MAO Xiaoping, 2018. Characteristics of Temperature Distribution and Control factors in Geothermal Field. *Acta Geologica Sinica* (English Edition), 92(supp.2):96-98.

Characteristics of Temperature Distribution and Control factors in Geothermal Field

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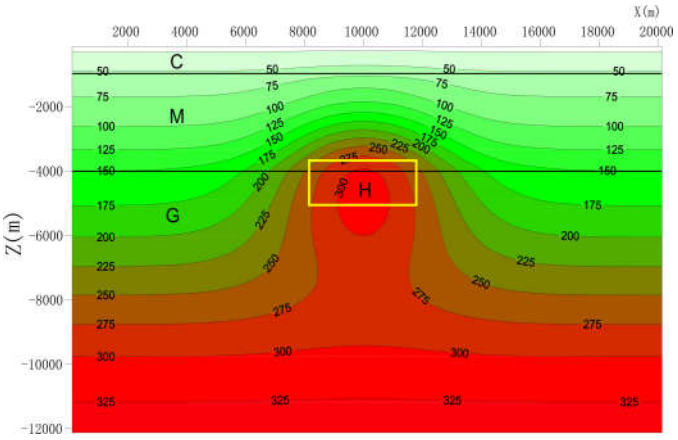
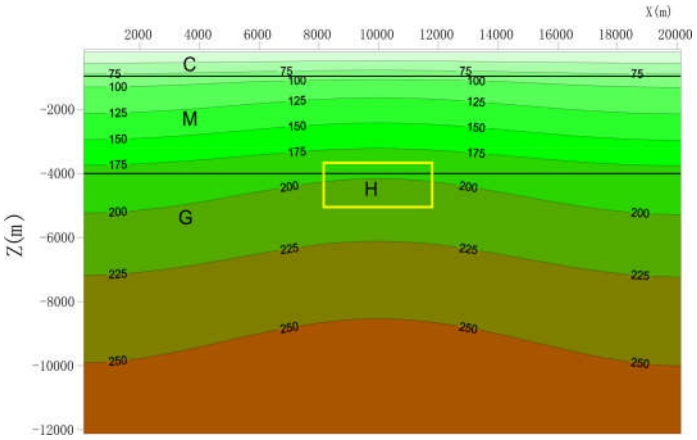
In recent years, China has carried out large-scale exploration, exploitation and utilization of geothermal resources, but there is no unified understanding of the distribution characteristics of geothermal field and the controlling factors of forming geothermal field. As for the heat source, some scholars think it is the contribution of radioactivity, fault, magma chamber, or an abnormal heat source, and even the heat generated by the influence of the tectonic movement. As a result, many exemplary geothermal explorations have made great mistakes. After drilling at a depth of 3000-5000m, the temperature obtained is not as good as the common low-temperature sedimentary basin, and the losses are huge and extremely uneconomical.



(a) 0.05Ma



(b) 0.4Ma

Fig.1. The temperature distribution in different time after the intrusion of rock mass

In this paper, a large number of geothermal data are collected for comprehensive analysis, and it is concluded that the lateral inhomogeneity of physical and thermal conductivity caused by tectonic movement is the main controlling factor of high-temperature geothermal field. According to the characteristics of the geothermal field, the shallow crust is divided into two types of areas: 1) Normal geothermal area N: sedimentary basin area, bedrock uplift area, the rock body intrudes and has emerged to the surface; 2) Abnormal geotherm area A: an area of ancient uplift or intrusion of rock mass with a certain thickness of cap. It is suggested that the search for geothermal fields is mainly carried out in the areas with a certain thickness of heat capping in the shallow part and in areas with high conductance in depth (area A), in which the thermal capping is a necessary condition, while the high thermal conductivity layer, such as rock intrusion, is the sufficient condition for the older metamorphic basement. Based on the software system of forwarding modeling of geothermal field developed by the project team, two kinds of cases of heat conduction

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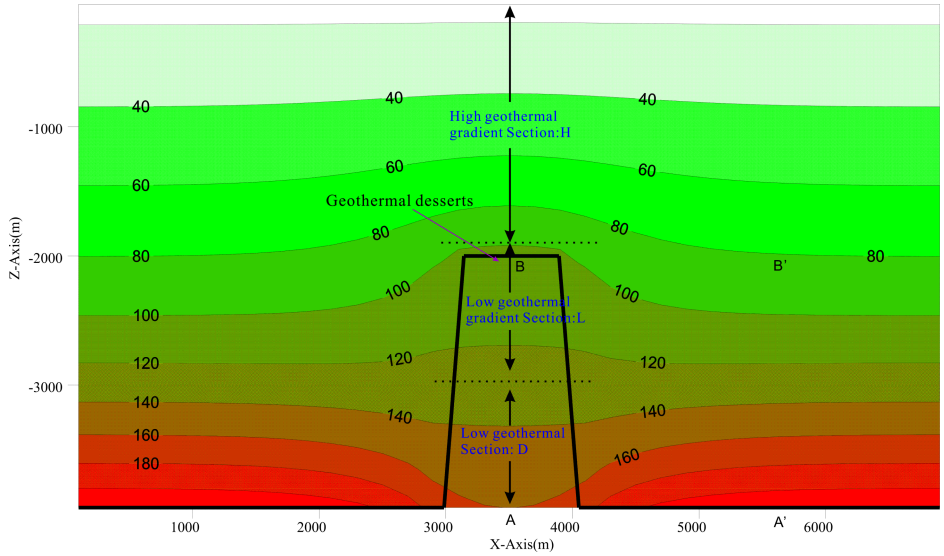

Fig. 2. The temperature distribution of paleouplift after entering steady state under normal basement heat flow

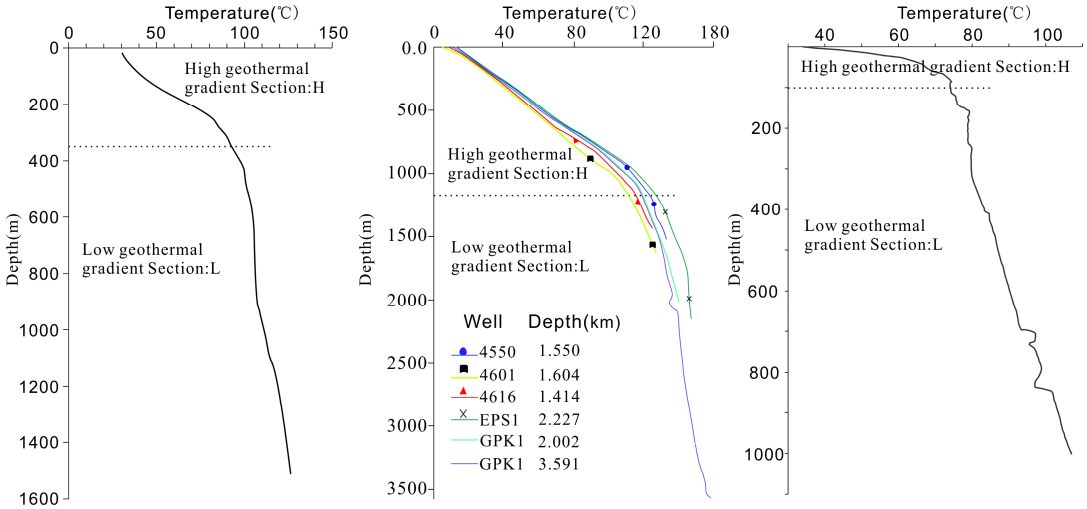

Fig. 3. typical geothermal field temperature curve at home and abroad
(a) Temperature Curve of ZK302 well in Yangbawell Geothermal borehole (Liu, 2014)
(b) Temperature distribution in Surtz area, France (Baria R, 1994)
(c) Geothermal Field, Xinzhou, Yangjiang City (Lin, 2016)

with an abnormal heat source, magmatic sac and no heat source, are studied. It is concluded that most abnormal heat sources, such as the magmatic chamber, can not directly heat the current geothermal field because of its fast cooling rate compared with the time scale of geological evolution(Fig. 1), thus negating the view that magmatic chamber is heated supply for the geothermal field. China is defined as a region free of magmatic activity or weak magmatic activity. The geothermal field generally develops in area A, and the temperature field in the vertical direction is mirrored reflection with depth. Compared with the region N, the temperature field can be divided into three sections: The shallow layer is the high geothermal gradient segment H; the lower

geothermal gradient segment L with a sharp decrease in the deep geothermal gradient; and the deeper low-temperature section D, as shown in Fig.2.

The results of real drilling in a large number of geothermal fields prove this view. As shown in Fig. 3, the measured temperature curves of some geothermal boreholes at home and abroad are measured in recent years. From this, we can see that between the surface and the hot caprock there is a higher H section, while the lower gradient section L appears below. At the end of 2017, the well GRY1 was drilled by Hebei Coalfield Geology Bureau and the Hydrology Institute of the Central Academy of Sciences in Xianxian County, Hebei Province. The depth above 1200 m is H section, reaching 85 ℃, and then to the depth of 3700 m is section L, only reaching 106℃, below which there is a low temperature section D which is lower than the normal low temperature region N.

Keyword:Geothermal desserts; heat conduction; tectonic movement; new energy; magma chamber zoic in China. Mafic and ultramafic magma derived from deep mantle.

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