The Mineral Industry of Puerto Rico, the Panama Canal Zone, the Virgin Islands, Pacific Island Possessions, and Trust Territory of the Pacific Islands

The Puerto Rico section of this chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Mineralogy and Geology Section, Industrial Research, Economic Development Administration, Commonwealth of Puerto Rico, for collecting information on all minerals.

By Harry F. Robertson,[1] Eduardo Aguilar [2] and Roy Y. Ashizawa [3]

PUERTO RICO [4]

Mineral production in Puerto Rico was valued at $67 million, a slight decrease from that of 1968. Construction materials, represented by cement, sand and gravel, and stone comprised about 42 percent, 35 percent, and 20 percent, respectively, of the total value.

[1] Supervisory mining engineer, Bureau of Mines, Bartlesville, Okla.

[2] Chief, Mineralogy and Geology Section, Economic Development Administration, Commonwealth of Puerto Rico.

[3] Mineral specialist, Bureau of Mines, San Francisco, Calif.

[4] Prepared by Harry F. Robertson and Eduardo Aguilar.

Table 1.—Mineral production in Puerto Rico [1]

Mineral		1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Cement	thousand 376-pound barrels	8,923	$27,577	8,943	$27,920
Clays	thousand short tons	512	481	438	454
Lime	do.	39	1,187	41	1,505
Salt	do.	32	395	32	395
Sand and gravel	do.	16,146	24,723	9,432	23,296
Stone	do.	7,367	13,580	6,985	13,550
Total		XX	67,943	XX	67,120
Total 1967 constant dollars		XX	r 67,265	XX	p 65,374

r Revised. p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Puerto Rico, by districts

(Thousands)

Senatorial district	1968	1969	Minerals produced in 1969 in order of value
Aguadilla	$1,683	$2,935	Sand and gravel, stone.
Arecibo	1,538	3,810	Do.
Guayama	4,560	2,356	Stone, sand and gravel.
Humacao	1,078	1,741	Sand and gravel, stone.
Mayaguez	4,330	3,922	Sand and gravel, stone, salt.
Ponce	23,572	25,385	Cement, sand and gravel, stone, lime, clays.
San Juan	31,182	26,971	Cement, sand and gravel, stone, clays.
Total	67,943	67,120	

Union Carbide Corp. began construction to increase production and accelerated proposed expansions, ultimately costing $300 million, at its petrochemical complex at Peñuelas. The original facility, operated since 1959, currently produces ethylene, glycols, and various alcohols. Nine major units will be added to the plant between 1969 and 1971 during the first stage of the expansion. Plant products and annual capacities will be as follows: Olefin, 775 million pounds; butadiene, 160 million pounds; ethylene oxide-glycol, 450 million pounds; glycol esters, 200 million pounds; low density polyethylene, 300 million pounds; bisphenol A, 35 million pounds; plasticisers, 150 million pounds; cumene, 640 million pounds; phenol, 200 million pounds; and acetone, 120 million pounds. In the second stage of the expansion the olefin unit will be expanded.

Fibers International, jointly owned by Phillips Petroleum Co., and Rhone-Poulenc confirmed that annual capacity of its nylon 66 plant near Guayama was being expanded to 20 million pounds. Completion is expected in 1971.

A five-company financed facility under construction at the Commonwealth Oil Refining Co., Inc. (Corco) complex near Carbide's facility at Peñuelas was dedicated. This complex involves Corco, W. R. Grace & Co., Air Products and Chemicals Inc., PPG Industries, and Hercules, Inc., and will produce aromatics, olefins, oxo-alcohols, o-xylene, and industrial gases.

A new program of geological studies of the sea floor, covering an area of 1,500 sq. miles off the south and southwest coast of Puerto Rico, was undertaken by scientists of the U.S. Geological Survey, Department of the Interior, in cooperation with the Industrial Development Administration of Puerto Rico. Objective of the survey is evaluation of the heavy mineral, gas, and oil potentials.

Puerto Rico Sun Oil Co. received approval of the Public Service Commission (PSC) to dredge a harbor at Yabucoa. The dredging operation will be the first step in construction of a petrochemical complex and oil refinery. One of the conditions made by the PSC is that Sun Oil Co. will be responsible for any damages that it causes to private or public areas along the coast. The PSC also requires that some 5 million cubic meters of the dredged material be deposited at a depth of at least 60 feet below the ocean surface. The remaining dredged material, used for fill, must be properly drained. The company began working on the first of three docks for the complex; the facility is a construction dock where barges and other ships will unload building material.

The Water Resources Authority planned construction of a thermonuclear powerplant on the south coast. The 600-megawatt plant, to be located in Puerto de Jobos in Aguirre Bay, will be built by the Westinghouse Electric Corp. and will be a boiling water reactor with integral superheater type.

San Juan Cement Co., Inc. continued construction of a new plant in the Barrio Espinosa area of Dorado, west of San Juan. Annual capacity of the plant will be 2.5 million barrels of portland cement. Electrostatic precipitators were installed to control dust emission from the kilns. Initital production at the plant was scheduled for mid-1970.

The Geologic Division of the U.S. Geological Survey, working under a cooperative agreement with the Puerto Rico Economic Development Administration, continued a program of preparing geologic maps of several 7½-minute quadrangles of the Island. Reports were published on the geology of the Aguadilla quadrangle and the Moca and Isabela quadrangles.[5] A stratigraphic study in east-central Puerto Rico was published.[6]

The Geological Society of Puerto Rico published a comprehensive bibliography and index of the geology of Puerto Rico and vicinity.[7]

Government-company negotiations for exploiting copper deposits at Utuado and Lares continued. American Metal Climax, Inc. (AMAX) proposed operating the mines as a joint venture with Kennecott Copper Corp. Royalty rates, air and water pollution controls, and construction of a

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[5] Monroe, W. H. Geologic Map of the Aguadilla Quadrangle, Puerto Rico. Misc. Geol. Inv., Map No. I–569, U.S. Geol. Survey, 1969.
———. Geologic Map of the Moca and Isabela Quadrangles, Puerto Rico. Misc. Geol. Inv., Map No. I–565, U.S. Geol. Survey, 1969.

[6] Briggs, R. P. Changes in Stratigraphic Nomenclature in the Cretaceous System, East-Central Puerto Rico. U.S. Geol. Survey Bull. 1274–O, 1969, pp. 01–031.

[7] Hooker, Majorie. Bibliography and Index of the Geology of Puerto Rico and Vicinity 1868–1968. The Geol. Soc. of Puerto Rico, 1969, 53 pp.

smelter, refinery, and sulfuric acid plant were included in the discussions.

A contract for constructing the Rio de la Plata Dam on the Toa Alta River (or drainage system) was awarded. Along with the existing Loiza Dam, it will rank as one of the most important dams in Puerto Rico. The new dam will be 263 meters wide across the crest with a maximum height of 40 meters. The dam will include a concrete intake and pumping station. The pumping station will contain two 20-million-gallon-per-day pumps and two 10-million-gallon-per-day pumps. The dam marks the first stage in a project that includes a water treatment plant that eventually will be expanded to quadruple its initial treatment capacity.

The sand resources of Puerto Rico were investigated by an engineer of the U.S. Bureau of Mines assisted by geologists of the Puerto Rico Department of Public Works during June–July 1969; results of the investigation were reported informally.[8] Data relating to output and estimated resources of Puerto Rico's principal sand producers were obtained and correlated with the projected needs of the construction industry to show the relationship between known sand resources and future requirements. The results indicated that the conventional sand supply has decreased rapidly while the demand continued a strong upward trend in the foreseeable future. Obviously, assuming no change in consumption patterns, the answer lies in development of another source of construction sand.

Other major sources of fine aggregate available to Puerto Rico include flood plain and terrace gravel deposits underlying agricultural land; manufactured sand and aggregate from decomposed granitic rocks cropping out in the southeast (Humacao) and west-central (Adjuntas) parts of the Island and, an offshore sand deposit, off the east coast of Puerto Rico (Escollo de Arena, Vieques Island).

REVIEW BY MINERAL COMMODITIES

Nonmetals.—*Cement.*—Construction industry activity resulted in increased shipments of portland cement. Domestic production gained slightly while imports—principally from Colombia, Venezuela, and Japan—gained 11 percent. Most of the cement was sold to building material dealers, ready-mix concrete companies, and concrete product manufacturers. Concrete is a major component of all types of construction on the Island.

Clay.—Output of clay by the Puerto Rican Cement Co., Inc., a major producer and consumer, dropped about 21 percent compared with that of 1968. The clay is used as a raw material in cement manufacture at the San Juan and Ponce plants.

Diazlite, Inc., processed clay with an oil additive to make lightweight aggregate at its plant near Trujillo Alto. Installation of a second rotary kiln to increase plant capacity was planned. Fines produced at the plant are a potential competitor for sand in concrete.

Lime.—Puerto Rican Cement Co., Inc., processed high-grade limestone into quicklime and hydrated lime at Ponce. About 69 percent of the hydrated lime output was used as mason's lime in the construction industry. The remainder was used for sugar refining, water purification and softening, and in alumina production. The quicklime was used principally as a fluxing agent in electric steel furnaces.

[8] Christiansen, Carl, H. F. Robertson, and P. A. Hamilton. Sand Resources and Production in Puerto Rico. Report to the Secretary of Public Works, 1969, 64 pp.

Table 3.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments		
		Quantity	Value	
			Total	Average per barrel
1965	7,269	7,284	$23,415	$3.21
1966	8,071	7,603	24,277	3.19
1967	7,963	8,447	27,397	3.24
1968	8,924	8,923	27,577	3.09
1969	8,945	8,943	27,920	3.12

Salt.—Recovery of salt from seawater remained at about the same level as that of 1968. Producers were Sal De Borinquen, Ponce Salt Industries, and other producers along the southwest coast. Seawater is passed through a series of evaporating ponds to increase salinity to the precipitation point. Crude salt, imported from Gran Inagua, was refined by Ponce Salt Industries for domestic use.

Sand and Gravel.—The volume of sand and gravel produced in Puerto Rico in 1969 was adjusted downward in accordance with the survey of active sand and gravel producers conducted during June–July. Most of the material was used as concrete aggregate. Silica sand from inland deposits west of San Juan was used in nearby cement and glass plants, in foundries, in sandblasting, and in marble polishing. Puerto Rico Glass Corp. was the principal user of the white, high-grade sands. Feldspar and other raw material, also used in making the glass, were imported.

A joint seminar on the manufacture and use of sands was planned for February 1970. The meeting would be jointly sponsored by the Puerto Rico Department of Public Works and the Aggregate Producers Association of Puerto Rico. The predicted acute shortage of fine, natural aggregate in Puerto Rico and how to meet the problem, would be the theme of the seminar.

Table 4.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,269	$6,554	2,726	$6,730
Paving	3,032	3,678	1,945	4,445
Fill	1,064	920	1,012	1,205
Total	7,365	11,152	5,683	12,379
Gravel:				
Building	2,798	5,336	1,760	5,839
Paving	3,352	5,488	1,147	3,779
Fill	735	679	675	776
Total	6,885	11,503	3,582	10,395
Total sand and gravel	14,250	22,655	9,265	22,774
Government-and-contractor operations:				
Sand:				
Building	4	8	137	425
Paving	565	803	30	98
Fill	624	522	------	------
Total	1,193	1,333	167	522
Gravel:				
Building	5	10	------	------
Paving	338	468	------	------
Fill	360	257	------	------
Total	703	735	------	------
Total sand and gravel [1]	1,896	2,066	167	522
Grand total [1]	16,146	24,723	9,432	23,296

[1] Data may not add to totals shown because of independent rounding.

The Department of Public Works was authorized by legislative action in Law No. 132 to regulate the extraction of sand, gravel, stone, and other aggregates, whether on public or private land. The Department of Public Works now requires a royalty of 15 cents per cubic meter for extraction of sand, gravel, or stone to be used as concrete aggregate and 5 cents per cubic meter for material used as fill. The law became effective on February 27 1969.

Stone.—Although domestic cement output registered a slight increase in 1969, production of crushed limestone, the principal raw material did not gain accordingly. Imports of 95,000 barrels of

hydraulic cement clinker from Colombia in the last quarter of 1969 resulted in decreased domestic consumption of crushed limestone and clay. Andesite, tuffaceous siltstone, and other volcanic stones were mined in all districts except Arecibo. Granite was produced in Humacao and Guayama Districts. Marble from various parts of the Island was sawed and polished to make slabs and shapes by Marmoles Cienne at a plant west of Bayamon.

Mineral Fuels.—Crude and unfinished oil imported from Venezuela and the Netherlands Antilles averaged 196,100 barrels per day, up 16 percent from the 1968 imports. Caribbean Gulf Refining Corp. at Cataño and Corco at Guayanilla refined crude and unfinished oils; Phillips Petroleum Co. at Guayama refined only unfinished oils.

Table 5.—Stone sold or used by producers
(Thousand short tons and thousand dollars)

Year	Dimension limestone		Crushed limestone [1]	
	Quantity	Value	Quantity	Value
1965	74	$180	4,236	$6,607
1966	88	231	4,416	7,555
1967	101	293	5,578	8,767
1968	101	293	5,619	9,408
1969	101	292	5,238	9,380

	Miscellaneous stone [2]		Total	
	Quantity	Value	Quantity	Value
1965	1,034	$2,324	5,344	$9,111
1966	1,228	2,755	5,732	10,541
1967	1,590	3,735	7,269	12,795
1968	1,647	3,879	7,367	13,580
1969	1,646	3,878	6,985	13,550

[1] Includes limestone for cement and lime.
[2] Includes granite, marble, and miscellaneous stone.

About mid-November, Corco began operating its new aromatics unit at Peñuelas. The new unit gives Corco the capacity to export benzene and other aromatics. The new unit doubles the company's aromatics capacity and is integrated with its first aromatics unit. When running at full capacity, the plants will produce 13 to 15 percent of the U.S. benzene supply or 6 percent of the free world supply. The aromatics are recovered from a wide variety of feed stocks, including byproduct from other process units.

Corco also announced plans to expand its daily oil refining capacity at its Peñuelas plant to 175,000 barrels. A major factor in the expansion is the signing of a long term contract by Corco with the Puerto Rico Water Resources Authority to supply fuel-oil for two 400-megawatt generating units being built at the south coast, government-owned steam-electric plant.

Metals.—Various sizes of steel reinforcing bars for use in concrete structures were produced by Industrial Siderurgica, Inc., at its steel mill near Cataño. Two 20-ton electric furnaces were used to melt domestic and imported iron and steel scrap.

Ponce Mining Corp. and the Puerto Rico Mining Commission continued negotiations on formulation of a contract to allow exploitation of the copper deposit near Utuado and Lares. Under the latest proposal Ponce Mining Corp. would operate the mines as a joint venture with Cobre Caribe (Kennecott Copper Corp.).

PANAMA CANAL ZONE [9]

The value of mineral production in the Panama Canal zone dropped about 11 percent compared with that of 1968. Sand and gravel and stone used as roadstone and concrete aggregate comprised the mineral output.

[9] Prepared by Harry F. Robertson.

VIRGIN ISLANDS [10]

Expansion of dock and ore handling facilities continued at the Harvey Aluminum, Inc., St. Croix alumina plant. Completion is scheduled for late 1970. A new high-capacity bauxite unloader will increase the unloading rate considerably. Modification in several areas of the alumina process resulted in increased production and improvement in quality control.

Near Christiansted, St. Croix, Hess Oil and Chemical Corp. constructed a new 75,000 barrel-per-day refining unit that more than doubled the capacity of the original refinery. A 30,000-barrel-per-day vacuum gas-oil desulfurization plant and an 18,000-barrel-per-day benzene-toulene-xylene (BTX) plant were completed. Other related petrochemical facilities were scheduled for construction in the near future.

Table 6.—Mineral production in the Panama Canal Zone and Virgin Islands [1]

Mineral	1968		1969	
	Short tons	Value	Short tons	Value
Canal Zone:				
Sand and gravel	55,000	$77,000	59,535	$96,803
Stone [2]	106,130	290,208	74,095	231,007
Total	XX	367,208	XX	327,810
Total 1967 constant dollars	XX	r 363,572	XX	p 319,192
Virgin Islands:				
Stone (basalt)	365,677	1,555,007	411,358	1,682,483
Total 1967 constant dollars	XX	r 1,539,611	XX	p 1,638,250

r Revised. p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Includes basalt.

At St. Croix, a suction dredge was used to recover sand offshore from Christiansted. The dredged sand was stockpiled on the beach and often was mixed with manufactured sand (ground basalt) to improve the quality of concrete. Reportedly, permission to stockpile the sand on the beach was withdrawn early in 1970.

Basalt was mined and crushed for concrete aggregate, roadstone, and riprap. Quarries on St. Croix and on St. Thomas accounted for the stone output. Companies producing aggregates on St. Croix were Caribbean Material Supply Co. and Springfield Crusher, Inc.; on St. Thomas, Controlled Concrete, Inc. was the operating Company. Both Springfield Crusher, Inc., and Controlled Concrete, Inc., are subsidiaries of Masonry Products, Inc., a United States-based company.

[10] Prepared by Harry F. Robertson.

PACIFIC ISLAND POSSESSIONS [11]

REVIEW BY ISLANDS

American Samoa.—Basalt rock, volcanic cinder, and dredged coral limestone and sand were processed by Government crews for use in improvement of roads and utilities and in building construction. A rock crusher and concrete and asphalt batch plants were operated at the Tafuna Public Works Compound near the Pago Pago International Airport.

Guam.—A building boom on Guam resulted in production of more than 654,000 tons of coral aggregate during 1969. Over 60 percent of the quantity was processed for use in concrete and concrete products, 20 percent for road base, and the remainder for road surfacing and as riprap. Public Works crews quarried coral material in the Barrigada, Dededo, and Malojloj areas. Commercial producers of crushed coral and coral sand operated plants at Agana and Oka.

[11] Prepared by Roy Y. Ashizawa.

Table 7.—Mineral production in the Pacific Island Possessions

Area and mineral	1968		1969	
	Short tons	Value	Short tons	Value
American Samoa:				
Pumice (volcanic cinder)	20,535	$51,338	1,565	$5,478
Sand	20,000	19,000	7,000	7,000
Stone	52,718	79,077	54,183	107,739
Total	XX	149,415	XX	120,217
Guam: Stone	559,529	998,032	654,176	1,399,127
Wake: Stone	41,000	132,000	9,000	45,000

XX Not applicable.

Wake.—The Wake Island group is a U-shaped coral atoll, with the islands of Wilkes and Peale comprising about one-third of each tip and connected to the main island by causeways. During 1969, coral was quarried on Wilkes Island for use as concrete aggregate in housing construction and for rehabilitation of facilities damaged by Typhoon Sarah.

Other Pacific Island Possessions.—No mineral production was reported on the islands of Canton, Enderbury, Jarvis, Johnston, Midway, and Palmyra. Requirements for construction and maintenance of facilities on Johnston Island were supplied by contractors from Hawaii and the U.S. mainland.

TRUST TERRITORY OF THE PACIFIC ISLANDS [12]

The Trust Territory of the Pacific Islands comprises some 2,100 islands scattered over an expanse of ocean about the size of the conterminous United States. Deposits of phosphate rock and bauxite exist on several of the islands, but neither of these minerals was mined during 1969.

Mineral production in the territory was limited to the quarrying of basalt rock and coral in the Mariana, Palau and Caroline Islands, and of coral in the Marshall Islands. Large quantities of these materials were produced and processed for use in construction and for restoring facilities damaged by typhoons. Crushed coral was more commonly utilized as road base and concrete aggregate. Marine biologists conducted studies of the Crown-of-Thorns starfish, which was destroying the live coral of the reef areas.

[12] Prepared by Roy Y. Ashizawa.