Delineating the Kitumba IOCG deposit with the ORION 3D DCIP/MT system

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INTRODUCTION AND HISTORY

Blackthorn Resources’ Kitumba IOCG deposit is located in Zambia’s Central Province, approximately 200 km west of Lusaka, near the town of Mumbwa. Artisanal copper mining in the area dates from the late 19th century, and the area has been explored for Iron Oxide Copper Gold (IOCG) deposits since the 1990’s.

Exploration interest in the area was initially spurred by a United Nations sponsored aeromagnetic survey followed by ground mapping and sampling. Based on these results, a FALCON airborne gravity gradiometry survey was flown. Three targets were identified along a 25 km corridor showing magnetic and gravity anomalies.

During the second phase of drilling in 2006-2007, the discovery hole intersected 655.4 m of 0.46% Cu.

After further drilling, an initial mineral resource estimate of 87 Mt at 0.94% Cu was issued in October 2009.

During Phase 5 of drilling, hole S26-038 intersected 223 m of 4.67% Cu, including intersections of 23 m at 11.28% Cu, 23 m at 9.06% Cu, and 36 m at 8.84% Cu. The current resource estimate stands at 187 Mt at 1.14% Cu, with a cut-off of 0.5% Cu.

During June and July 2012, Quantec Geoscience Ltd. was contracted to acquire ORION 3D DC/IP and MT data over the Kitumba deposit. The survey took approximately 3 weeks to complete, and acquired approximately 160,000 data points.

THE KITUMBA DEPOSIT AND ORION 3D

Deposit Geology

The Kitumba deposit is associated with the Hook Granitoid Suite, quartz-feldspar porphyry granites and syenites that intrude the host metasediments. There are also extensive brecciated zones associated with hematite replacement.

The Mumbwa fault zone runs N-S through the Kitumba property, and is intersected to the north of the known deposit by the pre-mineral ENE-trending Kankamu Fault.

The area is deeply and intensely weathered. Weathering-related alteration products have been detected along post-mineral reactivated faults to depths in excess of 700 m, and the near surface layers are extensively leached of most Cu sulphide mineralization.

Hypogene mineralization at Kitumba is primarily pyrite and chalcopyrite, either breccia- or stockwork vein-hosted. The hypogene zones are not well mapped, and one of the primary objectives of the ORION 3D survey was the identification of areas of hypogene sulphide mineralization.

The highest Cu grades to date have been discovered in the supergene zone, primarily in the form of native copper, malachite, and chalcocite.

ORION 3D survey

ORION 3D is an omnidirectional-sampling DCIP/MT system that collects DCIP data simultaneously across an array of receiver dipoles. The survey design allows data to be collected without receiver geometry bias.

Data at Kitumba were collected using a layout consisting of 210 100 m dipoles. Two adjacent layouts were surveyed, resulting in approximately 160,000 data samples over a 6 km² survey area (Figure 1). Data were processed with Quantec’s proprietary software, and the DCIP results were inverted using the UBC 3D inversion code (Li and Oldenburg, 2000). The resulting DC resistivity and chargeability models provided

SUMMARY

An ORION 3D DC/IP survey was conducted over Blackthorn Resources’ Kitumba IOCG deposit in Zambia. The survey results provided 3D models that successfully delineated the known deposit and provided an enhanced understanding of the three-dimensional geometry of the mineralization. With this improved understanding of their deposit, Blackthorn was able to refocus their ongoing drilling program to best target possible extensions of the existing mineralization.

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information to 750 m depth. The MT data were inverted using the WSMT3D code (Weerachai, 2005), and resulted in an MT resistivity model to 2 km depth (Figure 2)

![Figure 1. The ORION 3D receiver electrode layout used at Kitumba. The southern layout is shown in dark blue, the northern in light blue.](image1)

**Survey Results**

The ORION 3D DC resistivity data mapped and confirmed the locations of the previously known Mumbwa and Kankamu fault zones, as well as the boundaries of intrusive granitoid units (Figure 4). The DC resistivity data also revealed a distinctly different setting to the north of the Kankamu fault; much more conductive than the granitoid intrusives flanking the Mumbwa fault to the south. This information contributed to an enhanced understanding of faulting and lithological units in the survey area.

The chargeability model showed good correlation between areas of high chargeability and the known mineralized zones, both supergene and hypogene (Figure 3). In the hypogene zones, both chalcopyrite and barren pyrite showed an elevated chargeability response, as expected from sulphide minerals.

The chargeability anomaly associated with the Kitumba deposit appears to be controlled to the east by the Mumbwa Fault Zone, but also extends to the south and west, outside the current extents of the known mineralized zone. With this enhanced understanding of the geometry of the deposit, Blackthorn revised their drilling plans mid-season to target most prospective zones to the west of the existing mineralization.

![Figure 2. ORION 3D Kitumba models: DC resistivity (top), chargeability (centre), and MT resistivity (bottom)](image2)

**CONCLUSIONS**

The high-resolution three-dimensional DC resistivity and chargeability models obtained from the ORION 3D survey clarified the understanding of the Kitumba deposit. Integration of the ORION 3D DC resistivity and chargeability data with previous geophysical results and existing geological information allowed Blackthorn Resources to understand the Kitumba deposit clearly in three dimensions, and adjust their drilling program mid-season to focus their exploration efforts in the most prospective areas.
Figure 3. IP chargeability anomaly of the Kitumba deposit (top), showing drill holes and Cu assays. 50 mrad 3D chargeability isosurface (bottom) outlining the Kitumba deposit (red) superimposed on the 0.5% Cu grade shell (blue).

Figure 4. Cutaway view of the DC resistivity model showing the 0.5% Cu grade shell (orange), the Kankamu fault (green), and the Mumbwa Fault Zone (blue).

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REFERENCES

