INTERNATIONAL
URANIUM RESOURCES
EVALUATION PROJECT

OECD
NUCLEAR ENERGY AGENCY
PARIS, FRANCE

INTERNATIONAL
ATOMIC ENERGY AGENCY
VIENNA, AUSTRIA

IUREP ORIENTATION PHASE MISSION

Summary Report

VENEZUELA

A summary report prepared on behalf of the
Executive Group for the IUREP Orientation Phase

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THE OECD NUCLEAR ENERGY AGENCY

38, Boulevard Suchet, F-75016 Paris (France)

The OECD Nuclear Energy Agency (NEA) was established on 20th April 1972, replacing the OECD's European Nuclear Agency (ENEA).

NEA now groups all the European Member countries of OECD with Australia, Canada, Japan and the United States. The Commission of the European Communities and the International Atomic Energy Agency take part in the Agency's work.

The main aims of the NEA are to promote cooperation between Member governments in the safety and regulatory aspects of nuclear power and in the development of nuclear energy as a contributor to economic progress.

This is achieved by:

- *encouraging the harmonisation of governments' regulatory policies and practices;*
- *reviewing technical and economic aspects of the nuclear fuel cycle;*
- *assessing demand and supply, and forecasting the potential contribution of nuclear power to energy demand;*
- *exchanging scientific and technical information; and*
- *coordinating and supporting research and development programmes, notably through the setting up of joint projects.*

INTERNATIONAL ATOMIC ENERGY AGENCY

Wagramerstrasse 5, A-1400 Vienna (Austria)

The International Atomic Energy Agency (IAEA) came into being in Vienna, Austria, on 29 July 1957. Its main objectives are to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world" and to "ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose".

The IAEA is an intergovernmental organization like the United Nations, the World Health Organization and other specialized agencies of the United Nations. It is directed by a Board of Governors, which is composed of representatives from 34 Member States, and a General Conference of the entire membership of 112 States. The IAEA has its own programme, approved by the Board of Governors and the General Conference, and its own budget, currently at 107 million dollars (1985), financed by contributions from its Member States.

Although autonomous, the IAEA is a member of the United Nations system and sends reports on its work to the General Assembly and to other United Nations organs.

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SUMMARY

A report has recently been published which describes the findings of the International Uranium Resources Evaluation Project (IUREP) mission to Venezuela.

The IUREP Orientation Phase mission to Venezuela estimates that the Speculative Resources of that country fall within the range 2,000 to 42,000 tonnes uranium. The majority of this potential is expected to be located in the Precambrian crystalline and sedimentary rocks of the Guayana Shield. Other potentially favorable geologic environments include Cretaceous phosphorite beds, continental sandstone and granitic rocks.

The mission recommends that approximately US $18 million be spent on exploration in Venezuela over the next five years. The majority of this expenditure would be for surface surveys utilizing geologic studies, radiometric and geochemical surveys and some drilling for geologic information. Additional drilling would be required later to substantiate preliminary findings.

INTRODUCTION

During the bibliographic study, which formed the first phase of the International Uranium Resources Evaluation Project (IUREP), Venezuela was identified as one of the countries with good potential for uranium resources in addition to those reported in "Uranium Resources, Production and Demand, December 1977."* Following a meeting at which the objectives of the IUREP Orientation Phase were discussed in some detail with a number of selected countries the Venezuelan authorities requested an Orientation Phase mission. This mission was undertaken by two consultants, D.L. Hetland and J.M. Obellianne, in March/April 1981.

The full report on the mission is available for study at the locations listed in the Annex of this summary report.

The Executive Group for the IUREP Orientation Phase acknowledge the excellent cooperation given to the mission by the Venezuelan authorities. Special thanks are expressed to Senor J.C. Pineda, Executive Secretary of CONADIN, and his staff who assisted in the organization of the mission and the coordination with local authorities. Also to the Ministry of Energy and Mines, (MEM) particularly Eng. E. Herrero, Chief of the Geophysics Division and geologist H. Cardenas for their full cooperation.

GENERAL GEOGRAPHY

Venezuela, located in the northern part of the South American continent, has an area of 912,050 km^2 including the island of Margarita and 71 other islands. It has common frontiers with Colombia, Brazil and Guyana and an extensive coastline on the north bordering the Caribbean sea. The country may be divided topographically into the mountains on the north and west, the large flat Orinoco lowlands extending east to west across the center of the country and to the south the several lowlands and high plateaus which constitute the Guayana Shield area in Venezuela. The climate is tropical and humid however it varies directly with elevation. The population is over 13,000,000 of whom over 3,000,000 live in the metropolitan area of the capital, Caracas.

Topographic maps of the country are available from the Servicio de Cartographia Nacional at scales of 1/1,000,000 and 1/100,000. Only the 1/1,000,000 scale series is complete. Geologic maps at a scale of 1/500,000 covers the entire country with 25 sheets and are available from the Ministerio de Energia y Minas. Geologic maps at other scales are also available but the coverage is far from complete. Aerial photographs at a scale of 1/40,000 are available.

* "Uranium Resources, Production and Demand, December, 1977", OECD (NEA)/IAEA

ADMINISTRATIVE BODIES CONCERNED WITH URANIUM

At the present time the Government agencies concerned with uranium geology and exploration activities are the following:

1. Ministerio de Energia y Minas - Direccion de Geologia - The Division of Geophysics has the responsibility for directing all uranium exploration in Venezuela.

2. National Council for the Development of Nuclear Industries (CONADIN)- responsible for research and development of nuclear energy, orientation of nuclear industry, recommendation and plans for safety, education and research for specific development of nuclear energy. All agreements or contracts with domestic or foreign companies or governments relating to nuclear energy has to be approved by CONADIN.

3. The National Utility Company (CADAFE) - a wholly-owned government company whose objective is to provide electrical power for Venezuela from various sources including uranium. Another objective is to oversee and initiate the industrialization of a nuclear fuel cycle.

LEGISLATION CONCERNING URANIUM EXPLORATION, DEVELOPMENT AND PRODUCTION

Prior to 1975 (before CONADIN was created) uranium was treated as any other metal under the 1945 mining regulations. Since 1975 uranium exploration and exploitation is restricted to the Government. There are no private, national or foreign companies participating in uranium exploration.

Exploration is conducted by the Ministerio de Energia y Minas or funded by CADAFE who will inform CONADIN if they discover a commercial deposit of uranium. CONADIN will then determine proceedings for development of the deposit within the framework of Government guidelines.

GEOLOGY OF VENEZUELA

Venezuela may be divided geologically into three continental regions plus the numerous small islands near the Caribbean coast. These regions from southeast to northwest are commonly referred to as (1) the Provinces of Guayana, (2) the Province of the Llanos, and (3) the Venezuelan Mountains and Maracaibo Basin. (Fig. 1)

The Provinces of Guayana

This area (also called the Guiana Highlands) rises almost immediately south and east of the Orinoco River and comprises about 45 percent of the national territory. The vast region which is extremely remote and complex may be divided into four provinces based on rock type and age. These provinces are: 1. Imataca, 2. Pastora, 3. Cuchivero, and 4. the Roraima. (Fig. 2)

GENERALIZED GEOLOGICAL MAP OF VENEZUELA

Legend

Q	Cenozoic Sediments
K	Cretaceous Sediments
T	Lower Mesozoic Sediments
P	Paleozoic Sediments
Pi	Mesozoic and Paleozoic Igneous Rocks

PRECAMBRIAN

R	Roraima Group
Y	Young Granites (~2,000 m.y.)
M	Mafic Volcanics and Graywacke Slate
F	Felsic Volcanic Rocks
G	Gneiss, Granite, Iron Formation
P€	Undifferentiated

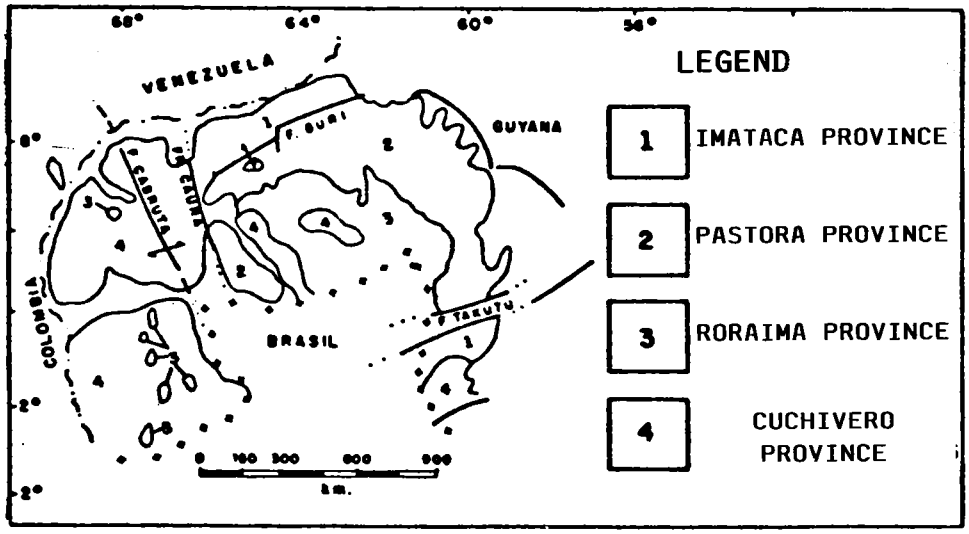


Fig. 2 Geological Sub-Areas of the Guayana Shield. From Mendes, 1976 and Mendoza 1977

1. Imataca Province. In general the rocks in this province consist mainly of a leucogranite granulite belt of Archean age. The granulite belt consists of about 80 percent banded felsic, leucocratic rocks. The remainder of the belt consists of interbedded mafic gneiss, magnetite, granitic gneiss and amphibolite. The structural geology of this belt is extremely complex with blocks of different age positioned against each other by several large overthrust faults. Rocks of this belt are composed of the oldest rocks in Venezuela (3500 m.y.) and probably on the South American Continent.

2. Pastora Province. This large area in the eastern part of the Shield consists of large acid and basic volcanic extrusives superposed with sedimentary rocks containing volcanic debris. Also extensive gabbro and diabasic dikes and sills intrude the volcanic extrusives and sedimentary rocks. The geology of the province has been further complicated by the intrusion of the Supamo Granotoid Complex of early Proterozoic age. This complex consists mainly of sodic crystalline rocks, primarily trondhjemite, granodiorite and quartz-monzonite.

3. Cuchivero Province. The province includes the area west of Ciudad Bolivar and all of the Amazonas Territory to the south. The predominate rocks in the area are well developed epizonal and epimesozonal plutonic crystalline rocks and slightly metamorphosed volcanic and sedimentary rocks.

The plutonic rocks are represented by alkalic granites, leucogranites and quartz monzonites, granodiorites, tonalites and minor diorite intrusives.

The volcanic rocks are acid type lavas, tuffs, and ash ranging from alkaline rhyolite, rhyodacite, dacite to quartz-latite.

4. Roraima Province. This province consists of high, steep sided plateaus near the center of the Guayana Shield with many sandstone outliers or remnants scattered mainly to the west and southwest from the main plateau. Rocks of this province, called the Roraima Group, average about 2,800 meters thick, and has been subdivided into four formations which from the base to the top are: a. Uairen, b. Kukenan, 3. Uaimapue, and d. Matavi.

The Uairen Formation at the base averages 850 meters thick and consists of fine- to coarse-grained sandstone with conglomerate lenses interbedded with the siltstone of probable volcanic origin. The Kukenan Formation immediately above the Uairen consists of about 100 meters of black laminated siltstone and mudstone. The overlying Uaimapue Formation is approximately 150 meters thick and consists of tuffs, siltstone with jasper, mudstone, rhyolite flows and some coarse conglomerate. The top Matavi Formation estimated at 600 meters thick, consists of massive silicified sandstone of probably eolian origin.

The Province of the Llanos

The Province of the Llanos are the lowlands that extend from the Colombian border to the Atlantic and from the Northern Mountains to the Orinoco River. Topographically the area slopes southeastward from the Northern Mountains to the Orinoco and northeastward from the Colombian border to the Atlantic, but nowhere are altitudes greater than 200 meters.

Subsurface exploration for oil has determined the existance of two deep basins separated by the El Baul Saddle. The El Baul Saddle is a northwest-southeast trending structure of intrusive granites, of varying facies, into Ordovician marine sediments. This structure is further complicated by a Triassic-Jurassic volcanic complex consisting of tuffs, rhyolites and rhyodacites.

The Barinas-Apure Basin on the west and the Eastern Venezuela Sedimentary Basin on the east are filled with Mesozoic and thick Cenozoic marine and continental sediments. Relatively small oil fields have been found in the Barines-Apure Basin while the Eastern Venezuela Basin contains the largest oil field in Venezuela.

The Venezuelan Mountains and Maracaibo Basin

The Venezuelan Mountains are represented by two distinct and separate mountain systems: The Andes system on the west and the Montañoso system to the north and east.

The Andes system is subdivided into two branches. At the Colombia Border the eastern Cordillera of the Colombia Andes divides into the Sierra de Perija, which juts northward along the border toward the Gulf of Venezuela and the Merida Andes (Cordillera de Merida) which extends east of Lake Maracaibo.

The Venezuelan Andes have a tectonic history ranging from the Paleozoic to the Cenozoic but the present structural framework was formed during the Tertiary. There is a metamorphic crystalline core with considerable granitization and minor volcanic activity. Granitic intrusives were significant during the Paleozoic.

During the Triassic and Jurassic thick fluvio-deltaic and lacustrine sedimentation was prevalent and the typical red beds of the Merida Andes and the Sierra de Perija were deposited.

During the early Cretaceous there was a marine transgression at which time clastic marginal marine sediments followed by limestones, phosphates and black shales were deposited.

During the Paleocene and Eocene epochs the Maracaibo Basin began subsiding. Major uplifting of the Venezuelan Andes to their present level occurred mainly during the Oligocene, Miocene and Pliocene epochs. Enormous quantities of detrital material was eroded from the mountains into the basin. The Maracaibo Basin is a major oil producing area in Venezuela.

The Montañoso Mountain System is divided into two sets of east-west trending parallel mountain ranges. The ranges are separated by an intermediate lateral depression that reaches a maximum width of about 50 kilometers. The coastal range, where altitudes often exceed 1,500 meters and peaks reach from 2,100 to 2,800 meters consists of Mesozoic metamorphic rocks with late Mesozoic acid intrusives. The southern range has maximum elevations of less than 1,500 meters and is composed primarily of metamorphosed Mesozoic sediments with basic extrusive rocks.

Mineral Resources

Venezuela is among the leading countries of the world in terms of proven petroleum reserves (reported about 18 billion barrels in 1981) mostly in the Maracaibo and eastern Venezuela basins. Large reserves of high grade iron ore have been found in the Guayana Shield. Also significant deposits of bauxite, gold, diamonds, manganese, copper and coal are being produced in various sectors of the country.

PAST EXPLORATION

Exploration for uranium began in 1951 when the Ministry of Mines and Hydrocarbon invited the U.S. Geological Survey to make a survey for uranium in Venezuela. This joint effort consisted of a bibliographic compilation, examination and evaluation of oil well logs and general field reconnaissance throughout Venezuela. The three months project also included an investigation of 12 anomalous areas and over 100 localities in various parts of Venezuela. Uraniferous areas were recognized in phosphatic shales (La Luna), in low-grade placer deposits, and in copper-uranium bearing sandstones (La Quinta).

Additional exploration work was undertaken by the Ministry of Mines and Hydrocarbon during the period 1951-1974 which consisted of carborne radiometric surveys, geochemical studies and contractual aerial radiometric surveys. Carborne surveys, limited to the northern half of the country because of a lack of roads in the south, and geochemical surveys, mainly in the states of Merida and Tachira, found a few anomalous areas but in general were unsuccessful. Three large scale aeroradiometric survey projects have been completed in Venezuela. These surveys, mostly integrated magnetic-gamma spectrometric, covered most of the Guayana Shield area of southern Venezuela and the State of Zulia in the extreme northwestern part of the country. Many apparent anomalies were found in the Guayana Shield area in inaccessable and remote areas. To date, there has been no concerted effort to evaluate most of these anomalies on the ground. However what appeared to be the best anomaly, Cerro Impacto, was drilled but only thorium, rare earths, zirconium and niobium were found in the subsurface.

Since 1974 three government bodies, CONADIN, CADAFE and the Ministry of Mines (MEM) have been involved in exploration for uranium. Exploration during this period consisted mainly of radiometric carborne surveys, geochemical soil and water surveys, and detailed geologic studies. CONADIN currently acts only as an advising agent with one geologist while CADAFE is funding a small research program on the geochemistry of uranium in tropical climates. Exploration for uranium in Venezuela is at a very low point.

OCCURRENCES OF URANIUM

Known occurrences of uranium are not abundant in Venezuela and no occurrence has been sufficiently explored to develop any ore reserves.

For the purpose of this report the known uranium occurrences have been described by Province and State or Territory. The states where radioactive anomalies and uranium occurrences have been found and partially studied are as follows: (Fig. 3)

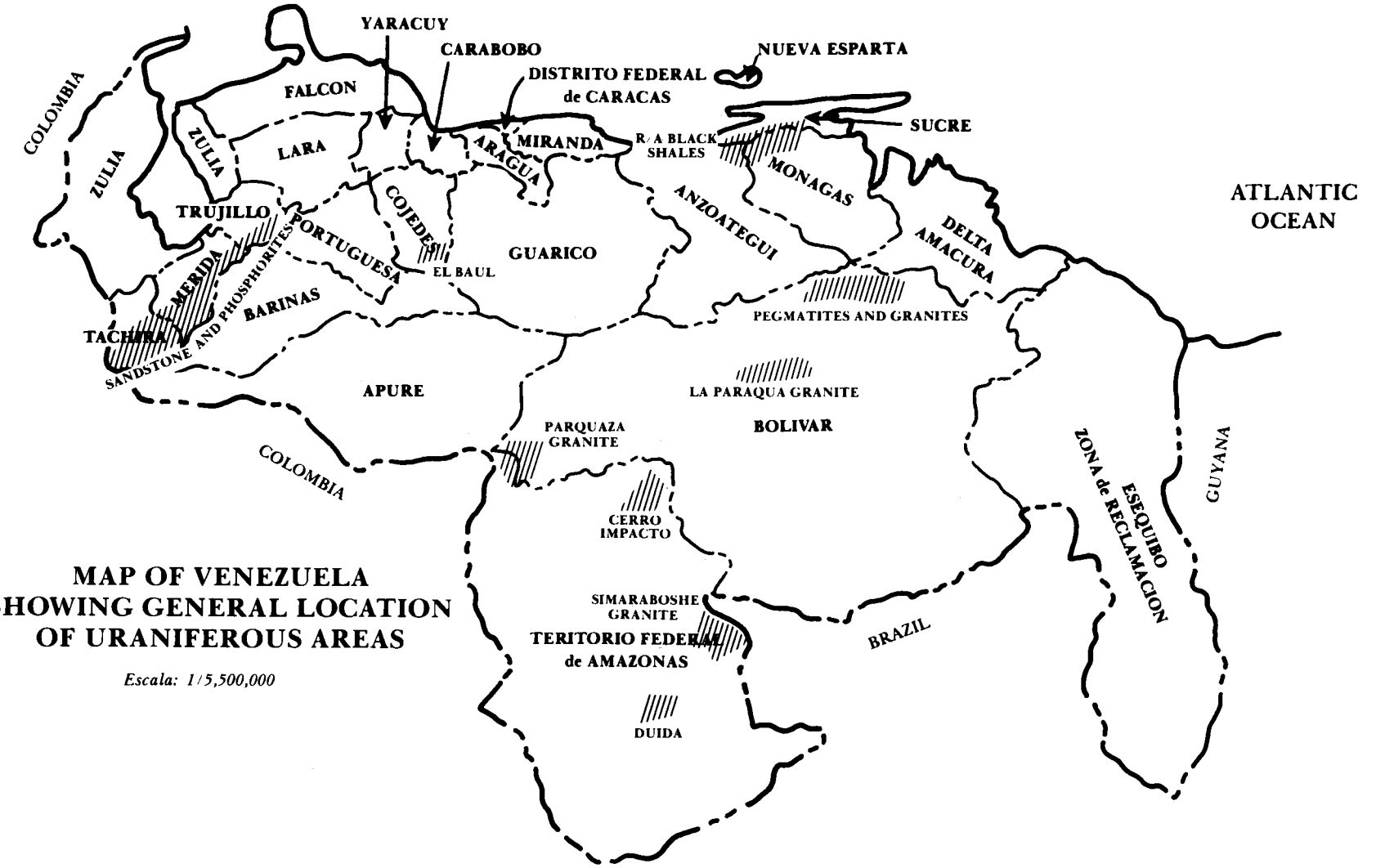
a. Venezuelan Mountains: Tachira, Marida and Trujillo States
b. Guayana Shield: Bolivar State and the Amazonas Territory.
c. Llanos Province: Cojedes, Anzoategui, Monegas and Sucre States.

Venezuelan Mountains - Andean States

Crystalline, metamorphic and sedimentary rock units which have radioactive anomalies and uranium occurrences are as follows:

1. Iglesias Group - Precambrian -- Uranium anomalies (up to 60 ppm) occur in micaceous gneiss, micaceous pegmatites and in amphibolites near the town of Aquila, Merida State.

2. La Quinta Formation - Jurassic -- A few small uranium occurrences and anomalous areas are found in this unit which consists of continental beds of sandstone, siltstone and mudstone with some thin local limestone and conglomerate lenses. Small quantities of acid to intermediate volcanic extrusives are also present. The known occurrences are found in a variety of environments as follows:



MAP OF VENEZUELA SHOWING GENERAL LOCATION OF URANIFEROUS AREAS

Escala: 1/5,500,000

FIGURE 3.

a. Pods of arkosic sandstone with organic matter in the matrix and minor quantities of black uranium minerals located in the area of Chorro del Indio, Mesa de Chaucha, District of San Cristobal, Tachira State. Selected samples reportedly assayed as high as 3,337 ppm uranium.

b. Radioactive, interbedded carbonaceous seams in an arkosic sandstone located at La Quebrada El Tesora (Los Canos-Uribante area, Tachira State).

c. Volcanic or sedimentary rocks (waterlain tuff or ashes) with minor occurrences of uranium with associated silver and copper located in the area of Los Canos de Uribante, Tachira State. Some uraninite has been identified in a selected volcanic glass sample which assayed 2,000 ppm uranium.

3. La Luna and Navay Formations - Cretaceous -- These two formations are laterally equivalent and consist of black shales and grey-black fetid limestone. Marine phosphorite beds occur throughout the La Luna and Navay Formations but they are discontinuous and frequently occur as isolated lenses or pods. Some of the phosphorite beds contain uranium averaging 70 ppm in the following areas.

a. East of San Joaquin de Navay, Tachira State, the La Luna Formation has a facies change to the Navay Formation which contains an extensive phosphorite bed. This facies change occurs in the transition zone between the deep Uribante Basin on the west and the Barinas platform on the east.

b. Several anomalous radioactive areas have been identified in the Las Cruces and Capaz region in Merida State. The anomalous areas are associated with phosphorite beds which reportedly average 140 ppm uranium.

c. In the Mines-Torococo region, Trujillo State, one anomalous area has been identified in phosphorite beds of the La Luna Formation.

d. In the Las Tapas-Los Monos region, Tachira State, an anomalous area is located in very permeable phosphatic quartz sandstone, phosphatic mudstone and beds containing fish bones and mollusc remains, in the Navay Formation. The estimated uranium content for the phosphatic quartz sandstone is 100-600 ppm while the phosphatic mudstone averages 50-200 ppm and the rocks with organic remains averages 50-160 ppm uranium.

In general the quantity of uranium in the phosphorites of the La Luna Formation is too low to be a potential source of uranium. The Navay Formation has the greatest tonnage and the highest grade of phosphate. It also has the highest grade uranium which could be recovered as a byproduct of wet process phosphoric acid production. The potential is limited however to near surface deposits enriched by weathering.

4. Isnotu and Beltijoque Formations - Miocene -- Minor radioactive anomalies have been detected in these two formations in continental, arkosic sandstone, siltstone and mudstone facies on the northwestern flank of the Merida Andes. The sandstone in some localities contains abundant organic plant debris.

5. Bocono Fault Zone - Several anomalous areas have been identified along the Bocono fault zone in metamorphic rocks of the crystalline core and in the La Quinta Formation.

Guayana Shield

Aerial radiometric surveys in the Guayana Shield reportedly identified a great many anomalous localities. Many of these anomalies however are probably false anomalies and are due to unmapped variations in the surface geology. To date ground follow-up studies to evaluate the many apparent anomalies has been very limited. The most significant anomaly, the Cerro Impacto, was drilled but the anomaly appears to be a thorium occurrence.

A radiometric airborne survey along the road from Ciudad Bolivar to Santa Elena detected several anomalies in the Imataca Province related to refractory type minerals in pegmatites, anomalous granites and minor soil anomalies.

Llanos Province

Anomalous radioactivity has been found by carborne surveys in late Paleozoic El Baul granite in Cojedes State. Subsequent ground follow-up work revealed uraniferous thorite in fault zones associated with hematite, (2,000 ppm U_3O_8 in selected samples). Triassic-Jurassic volcanic rocks in the same area are also slightly mineralized.

Carborne surveys near the common boundary of Anzoateque, Monagas and Sucre States has discovered uranium (171 ppm) in black shales interbedded with sandstone.

FAVORABLE AREAS FOR SPECULATIVE POTENTIAL RESOURCES

Past exploration in Venezuela has resulted in the discovery of very few uranium occurrences and radioactive anomalies except for the many airborne anomalies recorded on the Guayana Shield. To date no economic deposits or significant uranium occurrences have been found in Venezuela except for the uraniferous phosphorites in the Cretaceous Navay Formation which are very low-grade. There has been no production and there are no official government estimates of uranium resources for Venezuela. Physical exploration in the country however has been extremely limited.

The mission estimates that the Speculative Resources of Venezuela are between 2,000 and 42,000 tonnes uranium. The most favorable host rocks for Speculative potential uranium resources appears to be in the Guayana Shield area. However the severe climatic conditions and the inaccessability of this area will make the task of developing this potential difficult and expensive.

Based on the geology of the country gleaned from what little literature is available, particularly the Guayana Shield area, correlating with uranium deposits discovered in similar geological environments, past exploration results and limited field examinations, the following geologic environments and the estimated speculative potential could be hypothetically expected.

a. Guayana Shield

From the standpoint of Speculative Potential, the Precambrian rocks of the Guayana Shield are perhaps of most interest and at least six different types of uranium deposits may be postulated as follows:

1. Precambrian unconformity related type deposits. The main interest is the unconformity of the Roraima Sandstone on the lower Proterozoic.

2. Disseminated uranium in igneous and metamorphic rocks. Disseminated uraninite may be associated with alaskite or albitite mostly in shear zones as in the Rossing type deposit. The great fault lineaments in the Guayana Shield would be favorable targets.

3. Hydrothermal vein type deposits in igneous and metamorphic rocks. This type of deposit is associated with syntectonic and late tectonic intrusive leucogranites, rich in deuteritic fluids and alteration zones associated with episyenite bodies. This type may also be associated with large alkalic intrusives as Pocos de Caldas in Brazil. The most favorable areas for this type deposit in the Guayana Shield are

-- syntectonic trans-amazonian granites in the Supamo complex of the Pastora Province.

-- late syntectonic trans-amazonian granites in the Cuchivero Province.

-- late tectonic granites as the Parguaza granite near Puerto Ayacucho.

-- younger alkaline granites as the La Paragua.

4. Acid volcanic rock stockwork and pipe deposits. This type deposit associated with faults and fractures may occur in the effusive acid volcanics in the Cuchivero Province.

5. Sandstone type deposits. This type deposit may be present in paleochannels in the upper part of the lower formation of the Roraima Sandstone Group. This formation consists of fluviatile sandstone and minor conglomerate and is overlain by mudstone and black shales.

While the Mission suggest looking for various types of deposits in Venezuela which are significantly large in other parts of the world, the Mission believes deposits in the Guayana Shield will be relatively small because most of the host rocks are mantle derived rather than from the sialic crust. Thus, the Mission's estimate of Speculative Potential in the Guayana Shield range between 0 and 25,000 tonnes uranium.

b. Llanos Province

Two areas are considered to have minor quantities of Speculative uranium resources in this province. These areas include:

1. Tertiary sediments in the eastern Llano Province south of the Orinoco Oil Fields and north of the Guayana Shield. The potential host rocks for the postulated sandstone type uranium deposits are the continental and fluvio-deltaic facies of the Morichito, La Pascua, Las Piedras and the Chaguaramas Formations. These formations are transgressive on the Guayana Shield. Precipitation of the uranium, probably leached from the Guayana Shield, could be due to a reducing environment produced by organic material in the sediments and/or H_2S from the petroleum in nearby oil fields.

Because of the lack of any positive indications of uranium and because the sediments cannot be examined on the surface, the mission assigned a Speculative Potential estimate of 0 to 5,000 tonnes uranium to the area.

2. El Baul area in the northwest section of the Llanos Province in Cojedes State. Minor, unexplored uranium occurrences have been found in faults and fractures of the central facies of the Paleozoic El Baul granite intrusives and in Triassic-Jurassic volcanics. Because the occurrences are weak and show no continuity the mission assigned a small Speculative Potential of 0 to 2,000 tonnes uranium to the area.

c. Venezuelan Mountains and Maracaibo Basin Province

There is a limited potential for uranium in this province, mainly in Tachira State. The States of Merida and Trujillo are less favorable. After field examination of selected areas and review of all available literature, Speculative Potential resources were estimated in two formations as follows:

1. La Quinta Formation. Only the upper part of the Jurassic La Quinta Formation (upper 200-300 meters) near the unconformable contact with the lower Cretaceous Rio Negro Formation appears favorable for the discovery of commercial uranium deposits. The mission estimates the Speculative Potential Resources of this formation to be 0 to 4,000 tonnes uranium.

2. Navay Formation. Some Speculative Potential, i.e., 2,000 to 6,000 tonnes uranium is assigned to the Cretaceous Navay Formation in the State of Tachira to be recovered as a byproduct of wet-process phosphoric acid production. Currently there are no acid processing plants in the area but some of the phosphate is of commercial grade.

RECOMMENDATIONS

The national economy of Venezuela is essentially based on development and production of its large oil reserves. Therefore, it is difficult for National Organizations concerned with uranium to obtain adequate funding to develop alternative sources of energy. As a consequence the budget and effort currently being expended on uranium exploration is extremely small.

The mission recommends that over a period of five years, some 18 million U.S. dollars be spent on surface surveys, including some drilling, in a first phase reconnaissance program in Venezuela. The objective of this first phase would be to identify new occurrences and to verify and further delineate the aerial extent of the presently known occurrences and trends and to provide a geological, geophysical and geochemical data base for an in-depth evaluation of the uranium resources. Suggested projects to be accomplished in this first phase are as follows:

Guayana Shield Province - The first priority should be directed toward the unconformity related type deposits which may occur below the Roraima Sandstone. This should be followed by studies for hydrothermal vein-type deposits in igneous and metamorphic rocks, and then exploration for stockwork and breccia pipe deposits in volcanic rocks in the Cuchivero Province. Geologic studies including mapping, ground radiometrics, geochemical sampling, detailed gamma spectrometric airborne surveys and trenching are recommended for this large area.

Llanos Province - Since most of the Tertiary Basins are covered by thick Quaternary and Recent sediments, surface studies are of little value. Compilation of a detailed study of all available data particularly oil well logs and cuttings from the drilling are recommended. Hydrogeochemical sampling of water wells should be initiated. Some drilling to test the favorability of the sediments is also recommended.

In the El Baul area exploration techniques similar to those in the Guayana Shield should be applicable, i.e., geologic mapping, radiometric traversing, geochemical studies and trenching and sampling. In addition, some drilling is recommended to determine if the uranium and structures persist at depth.

Venezuelan Mountains and Maracaibo Basin - Because surface exploration work in the known favorable areas such as on the La Quinta Formations in Tachira State has been extensive and less than successful it is improbable that additional work of this kind would materially change the current situation. Further surface work in these areas should be mainly designed to assist in understanding of the sedimentalogy and paleoclimate during deposition, hydrology, and the geologic structures at depth. Helicopter radiometric traversing would expand on the extensive carborne surveys and determine if trends may be established. Some drilling is recommended on the best occurrences.

Recommended exploration in the Navay Formation consists of drilling to varying depths in the potential areas to corroborate and if possible expand the estimated potential.

A summary of the Mission's proposed cost of exploration and the Speculative Potential estimates is given in Table I.

TABLE I

IRUEP MISSION 5 YEAR FIELD RECONNAISSANCE PROGRAM
AND SPECULATIVE URANIUM RESOURCES

Province	Surface Kms^2	Drilling meters	Estimated expense U.S.$	Speculative uranium resources* metric tonnes
Guayana Shield	100,000	- - - -	10,000,000	0 to 25,000
Llanos				
Tertiary	30,000	9,000	1,000,000	0 to 5,000
El Baul	2,000	5,000	2,000,000	0 to 2,000
Andes Mtns	45,000			
La Quinta		8,000	2,750,000	0 to 4,000
Navay		2,000	250,000	2,000 to 6,000
Total	177,000	24,000	16,000,000	2,000 to 42,000
Geologists training & consultants			500,000	
Overhead (10%)			1,500,000	
Grand Total	177,000	24,000	18,000,000	2,000 to 42,000
		Bolivares	77,400,000	

* Speculative Resources refers to uranium in addition to Estimated Additional Resources, that is thought to exist mostly on the basis of indirect indications and geological extrapolations in deposits discoverable with existing exploration techniques. The location of deposits envisaged in this category could generally be specified only as being somewhere within a given region or geologic trend. As the term implies, the existance and the size of such resources are highly speculative.

FUTURE EXPLORATION SUMMARY

In 1980; CONADIN, recommended a five-year plan for uranium exploration in Venezuela. This proposed plan which includes personnel requirements, equipment needs, target areas, exploration methods, and the estimated costs of Bolivares 352,000 per year for five years ($2,243 U.S. dollars per year) has not been officially adopted by the Government to our knowledge.

Comparison between the IUREP mission proposal and the recommendation of CONADIN appears to be less than two million U.S. dollars. The mission in effect, agrees with the magnitude of the exploration program recommended by CONADIN although the relative emphasis on techniques may differ as for example, in the greater use of geological field reconnaissance surveys which the Mission recommends. It would however call for much new modern equipment, well trained crews and first class administration and geological management.

ANNEX

Those wishing to consult the full report on which this summary is based should write to one of the following:

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