TREK Mapping Project Year 1:
Correlating Airborne Magnetic Signatures to Geological Features

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I. INTRODUCTION

The northern Interior Plateau region of central British Columbia is considered to have high exploration potential as it hosts several significant epithermal and porphyry deposits including the 270 million g (9.5 million oz; Christie et al., 2014) Blackwater epithermal Au-Ag deposit. However, the masking effects of Neogene flood basalts and Quaternary glacial till have hindered our understanding of the regional geology, leading to high exploration risk. In an effort to reduce this risk, Geoscience BC contracted an airborne magnetic survey over the study area (Aeroquest, 2013). During the summer of 2014 the TREK mapping team conducted targeted mapping to provide ground-truthing of features identifiable in the airborne survey, including those presented herein. The results of this research will be incorporated into the bedrock geology map to aid future exploration efforts.

The tectonic domains in Figure 1 were developed based on existing geological information, the airborne magnetic data presented herein and gravity data. Juxtaposition of these differing domains requires significant structural breaks. While some of the domain bounding faults were previously documented (eg. Pinchi, Fraser-Straight Creek, Yalakom) others are newly identified (eg. Bobtail, Tatuk). An improved understanding of these major structures will lead to a better understanding of structural controls on mineralization within the region.

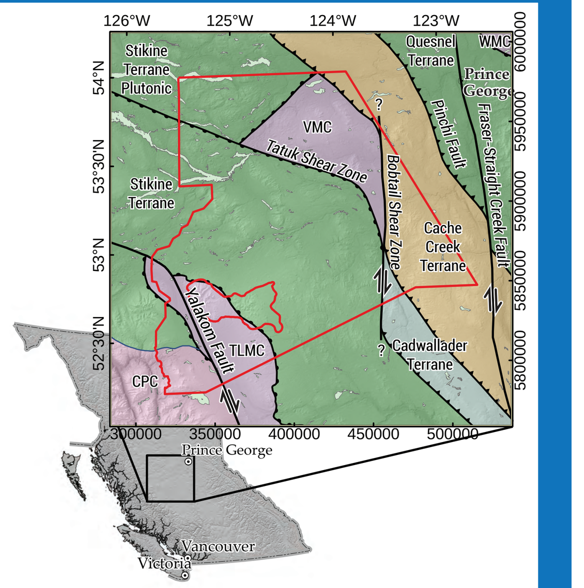


Figure 1: Location of the study area with tectonic domains and major structures based on a combination of British Columbia map compilation, airborne magnetic and gravity data. Some of the structures presented here have not previously been documented. The red line corresponds to the extent of the TREK aeromagnetic survey. TLMC - Tatla Lake Metamorphic Complex, VMC - Vanderhoof Metamorphic Complex, WMC - Wolverine Metamorphic Complex, CPC - Coast Plutonic Complex.

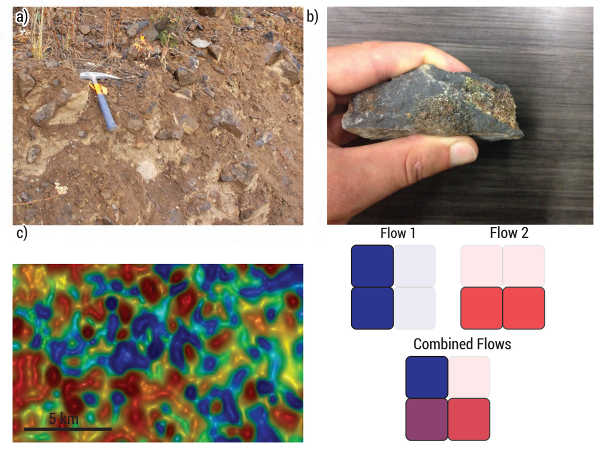


Figure 2: Characteristics of Chilcotin Group volcanic rocks: a) distinctive red weathering colour; b) hand specimen with lherzolite xenoliths; c) representative RTP magnetic response with unique 'mottled' texture; d) schematic model showing how a reversed polarity flow (blue) and a normal polarity flow (red) with variable thickness could combine to form domains of negative (blue), positive (red) and neutral magnetic response in an RTP magnetic grid.

II. CHILCOTIN GROUP

The Neogene Chilcotin Group is comprised of frequently columnar jointed, dark grey olivine basalt with a characteristic red-brown weathering colour (Figure 2a). It sporadically contains diagnostic ultramafic xenoliths (Figure 2b). The Chilcotin Group can be identified in reduced to pole (RTP) aeromagnetic data by its distinctive 'mottled' appearance with relatively small (~1 km in diameter) highs in the range of 400 to 800 nT and lows in the range of -400 to -800 nT (Figure 2c). This has been attributed to a uniquely low (for basalt) magnetic susceptibility and high ratio of remnant to induced magnetism (Enkin, 2014). When combined with a complex layering of normal and reversed polarity flows this results in domains of high, neutral, and low magnetic response (Figure 2d).

III. ENDAKO GROUP

The Eocene to Oligocene Endako Group is comprised of dark grey basaltic andesite flows that exhibit variable dips up to 20° and pahoehoe textured flow tops (Figure 3a,b). They are sparsely plagioclase porphyritic and commonly amygdaloidal, often with opalescent silica filling vesicles (Figure 3c). Magnetic susceptibilities measured in the field are predominantly high, averaging 19.2×10^{-3}. Thick exposures of Endako Group basalt correspond to domains of exceptionally high magnetic response, up to ~1400 nT, in the airborne magnetic data (Figure 3d, 5).

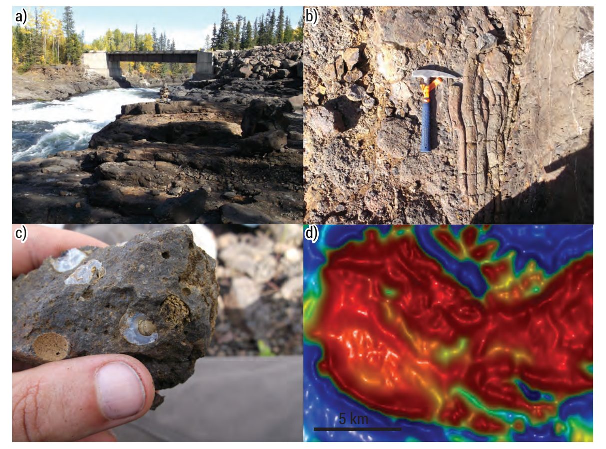


Figure 3: Characteristics of the Endako Group volcanic rocks: a) parallel flows exhibiting a 10° dip to the east, photo taken looking down dip; b) pahoehoe textured flow top; c) opalescent silica filled amygdules; d) representative RTP magnetic response exhibiting high intensity and sharp boundaries.

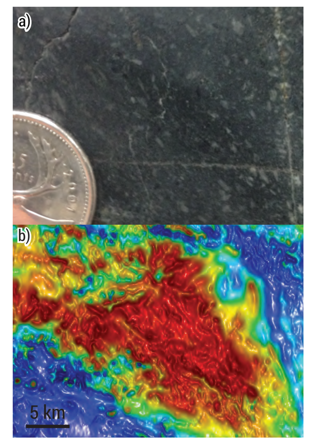
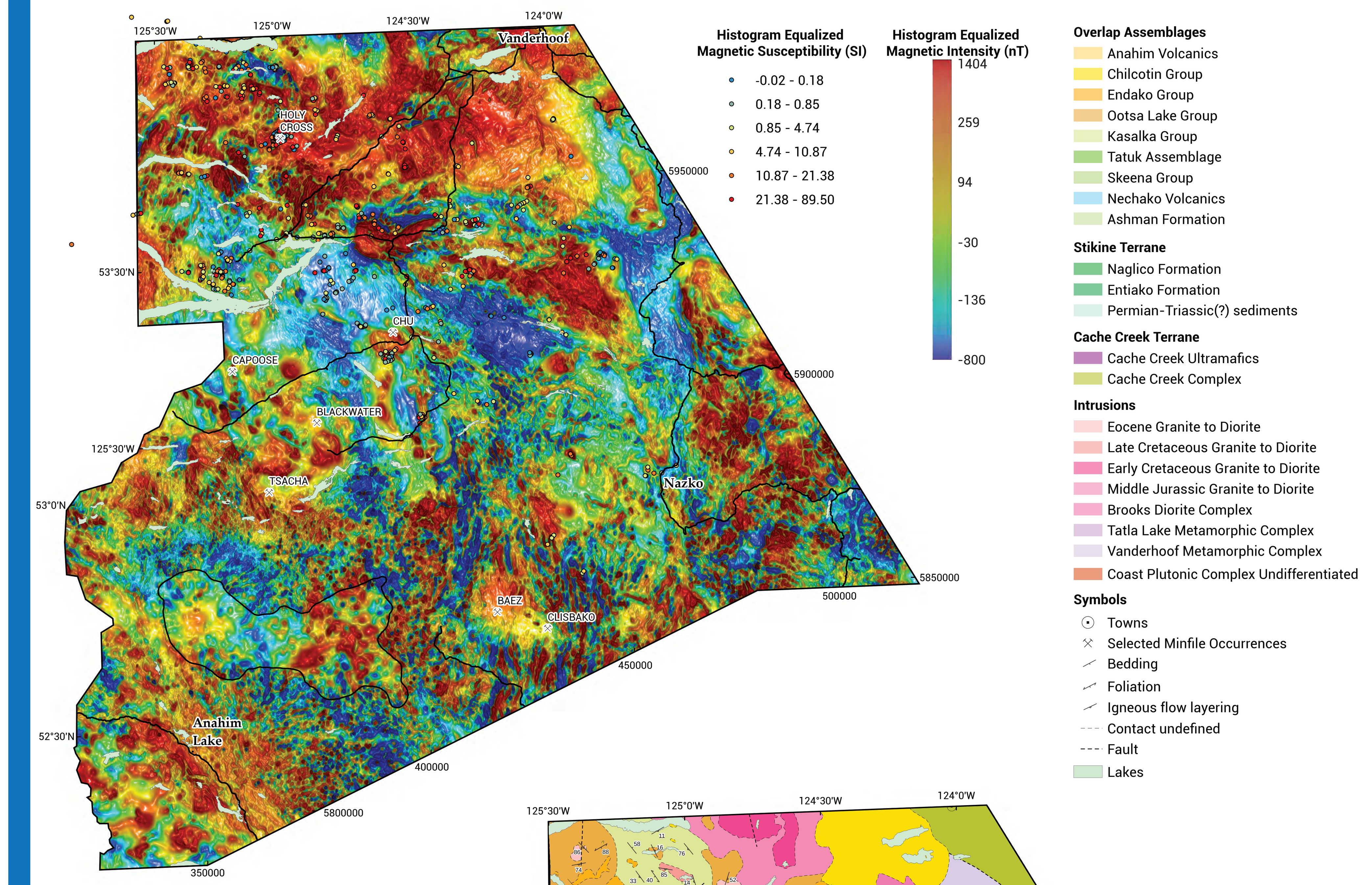


Figure 4: a) Tatuk assemblage plagioclase and hornblende phyric andesite; b) representative RTP magnetic signature of the Tatuk assemblage exhibiting high magnetic response and diffuse boundaries.

IV. TATUK ASSEMBLAGE

A linear trend of high magnetic response from five to 25 km wide defines a newly identified unit, the informally named Tatuk assemblage. It is comprised predominantly of dark grey and maroon andesite to basalt flows and related volcaniclastics. They are commonly plagioclase rich with up to 20% plagioclase phenocrysts (Figure 4a). Based on inferred stratigraphic position this assemblage is tentatively assigned to the Upper Cretaceous. This assignment and potential correlations are being tested through whole rock geochemistry and geochronology.



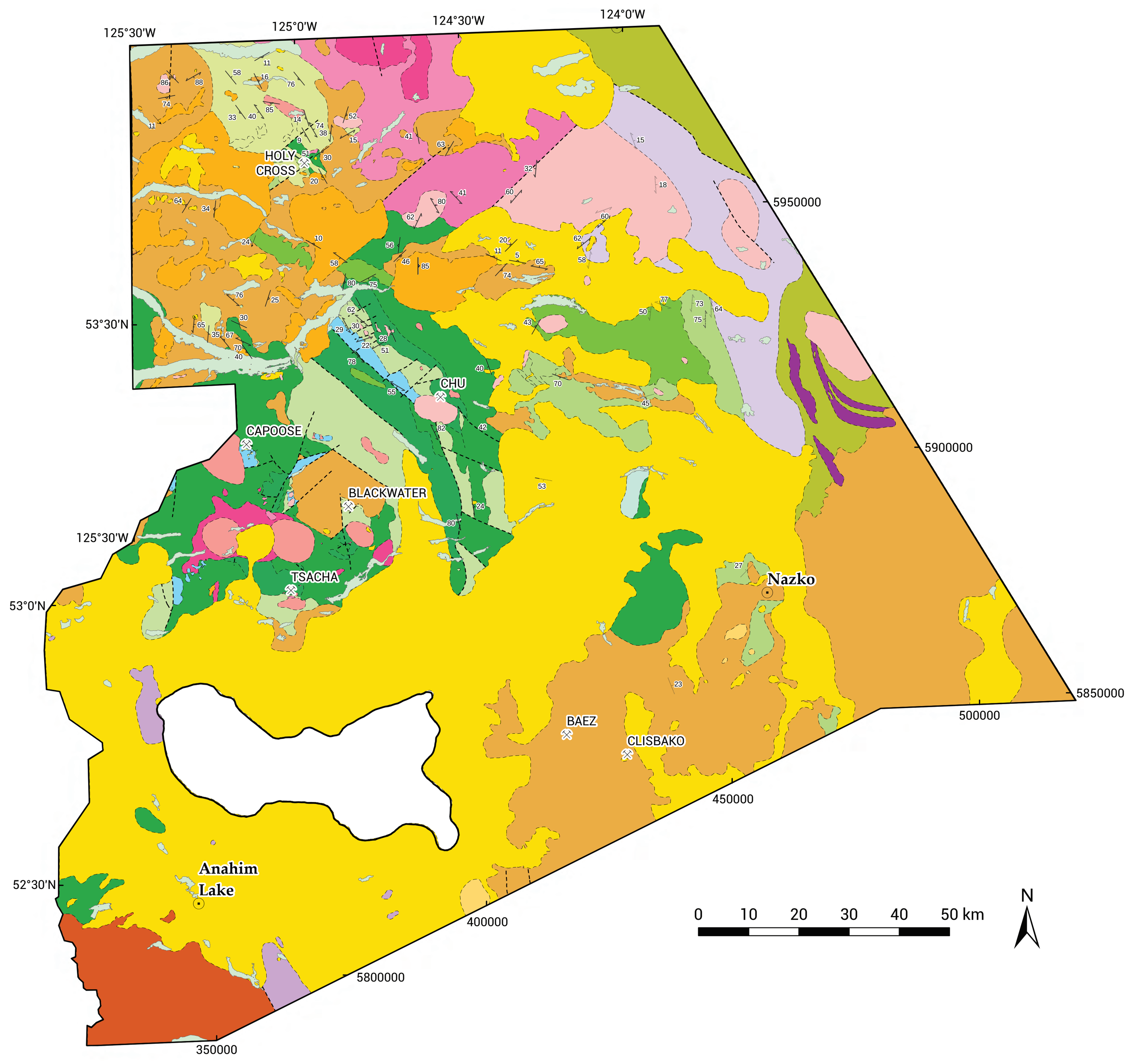


Figure 5: a) (above) RTP magnetic intensity map of the TREK area produced by Fathom Geophysics from the 2013 TREK airborne magnetic survey (Aeroquest, 2013). Average magnetic susceptibility measurements from 2014 field stations are overlain on it; b) (right) interim bedrock geology map of the TREK area developed from new mapping carried out during the summer of 2014, interpretation of aeromagnetic data, and previous mapping including Tipper, 1959, 1963, 1969; Diakow and Levson, 1997; Struik et al., 2007; and Bordet, 2014. Both maps are produced in NAD 83 BC Environment Albers Projection.

V. PORPHYRY STOCKS

A number of ovoid, approximately 5 km wide, high magnetic response halos can be seen in the aeromagnetic data (Figure 5, 6). Previous and new mapping confirm that some of these reflect the presence of granitic porphyry stocks. Available ages indicate these are Late Cretaceous and Eocene features. Given the proximity of these features to known epithermal deposits (eg. Blackwater, Capoose), they may be a first order control on epithermal mineralization. The presence of stockwork Mo style mineralization CHU deposit (Figure 5) suggests the intrusions themselves are exploration targets as well. Two such halos exist within what was previously mapped as the Early Cretaceous Laidman batholith (ca. 148 Ma; Ponzikoff et al., 2000). Again, this hypothesis will be tested through U-Pb geochronology.

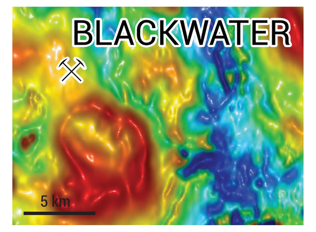


Figure 6: Representative RTP signature of a proposed porphyry stock immediately south of the Blackwater deposit.

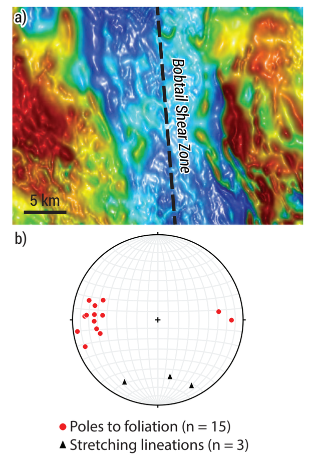


Figure 7: a) representative RTP magnetic signature of the Bobtail Shear Zone as a linear trend of low magnetic intensity that juxtaposes domains of differing magnetic character; b) structural measurements from the Bobtail Shear Zone .

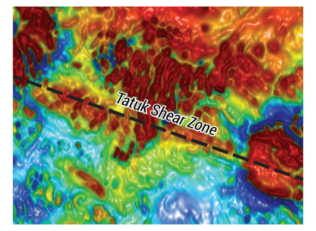


Figure 8: Representative RTP magnetic signature of the Tatuk Shear Zone as a linear trend of high magnetic intensity that juxtaposes domains of differing magnetic character.

VI. STRUCTURES

Linear features that juxtapose distinct magnetic domains are likely structural breaks or faults. Faults are usually considered to record low magnetic responses as they are affected by magnetite destructive processes (eg alteration). The north striking Bobtail high strain zone is represented by a wide zone of low magnetic response (Figure 5, 7a). It locally defines the western boundary of Cache Creek Terrane (Figure 1). Steep mylonitic fabric with shallowly plunging lineations in this region suggest strike slip shear (Figure 7b). This fabric is developed within Skeena Group strata but not observed in Ootsa Lake Group along strike to the south constraining a component of deformation to the Late Cretaceous. Similarity in orientation with the Fraser-Straight Creek fault system to the east suggests a likely shared history (Figure 1).

The Tatuk high strain zone similarly contrasts domains of differing magnetic character but it is not represented by low magnetic response (Figure 5, 8). This is reasonably interpreted as a fault that has subsequently localized emplacement of a unit with high magnetic response (). In this case it has localized deposition of the Tatuk assemblage basalts and, to a certain degree, the Endako Group basalts (Figure 6). Direct observation of the structure is therefore not possible. It's structural history must be determined from indirect means. An initial constraint is that it separates predominantly plutonic and high grade metamorphic rocks to the north from predominantly stratified rocks to the south. It therefore must have a component of north side up shear. The presence of undeformed Kasalka Group rocks on both sides of the fault requires this deformation to predate ~70 Ma. Note that the southern boundary fault of the Endako deposit is similarly oriented and constrained as an Early Cretaceous feature.

VI. CONCLUSIONS

The TREK airborne magnetic survey has aided in delineating known lithological units, led to the identification of a new unit and several previously unmapped major structures. Along with modifying the geological map, further investigation will focus on deciphering the kinematic history of these previously unidentified faults, development of an aeromagnetic interpretation based structural framework map and the reliability of porphyry stocks as controls on mineralization. These significant advances in our understanding of the geological framework of the Interior Plateau will contribute to future endeavours to understand the controls on mineralization within the region.

REFERENCES:

Aeroquest Airborne Ltd. (2014): Report on a fixed wing and magnetic geophysical survey, TREK Project, Interior Plateau/Nechako Region, British Columbia, Canada; Geoscience BC, Report 2014-04, 40 p.

Bordet, E. (2014): Eocene volcanic response to the tectonic evolution of the Canadian Cordillera; Ph.D. thesis, University of British Columbia, 220 p.

Christie, G., Lipiec, I., Simpson, R.G., Horton, J. and Borntraeger, B. (2014): Blackwater gold project British Columbia, NI 43-101: technical report on feasibility study; AMEC Americas Limited, report prepared for New Gold Inc., 336 p.

Diakow, L.J. and Levson, V.M. (1997): Bedrock and surficial geology of the southern Nechako plateau, central British Columbia; BC Ministry of Energy and Mines, BC Geological Survey, Geoscience Map 1997-2, scale 1:100 000.

Enkin, R.J. (2014): The rock physical property database of British Columbia, and the distinct petrophysical signature of the Chilcotin basalts; Canadian Journal of Earth Sciences, v. 51, p. 327–338.

Henkel, H. (1991): Petrophysical properties (density and magnetization) of rocks from the northern part of the Baltic Shield; Tectonophysics, v. 192, p. 1–19.

Struik, L.C., MacIntyre, D.G., and Williams, S.P. (2007): Nechako NATMAP Project: A Digital Suite of Geoscience Information for Central British Columbia(NTS Map Sheets 093N, 093K, 093F, 093G/W, 093L/9,16, & 093M/1,2,7,8); BC Ministry of Energy and Mines, Open File 2007-10.

Tipper, H.W. (1959): Quesnel, British Columbia. Geological Survey of Canada, Map 12-1959; scale 1:253 440.

Tipper, H.W. 1963): Nechako River, British Columbia; Geological Survey of Canada, Map 1131A; scale1:253 440.

Tipper, H.W. (1969): Anahim Lake, British Columbia; Geological Survey of Canada, Map 1202A, scale 1:253 440.

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