

History of Previous Activities of the U.S. Geological Survey in Puerto Rico

by

Robert E. Learned

The U.S. Geological Survey's activities in Puerto Rico began nearly a century ago. In fact it was on January 9, 1899, the month following Spain's cession of the island to the United States on December 10, 1898, that R.T. Hill and H.B.C. Nitze conducted a reconnaissance of the island's geology and mineral resources. They subsequently published the results of their mineral resource investigations in the USGS twentieth Annual Report for 1898-1899. H.M. Wilson's concurrent investigation of the topography and water resources of Puerto Rico was published as Water-Supply paper No. 32.

In January of 1900, Director Charles Walcott requested \$16,000 from Congress to carry out topographic and geologic surveys of Puerto Rico, but it was not until March of 1908 that E.M. Douglas led a team to survey the boundaries of the Luquillo National Forest. Later that year, USGS topographers mapped 150 square miles of the southern coastal plain near Ponce and Guayama in support of a proposed irrigation project. In the meantime, in 1901, Henry Gannett, Chief Geographer, published a 50 page gazetteer of the island as USGS Bulletin 183 (Gannett, 1901).

During World War I, on March 2, 1917, Congress passed the Jones Act, which granted U.S. citizenship to Puerto Rico's inhabitants. In the spring of 1918, the USGS extended its search for war-critical minerals to the Caribbean, where Max Roesler led the effort in Puerto Rico.

The Survey's topographic work in Puerto Rico recommenced in the first half of 1922 (January-June), again in support of an irrigation project. D.H. Watson, accompanied by geologist G.H. Mansfield, led a team of topographers to map some 40 square miles along the northwestern coast between Rio Guajataca and the town of Aguadilla.

USGS efforts in Puerto Rico continued during the Great Depression as the Public Works Administration, in 1933, allocated \$25,000 for topographic surveys in Puerto Rico as part of a \$2.4-million program of topographic mapping in the United States. During the months of February to July 1934, a USGS party led by topographer B.H. Yoakum completed triangulation of the island and extended spirit leveling in the western half. Then, in 1935, a USGS party led by topographer W.R. Chenworth mapped an area of 150 square miles in the southwestern corner of the island in support of a proposed irrigation project in the Lajas Valley. In 1937, Congress amended the Temple Act (1925) to include Puerto Rico in the cooperative State/USGS topographic mapping program. Accordingly, a USGS topographic team led by K.W. Trimble commenced systematic topographic mapping of the island at 1:20,000 scale. The mapping was completed after World War II, and the USGS National Mapping Division continues to revise maps as changes dictate.

Puerto Rico's post-war Operation Bootstrap, a program designed to promote industrial development, was launched in 1945. That same year, the USGS, in cooperation with the Puerto Rico Development Company (PREDA), an agency of the insular government, conducted a geologic investigation of the islands' coastal plains to assess oil and gas potential. Teodoro Moscoso, Director of PREDA, and Rafael Fernandez Garcia, Chief Engineer, provided logistical

support to the USGS team of geologists, A.D. Zapp, B.R. Berquist, and C.R. Thomas. The results of their investigation were published in 1948 as USGS Oil and Gas Investigations Map No. 85 (Zapp and others, 1948).

USGS investigations of the water resources of Puerto Rico were also initiated in 1945, when A.G. Unklesbay conducted a brief investigation of the ground-water supplies of the San Juan area, at the request of PREDA. A cooperative investigation between the USGS and the Puerto Rico Aqueduct and Sewer Authority began later that year and continued into 1947. Its purpose was to obtain island-wide information on ground-water supplies with respect to its quality, quantity, and availability for public supply systems and domestic, industrial, and agricultural uses. Sergio Cuevas Bustamante, Administrator and Chief Engineer of the Puerto Rico Aqueduct and Sewer Service, took the initiative in arranging for the cooperative investigation and facilitated its conduct. Alberto Hernandez, Chief of the Production and Distribution Division, provided valuable information on ground-water supplies. C.L. McGuiness, a USGS hydrologist, presented the results of the investigation at the 1947 annual meeting of the Society of Economic Geologists, and published the results in volume 42 of Economic Geology.

From March of 1949 to September of 1951, USGS geologist C.A. Kaye served as advisor to four Puerto Rican Government agencies, providing those agencies with geologic advice of an engineering nature. The lead personnel of the cooperating agencies with whom he worked included Antonio Lucchetti, Executive Director of the Puerto Rico Water Resources Authority; Rafael Fernandez Garcia, Director of Industrial Research of the Puerto Rico Economic Development Administration; Sergio Cuevas Bustamante, Administrator of the Puerto Rico Aqueduct and Sewer Authority; and Enrique Rubio, Official of the Insular Department of the

Interior. During the same period, Kaye carried out field studies that resulted in a geologic map of the San Juan area, a report on shore line forms and processes, and a geologic report on Isla de Mona, all of which appeared in USGS professional paper 317, (Kaye, 1959 a-f).

In the same year that Puerto Rico became self governing (1952), the USGS, in cooperation with PREDA, carried out an investigation to determine the adequacy of available geologic and mineral resource data, and to examine the field occurrences of the known mineral resources. Rafael Fernandez Garcia, Director of Research at PREDA, actively supported the USGS project geologists, H.M. Bannerman and R.J. Smith. One of the principal conclusions of their investigation was that basic geologic data needed for the appraisal and development of the Island's mineral resources be collected through detailed geologic mapping. Consequently, in 1955, the USGS Office of Regional Geology, in cooperation with PREDA, inaugurated a program of geologic quadrangle mapping that ultimately produced sixty 7 1/2-minute geologic maps, as well as a great many related scientific reports. More than 20 USGS geologists participated in the program, which was led consecutively by resident geologist-in-charge R.J. Smith, J.P. Owens, W.H. Monroe, R.P. Briggs, and J.M. Aaron. Puerto Rican participants included Eduardo Aguilar, Jose Francisco Cadilla, Carlos Cram, Angel Curet, Pedro Gelabert, and Leovigilda Vasquez. Two geologic maps of the entire island were published at 1:240,000 scale by R.P. Briggs in 1964 (HA-197, I-392).

In 1957, the Water Resources Division of the USGS, in cooperation with the Puerto Rico Water Resources Authority and other Puerto Rican Government agencies, established a program to investigate the water resources of Puerto Rico. This program, which is still in operation today, has

produced many water-supply reports and other significant publications during the 35 years since its inception. Resident hydrologists-in-charge have been in chronological order D.B. Bogart, D.G. Jordan, C.B. Bentley, E.D. Cobb, F. Quinones, and A.L. Zack.

In 1968, the USGS Office of Marine Geology, in cooperation with the PREDA initiated a study of the insular shelf of Puerto Rico. When the marine project was integrated into the Puerto Rico Department of Natural Resources in 1973, its emphasis was redirected toward systematic geologic mapping of the entire insular shelf. The resident USGS scientific and support staff has consisted almost entirely of Puerto Ricans. Rafael Rodriguez, the current project chief and USGS geologist-in-charge succeeded J.V.S. Trumbull, who had served since the project's inception.

In 1969, the USGS Office of Mineral Resources, in cooperation with the Puerto Rico Department of Public Works, began an investigation of the mineral resources of the island and established a geochemical laboratory in San Juan. Antonio Santiago Vasques, Secretary of the Department, and Cruz Matos, Sub-Secretary of the Department's Area of Natural Resources, were instrumental in initiating the project and supported it vigorously until its completion in 1974. Much of the project's attention was focused on the geology and geochemistry of the porphyry copper deposits in west-central Puerto Rico, an area that also served as a training ground for several Puerto Rican geologists. The geochemical laboratory, which analyzed all the samples collected by project geologists, was staffed entirely by Puerto Rican personnel. Ileana Perez, the current Chief Chemist, succeeded Rafael Boissen, who had served in that capacity from 1969 to 1973. The project produced many scientific publications, including a metallogenic map of Puerto

Rico by D.P. Cox, who served as resident geologist of the project.

In 1974, at the request of the Puerto Rico Electrical Power Authority, the USGS designed and established a seismic network to assess regional and local seismicity that could affect the proposed construction of a nuclear power plant. The Power Authority's objectives were accomplished by 1979, but USGS scientists continue to provide limited support in the interpretation and processing of accumulated data.

In 1980, the USGS Office of Mineral Resources and the Puerto Rico Department of Natural Resources (PRDNR) initiated a systematic geochemical survey of the drainage basins of Puerto Rico. Geologists Robert E. Learned, USGS, and Ramon Alonso, PRDNR, led the project. Lack of financial support terminated the undertaking before its completion, but the results for one major drainage basin were published in 1981 and the remainder is incorporated in the present work.

Immediately following the Puerto Rico landslide disaster of October 7, 1985, a hazard research team from the USGS Office of Earthquakes, Volcanoes, and Engineering responded to requests for an assessment of the hazards related to the landslide. Reports of their evaluation and recommendations were provided to federal and insular government agencies, and were subsequently published in 1985 and 1986.

In 1985, the USGS, in cooperation with the United Kingdom Institute of Oceanographic

Sciences, conducted a side-scan sonar survey (GLORIA) of Puerto Rico's Exclusive Economic Zone (EEZ) and in 1987 published the resulting maps in its "Atlas of the Exclusive Economic Zone, Gulf of Mexico and Eastern Caribbean Areas".

Side-looking airborne radar imagery (SLAR) of Puerto Rico was produced for the USGS in 1987, and in 1989, K.M. Scanlon and C.S. Southworth combined GLORIA and SLAR mosaics to more effectively interpret the tectonics of the northern Caribbean plate boundary zone.

In 1990, USGS geoscientists began compilation of the information required to make a mineral resource assessment of the island. This assessment constitutes the subject matter of the present work.

For almost a century, geoscientists of the USGS, often in cooperation with agencies of the insular government, have studied many aspects of Puerto Rican geology. Their efforts have resulted in major contributions to an understanding of the island's geology, and to the welfare of its people.