Unconventional geothermal technology to help the climate change issue in the densely populated areas of the world with a demand for higher energy.

by

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Worldwide, conventional geothermal development is mainly confined to high enthalpy areas of the world such as Italy, Philippines, Indonesia, New Zealand, Iceland and others where the depth required to access high temperatures in these volcanic environments is relatively shallow. Economically this is a distinct advantage as the drilling cost can be relatively low and the resource is relatively well defined. On the other hand, on average, the density of population in these specific areas is extremely low, which makes the contribution of such development relatively insignificant on a world-wide scale compared to the total available geothermal energy resource. The higher demand for energy is clearly correlated with the areas of the world that have a higher population density. Furthermore, because the issue of climate change is becoming critical it will be these areas of higher population density where there will need to be the most drastic reductions in fossil fuel usage, in order to slow down the emission of greenhouse gases.

Various assessments indicate that climate change will occur and as a consequence some parts of the world will become uninhabitable due to extreme conditions, such as desert or flooding. It is anticipated that this could cause a massive migration of people away from the equatorial regions to the northern and southern hemisphere. This migration is assessed to be in terms of tens of millions of people which could lead to the depletion of food, commodities and conventional energy resource, which in turn could lead to conflict between nations. A scenario is put forward in this paper, based on experience, which could help to reduce the impact of this phenomenon and provide a glimpse of hope for the future.

Research is being carried out in various parts of the world to see if the geothermal energy resource can be made accessible economically in the non-volcanic regions of the world, where the majority of the densely populated regions exists (~ 7 billion). One of these concepts is Engineered Geothermal System (EGS) whereby deep conductive faults are hydraulically manipulated at great depth to emulate a natural (conventional) heat exchanger which can then allow cold injected water to be heated up and brought to the surface as high temperature heat for commercial application.

Developments at the Rosemanowes site (UK) and the European EGS site at Soultz (France) have shown that natural hydraulically conductive faults do exist in igneous basement at great depth and these can be hydraulically manipulated for extracting and high-temperature fluid. These faults are linked to the geo-mechanic properties of the rock mass and are inclined to be in the maximum horizontal stress direction. A good knowledge of geo-mechanics is therefore crucial to understanding the preferential direction of fluid flow and enhancing the properties of these large conductive faults.

Two successful commercial EGS projects have been established in Germany (Insheim, Landau) and in France (ECOGI; Rittershoffen), all of which are located in the Rhine Graben. It is apparent now that deep faults, with favourable orientations, in Rhine Graben can be hydraulically conductive and therefore be used for EGS. However for this EGS concept to be universally applicable, one needs to test such deep faults away from the rather unique hydrological characteristics of the Rhine Graben.

A similar project, using the same concept, is being proposed 1200 km away in Cornwall (UK), at the Eden Project. The geology of Cornwall comprises homogenous fractured granite that is very different in characteristics from that in the Rhine Graben. However the existence of deep faults in Cornwall is apparent from satellite images, surface expressions and also geological knowledge from deep metalliferous mines. Therefore, if the evaluation in Cornwall is successful, it would demonstrate the wider applicability of the approach and therefore the potential of the vast geothermal resource worldwide. It would then provide an opportunity to use unconventional geothermal energy worldwide as a sustainable energy resource in highly populated non-volcanic regions and thus assist in the mitigation of the long-term effects of climate change.