Application of comprehensive survey method to water exploration in mountainous area

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Abstract. Looking for groundwater in mountainous areas is faced with many technical problems, which restrict the economic and livelihood of the local people. Based on the practice of water prospecting project in mountainous area, this paper discusses the application of comprehensive prospecting method in Groundwater Prospecting in mountainous area. We use data collection and collation, field investigation and reasoning, geophysical detection and analysis methods to explore the surface to line, line to point, gradually accurate groundwater comprehensive search method. This paper analyzes the significance of the comprehensive survey method, introduce the work flow of comprehensive survey method combined with engineering practice, and put forward suggestions and suggestions on how to use this method. The research results in this paper can be used as guidance and reference for the search of groundwater in mountainous areas.

1. Introduction

The mountain area usually suffers from drought and water shortage, which restricts the local economy and people's livelihood. There are many kinds of Groundwater Prospecting techniques, such as traditional geological and hydrogeological inference, advanced electrical and magnetic prospecting instruments, and regional drilling technical prospecting. The distribution of groundwater in mountainous area is large and complicated. It is very difficult to find the underground water source effectively and accurately by using traditional and single survey methods. Comprehensive survey method refers to the use of data collection, field investigation and geophysical prospecting methods, from surface to point, mutual verification, comprehensive exploration to achieve the mountain groundwater exploration method. Comprehensive survey is not only a way to find water, but also a process to survey groundwater.

2. The Significance of comprehensive survey method in groundwater investigation

The uneven distribution of groundwater has brought great difficulties to the investigation of groundwater. Geological, hydrogeological and geophysical prospecting methods are used to find the enrichment sites of groundwater. Geological methods mainly focus on geological exploration and geological lithology by exploring holes or surface. The hydrogeological method focuses on the investigation of groundwater recharge, discharge and hydrogeological conditions. Geophysical prospecting method is using geophysical methods to directly detect the physical parameters of the formation, transform the formation parameters into the distribution basis of inferring the groundwater source through analysis and transformation, thus inferring the characteristics of groundwater source distribution. However, all of the above methods have their limitations. How to avoid the errors caused by the methods in groundwater exploration and determine the well position accurately is the key to
groundwater exploration. By the above methods, the accurate investigation and search of “from surface to line and from line to point” can not only improve the accuracy of groundwater source search, but also improve the efficiency of groundwater source exploration. It has good application value in the complex mountainous area where the groundwater source is distributed. It has been widely used in engineering to find groundwater source by using comprehensive survey method, and good practical benefit has been obtained.

3. Analysis of comprehensive survey method to water exploration in mountainous area
Combining with the actual work, we have carried out the practice of water exploration in Shengwo Village, Xuzhuang Town, Xuzhou City, Jiangsu Province. Drilling and well completion were carried out to confirm the survey results.

3.1 Basic engineering situation
Sheng Wo Village, Xuzhuang Town, Xuzhou City, Jiangsu province is located in the eastern part of Lvliang mountain area. To develop the tourism industry in the village, we need to drill a deep well in this area. The area is surrounded by mountains on three sides, flat in the northeast, and has a reservoir, belonging to low hills and hills. From the perspective of topography, the three sides are surrounded by mountains, and there are large areas of piedmont water supply areas. There are strata contact zones in the area, which are easy to form groundwater runoff channels. The area is rich in water. The groundwater tends to flow south-west to the northeast along the strata after receiving groundwater recharge in the recharge area.

3.2 Data collection and arrangement
Data Collection refers to the collection and analysis of the text, charts, specimens, samples, cores and other geological data related to the region. On the basis of the existing research results and previous surveys, we should master the hydrology and geology of the area. After reading the hydrogeological map and water resources evaluation report of the region, we know that: The strata in this area are Sinian, including two geological groups: Zhao Wei and Ni Yuan formations. The upper part is gray, gray, yellow, gray and purple striped thin layer to middle thick argillaceous limestone. The lower part is gray, bluish gray, thick layer of thin layer of mudstone limestone, and is laminated with stone and limestone limestone lens. The bottom is bounded by thick mudstone limestone and Ni Yuan formation silty mudstone limestone, and the top is bounded by medium-thick mudstone limestone and Ni Yuan formation dolomite, which are integrated contacts. The rocks of Xue mountain, DaHei mountain and Wu mountain are mainly monoclinic, anticline and fault zones. In the northeastern direction, the flat area is Quaternary loose rock, and there is no obvious structural development around it. Limestone is mainly distributed in the region, and the water-rich fracture is well developed. The water-rich area is determined on the “surface”.

3.3 Field investigation and reasoning
Field investigation mainly uses the means of field investigation, hydrogeological survey, geomorphology and Quaternary sediment survey, groundwater outcrop survey, etc. to investigate the geological structure and hydrogeological conditions in this area, and draw the relevant maps and data. After exploration, a geological profile is drawn, which traverses a predetermined well site in the middle for tracing the depth of aquifer and unconsolidated strata in the region, as shown in Figure 1.
We investigated three wells in the area, of which well No. 2 is located in a geographic location close to the predetermined well location and geological conditions are similar. Therefore, choosing No. 2 well as reference well, it is deduced that the thickness of the loose bed of the preset well location is 10 meters, and no water cut is required. The contact zone of bedrock is 10-13 meters, the fractured bedrock aquifer is 15-60 meters, and the aquifer rock group is the Ordovician Xiaoxian Formation limestone. According to the water content of geological section and known well location, we can grasp the water content of groundwater in well location connection and get the underground distribution on the line.

3.4 Geophysical survey and analysis

Geophysical survey is based on the determination of various physical properties of strata to indirectly determine underground water content. On the basis of known points, the workload of geophysical exploration can be greatly reduced by knowing the unknown. We can select a known point, and electrical sounding measurement of the known point, get the results of the known point, as a model. Then, the same method and measurement parameters are used to carry out geophysical prospecting at the predetermined point, and the measured results are compared with the results of known points, so as to infer the method of the depth of the aquifer at the predetermined point. The geophysical survey uses the electrical sounding device of DZD-6A multi-function DC electric apparatus to measure. The electrical sounding curve of well No. 2 is shown in Figure 2.

From the shape analysis of the curve, 150 meters of sounding penetrates two strata, the upper part is loose layer, the lower part is bedrock layer. The resistivity decreases from 127.77 (Ω•m) to 22 (Ω•m) at 0 to 15 m, which is interpreted as a loose layer. The resistivity between 15 and 20 meters is low, about 22 (Ω•m), reflecting muddy clay, or limestone cave, filled with muddy clay. The 20~150 meter curve is unknown. The elevation of the curve is not greater than 45 degrees, reflecting limestone. Because of the abundance of water inflow from the well, it can be judged that the section reflects the
water cut section of karst fissure. Through the above analysis, we can draw the following conclusions: The thickness of the loose layer is 15 meters and the water content is weak. 15~20 meters karst fracture develops, clay fills, does not contain water; 20~150 meters of karst fractures developed, rich in water. The electrical sounding curve of the well location is shown in Figure 3.

![Figure 3. Comparison of electrical sounding curves](image)

The electrical sounding curves of two points are compared. The predetermined well location is 0~7 m, and the resistivity decreases from 55.52 (Ω•m) to 22 (Ω•m), which is a loose layer. The resistivity between 7~50 meters is low, about 22 (Ω•m), and it is argillaceous clay. The slow rise of the 50~70 meter curve reflects the water cut section of the karst fissure. The ascending curve of the tail branch is larger than 45 degrees, reflecting limestone, which is more complete and does not contain water. Therefore, the following conclusions can be drawn: The thickness of the loose layer is 7 meters and the water content is weak. 7~50 meters, karst fracture develops, clay fills, no water cut; 50~70 meters, karst fractures develop, water content is 70~150 meters, and cracks are not developed. Thus, the buried depth, thickness and type of underground water sources on the “point” are accurately determined.

3.5 Engineering results
The well depth is designed to be 80 meters and the well diameter is 200 millimeters. The SPC-300ST drilling rig is used for drilling and completion. The geological results of drilling are as follows: 0~7.5 meters are loose layers. 7.5~26.2 meters are limestone, karst, clay filled, weak water cut; 26.2~40 meters are limestone, karst, fissure and water content, which are basically consistent with the above investigation results. After completion, the static water level of the well is 36.5 meters, and the water output per well is 20 tons per hour.

4. Matters needing attention in comprehensive prospecting method for water exploration in Mountainous Areas
The distribution of groundwater in mountainous areas is complex. We should pay attention to the following problems when we use the comprehensive survey method in groundwater exploration in mountainous areas. Firstly, the authenticity and promptness of data collection. Comprehensive survey method is not only the comprehensive utilization of technology, but also the comprehensive analysis of data. The hydrogeological data collected in mountainous areas must be authentic and credible. For water source conditions have changed, not only timely collection, but also timely updates. In addition, the data should be collected in advance and summarized in time for emergency use. Secondly, Field investigation must be true, accurate and complete. Relevant personnel must personally reconnaissance, field visits, and widely ask for inaccurate information. As for the investigation of known water wells, it is necessary to investigate the current situation and drilling process of pipe wells comprehensively, and to restore drilling cores conditionally. Thirdly, you must selection of geophysical methods rationally. According to the geological and hydrogeological conditions previously grasped, the
geophysical instruments such as electric method and magnetic method should be used rationally. The form of instrument measuring device should be selected to ensure the reference value of geophysical prospecting results.

5. Conclusion
By means of data collection and collation, field investigation and reasoning, and geophysical prospecting analysis, groundwater can be effectively used to find groundwater. It can effectively avoid the drawbacks of single or traditional water finding methods, and has both accuracy and efficiency. It has good application value on water exploration in mountainous areas.

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