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Central Intelligence Agency

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Washington, D.C. 20505

DIRECTORATE OF INTELLIGENCE

17 OCT 1985

MEMORANDUM FOR: Mr. Ronald K. Lohrding  
Assistant Director for Industrial and  
International Initiatives  
Los Alamos Scientific Laboratories

VIA: David Wigg  
National Security Council

FROM: [Redacted]  
Director of Global Issues

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SUBJECT: El Salvador: Assessment of Petroleum Potential [Redacted]

Attached is a technical assessment of the petroleum geology of  
El Salvador. The body of the report is intended for a technical readership  
and is unclassified when detached from the summary. We intend to complete  
similar reports assessing the hydrocarbon potential of other Central American  
countries. We will, of course, forward copies of these reports to you as they  
become available. If we can be of any further assistance to you on this or  
any related matter, please call [Redacted]

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Attachment:  
El Salvador: Assessment of Petroleum Potential [Redacted]  
GI M 85-10242, October 1985 [Redacted]

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SUBJECT: El Salvador: Assessment of Petroleum Potential

OGI/SRD/PRB, (15 October 1985)

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Washington, D.C. 20505

DIRECTORATE OF INTELLIGENCE

15 October 1985

El Salvador: Assessment of Petroleum Potential

Summary

Examination of the geology of El Salvador indicates that the petroleum potential of the country is extremely poor. The absence of marine sedimentary basins onshore and the lack of immaturity of offshore source beds preclude the presence of significant petroleum accumulations. The forearc basin off El Salvador's coast is geologically the most promising area for the possible accumulation of petroleum. Nevertheless, our analysis indicates that even under the best of circumstances the amount of petroleum that could have been generated in this basin is so small that it would not even be adequate to meet El Salvador's relatively meager domestic oil requirements—currently estimated at some 11,000 b/d. [redacted]

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In view of this pessimistic assessment, El Salvador will need to continue relying on imported oil, mainly from Mexico and Venezuela, to meet all of its domestic requirements. In 1984, El Salvador's oil import bill exceeded \$100 million. We believe that oil imports will increase to about 20,000 b/d by the mid-1990s with nearly all of the growth in consumption occurring in the transportation and industrial sectors. [redacted]

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Hydroelectric and geothermal power currently provide about 75 percent of El Salvador's energy needs. Planned expansion of hydroelectric and geothermal plants will provide excess electrical generating capacity, but few additional possibilities exist for El Salvador to substitute electricity for oil. If hostilities were ended, El Salvador might be able to export surplus electricity to neighboring countries and lessen the financial burden of importing oil. [redacted]

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This memorandum was prepared by [redacted] Petroleum Resources Branch, Office of Global Issues. The information contained herein is updated to 15 October 1985. Comments may be directed to [redacted] Chief, Strategic Resources Division, [redacted]

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## El Salvador: Assessment of Petroleum Potential

### Regional Setting

El Salvador is located in the northern geologic province of Central America. This province, containing Guatemala, Honduras, El Salvador and Northern Nicaragua, is underlain by continental crust basement of Proterozoic and early Paleozoic age. Rock types are metasediments, anatexites, and plutonics. This basement is overlain by upper Paleozoic, Mesozoic, and Tertiary sediments which have undergone middle Permian and Cretaceous-Tertiary deformation. The start of subduction along the Middle American Trench during the Miocene resulted in periodic andesitic volcanism which continues to the Present.<sup>1</sup>

### Geology of El Salvador

The oldest basement rocks in El Salvador are pre-Triassic metasediments of the Honduras Massif. These rocks consist of phyllites, sericite schists and graphite schists. The extent of these rocks is unknown, but they outcrop along the Honduras border and form the core of the Honduran Massif to the north. They may form the basement under much of El Salvador.<sup>2</sup>

Pre-Triassic metasediments are unconformably overlain by upper Cretaceous red sandstones, marls, and limestones. These sediments outcrop in northwestern El Salvador and probably underlie younger volcanics which cover most of the country. These sediments are known as the Metapan Formation, and they correlate with the Todos Santos Formation, Yojoa Group, and Valle de Angelles Formation of central Honduras.<sup>3</sup> Unlike areas to the north, the Mesozoic in El Salvador is poorly developed and represents the marginal basin facies of the thicker and more complete Mesozoic sequence to the north. Uplift and erosion at the end of the Mesozoic resulted in the removal of the Mesozoic over most of El Salvador and created an unconformity between Mesozoic sediments and Tertiary volcanics.

The start of subduction along the Middle American Trench during the Miocene resulted in a period of widespread volcanism which continues to the Present. Miocene volcanics occur in the northwest corner of the country; Pliocene volcanics occur in a belt throughout central El Salvador, and Pliocene to Recent volcanics occur along El Salvador's Pacific coast.

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<sup>1</sup>Weyl, R., 1980, Geology of Central America., Berlin, Gebruder-Borntraeger.

<sup>2</sup>Fairbridge, W., 1975, El Salvador., in the Encyclopedia of World Regional Geology Part 1: Western Hemisphere. Dow Hutchinson and Ross Inc., p. 270-272.

<sup>3</sup>Wiesemann, G., 1975, Remarks on the Geologic Structure of the Republic of El Salvador., Mitt. Geol.-Palaont. Inst. Univ. Hamburg, 44, 557-574, Hamburg.

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The start of subduction along the Middle American Trench also formed a trench-accretionary-wedge-forearc basin complex off El Salvador's Pacific coast. Drilling by the Glomar Explorer during Leg 67 and offshore geophysical surveys show that the accreted sediments reach a depth of 2300 meters. Rock types are upper Cretaceous to Miocene micritic limestones, mudstones and claystones. Pliocene to Recent sediments are unconsolidated diatomaceous muds with numerous volcanic ash layers.

The forearc basin extends along the Latin American coast from the Nicoya Peninsula in Costa Rica to the Gulf of Tehenupec off Mexico.<sup>4</sup> Off the coast of El Salvador this basin contains up to 10,000 meters of Cretaceous, Paleocene, Eocene, Miocene and Pleistocene sediments. The Lower Cretaceous and Lower Paleocene sediments were deposits at abyssal depths and are composed of limestones and calcareous schists. The Upper Paleocene, Eocene, Miocene and Pleistocene sediments were deposited at lower to middle bathyal depths and consist of limestones, mudstones, and tuffaceous arenites.<sup>2, 5</sup>

### Petroleum Potential

Evaluation of the petroleum potential of El Salvador is hampered by the small amount of onshore and offshore subsurface data. No exploration wells have been drilled on or offshore and little seismic exploration work has taken place. The only sources of data are the results of Leg 67 of the Glomar Explorer Drill Program, and data presented by Seely (1978) on the forearc basin off El Salvador's coast.<sup>4</sup> These sources and tectonic reconstructions presented in Weyl (1980) were used to evaluate El Salvador's petroleum potential.<sup>1</sup>

The petroleum potential of El Salvador is limited to the following areas:

- o Mesozoic sediments of the Metapan Formation;
- o sediments in the offshore accretionary wedge; and
- o sediments in the forearc basin off El Salvador's coast.

Although sedimentary equivalents of the Metapan Formation are petroleum bearing in the areas north of El Salvador, the formation has no petroleum potential in El Salvador. Late Mesozoic uplift and erosion removed the Metapan Formation over much of El Salvador, and where it does occur it is thin and disturbed.

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<sup>4</sup>Seely, D.R., 1978, The Evolution of Structural Highs Bordering Major Forearc Basins., in American Association of Petroleum Geologists Memoir 26, p. 245-260.

<sup>5</sup>Coulbourn, W.P., Hesse, R., Azema, J., Shiki, T., A Summary of Deep Sea Drilling Project Leg 67 Sites: The Middle America Trench and Slope off Guatemala., in Initial Reports of the Deep Sea Drilling Project, V.67, p. 759-777.

Sediments in the offshore accretionary wedge are not petroleum bearing. Investigations by the Glomar Explorer show that organic-rich hemipelagic sediments are being deposited between 300 and 1500 meters below sea level. Sediments below 1500 meters are poor in organics and therefore cannot be considered petroleum source beds. Examination of drill core from the accretionary wedge shows that some hydrocarbon generation is occurring within the organic-rich interval. The sediments are still too immature, however, for significant hydrocarbon generation, and the high sulfur content of the sediments may prevent formation of hydrocarbons due to reaction with lipids.<sup>6</sup>

The forearc basin off El Salvador's coast offers the best chance for the occurrence of petroleum, but a number of factors indicate that it does not contain commercial accumulations of petroleum. This basin extends along the Central American Coast from the Nicoya Peninsula in Costa Rica to the Gulf of Tehautepec off Mexico's Pacific coast and contains up to 10,000 meters of Lower Cretaceous, Paleocene, Eocene, Miocene and Pliocene sediments. Lower Cretaceous to Lower Paleocene sediments were deposited at abyssal depths. This indicates that the organic content of these sediments is too low for them to have been petroleum source beds. Upper Paleocene and Eocene sediments were deposited at lower to middle bathyal depths. Pre-Miocene sediments off the Pacific coast of Latin America are organically poor no matter what their depth of deposition is.<sup>7</sup> This observation was confirmed in this area by results of Glomar Explorer Leg 67. This eliminates these formations as petroleum source beds. Application of the improved Lopatin's method to Miocene and Pleistocene sediments indicates that these sediments are not mature enough to generate petroleum. Therefore, these sediments cannot be considered petroleum source beds.<sup>8</sup>

### Energy Outlook

Because of its lack of hydrocarbon resources, El Salvador will remain totally dependent on imported oil to meet transportation and industrial needs. Imports amounted to about 11,000 barrels per day (b/d) in 1984 and the annual oil import bill exceeded \$100 million. If trends over the last five years continue, daily oil requirements could reach about 20,000 b/d by the mid-1990s. There is little El Salvador can do to limit its dependence on

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<sup>6</sup>Summerhayes, C.P., and Gilbert, D., 1981, Distribution, Origin, and Hydrocarbon Potential of Organic Matter in Sediments from the Pacific Margin of Guatemala., in Initial Reports of Deep Sea Drilling Project, V.67, p. 546-595.

<sup>7</sup>Summerhayes, C.P., and Gilbert, D., 1980, Distribution, Origin and Hydrocarbon Potential of Organic Matter in Sediments from the Pacific Margin of Southern Mexico., in Initial Reports of Deep Sea Drilling Project, V.67, p. 541-546.

<sup>8</sup>Waples, D.W., 1980, Time and Temperature in Petroleum Formation Application of Lopatin's Method to Petroleum Exploration., AAPG Bul. V.64, No. 6, p. 916-920.

imports. Virtually all of present oil use and all of the projected increase in oil consumption will be in the transportation and industrial sectors, where few, if any, interfuel substitution possibilities exist and where conservation possibilities are very limited. Only about one percent of the imported oil is used to generate electricity--a share unlikely to change much.

El Salvador has substantial hydroelectric and geothermal resources which presently provide about 75 percent of the country's energy needs. Completion of the San Lorenzo hydroelectric project will boost electric power generation capacity to 2.3 gigawatt-hours--the energy equivalent of 3,700 b/d--and will give El Salvador excess generating capacity. This surplus could increase if plans to increase the capacity of the Ahuchapan geothermal plant are carried out.

El Salvador will not be able to fully develop its hydroelectric and geothermal potential until the guerrilla war ends. Power line transmission towers are repeatedly dynamited and work on the San Lorenzo hydroelectric project is being hampered by guerrilla attacks. El Salvador has been forced to construct an oil-fired generating plant to assure a constant electric supply for San Salvador. If hostilities end, the country's potential generating capacity is more than adequate to meet any realistic increase in electrical demand and will possibly provide an exportable surplus as well.