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RESOURCE APPRAISAL OF DOMINICA, LESSER ANTILLES

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CONTENTS

	Page
INTRODUCTION.....	1
RESOURCES OF DOMINICA.....	2
RECOMMENDATIONS.....	7
KEY REFERENCES FOR DOMINICA.....	8

FIGURES

Figure 1. Index map showing location of Dominica and track of United GEO-1.....	2A
Figure 2. Seismic reflection profile, leg 3, part of line 46, UNITED GEO-1.....	6A

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INTRODUCTION

In response to requests from the Honorable Premier Col. Patrick John to the U.S. Geological Survey, I visited Dominica, Lesser Antilles, during the interval November 29–December 2, 1977. The trip objective was to make, in cooperation with Dominican officials, rapid appraisal of the natural resources of the island.

Dr. John Tomblin, Professor at the University of the West Indies, Trinidad, who is one of the few geologists-geophysicists familiar with Dominica, was kind enough to provide me with much background information on Dominica, including copies of a large number of informal reports that deal with such topics as resources, seismic risk, and volcanic risk. We owe a considerable debt of gratitude to Dr. Tomblin and his group.

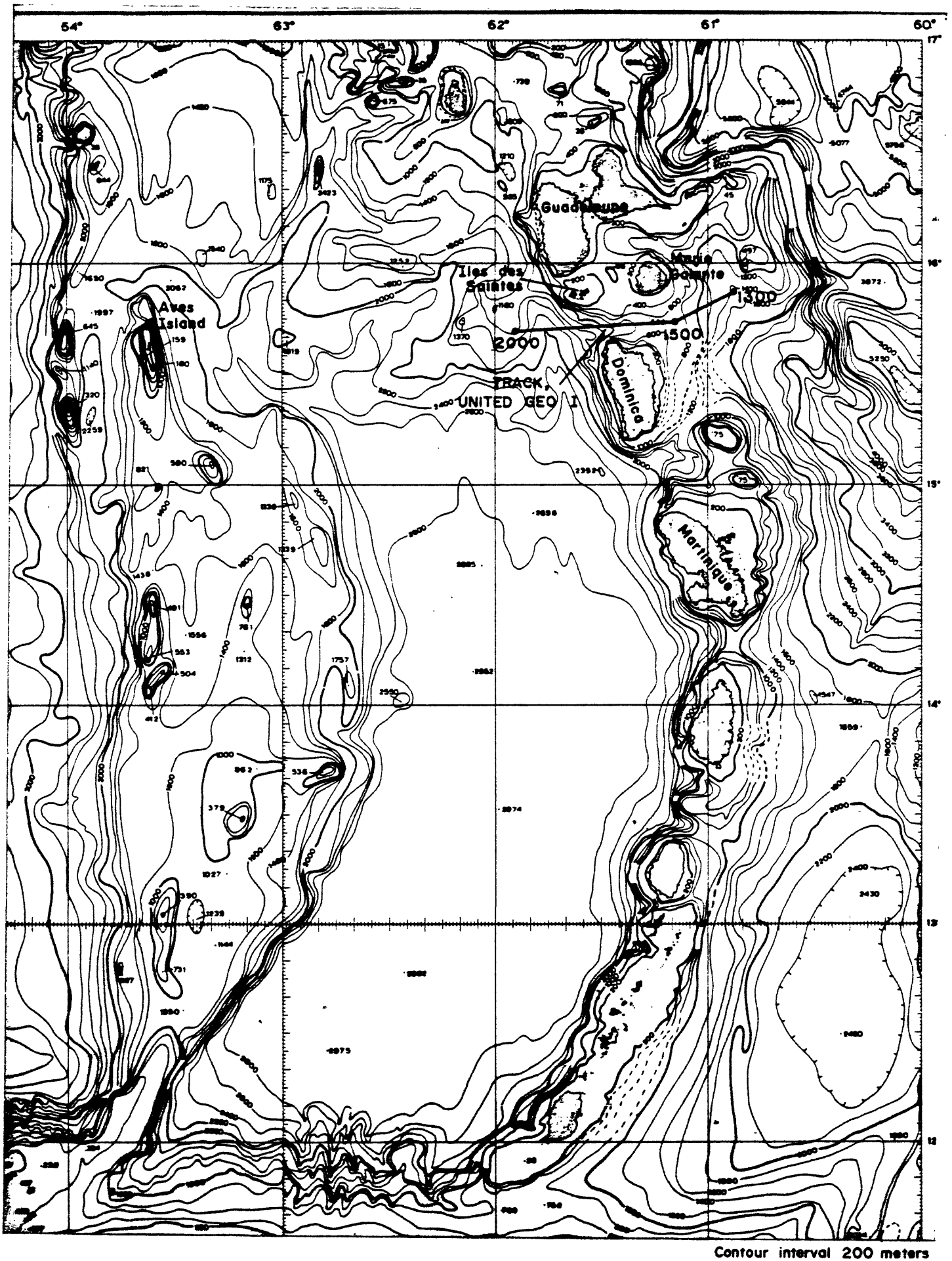
On Nov. 29, during a change of planes in Barbados, I spoke briefly with Mr. John Eddy of the American Embassy who telephoned Dominica, and when I arrived at Dominica on the afternoon of the 29th, I was met by Mr. Jerome Robinson, Head of the Survey Department, Ministry of Agriculture, Lands, Fisheries, and Co-operatives. Most of the previous geologic work in Dominica had been done under the auspices of this Ministry. During the two-hour drive from the airport to Roseau (an airline distance of about 20 miles), Mr. Robinson reviewed the known resources of Dominica, the status of geologic investigations as he understood them, and prospects for future development. Plans were made for two days' work: first a review of geologic materials on file in the Ministry, followed by examination of key geologic localities in the field.

On the morning of Nov. 30, I met Mr. Walter Cooke, a technician in the Ministry, who has been responsible for laboratory and office aspects of their geologic program in recent years. He has been most concerned with geochemical analysis of stream sediments and soil samples, most of which had been collected by Walter Williams, a field technician. Several thousand stream-sediment samples have been collected throughout the island, but they have not been analyzed. They could be the basis of a fairly complete geochemical inventory.

RESOURCES OF DOMINICA

Dominica is a volcanic island, about 48 km long and 22 km across, located between Martinique and Guadeloupe in the Lesser Antilles (fig. 1). The island is extremely rugged, with very steep slopes, and has a heavy cover of tropical rain forest. The population is about 70,000. Principal industry is agriculture, and bananas, coconuts, and citrus fruits are exported. There is a minor timber industry (being developed by Canadian firms, as I understand). Standard Caribbean tourism has not developed on the island, because of the scarcity or absence of white-sand beaches and because of the rainy weather. The island has experienced historic volcanic eruptions (steam) and minor earthquake swarms.

Copper.—Dominica has been explored for copper for more than a decade. Dawson (1966) reported copper anomalies, as does the U.N. report by Barnea and others (1969). A possibly significant copper anomaly (values as high as 2000 ppm) occurs in the Deux Branches area, 8-10 miles west of Marigot near the main highway from the airport to Roseau. This is an area of older volcanic rocks (probably pre-Miocene, see discussion by Brown and others, 1977, p. 786). Some of the samples submitted by



Contour interval 200 meters

Figure 1. Index map showing location of Dominica and track of UNITED GEO-1

the Government of Dominica and several that I collected are from the general anomaly area. Although most of the rocks are weathered andesite or dacite, D. Cox (USGS, written commun.) reports a porphyry in the samples submitted by the Government of Dominica. Several shallow holes have been drilled in the anomalous area, but results of analyses were not made available to me. Copper values reported for random whole-rock specimens from the island range from about 42 to 131 ppm and average about 70 ppm (Brown and others, 1977).

Zinc and lead.—The geochemical samples indicate some zinc and lead anomalies on the island, mainly in the area of the copper anomaly. It is doubtful that zinc and lead would occur in sufficient quantities in this geologic environment to merit exploitation, but the anomalous areas might serve as guides to deposits in other metals, especially copper and gold.

Gold.—Several enigmatic reports indicate that gold has been found in small quantities in some of the streams. Because the stream-sediment samples represent most of the island, it appears that selected samples should be tested for gold, especially those from the areas of copper anomalies.

Iron.—Although minor pyrite deposits occur, it is doubtful that iron deposits of economic significance exist in this geologic environment.

Pumice.—Some very good pumice deposits are present near Roseau. These deposits have been exploited in the past for light-weight aggregates, but they are not being mined at present. Sigurdsson (1972) has described these deposits; they are sufficiently extensive that they

probably constitute a major long-term resource. Pozzolana deposits also are present on the island.

Black sands.—Black sand is deposited locally along the shore. Most of the sand appears to contain a high proportion of mafic minerals, but some sand on the northeast coast contains magnetite-rich stringers.

Limestone.—Beach rock and coral-reef terrace deposits are interstratified with volcanic rocks on the west coast north of Roseau. Although locally pure, most of the "limestone" contains so much volcanogenic material that it is doubtful that economic deposits of limestone for cement can be developed. However, until the beds are mapped in detail, a proper evaluation of the potential limestone resource cannot be made. Some analyses of limestones were made by the Ministerio de Energia y Minas, Venezuela, and copies of their reports are on file in Roseau.

Sand and gravel.—Sand and gravel resources appear to be quite limited in areas close to the present highway facilities. It is doubtful that sufficient quantities exist for exportation; sand and gravel probably should be reserved for construction on the island. At several places near the main highways, massive intermediate to mafic flows crop out, and such flows could be (and probably have been) utilized for road metal. Sand and gravel might occur on the offshore shelf of the island. However, because of the youthful volcanic setting of the island, the shelf is very narrow in most places and the offshore gradients are quite steep. The widest shelf is off the northeast coast, remote from the main population center of Roseau.

Bauxite.--Dawson (1966) conducted a reconnaissance exploration of the island, as did the United Nations group (Barnea and others, 1969). No significant bauxite deposits have been found. Because of the scarcity of limestone, it is doubtful that Jamaican-type deposits of bauxite exist on the island. Youthful volcanic rocks, which constitute most of Dominica, are not common sources of bauxite.

Clays.--Deep tropical weathering of the volcanic rocks has produced substantial volumes of clay. I was unable to learn whether a resource appraisal of clay has been made. If not, one certainly should be made by a clay specialist. Potential may exist for a brick industry, especially in view of the apparent scarcity of limestone for cement. Moreover, clays suitable for a pottery-ceramics industry may also exist.

Diatomite.--Minor diatomite deposits have been reported. As far as I could determine, these have not been exploited. Brief reports by Martin-Kaye (1969) are on file in the Ministry at Roseau.

Sulfur.--Minor sulfur deposits are associated with recent volcanic centers. These probably are not of sufficient volume to warrant exploitation.

Phosphate.--The geologic environment of the island is not favorable for phosphate deposits, except possibly in the vicinity of the scarce limestone deposits. No phosphate has been reported.

Water resources.--No water resource problems were identified. The heavy rainfall provides a surplus of water for the island. Most of the electric energy for the island is provided by hydroelectric power. Several streams could support moderate future expansion of the hydroelectric power capability.

Geothermal energy.--A very good potential for geothermal power exists on the island. An appraisal was made by James McNitt as part of the United Nations report (Barnea and others, 1969), and specific recommendations for exploitation were made. It appears that a study of the comparative costs of development of hydroelectric power vs geothermal power is needed.

Oil and gas.--Because of the volcanic environment of the island, the onland oil and gas possibilities are probably nil. Political boundaries have some bearing on an evaluation of the potential for oil and gas resources offshore. North of Dominica are the French islands of Iles des Saints, Marie Galante, and Guadeloupe; south of Dominica is Martinique (fig. 1). Moreover, 125 nautical miles west of Dominica is Aves Island, a Venezuelan possession. The ultimate availability for Dominica of possible oil and gas offshore may depend on where the boundaries are drawn between the French islands and Aves Island.

The Dominican shelf (water depth less than 200 meters) ranges from a few hundred meters to a few kilometers in breadth. The passage between Dominica and Marie Galante, to the northeast, has a depth of 622 meters. Several seismic-reflection profiles have been obtained in the passage, and at least one second (approximately 1 km) (see fig. 2) of well-stratified material occurs in the passage (see figure from Garrison and others, 1972) between lat. 15.79° N., long. 61.01° W., and lat. 15.75° N., long. 61.50° W. Stratified beds as much as 1.5 secs in thickness occur both to the east and west of the passage. Other seismic-reflection profiles should be available from Dr. L. K. Fink, Jr., Dept. of Oceanography, Ira C. Darling Center, University of Maine, Walpole, 6 Maine, 04573, and from Dr. T. L. Holcombe, U.S. Naval Ocean Research and Development Activity, Code 36, Bay St.

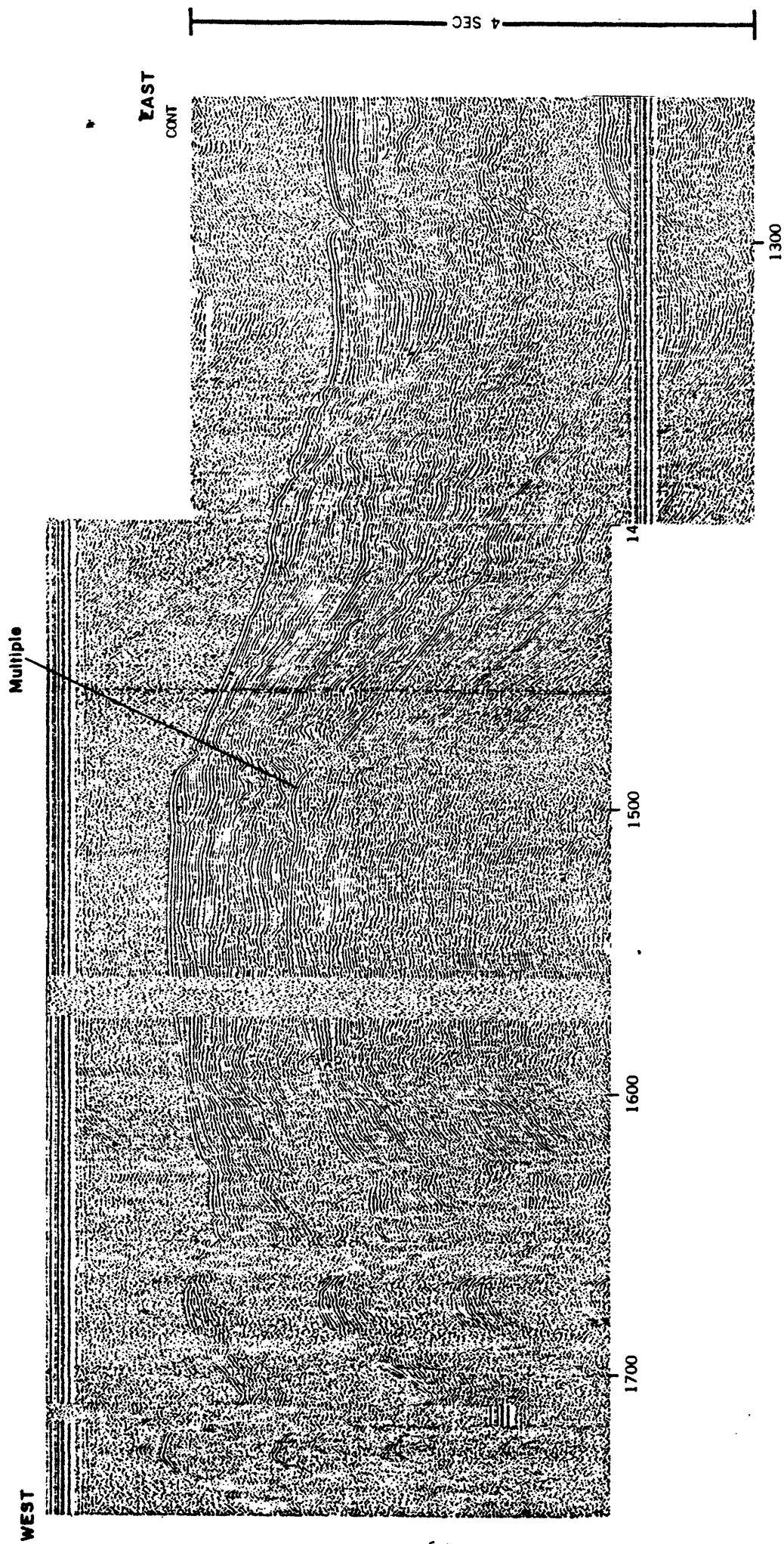


Figure 2. Seismic reflection profile of part of Leg 3, line 46, UNITED GEO-1

Louis, Miss., 39520. Another area of potential interest is an oval bank near lat. $15^{\circ}10'N.$, long. $60^{\circ}55'W.$ This bank appears to lie closer to Dominica than to Martinique. Although I have not examined seismic-reflection profiles across this feature, I believe that the U.S. Naval Oceanographic Office (NAVOCEANO) obtained two profiles across it, and details should be available from Dr. Holcombe. The presence of stratified beds does not, of course, indicate oil and gas, but merely the presence of potential source and/or reservoir rocks.

RECOMMENDATIONS

1. Samples submitted by the Government of Dominica and by me are being examined by D. Cox (USGS), and some spectrographic analyses are being obtained. Results of this examination should be sent to Dominica as soon as possible.
2. Because several thousands of stream-sediment samples exist for the island, basic data are available for a rather complete geochemical inventory of the island. Consideration should be given to determine a mechanism for funding systematic analyses of these samples. Furthermore, it appears that Dominican technicians should be involved in making the analyses as a training mechanism. If, for example, samples could be run in the laboratory facilities in Puerto Rico, it should be relatively simple for Messrs. Cooke and Williams to participate in the work and subsequent interpretation of the results.
3. A senior resident geologist is needed for a period of at least 4-5 months to cooperate in framing an exploration-exploitation strategy for Dominica. Such a geologist should be experienced in volcanology in tropical regions. Experience in clay deposits, light-weight aggregates, porphyry copper, and gold in tropical

volcanic environments would be most useful. Although several geologists in the Geological Survey have the requisite background, other commitments may preclude a lengthy involvement by any of them. If funding can be obtained from some international agency, consideration might be given to a cooperative agreement with academic institutions or with one of the regional cooperative groups such as the Instituto Centro-americano de Investigacion y Tecnologia Industrial (ICAITI) which has done similar work in the Dominican Republic and elsewhere in Latin America.

4. An updated appraisal of the potential for geothermal energy is needed. The McNitt estimate was made in 1966, and considerable advances have been made since then in technology and in techniques for appraisal. Comparative costs of development of geothermal energy and hydrothermal energy should be examined to determine the most effective priorities.
5. For an assessment of offshore oil and gas possibilities, all the available seismic records require careful study. I estimate that at least a month, and possibly two months, would be required for even preliminary evaluation.

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