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Geothermal energy prediction technique - Page 1

Report on

GEOTHERMAL IMPLICATIONS IN THE UNITED KINGDOM

GRESHAM R. T. CLACY, GEOPHYSICIST

Southampton project:
http://www.bbm.me.uk/portsdown/PH_450_Energy.htm

Synopsis:

The Southampton project is pulling up water at a temperature of around 70 degrees C.

Clacy contends that this is water which has travelled a number of miles sideways from the high temperature source whose location is currently unknown. Clacy believes that there are several UK sources of very high temperature water at over 1000 degrees C. (Yes, that's thousand degrees). This is water that has been in contact with magma. Clacy's recording equipment is able to detect these sources. Obviously the energy available from such a high temperature source would be far higher than that provided by the Southampton project and the likely rewards would be accordingly higher.

INTRODUCTION

The possibility of a deep Geothermal Aquifer supplying sufficient energy for the production of Electrical Energy is within our grasp. This report outlines from observation of present data, in conjunction with other areas in the world that Clacy has surveyed for Geothermal prospects. With this background of information, from practical field studies, the maps depicted in (Figs 2,3,6) coupled with information from several hot springs and their chemical analysis, outline areas for determining possible underground aquifers. These indicators follow a similar pattern to some other Geothermal fields worldwide.

Fig2 Click to enlarge

Fig3 Click to enlarge

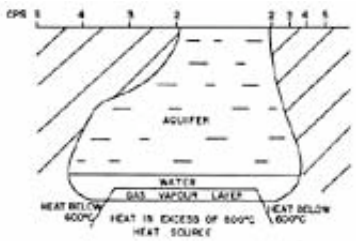


Fig4 Click to enlarge

DISCUSSION OF AREAS OF INTEREST TO DATE

I gave much thought to the areas of interest in the seismic presentations from the B.G.S. maps. The "aseismic" areas depicted in them attracted my attention. The earthquakes occurring in clusters along and around the grabens and sink holes depicted in figures 2 and 6, lead me to suspect that lying deep in these fairly impermeable grabens or holes there are geothermal aquifers - Figure 5 section B.

Fig2 Click to enlarge

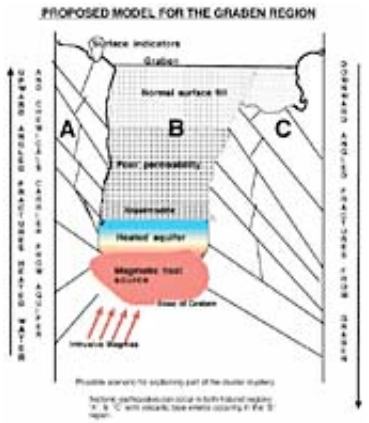


Fig5 Click to enlarge

Fig1 Click to enlarge

I shall try to explain a few of my thoughts on this matter, which to me are extremely important. I surmise that the fractures surrounding the "aseismic" anomaly are tilted upwards from the aquifer - (Fig 5) in the A section.These have the capacity to carry

the heated water up to the surface. This allows us to surmise that a mechanism exists to support these hot springs. It also shows we have some good evidence to start the search for the seismic signature that will give a fairly convincing evidence for the mechanism that is producing fluids under pressure. The seismicity produced from the intrusive magmas should produce seismic signatures similar to the ones that are found on active volcanoes. A list of these seismic signatures have been copied in (figure 7). From this information we can hope to outline drilling targets.

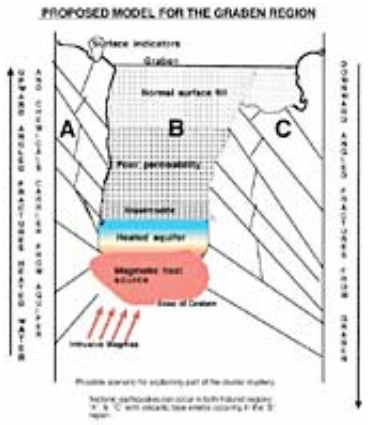



FIGURE 7

Fig5 Click to enlarge **Fig7** Click to enlarge

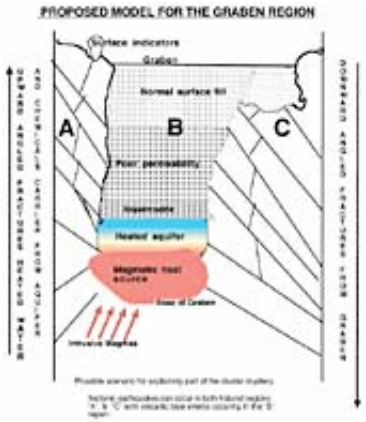
The area (figure 5 section C), where the fractures are all tilting downwards from the graben and aquifer, would tend not to carry the hot aquifer fluids to the surface. Both Section A and C are capable of tectonic earthquakes, whereas in section B the seismic signature of the intruding magmas should be recordable on the surface. The listening techniques developed by Clacy can be studied for volcanic activity as it was in New Zealand (figure 7) copied from Clacy's original paper on volcanic prediction in the 1960's and recently reassessed in the Internet. < http://www.glodark.com/volcanic prediction.htm>

It is well to remember that water on the bottom of the hole can, because of the air pressure, exist at a temperature of many hundreds of degrees-up to the flash point pressure. This I observed in Mexicali Mexico, where water existed at 600šC. This water can be recovered as steam if encouraged to rise up to a lower pressure level. The technique has been used on several geothermal areas in the world. This process involved sealing the well head and blowing in compressed air, then knocking a sealing chock free, which is retaining the compressed air.This causes the water to follow the vacating air up the bore hole to where a lower pressure exists, where the steam is then produced.This is

no problem in a fully cased bore hole. It is wise to put a small pipe down to the bottom of the bore hole, to provide a small amount of water, in case the need arises to quench the then producing well.

Imagine that the "aseismic" area was a graben at one time which filled up with eroding sediments or whatever. There is the possibility of having a hot water aquifer within this graben contained, as in my original paper*, with the boot diagram at the end of my paper being buried much deeper than for the Wairakei region in New Zealand. (paper available on Internet at * <http://www.glodark.com/volcanic_prediction.htm> This original paper is in the Addenda of this work number 4).

This type of deeper system (Fig 5) has a lot going for it; for example, it offers a better containment with a modicum of insulation and not too shallow to cause surface dangers. This theory does not require only an enclosed graben. It can occur in a large collapsed hole produced by removal of magmas to the surface, during an eruption, and the vacated area collapsing, as for a graben. These vacated areas often occur within the vicinity of surface volcanoes. These volcanoes themselves can be dormant on the surface, but contain magmas at depth, penetrating the area filled with loose material from erosion. These can be alongside zones of high seismicity. Tectonic earthquakes appear to be caused by large solid blocks of material colliding. However, it is important to realise that a graben area filled with sedimentary material cannot support a tectonic type earthquake, whereas volcanic shocks appear to be caused by magmas in bursts of tremor, (not the slippage of solid blocks), and usually only when encountering water and soft materials. Magmas can be traced and their flowing movement underground can even be plotted.



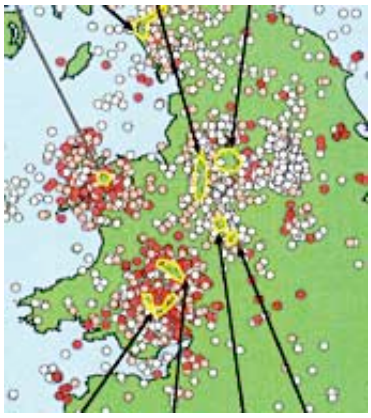


Fig5 Click to enlarge **Fig6** Click to enlarge

I am suggesting that recording in the areas outlined in (figure 6) could be very rewarding, assuming we can locate the vulcanicity

at depth in conjunction with the geological implications of the indicated areas. A tape recorder is undergoing modification to enable this project to get off the ground as soon as possible. Funding will now be required for the carrying out of a thorough investigation of the outlined proposal.

Gresham R.T.Clacy. Geophysicist.

Contact Form

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OVERALL ASSESSMENT FOR AREAS OF GEOTHERMAL INTEREST IN ENGLAND, WALES AND SCOTLAND

The ongoing studies taking place are utilising Gravity and Magnetic implications, full chemical history of springs and wells, assessing their locations and proximity to proposed areas of interest shown from the present seismic maps from B.G.S. reports. Buxton and Harrogate have already been visited to gather available information

These studies will need to be followed up by Ground Noise Surveys. The acquisition of recorders to be converted for these surveys is also at an advanced stage. The amplifiers are also being considered. There do not seem to be any problems to progress to making a ground noise survey. Some input of capital is now becoming necessary to continue the good progress so far in collating the information available, to identify targets. It may be necessary to combine with a University or Government department, or find a private totally committed company to the project. Up to now, Harrogate and Buxton have been visited and, shortly, the mid South Wales area with the North Wales and Leamington Spa will receive a visit.

For the area outlined in the Cumbria Volcanic complex, there are possibilities at the South Western end and at the North Eastern end for geothermal accessible systems. For the South Western end the mountainous topography may not lend itself to easy access for survey, although not impossible. But, if the aquifer lies close to the confines of the valley, it will make everything simpler; this is probably the case. The North Eastern area will be much easier to survey. Hopefully there will be some surface indicators. Both areas have good access to the National

Electricity Grid.

It could also be of interest to Bath and Southampton to locate the whereabouts of the source of their hot water supplier. This source looks as though it could be some distance from the drill termination. One could surmise that this hot water is supplied horizontally along underground layers. The location of the prime source will be of great benefit to the future of their projects.

This theory seems to apply to the Harrogate and Bedale source for its thermal waters, which seems to parallel the same kind of situation as for Bath and Southampton. There does not appear to be one outlet situated directly over these surface indicators. So this situation would call for a fairly wide noise survey to detect the source aquifers.

For Buxton East and West, Leamington Spa with the Cumbrian and Welsh systems, the common factors as seen at this time between all these areas identified in this report are: they appear to have a source supply not connected directly below the surface indicators; they seem to have underground systems which carry the geothermal waters to the surface. The only common denominator between all these systems is that they are all from volcanic activity. Only the mode of transport to the surface is different. There is always the possibility that the Bath and Southampton hot water supply, could share the same underground source, as could the Harrogate and Bedale one, but they may be fed from an underground fracture.

There are also areas in the Western Highlands in Scotland that show a few possibilities. Priorities as to the direction of the surveys, and the timing of them, will have to come from the investor assessing the results from surveys as they progress.

Fig2 Click to

Fig1 Click to

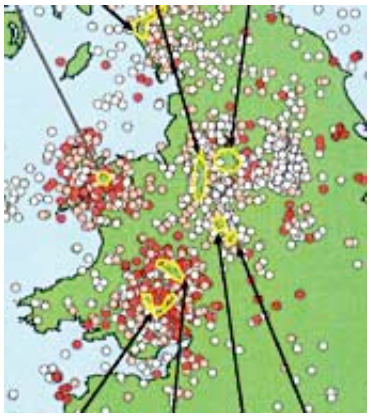


Fig6 Click to

enlarge enlarge enlarge

It is now important for Southampton, Bath, Harrogate and Bedale to realise that their hot waters do not come directly beneath where their borehole or surface manifestations occur. It would be very prudent to find the source of their heat, which, as indicated by their published cross section, is fed from some place within their horizontal strata shown in their diagram (Fig7) below. The discovery of this source could possibly increase both their heat output in both quantity and temperature with an added longevity of supply. It would be very naive judging from their cross section to believe that their borehole was the end of the matter. Just extend the Model "a" outwards from the volcanic complex and you can come up with a multitude of ways for their water to be heated away from their borehole which apparently is fed horizontally.

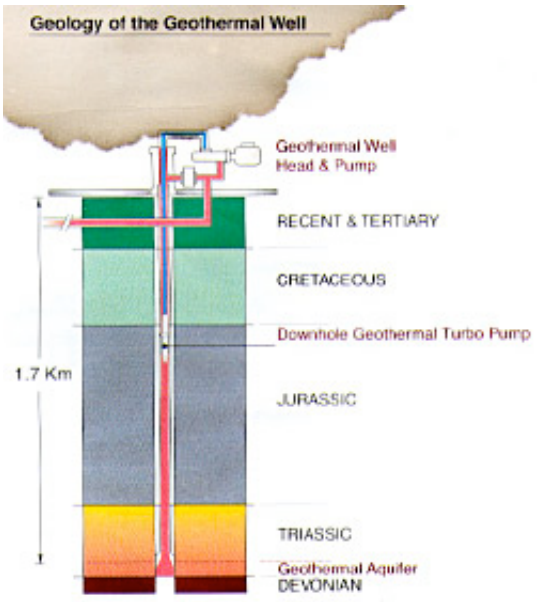


Fig7 CROSS SECTION COPIED FROM SOUTHAMPTON'S GEOLOGIC REPRESENTATION OF THEIR BOREHOLE

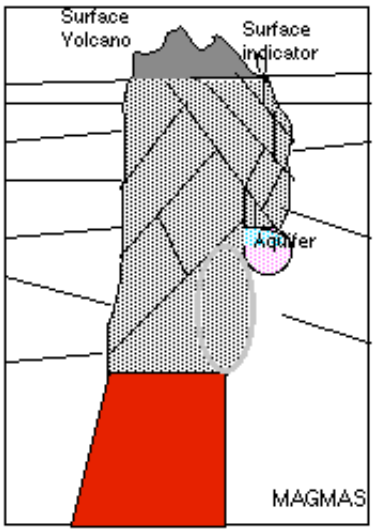
This is printed in their "Urban Community Heating and Cooling: the Southampton District Energy Scheme" booklet.

THE VOLCANIC UNDERLYING PUZZLE

It is quite normal to have many unexplained mysteries attached to data that has been collected and represented to try and see why they occur. Recently while trying to determine areas of deep geothermal systems for the production of electricity from steam naturally produced in certain areas of the world, my first choice was where are all the surface hot waters are occuring in this country. This information was simple to map. My next quest was to contact the British Geological Societies Seismic unit in Edinburgh as they have very expertly paid a lot of attention to the many local earthquakes in the United Kingdom. The information which they kindly sent to me contained many maps and written dialogue of their work. In the text they pointed out

to what they refer to as clusters of earthquakes which did not align themselves along obvious fault lines. There seems have have been no conclusive answer to this phenomenon, this attracted my attention because it was not the first time I had seen these clusters.

I would suggest that the clusters appear to be concentrated where large volcanic outpourings, which built our volcanic mountainous regions are. The evidence of our main hot springs showing at the surface shows that for a very long time thermal waters have been flowing to the surface. The outpourings of the volcanic materials on the surface suggest that large areas beneath these outpourings are still very active. The activity deep underground will have highs and lows producing stresses on the solidified ground above this deep activity (figure "8"). In turn this would produce stresses that produce these clustered earthquake zones. If this is the case then my model (figure"9") of the hot aquifer system becomes more believable than ever.



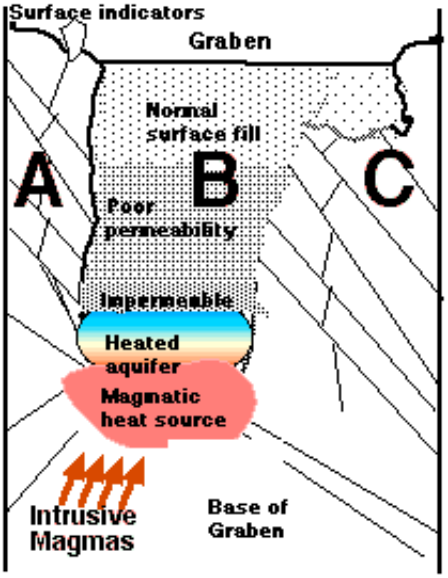


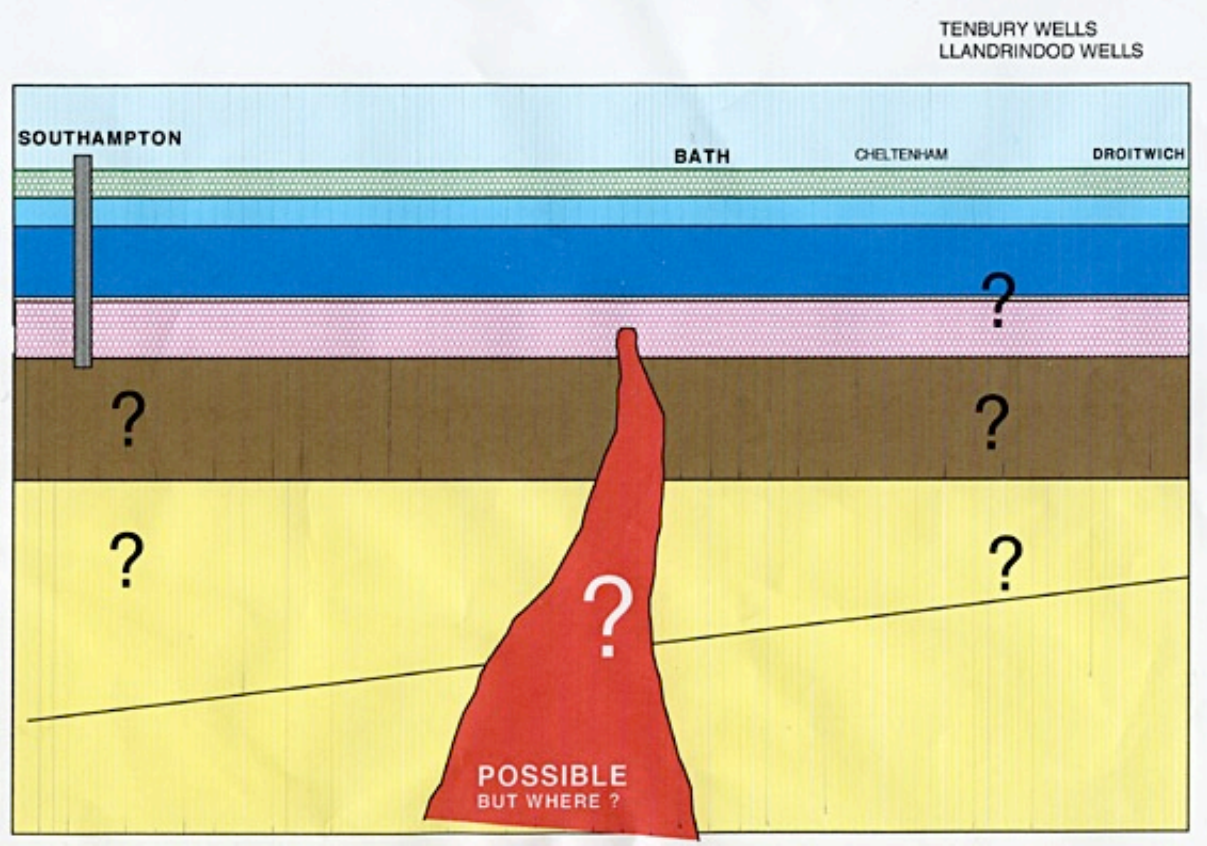
Fig8

Model theoretically suggesting cluster solution

Fig9

Possible scenario for explaining part of the cluster mystery.

Tectonic earthquakes can occur in both fractured regions "A" & "C" with volcanic type events occurring in the "B" region.



The water at Southampton has been coming up at the same temperature for over a decade. I believe this indicates that the main heat source is massive and effectively inexhaustible.

With the equipment I designed, I believe that I can locate the main heat source(s). At Southampton the water is merely warm and has to be pumped out. At the main heat source, the water will be so hot that it will come out under high pressure, requiring no pumps and providing an unbelievably powerful source of energy.

Gresham R.T.Clacy. Geophysicist.

Contact Form

Finally, here is the UK Government's response to my proposal:

18 May 2007

> Thank you for your letter of 5 March to David Miliband, enclosing correspondence from your constituent, Mr Gersham [sic] Clacy, about geothermal energy and his proposal for a UK survey of the resource potential. I am replying as this matter falls within my portfolio and apologise for the delay in doing so.
>
> As Mr Clancy [sic] points out, there are a number of regions

across the UK where aquifers exist and they form an important source for ground water. In some regions, formation water becomes naturally heated and in these circumstances water can be used as a heat transfer medium, particularly where there is a large demand for heat. There are many regions in Europe and across the world where the geothermal gradient is much higher than in the UK, making geothermal energy viable. However, the development of geothermal energy from aquifers depends on the quality of the resource, which is dependent on a number of factors including permeability, surface temperature, sustainability of flow and the proximity of the demand for heat.

The Government is aware of the potential for geothermal energy in the UK, spending around £50M between the mid 1970's and 1994 on a programme to determine the extent of the resource and its economic viability. This included a national appraisal of geothermal energy from permeable rock formations (aquifers) in order to provide a definitive statement of its potential and to determine whether aquifers could be developed in the UK. The conclusions of this work where [sic] published in 1986. The results revealed that the resource was limited either because surface temperatures or permeability were lower than expected. Only one area, underlying Southampton, was sufficiently promising and consequently a demonstration scheme was established.

Geothermal energy is an established technology. Techniques used in the oil industry are used to identify where suitable rock formations occur. It is therefore possible for developers to reappraise prospective regions for development. It must be stressed that geothermal energy in the UK is only suitable for heat as surface temperatures are too low for electricity generation. Developers would also need to identify suitable heat demand for the resource, which must be close to the wells drilled. Most areas identified in the UK are not close to major centres of population and are therefore unlikely to be economically viable.

Therefore the Government is currently not funding any major research into geothermal energy as unless the technical, practical and economic constraints identified under the previous Geothermal Programme can be addressed, the prospects for geothermal power in the UK would appear to be limited.

Lord Truscott
Parliamentary Under Secretary of State for Energy

Continued on Page 3

Free energy from the earth. Geothermal energy can be tapped either at or near the surface at a random point where hot water emerges, or from magma miles below the Earth's surface. The original programme looked at surface sources but ignored the possibility of a magma intrusion creating a high energy source. This is what we must investigate as a matter of urgency if our reliance on coal, oil and reactors is to be reduced.

Further reading

http://freeenergynews.com/Directory/Geothermal/index.html

http://pesn.com/2007/01/22/9500449_MIT_Geothermal_Report/

Gresham R.T.Clacy. Geophysicist.

Contact Form

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Malcolm Wicks MP
MINISTER FOR SCIENCE AND INNOVATION
Our ref: TC/621 184 Your ref: ClacOOl/2/sw

1 June 2007

To: Tim Farron MP

Thank you for your letter of 24 May, enclosing correspondence from your constituent, Mr Gresham Clacy, about his report 'Geothermal Implications in the United Kingdom'. I am replying as this matter falls within my portfolio.

There is little I can add to Lord Truscott's letter of 18 May, which sets out the reasons for the Government's current position with regard to the research of geothermal energy in the UK.

However, the Department of Trade and Industry does support the research and development on new and renewable energy through its Technology Programme. The priorities for the Technology Programme are determined by the Department's Technology Strategy Board.

Although geothermal energy is not a priority for research and development, as a renewable energy source, geothermal energy is relevant to the aims of the Department's policies and programmes for renewable energy. Therefore, Mr. Clacy is welcome to submit a proposal to this Programme. Any proposal should focus on innovative technologies offering the prospect of improving the economic attractiveness of renewable energy sources. The Programme does not support commercial projects, nor does it support-site specific feasibility studies for commercial projects.

The Technology Programme is a two-stage, competitive and open application process. Any proposal submitted will be evaluated on its merits and in competition with other proposals. The Department has appointed an independent panel, itself recruited in a fair, open and competitive manner in accordance with the principles of the Nolan process, to advise Department on which proposals to support.

Given that geothermal energy is a not a priority in the Technology Programme, the very competitive nature of the Programme and the fact that there is great competition for the available funding, any proposal will need a compelling case for support. It must clearly demonstrate that the concept has good prospects for eventual economic exploitation and show that the benefits are commensurate with the investment required. The Department will expect that such a case would include firm data and evidence, showing that the reasons for the Department closing its previous significant programme on geothermal research and development are no longer valid.

Further information about the Technology Programme on the DTI's website at: www.dti.qov.uk/innovation/technologystratepy/technologyprogramme

Best Wishes

MALCOLM WICKS

Department of Trade and Industry
LG 52 1 Victoria Street London SW1 H 0ET

HOUSE OF COMMONS

LONDON SW1A 0AA

Our Ref. Clac001/2/ag

Dear Gresham,

Thank you very much for your latest information upon the sterling efforts that you are making to attract the interest of policy makers to the potential of geothermal energy.

I share your frustration that there does not seem to be anyone in authority with the vision to take advantage of your work but we will keep trying.

With best wishes

yours sincerely

TIM FARRON MP

23 / 07 / 2007

Comments on a Geothermal study carried out for D.O.E.

I have just finished studying the government report entitled "***GEOTHERMAL AQUIFERS Department of Energy R & D Programme 1976-1986***". The main study was terminated at around 2000 feet below sea level. The geothermal bore at Southampton is operating at a depth of 1.7 Kms (0,588 of a mile). From then on they have made projections which appear only to assume that the depth beyond this level be homogeneous. Obviously this cannot be so when you consider the volcanic extrusions which have broken surface in this country, as you can see by the answers I have received from the top government sources. These being Lord Truscott and Malcom Wicks. They appear to have written off Geothermal for the production of electricity after only "scratching the surface" (literally). The people who carried out the work for this study are in the Nuclear Industry and the Oil Industry, who (in my opinion) do not even understand what the aims are - only their own selfish dominance of the energy business. I found this was so in the USA. The Oil industry were buying up all the leasable land for geothermal back in the 1970s, usually after following our surveys. A lot of opposition came from the Oil and Nuclear Industries there. At that time I was carrying out surveys across the Western States of that country. The USA has now realised that these earlier efforts were dogged by the oil and nuclear people and has set up a government department to push Geothermal ahead. It is well to understand that, in the USA, more especially in the West, land leases are half owned by the government and half by private enterprise. This should allow the USA government to proceed in these areas, now they have

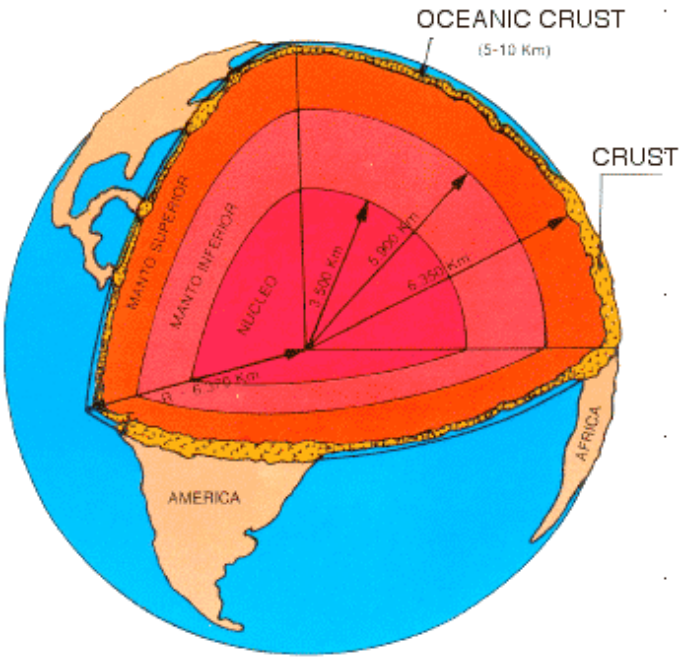
formed a full time Geothermal department .

I feel that, in this country, there should have been an assembled team with only one goal in mind: Geothermal. At least it should have been carried out by some people from the Geothermal Industry of which there were many available at that time throughout the world. The aforementioned report does not appear to have had a properly dedicated team with knowledge of Volcanic and Geothermal matters.

We were all taught in school using diagrams shown in the attached (figure 10, below), that one of the features is the intrusive magmas reaching up through the crust. The cross sections represent the Earth's very hot centre. This hot mantle and nucleus, in conjunction with intrusive magma's activity that reach up to and just below the surface of the Earth, indicates that it is very feasible to have one or more of these magmatic feeds underlying our present surficial volcanic areas. Its longevity is proven because of the length of time that the surface hot springs have been producing hot waters - at least since the Romans were here, and more than likely long before. The heat that is being lost is at the same time being replaced by one or more volcanic intrusive magmas reaching up through our crust. Apparently, Southampton has been utilising hot water from a shallow hole right under that city for at least 20 years. The *GEOTHERMAL AQUIFERS* report I have referred to has never considered its source for the heat regeneration. This is what I intend to do and I possibly have the skill to do just this. I am carrying on my own personal studies of this massive energy source right under our country.

Interestingly enough, the map in the final stages of the D.O.E. report does not even include Southampton. This report seems to rely a lot on conjecture and homogeneous modelling, but no one has drilled further than 2000ft in this report. However, records show that Monsanto drilled a 13,670 ft deep hole at Seal Sands, Teesside. This hole was probably drilled with only oil in mind. The question has to be asked if, when such a wonderful commodity as Geothermal power was the quest, why did the people involved in this project only drill up to 2000 ft boreholes? I certainly can ask many more questions of the report as above, which does not seem to be very knowledgeable of Geothermal and Volcanic matters.

Fig.10



This is how the earth is represented Internationally by academics to pupils.

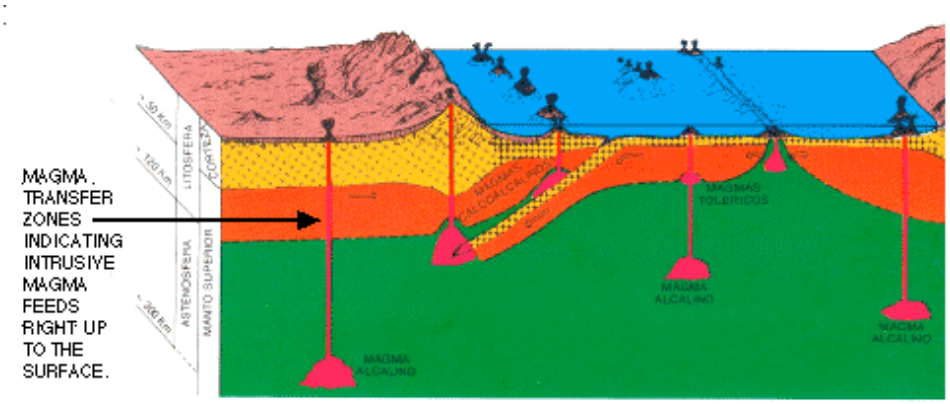


Fig 10

Fig 11

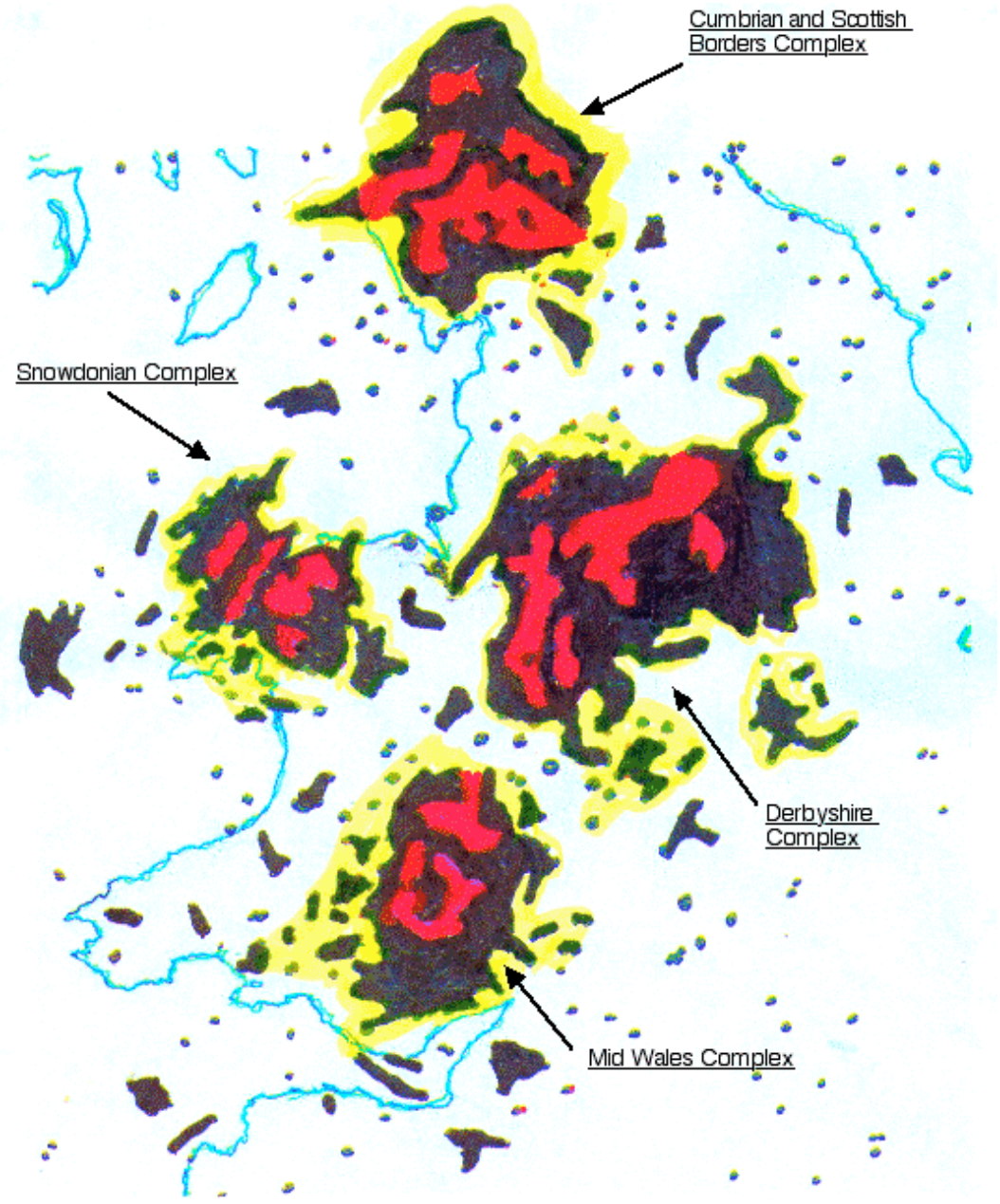
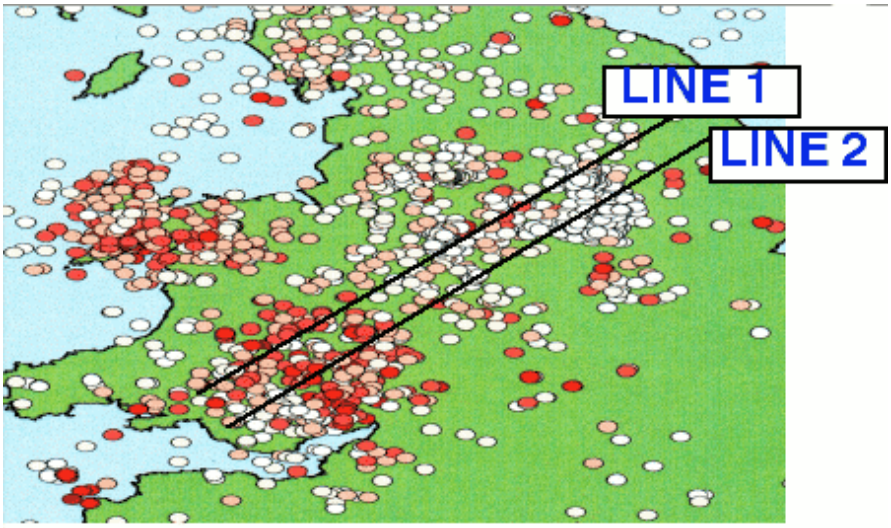


Fig 11

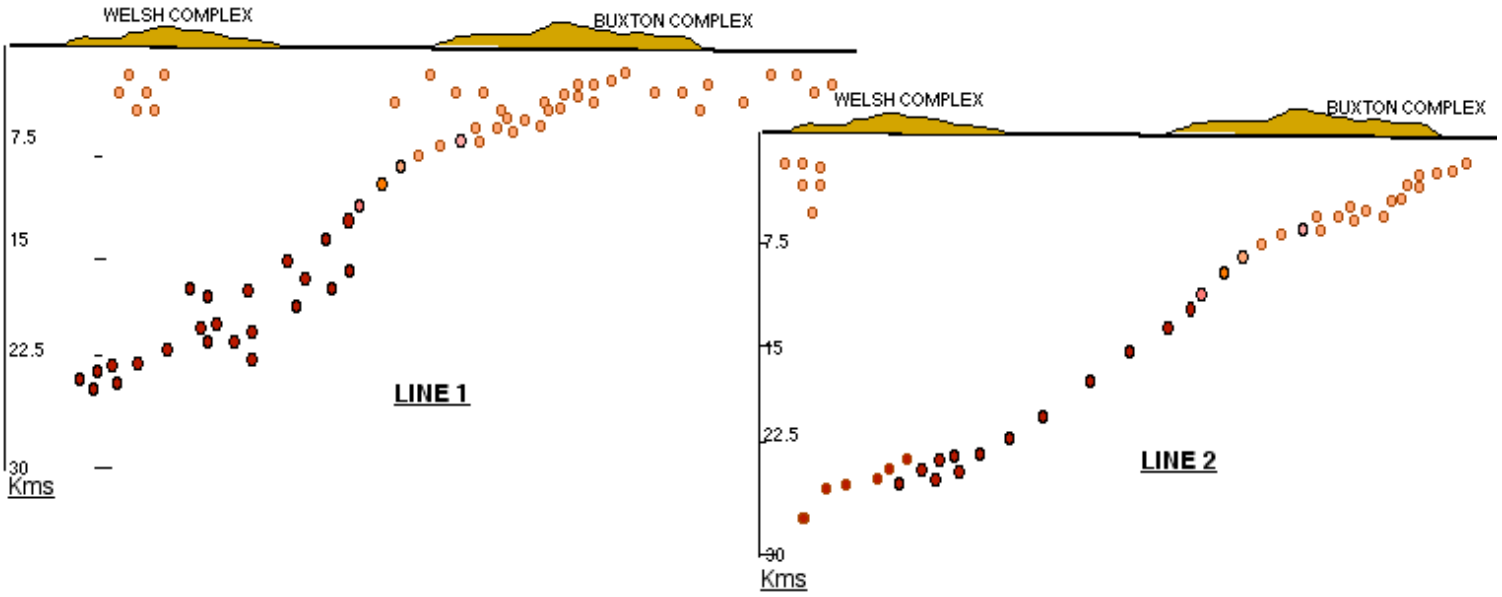
REPRESENTATION OF CLUSTER EARTHQUAKE ZONES AND ASEISMIC GRABENS TAKEN FROM B.G.S. SUPPLIED MAPS.

Red zones Aseismic Grabens.
Dark zones Densely Clustered Earthquakes
Black dots Single Earthquakes
Yellow shading Highlighting around the zones of interest



It is very noticeable that the deeper earthquakes are in the main clustered under the Welsh Complex. Where the shallower earthquakes are clustered under the Buxton Complex. The lighter coloured earthquakes are the shallower ones, whereas the Deeper ones are indicated by the deeper colours.

The deeper earthquakes under the Welsh Complex probably indicate more dense material at depth with a much deeper magmatic level beneath this denser solidified material. For the Buxton Complex it more than likely suggests the magmatic material at a much shallower depth. This seems to be true for the Cumbrian Complex as well. A less defined area in the Snowdonian Complex is indicated. So at this showing it looks as though the Buxton Complex and the Cumbrian one would be the ones to concentrate on, with a survey carried out in the aseismic zones. Surface to magma level appears to be much greater under the Welsh Complex, and shallower under the Buxton Complex. It will also be shallower under the Cumbrian Complex.



Scientific Objectives

What controls the location of British earthquakes?

The spatial distribution of earthquakes in the British Isles is not random. But the reason why earthquakes are clustered in some parts of the UK and not in others has always been a puzzle. We have recently reviewed the various theories that have been put forward.

Comparing a map of British seismicity with a geological or structural map poses problems. Earthquakes are relatively common in some parts of the country and totally missing from others, and there is no obvious geological explanation. Theories that have been put forward to explain this can be grouped into the following categories: influence of recent tectonic evolution; patterns controlled by deglaciation and isostatic recovery; conjunction of seismicity and zones of major faulting; distribution controlled by upper mantle processes; and patterns of stress interaction.

Most of these suffer from the problem that it is difficult to demonstrate that earthquake activity is controlled by a given factor, and that there are always some mismatches.

An example is the association of earthquakes with zones of major faulting. "Corridors" along the line of major faults in the UK take in most large earthquakes. However, to say that earthquakes are equally likely anywhere along these fault corridors is another matter. Large areas appear to be "suitable" for earthquakes yet remain aseismic.

A promising line of approach is that of stress patterns and the geometry of the crustal blocks that make up the British Isles.

The shape of different structural units determines how they interact when subjected to regional compression. For example, the northward angular point of the Midlands microcraton means it can act somewhat as an indenter under compression from the northwest, but with more seismicity both expected and observed on the western side than the 'protected" eastern side. If the microcraton had a different shape it would interact differently. Aseismic areas may be effectively in the stress shadow of sequences of blocks that are absorbing regional stress.

Ideally a model should be such that one could predict the distribution of seismicity without actually knowing it. In practice this is not likely to be possible because there are too many unknowns. However, this geometric approach to structural interaction does open up the possibility of a kinematic model of UK seismogenesis that should improve future estimates of seismic hazard.

COPIED FROM A B.G.S. REPORT: UK EARTHQUAKE MONITORING 2005/6 Seventeenth annual report Page 21.