Processing of historical geophysical data as an aid to mapping alteration and mineralization in the Wafi-Golpu porphyry system

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INTRODUCTION

The Wafi-Golpu Cu-Au porphyry system is located in the Marobe Province in Papua New Guinea approximately 65 km SW of Lae. It is owned by the Wafi-Golpu Joint Venture (WGJV) which is a joint venture between Harmony Gold and Newcrest Mining. The total mineral resource for the system as at December 2017 is estimated at 27 Moz Au and 8.6 Mt Cu. There are three major deposits; the Wafi high sulphidation deposit and the Golpu and Nambonga Cu-Au porphyry deposits.

The Wafi-Golpu project area is hosted within the 25km north-northeast trending Wafi Transfer Zone. It lies along the eastern margin of the Aure Trough - a geosynclinal structural basin that developed during the Tertiary period and is mainly composed of turbidites and volcaniclastic sediments (Newcrest 2012). The regional geology and RTP magnetics are shown in Figure 1.

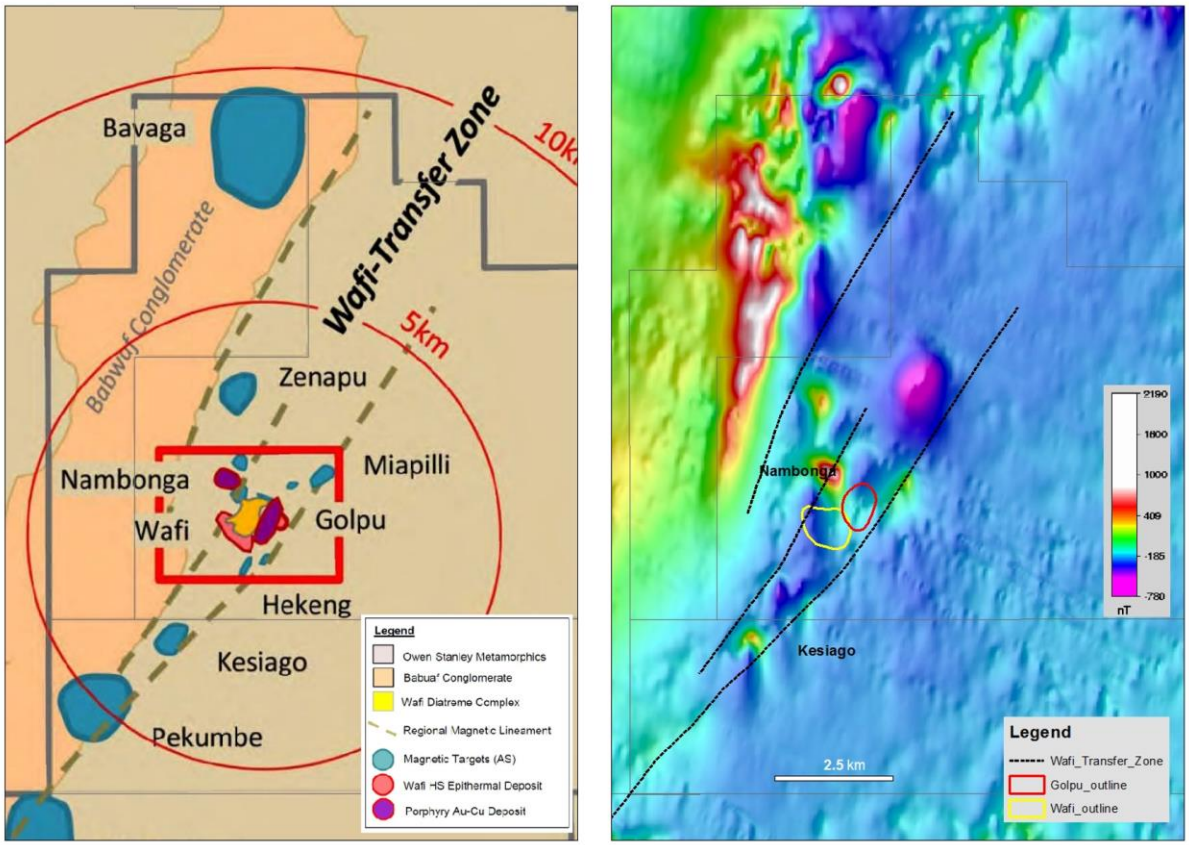

Figure 1. Regional geology and RTP magnetics. The geology is modified from Hayward et. al. (2011)

ALTERATION AND MINERALISATION

The porphyry-related copper and gold deposits are comprised of stockwork vein arrays and disseminated sulphides hosted in altered diorite porphyry intrusions and surrounding metasedimentary rocks. The highest grades are associated with abundant biotite and potassium feldspar alteration, typically rich in chalcopyrite, bornite and gold. The epithermal overprint that caps the porphyry system hosts mineralization that is disseminated and contains abundant pyrite with lesser covellite, enargite and electrum (Newcrest 2012).

The alteration system is about 2 km in diameter and includes the high sulphidation Wafi Au mineralisation and the Nambonga and Golpu porphyries. A section of alteration through the system is shown in Figure 2. Golpu is a large high grade porphyry with a total mineral resource of 19 Moz Au and 8.6 Mt Cu as at December 2017.

Alteration is zoned from centre of the Golpu intrusive complex as follows:

- K-feldspar inner core;
- magnetite-biotite zone;
- actinolite-biotite (-magnetite-K-feldspar-albite-epidote);
- biotite (± minor magnetite) alteration; and
- chlorite (propylitic) alteration.

There is also overprinting alteration due to the high sulphidation epithermal Wafi mineralisation associated with the younger Wafi diatreme complex. This includes advanced argillic alteration (alunite, dickite and kaolinite) over phyllic alteration typified by sericite + pyrite (Newcrest 2012).

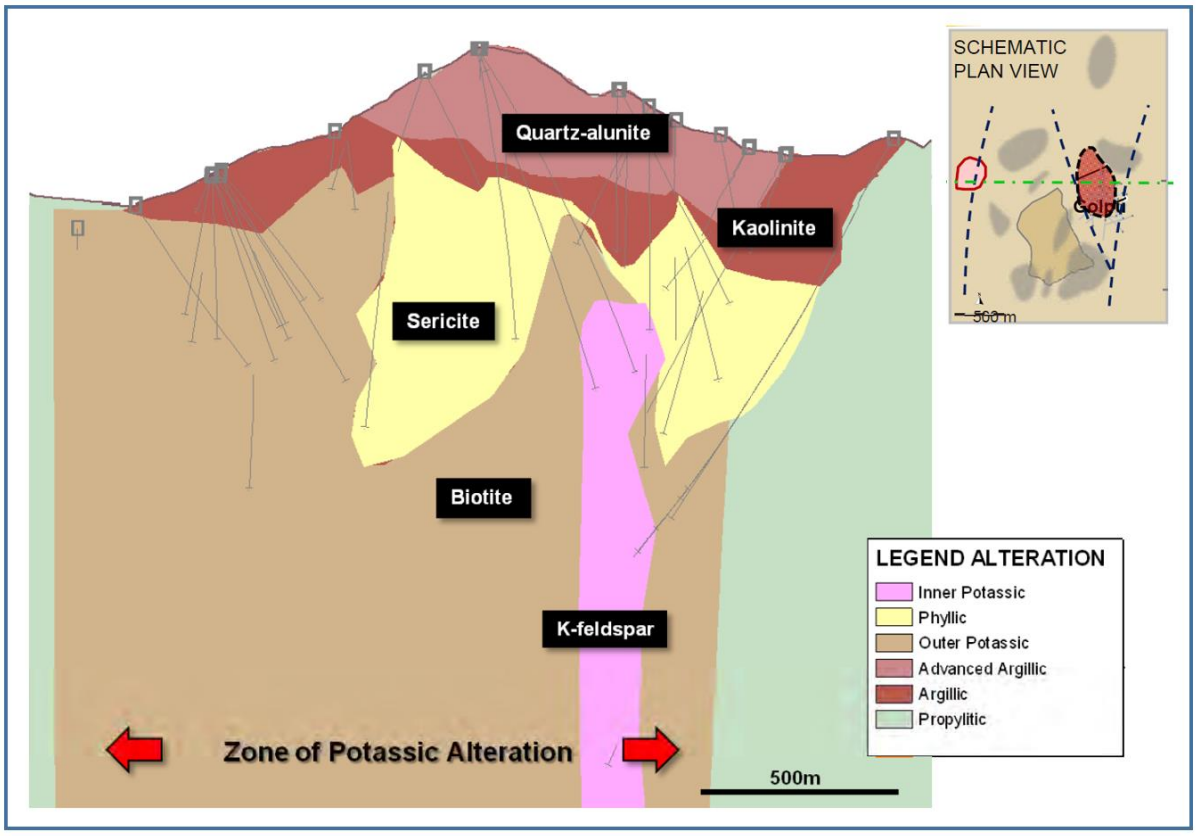

Figure 2. EW Alteration section through the Wafi-Golpu system modified from Hayward et. al. (2011)

GEOPHYSICAL RESPONSE

Regionally the Owen Stanley Metamorphics which host the deposits are non to weakly magnetic and the Babwaf Conglomerate to the west of the deposits is moderately to strongly magnetic (Figure 1). There is no detectable magnetic response from the Golpu porphyry as alteration has destroyed magnetite down to 500m or more below surface. Both the Nambonga and Kesiago

porphyries have clear discrete magnetic signatures (Figure 1). Nambonga has a classic discrete porphyry response of about 1000nt. The Kesiago anomaly is more subdued as much of the deposit has been truncated by thrust faults.

Data from a dipole-dipole IP/resistivity survey conducted in 1985, with 100m and 200m dipoles, was recently compiled and inverted in 3D. There are generally high chargeabilities over the system with particularly high chargeabilities (>80mv) as a shell around the system. The resistivity from this survey clearly defines the lithocap as a strong resistor above a relatively conductive zone of clay alteration (Figure 3).

A 100m moving loop time domain electromagnetic survey was conducted over the deposit in 1990. A 3D inversion of this data shows a clear conductor that coincides with the top of the Golpu deposit (Figure 3). This conductor is probably due to sulphide veining which, unlike magnetite, has not been affected by late advanced argillic alteration.

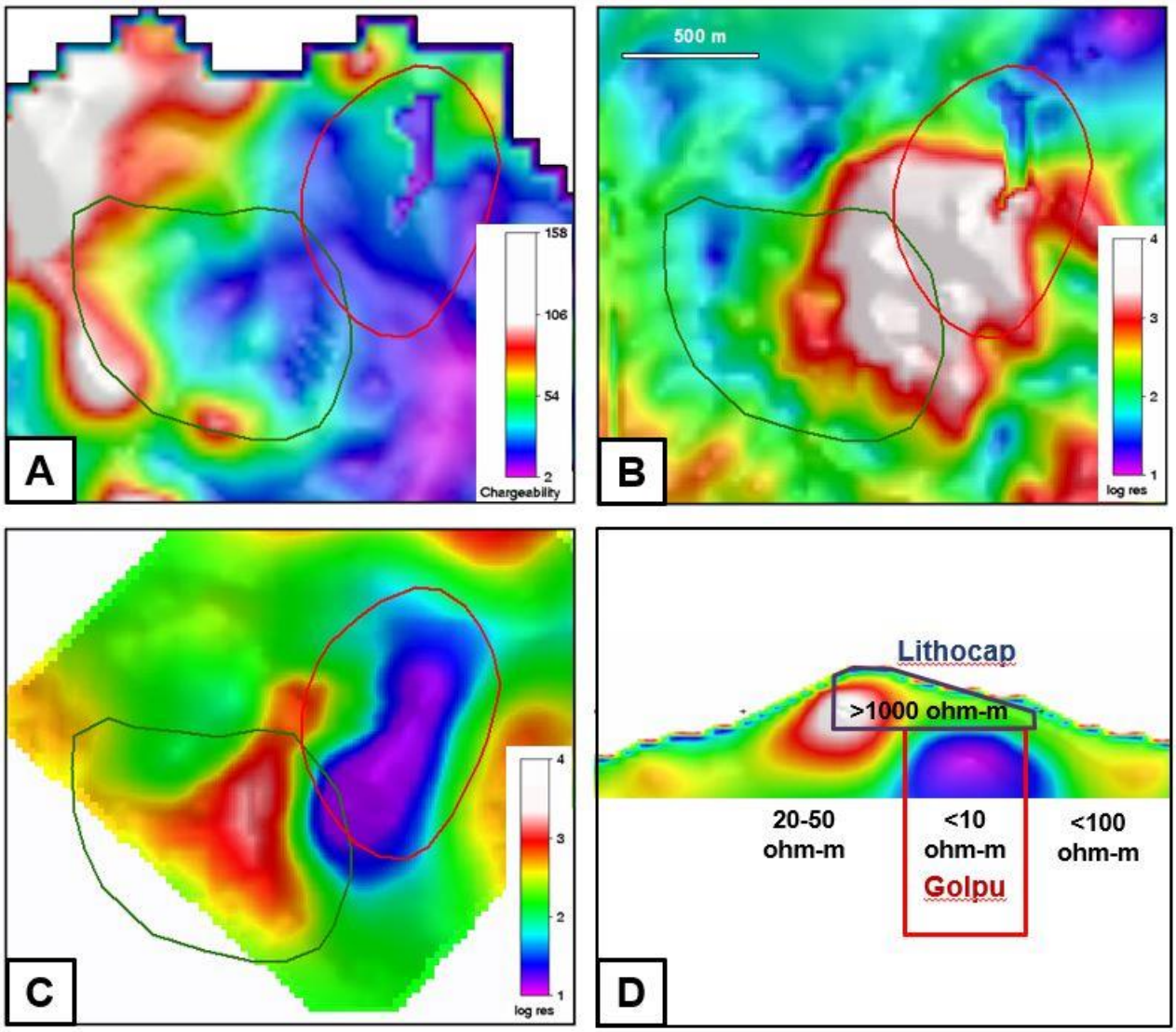

Figure 3. The red and green outlines are the projections of the Golpu and Wafi deposits respectively. (A) 100m depth slice of Chargeability from the IP inversion. (B) 100m depth slice of Resistivity from the IP inversion. (C) 300m depth slice of resistivity from the TEM survey. (D) generalised EW resistivity section across the system. The image is resistivity from the TEM inversion.

DISCUSSION

The ground geophysical surveys do not extend outside the clay-pyrite alteration zone. This zone is generally conductive and chargeable. Within this is a highly resistive lithocap and an excellent conductor due to sulphide veining associated with the Golpu porphyry. A type resistivity section through the deposit is shown in Figure 3D

Inversion of historical datasets and modern geophysical techniques have helped define alteration and mineralisation in the Wafi-Golpu porphyry system.

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