

## Geothermal Energy Exploration in Environmental Protected Areas in Costa Rica

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### ABSTRACT

The great biological diversity of Costa Rica represents one of its largest resources, and it is a focal point of the country's policies of environmental protection. For this reason the country is recognized worldwide as a leader in protecting the environment. In Costa Rica 25% of the country is environmentally protected and most of the geothermal resources are located in these zones; for this reason it is necessary to set the conditions for developing environmental-friendly geothermal projects in these areas. In the year 2008 Costa Rica's Congress rejected a proposal for a law that tried to allow geothermal exploitation in national parks, so ICE is now working with environmental-related NGOs in order to carry out experimental projects in low-level protected areas. The main objective is to develop the know-how and to prepare a proposal for a new law.

### 1. INTRODUCTION

As a result of the first geothermal studies, many areas of potential geothermal resources were located, and two of these areas are Miravalles and Las Pailas. Miravalles represents the first experience in geothermal development in Costa Rica and Las Pailas is now under construction.

The Miravalles Geothermal Field is located at the Miravalles Volcano in Bagaces Guanacaste between the Blanco and Cuipilapa rivers basins. The Miravalles I and Miravalles II power plants are located at the coordinates 298 000 N-405 700 E at 610 m a.s.l and the Miravalles III power plant at the coordinates 300 150 N-407 050 E at 720 m a.s.l The Miravalles Environmental Assessment was done in 1988. Since it was the first EIA ever done in Costa Rica it would change the way of creating models for future large projects. However, this study includes all the environmental aspects considered in the modern methodology for the EIA, even the social aspects.

Las Pailas Geothermal Field is located at the Rincon de la Vieja Volcano in Cañas Dulces Liberia between the basins of the rivers Colorado and Blanco.

In Costa Rica the laws clearly protect the environment but also the right of the inhabitants to well-being. The protection of the natural resources in a National Park is absolute. It is not possible to develop any projects in these areas even if is demonstrated that they are compatible with the environment.

The most important environmental Law (1995) indicates:

- The environment is a national heritage for all of its inhabitants. This implies the obligation to protect it but also the right to use it to provide well-being.

- The government has to ensure the sustainable use of the natural resources.

- Damage to the environment is a social, economic and cultural offense.

This law establishes seven categories of protected zones:

- Forest reserves.
- Protected zones.
- National parks.
- Biological reserves.
- Wild life national refuges.
- Wetlands.
- Natural monuments.

The most important of these areas are the National Parks which are also the most extensive areas.

The national park law indicates:

- In the national parks it is forbidden to use the natural resources, build roads, buildings, etc.
- Unfortunately most of the identified geothermal resources in Costa Rica are related with protected areas.

Conservation and environmental developments are two different but related concepts than need to be implemented together because the conservation of the environment cannot be sought by sacrificing development and the nation's well-being, since conservation alone does not contribute to poverty reduction.

Poverty is an important thing to consider when we talk about conservation because; people do not worry about conservation or sustainable development if they have an unacceptable well-being. For this reason, the national authority has to find the way of using natural resources to improve the quality of life of the population while protecting the resources. But in Costa Rica the national well-being is a constitutional right as well as the conservation of the natural resources, so they have to coexist and the use of resources related to environmentally acceptable ways of exploitation need to be explored.

The government uses the Environmental Impact Assessment as a tool to introduce the principles of conservation and protect the environment mainly in large projects. However, the resources to ensure accomplishment of the Environmental Impact Assessment recommendations are limited. So these mean the obligation to find creative options to exploit the geothermal natural resources

associated with National Parks ensuring the adequate management of the environment.

## 2. GEOTHERMAL RESOURCES AND PROTECTED AREAS

In Costa Rica 25% of the country is environmentally protected. By law, 2 kilometers from the crater of any volcano is a National Park and maybe because of this the most important and extensive National Parks are related to volcanoes.

Unfortunately in Costa Rica the most important identified geothermal zones are also associated with volcanoes, the geothermal studies identify the most promising areas along the volcanic zone of the country as is shown in figure 1. The red areas represent identified temperatures at 200 °C and 3 km deep.

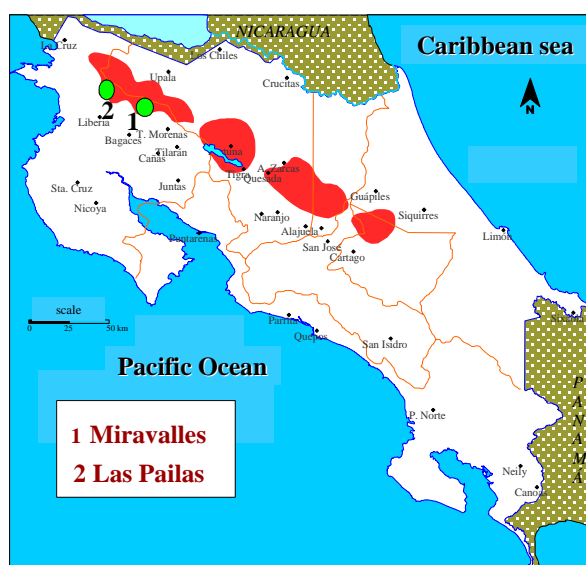


Figure 1: Geothermal zones

It is necessary to take into account that not only the temperature is important also it is necessary to find permeability and fluids, because of that after deeper studies the areas are reduced. Figure 2 shows clear examples of these.

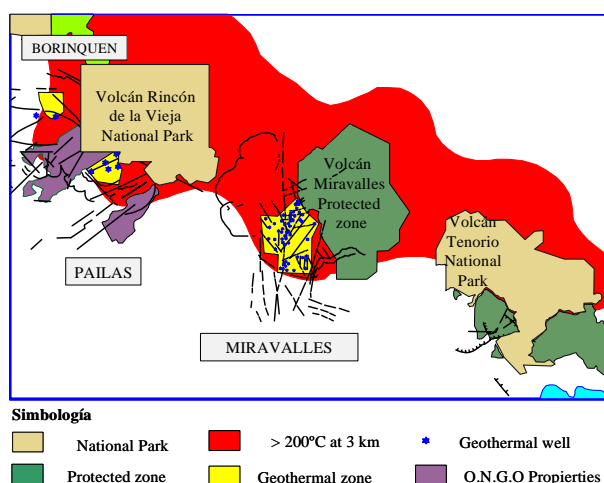


Figure 2: Geothermal zones and protected areas

The figure shows the location of the national park and the relation with the zones of geothermal potential. As was mentioned the national parks as well as the geothermal zones are associated with volcanoes and also in National Parks it is forbidden to develop any projects. This condition means problems for the geothermal development in Costa Rica because the deeper studies indicated that the highest quality resources are located inside the National Parks. As is shown in the figure 2 the yellow zones are identified as commercial zones but the studies suggest that the main resources are in the parks, this condition is more evident in Las Pailas and Tenorio. The actual development in Miravalles and Pailas are still outside of protected areas.

These national conditions show the need of finding a way to allow the geothermal resources exploitation in National Parks.

There are many international examples of geothermal development in National Parks; two of these are the examples from Philippines and Kenya.

In Philippines there are geothermal development in the Mt. Apo and Negros National Parks (Dolor, 2006). These experiences show that it is not an easy process, mainly because the people are always worried about the impacts of the projects, but once they understand the importance of the energy for the country, the benefits of the projects for the communities and the low impacts for the Parks they allow the development.

Figure 3 shows the location of the geothermal projects in National Parks in the Philippines. Three geothermal power plants with a total of 146 MWe are installed.

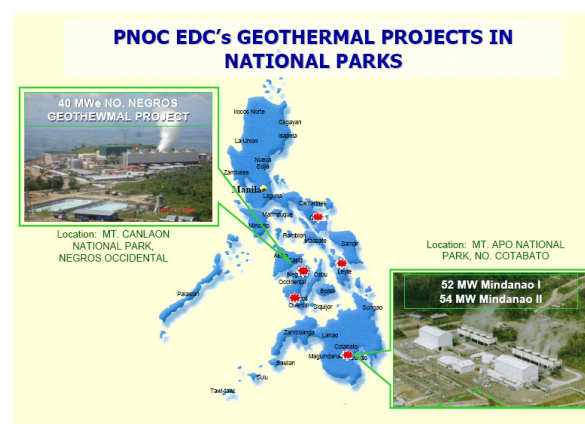
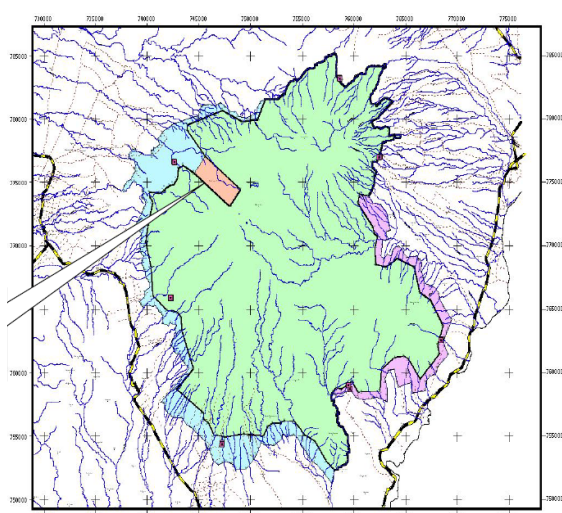


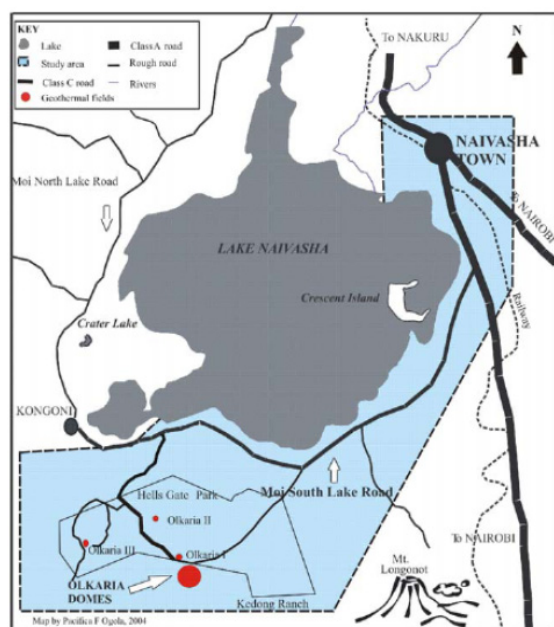
Figure 3: Geothermal in National Parks, Philippines (from Dolor, 2006)

Figure 4 shows the area used for the Mindanao Project, in this case the strategy was to designate a specific area of the park for the geothermal project -- a total of 701 hectares (1.3% of the park) was used.

The second example is Kenya where the Olkaria geothermal projects were developed in the Hell's Gate National Park and 137 MWe was produced in 2006 (Mwangi, 2006). As in the Philippines, the process was complex and involved many environmental issues but at the end the results demonstrated that the geothermal development can coexist with the natural conservation.



**Figure 4: Land used for Mindanao Geothermal project (from Dolor, 2006)**



**Figure 5: Geothermal in National Parks, Kenya. (Dolor, 2006)**

In Costa Rica, the Miravalles geothermal project also can be used as example of the coexistence between geothermal development and natural conservation. In 1973 when the projects started, the land use was basically for grassing. The area was completely deforested. For the projects development most of the land was acquired mainly because the owners desired to sell the properties and ICE started an induced and natural reforestation process. Actually all the land is reforested and a variety of fauna has been returned. The visual impacts are now very low and the coexistence of bought activities is evident.

But of course the detractor of these developments into national parks argued that it is not the same to develop a project in deforested areas as to develop in a National Park and they are right. But the Miravalles experience demonstrates that the geothermal activities are environmentally friendly, other way how to explain the fast recovery of the flora and the amazing recovery of the fauna.

If the geothermal impact was important the Miravalles recovery could not happen but the recovery is clear.

Figures 6 and 7 are examples of the positive effects of the geothermal developments if well managed environmentally. Figure 6 shows lands administrated by private people and Figure 7 shows the same lands a few years after acquisition by ICE -- the grade of recovery is clear.

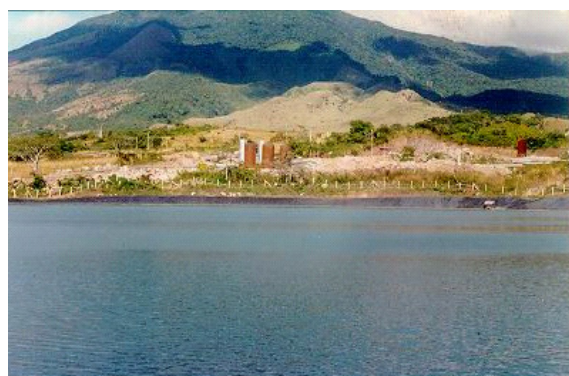


**Figure 6: Private owner's land**



**Figure 7: Land acquired by ICE, after few years**

Figures 8 and 9 show other examples. Figure 8 shows ICE properties at the boundaries of the separation unit one, the conditions of the area are mainly grass lands. Figure 9 shows the actual conditions and is clear the grade of recovering, these lands now are mainly forest. These examples demonstrate that these systems do not affect the natural conditions in an important way.



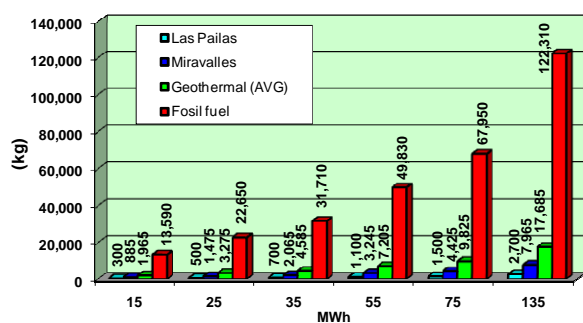
**Figure 8: Forest condition at the initial stages**





**Figure 9: Forest condition currently**

The reduction of CO<sub>2</sub> emissions is another important positive effect of the geothermal projects. Figure 6 shows different emissions for different power plants. These data indicates total emissions of 122,310 kg of CO<sub>2</sub> per MWh from a 135MW power plant using fossil fuel and only 7965 or 2700 kg for the same energy production using a geothermal plant considering the NCG of Miravalles and Las Pailas respectively. The reduction of the CO<sub>2</sub> emission will be extremely important if Costa Rica can replace the thermal production with geothermal production.



**Figure 8: CO<sub>2</sub> emissions (kg/MWh)**

In order to show the coexistence of these activities, another experience is to develop in Costa Rica in a private protected area. Due to the importance of these issues, ICE and the NGO Guanacaste Dry Forest Conservation Foundation are working to demonstrate the impacts of the geothermal process in protected areas -- the idea is to create an environmental model to develop geothermal projects in sensitive areas. At this time the projects are going very well as a result of the design of roads, gradient well platform and the gradient well building design being developed between ICE and the NGO. An environmental protocol was designed to control all the activities, all the people working in any activities receive environmental education, the management of the residual material and the use of dangerous material is documented and controlled, and all the activities are coordinated with the personnel of the conservation area. All of these ensure the development of an environmental project that can be used as a model for geothermal development in National Parks.

Considering these examples, it is necessary to look for alternatives to modify the law to allow the exploitation of the geothermal resources in National Parks. It is necessary to clarify that this is done because the studies show that the commercial resources are associated to National Parks even when the temperature studies demonstrated good temperatures out of protected areas the other necessary conditions are not present.

For this reason a bill file number 16 137 was presented to the Congress but after several analyses it was shelved. Unfortunately many sectors do not agree with the bill even when they agree to the importance of the exploitation of these environmentally friendly natural resources. Some of the aspects used to shelve the projects are:

- The National Parks are so sensitive so the government can not allow everyone to develop geothermal energy in National Park, only the public institution under a high regulation can be allowed.
- The geothermal development needs to be done under the supervision of the administrator of the protected areas, they need to participate in the planning and the environmental management.
- The areas of geothermal interest need to be clearly identified; it is not possible to open all the National Parks.
- It is necessary to try to find resources in areas out of the National Parks in order to keep the commercial development out of these areas.
- It is not clear how the geothermal development can affect these areas, the geothermal impacts over the natural resources are not well known yet.

Even when all these arguments are respected it is still needed to use the geothermal resources located in the Parks. The country can not continue to depend on fossil fuels to generate energy because is quite expensive, and because the environment impacts are also high. Most importantly, it has been demonstrated that the geothermal energy developments do not represent a high impact to the environments. For these reasons, a new law project was presented and is now under study at the Congress. This project proposes to allow the geothermal exploitation in National Parks but under the supervision of the administrator of the protected areas and only in predetermined zones of the National Parks. Of course this is an important step in the way of using the important geothermal resources associated with Parks but is still an important problem. The problem is that this law establishes that a new law is necessary for any geothermal projects to go ahead. It means that to develop a projects in the Miravalles National Parks, it will be necessary to create a specific law for these projects, then to develop a project in Rincon de la Vieja National Park it is necessary to create another law. Considering the controversy of the environmental issues this can means years of discussion to obtain the approval of these laws, and can even mean that it would never be possible to obtain the approval to develop a geothermal project in National Parks. It is necessary to find a fast way to obtain the approval, while ensuring the adequate protection of these areas.

The most adequate option seems to be the scheme of allowing the Ministry of Environment with the approval of the President to approve the project once the administration of the protected areas agrees with; the project location, the building plans and the proposed environmental management to ensure the adequate park resources conservation.

### 3. CONCLUSIONS

- The coexistence of geothermal development and conservation activities is possible.

- It is necessary to allow geothermal development in National Parks, once the protection of the natural resources has been ensured.
- The laws to allow the geothermal resource exploitation in National Parks needs to be effective and should not allow using this theme as a political issue.
- The international experiences as well as the national one demonstrate the feasibility of developing environmentally friendly geothermal projects in national parks.

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