ESTIMATE OF ENHANCED GEOTHERMAL SYSTEM (EGS) POTENTIAL IN MAINLAND RED RIVER BASIN, VIETNAM

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ABSTRACT

The Red River basin is said to be the hottest heating regime compared to the other basins of Da Nang, Nam Con Son and Cuu Long in Vietnam territory with thermal conductivity - 3.37W/mK; geothermal gradient - 35.9K/km and heat flow - 118 mW/m^2. So far, geological and tectonic studies have shown that most of the surface area of the Red river basin is covered by the Quaternary sediments, the underneath formations are Neogene then Paleogene sediments. The overall thickness of these sediment layers is unstable from zero to thousands of meters. The basement rocks are found at very deep levels and are composed of diverse and inhomogeneous formations. Making use of data from 19 wells to 1,200 m depth of the "Investigating and General Assessing the Coal Resources in Mainland of Red River Basin" project, the initial assessment of Enhanced Geothermal System potential in mainland of Red river basin is conducted following the method which has been recently applied in some countries in the world. The parameters of porosity, heat conductivity, U, Th and K contents of the well cores as well as gamma radiation, thermal gradients in the wells are analyzed and computed, along with the physical figures of the deep sedimentary layers those are referenced from studies in the world, the potential of enhanced geothermal system is calculated for the study area in the depth from 3 to 7 km is 133,600 MWe.

Keywords: *EGS, Red river basin, heat flow, thermal gradient*

1. INTRODUCTION

The study area is 2,800 Km^2 located in the mainland of Red River basin. Using 19 deep wells of up to 1200 m of the “Coal Reserve assessing project” in the study area, we have collected 180 core samples of different rock components at different depths in 19 wells for analysis of U, Th, K; thermal conductivity; porosity. The temperature logging and gamma spectra of these 19 wells are also used.

The existing geological and geophysical data have also been used. From these documents we have learned about the characteristics of deep basement rocks in the Red River basin as well as the thickness of the sedimentary layers thanks to the geological sections created by the geological and geophysical studies. Using the methods described in MIT (2006), Beardsmore G.R. et al., (2010) and references to some of the physical characteristics of the basement rocks (Scho¨n JH (2011)) we calculated EGS potential as well as EGS potential mapping for the mainland Red River basin using Arc GIS software.

2. COMPUTING THE EGS POTENTIAL FOR MAINLAND RED RIVER BASIN

The map of basement rocks is shown in Fig. 1. On this map, there are 4 geologic sections drawn: I-I (Fig. 1); II-II (Figure 2); III-III (Figure 3) and IV-IV (Figure 4). Also on this picture, the locations of the 19 wells are shown.

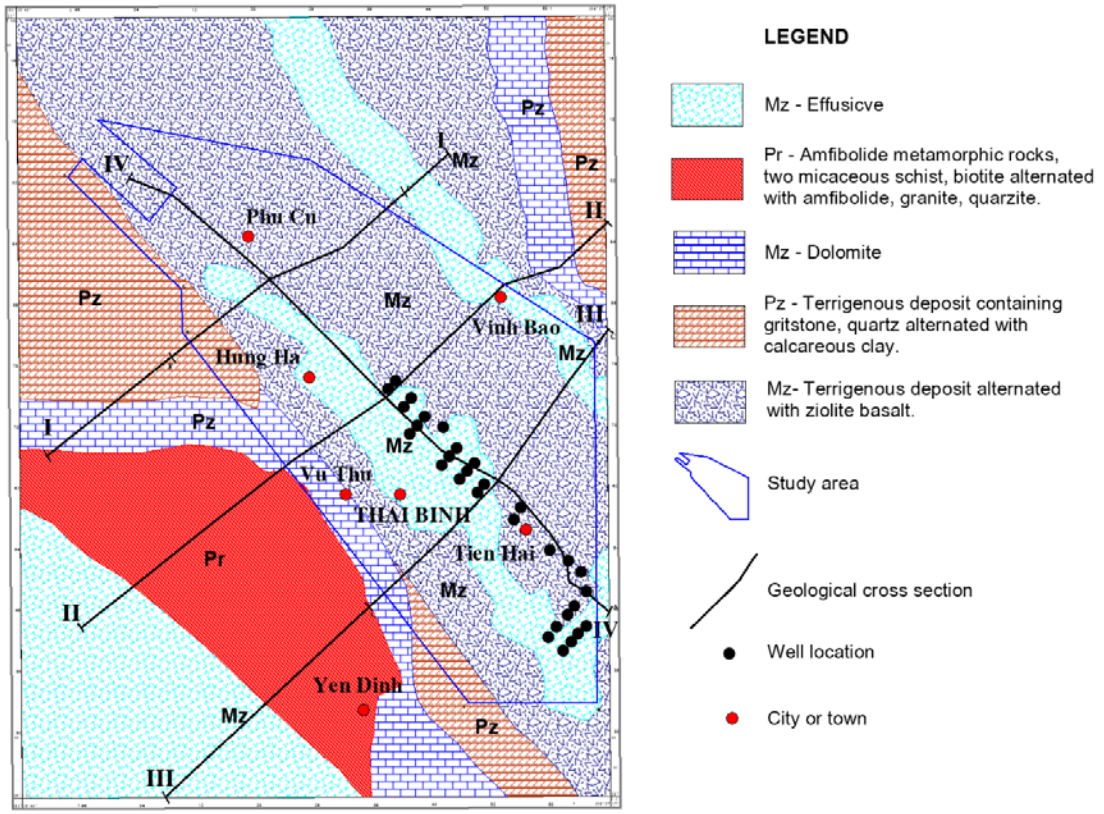

Fig. 1 Predicted pre-Cenozoic basement facies in inland Red River basin (Cao Đình Triều, 2008).

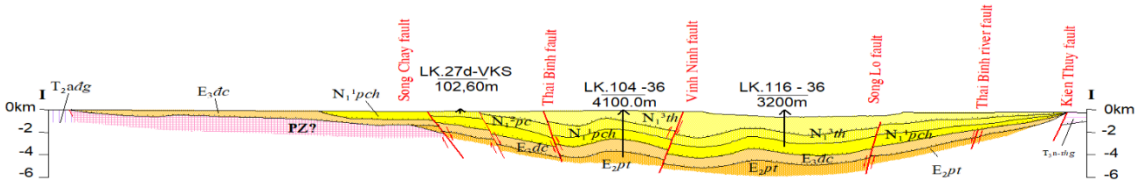

Fig. 2 Geological cross section I-I

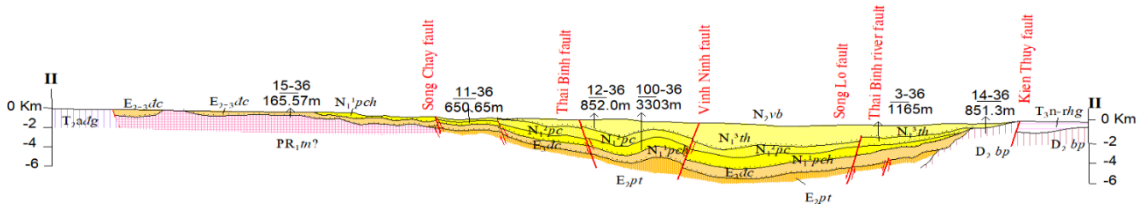

Fig. 3 Geological cross section II-II

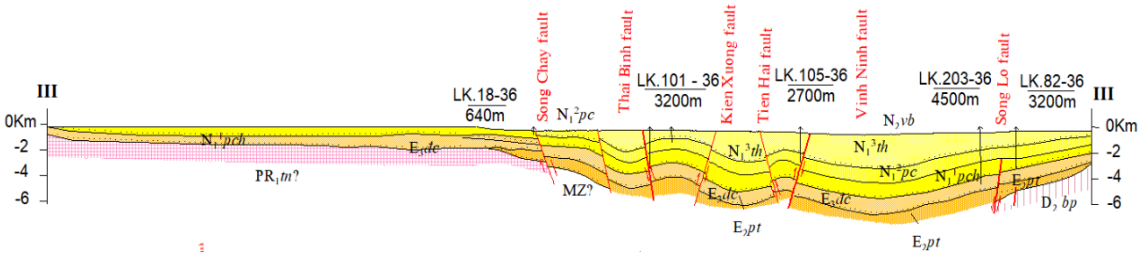

Fig. 4 Geological cross section IIII-III

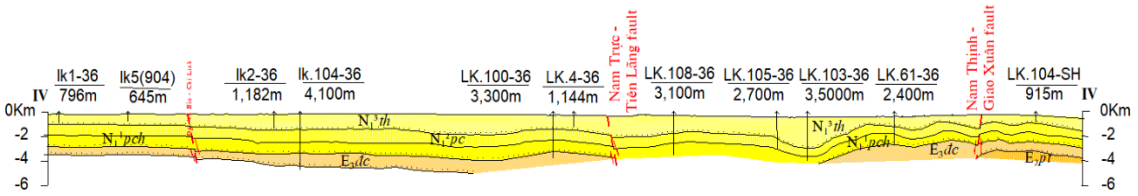

Fig. 5 Geological cross section IV-IV

From the cross sections, the depth to the basement of the sedimentary layers are estimated and shown in Table 1.

Table 1: Thickness of sedimentary layers at each well in the study area

Well name	Thickness of sedimentary layers (m)
51.SH	4.700
64.SH	4.800
76.SH	4.950
84.SH	5.000
90.SH	5.050
97.SH	5.100
98.SH	5.100

Well name	Thickness of sedimentary layers (m)
100.SH	5.200
102.SH	5.280
104.SH	5.350
105.SH	5.300
106.SH	5.400
107.SH	5.370
108.SH	5.320

Well name	Thickness of sedimentary layers (m)
109.SH	5.300
110.SH	5.250
111.SH	5.300
112.SH	5.230
113.SH	5.250

The results of EGS potential have been computed for 19 km^2 where each well located and represented in table 2.

Table 2: The power generation potential in each km^2 at the wells

Well Code	Heat flow (kW/km^2)	Temperature (^oC)				Total heat - Qr in $1Km^2$ from 3-7km (EJ = $1018J/km^3$)	Heat energy recovery factor - Rg (%)	Heat energy can be exploited Qth (EJ = $1018J/km^3$)	Power plant life time (year)	Power plant capacity factor (%)	Power generation potential We/Km^2 from 3-7km (MWe/km^3)
		3.5 Km	4.5 Km	5.5 Km	6.5 Km						
51-SH	77.56	150.32	185.40	220.49	255.57	1.92	0.20	0.38	30.00	0.15	61.03
64-SH	51.66	149.08	183.71	218.35	252.98	1.40	0.20	0.28	30.00	0.15	44.46
76-SH	108.03	161.77	200.27	238.76	277.26	1.57	0.20	0.31	30.00	0.15	49.89
84-SH	67.65	149.72	184.29	218.86	253.43	1.41	0.20	0.28	30.00	0.15	44.61
90-SH	62.85	144.45	177.30	210.14	242.99	1.33	0.20	0.27	30.00	0.15	42.31
97-SH	81.89	158.79	197.50	236.21	274.92	2.10	0.20	0.42	30.00	0.15	66.62
98-SH	118.72	150.10	186.77	223.44	260.11	1.96	0.20	0.39	30.00	0.15	62.01
100-SH	92.81	153.91	190.94	227.98	265.01	2.01	0.20	0.40	30.00	0.15	63.68
102-SH	83.83	119.31	145.21	171.10	197.00	1.36	0.20	0.27	30.00	0.15	43.27
105-SH	62.96	121.67	147.84	174.01	200.19	1.40	0.20	0.28	30.00	0.15	44.34
106-SH	88.51	147.29	181.51	215.74	249.96	1.38	0.20	0.28	30.00	0.15	43.75
107-SH	61.01	140.08	172.35	204.62	236.89	1.29	0.20	0.26	30.00	0.15	40.78
108-SH	170.41	170.77	213.73	256.68	299.63	2.33	0.20	0.47	30.00	0.15	73.95
109-SH	76.15	157.30	195.64	233.99	272.33	2.08	0.20	0.42	30.00	0.15	65.82
110-SH	95.24	144.09	178.54	212.99	247.44	1.35	0.20	0.27	30.00	0.15	42.93
111-SH	114.90	112.84	137.13	161.42	185.71	0.92	0.20	0.18	30.00	0.15	29.26
112-SH	96.59	128.72	157.43	186.14	214.86	1.13	0.20	0.23	30.00	0.15	35.87
113-SH	78.71	127.96	156.42	184.88	213.35	1.52	0.20	0.30	30.00	0.15	48.23

In average, the power generation in each 1 km^2 in the study area is 47 MWe. With the area of 2,800 km^2, the total electric power can be exploited is: 47MWe x 2800 km2 = 133,600 MWe.

Using the results of heat potential calculation, we created the map geothermal potential from the depth of 3-7 km in the study area.

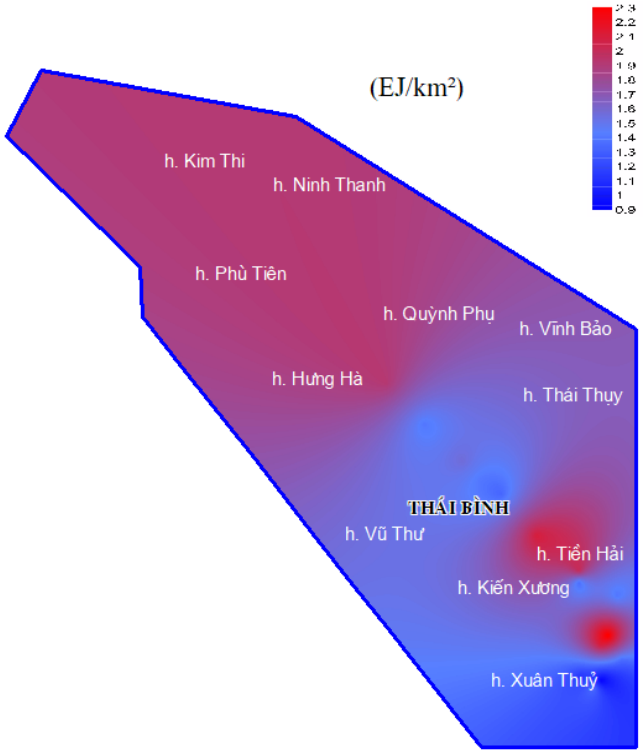

Fig. 6 EGS potential map of Inland Red river basin

3. CONCLUSION

This is the first times the EGS potential computation has been conducted in Vietnam altthough there are many issues to be discussed as well as more data to be exploited to produce better results.

Output results for the potential of 2.800 km^2 in the mainland Red river basin is 133,600 ME. This is a huge potential. By the date that, we are able to obtain the EGS potential and EGS potential map for all Vietnam territory.

REFERENCES

Beardsmore G.R. et al., (2010): A Protocol for Estimating and Mapping Global EGS Potential. *GRC Transactions*, Vol. 34, 2010, USA.

Geological Survey of Japan, 1997: Explanatory Note for Heat flow Map of East and Southeast Asia, *Miscellaneous Map Series (36)*, Ibaraki ken, 305 Japan.

MIT (2006): The Future of Geothermal Energy, Massachusetts Institute of Technology, USA.

Scho¨n J.H. (2011): *Physical Properties of Rocks* - A Workbook, Elsevier B.V.