Identification of the Concealed Structures in the Beiya Area of Western Yunnan

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The interpretation of regional gravity and magnetic data, especially the extracted information about concealed targets and structures, provide important evidence for geological structure research, oil-gas resource assessment, mineral potential forecast and prospective area delineation. Several interpretation methods have been proposed to determine structural boundary, including vertical derivative, horizontal first-order derivative, total horizontal derivative, total gradient modulus, tilt derivative, and theta graph, and each have their advantages and disadvantages. This study used the tilt derivative method to obtain bouger gravity anomalies in the Beiya area, as shown in Fig. 1a.

A total of eight concealed faults were inferred based on the principle that tilt derivative is zero at boundaries of field source, of which the faults F1–F5 trend NS, F7 and

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F8 trend nearly NNW, and F6 trends nearly EW. In addition, we deployed two AMT profiles to validate the effectiveness of this method (Fig. 1).

The AMT anomalies of lines 1 and 2 show that there is a vertical low resistance body in the distance of 3–4 km cut the high resistance bodies on both sides (Fig. 1c). There is also a low resistance body vertically cutting the high resistance bodies on both sides in the distance of about 5 km for Line 2. Both L1 and L2 lines have good response with the fault F6 speculated by gravity data, and this fault has a nearly upright angle, belonging to a hidden deep fracture.

The analysis of the 1:1,000,000 gravity data by Guan (2004) suggested that there are several nearly NE-trending structures meeting at right or tilt angles with the dominant NS-trending structures in the Sanjiang metallogenic belt, and that these EW-trending structures show concealed or deep structural features. Ge (2012) systematically summarized the relationship among the large deposits, deep structures and porphyries from the perspective of regional metallogenic dynamics, and deduced a series of EW-trending concealed faults. One EW-trending structure inferred by both Guan and Ge is the same as the concealed F6 in Fig. 1a. Therefore, we consider that the concealed fault F6 exists, and that the EW-trending structures are old while the NS-trending ones are young.

The distribution of porphyries and ore deposits in western Yunnan is controlled not only by the NS-trending Sanjiang Fault, and it is also controlled by the EW-trending structures (concealed or deep fractures). The quartz syenite porphyries distributed at both sides of F6 reveal that F6 plays a critical role in controlling the porphyries.

The exposed porphyries in Fig. 1a were dated at nearly 32–34 Ma (Liu, 2003), which are temporally consistent with the middle-stage quartz syenite porphyries (32–36 Ma) in Wantongshan (Xu et al., 2007; Xue et al., 2008; He et al., 2012). They are porphyries of the same stage, and their magmatic activities have a close relationship with the gold mineralization. Therefore, we suggest that there is prospecting potential near the concealed fault F6.

This study provides evidence for the existence of the EW-trending F6 by geophysical data, and suggests that it is reliable to speculate concealed structure with tilt derivative in the Beiya area. The deep Fault F6 has an important role in controlling the quartz syenite porphyries. The porphyries distributed near fault F6 have the same period with the medium-stage quartz syenite porphyries at Wantongshan in Beiya. There is prospecting potential near the concealed fault F6.