

Find the hidden diamond ore body Nearby No.50 kimberlite pipe in Wafangdian area, Liaoning, China

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The Wafangdian area in southern Liaoning Province is the most important area for diamond deposits in China. More than 100 kimberlite bodies have been discovered in the area, and diamond resources account for more than half of the country's total. The famous No. 50 kimberlite pipe in the area was discovered in 1974, and mining began in 1980. After 23 years, the mine was closed in 2002. This kimberlite pipe is famous for its high grade and good quality of diamond. According to records, the diamond extracted from the No. 50 kimberlite pipe accounts for over 60% of the gemstone grade. But the extension depth of the No. 50 kimberlite pipe is only over 200 meters, which is significantly smaller than other kimberlite pipes. By establishing a three-dimensional model of the kimberlite pipe, it is believed that the No. 50 kimberlite pipe was displaced by a thrust structure, and there are still hidden rock blocks around it that need to be discovered. Through work, a hidden diamond deposit was found approximately 1000 meters away from the No. 50 kimberlite pipe. This article introduces this process.

The Wafangdian diamond mining field is located in the eastern part of the northern margin of the Qaidam North China Plate. Large areas of Neoproterozoic and Paleozoic strata are exposed in the area. The kimberlite intrusion in the area is located in the Paleozoic era.

The kimberlite in this area can be divided into three types and five types of lithology, namely block type kimberlite, rock bearing ball type kimberlite, and breccia type kimberlite. Block like kimberlite can be divided into two types of rock types: porphyry kimberlite and porphyry phlogopite kimberlite; Breccia like kimberlite can be divided into two types of rock types: breccia containing surrounding rocks and breccia containing kimberlite materials; Porphyric kimberlite containing rock balls has a special spherical structure. When weathering is strong, the rock balls fall off, and circular balls of varying sizes can be seen in its residual slope deposits. Within the area, kimberlite is composed of approximately 20% kimberlite pipes, while the rest are rock veins. The kimberlite pipes are mainly composed of breccia like kimberlite, while vein like kimberlite is mostly block like kimberlite. Both rock veins and kimberlite pipes contain diamond (Fu Haitao et al., 2021).

Since the discovery of the first Kimberlite tube here in 1971, diamond exploration work has not stopped. It has gone through four stages: first, the stage of discovering mineral deposits and submitting resources (1971-1989), second, the stage of external cooperation (1989-2005), third, the stage of summarizing and exploring (2005-2017), and fourth, the stage of achieving breakthroughs in mineral exploration guided by new theories (2017-now).

In the first stage, four large primary diamond deposits and three small sand deposits were discovered successively, and No. 50 kimberlite pipe was developed.

In the second stage, foreign exploration companies such as Chichester Company, British (1989-1992), De Beers Company, South African (1993-1996), Lighttower Resources Co., Ltd., Australian (1997-2000), and

De Beers Australian Diamond Co., Ltd. (2005) cooperated with Liaoning Province to carry out diamond exploration work. During this period, many indicator mineral anomalies were discovered, and several kimberlite pipes were also discovered.

The third stage is the research and exploration stage: this stage mainly summarizes past experiences and lessons, and explores the amount of new resources. Due to the belief that the No. 50 kimberlite pipe was the root phase at the time, the focus of the work was on the deep part of the No. 30 kimberlite pipe, and 4 about kilometers of boreholes were drilled, but the ore body was not seen at the expected location. In order to investigate the reasons for the absence of ore, a three-dimensional modeling technique was used to establish a three-dimensional model of the No. 30 kimberlite pipe based on the drilling data. The results showed that the three-dimensional model of the No. 30 kimberlite pipe was significantly different from the original understanding. It was originally believed that the No. 30 kimberlite pipe was an inclined kimberlite pipe, while the three-dimensional model body was a nearly upright cylindrical body with several near horizontal cross-sections. According to the 3D model, the reasons for several unexplored boreholes can be well explained. The No. 30 kimberlite pipe is not inclined, but a columnar body composed of several fault blocks. The top plate elevation of each fault block is different and is misjudged as inclined. These fault blocks were formed due to the displacement of nearly horizontal faults, suggesting the existence of thrust structures in the local area (Fu Haitao, 2019). Subsequently, 3D models of kimberlite pipes 42 and 50 were established using the same method (Fig.1). These three kimberlite pipes are the most important primary diamond deposits in this area.

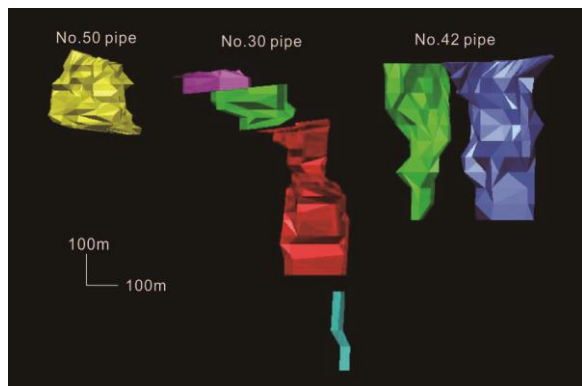


Fig.1 Typical 3D Model of kimberlite pipe (East-west section, not actual relative position) Looking at the three-dimensional morphology of kimberlite pipes No. 30, 42, and 50, the northern

part of kimberlite pipe No. 42 is basically undamaged, while the middle part of kimberlite pipe No. 30 has two dislocations, with a combined distance of about a few hundred meters. The lower rock mass is not seen in the southern part of kimberlite pipe No. 50, indicating that the distance of dislocations in the southern part is greater than that in the northern part. Based on the degree of damage caused by near horizontal faults to the kimberlite and the morphological characteristics of the damaged rock mass, it is speculated that the movement of the nappe structure from east to west caused damage to the shallow morphology of the kimberlite, and the impact varies at different locations.

The No. 50 kimberlite pipe is the only one in the area that has been developed and utilized with significant benefits. The downward extension depth of the No. 50 pipe is significantly smaller than that of other large mineral deposits. Previously, it was believed that the No. 50 pipe was the root phase. According to the 3D model, the No. 50 kimberlite pipe was displaced by a fractured structure, and there should be a corresponding lower rock mass nearby. The No. 50 kimberlite pipe is not the root of the rock mass, and deep exploration work should be carried out on its east side.

The fourth stage is the stage of achieving new breakthroughs: the new understanding has been recognized by investors, and a multi professional joint research team has been organized. Under the guidance of experts, each department is responsible and guided by the existence of thrust structures in the area. Special investigations on three-dimensional geological structures, regional and sectional geophysical surveys, and target drilling verification have been carried out (Fu Haitao et al., 2023).

The Wafangdian area is an area with a high degree of geological work. This work re-examines the structural geological point data from previous work from a new perspective. After screening and on-site verification, it is confirmed that there are overthrust structural traces in the area. Later, the phenomenon of the old Nanfen

Formation overlapping the new Qiaotou Formation was discovered in the drilling, thereby confirming the existence of overthrust structures in this area.

Based on the relationship between the intersecting geological bodies, it is speculated that the overthrust structure occurred in the Middle Late Jurassic (Zhang Guoren et al., 2020). The nappe body undergoes a nearly horizontal (10-25 °) thrust and slip from southeast to northwest (110-120 °), which is consistent with the understanding obtained from the three-dimensional model of the kimberlite pipe. This confirms that the nearly horizontal faults that destroyed the No.30 and 50 pipe are the fault planes of the nappe structure. The results of regional gravity and magnetotelluric measurements also support the understanding that the southern region is more affected by thrust structures than the northern region. Based on the characteristics of the overlying structure, In an area of 800×4800 meters including the position of the No. 50 kimberlite pipe An audio magnetotelluric(AMT) survey was conducted, with a survey line direction of 112 °. The measurement results showed that an apparent resistivity anomaly was found at a distance of approximately 1070 meters and 300-400 meters from the surface in the southeast 115 ° direction of the No. 50 kimberlite pipe. This anomaly is located below the overlying structural plane that cuts off the bottom interface of the No. 50 kimberlite pipe, and has been identified as a prospecting target area (Fig. 2).

Subsequently, drilling verification was carried out on this target area, but no ore body was found in the first borehole. In order to conduct in-depth research on this target area, a large-scale AMT survey profile with a small north-south distance was set up, and borehole geophysical surveys were carried out in the already constructed boreholes. Based on these new geophysical data, boreholes were re arranged. As a result, at a depth of 277.52 meters to 286.92 meters in ZK2008, a 9.40 meter breccia kimberlite was found (Fig.2), named the No. 50-1 kimberlite. During the grinding of core thin sections, one diamond was found. After exploration and evaluation from 2022 to 2023, it has been proven that the No. 50-1 is a horizontal fault block with an average thickness of 9.38m caused by the dislocation of the No.50 pipe. The diamond ore resources have reached a medium-sized deposit scale. Mineral processing experiments were conducted on the 9.35m core of one of the boreholes, and 16 diamonds with the same crystal structure, color, and clarity as the diamond in the No.50 pipe were selected. Meanwhile, the No.50-2 kimberlite was also discovered. According to new achievements, it is predicted that there will be large-scale diamond deposits within a narrow spatial range of 395 meters in length, 180 meters in width, and 300-400 meters in depth between the No. 50-1 and 50-2 rock masses; There is also potential to find large-scale diamond deposits on the eastern side of the No. 50-2 rock mass.

Further exploration of No. 50-1 and 50-2 kimberlite rock mass is underway in 2024.

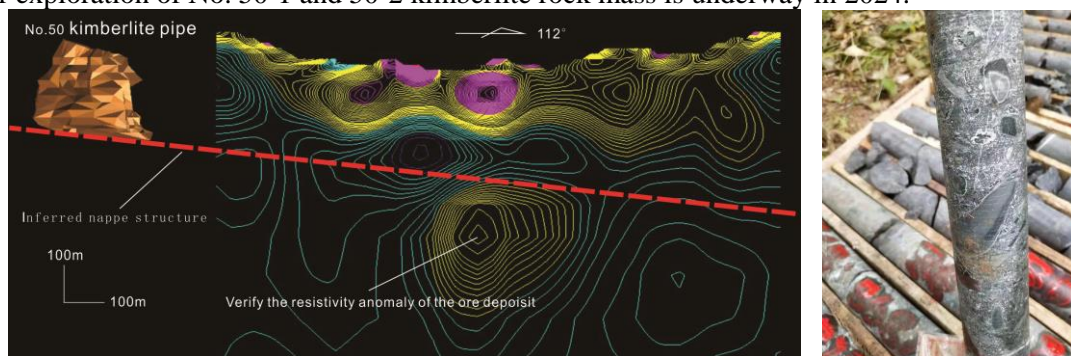


Fig.2 Abnormal visual acuity of AMT and Core of No. 50-1 kimberlite

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