Geothermal Nicaragua

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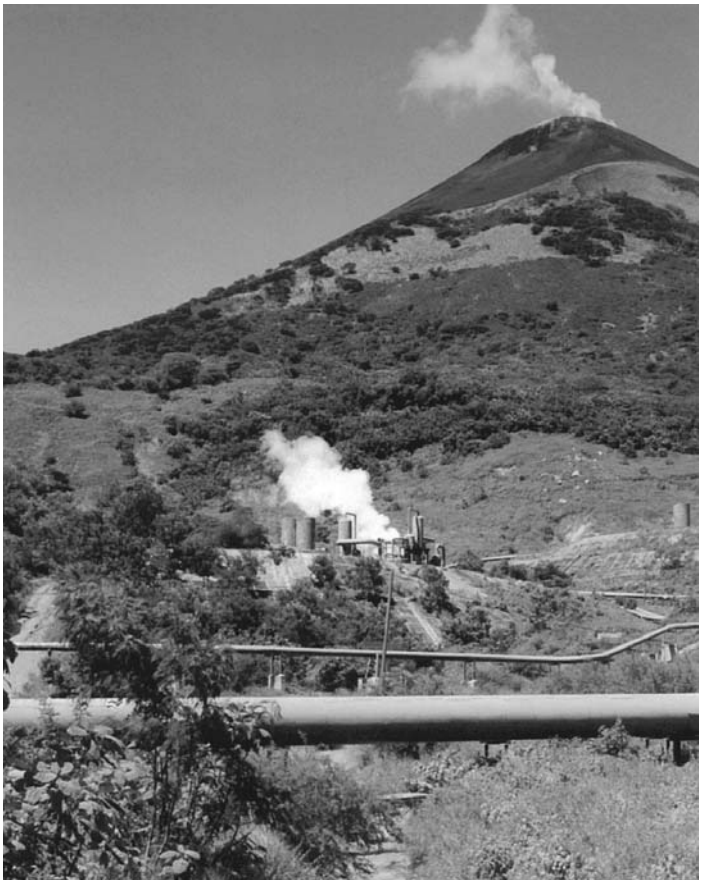


Momotombo steam lines and production well MT-23 at the base of the volcano, which has been celebrated over the years by national postage stamps (upper right).

Momotombo well OM-53. Production testing and gas sampling.

Nicaragua is the Central American country with the greatest geothermal potential, on the order of several thousand megawatts (MW). Reserves that can be estimated with a higher degree of confidence total about 1,100 MW (Klein et al., 2001). Medium- and high-temperature resources are associated with volcanoes of the Nicaraguan Depression, which parallels the Pacific Coast. The current installed geothermal capacity of the country is 77 MW—all at the Momotombo Geothermal Field (Fig.1).

Geothermal exploration began in the country at the end of the 1960s, focusing on the Momotombo and San Jacinto-Tizate geothermal fields. Studies increased after 1973, at a time when the oil crisis had a large impact on Nicaragua's economy. Geothermal electricity production started at Momotombo in 1983.

A Geothermal Master Plan for Nicaragua was completed in November 2001. It assessed the geothermal resource potential of identified fields and prospects in the country (Klein et al., 2001; Henneberger et al., 2002). At present, concessions for geothermal exploration and/or exploitation are in place for Momotombo, San Jacinto-Tizate, and Casita-San Cristóbal. (Fig. 1). Apart from these, the three most promising geothermal prospects are:

El Hoyo-Monte Galán. Located west of Momotombo, this field has an estimated capacity of 200 MW for 30 years.

Managua-Chiltepe. This area is located about 15 km NW of Managua, Nicaragua's capital, and has an estimated capacity of up to 150 MW for 30 years.

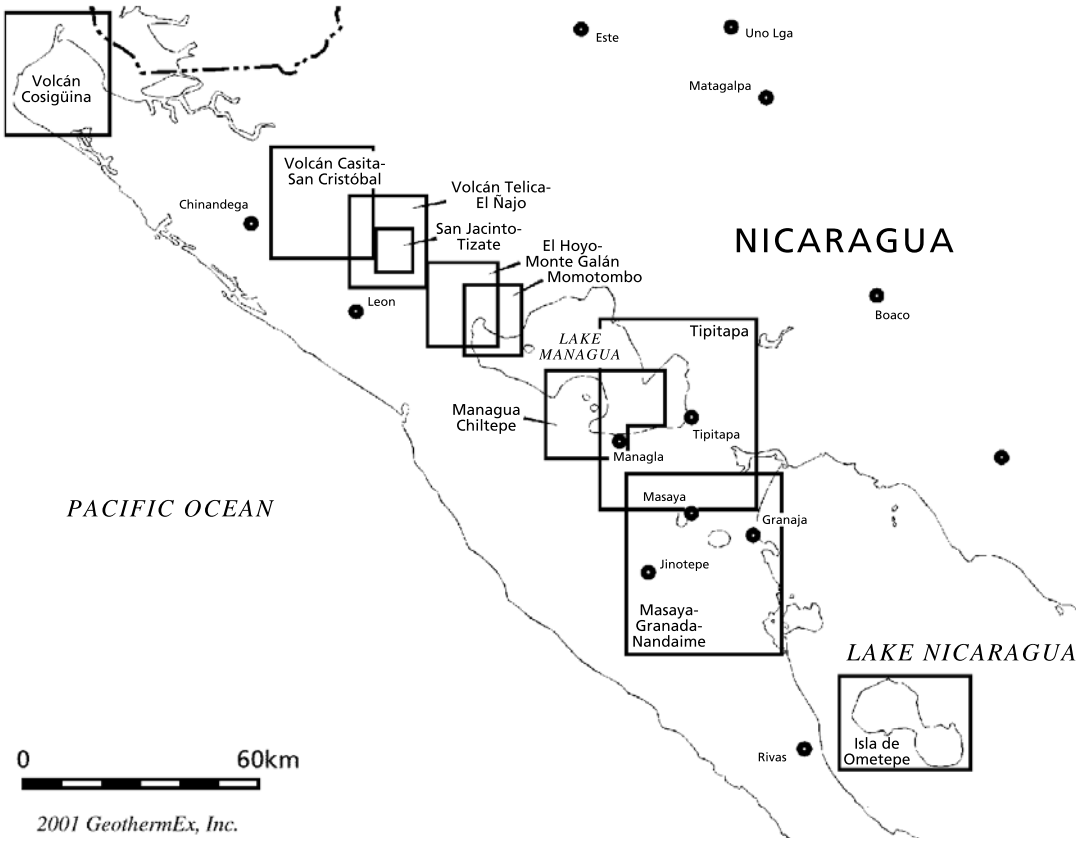
Masaya-Granada-Nandaime. This area, which includes several volcanoes and geothermal prospect areas, is near the northwestern shore of Lake Nicaragua. It may produce 200 MW for 30 years.

Recently, the International Atomic Energy Agency conducted isotopic studies around Mombacho Volcano, south of the town of Granada; and at Tipitapa, a low-temperature area near the shore of Lake Managua, east of the capital.

In November 2002, the country's Ley de Geotermia (Geothermal Law) was approved. It designates the Comisión Nacional de Energía (CNE) as the organization in charge of proposing to the Nicaraguan president new areas for geothermal exploration and development. Once the president has approved and declared such areas open for exploration or exploitation, the regulatory entity Instituto Nicaragüense de Energía (INE) is assigned to issue requests for bids.

INE and CNE are currently developing a program to attract investment in Nicaragua geothermal development. For that purpose, CNE drafted the first energy policy for Nicaragua, with a principal objective of developing the country's energy sector in concert with its social, economic, and environmental policies. The program—which emphasizes and promotes the use of renewable energy resources—should be ready for release by 2004.

Figure 1. Location of the geothermal areas in the Master Plan Study (from Klein et al., 2001).



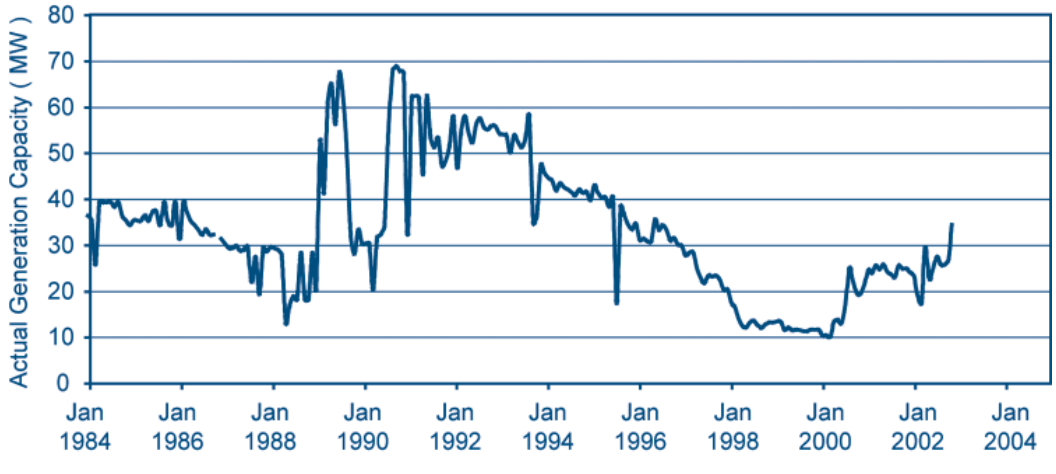
Momotombo

The Momotombo Geothermal Field lies on the northwestern shore of Lake Managua and on the southwestern slope of the active Momotombo Volcano, which last erupted in 1905. The first wells at the field were completed in the early 1970s. In 1983—after more than 10 years of exploration and development work—a 35-MW geothermal flash power plant was placed online. A second, identical unit was installed in 1989, bringing installed capacity to 70 MW.

Three geothermal reservoirs have been identified at Momotombo: one is shallow (from 300 m to 800 m depth); another is intermediate in depth (from 800 m to 1,700 m depth); and one is a deep reservoir (from 1,700 m to 3,000 m). Locations of wells and the geothermal reservoirs they intercept are shown in Figure 2.

Because of resource overexploitation, low injection volumes, inadequate maintenance, and rapid infiltration of lake water into the reservoir, the enthalpy and pressure of Momotombo geothermal producing wells have decreased rapidly. This affected the steam output of the wells and the plant's electricity production. In early 1999, only 12 MW were being generated (Fig. 3).

Figure 3. Actual electrical generating capacity at Momotombo.



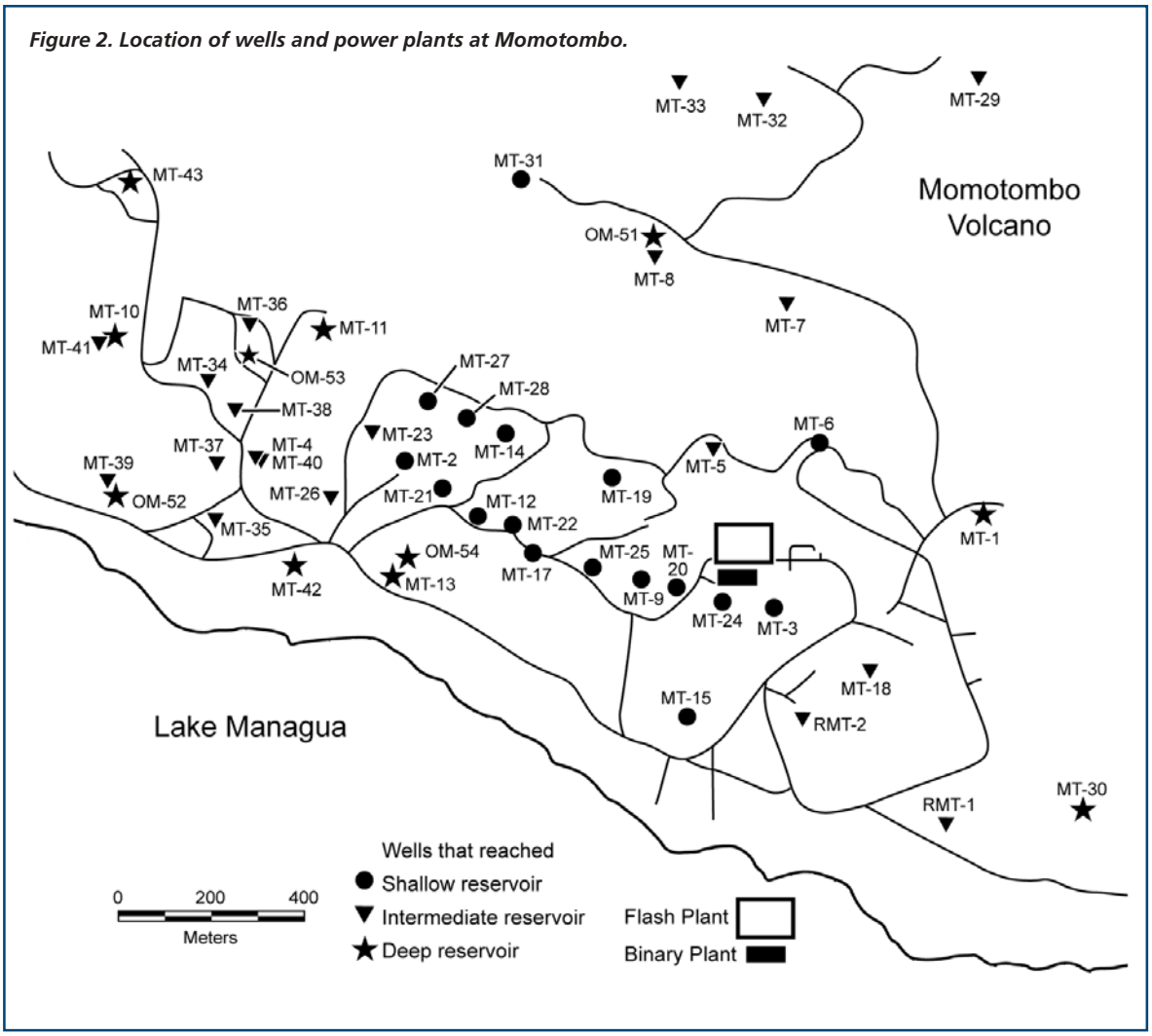


Figure 2. Location of wells and power plants at Momotombo.

In 1999, ORMAT International, Inc. (Sparks, NV) won a 15-year Build-Operate-Transfer (BOT) contract to exploit the geothermal resource and improve electricity output at the Momotombo Geothermal Field. Since then, the company has drilled four deep wells (OM-51 to OM-54), and of these, only OM-53 was a good producer (9 to 11 MW). Mineral scales have been cleaned out of eight production and four injection wells using mechanical methods. In addition, chemical-scale inhibition systems have been installed in five wells.

About 80 percent of waste geothermal fluids are being injected back to the reservoir at this time, and a new reservoir management plan has been implemented. Since May 2002, these efforts have increased and stabilized the electrical output of the flash plant at about 29 MW. In November 2002, a 7.5 MW ORMAT binary energy converter came online, raising generation capacity at Momotombo to about 35 MW (Fig. 3). The field now has 12 production wells, and four injection wells.

ORMAT has prepared a plan for Momotombo aimed at producing sufficient steam for the flash plant to reach its total installed capacity of 70 MW.

Conclusion

The integration of electricity markets in Central America and southeastern Mexico is moving forward with implementation of two initiatives: the Sistema Eléctrico para América Central (SIEPAC) and the Plan Puebla-Panamá. The main objective of these programs is to promote economic development in the region, taking advantage of economies of scale. This will lead to growth in electricity demand and an increased exploitation of indigenous renewable energy resources.

Recognizing the importance of the country's renewable energy potential, the Nicaraguan government is creating conditions that will allow for a "fast-track" geothermal development program with significant support from the private sector. Nicaragua's Geothermal Law and energy policies presently being drafted should attract local and foreign private investment in geothermal projects. The end result will be improvements in the country's standard of living and its environment.

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