Meeting Geophysical Challenges:
Application of Automated Detection Techniques in Magnetic Data for Identification of Cu-Au Porphyries in Covered or Magnetic Terrains

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Introduction

- Background
- Porphyry Magnetic Signatures
- Filter Theory
- Application Examples
- Conclusions
• Automatically detect and quantify porphyry magnetic signatures via user defined application of porphyry target model

• Research agreement between UWA-CET and Barrick signed in 2008 to sole-fund “Porphyry Texture Filter”

• Cu-Au rich porphyry focus

• Magnetic coverage available over most projects – capitalise on investment

• Rapid objective analysis of large datasets

• Discrimination within highly magnetic terrains and under cover
Porphyry Model Response

Alteration Dominant

Host Lithology Dominant

- Magnetic porphyry + magnetite-rich potassic zone
- Noisy signature from inhomogeneous volcanic rocks

Propylitic
- Non-magnetic propylitic and phyllic zones
- Modified from Clark 1992

Phyllic
- Potassic
- Magnetic volcanic rocks (k = 0.013 SI)
- Non-magnetic porphyry (k = 0.038 SI)
Porphyry Model Response (cont)

Surface Alteration

- Potassic
- Mixed Pot/SCC
- SCC
- Phyllic
- Propylitic

RTP Magnetics

500m

500m
Circular Feature Detection
- Define radius and shape of target
- Enhance target response
- Suppress non-circular features
- Output radial symmetry transform (RST) grid

Feature Validation
- Define expected magnetic contrast
- Pass features meeting criteria
- Assign threshold strength and radius to each centre
- Grid and database product

Boundary Splines
- Select appropriate threshold from feature validation
- Quantify outer edge of alteration dominant zone
- Polygon file output
Theory – Simple Example

- Centre of Symmetry
- Seed Radius
- Final Boundary

Input RTP Grid → Radial Symmetry → Magnetic Contrast → Final Product
Application Considerations

**Magnetic Dataset**
- Gridded and of appropriate scale
- Reduced to Pole
- Inducing Field
- No need for excellent data quality

**Geological/ Target Setting**
- Structural regime – geometry
- Host lithologies
- Target characterisation – shape, size, contrast
- Depth of emplacement
**Application – Reko Diq**

**Statistical Summary**

- 29 Pre-existing prospects
  - 21 Recognised
  - 8 failed to meet user defined criteria (size, contrast, not circular)
- 35 Centres located
  - 30 Boundaries
  - 9 Additional targets
Application - Grasberg

Modified from Meinert et al 1997
Application - Grasberg

Modified from Meinert et al 1997
Application - Grasberg

Central of radial symmetry

Radial Symmetry

Analytical Signal
Geology & Boundaries
Application – South America

Known Porphyry
Application – South America

Radial Symmetry

Magnetic Contrast

RTP + Boundaries
Application – South America

Known Porphyry

2km

RTP nT
• No clear discrete magnetic response associated with Golpu potassic in RTP data. Juxtapose against Miapilli
RST versus analytical signal in imaging deep response of potassic core (long wavelength)
Filter Limitations

Target Criteria Required
• Requires some knowledge of geology
• Existing porphyry in data preferable

RTP Required
• Remanence
• Low latitudes

Learning Curve
• Some familiarisation time required
Filter Advantages

**Noisy Data has Reduced Impact**
- Tends to reject non-circular noise

**Input Geologically Based Constraints**
- High rate of prediction for known porphyries

**Intermediate Products**
- Suite of results and simple quick analysis

**Quantification**
- Qualitative and quantitative
- Depth (economic) limits based on thresholds
- Works well in a magnetic environment

**Ease of Use**
- Operates in Geosoft environment
- Fast and objective
- Integration into GIS packages
Conclusions

• A successful research project which has given an additional layer for porphyry exploration

• Actively applied to all Barrick projects with ground truthing demonstrating continued success
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