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GEOLOGY OF PEAT DEPOSITS OF COSTA RICA

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ABSTRACT: The peat deposits of Costa Rica are better developed in the alluvial plains of the atlantic coast (tras-arc basin) and along the mountain systems. The peat swamps along the atlantic coastal plain display a morphology analogous to the back barrier or in irregular shapes which are associated with flooded areas of meandric rivers. Locally, peat thickness, are relatively continuous from 0.5 m to 15 m with calorific values varying from 2975 to 4695 kcal/kg (dry basis) and low in sulfur.

The Yolilla (Raphia) palm fragments are the main plant component of the atlantic coast peat deposits. The inorganic components originated in the magmatic arc to the south, which acted as the source for the volcanic sediments.

Peats along the small intra-arc basin (Talamaca range) are found in the higher valley elevations. These types of the peat deposits have not been well developed and have irregular cross-sections. Cold climate, the high precipitation, poor drainage and lack of inorganic sedimentation, inhibit the decomposition of organic matter and produce a low sulfur and ash peat, with a relatively high calorific value.

In this environment, the vegetation is that of tropical cloud forest with extensive open areas containing herbaceous vegetation such as sedges, ferns, peat moss (Sphagnum) and heaths.

RESUMEN: Los depósitos de turba de Costa Rica, se han desarrollado mejor en las planicies aluviales de la costa atlántica (cuenca tras-arco) y en los sistemas montañosos (pequeñas depresiones del arco magmático). Los pantanos de turba en las llanuras del atlántico, poseen una morfología alargada tipo tras-playa (back barrier) o bien formas irregulares asociadas a planices de inundación en ríos meándricos. Las turberas, localmente, son mantos relativamente contínuos con espesores de 0.5 m hasta 15 m, con valores caloríficos que oscilan entre 2975 y 4695 kcal/kg (en base seca) y bajos en azufre.

El contenido orgánico son pricipalmente fragmentos de Yolillo (Raphia), palma guía que identifica las turberas en la zona atlán-tica. Los componentes inorgánicos proceden del arco magmático si-tuado al sur, el cual aporta sedimentos principalmente de origen volcánico.

Las turberas de las depresiones inter-montanas, se localizan en las zonas más altas de Costa Rica (Cordillera de Talamanca, arco magmático). Este tipo de turberas son poco desarrolladas y poseen secciones transversales irregulares. El clima frío, la alta preci-pitación, el mal drenaje y la falta relativa de sedimentación inor-gánica, evitan la descomposición de la materia orgánica y producen una turba baja en azufre y con un valor calorífico relativamente alto. El componente orgánico más importante aquí es el musgo (Sphagnum), zacates, helechos y juncias.

INTRODUCTION

A first effort to define the areas with some peat potential in Costa Rica occurred during the map drawing of Ground Subgroup Association of Costa Rica (1978) at 1:200.000 scale of the National Geographic Institute (N.G.I.). Afterwards, in 1983, the Ministry of Industry Energy and Mining, gave RECOPE the responsibility of the research and development of the peat resource program at national level.

Based on the soil subgroup maps of Costa Rica, the petroleum Resources Division members (División de Recursos Carboníferos -D.R.C., RECOPE S.A.), marked the limits of the areas

with peat potential in the country. On March, 1984, Costarrican personnel of the D.R.C. and the Alamos National Laboratory of New Mexico (DR A. Cohen & R. Raymond) carried out the first peat sampling in the areas of San Isidro del General, Medio Queso de San Carlos and the Coastal North-East Plains, between and Parismina. Mission gathered preliminary field data and measured the peat potential of such swampy areas in Costa Rica.

From 1986, the exploration and evaluation of peat resources have been concentrated at Medio Queso swamp in the north area and at Moín, Aeropuerto and El Cairo swamps in the Caribbean Coastal zone and less frequently in other areas of Costa Rica.

LOCATION OF DEPOSITS

Swamps in Costa Rica have been developed in different tectonic basins (Fig.1). Nevertheless, most of them are located in the back-arc basin especially in the back barrier zones (for instance, Tortuguero, Moín and Aeropuerto peat deposit) or in areas of alluvial plains frequently flooded by meandric rivers in Medio Queso, El Cairo and Tortuguero peat deposits.

Other deposits are found in small elevated inter-mountain basins of the magmatic arc of Costa Rica (Talamanca).

The limited drainage, cold and wet climate typical of these places, favor the development of swamps with variable form and size, which offers the optimum conditions for the flora development and peat accumulation.

The biggest swamp areas of Costa Rica are located in the coastal plains in the Caribbean. Zones such as Barra del Colorado, Tortuguero, Parismina, Moín have swamps with significant potential in which evaluation and investigation have to be done (OBANDO,1986, Internal Report, RECOPE).

Other areas of interest have been studied near the border plains North of Costa Rica, especially Medio Queso and Caño Negro, at alluvial area of The Pacific Coast, especially in Sierpe, Naranjo, and Tempisque Rivers.

The preliminary study of the deposits shows peat thicknesses of 0.5 m up to 15 m (for example El Cairo) with calorific value between 2.468 kcal/kg and 4695 kcal/kg at dry base (Table 1).

The resources mentioned as previous calculated by the Los Alamos Laboratory staff (COHEN & RAYMOND, 1984) are as follows (in metric tons):

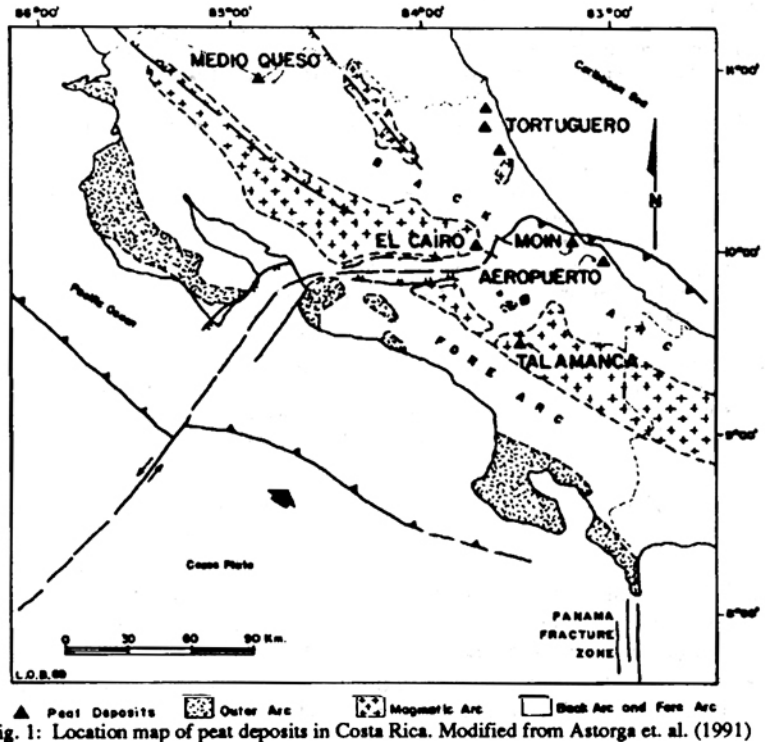

Fig. 1: Location map of peat deposits in Costa Rica. Modified from Astorga et. al. (1991)

Medio Queso : 8.400.000 M.t dry (0.6 m thick).
El Cairo : 1.300.000 M.t dry (4 m thick)
Talamanca : 38.500.000 M.t dry (1 m thick)
TOTAL : 48.200.000 M.t dry

These values have just been increased with the results of the preliminary evaluation by OBANDO & MALAVASSI (1987, RECOPE, internal report), which estimates a total of 12.852.000 M.t. and 5.400.000 M.t. dry for Moín and Aeropuerto deposits respectively.

Therefore the total preliminary deposits of peat in Costa Rica are estimated in 66.452.000 dry M.t. (OBANDO & MALAVASSI, 1987, RECOPE, internal report).

DEPOSITS

The deposits studied up to now are 6 (Table No.1), most of them are found at the Caribbean coast. They can be clearly identified by palm tree RAPHIA (Jolia) (COHEN & RAYMOND, 1984), which is the prevailing specie in these swamps.

RIO MEDIO QUESO PEAT DEPOSIT

The peat deposit of Medio Queso River is part of area flooded on the back arc basin of Costa Rica. It is located at approximately 1 km west the town of Los Chiles, Northern Costa Rica (Fig.2).

The Medio Queso River swamp is narrow in Costa Rica and its more developed towards Nicaragua. There is an asphalt, paved road, from San José to los Chiles, shifting in the area done along the neighboring roads, not only public but also private. In winter (from May to December) a four wheel drive vehicles required while in summer it is possible to travel in a single traction car using alternate roads.

Late in summer (at the end of March), there is access in a double wheel drive by the Rio Medio Queso plain.

The Medio Queso peat deposit is in a plain, which occasionally is totally cavered by 1 or 2 m of calm water. This plain is well defined and the surrounding elevated areas produce a strong and obvious topographic change towards the plain.

Table Nº 1

Peat deposits of Costa Rica

Peat deposits	(p) Tortuguero	(a) Moin	(a) El Cairo	(a) Aeropuerto	(o) Medio queso	(*) Talamanca
Investigation stage	Exploration	Exploration	Exploration	Exploration	Prefeasibil	Exploration
Boreholes	2.0	17.0	5.0	2.0	53.0	5.0
Samples	12.0	85.0	187.0	14.0	264.0	29.0
Thickess (maximum meters)	1.5	2.1	15.0	1.5	2.0	1.3
Thickness (average meters)	1.2	1.6	10.0	1.0	1.6	1.0
Area (km^2)	+ 70	34.0	2.0	3.0	5.5	175.0
Peat resources (T.M. dray)	N.D	12,852,000	1,3000,000(*)	5,400,000	1,024,284	38,500,000
Quality (dry basis, average):						
-Calorific value (Kcal/Kg)	3929	3862	2468	4695	2975	4277
-End Moisture (wt%)	17.50	12.50	14.60	11.33	11.16	83.60
–ASH (wt%)	22.93	27.26	49.00	21.60	40.14	26.74
–Volt. matter (wt%)	29.14	43.84	30.14	24.79	30.40	50.00
–Fix carbon (wt%)	37.16	17.00	16.42	46.80	17.22	21.27
–Sulfur (wt%)	0.43	1.50	0.20	0.64	0.33	0.23

(*) = Cohen & Raymond (1984)
(a) = Obando & Malavassi (1987)
(o) = Obando (1988)
(p) = Obando (1986)
N.D. = no data

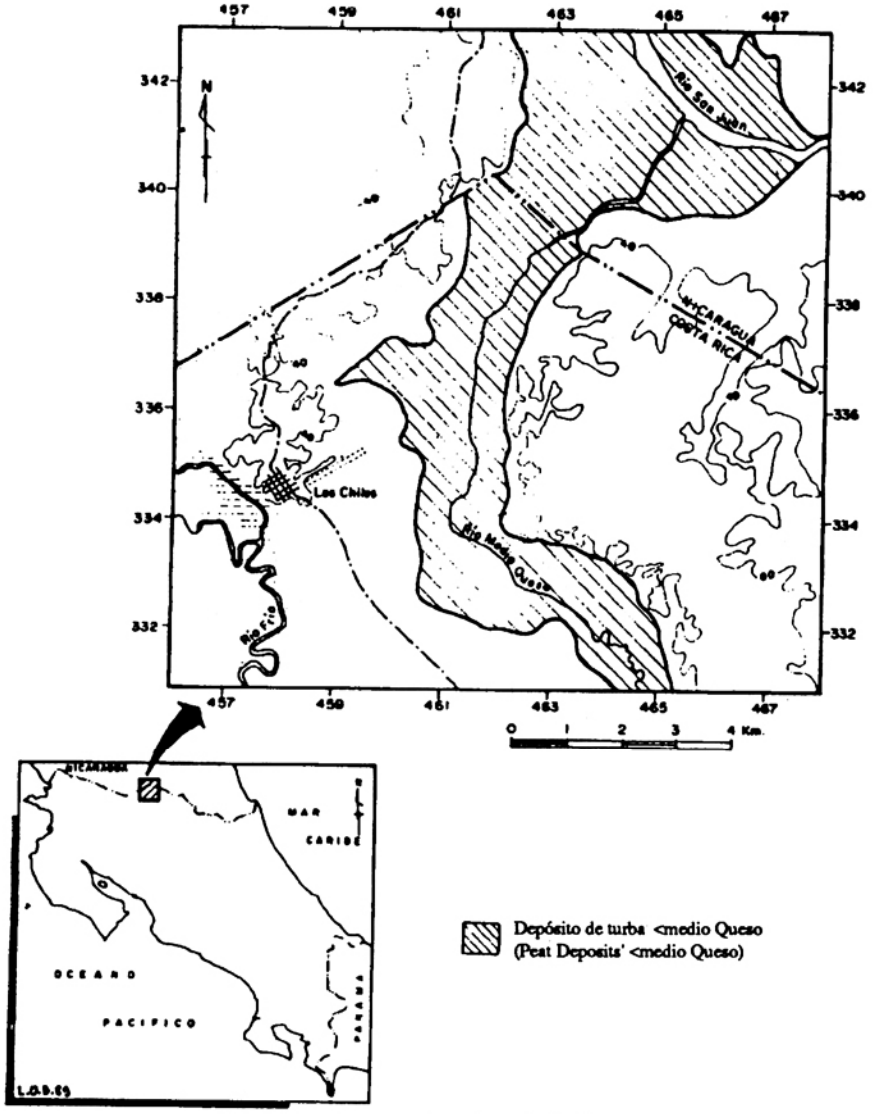

Fig. 2: Location map of peat deposit: Medito queso

The swamp is cover by pasture (Junco and Navajuela), bushes, little developed palm trees and other small plants. The trees are restricted just to the surrounding areas of the river.

The Medio Queso plain has been used for pasturing and agriculture (growth of beans and variety of tubers). The inhabitants have built numerous channels for draining water from the plain in the dry season. This systematic practice has provoked a strong oxidation and carbonization of the peat superficial strata, whereas the clay is mixed with a lot of organic matter, which giving it a very particular black color.

The terrigonous influence in the costarrican side not only on the up borders as the streams of the river it self, have greatly influenced the percentage of inorganic matter contained in the peat deposit. In this way thus, the ash contents are always very high (Table No.1) and most of the chemically analyzed boreholls result to be inorganic sediment (OBANDO, 1988, RECOPE, internal report).

The petrographic study at Medio Queso Peat shows the strong presence of ferns, lily, fodders, sedges and plants (sagittaria sp.) (COHEN & RAYMOND, 1984). Among the organic materials found at Medio Queso, there

is no Yolillo which is the predominant peat flora in other places of the atlantic zones. COHEN & RAYMOND (1984), carried out preliminary studies about peat features, indicating that the overall peat deposits were 8.400.000 dry M.t in a 70 km^2 area. Recently, OBANDO (1988, RECOPE, internal report) by carrying out detailed studies, with sampling nets (264 samples, Table No.1) in Costa Rica area, shows that for energetic uses, of the potential area is restricted to 5.48 km^2, and the resources are: 181.989 M.t dry (< 25% ash, ASTM standard), 791.116 M.t.dry organic sediment (25-50% ash, ASTM standard), and the total resources of organic matter are 1.024.264 M.t dry.

COHEN & RAYMOND (1984), have indicated that such organic matter has an excellent agricultural and horticultural use. OBANDO (1988, RECOPE internal report), suggests the production of biogas (CH_4).

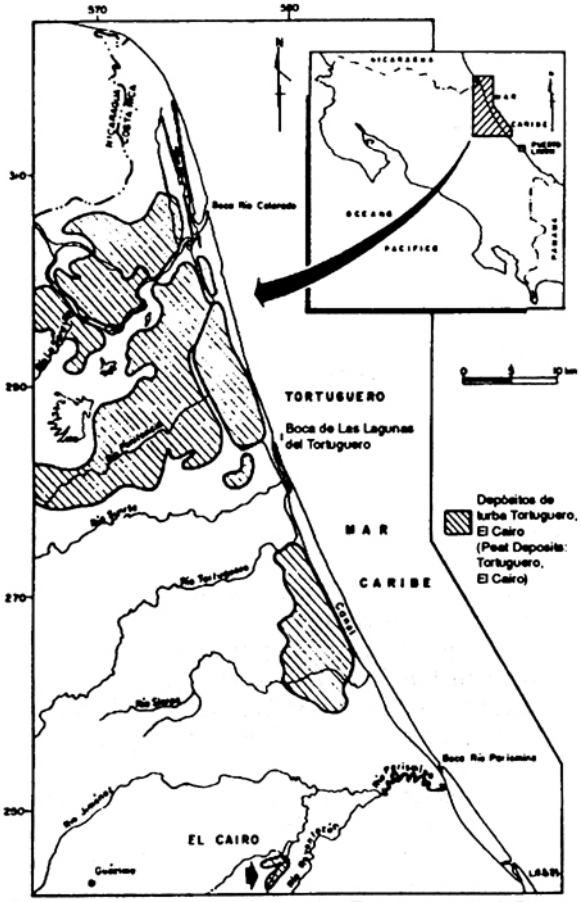

Fig. 3: Location map of peat deposits: Tortuguero and el Cairo (Río Silencio).

TORTUGERO PEAT DEPOSITS

These deposits are located at the north, in the atlantic Coast (Fig. 3), Limón province. There are big deposits in the back-arc basin. These deposits with high peat potential extend from the Nicaraguan border to the Parismina river, covering an 830 km^2 area approximately and have been originated as deposits of back barrier and meandric rivers. Sierpe, Tortuguero, Penitencia and La Sardina rivers among others drain the areas where these peat deposits are located.

Communication with the surrounding towns to the Barra del Colorado, Tortuguero area, for example, is done by using an artificial navigable channel which links the whole Caribbean Coast with Limón City, to the southeast.

These peat deposits are in the exploration phase and have only 12 samples have been gathered (OBANDO, 1986, RECOPE, internal report), chemical characteristics are given on Table 1.

EL CAIRO PEAT DEPOSIT (SILENCIO RIVER)

Located east of Guácimo Town (Fig. 3), 11 km north of Herediana Town, Limón Provincia. The surrounding area nearby this place Josefina Peje, Silencio and Herediana.

El Cairo Peat Deposit, with a 2 km^2 area, consists on a small alluvial local plain in the back-arc basin, drained by sub-meandric rivers: Silencio and Salto. The deposit has a wild jungle including Yolillo (Raphia) and trees little developed.

The maximum depth tested at this peat deposit is of 15 m, which is abnormally high for the national peat deposits (OBANDO & SOTO, in press). 187 samples have been taken from the preliminary exploration work at El Cairo. Nowadays, investigation has been oriented towards the exploitation for agricultural and horticultural uses in order to sell and export ornamental plants.

MOIN PEAT DEPOSIT

Located north of Limón City, at the Caribbean Coast (Limón Province, Fig. 4) at approximately 4 km northwest of the Refinery of RECOPE. It has a 34 km^2 area. The nearest towns are: Liverpool, Búfalo, Maravilla and Cocal.

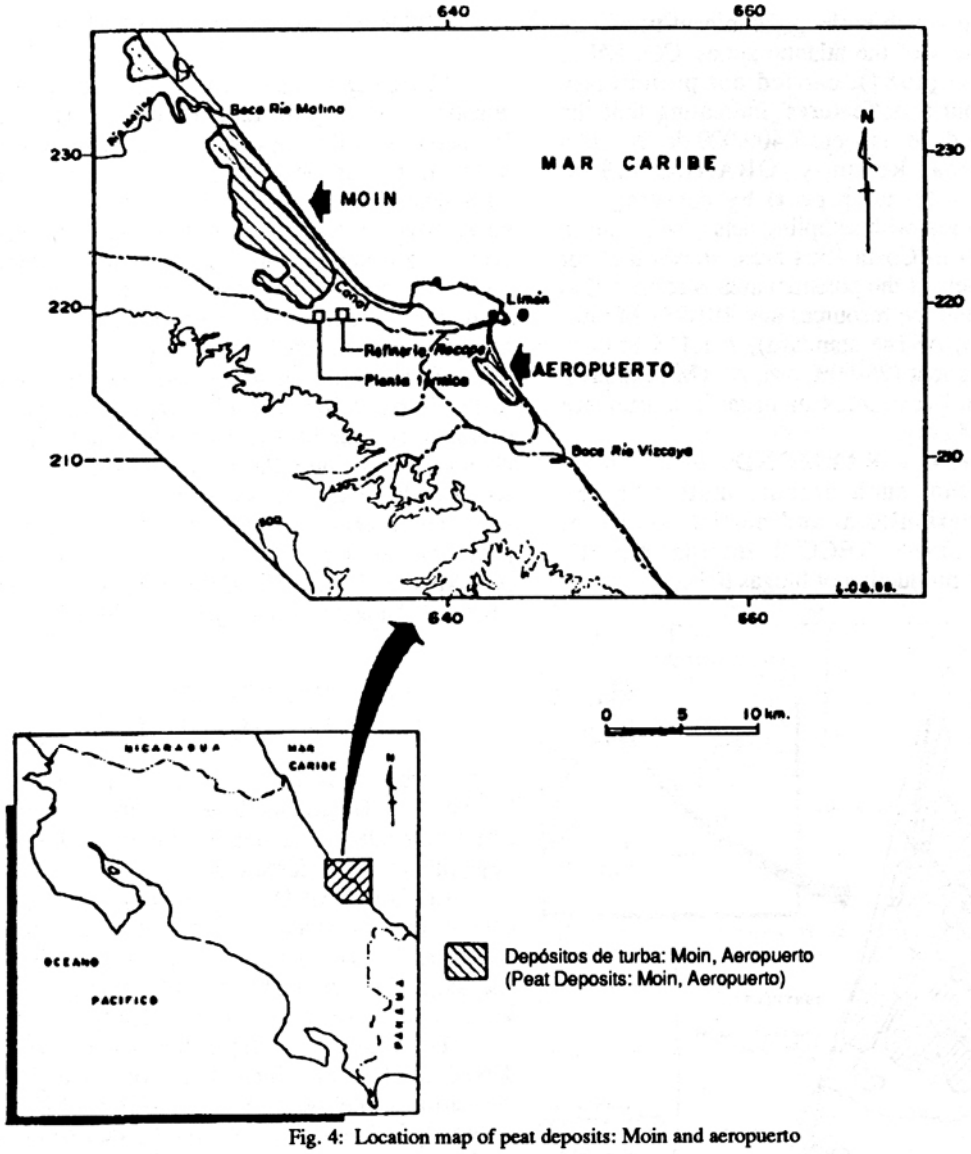

Fig. 4: Location map of peat deposits: Moin and aeropuerto

The Moín Peat Deposit is located at strategic place, near the Refinery of Petroleum and the Moín Thermoelectric Plant (4 km northwest, Limón City), Limón Airport and Limón Port (6 km east), the main port of Costa Rica at the Caribbean Coast.

This peat deposit corresponds with a back barrier deposit in the Tras-arc Basin, drained by Vueltas, Toro and Pascual rivers and the artificial channel that run parallel to the coast. The fluvial contribution (the ones which are high at the rainy season) are carried by Toro, Cuba, Escondido rivers and other maior drainages. Most of the vegetation is Yolillo, mangrove tree, trees and diversity of vascular plants.

Up to now, 85 samples out of 17 wells have been analyzed (Table No. 1), and show a 1.6 m thickness average, a 38 kcal/kg calorific value, a 27% ash an d 1.5% sulphur, the highest in the whole country.

Due to nearness of the Refinery of Petroleum to the Moín Peat deposit, it has been proposed the use of this peat for the production of electric energy and substitute partially the bunker used for the refining processes.

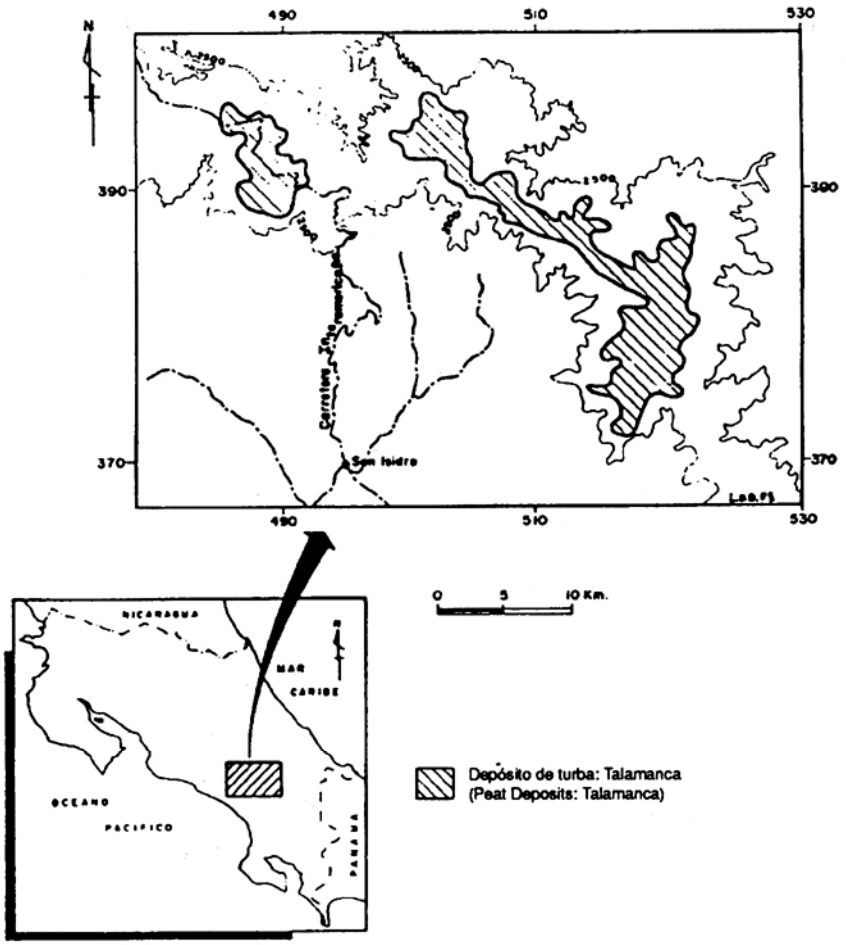

Fig. 5: Location map of peat deposits: Talamanca range.

AIRPORT PEAT DEPOSIT

It is located at the Tras-arc Basin, south of Limón City (in front of the airport, Fig. 4) and has an asphalt road which leads to Limón City and the southeast of the region.

With elongated shape parallel to the coast, this is a back barrier deposit with a 3 km^2 area approximately. The peat deposit is drained by the Cieneguita Swampy and the Westfalia stream. Vegetation includes Yolillo and its extension has been reduced notably due to the use of land for cattle feeding.

Up top now, 14 samples have been gathered in the current exploration phase, there is one meter of average thickness, with a 4695 kcal/kg calorific value and a 21.6% ash, and 0.64% sulphur (OBANDO & MALAVASSI, 1987, RECOPE, internal report).

Due to its low content of sulphur and high calorific power, this peat has several applications like electric generation, agriculture and horticultural uses.

TALAMANCA PEAT DEPOSIT

Located in the moors of the Talamanca mountain range (Fig. 5), north and northwest of San Isidro Town, southeast of San José.

They are moors with elongated peat, which occurs in the small closed basins of the Magmatic arc of Costa Rica. The total area is of 175 km^2 approximately. The Peat Deposits of the Magmatic Arc are located in the highest areas, where they cover the intra-arc basins. These basins are little developed and have irregular transversal areas, some of which do no have drainage.

The cold weather, high humidity, and precipitation, as well as inefficient or drainage avoid the decomposition of organic matter, producing a low sulphur peat (0.23%) and relatively high calorific value (4277 kcal/kg). The most important organic content here is the moss (sphagnum) as well as grass, ferns, and sedges (COHEN & RAYMOND, 1984).

According to COHEN & RAYMOND, (1984), this peat could be used in agriculture, horticulture, chemicals, and energetic use as well.

USAGE

THAYER et al.(1985), has estimated 13 possible uses for the peat in Costa Rica, taking into account cost, technical risks, balance of payments, needs and domestic priorities. These are, boilers of fluidized stratum, gasification (low BTU), substitute for natural gas, ammoniac, electricity production, refrigeration, agricultural and horticultural uses.

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