Improved Structural and metallogenic Framework for the Skeena Arch through Aeromagnetic Interpretation and Targeted Mapping

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I. Introduction

The Skeena arch is a northeast-trending (arc-transverse) topographic high that transects the Stikine terrane in central BC (Figure 1). It is considered to have significant mineral potential, with the majority of mineral occurrences interpreted as genetically related to Late Cretaceous and Eocene intrusive suites (MacIntyre, 2006). Improvements to the structural framework have been made through interpretation of aeromagnetic data, targeted mapping and geochronology. In particular, northeast and southeast trending structures have been identified and have bearing on mineral exploration in the Skeena Arch.

Structural features identified through detailed mapping are emphasized herein along with their bearing on new and previously documented mineralization. Aeromagnetic interpretation is discussed in detail by Rahimi et al. (2017).

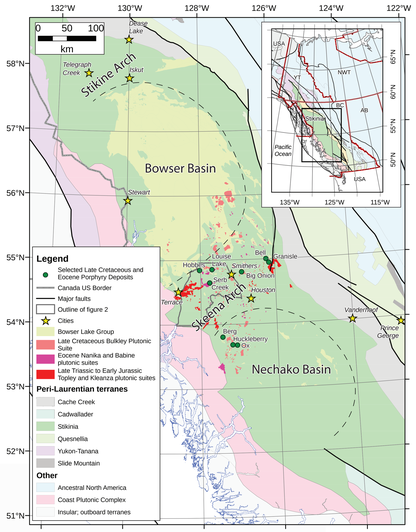


Figure 1: Location of the Skeena arch within the Stikine terrane in central British Columbia. It is a paleotopographic highland that separates the Bowser Basin from the Nechako Basin. The SeArch Phase 1 study area is outlined in grey.

II. Targeted Mapping

The SeArch Phase 1 aeromagnetic data (Precision Geosurveys, 2016; Figure 2b) was investigated in combination with previous mapping, geochronology, and mineral exploration efforts to define target areas. The areas selected were thought to have important structural, stratigraphic, or magmatic relationships. Observations made in the seven study areas presented in figure 3 allowed for characterization of structures identified from aeromagnetic interpretation and form the basis for interpreting the tectonic and metallogenic significance of these structures.

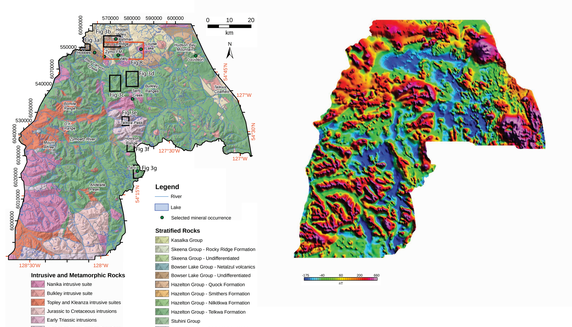


Figure 2: Geology and aeromagnetic data for the SeArch Phase 1 study area. (a) Bedrock geology modified after Cui et al. (2016). (b) Reduced to pole aeromagnetic data for the same area (Precision Geosurveys, 2016)

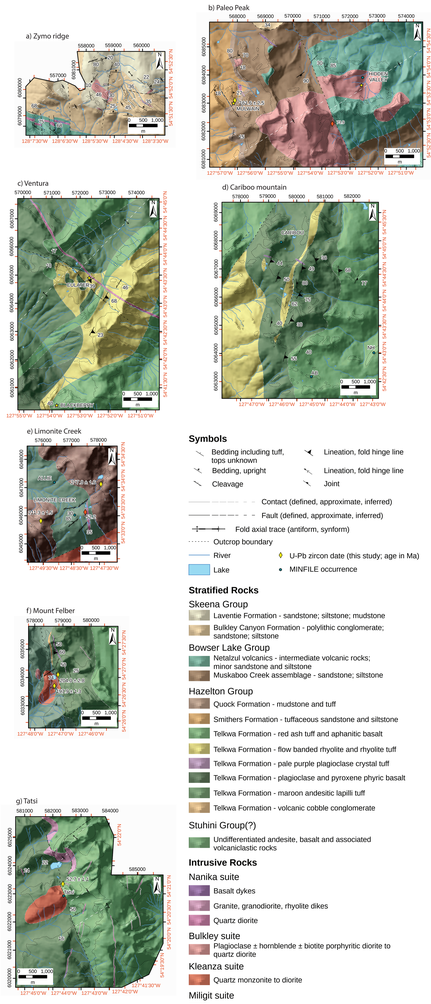


Figure 3: Detailed map areas investigated during the 2016 field season. See figure 2 for locations.

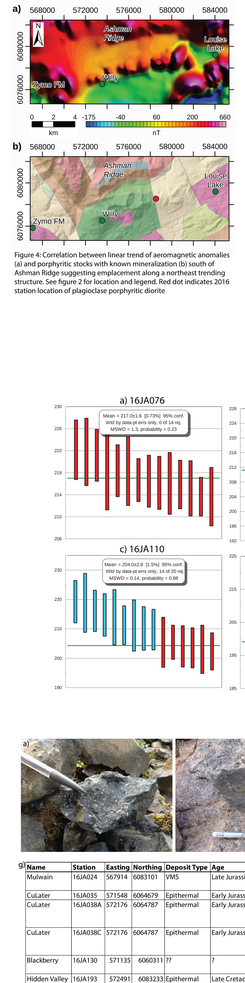


Figure 4: Correlation between linear trend of aeromagnetic anomalies (a) and porphyritic stocks with known mineralization (b) south of Ashman Ridge suggesting emplacement along a northeast trending structure. See figure 2 for location and legend. Red dot indicates 2016 station location of plagioclase porphyritic diorite

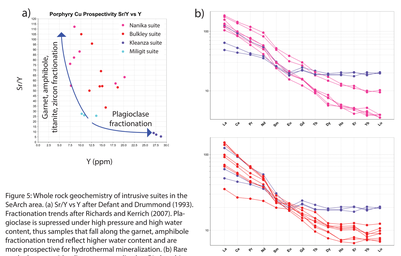


Figure 5:Whole rock geochemistry of intrusive suites in the SeArch area. (a) Sr/Y vs Y after Defant and Drummond (1993). Fractionation trends after Richards and Kerrich (2007). Plagioclase is supressed under high pressure and high water content, thus samples that fall along the garnet, amphibole fractionation trend reflect higher water content and are more prospective for hydrothermal mineralization. (b) Rare earth element spider diagrams normalized to C1 chondrite (Sun and McDonough , 1989). Note the pronounced negative Eu anomaly for Kleanza suite samples indicating plagioclase fractionation. The lack of depletion in MREE and HREE indicates that garnet and amphibole were not significant residual components during fractionation of the Kleanza suite. In contrast, the Nanika, Bulkley and Miligit suites do not show Eu anomalies and are strongly depleted in MREE to HREE. The pronounced listric shape present for Bulkley and Miligit samples is indicative of amphibole fractionation (Richards and Kerrich, 2007).

III. Northeast Trending Structures

The northeast-trending Skeena arch contains prominant northeast-trending aeromagnetic lineaments interpreted to reflect multiply reactivated structures which have contributed to magma emplacement since the Late Triassic. One such structure occurs along Telkwa Pass where potential Stuhini Group volcanic rocks locally contain northeast-trending foliation not seen in Late Triassic plutons of the informal Miligit intrusive suite recording an early phase of deformation (Figure 3e).

Northeast-trending folds are a widespread structural feature documented in the Tatsi, Zymo ridge, Ventura Peak, and Paleo Peak map areas. These folds are interpreted to have formed between the Late Jurassic and Early Cretaceous as at least some of the folds affect Early Cretaceous Skeena Group (Figure 3a). They likely correlate with early deformation within the Skeena Fold Belt (Evenchick, 2001). This deformation may be related to uplift of the Skeena arch and is interpreted to reflect reactivation of the older northeasterly anisotropy represented by foliation in Triassic strata.

Emplacement of the economically important Bulkley (Late Cretaceous), Babine and Nanika (Eocene) intrusive suites is in part localized along northeast trending structures. A northeasterly trend of aeromagnetic highs occurs south of Ashman Ridge (Figure 4a). Each of these highs corresponds to a plagioclase porphyritic stock, three are known to host mineralization including the FM porphyry prospect, the Willy polymetallic prospect, and the Louise Lake porphyry prospect (Figure 4b).

IV. Southeast Trending Structures

Two U-Pb zircon ages of 217.0 +/- 1.6 Ma and 211.3 +/- 1.5 Ma (Figure 6a,b) confirm the presence of a Late Triassic intrusive suite (herein called the Miligit suite) in the Howson Range originally documented by Deyell et al. (2000). A strong aeromagnetic lineament along the west side of the Howson Range (Figure 2) juxtaposes these Late Triassic plutons and the older volcanic rocks which they intrude to the east against Middle Jurassic Bowser Lake Group sedimentary rocks to the west near Telkwa Pass (Figure 2). The lineament is therefore interpreted to reflect a southwest side down normal fault. Parallel minor faults were documented in the Tatsi and Mount Felber map areas (Figure 3f, g).

The Miligit suite intrusions contain geochemical similarities with the Bulkley (Late Cretaceous) and to a lesser extent Nanika (Eocene) intrusions both of which are known to be associated with porphyry and related mineralization in the Skeena Arch. All three suites have characteristics indicative of magmas with high water content (Figure 5). These contrast with the Kleanza (Latest Triassic to Early Jurassic) suite intrusions which do not appear to be prospective according to the same geochemical criteria (Figure 5). The epithermal alteration and mineralization at the Limonite Creek prospect is interpreted to be genetically related to the adjacent Miligit suite intrusions (Figure 3e).

The base of the Hazelton Group, marked by a volcanic cobble conglomerate, occurs in the Mount Felber map area. A crystal tuff stratigraphically above the conglomerate yielded a U-Pb zircon age of 204.0 +/- 2.8 Ma confirming a latest Triassic age for the base of the Hazelton Group in this area. Proximity to the Triassic-Jurassic boundary has been empirically correlated with many significant deposits in Stikinia (cf. Northern Miner, 2015)

Nanika suite dykes occur parallel to the interpreted southwest side down fault throughout the Howson Range (Figure 3e, f, g), consistent with interpreted Eocene extensional deformation.

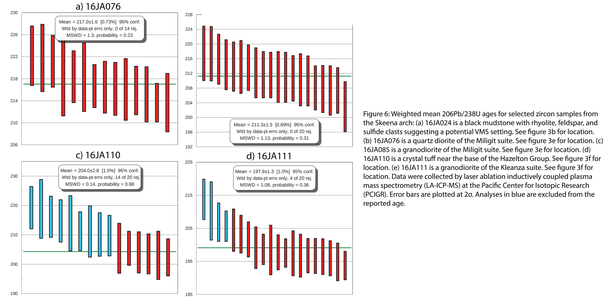
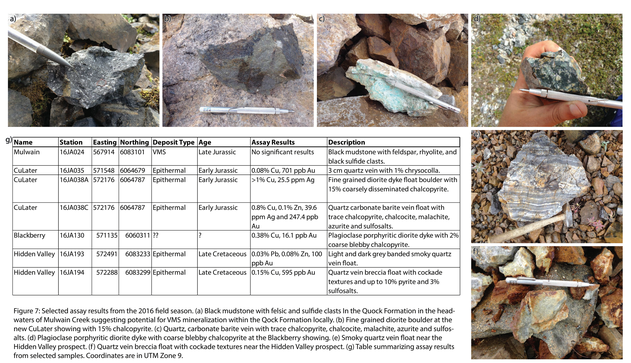


Figure 6: Weighted mean 206Pb/238U ages for selected zircon samples from the Skeena arch: (a) 16JA024 is a black mudstone with rhyolite, feldspar, and sulfide clasts suggesting a potential VMS setting. See figure 3b for location. (b) 16JA076 is a quartz diorite of the Miligit suite. See figure 3e for location. (c) 16JA085 is a granodiorite of the Miligit suite. See figure 3e for location. (d) 16JA110 is a crystal tuff near the base of the Hazelton Group. See figure 3f for location. (e) 16JA111 is a granodiorite of the Kleanza suite. See figure 3f for location. Data were collected by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) at the Pacific Center for Isotopic Research (PCIGR). Error bars are plotted at 2σ. Analyses in blue are excluded from the reported age.



ID	Name	Station	Easting	Northing	Deposit Type	Age	Assay Results	Description
a)	Mulwain	16JA024	567914	6083101	VMS	Late Jurassic	No significant results	Black mudstone with feldspar, rhyolite, and black sulfide clasts.
b)	CuLater	16JA035	571548	6064679	Epithermal	Early Jurassic	0.08% Cu, 701 ppb Au	3 cm quartz vein with 1% chrysocolla.
c)	CuLater	16JA038A	572176	6064787	Epithermal	Early Jurassic	>1% Cu, 25.5 ppm Ag	Fine grained diorite dyke float boulder with 15% coarsely disseminated chalcopyrite.
d)	CuLater	16JA038C	572176	6064787	Epithermal	Early Jurassic	0.8% Cu, 0.1% Zn, 39.6 ppm Ag and 247.4 ppb Au	Quartz carbonate barite vein float with trace chalcopyrite, chalcocite, malachite, azurite and sulfosalts.
e)	Blackberry	16JA130	571135	6060311	??	?	0.38% Cu, 16.1 ppb Au	Plagioclase porphyritic diorite dyke with 2% coarse blebby chalcopyrite.
f)	Hidden Valley	16JA193	572491	6083233	Epithermal	Late Cretaceous	0.03% Pb, 0.08% Zn, 100 ppb Au	Light and dark grey banded smoky quartz vein float.
g)	Hidden Valley	16JA194	572288	6083299	Epithermal	Late Cretaceous	0.15% Cu, 595 ppb Au	Quartz vein breccia float with cockade textures and up to 10% pyrite and 3% sulfosalts.

Figure 7: Selected assay results from the 2016 field season. (a) Black mudstone with felsic and sulfide clasts in the Quock Formation in the headwaters of Mulwain Creek suggesting potential for VMS mineralization within the Qock Formation locally. (b) Fine grained diorite boulder at the new CuLater showing with 15% chalcopyrite. (c) Quartz, carbonate barite vein with trace chalcopyrite, chalocite, malachite, azurite and sulfosalts. (d) Plagioclase porphyritic diorite dyke with coarse blebby chalcopyrite at the Blackberry showing. (e) Smoky quartz vein float near the Hidden Valley prospect. (f) Quartz vein breccia float with cockade textures near the Hidden Valley prospect. (g) Table summarizing assay results from selected samples. Coordinates are in UTM Zone 9.

V. Conclusion

New detailed mapping in conjunction with aeromagnetic interpretation has improved our understanding of the structural framework of the western Skeena Arch and its impact on localizing and exposing mineralization. In particular,long-lived northeast-trending structures have localized magma emplacement and associated hydrothermal systems and southeast-trending extensional fault west of the Howson Range has exposed rocks to the depth of the Triassic-Jurassic boundary,

VI. References

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