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The Role of the Government on the Geothermal Management in Beijing, China

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ABSTRACT

Beijing is rich in low-temperature geothermal, which is stored in the limestone and dolomite reservoirs in a sediment basin. In the Beijing, where the plain is about 6000km^2, there have been identified more than 2300 km^2 of geothermal potential. The geothermal water is used for various direct purposes, and has played an effective role in the battling with the air pollution in the city. The geothermal is developed and utilized by a lot of different users, making the management of the geothermal resources a difficult task. The Geothermal Division under the Beijing Bureau of Land Resources and Housing is responsible for the supervision and administration of geothermal development and protection. Set up in 1985, the Geothermal Division has been doing well in the controlling of geothermal water production. This helped to lower the reservoir pressure. To meet the needs of sustainable use of the geothermal resources, the Geothermal Division put forward a series of policies that aim to encourage cascaded use of geothermal water, promote reinjection of the return water from space heating and control the drilling of new geothermal wells. Recently, the Geothermal Division has funded a few geothermal research projects. This will increase the effectiveness of its decision-making. The experience of geothermal management in Beijing has been widely adopted by other cities and provinces in China.

1.GENERAL

The City of Beijing, the capital of the People's Republic of China, is a fast developing city. It covers an area of 16,800 km^2, of which about 6,000 km^2 is plain area and 10,800 km^2 is mountain area (Figure 1). Currently, its population is about 13 million. The development of the city resulted in some environmental problems, such as air pollution. Although, a lot of effective measures have been undertaken in solving the problems, the pollution control is still a serious issue. Beijing is rich with low-temperature geothermal resources that are stored mostly in the dolomite or limestone reservoirs of a sediment basin of the plain area. Geothermal utilization has been ever increasing since the first geothermal well was drilled inside the urban area in 1971. Geothermal utilization is playing an important role in the air pollution control of the city, replacing the use of fossil fuel. It is believed that more and more of environmentally friendly energy, such as geothermal, will be used, so as to "make the sky return to blue".

"A large number of users in the same reservoir" is one of the most important features of the geothermal development in the City of Beijing. This could easily cause the geothermal exploitation out of control, hence over-use and rapid decline of reservoir pressure. Therefore, it is necessary to have a proper control and management of the geothermal use. In 1984, an institution of geothermal administration, Geothermal Division, was set up in the Government of the city. Since then, the geothermal utilization has been developing in a rational or a sustainable way. Management measures mainly include setting up of overall development plan, controlling the drilling of new wells and production of all the users, charging of geothermal resources fee, funding research projects, and encouraging reinjection, etc. In this paper, the geothermal resources and their utilization, the responsibility and the achievements of the Geothermal Division and the important future works of geothermal management will be introduced.

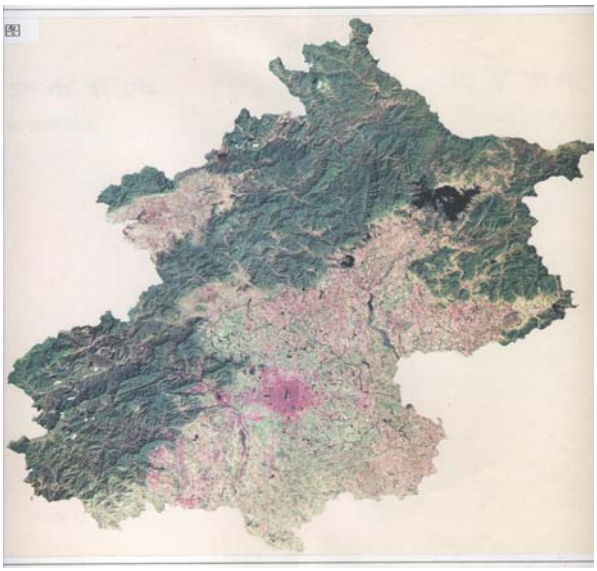

Figure 1. A satellite image of the City of Beijing: dark color represents mountain area, and shallow color is plain area

2. GEOTHERMAL RESOURCES AND THE UTILIZATION

The geothermal in the City of Beijing mostly occurs in the plain areas that include the Beijing Plain and Yanqing Basin, both of which are sediment basins. The area identified with geothermal potential, composed of 10 geothermal fields, is over 2300 km^2 and is located in the plain areas. Most of the developed geothermal fields are the in the urban area, Xiaotangshan and Liangxiang. The geothermal reservoirs are often karsted dolomite or limestone strata that are buried 800 to over 3500m under the ground. Only in the southernmost part of the city, the geothermal reservoir is composed of the sandstone. Before first geothermal well was drilled in the urban area of the city in 1971, the geothermal use was only bathing from the

warm springs. After then, the geothermal development has been ever increasing. By the end of 2003, there have been over 230 geothermal wells in the area of Beijing, which produce geothermal water with a temperature ranging from 38 to 89□. The geothermal water is often of a low mineral content, containing components that are useful in curing certain diseases when used for bathing. The geothermal water is used for bathing, space heating, fish farming, greenhouse, swimming pool and recreation etc. Multi-purpose and cascaded use is becoming more and more popular (Liu et al., 2002).

Before 1985, the geothermal water production was mostly coming from the two geothermal fields in Xiangtangshan and the urban area, which increased the production rapidly. That caused rather fast declining of the reservoir pressure in the two geothermal fields. The Geothermal Division, a governmental institution for geothermal development administration, was set up in 1984 (Chen, 2002). As a result of the measures taken by the Geothermal Division, the production was reduced slightly, and the reservoir pressure declining slowed down gradually as well (Figure 2 and 3). Currently, the annual city production is around 10 million m3/a: from the Urban, Xiaotangshan and Liangxiang geothermal fields of 4, 4 and 1 million m^3/a respectively (Zhang and Liu, 2004).

With the development of the city, more and more geothermal water will be needed. It is believed that geothermal development will keep increasing in the near future. The Olympic Games in Beijing in 2008 is a strong stimulating factor for the geothermal development. For example, geothermal will be used in the Sports Village of the Olympic Green where a large number of facilities for the games is located (Liu, 2003).

3. INSTITUTION FOR GEOTHERMAL ADMINISTRATION

As was mentioned above, in the City of Beijing before 1984, governmental institutions and regulations related to the management of the geothermal resources did not exist, and the geothermal development was out of control. That caused serious problems such as uncontrollable drilling of geothermal wells, fast increase of geothermal water production and rapid declining of reservoir pressure, especially in the Urban Geothermal Field and Xiaotangshan Geothermal field. As a result in 1983, it was proposed that an institution specialized in geothermal administration should be set up. In 1984, the Geothermal Division was established under the Beijing Bureau of Geology. In 1985, the regulations for geothermal resources management in the Municipality of Beijing were stipulated by the Government. The regulations were revised in 1999 to be compatible to the developments of the geothermal utilization. In 2000, a institutional adjustment was made, and consequently the Geothermal Division was assigned to the Beijing Bureau of Land Resources and Housing (Chen, 2002).

The responsibility of the Geothermal Division is to be in charge of the planning, exploration, development, utilization and protection of geothermal resources, including the following in details:

(1) To organize the policy making of geothermal utilization and protection; to organize the planning of geothermal development according to the geothermal resources and the geothermal needs of the city

(2) To approve and register the geothermal development projects, according to the Law of Mineral Resources and related regulations

(3) To complete the routines of geothermal resource administration: the statistics of geothermal water production, making the norms of geothermal production for all the users, monitoring and checking the geothermal development and utilization; assisting the investigation and treatment of the violation of geothermal regulations, treatment of the waste of geothermal resources, charging geothermal resource fee from the users

(4) To direct the geothermal development activities. To promote the rational utilization and scientific management of geothermal resources.

(5) To organize the funding of geothermal research projects.

4. THE ACHIEVEMENTS OF THE GEOTHERMAL DIVISION

Since its setup, the Geothermal Division has played a positive role in the administration of geothermal development activities in Beijing. The geothermal management experience has been widely adopted by other cities and provinces in China. The main achievements of the Geothermal Division are introduced below.

4.1 Geothermal Resources Management

On the aspect of geothermal resources management, the geothermal community in Beijing did a lot under the guidance of the Geothermal Division, which includes the following:

(1) Planning of geothermal development on a regular basis, so that the geothermal development in Beijing could be compatible to the overall development of the city. The Geothermal development plan for the beginning of the 21st Century made in 1999 (Bin et al.) played a positive role in a new planning.

(2) Controlling the drilling of geothermal wells so that to make the distance between two adjacent wells more than 1000m, and to make the disturbance between wells in a rather small magnitude

(3) Controlling the total amount of geothermal water production through limiting the amount of production of single well or a group of wells, especially in geothermal fields under large-scale production

(4) Monitoring the changes of the reservoir pressure and chemical components of geothermal water from the beginning of the geothermal production through dedicated geothermal and production wells (Zhang and Liu, 2001; Zhang and Liu, 2002; Zhang and Liu, 2003; Zhang and Liu, 2004)

(5) Facilitating research projects related to geothermal exploration, management, utilization, reinjection and modeling etc. About 30 of such projects have been completed since 1970, and some of the projects won the Scientific Progress Prize of the City of Beijing: for example, the project of Synthetic Assessment of Geothermal Resources in the Urban Geothermal Field, Beijing, which was completed in 2001 (Liu et al.)

(6) Encouraging cascaded use of geothermal water and reinjection, through a Geothermal Resources Fee charging system. Cascaded use of geothermal water and reinjection

has been increasing very fast since 2000, and there have been 6 reinjection wells in operation.

All the above measures ensured that the geothermal development in Beijing is in or close to a sustainable manor. The reservoir pressure in most of the geothermal fields is declining in a acceptable speed (Figure 2 and 3), and it is predicted that the declining in the most exploited Urban Geothermal Field will slow down as the production continues (Liu et al., 2002).

4.1 Avoiding risks of Geothermal Development

Since the day it was set up, the Geothermal Division always makes avoiding the risk of geothermal development as one of its important goals. The main measures taken for this purpose include funding geothermal geological exploration projects, forcing the feasibility study before drilling of geothermal wells, and having strict quality control on the drilling of geothermal wells. As a result of these measures, over 90% of the boreholes drilled in the area of Beijing for geothermal production are successful, considering the increasing trend of the depth of geothermal wells, and the drilling activities outside the area of geothermal anomalies.

4.2Reducing the Waste of Geothermal Resources

The geothermal systems in Beijing are often not closed, and often have some natural recharge, i.e. the geothermal system is renewable by certain degree, but the water recharge is not sufficient. The Geothermal Division, therefore, makes reducing the waste of geothermal resources as one of its important goals. Before a geothermal well is put into operation, the geothermal utilization process has to be approved by the Geothermal Division, by considering rationality of the process, especially the temperature of the tail water. If the temperature of the tail water is rather high, the user is asked to do reinjection. On the other hand, the geothermal Division assists to give punishment to activities out of the related geothermal regulations, such as drilling of geothermal wells without approval, producing geothermal water over the approved limits and etc.

5. IMPORTANT PROJECTS IN THE FUTURE

To make better management of the geothermal resources in Beijing, the most important goals for the Geothermal Division in the near future include:

(1) In the geothermal project for the Olympic Games in 2008, geothermal will be used for space heating and domestic hot water supply of the sports village which is located in the northern part of the city.

(2) The promotion of sustainable utilization of geothermal resources: reinjection and numerical modeling of the geothermal reservoirs will be taken as the kernel.

6. CONCLUSIONS

Since its establishment in 1984, the Geothermal Division of the Beijing Bureau of Land Resources and Housing played a positive role in the geothermal management of the City of Beijing. Its responsibilities include being in charge of the planning, exploration, development, utilization and protection of the city. Its effective measures ensured the geothermal development in the city as sustainable or close to sustainable manor, significantly avoided the risks of geothermal development, and considerably reduced the waste of geothermal water.

REFERENCES

Bin, D., Liu, Y., Bai, T., Pan, X., Zhang, D., Wu, M., Chen, J., Jia, H., Liu, Z. and Yu, X.: The Geothermal Development Plan for the Beginning of the 21st Century in the City of Beijing, Beijing Bureau of Geology and Mineral Resources, (1999) (In Chinese).

Chen, J.: Geothermal Management in the City of Beijing, Proceedings, 2002 Beijing International Geothermal Symposium, China Geological Publishing House, (2002) (In Chinese).

Liu J., Pan X., Yang Y., Liu Z. and Wang, X.: Report of Geothermal Synthetic Assessment for the Urban Geothermal Field in the City of Beijing, Beijing Institute of Geological Engineering, (2001)(in Chinese).

Liu, J., Pan, X., Yang, Y., Liu, Z., Wang, X., Zhang, L., and Xu, W.: Potential Assessment of the Urban Geothermal Field, Beijing, China, Proceedings, 2002 Beijing International Geothermal Symposium, China Geological Publishing House, (2002).

Liu, J.: Geothermal Development Scheme for the Olympic Park in Beijing, Proceedings, International Geothermal Conference IGC-2003, Geothermal Association of Iceland, (2003).

Zhang, L. and Liu, J. Report of Geothermal Resources Monitoring in the Year 2000 in the City of Beijing, Beijing Institute of Geological Engineering, (2001) (In Chinese).

Zhang, L. and Liu, J. Report of Geothermal Resources Monitoring in the Year 2001 in the City of Beijing, Beijing Institute of Geological Engineering, (2002) (In Chinese).

Zhang, L. and Liu, J. Report of Geothermal Resources Monitoring in the Year 2002 in the City of Beijing, Beijing Institute of Geological Engineering, (2003) (In Chinese).

Zhang, L. and Liu, J. Report of Geothermal Resources Monitoring in the Year 2003 in the City of Beijing, Beijing Institute of Geological Engineering, (2004) (In Chinese).

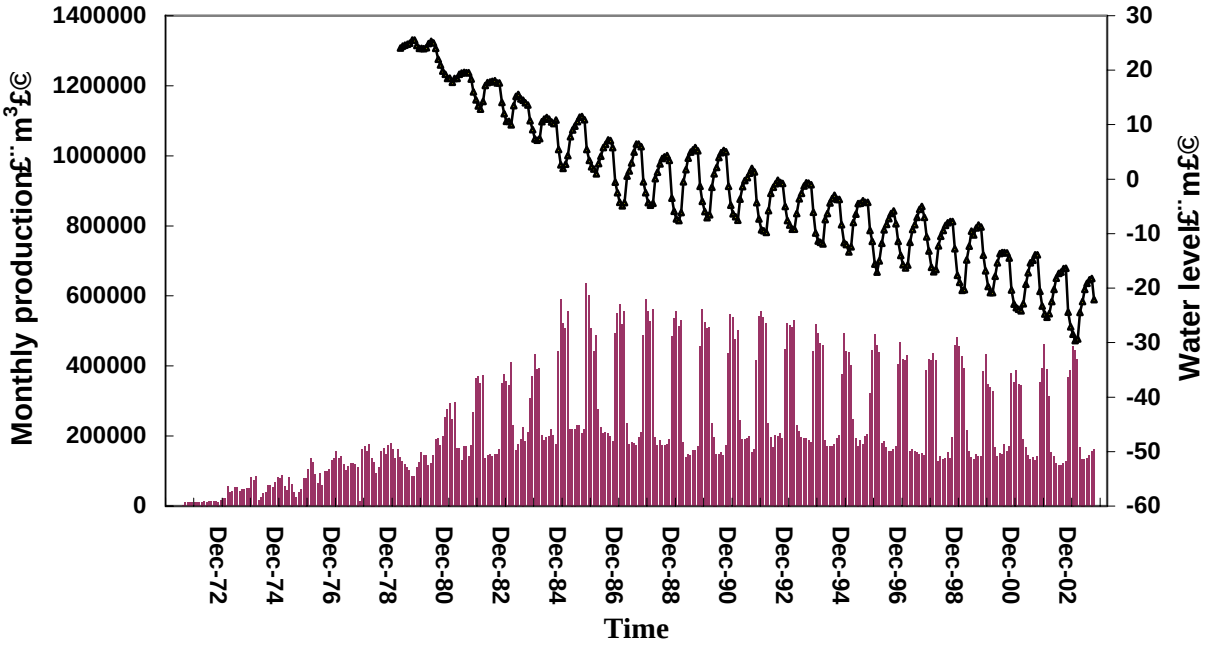

Figure 2. Water level and monthly production in the Urban Geothermal Field, Beijing, China

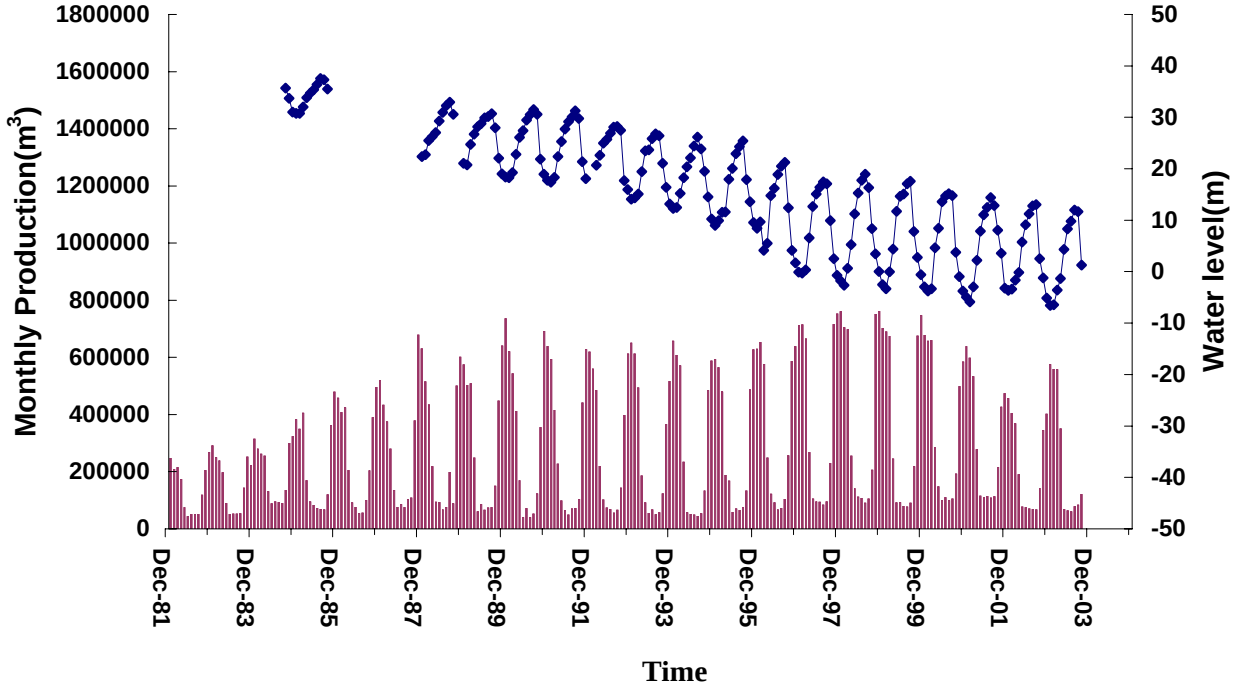

Figure 3. Water level and monthly production in the Xiaotangshan Geothermal Field, Beijing, China