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The Mineral Industry of Ecuador

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Despite known high-value mineral targets, the value of mining and quarrying activities (including fabrication of nonmetallic mineral products) have accounted for less than 1% of Ecuador's real gross domestic product (GDP) every year since at least 2004. Geologic investigations of Ecuador's mineral deposits have been reported upon since the late 1800s. In the mid- to late-1990s, international agreements for technical cooperation resulted in the Geological Map of the Republic of Ecuador and the Tectono–Metallogenic Map of the Republic of Ecuador, both of which were completed at a scale of 1:1,000,000. In the early 2000s, the Primary Auriferous Potential Map of Ecuador and a simplified geologic map of the Andes of Ecuador were released, the latter of which focused on Tertiary magmatic units. The primary conclusions of these studies were that the copper porphyries, epithermal mineralization, and volcanic massive sulfide deposits in the study areas were very similar to those in metallogenic belts of other Andean nations (Bolaños, 2010; Banco Central del Ecuador, 2015).

The mineral deposits in Ecuador were determined to include antimony, copper, gold, iron ore, and silver. Five districts, all of which encompassed some amount of protected area, were identified as prospective for metal deposits; they were the Alao Paute, the Azuay, the Imbaoeste, La Plata, and the Zamora Districts. About two dozen foreign mining companies had active projects in Ecuador by the early 2000s, and the country was known to host world-class copper and gold deposits. Continued structural reform and policy revisions in the mineral sector, which resulted in one of the highest tax rates in Latin America, contributed to decreased exploration investment as well as disinvestment or divestiture by mining companies already active in Ecuador. In 2014, the Government's efforts in the mining industry were focused on eradicating artisanal mining operations and mitigating the barriers to foreign investment that had been in place since the late 2000s (Bolaños, 2010).

Ecuador remained a member of the Organization of the Petroleum Exporting Countries in 2014, but owing to decreasing petroleum prices towards the end of the year, the relatively lower quality blend of Ecuador's petroleum compared with Brent crude, and Ecuador's aging oilfields, the cost of producing a barrel of oil was about 20% to 25% greater than the per barrel price that the country received on the international market. The Government of Ecuador had revised the country's oil industry regulations in the late-2000s. To increase the revenue that the Government receives through taxation, the new law requires companies to renegotiate operating contracts to service contracts or face expropriation and to agree to a fixed price per barrel that the Government pays producers. As a result, when oil began trading below the average service fee, it appeared that the country was accruing debt for every barrel of crude produced (Blas, 2015).

Minerals in the National Economy

Provisional data from the Central Bank of Ecuador indicated that the contribution (by value of production) of natural gas, petroleum, and related services to the GDP (using 2007 as the base year) in 2014 increased to $7 billion, or by 3% compared with that of 2013; this amount accounted for about 9.5% of the GDP compared with 9.7% in 2013. The value of production of petroleum refinery products decreased to $415 million in 2014, or by a revised 42% compared with that of 2013. The combined value of production from mines and quarries, the fabrication of unspecified nonmetallic mineral products, and the fabrication of base-metal products and products derived from metal increased by 6.3% compared with that of 2013 to $1.6 billion and accounted for 2.3% of the GDP compared with 2.2% in 2013. In nominal terms, the value of the production of natural gas, petroleum, and related services in 2014 was $10.8 billion; that of production from mines and quarries, the fabrication of unspecified nonmetallic mineral products, and the fabrication of base-metal products and products derived from metal was $2.5 billion; and that of the output of petroleum refinery products was $452 million (Banco Central del Ecuador, 2015).

The value of mineral exports in 2014 was $14.1 billion, which accounted for 55% of total exports, compared with a revised $13.9 billion in 2013. About 92% of the value of mineral exports was accounted for by crude petroleum. Imports of unspecified mineral products accounted for 26% of total imports, or $6.8 billion compared with $6.4 billion in 2013. The value of imported base metals and articles thereof decreased by 2% (or was about $2.2 billion). The value of imported articles of cement, ceramic products, glass and glassware, gypsum, mica or similar materials, stone, and plaster decreased by less than 1% (or was about $313 million) (Banco Central del Ecuador, 2015).

Production

Production of mined copper decreased by 37% in 2014 compared with that of 2013 to 131,259 metric tons (t); that of gold decreased by about 16% to 7,322 kilograms (kg); that of silver decreased by about 52% to 577 kg; and that of crude steel increased by about 18% to 662,000 t. Excluding construction materials (unspecified), production of all reported industrial minerals decreased in 2014. Production of unspecified construction materials increased by 31% to about 14 million cubic meters. Production of natural gas and crude petroleum increased by 12% and 7%, respectively. The production of some refinery products increased whereas that of others decreased, but the total production of refinery products overall decreased by 6%. Data on mineral production are in table 1.

Structure of the Mineral Industry

In 2014, the majority (48) of mines and quarries, of which there were 70 that appeared to be incorporated, were

domestically owned by public limited corporations. The Empresa Nacional Minera del Ecuador (ENAMI) is a state-owned mining company that was established in 2010, and Empresa Estatal Petróleos del Ecuador (Petroecuador) is a state-owned petroleum company. In November 2014, Union Andina de Cementos of Peru announced that it had finalized its deal to acquire 98.57% of the shares of Lafarge Cementos S.A.'s operations in Ecuador. Table 2 is a list of major mineral industry facilities (El Comercio, 2015; Instituto Nacional de Estadistica y Censos, 2015).

Commodity Review

Metals

Copper.—Copper production was not reported in Ecuador prior to 2011, but production of copper concentrate was reported in 2011, 2013, and 2014. Production of copper concentrate in 2014 decreased by 36% compared with that of 2013 to 596,630 t. No production was reported in 2012, but production of 953 t of copper concentrate was reported in 2011. The copper concentrate was reported to have been produced from the Miranda Alto area of El Oro Province. Estimates of copper production in table 1 were made assuming a copper content of 22% in the concentrate (table 1; Agencia de Regulación y Control Minero, 2015).

ENAMI had several active copper-molybdenum exploration projects in Imbabura and Bolivar Provinces. Llurimagua (also known as the Junin project) is a porphyry deposit with inferred resource estimates of 2.2 million metric tons of contained copper, 83,000 t of contained molybdenum, and a gold grade of 1.6 grams per metric ton. The project area covers 4,839 hectares in Imbabura Province in the Intag Valley, which borders or overlaps with the Intag Cloud Forest Reserve, national parks, and numerous small communities. Since a mining operation caused environmental damage in the area in the 1990s, communities in the Intag Valley had protested against mining in the area for decades, which resulted in violence and ultimately the expulsion of foreign mining companies. The conflict was renewed when ENAMI partnered with the Government of Chile on the Llurimagua project in 2011, and the controversy escalated further in September 2014 when a hastily completed 1,000-page environmental impact assessment released by the Government of Ecuador was given a public review period of less than 2 weeks (Empresa Nacional Minera del Ecuador, 2015; Smilowitz, 2014).

Gold and Silver.—Ecuador's annual gold production has fluctuated since 2000 (the earliest year for which data were available) from a minimum of 2,871 kg in 2000 to a maximum of 8,676 kg in 2013, for a cumulative total of 73,845 kg from 2000 through 2014. In 2014, gold production of 7,322 kg generated $250 million in revenue. The Provinces of Azuay and El Oro accounted for 93% of the gold production and 94% of the revenue generated by gold production. Little or no silver production was reported in Ecuador prior to 2004. The annual rate of silver production fluctuated greatly since 2004 (and did not correlate with the variation of gold production) within a minimum of about 159 kg in 2006 and a maximum of 2,900 kg in 2012 for a cumulative total of about 9,200 kg from 2004 through 2014. About 77% of the silver produced and 87% of the revenue from silver production in 2014 came from Oro Province, and the rest came from Imbabura Province (table 1; Agencia de Regulación y Control Minero, 2015).

In December 2014, Lundin Gold Inc. (formerly Fortress Minerals Corp.) of Canada completed its acquisition of the Fruta del Norte gold project from Kinross Gold Corp., also of Canada, after Kinross and the Government failed to negotiate an agreement regarding new taxes and royalties. The Fruta del Norte deposit is an intermediate sulfidation epithermal gold and silver system. Proven and probable reserve estimates as of yearend 2012 included more than 200 t (reported as 6.7 million troy ounces) of gold and about 280 t (reported as 9 million troy ounces) of silver (Fortress Minerals Corp., 2014, p. 6–10).

Industrial Minerals

The value derived from the production of industrial minerals accounted for 8% of the total of reported mineral production from mines and quarries in 2014. Production from the Provinces of Guayas and Pichincha accounted for 73% of the value derived from construction materials. Limestone and clays were produced primarily in Imbabura Province (Agencia de Regulación y Control Minero, 2015).

Mineral Fuels and Related Materials

Natural Gas.—In 2014, Ecuador's natural gas reserve estimate was 10.9 billion cubic meters. Marketed production of natural gas, which includes gross withdrawals from reservoirs less the quantities used for reservoir repressuring and the quantities vented or flared (Ecuador flared about one-half of the gross total volume of natural gas extracted) was 578 million cubic meters in 2014 compared with 515 million cubic meters in 2013. The country reported no natural gas exports in 2014 (Organization of the Petroleum Exporting Countries, 2015, p. 93, 96, 100).

Petroleum.—In 2014, Ecuador produced about 557,000 barrels per day (bbl/d) of crude petroleum, which accounted for less than 1% of the world's total production for the year but was a 6% increase compared with the country's production in 2013. In 2014, petroleum output from state-owned and public companies, which had increased every year since 2005, reached 157 million barrels (Mbbl) compared with 145 Mbbl in 2013. Production from private companies, which had decreased every year from 2005 through 2013, increased by 4% in 2014 to 49 Mbbl. Petroleum reserve estimates had been steadily increasing since 1990 when the reserve was estimated to be 1.4 billion barrels (Gbbl), followed by a significant increase in 1992 to 3.2 Gbbl. Ecuador's crude oil reserve in 2014 was 8.3 Gbbl, which was a 5% decrease compared with that of 2013. The country's cumulative petroleum production from 1960 through 2014 was 5.3 Gbbl. There were 41 active oil rigs in Ecuador in 2014 compared with 50 in 2013 (Banco Central del Ecuador, 2015; Organization of the Petroleum Exporting Countries, 2015, p. 8, 22, 23).

Refinery Products.—Ecuador's production of refinery products in 2014 decreased by 6% to 65 Mbbl compared with

that of 2013. The nation's refinery capacity remained constant at 190,800 bbl/d (Banco Central del Ecuador, 2015; Organization of the Petroleum Exporting Countries, 2015, p. 34).

Outlook

The Government of Ecuador's primary initiative in the mining sector in the near term will be to strengthen its ability to attract foreign investment to continue developing its base- and precious-metal deposits. The country has been actively reorganizing its mining sector in the past decade, but it still faces challenges in striking a balance among the interests of the state, stakeholders from local communities, and corporations. The Government of Ecuador set out to revise its mining sector in the mid-2000s when mineral commodities were in demand and prices were high. A justification for streamlining the industry was that nonperforming mining concessions had up until that time plagued the industry. As that trend has begun to reverse, the Government is continuing its efforts to boost the country's economy through mining.

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TABLE 1

ECUADOR: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		2010	2011	2012	2013	2014
METALS						
Copper, mine output, Cu content		--	210	--	208,021	131,259
Gold, mine output, Au content	kilograms	4,593	4,923 r	5,319 r	8,676 r	7,322
Silver, mine output, Ag content	do.	1,169	1,589 r	2,934 r	1,198 r	577
Steel, crude		372,000	525,000	536,000	562,000	662,000
INDUSTRIAL MINERALS						
Carbon dioxide (CO_2)	kilograms	126	512	415 r	295 r	229
Cement, hydraulic	thousand metric tons	5,280	5,700	6,025	6,600	6,000
Clays, unspecified		1,415 r	2,016 r	1,950 r	1,413 r	771
Construction materials	thousand cubic meters	7,700	12,386	13,726	10,653	13,971
Feldspar		156,888	103,948 r	152,590 r	210,142 r	183,259
Kaolin		41,089	95,061	42,564	100,195	40,236
Limestone	thousand metric tons	3,862	5,309 r	6,319 r	6,838 r	6,319
Pumice	do.	719	802	951	1,735	1,729
Sand (iron)		5,568	27,061	7,630 r	2,616 r	408
Zeolite		120	--	28	--	--
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural, marketed	million cubic meters	330	240	517	515	578
Petroleum:						
Crude	thousand 42-gallon barrels	177,374	185,800	184,315	191,825 r	206,000
Refinery products:						
Diesel fuel	do.	11,064	15,629 r	12,215	10,897	9,607
Distillate fuel oil[3]	do.	8,472	9,917	9,048	8,718	9,167
Residual fuel oil[4]	do.	9,947	10,753	8,238	6,784	1,037
Gasoline[5]	do.	12,486	15,415	17,133	18,619	19,294
Gasoline[6]	do.	4,704	4,874	5,638	5,213	5,693
Liquefied petroleum gas	do.	2,004	3,045	2,674	2,604	1,975
Other	do.	12,954	13,002	16,704	16,843	18,443
Total	do.	61,631 r	72,635 r	71,650 r	69,678	65,216

rRevised. do. Ditto. -- Zero.

[1]Table includes data available through December 11, 2015.

[2]In addition to the commodities listed, some additional commodities are produced, including barite, bentonite, gravel, marble, and sulfur, but available information is inadequate to make reliable estimates of output.

[3]Reported as Fuel Oil #4.

[4]Reported as Fuel Oil #6.

[5]Octane rating 87.

[6]Octane rating 92.

TABLE 2
ECUADOR: STRUCTURE OF THE MINERAL INDUSTRY IN 2014

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement		Holcim Ecuador S.A. (Holcim Ltd., 92.2%)	Cerro Blanco plant, Guayaquil, Guayas Province, and San Rafael grinding plant, Latacunga, Cotopaxi Province	5,500
Do.		Unión Andina de Cementos, 98.5%	Cement plant near capital city of Quito, Pichincha Province	1,600
Do.		Cemento Chimbarazo CA (Unión Cementera Nacional, UCEM, C.E.M), 100%	Kriobamba, Chimborazo Province	1,000
Do.		C.E.M. Industrial Guapan S.A., 100%	Agozes, Canar Province	600
Copper		NA	El Oro Province	1,000
Gold	kilograms	Dynasty Metals and Mining Inc., 100%	Zaruma gold mine, El Oro Province	2,200
Do.	do.	Bella Rica Mining Cooperative	Bella Rica Mine and La Guanache-Tres de Mayo Mine, Azuay Province	3,000
Do.	do.	Elipe S.A., 90%	Cabo de Hornos concessions, Portavelo and Zaruma Provinces	2,000
Natural gas	million cubic meters	Empresa Estatal Petróleos del Ecuador (Government, 100%)	Amistad field, Gulf of Guayaquil	500
Petroleum:				
Crude	thousand 42-gallon barrels	Petroamazonas EP [Empresa Estatal Petróleos del Ecuador (Government, 100%)]	About 26 active fields, led by Sacha, Sucumbios Province, and Shushufindi, Napo Province	200,000
Do.	do.	Petroamazonas EP [Empresa Estatal Petróleos del Ecuador (Government, 100%)]	About 85 active fields led by fields in the Amazon basin with operations in Guayas, Napo, Orellana, and Sucumbios Provinces	105,000
Do.	do.	Operaciones Rio Napo	Sacha oilfield	21,000
Refinery products	thousand 42-gallon barrels per day	Empresa Estatal Petróleos del Ecuador (Government, 100%)	Esmeraldas refinery, Esmeraldas Province	110
Do.	do.	do.	La Libertad refinery, Santa Elena Province	45
Do.	do.	do.	Shushufindi Industrial Complex	20

Do., do. Ditto. NA Not available.