Central America Geothermal Development and EGS Perpectives

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LaGeo

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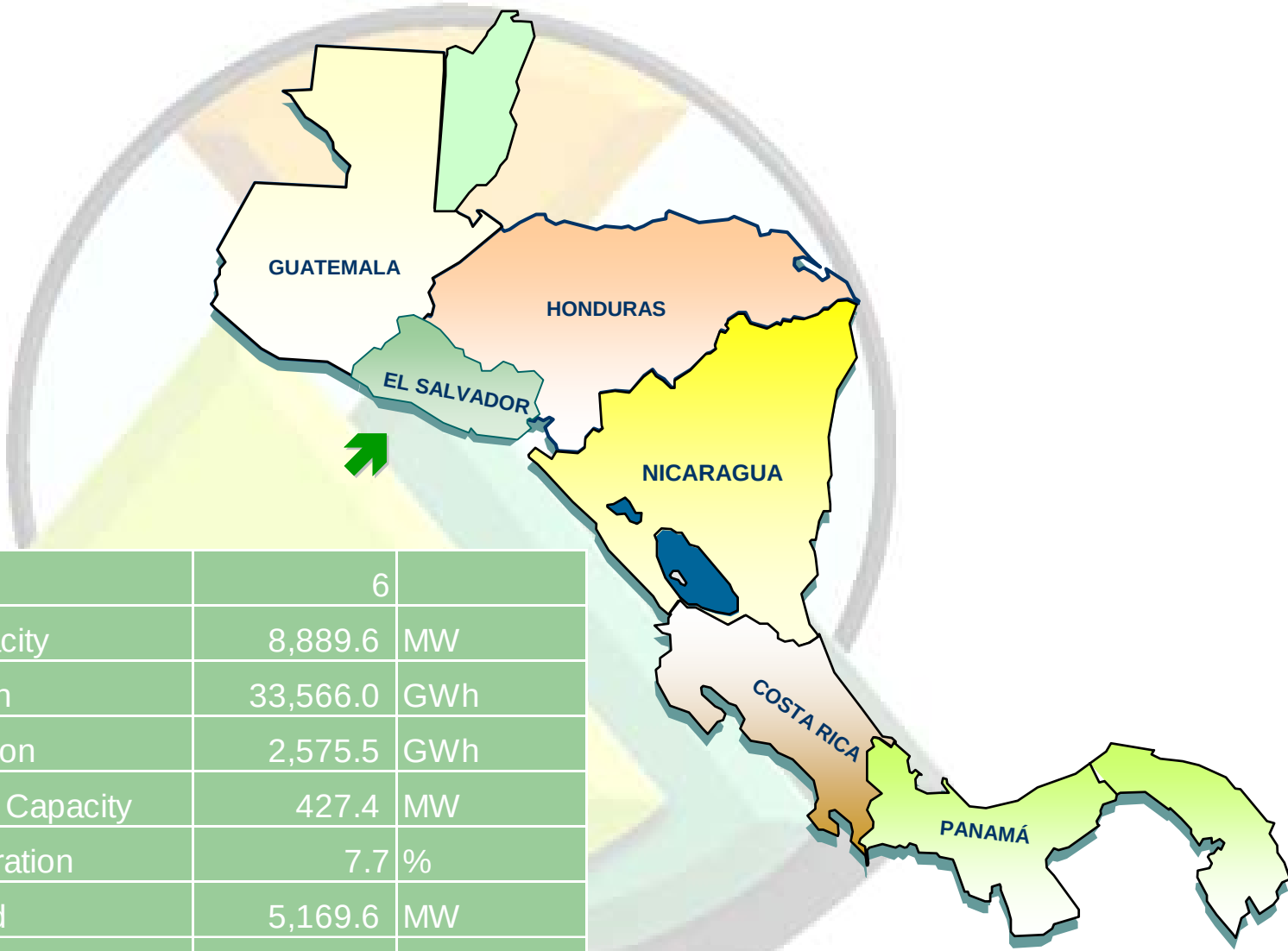
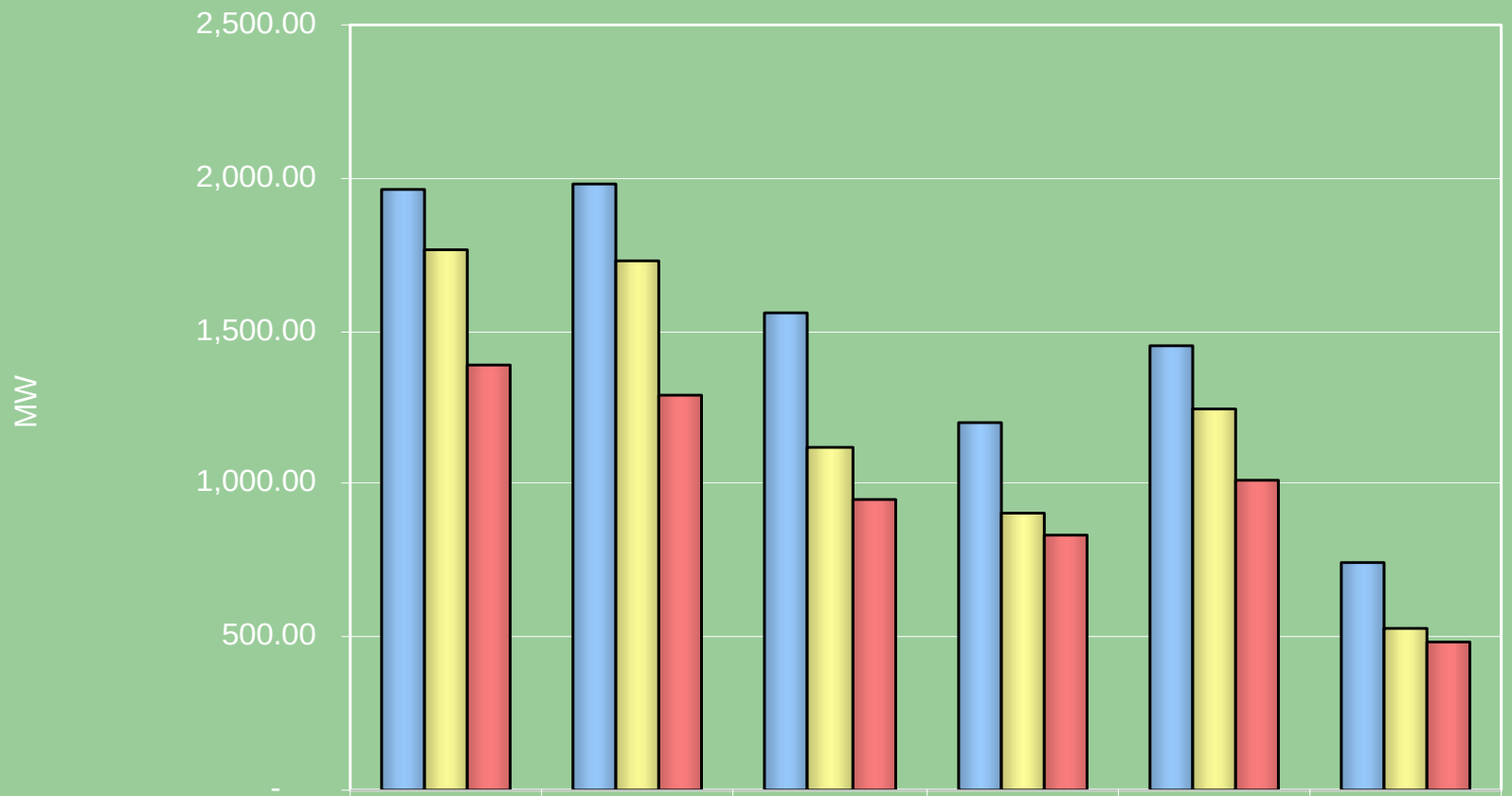


Countries	6	
Installed Capacity	8,889.6	MW
Net Generation	33,566.0	GWh
GEO Generation	2,575.5	GWh
GEO Installed Capacity	427.4	MW
% GEO Generation	7.7	%
Peak Demand	5,169.6	MW
Electricity Growth	6.0	% annual

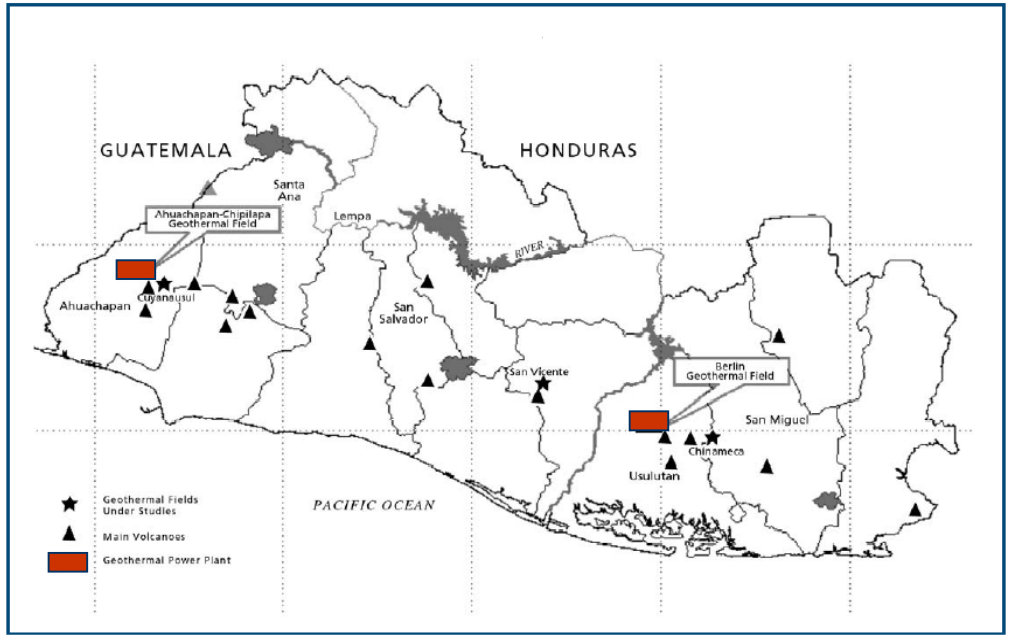
Central America Electricty demand

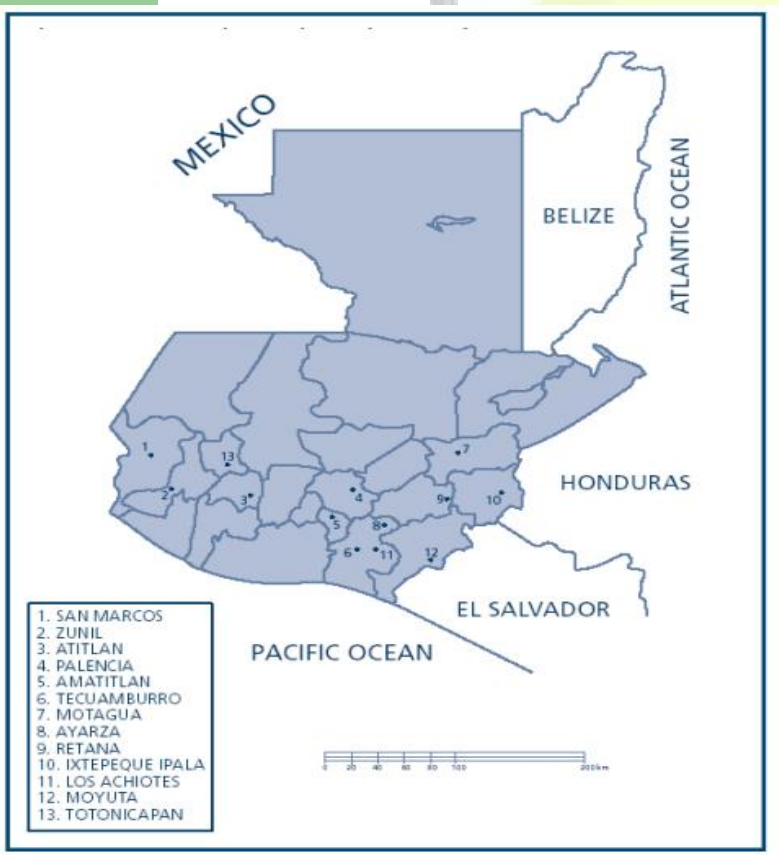
Installed Capacity and Peak Demand



	Costa Rica	Guatemala	Panamá	El Salvador	Honduras	Nicaragua
Capacidad Instalada	1,961.10	1,983.10	1,555.90	1,197.90	1,449.40	742.20
Capacidad Disponible	1,761.1	1,728.1	1,124.0	905.0	1,249.4	527.0
Demanda Máxima	1,389.60	1,290.10	946.30	829.00	1,014.00	482.80

Power plants in operation
Ahuachapan 95 MW
Berlin 56 MW
Under construction 49.2 MW





Power plants in operation
Zunil I 19 MW
Amatitlan 5 MW

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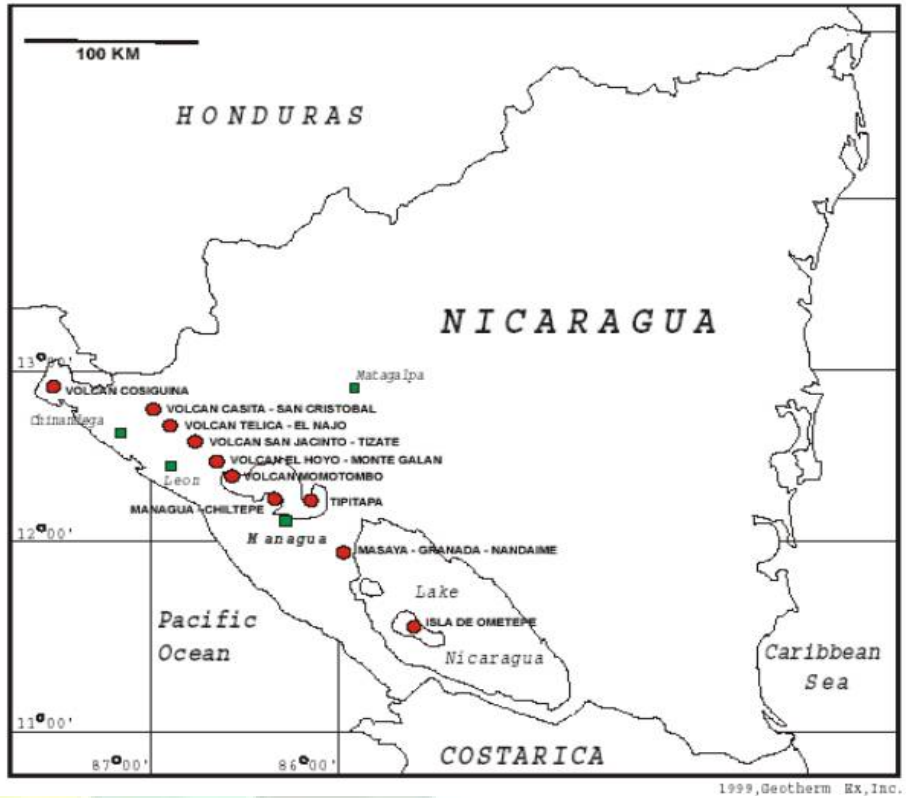
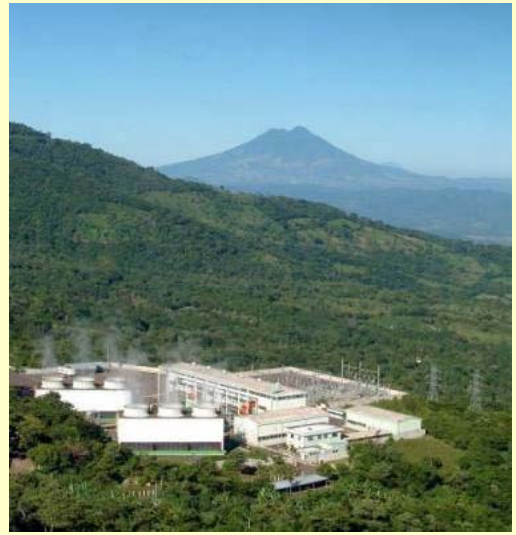
Power plants in operation
Momotombo 47 MW
San Jacinto 10 MW



Power plants in operation
Miravalles 163 MW

Zunil I, GUA

Ahuachapan, ELS



Berlin, ELS

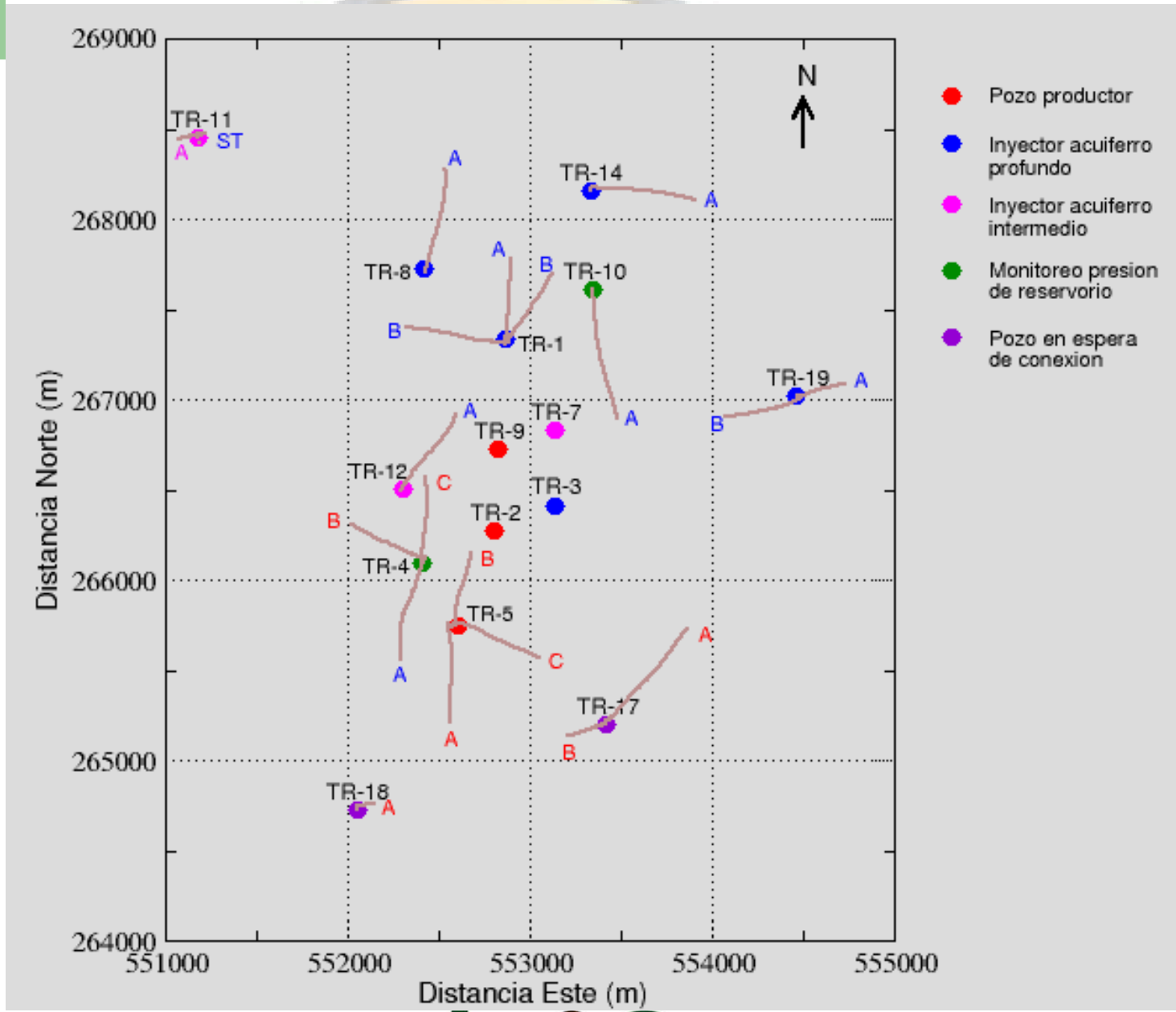
Momotombo, NIC

San Jacinto Tizate, NIC

Miravalles, CR

HFR (EGS) test carried out by Shell

- The main objective of the project was to explore the feasibility of commercial HFR energy generation.
- Well TR-8A at the Berlin field was selected due low permeability and relatively high temperature (250 °C, 7 l/s at 25 bar).
- The test was carried out in two phases June 28-July 17, and August 28- Sept 3, 2003 in total 40 days.
- Two separated feed zones were fractured 1753 and 2,200 m.
- A comprehensive monitoring was undertaken, fluids chemistry, seismic monitoring, pressure and pumping parameters, etc.


269000
268000
267000
266000
265000
264000
551000
552000
553000
554000
555000
Distancia Norte (m)
Distancia Este (m)
N
TR-11
ST
TR-14
TR-8
TR-10
TR-1
TR-19
TR-7
TR-9
TR-12
TR-3
TR-2
TR-4
TR-5
TR-17
TR-18
Pozo productor
Inyector acuiferro profundo
Inyector acuiferro intermedio
Monitoreo presion de reservorio
Pozo en espera de conexion

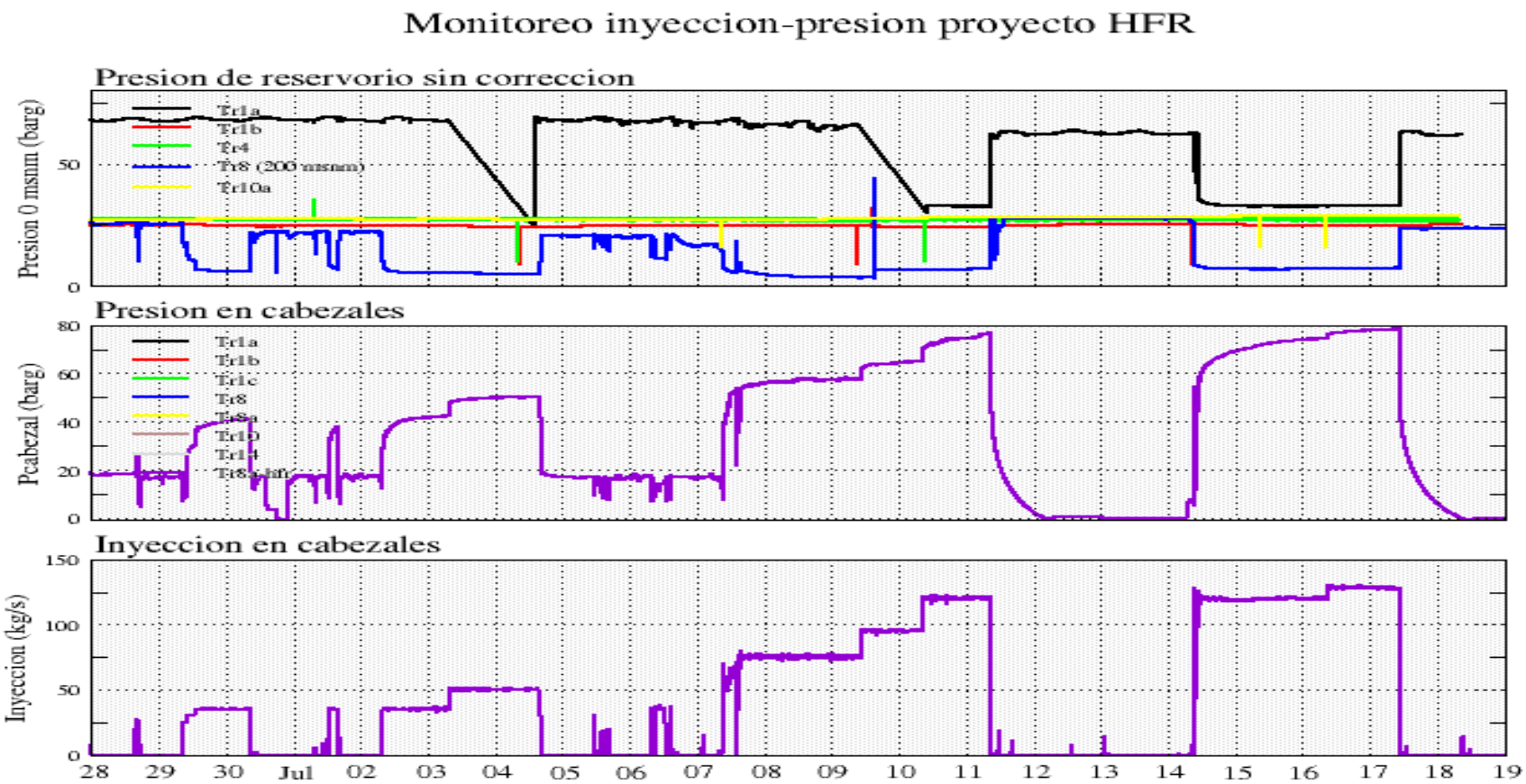
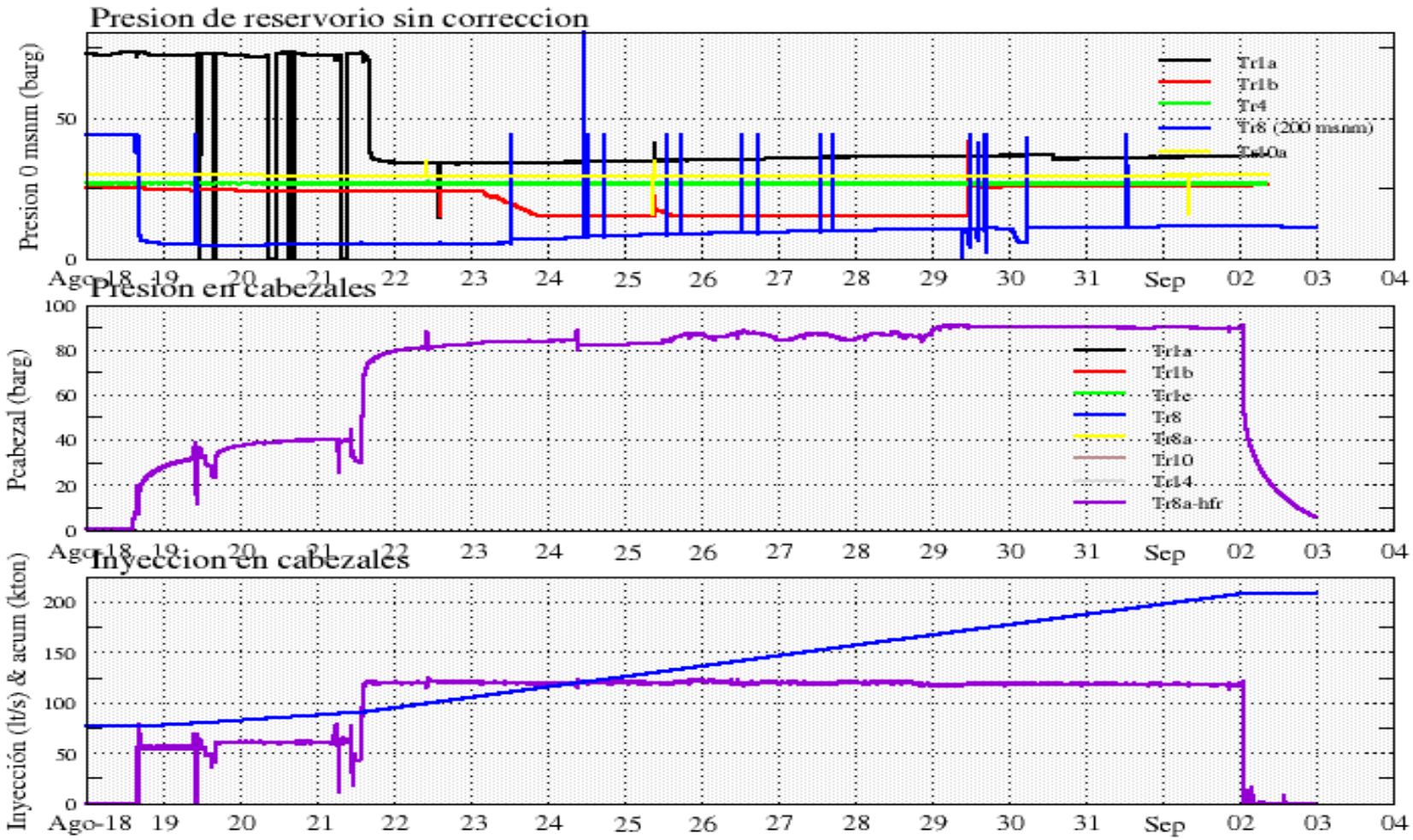


Figura No. 1 Estimulacion hidráulica del 28 de junio al 17 de julio 2003

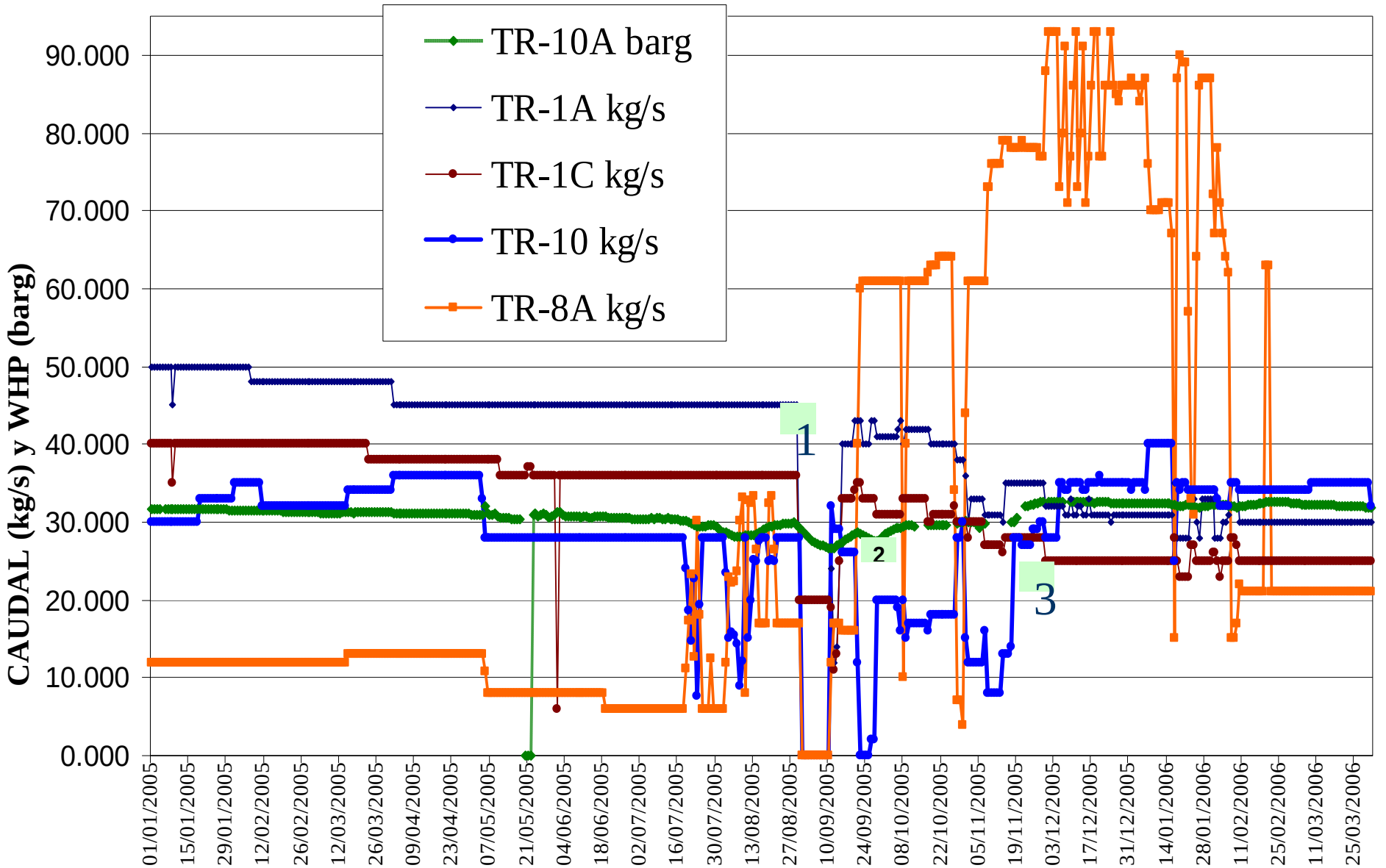
Monitoreo inyeccion-presion proyecto HFR



Injection test using HFR pumping system

- After the Shell´s test LaGeo acquiered all the equipments. In 2005, decided to repeat the test for a longer period of time (120-240 days for 24 hour a day).
- The equipments were reinstalled in well TR-8A and the test start on September 2005.
- The main objective was to evaluate the pressure interference in order to install a permanent pumping system at 250 l/s at 50 bar

HISTORIAL PRUEBA DE BOMBEO POZO TR 8A 2005



Results of hydrofracturing jobs

- Any fluids return were observed during the pumping test, according the tracer results.
- The seismic level was much lower than the expected.
- The injection capacity of the well TR-8A was improved after the injection test.
- The long term injection test indicate there are any pressure interference between injection wells, therefore a permanent pumping station could be used.

Conclusions.

- The geothermal development is an sustainable energy resource alternative for the Central America countries electricity demand
- There are some posibilities to receive incentives to the geothermal developer due to most of the countries in the region are considering as national energy estrategy the development of indigenous energy resource like geothermal.
- At the momment, the total installed capacity from geothermal energy reach 427 MW, contributing with 7.7% the whole energy consupmtion

Conclusion ..

- The Hydro Fracturing Rock (HFR) test did by SHELL and the long term injection test did by LaGeo in TR-8A has been demostrate that is possible to inject brine (200 kg/s at 160-180°C) with pressure higher than 100 bar without pressure interference or thermal breaktrought in the surrounding wells.No evident seismicity was related with both test
- The feasibility to continue the hydrofracturing in low permeability wells has been done in order to improve its injection or production capacity