[PS]Fuzhou “Yu Quan”: Warning From Chinese Ancient to the Exploitation of Geothermal Resources in Contemporary China*

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Abstract

Although China's emphasis on the development and utilization of geothermal resources was developed from twenty-first Century, even before the Tang Dynasty in Fuzhou, traditional Chinese medicines have used geothermal resources to cure skin diseases. Ancient Chinese people used to call hot spring water the “Yu Quan”, which means springs hide the secret of fire. With the passage of time, more “Yu Quan” was discovered and put into use, so the ancient Chinese diverted the water at temperatures of thirty-five to forty degrees through a stone culvert into bathrooms for people to take a shower and treat a disease with the help of the ingredients in “Yu Quan”. However, with the demand of spring water increasing and the method of exploitation and utilization falling behind, the number of natural springs sweltering decreased in the early part of the 20th century. In 1960s, due to the lack of exploration of underground reservoir structure of geothermal resources and excessive artificial sinking mining, “Yu Quan” nearly disappeared in Fuzhou basin. Excessive use of Yu Quan in Fuzhou is a negative example of the ancient Chinese exploitation of geothermal resources. In China, the exploitation of geothermal resources, especially the exploitation of oil associated geothermal resources; need to consider specific character of the stratum development. We need pay attention to the recharge of the groundwater to reduce the impact on the environment. China has abundant geothermal resources, which is a kind of clean renewable resources used for power generation, heavy oil production and so on. However, when we enjoy the convenience of geothermal resources, we should bear the ancient Chinese warning about “Yu Quan” in mind.

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1.Introduction

“Yu Quan” is located in Fouzhou,the southeast of China.Ancient Chinese people used to call it "Yu Quan",which means springs hids the secret of fire.Based on the description in the book of Three Mountains(Figure3) ancient Chinese have enjoyed the culture of bathing with the hot spring from Song Dynasty(Figure4) even before.

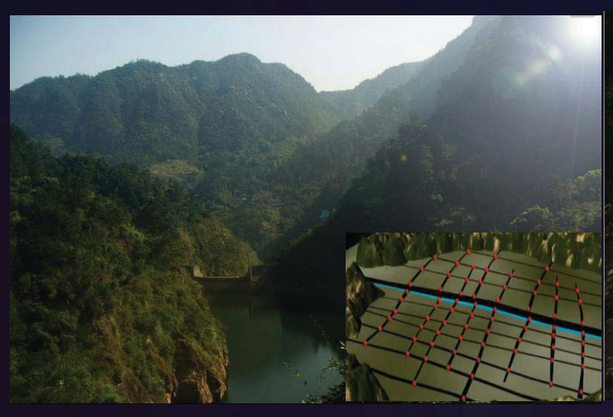


Fig.1 Fu Zhou Basin

Fig.2 Fu Zhou “Yu Quan”

Fig.3 The Book of Three Mountains

Fig.4 Chinese Painting of bathing

2. Background

China has abundant geothermal resources,especially low-temperature geothermal(Figure5).China's emphasis on the development and utilization of geothermal resources was developed from twenty-first century and developed very rapid. (Figure6)

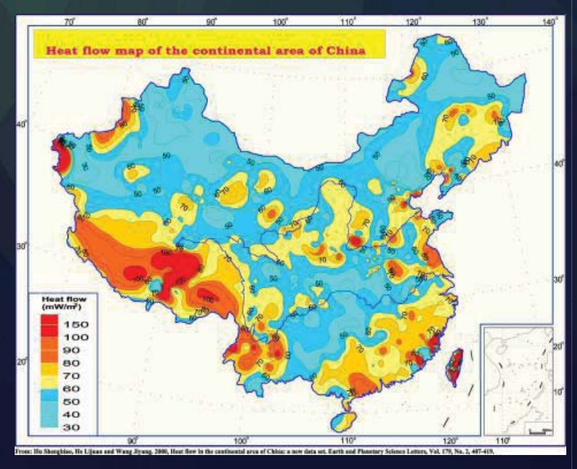


Fig.5 Heat flow map of the continental area of China

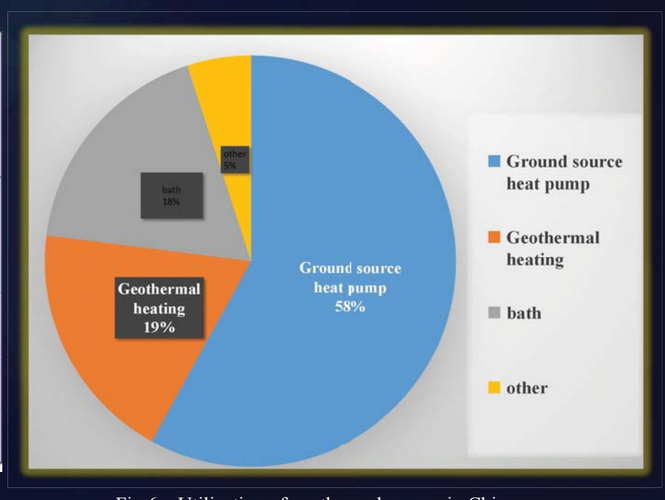


Fig.6 Utilization of geothermal energy in China

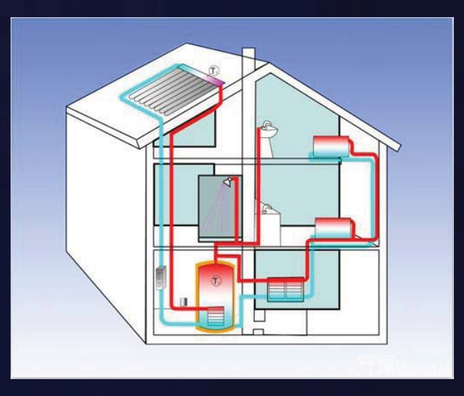


Fig.7 pipes equiped indoor

Fig.8 Heat pump equipment

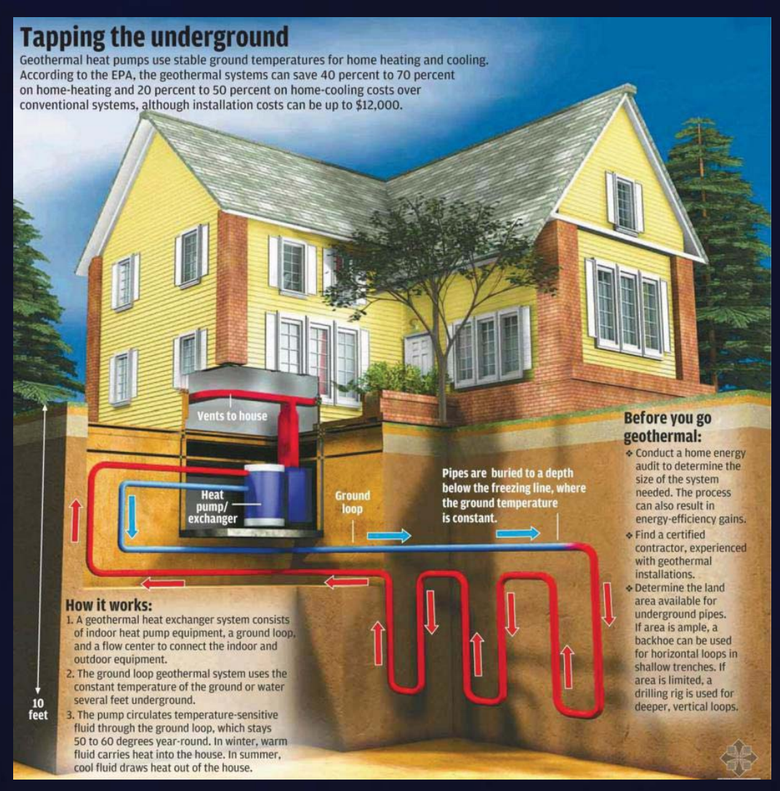
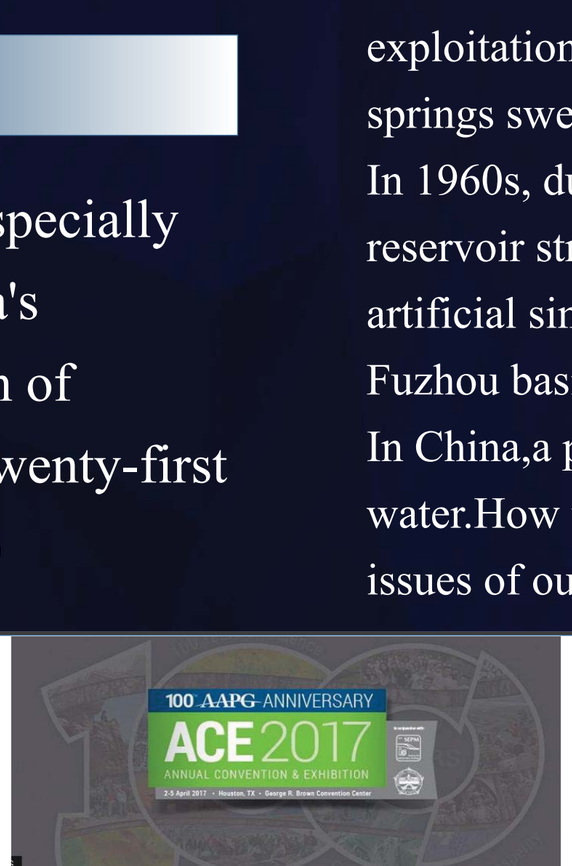


Fig.9 Geothermal heating systems for home
(From Delta-Montrose Electric Association)

3. Existing Problems

With the demand of spring water increasing and the method of exploitation and utilization falling behind, the number of natural springs sweltering decreased in the early part of the 20th century. In 1960s, due to the lack of exploration of underground reservoir structure of geothermal resources and excessive artificial sinking mining, "Yu Quan" nearly disappeared in Fuzhou basin.

In China,a plenty of oil fields are occupied more than 90% by water.How to exploit these resourses is one of the burning issues of our times.



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4. Method

Based on the existing data considering the information of oilfield nearby,exploit oil associated geothermal resources combined with predicting the character of the stratum development.Therefore precise reservoir characterization is very important before geothermal exploitation.

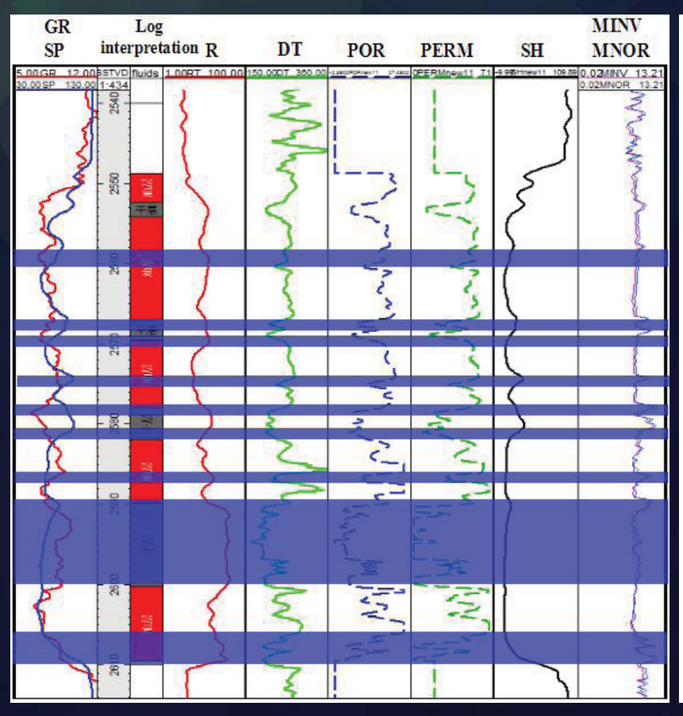


Fig.12 Identification of calcareous cementations

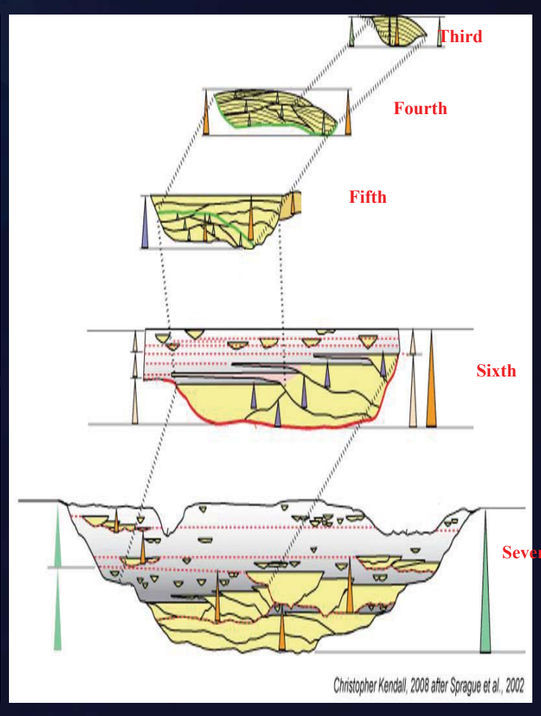


Fig.13 Different levels of architectural elements (FromChiristopher Kandal,2008 after Sprague et al,2002)

(1)The sedimentary environment of aimed formation is researched by outcrop、 core data and thin section observation.

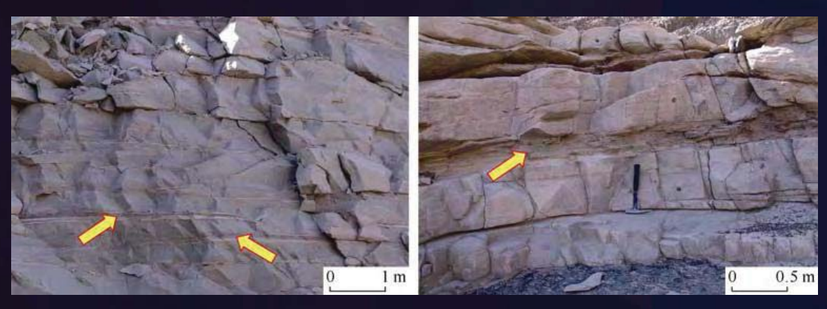


Fig.10 Outcrop

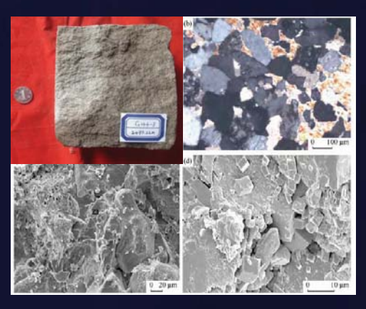


Fig.11 Core data and thin section observation

(2)Take advantage of the analysis of practical well logging data.

Architecture surface hierarchy is a new method of Reservoir Description Service.With sufficient well logging data(especially later development stage),we can research the reservoir architecture for exploring geothermal resources.

(4)Hydrochemical analysis

On basis of reservoir architecture,analysis of groundwater composition is necessary. When we recharge the groundwater,we need to take advantage of the geothermal that doesn't meet the industrial demand with the atention to the similar components.

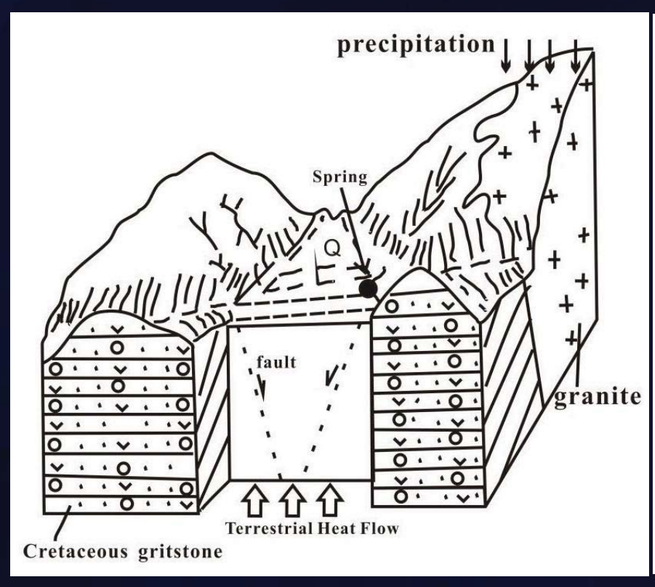


Fig.14 Hot spring in Yunnan

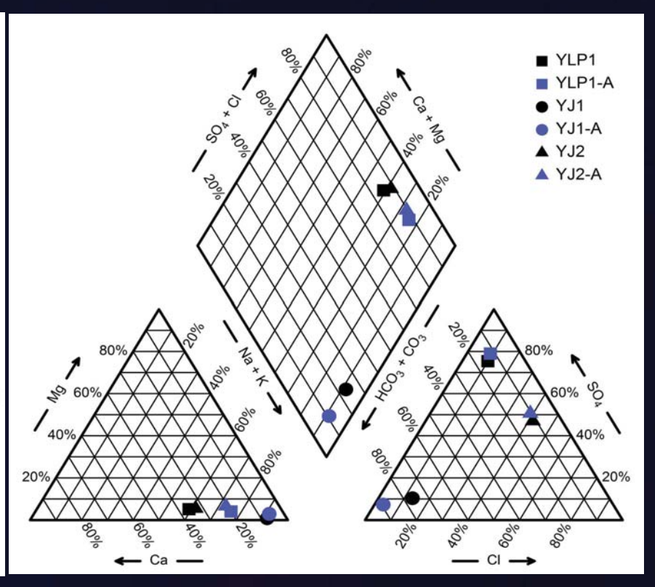
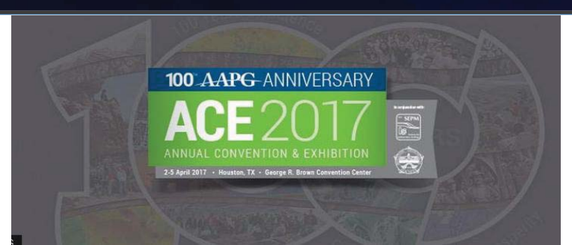


Fig.15 Piper map of groundwater samples



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5.CONCLUSIONS

Excessive use of Yu Quan in Fuzhou is a negative example of the ancient Chinese exploitation of geothermal resources. In China, the exploitation of geothermal resources, especially the exploitation of oil associated geothermal resources, need to consider specific character of the stratum development. We need pay attention to the recharge of the groundwater so as to reduce the impact on the environment. China has abundant geothermal resources, which is a kind of clean renewable resources used for power generation, heavy oil production and so on. But when we enjoy the convenience of geothermal resources, we should bear the ancient Chinese warning about "Yu Quan" in mind.

Fig.16 Spring in Huaqing Palace for empoire

6.ACKNOWLEDGEMENT

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7.PERSONAL PROFILE

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