United Kingdom, China
IODINE	99	Chile, Japan
GEMSTONES	98	Israel, India, Belgium, South Africa
GERMANIUM	90	China, Belgium, Russia, Germany
BISMUTH	89	China, Belgium, United Kingdom,
DIAMOND (dust, grit and powder)	89	China, Ireland, Republic of Korea, Russia
PLATINUM	88	Germany, South Africa, United Kingdom, Canada
ANTIMONY	87	China, Mexico, Belgium
RHENIUM	87	Chile, Netherlands, Germany
STONE (dimension)	85	Brazil, China, Italy, Turkey
POTASH	83	Canada, Belarus, Russia
VANADIUM	80	Rep. of Korea, Canada, Austria, Czech Republic
BARITE	78	China, India
SILICON CARBIDE	76	China, Brazil, Vietnam, Norway
TIN	76	Peru, Bolivia, Indonesia, China
COBALT	75	China, Norway, Russia, Canada
SILVER	75	Mexico, Canada, Peru, Chile
ZINC	73	Canada, Peru, Mexico, Ireland
TITANIUM (sponge)	69	Kazakhstan, Japan, China, Russia
TITANIUM MINERAL CONCENTRATES	68	South Africa, Australia, Canada, Mozambique
PEAT	63	Canada
CHROMIUM	60	South Africa, Kazakhstan, Russia, China
PALLADIUM	56	Russia, South Africa, United Kingdom, Norway
MAGNESIUM COMPOUNDS	53	China, Canada, Brazil, Austria
NICKEL	47	Canada, Russia, Australia, Norway
SILICON (ferrosilicon)	42	China, Russia, Venezuela, Canada
NITROGEN (fixed), AMMONIA	41	Trinidad and Tobago, Russia, Canada, Ukraine
GARNET (industrial)	39	India, Australia, China, Canada
GOLD	36	Mexico, Canada, Colombia, Peru
TUNGSTEN	36	China, Bolivia, Canada, Germany
COPPER	35	Chile, Canada, Peru, Mexico
MAGNESIUM METAL	35	Israel, Canada, China
PERLITE	27	Greece
SULFUR	24	Canada, Mexico, Venezuela
SALT	22	Canada, Chile, Mexico, The Bahamas
BERYLLIUM	21	Russia, Kazakhstan, Japan, Russia
MICA, scrap and flake (natural)	20	Canada, China, India
VERMICULITE	20	China, South Africa, Australia, Brazil
ALUMINUM	13	Canada, Russia, China, Mexico
GYPSUM	13	Canada, Mexico, Spain
PHOSPHATE ROCK	13	Morocco, Peru
IRON and STEEL	9	Canada, European Union, China, Mexico
IRON and STEEL SLAG	8	Japan, Canada, South Africa, Italy
CEMENT	6	Canada, China, Republic of Korea, Mexico
PUMICE	5	Greece, Mexico, Iceland, Montserrat
DIAMOND (natural industrial stone)	3	Botswana, South Africa, Russia, Namibia
LIME	1	Canada, Mexico
STONE (crushed)	1	Canada, Mexico, The Bahamas

[1]In descending order of import share.