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A new insight of the geothermal systems of the Martinique Island (Lesser Antilles): results of the 2012-2013 exploration

A. GADALIA(1), J.M. BALTASSAT(1), V. BOUCHOT(1), S. CARITG-MONNOT(1), F. GAL(1), J.F. GIRARD(1), A. GUTIERREZ(1), T. JACOB(1), G. MARTELET(1), N. COPPO (1), S. RAD(1), A.L. TAILAME(2), H. TRAINÉAU(3), B. VITTECOQ(4), P. WAWRZYŃIAK(1), C. ZAMMIT(1)

(1) BRGM, ORLEANS, FRANCE; (2) BRGM, FORT DE FRANCE, MARTINIQUE; (3) CFG SERVICES, ORLEANS, FRANCE; (4) BRGM, CAEN, France

Geothermal exploration of the Martinique Island (Lesser Antilles) focused, at first (1960-1980 years), on the Lamentin lowlands and on the Southern flank of the Mount Pelée volcano. In 2003, a new step was done with the identification of two areas of interest: the SW side of Mount Pelée dome and the surroundings of the Petite Anse – Diamant hot springs (Sanjuan *et al.*, 2003).

The 2012-2013 additional and combined – geological, hydrogeological, geochemical, geophysical - surface exploration results in a new insight of the Martinique geothermal systems, including Mount Pelée volcano, Petite Anse – Diamant area, Pitons du Carbet domes and Lamentin lowlands. High temperature geothermal systems are supposed to be active at both the former sites whereas only signs of medium to low temperature were detected at the Lamentin and Pitons du Carbet areas.

Mount Pelée volcano was affected by 3 flank collapses likely facilitated by a hydrothermal activity. A magma chamber (800°C at 5-6 km depth), is supposed to have heated the geothermal system for about 400 000 years. The abundant rainfalls at the top of the volcano and the high permeability of the recent pyroclastic formations allow a significant recharge.

The geothermal system could be split on two reservoirs:

- 1) a central one, below the top dome, where the almost continuous, 500 m - thick MT (magneto-telluric) conductive layer is uplifted, a characteristic of geothermal system top. Na - HCO₃ Rivière Chaude hot springs are supposed to represent a reservoir leakage whose estimated deep temperature reaches 180-200°C;
- 2) a lateral one, on the Western slopes of the volcano, where several geophysical (gravimetric, seismic, self-potential) anomalies coincide, disrupting the MT conductive layer. The mixed Na - HCO₃ - Cl Rivière Picodo hot springs are supposed to be a leakage from a reservoir whose temperature is estimated at 155-180°C.

The other flanks of the volcano do not display any indication of geothermal activity.

The coexistence of two reservoirs could be a consequence of the recent activity of Mount Pelée volcano. Both reservoirs are considered as potential targets for exploration drilling.

The **Petite Anse – Diamant** hot spring is located at the foot of a small volcano - Morne Jacqueline – part of a NW-SE volcano-tectonic corridor. The Southern flank of this volcano collapsed leading to the outcrop:

- 1) a previous neutral, high temperature hydrothermal activity corresponding to a MT conductive layer interpreted as a clay cap of the present geothermal system. This layer displays also a doming characterizing the top of geothermal systems;
- 2) a dyke of diorite coinciding with the top of a huge MT resistive body, following the volcanic corridor, and interpreted as a magma intrusion; it generates several on and off-shore spots of magmatic degassing; this intrusive gas –rock may act as a heat source and interact with the geothermal fluid.

The Petite Anse spring water is of Na-Cl type due to a sea water contribution. The associated geothermal reservoir temperature is estimated at 190-210°C.

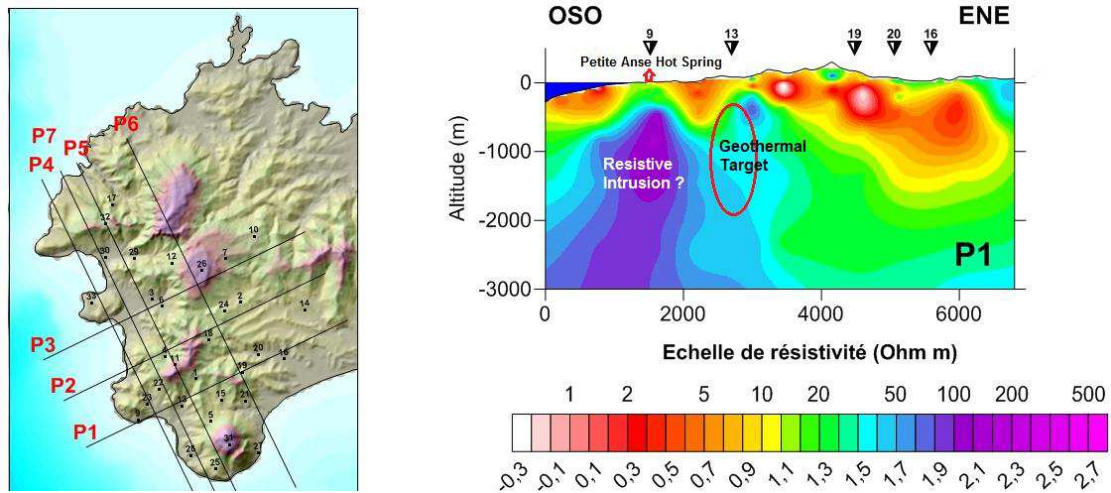


Figure 1 : Magneto-telluric transect crossing the Petite Anse prospective area

The recharge of the system is likely more restricted than the Mount Pelée one, because of both a bad permeability resulting from the extensive kaolinization (previous fumarolic alteration), and lower rainfalls.

An exploration drilling area is proposed at the North of the Petite Anse village.

References

Sanjuan B., Genter A., Baltassat J.-M., Roig J.-Y (2003) - Réévaluation du potentiel géothermique dans les régions de Morne Rouge - Montagne Pelée et du Diamant (Martinique) : principales conclusions et recommandations. *Report BRGM/RP-52549-FR*, 38 p.