Proceedings World Geothermal Congress 2000
Kyushu - Tohoku, Japan, May 28 - June 10, 2000

NICARAGUA COUNTRY UPDATE

Ariel Zúñiga and Mauricio Medina

Instituto Nicaragüense de Energía, Apartado Postal 3226

Abstract

Geothermal studies in Nicaragua started at the end of the 1960s, demonstrating the large geothermal potential of the country and giving priority to the Momotombo and San Jacinto field.

The principal use of geothermal energy in Nicaragua is for electric power generation from high enthalpy resources in five geothermal areas. However an ongoing project includes the use of low enthalpy fluids in rural electrification and direct uses at Ometepe Island and Cosigüina Volcano, with the support of the European Community and the U.N. Economic Commission for Latin America and the Caribbean.

The commercial exploitation of Momotombo began in 1983, when the first 35 MWe unit was put in operation. In 1989 a second unit of 35 MWe was installed in the field.

During the 1993-1995 period, seven exploration-production wells were drilled in the San Jacinto-Tizate geothermal area with total depths between 724 and 2,235 m, encountering temperatures form 264 to 289°C. The production tests demonstrated the commercial viability of the field with a proven capacity of 25 MWe.

The Government of Nicaragua is interested in the development of the natural resources of the country particularly geothermal, and has granted concessions to private entities in new geothermal areas, realizing that the private sector could be an important factor in the development of this indigenous resource. Such areas are: El Ñajo-Santa Isabel (relinquished by UNOCAL) to SAI Geothermal Nicaragua, El Casita to Triton Energía S.A. (subsidiary of Black Hawk Mining, Inc.). El Hoyo-Monte Galán to Transpacific Geothermal Corporation and Momotombo to Ormat.

The Geothermal Master Plan Study for the Pacific Coast of Nicaragua is under way with a loan from the Interamerican Development Bank.

Introduction

Nicaragua is a country endowed with large geothermal potential, due to the presence of volcanoes of the Marrabios range along the Pacific Coast. Geoscientific investigations started at the end of the 1960s, prioritizing the Momotombo and San Jacinto-Tizate geothermal fields. These studies reached their apogee after 1973, when the oil crisis affected Nicaragua's trade balance strongly.

The commercial exploitation of Momotombo started in 1983, when the first Geothermal Electric unit of 35 MWe was put in operation. The second unit of 35 MWe was installed in 1989.

In 1993, the drilling of a number of deep exploratory wells began, to demonstrate the existence of geothermal resources large enough to be exploited to generate electricity commercially.

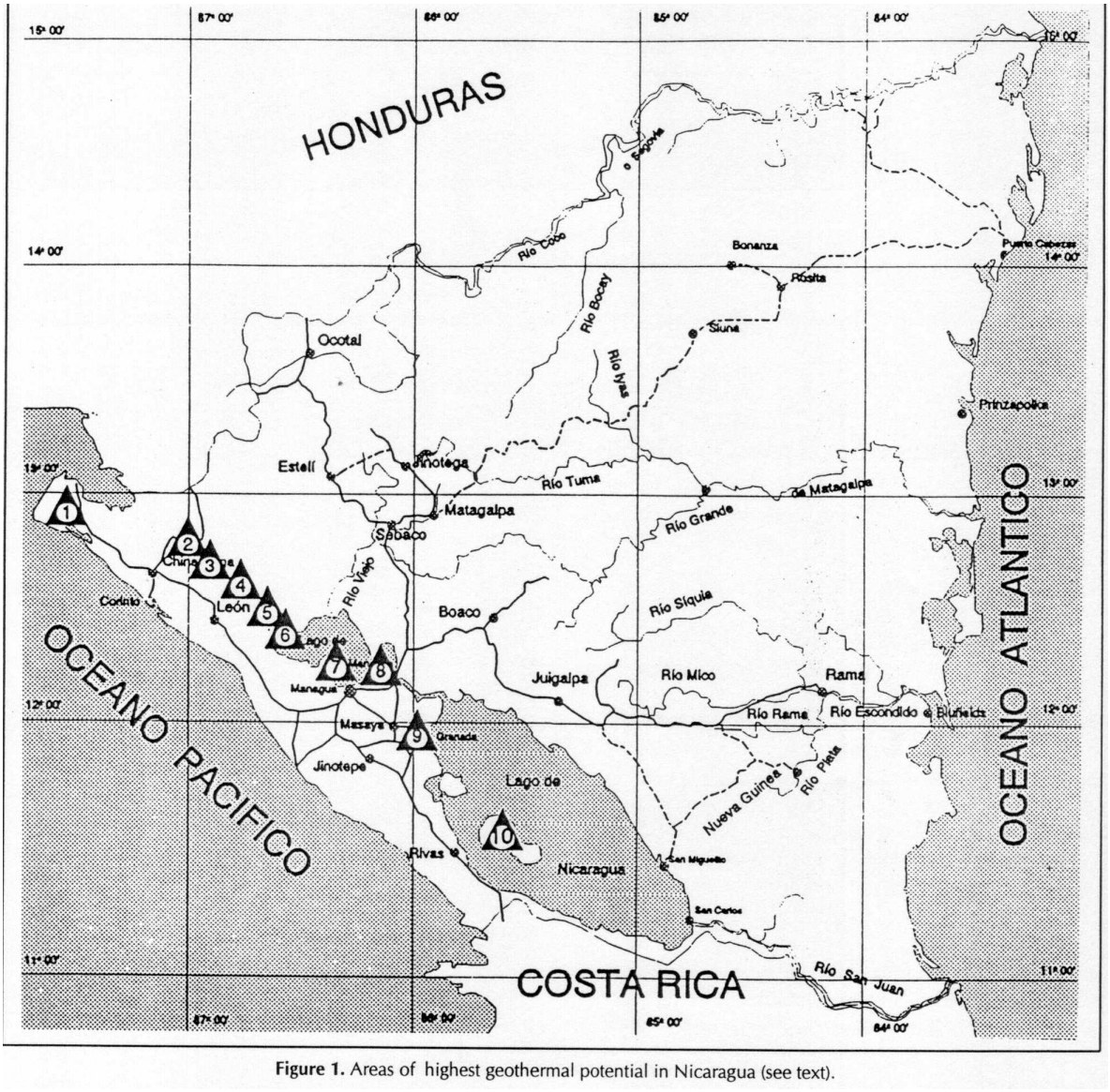

Figure 1. Areas of highest geothermal potential in Nicaragua (see text).

The geothermal investigations identified the following ten areas of great geothermal interest (Fig. 1):

1. Cosiguina Volcano
2. Casita-San Cristobal Volcano
3. Télica-El ÑajoVolcano
4. San Jacinto-tizate Volcano
5. El Hoyo-Monte Galán Volcano
6. Momotombo Volcano
7. Managua-Chiltepe
8. Tipitapa
9. Masaya-Granada-Nandaime
10. Ometepe Island

Geothermal Master Plan of Nicaragua

Studies associated with Nicaragua's Geothermal Master Plan started on August 1999. The main objectives of the studies are to reevaluate and classify the geothermal resources of the country, in terms of electrical generation potential, and to plan for the exploration and development activities that will follow.

The Master Plan in addition to being a planning instrument will offer a solid base which will establish lease limits and conditions for the private sector. The Plan will also be a document describing and promoting the development of Nicaragua's geothermal areas.

The studies in each area will include:

1. General description and geographic limits.
2. Description of available scientific data.
3. Additional geoscientific investigations
4. Data synthesis and reinterpretation
5. Development of a preliminary geothermal

model.

6. Preliminary evaluation of the resource, in terms of electrical power.
7. Evaluation of environmental aspects.
8. Specification of studies needed to reach the feasibility stage**.**
9. Estimation of the costs to reach the feasibility stage.

Geothermal Concession Areas

The Nicaragua Government has released the following geothermal areas for exploration (Fig. 3; Table 1), realizing that the private sector could be an important factor in the development of the natural resources of the country, particularly geothermal.

Table 1. Exploration Concessions

Concession	Area (Km^2)	Concessionaire
El Hoyo Monte Galán	89	TGC
San Jacinto Tizate	90	Intergeoterm
Ñajo-Santa Isabel	100	SAI
Momotombo	9	ORMAT
Casita	128	TRITON

Concession Areas

El Hoyo-Monte Galán

In December 1995, the Instituto Nicaragüense de Energía (INE), the Energy Institute of Nicaragua, granted an exploration lease to Transpacific Geothermal Corporation (TGC) in the El Hoyo-Monte Galán geothermal area to determine the possibility of generating 50-150 MWe using geothermal fluids.

From January 1996 to February 1997, TGC carried out the following studies and investigations:

a) Geologic mapping
b) Gas geochemistry
c) Interpretation of aerial photographs and satellite images
d) Microseismic studies
e) Magnetic reconnaissance
f) Geophysical (MT and AMT) studies.

These studies identified various anomalies indicating a large geothermal resource characterized by shallow seismicity, fumarole activity, surface fractures and high subsurface temperatures.

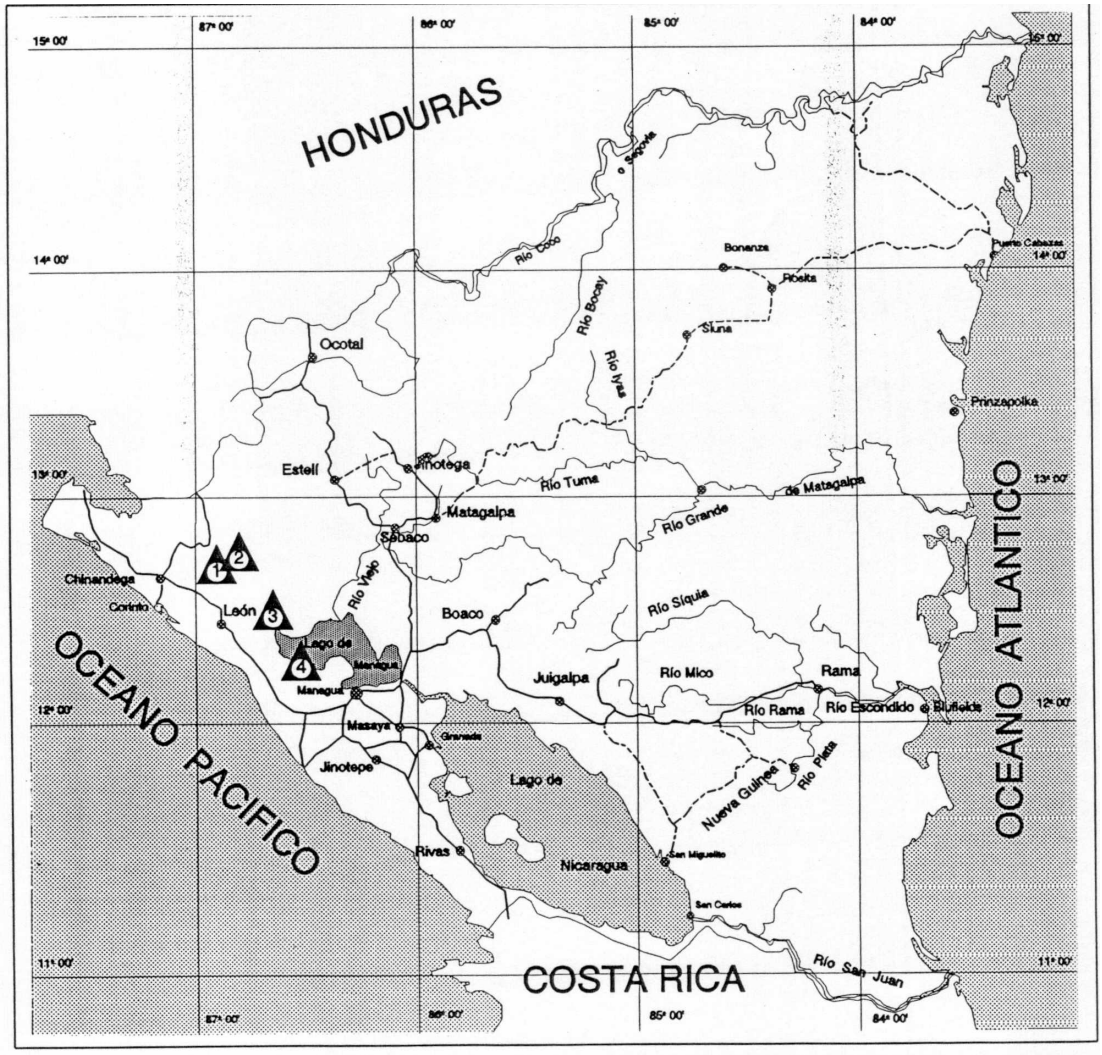

Figure 3. Geothermal concession areas. (1): Ñajo-Santa Isabel; (2) San Jacinto-Tizate; (3) El Hoyo-Monte Galán; (4) Momotombo.

The following four areas were identified as places to drill a number of small diameter wells:

a) Upper regions of the El Hoyo and Picacho Volcanoes
b) Northeast-East of El Hoyo volcano
c) Cerro Colorado
d) Monte-Galán Caldera fracture systems.

Based on volumetric calculations and an integrated analysis of geoscientific data, TCG estimated an economically feasible potential between 150 and 200 MWe within its lease area.

El Ñajo-Santa Isabel

In August 1997, INE granted Unocal Geotérmica Nicaragua, a subsidiary of Unocal Geothermal International, a 100 km^2 exploration lease in the El Ñajo-Santa Isabel geothermal area.

The objective of the lease was to demonstrate the commercial viability of the area on the basis of geoscientific studies and deep exploration-production wells. Unocal carried out the following activities during the last quarter of 1997:

a) Geological mapping
b) Geochemistry studies
c) Geophysical surveys
d) Satellite image interpretation

On August 19 of 1999 Unocal Geotérmica Nicaragua made the decision to relinquish the El Ñajo Santa Isabel exploration concession, therefore SAI Geothermal Inc. created a

subsidiary SAI Geotérmica Nicaragua S.A. in order to follow the surface surveys and investigations made by Unocal. As a result SAI Geotérmica Nicaragua applied for a geothermal exploration concession on the same El Ñajo-Santa Isabel area. This concession was granted from the Nicaragua Government on December 19 of 1999. SAI Geotérmica Nicaragua intends to build a 60 MWe geothermal electric plant.

El Casita geothermal exploration concession.
Black Hawk Mining Inc. has established a subsidiary in Nicaragua, Triton Energía S.A. to develop electrical energy from renewable natural resources.

On August 1999 Triton Energy obtained for INE an exploration concession within an area of 90 km^2 called El Bonete located near of Telica, Santa Clara and Casita Volcanoes.

Objective. Triton Energia´s goal was to carry out geoscientific investigations near the El Limón Mine, as well as to obtain access rights from property owners in the district, to enable it to develop its own geothermal field in order to build a 10 MWe geothermal electric plant to supply its energy needs.

Prefeasibility study. Early exploration results of the prefeasibility study in this area confirmed the existence of a heat anomaly, however the geochemistry and geophysical surveys demonstrated that the heat source is located South – East of the original concession area.

Therefore Triton Energía S.A. has requested a new geothermal exploration concession area to follow the surface survey and investigations on the shoulders of El Casita Volcano close to the former concession of El Bonete area, this new area is called El Casita and it will be 128km^2 in area. The slide and mudflow that occurred at El Casita Volcano in heavy rains from hurricane Mitch in October 1998 caused the deaths of more than 2,000 persons. Triton Energía S.A. must take into in consideration environmental and geologic hazard concerns when planning the development of this geothermal generation project.

Momotombo
The Momotombo geothermal area, located at the foot of the volcano of the same name, was identified and studied starting in the late 1960s. The first four wells were drilled in the early 1970s, culminating in the installation of a 35 MWe unit in 1983. Six years later, a second unit of 35 MWe went on line.

Due to the overexploitation of the field and a total lack of reinjection during the 1980s, the power has declined with time, amounting to only about 20 MWe at present.

At present Ormat is in charge of the operation of the Momotombo field with a goal of reaching a generation level compatible with the installed capacity in the field (70 MWe).

San Jacinto Tizate
In May of 1993, the Nicaraguan-Russian consortium Intergeoterm received from the INE the right to explore the San Jacinto-Tizate geothermal area.

Between 1993 and 1995, Intergeoterm drilled seven wells with depths that varied between 724 and 2,335 m (Table 2). The last well (SJ'7) was not finished due to financial problems.

The measured downhole temperatures are between 264 and 289°C. Wells tests indicated that cumulative capacity of wells SJ-4, SJ-5 and SJ-6 is about 25 MWe (Table 2).

At present, in order to continue the development activities at San Jacinto-Tizate, Intergeoterm is searching for a financially strong partner.

Table 2. Characteristics of San Jacinto-Tizate wells.

WELL	DEPTH	MAX	CAPACITY
SJ-1	2322	188	No Production
SJ-2	1471	97	Impermeable
SJ-3	1867	265	Non Commercial
SJ-4	724	267	Abt. 17
SJ-5	2335	289	Abt. 5
SJ-6	1877	264	Abt.3
SJ-7	1260	-	-

Geothermal Rural Electrification and Direct Application Pilot Project.

The Government of Nicaragua supported by the European Community and the U.N. Economic Commission for Latin America and the Caribbean, will carry out a geothermal rural electrification and direct application pilot project in two areas. Low-and medium-enthalpy fluids will be used at Cosigüina Volcano, and Cosigüina and Ometepe Island. These areas were chosen based on the importance of their agricultural and tourist activities and the results of preliminary investigations.

By using geothermal fluids to generate electricity in isolated zones, such as Ometepe Island, it is possible to reduce the dependence on oil products, which in many instances have to be transported over long distances, sometimes in environmentally sensitive areas. For example in Lake Cocibolca, which hosts unique species, fuel for diesel plant is transported by ship. The possibility of a spill is always a big concern.

The Cosigüina area is predominantly an agriculture zone. Low-enthalpy geothermal fluids could be used extensively to dry grains, in fish farming and in greenhouses.

To summarize, the goal of the pilot project is to demonstrate the use of low-to-medium enthalpy geothermal fluids and help improve the standard of living of the population, from the environmental and economic points of view.

Conclusion

The economic development of Nicaragua depends to a great extent on electrical energy. The country has in its geothermal resources an abundant, cheap, and clean indigenous source capable of satisfying the energy needs of industry, schools and hospitals.

In other words, Nicaragua's geothermal resources can improve the standard of living for its population in the upcoming years.