Mod property, VMS mineralization in the western part of the Yukon-Tanana terrane? (Yukon MINFILE 105B 028, 029, 031)

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ABSTRACT

Base metal-silver prospects have been known to exist in the upper Swift River region since 1946. These prospects, occurring in Yukon-Tanana terrane, have been previously described as isolated skarn occurrences and have hitherto received limited prospecting attention. Exploration work at the Mod property in 2016 has indicated that the sulphide mineralization is deformed (hence it predates the adjacent Cretaceous Seagull batholith) and that it demonstrates textures that are not consistent with a skarn origin. If, indeed, this mineralization is of exhalative origin then a large region of Yukon-Tanana terrane becomes prospective for mineralization similar to that of the Finlayson VMS district.

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INTRODUCTION

The Mod property contains three MINFILE occurrences: MOD (105B 031), TBMB (or Munson, 105B 029) and Bom (105B 028) which are located in the headwaters of the Swift River and are hosted in Yukon-Tanana terrane (Fig. 1). Base metal-silver prospects in the upper Swift River were discovered in 1946 during prospecting by Hudson Bay Mining and Smelting following the route for the Alaska Highway. A limited amount of diamond drilling was performed in 1947; in the 1960s Boswell River Mines undertook an aeromagnetic survey and several small-scale geochemical surveys. The TBMB to MOD trend, the southernmost of two known trends, has received limited excavation and structural mapping since then (McLeod and Sevensma, 1969; D'el-Rey Silva *et al.*, 2001a,b). The prospects are contained in metavolcanic and metasedimentary units of the Yukon-Tanana terrane that have been regionally metamorphosed and deformed with an overprint of thermal metamorphism from the mid-Cretaceous Seagull batholith. Consequently, the gangue mineralogy of the mineralization is of calc-silicates: either chlorite-epidote or diopside dominant. Based on the metamorphic overprint, these occurrences have previously been described as skarns. However, fieldwork since 2015 has revealed that the geological setting and sulphide mineralogy and textures are more consistent with an exhalative origin. If, indeed, this mineralization is of exhalative origin, then an underexplored region of many tens of kilometres strike length within the Yukon-Tanana terrane southwest of Tintina fault becomes prospective for VMS-style mineralization.

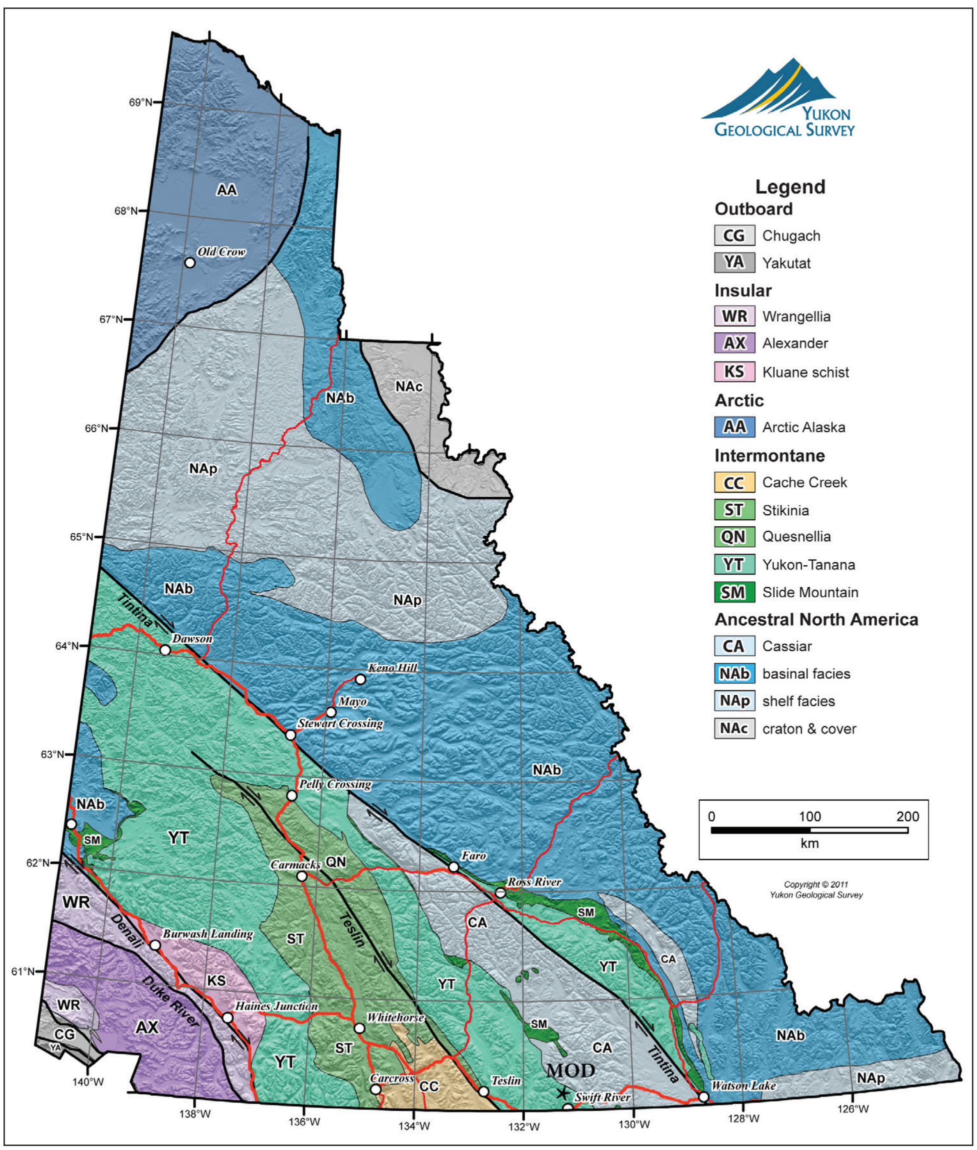

Figure 1. *Terrane map of Yukon (after Colpron and Nelson, 2011) showing location of the Mod property in the Yukon-Tanana terrane, southwest of Tintina fault.*

REGIONAL GEOLOGY

The upper Swift River basin contains metasedimentary and metavolcanic strata that have been assigned to the Snowcap and Finlayson assemblages of the Yukon-Tanana terrane (Colpron *et al.*, 2016). These relationships were originally mapped by Roots (D'el-Rey Silva *et al.*, 2000a,b) and have been compiled by Colpron (2016). These rocks are in fault contact on the northern side of the drainage basin with lower Paleozoic strata of displaced North American continental assemblages (Cassiar terrane). The Yukon-Tanana rocks are intruded by a Jurassic diorite-granodiorite sill of approximately 1 km in thickness, approximately 3 km to the north of the MOD-TBMB trend, and by a mid-Cretaceous granite stock, satellite to the Seagull batholith, 1 km north (Fig. 2). The units in proximity to the MOD-TBMB showings contain metamorphosed volcanic rocks, marble, siltstone, felsic and basic tuff, sandstone, greywacke, chert and phyllite of the Snowcap assemblage. Immediately south of the prospect, siliciclastic rocks of the Finlayson assemblage are in fault contact with the Snowcap assemblage.

PROPERTY GEOLOGY

Figure 3 presents a compilation of the detailed geology of the vicinity of the TBMB and MOD properties produced (D'el-Rey Silva *et al.*, 2000a,b). This map shows that at least two generations of folding have been recognized (D'el-Rey Silva *et al.*, 2000a,b). Tight F_2 folds are overturned to the northeast and have wavelengths in the order of 600 m. A marble unit adjacent to the obvious mineralization is traceable between the TBMB, MOD and Bound occurrences, with some obvious, but relatively minor, displacement by faults. Sphalerite mineralization is known to the northeast of the TBMB trenches, as well as weak copper-gold mineralization associated with the metavolcanics, but these occurrences require further mapping to elucidate their extent.

Chlorite-amphibole gangue mineral assemblages are seen at the TBMB (2.8 km NW of the MOD) and diopside/hedenbergite-epidote at the MOD occurrence. A leucogranite stock, satellite to the Seagull batholith, crops out in the canyon 1 km to the NE of the MOD and a

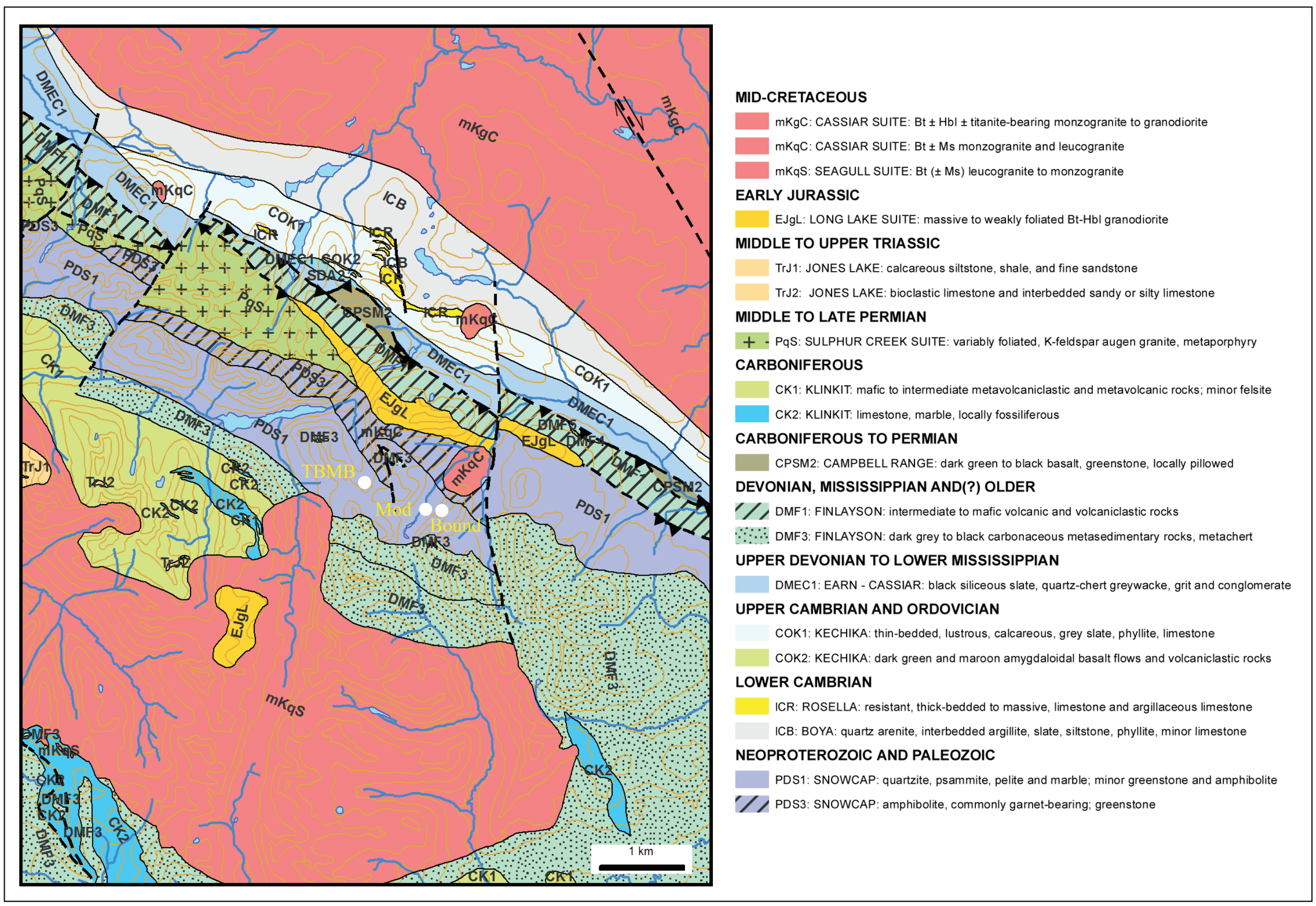

Figure 2. *Regional geology of the area around the Mod property (after Yukon Geological Survey, 2017); mKqS-Seagull Suite, mKqC- Cassiar Suite, EJgL- Long Lake Suite, PqS- Sulphur Creek Grp, DMF1- Ram Creek Fm, DMF3- Swift River Fm, DMEC1- Earn Grp, COK1- Kechika Grp, PDS1, 3- Snowcap Grp.*

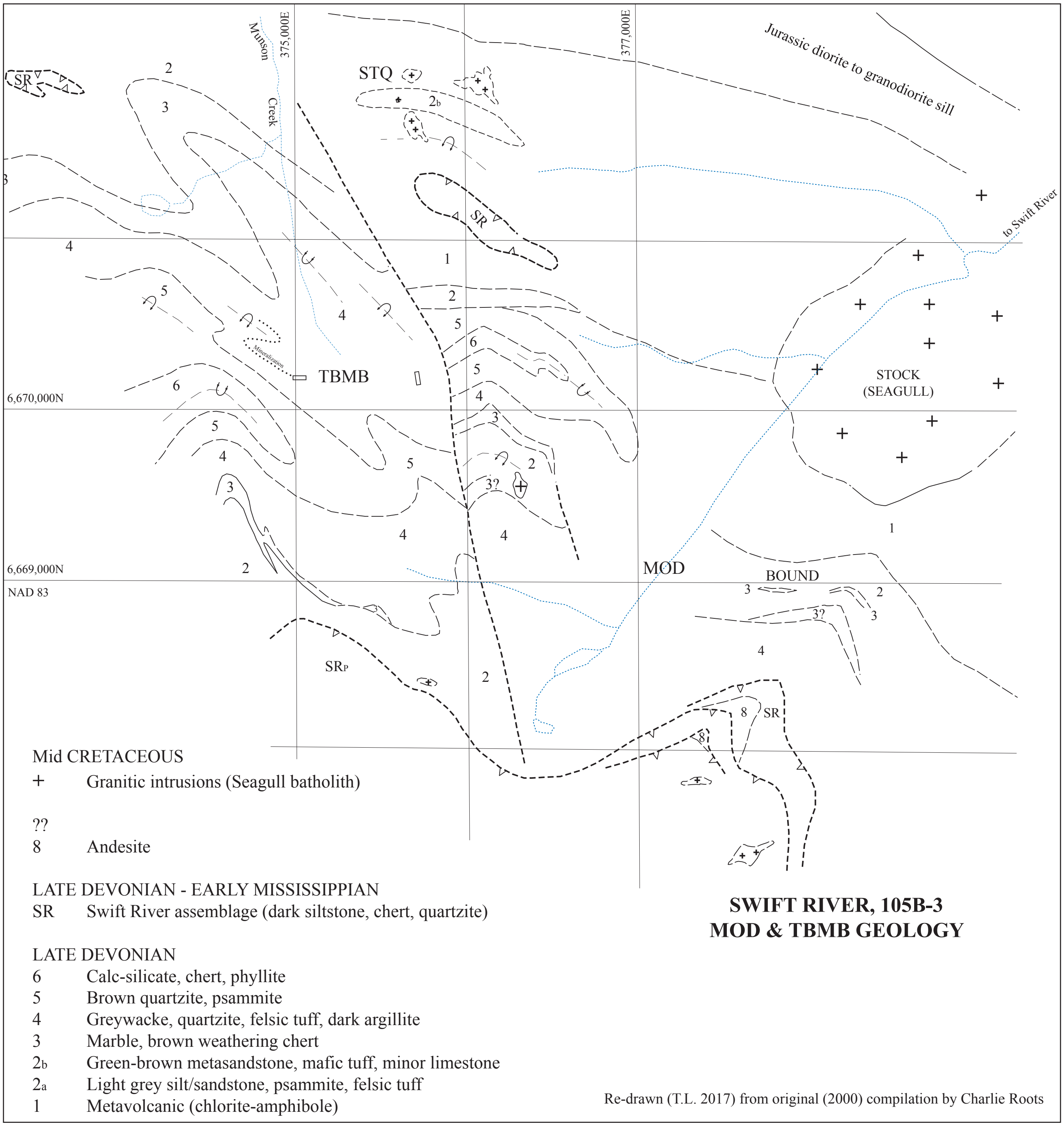

Figure 3. *Property-scale geology from mapping by Charlie Roots and Tim Liverton in 2000.*

further stock (the STQ) is exposed in a cirque 2 km NW of the TBMB. It is likely, therefore, that the batholith underlies the whole TBMB-MOD region and that this intrusion has produced the calc-silicate mineral assemblages seen in carbonate and the volcanic rocks.

MINERALIZATION

The MOD showing is exposed for a stike length of 170 m in two bulldozer cuts. Two locations, 140 m apart and 25 m vertically apart, have been cleaned to expose 2.2 m true thickness of sulphide in the northwestern ('lower') showing and 8.4 m thickness at the 'upper' showing. Mineralization may be traced to the southeast to the top of the ridge. Some 800 m along strike sphalerite-magnetite mineralization is found adjacent to a marble horizon at the Bound occurrence.

The sulphide mineralization is layered on a decimetre scale and foliation is obvious in thin section (Figs. 4 and 5a,b). Pyrrhotite forms one layer of 20 cm thickness at either exposure. The sulphides are laminated into pyrrhotite, sphalerite/tetrahedrite, sphalerite/magnetite, and galena-rich layers which is consistent with the mineralization being of exhalative origin. Slabs cut from the pyrrhotite show disjointed folds and intrusion of the sulphide into extension fractures in the calc-silicate gangue layer. This is typical of the 'durchbewegung' texture of deformed sulphides. Mixed sulphide layers contain sphalerite, often with tetrahedrite along its grain boundaries, with galena, euhedral magnetite crystals and rare arsenopyrite. Centimetre-scale folding of the mixed sulphides shows varying plunge directions (Figs. 6 and 7).

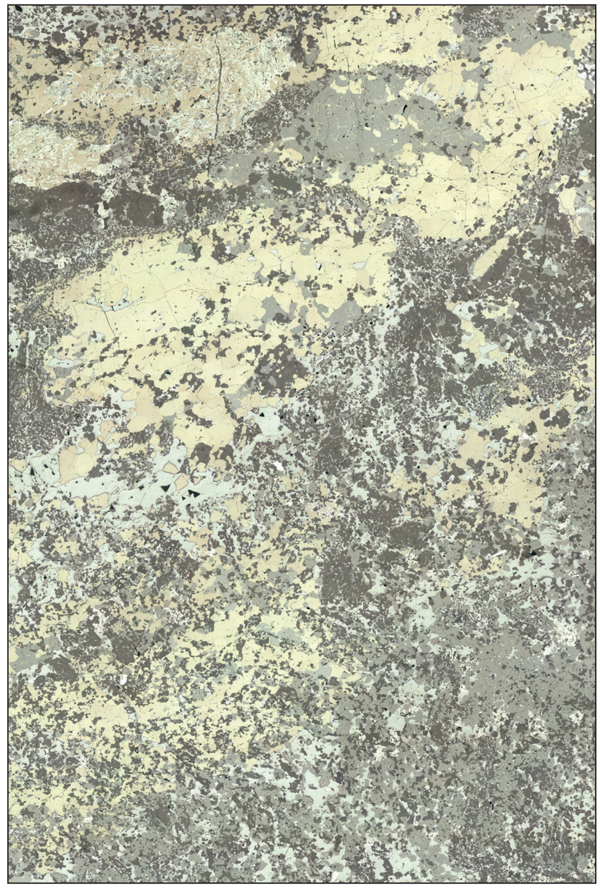

Figure 4. *Photomicrograph showing detail (plane polarized reflected light) of the region outlined in Fig. 7. The width of the image is approximately 22 mm.*

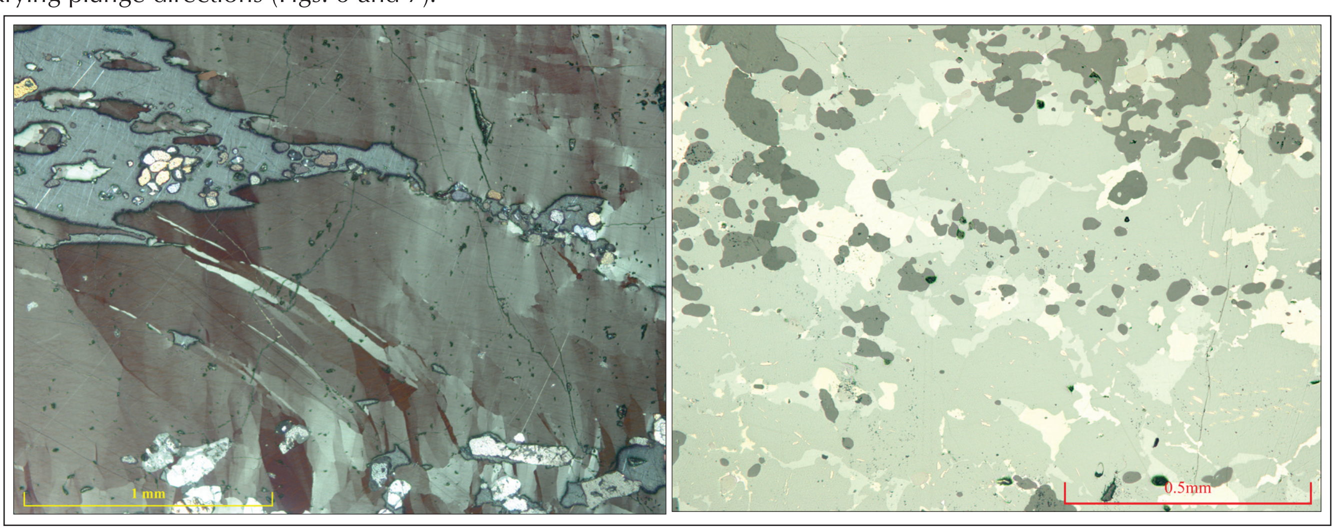

Figure 5. (a) *Polished thin section, polarizers at 85° showing deformation twinning in pyrrhotite (reflected light).* ***(b)*** *Zinc-rich mineralization from the upper showing. Plane polarized reflected light. Sphalerite is mid grey; tetrahedrite is a lighter grey; pyrrhotite is yellow; magnetite is brownish grey (crystals in upper R.H. corner); gangue is black.*

Channel sampling of the lower showing yielded an average grade of 7.49% Zn, 5.12% Pb and 8.4 oz/ton Ag over 2.2 m true thickness. The upper showing has not been systematically channel sampled, however ~10 kg blocks of coarse galena gave an assay of 41.6% Pb and 62.7 oz/ton Ag, and the fine-grained pyrrhotite-bearing sulphide assayed 5.61% Zn, 3.19% Pb and 7.8 oz/ton Ag.

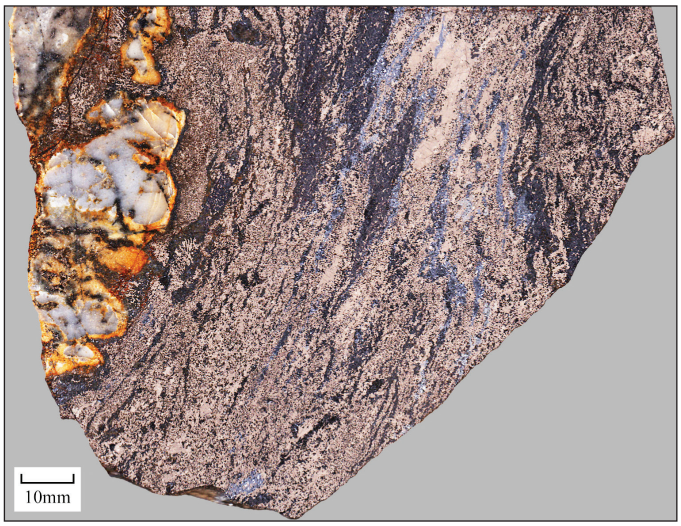

***Figure 6.** Ground slab of folded, layered pyrrhotite-galena from the upper showing with durchbewegung texture. Pyrrhotite is bronze, galena bluish grey, calc-silicate/ carbonate gangue black.*

DISCUSSION AND CONCLUSIONS

The finely laminated and highly deformed nature of the sulphides at the Mod property is inconsistent with this mineralization being a skarn produced by the Seagull batholith. The deformation has preceded the thermal metamorphism that produced calc-silicate gangue minerals. Skarns are known to have layered magnetite/pyrrhotite or pyrite mineralogy, but not with the textures shown by the Mod mineralization. Layered skarns (wrigglite: Kwak and Askins, 1981a,b) have discrete monomineralic layering (see also Liverton, 2016, his Figs. 11c, 12b,c). The geological setting at the Swift River area is prospective for VMS formation: the area is underlain by an abundance of basinal metasedimentary rocks and felsic meta-volcanic rocks. The authors are of the belief that the mineralization is likely to be of exhalative origin that was coeval with deposition of the volcano-sedimentary units that are part of the Yukon-Tanana terrane. The mineralization at Mod appears to be of VMS-origin, making this a significant new region that is comparable to the Finlayson district and is prospective for Zn-Pb-Ag VMS deposits. Detailed mapping, rock geochemistry and petrography are recommended to test this model.

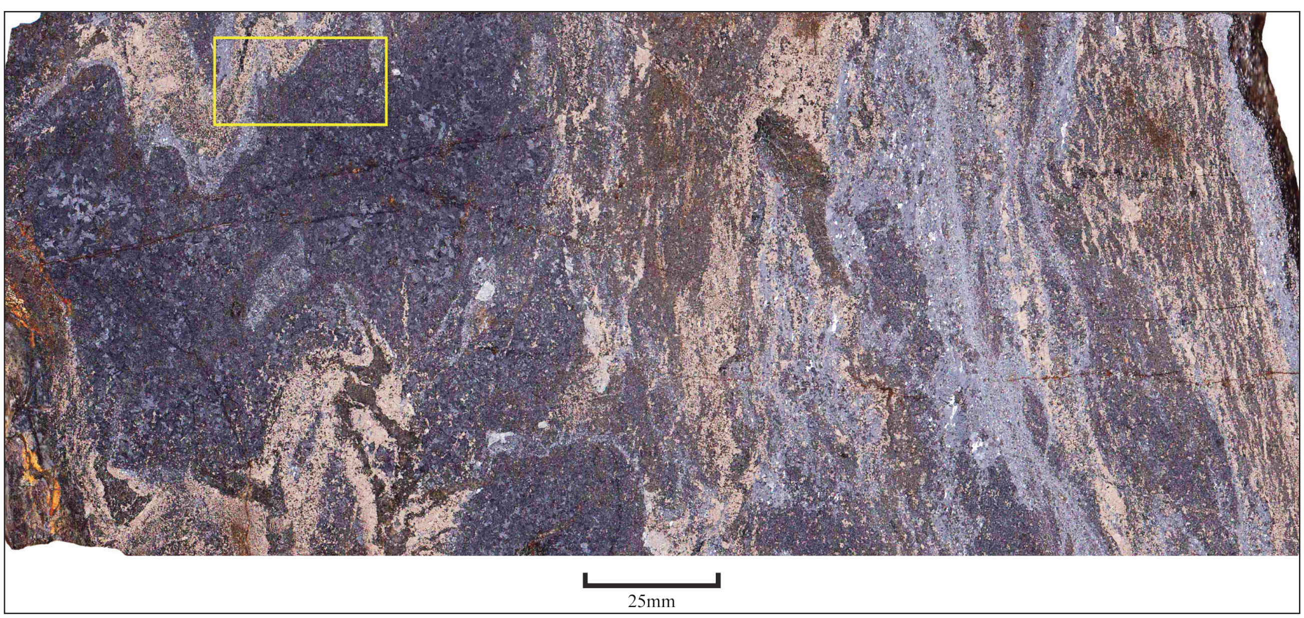

***Figure 7.** Slab of layered, mixed sulphides showing folding. The fold at the top left plunges (upward) at 40° to the section plane. The approximate corresponding location for Figure 4 is outlined in yellow.*

REFERENCES

Colpron, M. and Nelson, J.L., 2011. A digital atlas of terranes for the northern Cordillera: Yukon Geological Survey, www.geology.gov.yk.ca/bedrock_terrane.html [accessed May 15, 2013].

Colpron, M., Israel, S., Murphy, D.C., Pigage, L.C. and Moynihan, D. (compilers), 2016. Yukon Bedrock Geology Map. Yukon Geological Survey, Open File 2016-1, map and legend.

D'el-Rey Silva, L.J.H., Liverton, T., Paradis, S. and Roots, C., 2001a. A structural analysis of the upper Swift River area (105B/3), Yukon, Part I: Dan Zn occurrence and implications for sulphide mineralization. *In:* Yukon Exploration and Geology 2000, D.S. Emond and L.H. Weston (eds.), Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 289-300.

D'el-Rey Silva, L.J.H., Liverton, T., Roots, C. and Paradis, S., 2001b. A structural analysis of the upper Swift River area (105B/3), Yukon, Part II: The TBMB claims and implications for the regional geology. *In:* Yukon Exploration and Geology 2000, D.S. Emond and L.H. Weston (eds.), Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada. p. 301-310.

Kwak, T.A.P. and Askins, P.W. 1981a. Geology and genesis of the F-Sn-W (-Be-Zn) skarn (wrigglite) at Moina Tasmania. Economic Geology, vol. 76, p. 439-467.

Kwak, T.A.P. and Askins, P.W. 1981b. The nomenclature of carbonate replacement deposits, with emphasis on Sn-F-(-Be-Zn) 'wrigglite' skarns. Journal of the Geological Society of Australia, vol. 28, p. 123-136.

Liverton, T., 2016. A-type granite plutons and tin skarns in southeast Yukon: Mindy prospect and surrounding granite of 105C/9. *In:* Yukon Exploration and Geology 2015, K.E. MacFarlane and M.G. Nordling (eds.), Yukon Geological Survey, p. 151-164.

McLeod, J.W. and Sevensma, P.H., 1969. Boswell River Mines Ltd., Dan Group, Summary of 1968 Work Program. Yukon Energy, Mines and Resources Assessment Report 018616.

Yukon Geological Survey, 2017. Yukon Digital Bedrock Geology. Yukon Geological Survey, http://www.geology.gov.yk.ca/update_yukon_bedrock_geology_map.html [accessed December, 2017].