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IGA NEWS

Newsletter of the International Geothermal Association

IGA ACTIVITIES

Message from the President

Ladsi Rybach, President

Dear IGA member, this is the fourth message from your President.

In the geothermal community we more than often deplore the fact that when it comes to renewable energies in the media or in other domains of visibility then solar, wind, and biomass are regularly quoted but geothermal is omitted. To quite some extent, I must say, that this is our own fault. Just one example: from July 21-24 I attended the 10th World Renewable Energy Congress and Exhibition in Glasgow/UK (WREC X; www.wrecx.com), with an Invited Plenary Paper/presentation "Geothermal Energy - Worldwide Status and Prospects". Apart from several sessions on solar PV and thermal, wind, and biomass with numerous contributions, there were also eight (!) sessions on ocean energy, with a total of 45 presentations. However, there was not a single session on geothermal. Altogether, only five geothermal papers were given, hidden in sessions like Policy Issues. WREC conferences are part of the World Renewable Energy Network (details under www.wrenuk.co.uk), held biannually. The previous WREC conference took place in Florence/Italy in 2006, again without any geothermal session (but an excursion to Larderello was part of the official program….). When complaining to the organizers about missing geothermal sessions one receives a straightforward answer: there is no interest within the geothermal community to submit contributions!

We are much too self-sufficient. At geothermal meetings we just talk to each other in closed circles. No synergies and alliances with other renewables can be established if we continue this way, not to mention outreach to the media or to the general public. We need to be much more present at large international conferences on renewable energies! Fortunately there will be three geothermal sessions -thanks to the efforts of Dr. Yoonho Song, Korea Institute of Geoscience & Mineral Resources (KIGAM)- at the International Conference & Exhibition RENEWABLE ENERGY 2008 (www.re2008.org) in Busan/S.Korea, October 13-17. This is the way to go: it is the enhanced presence at international meetings that we need more of moving forward. Among others I shall present in Busan the Invited Paper "The International Status, Development, and Future Prospects of Geothermal Energy". At the prestigeous Salzburg Global Seminar "Combating Climate Change at Local and Regional Levels: Sustainable Strategies, Renewable Energy", Salzburg/Austria July, 9-13 (www.SalzburgGlobal.org) I already had the opportunity, as one of the Seminar Faculty Members, to wave the geothermal flag, by presenting the Invited Paper "Geothermal energy resources - sustainable use and contributions to mitigate climate change".

Another international conference that deserves special attention is the 2009 General Assembly of the International Association of Seismology and Physics of the Earth's Interior (IASPEI), to take place in Cape Town, South Africa, January 10-16, 2009. Symposium H1 "From Heat Flow to Geothermal Energy" is especially timely, in view of the booming geothermal development in Australia that relies mainly on high heat flow/heat production granites. I am Co-Convenor of Symposium H1.

An upcoming international geothermal conference "Second African Rift Geothermal Conference C2" (ARGeo C2), organized by Uganda's Department of Geological Survey and Mines, will be held at the Imperial Beach Hotel in Entebbe, Uganda, 24-28 November 2008 (contacts through argeoc2@minerals.go.ug). The meeting includes a highly promising post-conference field trip to see geothermal prospects in the two dominant geological domains of the western part of the East African Rift System. I will present an Invited Paper; hopefully among many other papers from IGA members. In conjunction with ARGeoC2 the 2009 fall meeting of the IGA Board of Directors is planned for 22nd and 23rd November (Committee meetings on 22nd, full Board meeting on 23rd November). The great majority of the IGA Directors has already signalized attendance.

Our "own show" will be the World Geothermal Congress 2010 in Nusa Dua, Bali, Indonesia, April 25-30, 2010. The ongoing preparations, carried out by the Organizing Committee for WGC2010 (OC) of INAGA and IGA's Steering Committee (SC), are continuing and are well on track. The Second Announcement has been completed and is in distribution.

Finally quite some progress can be reported now on the obligations towards the World Bank GeoFund. Thanks to the concentrated efforts of several individuals, especially of Education Committee Chairman Prof. Horst Rueter, the preparations of several events like the International Geothermal Workshop 2008, the Workshop on Geothermal Risk Insurance, and the Roadmapping Session on Geothermal Development Needs are now nearing completion. All activities for the World Bank GeoFund need to be finished before the end of 2008.

I look forward to continuing to work with you in our joint effort to promote geothermal and thank you all for your support.

IGA News goes all-electronic!

Eduardo Iglesias, IGA News Editor

At its 45th meeting (Bali, April 29, 2008) the IGA Board of Directors approved a motion to terminate the production of printed copies of IGA News, as of issue No.73. Thus, in this issue we start producing the newsletter only in electronic format. The new format gives us greater scope to include color prints and pictures (starting this issue), and to upgrade its design (soon). This decision will also save the previous printing and postage costs. It is expected these savings will contribute to financing the upcoming restructuring and reshaping of the IGA website.

WORLD GEOTHERMAL CONGRESS 2015

Call for expression of interest to host WGC in 2015

The next World Geothermal Congress (WGC) will be held in Bali, Indonesia, in April 2010 (www.wgc2010.org). The country that will host WGC in the year 2015 will be announced at the end of the congress. The IGA Board of Directors hereby is calling for expressions of interest to host the World Geothermal Congress in 2015.

The role and obligations for the host of WGC in 2015 will be defined by a Memorandum of Understanding (MoU) with IGA. A typical example of the MoU is available on the IGA website at www.geothermal-energy.org. The expressions of interest should be sent to the IGA Secretariat, c/o Samorka, Sudurlandsbraut 48, 108 Reykjavik, Iceland, e-mail: iga@samorka.is, no later then November 1st 2008.

For further information please contact the IGA Secretariat at iga@samorka.is

EUROPE

TRANSTHERMAL - Trans-Border Geothermal Potential Study between Austria and Slovenia

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First comprehensive bilateral datasets for Austria and Slovenia

The border region between Austria, Slovenia and Hungary represents one of the most important balneological areas in Central Europe. The substantial use of thermal water in south-eastern Styria, southern Burgenland, north-eastern Slovenia and south-western Hungary has become an essential driving force of economic development within the last decades. Moreover, since the public awareness of environmentally-neutral alternative energy sources constantly increases, geothermal energy utilization for heating and electricity production is of growing interest within this region and the first demonstration plants are already in operation in south-eastern Styria (Blumau, Waltersdorf & Fuerstenfeld).

Although there is economic interest in this advantageous geothermal potential, there are hidden exploitation risks in the eastern area of the Austria-Slovenia border region. Here, the intensive use of natural thermal water horizons can lead to over-exploitation and a loss of efficiency. This is particularly problematic if cross-border aquifer systems exist and there is no integrated trans-border aquifer planning (i.e. in the area of Bad Radkersburg) In addition, economically successful examples of geothermal use prompt municipalities and investors to make exploration plans in areas of low utilization potential which in many cases prove uneconomical later on. An economic disappointment is often a consequence of lack of knowledge of basic geothermal conditions combined with exaggerated expectations.

Owing to such risks the need for a trans-border initiative was recognized in 2005, leading to the bilateral study called TRANSTHERMAL. The main goal of TRANSTHERMAL was to establish an Austrian-Slovenian bilateral multilingual geothermal database focused on thermal water resources. Although over the last 20 years a great number of local scale geothermal studies were carried out, only limited data were recorded for the whole region.

Border region Carinthia - Styria - Slovenia

The investigation area is situated in the border region between Austria and Slovenia and occupies the northern part of Slovenia, the eastern part of Carinthia and the southern part of Styria.

According to the hydrogeological and morphological interpretations in the western part of the project area the existing geothermal reservoirs consist of near surface, partly naturally-discharging subthermal and moderate temperature thermal springs (e.g. Bad Kleinkirchheim, Warmbad Villach, Vaseno, Zgornja Besnica). The eastern and south-eastern part of the project area is affected by the basin scenery of the prevalent Pannonian basin. Thermal water is produced from deep wells and the temperatures of the basin waters range from moderate to highly elevated (e.g. Bad Blumau, Bad Waltersdorf, Moravske Toplice, Lendava).

Analysis of the geothermal utilization potential in various depths

Within the bounds of the project TRANSTHERMAL we analyzed and represented the geothermal capacity of the area. In doing so we included only deeper geothermal potential, with a focus on hydrothermal potential, and shallow geothermics was not tackled here.

An analysis of the geothermal potential was carried out on the basis of a transnational representation of basic geological, hydrological and thermal parameters and unified processing of the geological data (geological maps and cross-sections). Its specification in terms of prospective utilization

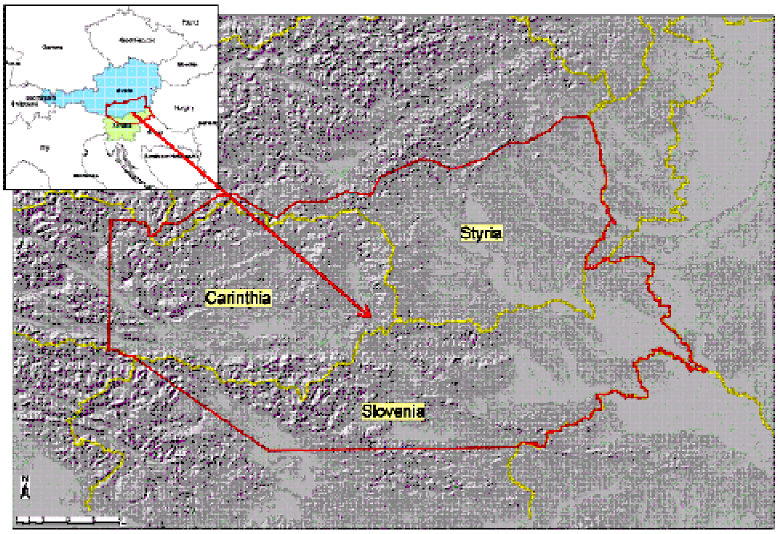

Fig. 1 Situation of the investigation area

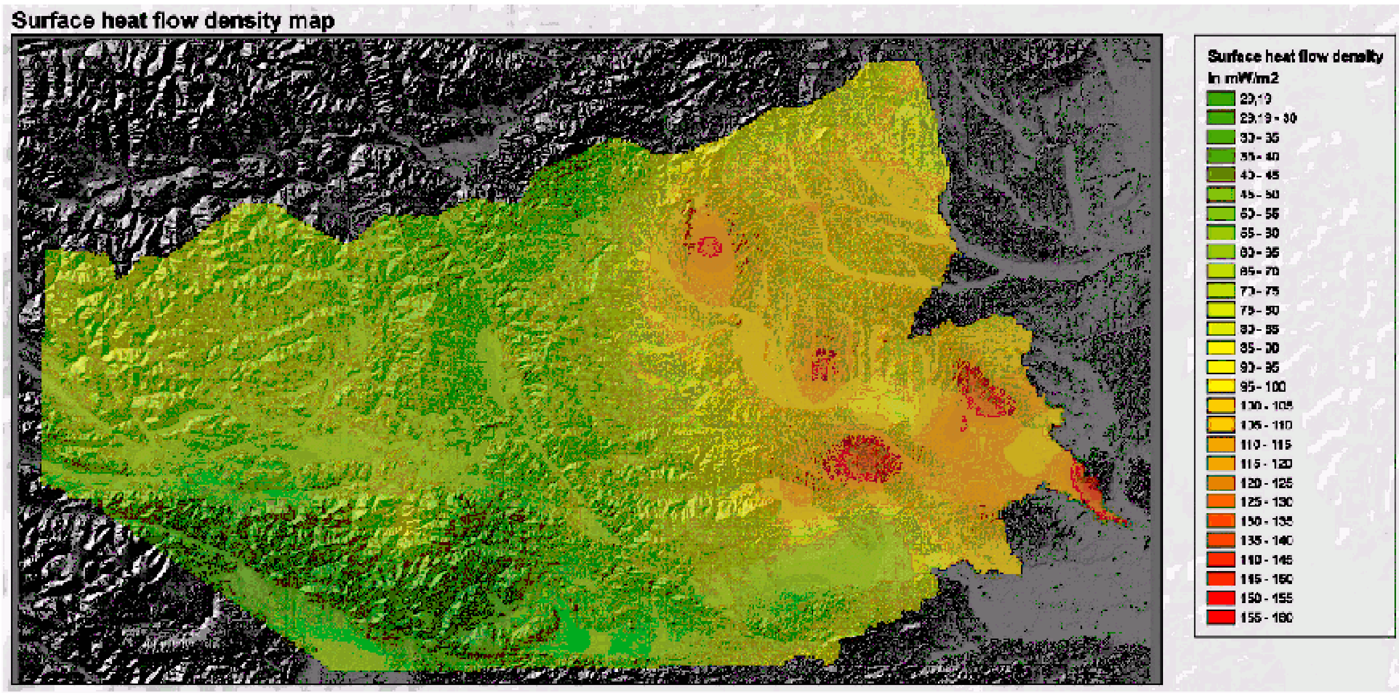

Fig. 2 Distribution of the surface heat flow density as an important element of the thermal potential.

possibilities required knowledge of the current use (spas, heating, electricity production) and available aquifer data (i.e. capacity, water temperature, chemistry). Furthermore, there was a strong focus on the regional geothermal regime (heat flow density, rock temperatures at different depths), particularly since the geothermal gradient represents an important factor for economic efficiency of a project.

The geothermal potential of systems that might be exploitable by Hot Dry Rock Technology had not been analyzed previously. To overcome this and visualize the potential, various temperature-depth maps were constructed down to 4000 m below surface.

Representation of the geothermal subsurface conditions

All essential data used for evaluation of the geothermal utilization potential during the project were archived in a multilingual project database and linked to the GIS-software ArcGIS 9.2 for spatial visualization.

Because of the geological conditions the geothermal utilization potential was split into two “part-potentials”: potential of the solid rocks (basement) and potential of the sedimentary basement fill (Tertiary rocks and sediments). By superposition of these two a “total geothermal potential” was derived that highlighted areas with advantageous subsurface conditions. Subsurface thermal conditions (geothermal gradient, heat flow density) were processed by means of common correction and modelling methods based on borehole temperatures. A comprehensive cartography was developed by combining geological, geothermal, borehole and utilization information from available sites. This methodology enabled efficient project management and visualization of the results.

Regionally varying exploration risks and development costs

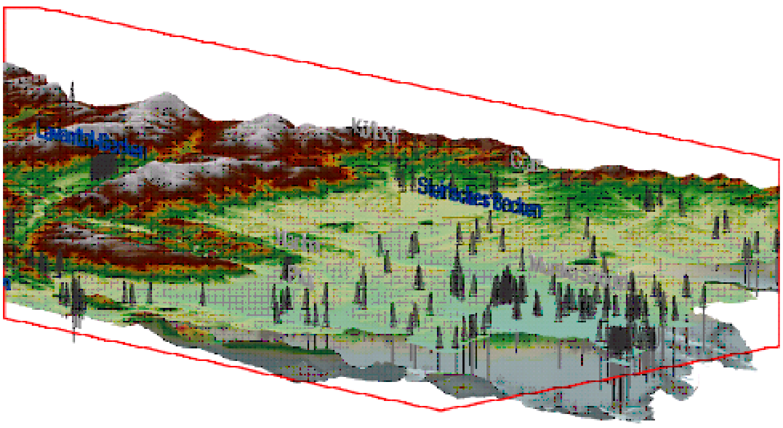

Fig. 3 3D-View of the Pannonian basin in the project area with a display of existing deep boreholes

Because of the coincidence of favourable geothermal gradients with favourable hydrological-lithological subsurface conditions, current geothermal utilization areas are preferentially situated in the south-eastern basin regions of the project area. Elsewhere, the geothermal potential cannot generally be described sufficiently, because the lack of exploration boreholes means that we have only sparse subsurface information. But, in principle, the geothermal utilization possibilities should not be excluded in these areas because there are already prosperous economic examples, represented by the spas of Bad Kleinkirchheim and Bad Bleiberg (both in Carinthia). However, the exploration risk is increased in these areas compared to basin regions as the geothermal gradients are often lower.

Moreover, it has to be kept in mind that even in areas with proven geothermal potential, only tested exploration boreholes can prove or disprove the predicted conditions. Uncertainties can only be reduced by means of adequately detailed investigations (hydrogeological and geophysical studies) which lead to an accurate estimate of the development risk. Furthermore, attention has to be paid to the regions where existing intensive thermal water utilization allows only limited additional exploration. Areas with high exploitation levels occur especially in the east at the Styrian-Slovenian border (Bad Radkersburg, Murska Sobota).

Beside the geological risk, the regionally varying temperature with depth represents another crucial limiting economic criterion. Drilling costs are a non-negligible part of the total exploration/exploitation costs of geothermal development, depending mostly on drilling depth. When looking at the distribution of depths necessary to achieve for example a rock temperature of 90°C (the practical lower limit of geothermal electricity production using ORC), foreseeable reservoir depths vary from 1600 2200 m below surface in the areas of the Styrian basin and north-eastern Slovenia to 3000 4500 m in most of Carinthia and north-western Slovenia. Converting the estimated drilling depths into drilling costs, the additional expenses for the latter area, resulting from the increasing drilling depth, are estimated to be about 250% to 300% in comparison to the south-eastern part of the project area.

Conclusion

The complete compilation of geological and thermal data plus production parameters stored in the multilingual bilateral database is available from the federal offices of Styria, Carinthia and the state of Slovenia. In this way, the protection of sensitive data is guaranteed. The public can access the general overview data and the 15 thematic maps, displaying geology, tectonics, relief and lithology of Pre-neogene basement rocks, thickness of Tertiary sediments, location of deep wells and natural thermal springs, produced water temperature, chemistry, yield and usage, temperature distribution with depth, heat flow density and geothermal potential (Neogene sediments, basement, total). The thematic maps show the result of the geothermal interpretation based on the complete data compilation. They are combined in internet applications available at http://www.geo-zs.si/publikacije _arhiv /Transthermal/Porocilo.pdf (Slovenia) or at http://gis.ktn.gv.at/atlas/(S(q51jzyej5hlomo550atiza55))/init.aspx (Austria).

To guarantee the topicality of the achieved results there will be recurring working meetings of the project group in order to supplement the database with current information. Therefore TRANSTHERMAL not only offers the opportunity of state-of-the-art surveying and mapping of the geothermal utilization potential but also forms the foundation of a future bilateral exchange platform for a reasonable and enduring utilization of the geothermal resources.

AMERICAS

French West Indies

Development of the Bouillante geothermal field (Guadeloupe)

B. Sanjuan (BRGM), H. Traineau (CFG Services)

Abstract

The Bouillante high enthalpy geothermal field in Guadeloupe, 250-260°C, related to the occurrence of recent active volcanoes, is the only exploited French field of this type (Fig. 1). In all the volcanic islands of the French Overseas Departments (Guadeloupe, Martinique, La Reunion), with rapidly increasing populations and consequently a strong growth of electricity consumption, geothermal energy seems to be a promising solution from both economic and environmental standpoints. The Bouillante field is currently being exploited by Geothermie Bouillante, a subsidiary of BRGM and EDF (Electricité de France). The research efforts carried out by the BRGM group have contributed to increasing the electricity production of the Bouillante power plant from 2 to 6-8% of the annual needs in the Guadeloupe Island, with an installed capacity of 15 MWe gross since 2005. Other developments are expected in the Northern and the Southern parts of Bouillante Bay and should allow a considerable increase of the present electricity production. Re-injection of the residual waters, which are currently discharged into the sea, is also envisaged in order to maintain production rate and pressure within the reservoir.

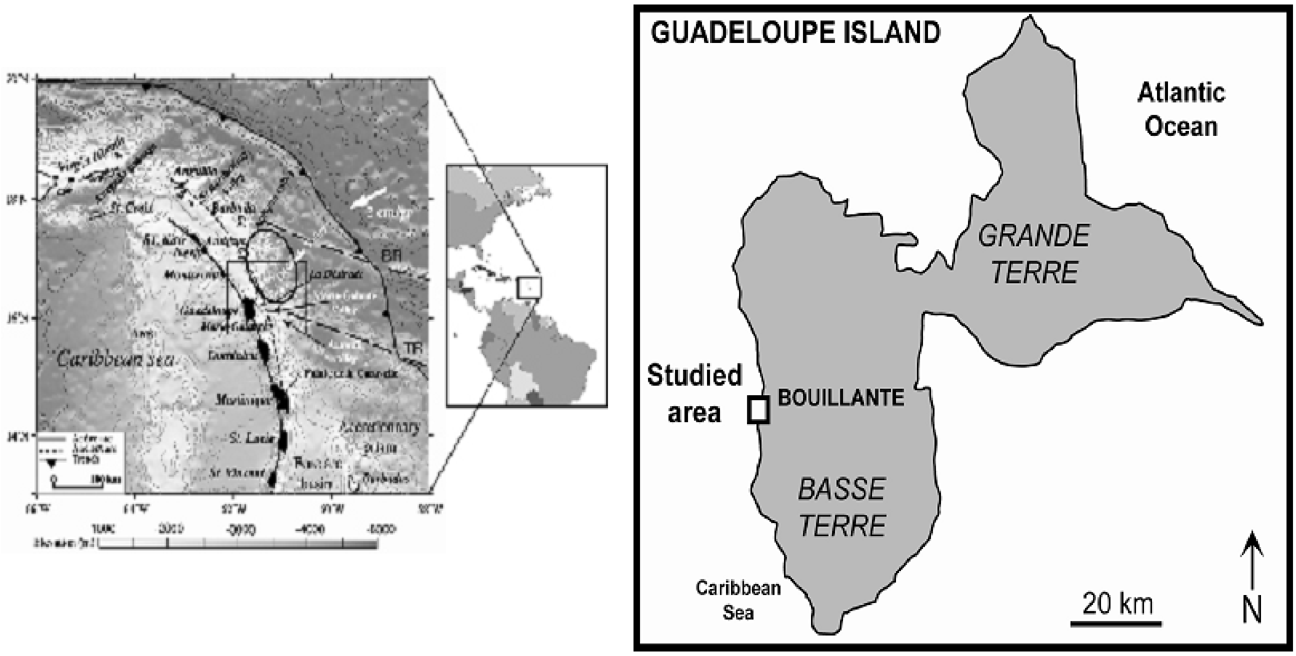

Fig. 1a - Location of the Bouillante geothermal field (Guadeloupe, French West Indies)

Introduction

The Bouillante geothermal field is located on the western coast of Basse-Terre (Guadeloupe, Fig. 1). It has been developed near the coast and around the Bouillante town, where numerous hydrothermal manifestations such as hot springs, mud pools, steaming grounds and fumaroles occur. The main active terrestrial geothermal manifestations are located south of Bouillante Bay. The first producing well at Bouillante (BO-2, 350 m deep, 150 tons/h of discharged fluid of which 30 tons/h is steam) dates from the beginning of the 1970s and fed the first turbine Bouillante 1 (4.5 MWe). In 1995, the majority of the shares in the geothermal power plant was purchased by the BRGM Group, which then further stimulated the exploitation with research projects aimed at supporting and developing the exploitation of the geothermal field: thermal stimulation with cold seawater of a former well (BO-4; Correia et al., 2000), development of exploration methods, exploration of other sites (Traineau et al., 1997; Sanjuan et al., 2001), monitoring of the wells, understanding of the field's regime, etc. These research projects, financially supported by BRGM, ADEME (French Environment and Energy Management Agency), the European Union and Region Guadeloupe, have contributed to increasing from 2 to 6-8% the percentage of Guadeloupe's annual electricity production supplied by the Bouillante geothermal field. Presently, 3 wells (BO-4, BO-5 and BO-6, Fig. 2) can produce up to 15 MWe, which represents about 600 tons/h of discharged fluid, giving 120 tons/h of steam that are exploited by Geothermie Bouillante. The last wells, BO-5 and BO-6, were drilled in 2001.

Present research activities

Present research is focused on developing and improving:

- The tools necessary to estimate the potential of a high-enthalpy geothermal field such as Bouillante.
- The methods of monitoring and exploitation management of this type of field in order to optimize and secure the electricity production.

The development of prospecting tools so as to reduce the geological hazards and risks when drilling the very costly exploration and production wells is also another main objective.

Bouillante was used as a pilot site to test geological, geochemical and geophysical methods and identify those that were the most effective (Sanjuan et al., 2001; Truffert et al., 2004; Fabriol et al., 2005). This work has already made it possible to select other potential geothermal sites in the Northern and Southern parts of the Bouillante Bay where submarine and terrestrial thermal springs with a geothermal fluid, similar to that analyzed in the geothermal wells, and associated He and CO_2 gas anomalies were identified in these fractured areas.

The geochemical studies indicate that the composition of the deep geothermal fluids (NaCl fluids with a TDS of about 20 g/l and a pH value of 5.3) results from a mixing of 58% of seawater and 42% of freshwater in chemical equilibrium with volcanic rocks at 260°C. The low amount of non-condensable gases (0.4% of the produced steam mass) is composed of 95% CO_2 and has been relatively constant since 2005. Freshwater probably comes from the neighbouring Pitons of Bouillante, arising from the existence of N100-120° faults (Traineau et al.,1997). Another network of faults with a general N-S direction is also considered. The geochemical data suggest the existence of a large deep interconnected reservoir, the volume of which is estimated, using organic tracers and a parametric model, to be greater than 30 million m^3. Despite the reservoir continuity observed from the wellhead pressure measurements, tracer tests show that the hydraulic connections between wells are relatively complicated. However, they also suggest relatively fast hydraulic connections between BO-2 and BO-4 and a natural circulation of the geothermal fluids from the North to the South. According to the isotopic lithium signature of the geothermal fluid, combined with geological, geophysical and drilling data, the main geothermal reservoir could be located below a depth of 3000 m.

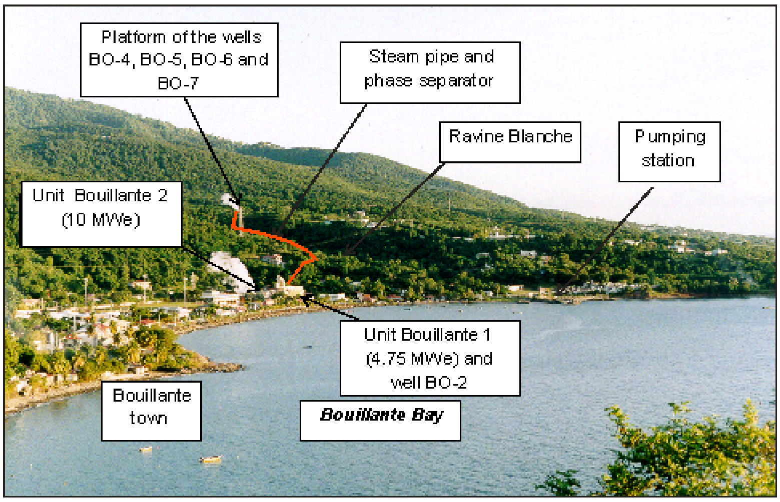

Fig. 1b - View of the Bouillante geothermal field (CFG Services document)

Mineralogical studies performed on well cutting samples show the existence of 3 successive clay zones, dominated respectively by dioctahedral smectite, illite and chlorite at increasing depths (Mas et al., 2006), as is often observed in geothermal systems. Whereas chlorite was formed during a first alteration stage, where most of the primary minerals of the volcanic formations were affected, smectite and illite precipitated during a second alteration stage related to the circulation of the present geothermal fluids. From mineralogical and $\delta^{18}O$ data, Guisseau et al. (2007) showed the existence of two types of smectites down to a depth of 260 m in the wells: the beidellitic smectites precipitated from the hot geothermal fluid between 110 and 163°C and the montmorillonitic smectites precipitated from reacting solutions mainly composed of meteoric waters at temperatures below 100°C.

A 3-D reservoir model around the geothermal wells and hydrodynamic modelling are under development for the Bouillante site. Some of these works have already allowed improvement of the

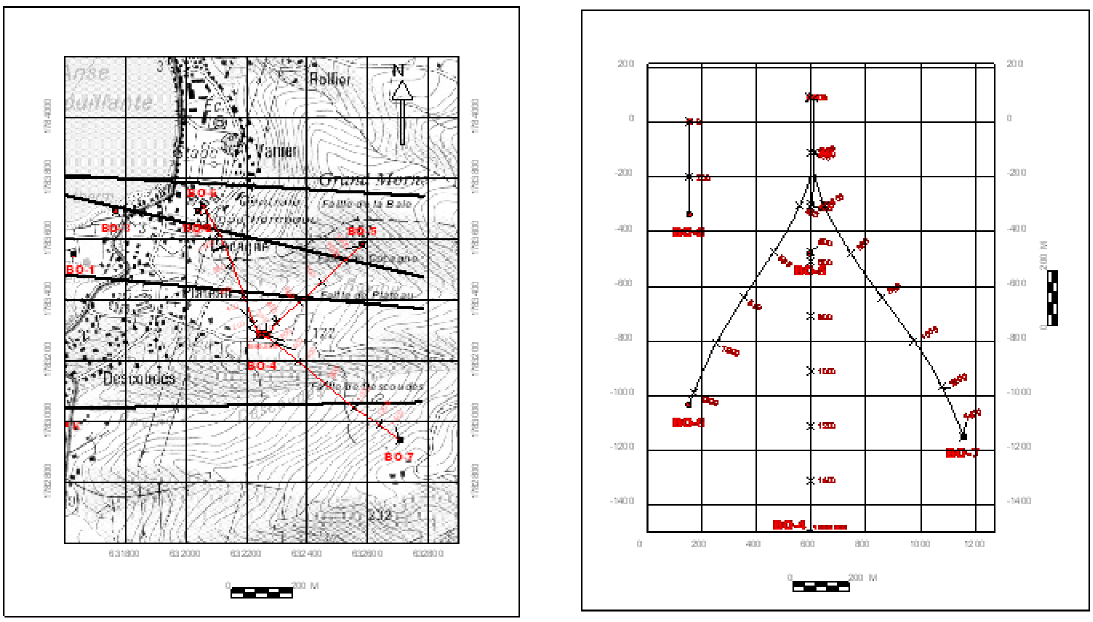

Fig. 2 - Location of the geothermal wells (CFG Services document)

understanding of the geothermal reservoir and assessment of the best operating conditions to optimize the long-term exploitation management of the geothermal reservoir in the present configuration.

Several monitoring techniques (surface soil thermometry, fluid geochemistry, gravity, broadband seismology, INSAR technology) are used in the Bouillante field in order to control the impact of the geothermal exploitation on the evolution of production and the immediate environment of the power plant. Geochemical monitoring of the fluids collected from the geothermal wells and neighbouring thermal springs has therefore been carried out since 1998 (Fig. 3) and is being continued in order to study the chemical evolution of these fluids (gas/steam ratio evolution in the geothermal fluids, the evolution of the proportion of steam condensate in the surface aquifers, etc.) and to avoid the scaling risks in the installations. Presently, as recommended by geochemical modelling, a chemical inhibitor is continuously injected at the well bottom to prevent calcite scaling. Except for a thermal spring located near the power plant, no significant change has been observed in the fluid compositions since 1998. These results are in good agreement with the data obtained by the other monitoring methods.

Fig. 3 - The well head

The re-injection of the residual waters is under study. It should maintain reservoir pressure and avoid wastage into the sea.

Future research activities

Among the exploration methods used at the Bouillante site, magnetotelluric measurements are envisaged in the near future in order to investigate the areas where the main inflows of geothermal fluids have been observed in the wells (depth of 900-1000 m) and to complete the data obtained by the electrical profile, for which the investigation depth was limited to only 700 m (Fabriol et al., 2005). More seismic data could be acquired in order to locate deep structural features and increase the location accuracy. All the monitoring methods previously initiated will be pursued in the next years in order to control the evolution of the production and the impact of the exploitation on the reservoir. The 3-D reservoir model must be extended to the Northern part of the Bouillante Bay and the work of hydrodynamic, thermal and geochemical modelling must be continued and increased in order to understand this geothermal system better and be able to select the best sites for re-injection of the residual waters. Especially for this last application, the hydrodynamic model will have to take into account the reservoir geometry.

The small number of wells drilled in the Bouillante field, the absence of cores collected during drilling and the reduced measurements done in the wells are a significant limitation to improving the knowledge and understanding of this field. More exploration and production wells, coring during drilling, and well logging, would bring valuable information about this field. For structural investigations, borehole imagery is necessary. Tools able to determine the stress field conditions are also needed. Tracer testing using organic compounds at high temperatures is very useful to estimate the inter-well interferences, reservoir volume, processes of fluid mixing, deep fluid circulation, fluid velocities and water/rock ratios.

Conclusions

All the research activities carried out between 1995 and 2001 have allowed a poorly-productive well (BO-4) to be stimulated and three wells to be drilled (of which only two are productive), which has significantly increased the electricity produced from the Bouillante geothermal field. These activities and additional research works have contributed to a better knowledge and understanding of the Bouillante field. They suggest the existence of very promising geothermal potential areas in the Northern and Southern parts of the Bouillante Bay. Consequently, the Bouillante site can still be greatly developed. Moreover, future re-injection of the residual waters can stabilize and improve the present reservoir production. All the knowledge and experience acquired during the development of the Bouillante field will be useful to develop other high temperature geothermal fields in volcanic islands such as Martinique, Dominica or La Reunion.

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ASIA/PACIFIC RIM

Turkey

45MW Germencik geothermal power plant

Mahmut Parlaktuna, Middle East Technical University

Turkey's third geothermal power plant will be in operation in Germencik Geothermal Field by the end of 2008. The field is situated in Büyük Menderes graben on which the two previous power plants (Kizildere and Salavatli) are also located.

Exploration studies of the field were started in 1967 and the first shallow drilling (167 meters) in 1970 resulted in a recorded temperature of 105°C at 97 meters. The General Directorate of Mineral Research and Exploration of Turkey (MTA) studied and evaluated the geothermal power production capacity of Büyük Menderes Graben in the period 1978 to 1982 which resulted with the first deep well of Germencik field in 1982. It was completed at a depth of 1002 m with a temperature of 203°C. Eight more wells were drilled in the field during the period of 1983-1986 with reservoir

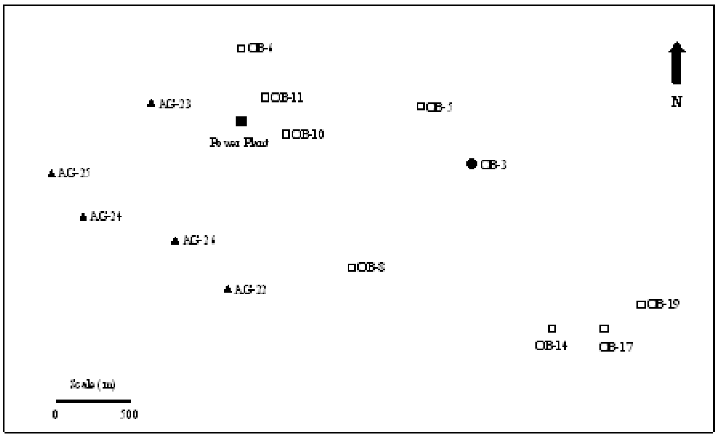

Fig. 1. Location of the wells at Germencik geothermal field (near the west coast of Turkey below the Çesme peninsula).

Fig. 2. A general view of Germencik power plant.

temperatures of 203-232°C. The primary permeability of the Germencik geothermal resource occurs in fractured metamorphic rocks of the Menderes Massif. Permeability is present in fractures related to the steeply dipping Ömerbeyli fault. Static reservoir pressures are over 100 barg at 1000 m and static reservoir temperatures are approximately 220°C within an isothermal zone several hundred meters thick.

Although several attempts were made to develop the field, GURMAT Electricity Production A.S. received the concession in April 2004. Since then field tests and feasibility studies have been carried out and construction of the 47.4 MWe power plant was started. Studies indicated that the production characteristics as well as physical conditions of three wellbores drilled by MTA are suitable for production and two others required workover operations. In addition, GURMAT drilled nine new wellbores (five production and four re-injection) between August 2007 and July 2008.

The main work principle of the system is that the gathering system collects brine from the production wells OB-5, OB-6, OB-8, OB-10, OB-11, OB-14, OB-17 and OB-19 (Fig. 1). The geothermal fluid is low in

Fig. 3. Testing of a production well

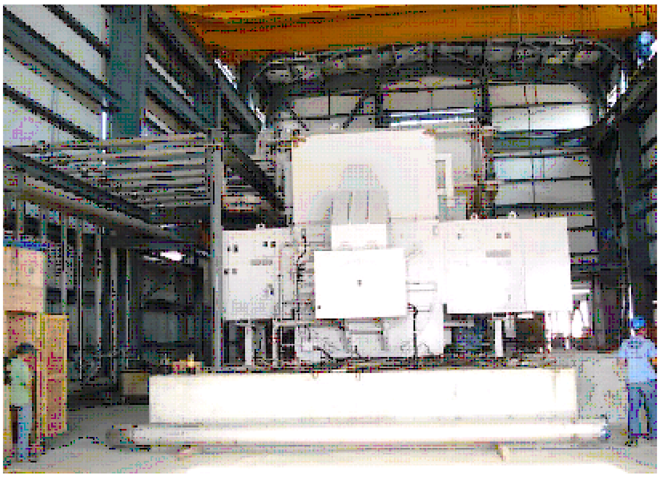

Fig. 4. A view of the turbine house.

Fig. 5. Well AG-22 during clean-up.

dissolved salts but high in non-condensable gases. Large quantities of non-condensable gases, particularly CO_2, will flash off the brine with the high pressure steam. This gas will be carried through the turbine into the condenser and then to the cooling tower by a combination of steam jet ejectors and vacuum pumps. The turbine-generator is double flash, top exhausting. Both inlets (HP and LP) are equipped with main stop valves (MSVs) and governing valves (GVs). The generator, rated at 47.4 MW, was supplied by Melco, a subsidiary company of Mitsubishi Corporation.

After both low and high pressure steam have been flashed, the brine will be taken to re-injection wells. As a result of the well tests, it is planned to use five of the nine drilled wells as injection wells. The wells are designated as AG-22, AG-23, AG-24, AG-25 and AG-26 (Fig. 1). On the other hand, the former well OB-3 will be utilized to inject condensate.

GURMAT completed the procurement stage and the drilling stage is already finished. The erection and engineering stages are well in progress and aim to commence commercial operation at the end of 2008 (Figs. 2-5).

China

GSHP application in Beijing 2008 Olympic Games

Keyan Zheng, GCES, China

The IXXX Olympic Games began on 8th August 2008 in Beijing. Chinese Geothermal workers made their contribution to the “Green Olympics” through a series of GSHP applications. They intended initially to drill 10 geothermal wells and then install geothermal space heating in the Olympic Village. One well was drilled to 3,326 m depth in 2004 and produced 84m^3/h of thermal water at 53°C. The complex geothermal geological condition showed that the initial plan was not suitable for implementation. Therefore, the conventional plan had to be changed. A series of GSHP applications were substituted for the initial geothermal utilization. They include the following projects:

The Olympic Tennis Center located in Beijing Olympic Forest Park. There are 10 tennis courts for matches and another 6 courts for practice. Ground source heat pumps were used for the game halls, including summer cooling and winter space heating. One example for 2# game hall: 35 holes were drilled to 100 m depth with a diameter of 150mm. They are arranged on a 7m x 7m grid. Double U-pipes of PE material were installed in the holes for heat exchange. The GSHP unit is 138.2 kW heating capacity (input power 37.5kW) and 139.6kW cooling capacity (input power 32kW).

The Olympic Badminton Hall located in Beijing University of Technology. A GSHP has been used for summer cooling and winter space heating in the badminton hall (see photo).

However, Tianjin Olympic Stadium used geothermal space heating and hot water supply, and GSHP cooling, because it is located in a good area of the geothermal field.

In addition, the State Stadium, the State Swimming Hall, the State Gymnastics Hall and the Olympic Village use GSHP in part. A total of 410,000 m^2 buildings in the Olympic Village use a waste water heat pump for summer cooling, winter space heating and hot water supply. The other three main game sites use GSHP in part. The urban thermal-power pipeline is used as the main heat source for winter space heating. The summer cooling uses conventional facilities but combined with GSHP. A small number of heat exchange holes were drilled nearby for heat release when cooling and for heat extraction when heating.

Australia

Australia develops world's first geothermal reporting code

The development in Australia of the world's first uniform code for assessing geothermal energy resources could generate a wave of investment in the sector. With this more rigorous and consistent standard applied to reporting Reserves and Resources, investors will be more confident and those projects that are more worthy will find it easier to attract financial support.

The Australian Geothermal Resources and Reserves Reporting Code was unveiled in August at the AGEG Annual Conference in Melbourne.

The Code is a response to the recent trend for the financing of geothermal development companies through stock market listings. Whilst this presents a welcome market-driven mechanism for funding the exploration and development of geothermal prospects, informed decisions about investment are difficult to make given the long development path from exploration to power generation. In particular it is difficult for investors to have confidence in the claims made by developers about the energy resources and reserves available within each project.

Although geothermal energy extraction and electricity generation is a mature industry, to date there has not been a universal or even widely agreed code for reserves and resources reporting. Given the current and future intense interest surrounding renewable energy forms, a standardised and trusted approach to geothermal energy resources and reserves classification and estimation was long overdue.

A unique aspect of the Code is that it has been designed to apply both to "conventional" magmatic-related high temperature geothermal resource developments, lower temperature hot aquifers, and Hot Rock systems.

The rapid pace of development of Australia's geothermal industry is perhaps not widely appreciated. Since the grant of the first Geothermal Exploration Licence (GEL) in Australia in 2001 through year-end 2007, 33 companies have joined the hunt for renewable and emissions-free geothermal energy resources in 277 licence application areas covering ~219,000 km^2 in Australia. The associated work programs correspond to an estimated investment of AUS$851 million over the period 2002-2012.

Because many of the companies active in the Australian geothermal industry have a strong mining background, developing a standard based around mineral reserves was deemed the most suitable approach. The simplicity and wide acceptance of the reporting code that is most commonly used for reporting of mineral reserves and resources (the Joint Ore Reserve Committee's "JORC" Code) made it a natural choice for the basis of the new geothermal code.

The resulting Australian Geothermal Resources and Reserves Reporting Code covers a minimum, mandatory set of requirements for public reporting of estimates. While it tabulates a large number of issues to be considered in reporting, it is not particularly prescriptive as to methodology.

A key distinction that the Code makes is that 'Reserves' are deemed to be energy that is considered to be commercially recoverable now. 'Resources', on the other hand, require further work to be classified as Reserves. Confusion between these two classifications can be the root of confusion for investors, especially when there is intense marketing going on to raise funding. The code relies upon a two dimensional classification taking into account levels of geological knowledge and confidence and Modifying Factors which directly affect the likelihood of commercial delivery.

The Code is accompanied by a 'Geothermal Lexicon' that provides guidance on how resources and reserves can be estimated for reporting purposes. The techniques described in the Lexicon are not a mandatory part of the code. However, any significant deviations from the Lexicon should be disclosed and explained when reporting under the Geothermal Code. Example reports are under preparation.

At the time of writing the first edition of the Code and Lexicon had been extensively reviewed and agreed within AGEG, with a formal launch in mid-August. The Australian Geothermal Energy Association (AGEA) has resolved that use of the Code will be mandatory for Public Reports by its members, which include all of the significant geothermal companies in Australia. The draft Code and Lexicon were submitted to the International Geothermal Association (IGA), which has recognised the Code as appropriate and endorsed the Lexicon. The International Energy Agency has also received a submission.

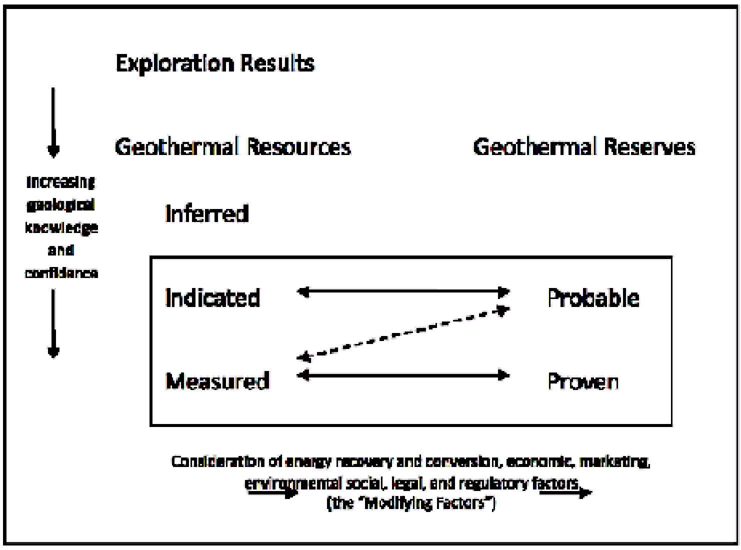

Fig 1. Relationship between Exploration Results, Geothermal Resources and Geothermal Reserves

Preliminary discussions have been held with the Australian Securities Exchange (ASX), and copies of the Code and Lexicon have been submitted to the Toronto Stock Exchange and the Ontario Securities Commission.

Future hopes

It is hoped that once the Code becomes accepted by the investment community in Australia it will become the basis for a more uniform international approach to the issues. In an open letter to AGEG, the President of the International Geothermal Association, Dr Ladislaus Rybach said: " … we commend you on the effort that has been put in and the rigour of the approach taken." The Chairman of IGA's Ad Hoc Committee on Reserves and Resources, Jim Lawless of SKM, says that this more rigorous approach could assist the geothermal industry around the world. "The Code gives investors the chance to measure different schemes and brings some consistency to the business."

"There have often been differing opinions in the past about what to measure and how to measure it," says Mr Lawless. "By standardising reporting of Reserves and making it mandatory to define what is actually commercially recoverable now, the Code will facilitate investment and inspire more confidence in geothermal schemes."

For copies of the Code and Lexicon, contact:
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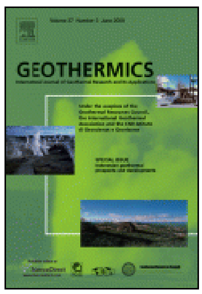

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To obtain a copy, please contact your local IGA representative

UPCOMING EVENTS

GRC 2008 Annual Meeting/2008 Geothermal Energy Trade Show, 5-8 October 2008, Reno,NV, USA. Website: http://www.geothermal.org

World Energy Engineering Congress (WEEC), 8-10 October 2008, Washington, DC, USA. Website: www.energycongress.com

RENEXPO, 9-12 Oct. 2008, Augburg, Germany. Website: www.renexpo.de

International Conference and Exhibition RENEWABLE ENERGY 2008, 13-17 October 2008, Busan, South Korea. Website: www.re2008.org

ETH Energie Tage Hessen, 7-9 November 2008. Wetzlar, Germany. Website: http://www.energietage.com/

International Geothermal Sustainability Modelling Workshop, 10 November 2008, Taupo, New Zealand. Contact: Gudni.Axelsson@isor.is and C.Bromley@gns.cri.nz

New Zealand Geothermal Workshop and Celebration of 50th Anniversary of the Wairakei Power Station. 10-16 November 2008. Contact: wairakei.50th@contact-energy.co.nz

2nd African Geothermal Conference (ARGeoC2), 25-29 November 2008, Entebbe, Uganda. Contact: argeoC2@minerals.go.ug

8th Asian Geothermal Symposium, Hanoi City, Vietnam, December 9-12, 2008. Contact: http://unit.aist.go.jp/georesenv/event/asia8.html

Renewable Energy Asia-2008, 11-13 December 2008, New Delhi, India. Website: http://web.iitd.ac.in/~rea2008/

IASPEI GENERAL ASSEMBLY 2009, Symposium H1 “From Heat Flow to Geothermal Energy”, 10-16 January 2009, Cape Town, South Africa. Website: www.iaspei2009sa.com

34th Stanford Workshop on Geothermal Reservoir Engineering, 9-11 February 2009, Stanford, CA, USA. Website: http://pangea.stanford.edu/ERE/research/geoth/conference/workshop.html

World Geothermal congress 2010, 25-29 April 2010, Bali, Indonesia. Website: www.wgc2010.org

IGA News

IGA News is published quarterly by the International Geothermal Association. The function of IGA News is to disseminate timely information about geothermal activities throughout the world. To this end, a group of correspondents has agreed to supply news for each issue. The core of this group consists of the IGA Information Committee:

The members of this group submit geothermal news from their parts of the world, or relevant to their areas of specialization. If you have some news, a report, or an article for IGA News, you can send it to any of the above individuals, or directly to the IGA Secretariat, whatever is most convenient. Please help us to become essential reading for anyone seeking the latest information on geothermal worldwide.

Send IGA News contributions to:
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APPLICATION FOR MEMBERSHIP

Please complete the following form and return it with payment to:
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c/o Samorka
Sudurlandsbraut 48, 108 Reykjavik, Iceland
tel: +354-588-4437; fax: +354-588-4431; e-mail: iga@samorka.is
IGA Home Page: www.geothermal-energy.org

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