

A study on the Geothermal Energy in Jeju island

KO Dong-gwan¹ , Lee Dong-Wan², Hyeon Myeong-Taek³

¹Cheju National University, Jeju City, Korea, kdg82528@naver.com

² Cheju National University, Jeju City, Korea, dwmeca@daum.net

³ Cheju National University, Jeju City, Korea, mthyun@cheju.ac.kr

ABSTRACT: It is an unusual geological feature due to a volcanic island. So, characterization of geothermal is a contrast to other region. This paper investigate the characterization of shallow geothermal resources for the utilization of geothermal energy in Jeju. it is investigated the characterization of underground air. it is the temperature about 17 to 22 Celsius degree and the environmental quality of the air is very clean. So, the underground air can clearly be used source of geothermal heat pump.

Keywords: Geothermal energy, Volcaniclastic, Underground air

1. INTRODUCTION

Geothermal energy is the energy contained as heat in the Earth's interior. This energy is immensely present and practically inexhaustible quantities in the Earth's crust. But it is irregularly distributed and seldom concentrated to be utilized industrially. Geothermal energy is divided into deep geothermal and shallow geothermal in the formation of energy. The origin of deep geothermal energy is linked with the internal structure of our planet and the physical processes occurring there. The deep geothermal energy that is high-temperature geothermal resources are generally used for power generation. In shallow, geothermal heat pump is utilized on space and process heating, cooling and aquaculture[1].

The total installed capacity, reported for geothermal direct utilization worldwide[2], is 28,268 MW growing at an annual compound rate of 13.3%. Geothermal heat pumps(shallow geothermal source) have the largest energy use and installed capacity,

accounting for 54.4% and 32.0% of the worldwide capacity and use.

The geothermal energy in Korea is mainly used shallow. In shallow, the scheme of geothermal energy is heat pump, influenced by physical characterization of geological constitution, for the space heating and cooling[3]. In Jeju, it is an unusual geological feature due to a volcanic island. So, characterization of geothermal is a contrast to other region. This paper investigate the characterization of shallow geothermal resources for the utilization of geothermal energy in Jeju.

2. Geological feature in Jeju

Geological feature in Jeju In shallow, the formation of geothermal energy is caused from solar energy and internal Earth's heat energy. The shallow geothermal characterization, as the geothermal gradient and geothermal heat flow, is attributed to geological feature and rock material. Jeju

island is the structure of shield volcano that created by volcanic activity to spout about 41 times and 350 points[4]. So, it construct most of volcanic rock and contain air holes and caves into the ground.

The researchers[5] reconstituted the geological map that is constantly accumulated and investigated the data of geological columns in Jeju. And it is afford to release geological map(Fig. 1). In the horizontal and tangential Geological feature, it is complicated and irregular. As the local geological column(Fig. 2), the distribution of geological feature present to pile up alternately the layer of rock and the volcaniclastic. As the peculiar geological feature, a air and waterdrop ordinarily remain on the volcaniclastic. This air, being to circulate through the volcaniclastic between underground and the atmosphere, be to call as underground air.

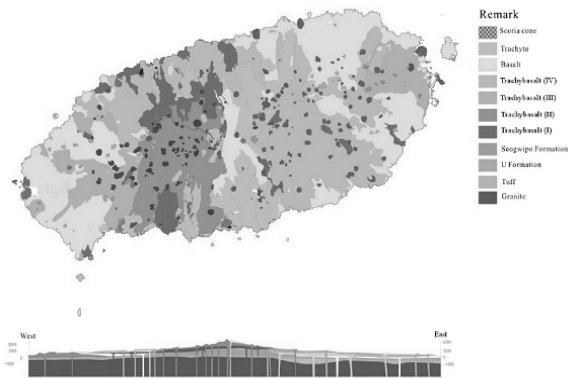


Fig. 1 The geological map in Jeju[4]

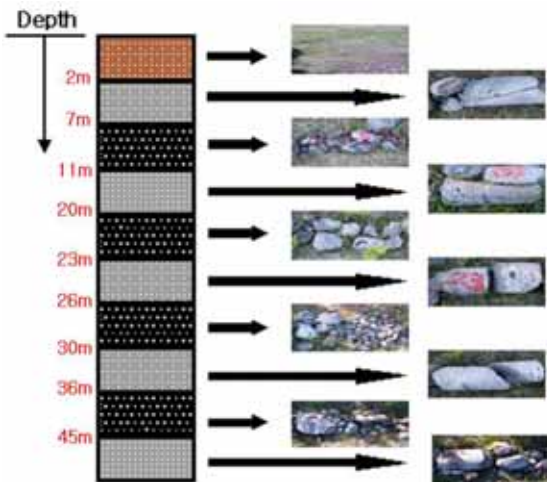


Fig. 2 The local geological column in Jeju.

3. The geothermal Characterize of underground air

3.1 Mechanism of underground air

As the unusual structure of geological feature in Jeju, The air and water, running down ground on the atmosphere, can naturally flow to the gap of rocks and the volcaniclastic(fig. 3). Specially, it is occurred periodic(in-out a ground) air flow with changing the level of underground water. Perforating into ground and inspiring the air by a blower, we can continually obtain the underground air. For passing among layers of the underground, the air, exchanged heat to layers of rock, obtain energy into the underground. This processes can occur continuous and extensive in Jeju.

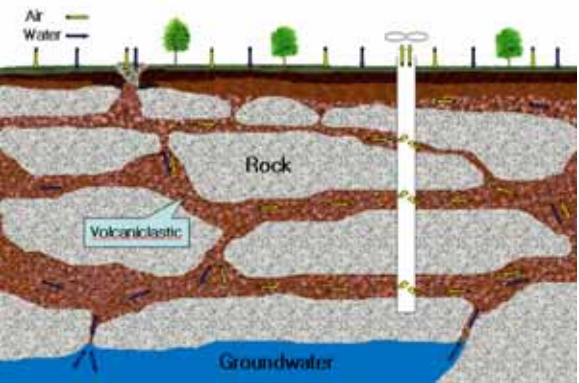


Fig. 3 Mechanism of circulating underground air

3.2 The geothermal Characterize of underground air

In Jeju, it is many the boring hole for the usage of underground air. The system, acquiring underground air, is shown the table 1. On the air blower, the blower is turbo fan and capacity of power is 7.5 kW and 5.5kW. Table 2 represent the temperature and flow rate of the air at the drilling points. it is investigated for two day(from 24 to 25, June). The temperature of air is minimum 17.2 Celsius degree and maximum 21.6 Celsius degree. The flow rate of air is range 1.31 to 2.32. The flow rate is different of drilling points.

Table 1 The specification of system for acquiring underground air.

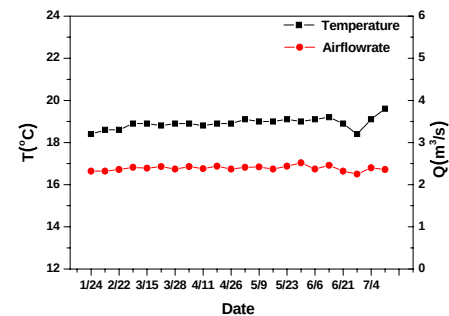
Diameter (mm)	Depth (m)	Power of Air blower
300	40~60	7.5kW

Table 2. The geothermal Characterize of underground air at recently drilling points.

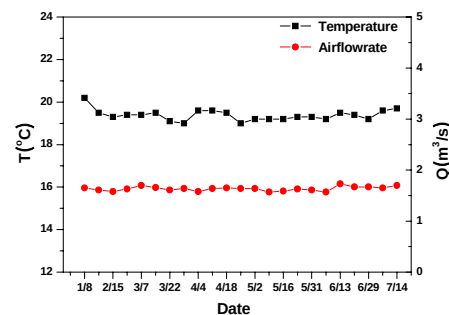
GPS	Height above sea level(m)	Depth(m)	Temperature(°C)	Air flow rate(m ³ /s)
126° 35'18.0" 33° 27'13.7"	367	55	17.5	1.48
126° 41'2.07" 33° 29'14.7"	119	49	18.4	1.57
126° 43'0.91" 33° 29'53.69"	180	48	17.9	2.26
126° 52'55.1" 33° 29'3.0"	53	40	18.1	1.73
126° 43'30.5" 33° 18'20.8"	85	51	19.7	1.73
126° 47'52.47" 33° 23'7.24"	137	45	18.2	1.53
126° 41'50.8" 33° 18'7.79"	139	68	18.4	1.50
126° 20'53.98" 33° 26'50.04"	136	48	18.4	1.45
126° 18'34.0" 33° 23'57.0"	160	50	18.8	1.61
126° 15'55.92" 33° 21'26.27"	129	56	17.8	1.36
126° 14'59.0" 33° 17'37.3"	129	56	21.6	1.31
126° 13'55.05" 33° 18'23.22"	70	52	18.6	1.84
126° 18'38.8" 33° 16'41.6"	155	40	19.5	1.89
126° 22'32.8" 33° 26'36.1"	122	62	17.2	2.11
126° 41'50.8" 33° 18'7.79"	174	45	19.5	2.12
126° 16'27.07" 33° 21'2.72"	144	45	19.3	1.87
126° 43'57.2" 33° 32'20.71"	60	42	19.4	1.67
126° 47'57.4" 33° 23'6.65"	95	51	18.9	2.32

It is caused by geological structure and the capacity of air blowers. it is shown the fluctuation of air temperature and flow rate of air in figure 4. The temperature slowly increase. It is different from the fluctuation

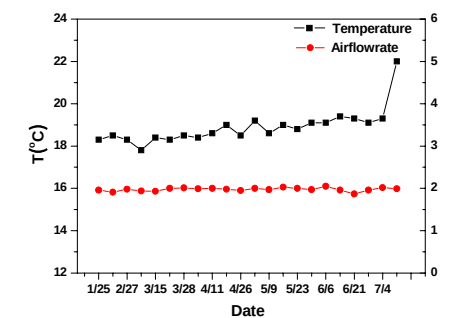
of underground temperature generally known. It originate from the effect of atmosphere temperature.



a) Sehwai(126° 47'57.4",33° 23'6.65")



b) Gimnyeongri(126° 43'57.2"33° 32'20.71")



c) Sangmyeongri(126° 16'27.07"33° 21'2.72")

Fig. 4 The fluctuation of temperature for the underground air at several drilling points.

3.3 The environmental impact of underground air.

This paper analyze the environmental influence of underground and show in table 3. The environmental substance, carbon monoxide, sulfur dioxide, nitrogen

monoxide, ozone, is extremely thin compared with the environmental standard. it is regarded as the physical and chemical change passing through the ground.

Table 3. The comparison of environmental quality of underground air.

Section	CO2 (ppm)	SO2 (ppm)	NO2 (ppn)	O3 (ppm)	Reference
environmental standard (Country)	Below 25	Below 0.15	Below 0.15	Below 0.10	
environmental standard (Jeju Island)	Below 15	Below 0.10	Below 0.10	Below 0.10	
Jeju city area (Downtown)	0.400~ ~0.500	0.002~ ~0.003	0.009~ ~0.023	0.020~ ~0.032	2000.1~2003. 12 in Summer Data. (Idodong)
Jeju city area (Forest ares)	0.100~ ~0.200	0.001	0.002~ ~0.003	0.030~ ~0.040	2001.1~2003. 12 in Summer Data. (Cheona OREum)
Research area (Geumreungri)	0.035	0.000	0.002	0.003	1hour data
Research area (Gasiri)	0.053	0.000	0.002	0.002	1hour data

[4]S. G. Lee, et al., Final report on the probing and utilization of Jeju island's geothermal resources, 1996.

[5]G. H. Par, et al., Final report on the procurement of clean underground water for Jeju island in the future, 2004.

4. Result and Conclusion

For the utilization of geothermal energy in Jeju, it is investigated the characterization of underground air. it is the temperature, about 17 to 22 Celsius degree, the flow rate, range of 1.3 to 2.3 m³ /s, and the environmental quality of the air is very clean. So, the underground air can clearly be used source of geothermal heat pump.

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