Preliminary geology of the southeastern part of Ddhaw Ghro Special Management Area

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ABSTRACT

Ddhaw Ghro Special Management Area (SMA) is currently withdrawn from mineral claim disposition. A mineral resource assessment of Ddhaw Ghro SMA will be carried out during the fall, 2001, in support of finalizing its management plan. Mapping at 1:20 000 scale, sampling, and prospecting in southeastern Ddhaw Ghro SMA shows complex structural and stratigraphic relations in layered rocks, which are further complicated by intense contact metamorphic alteration around McArthur Batholith. Rocks in roof pendants in the McArthur Batholith are pervasively altered. Southeast of the batholith, a structurally imbricated sequence of Ordovician (Duo Lake Formation) through Devonian (Portrait Lake Formation) rocks contain a slice of maroon and green shale, which may represent a far travelled thrust sheet of Early Cambrian Narchilla Formation, or a facies change in upper Road River Group towards Nogold Unit type lithologies.

Sulphide minerals are common in strongly oxidized areas in the contact metamorphic aureole, and in more localized skarn-altered zones.

RÉSUMÉ

La région de gestion spéciale (RGS) de Ddhaw Ghro est actuellement soustraite de toute disposition de claims miniers. On évaluera au cours de l'automne 2001 les ressources minérales de la RGS de Ddhaw Ghro dans le but d'en compléter le plan de gestion. Selon les travaux de cartographie au 1/20 000, d'échantillonnage et de prospection menés dans le sud-est de la RGS de Ddhaw Ghro, il existe dans les roches litées des relations structurales et stratigraphiques complexes, qui sont d'autant plus compliquées à cause de l'intense altération métamorphique de contact autour du batholithe de McArthur. Les roches encaissantes qui se retrouvent dans des enclaves dans le batholithe sont fortement altérées. Au sud-est du batholithe, une séquence à structure imbriquée de roches datant de l'Ordovicien (Formation de Duo Lake) au Dévonien (Formation de Portrait Lake) renferme une couche de shale vert et marron. Il pourrait s'agir d'une nappe, charriée sur une grande distance, de la Formation de Narchilla du Cambrien précoce ou d'un passage de faciès vers des lithologies du type de l'Unité Nogold dans la partie supérieure du Groupe de Road River.

Les minéraux sulfurés abondent dans les zones fortement oxydées dans l'auréole de contact métamorphique et dans des zones skarnifiées plus localisées.

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INTRODUCTION AND LAND STATUS

McArthur Wildlife Preserve was established in 1972, when an Ecological Reserve notation (#10-21) was applied to the Yukon Territorial Resource Base Maps. Initially, regulations limited hunting activity only, and the map notation flagged the area as having wildlife values. The McArthur Wildlife Preserve was selected as Ddhaw Ghro Special Management Area (SMA) through finalization of the Na'Cho N'yak Dun Final Agreement and negotiations of Selkirk First Nation Land Claims. The Special Management Area was established as a Habitat Protection Area. In 1997, Ddhaw Ghro was withdrawn from land disposition through 2005, or through the completion of a management plan.

PURPOSE AND SCOPE OF WORK

The purpose of this work was to begin the inventory of mineral resources that is needed to conduct a mineral assessment of the area. The mineral assessment will provide information on metallic mineral values of the SMA to the Ddhaw Ghro SMA Working Group (Yukon Government) and Steering Committee (Yukon Government and First Nations), in support of finalizing the management plan as outlined in Chapter 10, Section 6.4.12 of the Selkirk First Nation Final Agreement.

During the summer, 2000, the authors spent six days in the area between Grey Hunter Creek and Sideslip Creek, in the southeastern portion of Ddhaw Ghro SMA. The purpose of this fieldwork was to examine part of the stratigraphy, document known mineral occurrences and investigate the source of geochemical anomalies. Work included 1:20 000-scale mapping, prospecting, geochemical sampling, fossil dating, and petrographic studies. Traverses were based from two fly camps. The first camp was located near the Sideslip mineral occurrence (105M 039, Yukon MINFILE, 1997) and was set to investigate possible mineralized areas within the McArthur Batholith and its associated roof pendant rocks. The second camp was set near Grey Hunter Peak, to investigate the source of anomalous stream geochemical samples (Regional Geochemical Survey (RGS), Hornebrook and Friske, 1988).

LOCATION, ACCESS AND PHYSIOGRAPHY

Ddhaw Ghro Special Management Area consists of 1610 km^2 in central Yukon, located east of the Klondike Highway (Fig. 1). The SMA occupies the southwestern portion of Mayo map sheet (105M), southeastern corner of McQuesten map sheet (115P), and northeastern corner of Glenlyon map sheet (105L). The northwestern corner of Dhaw Ghro SMA is adjacent to the Klondike Highway, and approximately 25 km south of Stewart Crossing. Access to the southeastern portion of the SMA is by helicopter from Mayo (approximately 75 km).

Ddhaw Ghro SMA roughly outlines the high ridges of McArthur Range, immediately northeast of Tintina Trench. Elevations range from 700 m in the northwest corner of the SMA, where forest cover is dense, to areas above 1980 m, characterized by sub-alpine and alpine environments.

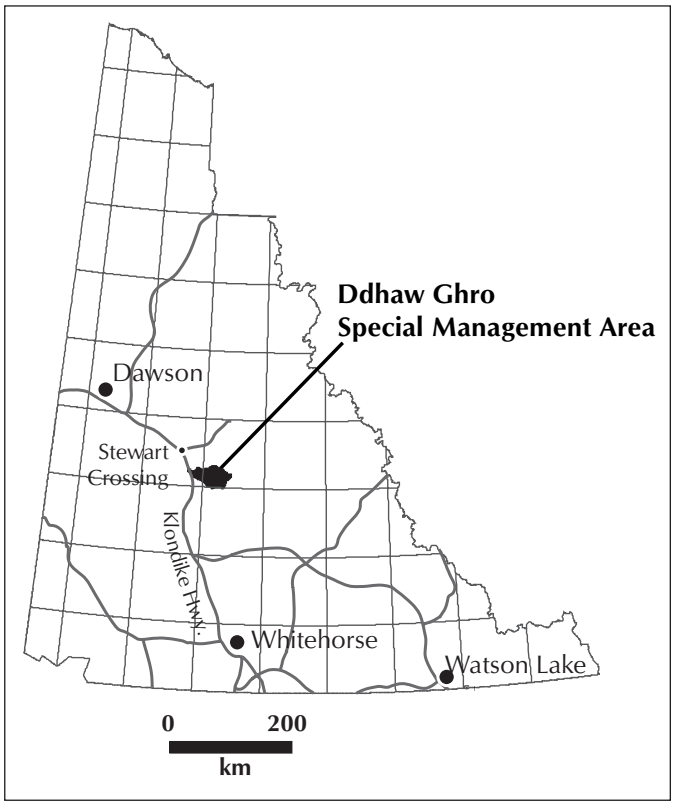


Figure 1. *Location map of Ddaw Ghro Special Management Area.*

MINERAL EXPLORATION HISTORY

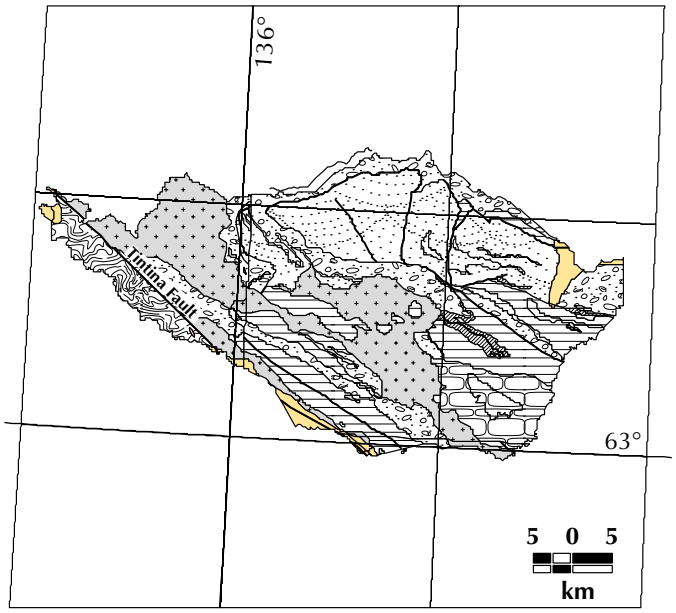
Mineral exploration in the southwestern Mayo map sheet dates as far back as 1929, when Treadwell Yukon Corporation Ltd.'s prospecting party reported discovering the 'Lost Wernecke Copper' (105M 043, Yukon MINFILE, 1997), a large tonnage, low-grade copper deposit in the McArthur Mountains. Treadwell Yukon did not stake the area, and subsequent efforts to locate the copper showings were unsuccessful, despite regional exploration programs by Atlas Exploration Ltd. in 1969 and by United Keno Hill Mines Ltd. in 1970.

Other exploration activity in the area lead to the discovery of the following mineral occurrences: Sideslip (105M 039, Yukon MINFILE, 1997), staked as early as 1950, but certainly in 1969 by Atlas Exploration Ltd.; Great Horn (105M 040, Yukon MINFILE, 1997), staked in 1971 by Great Horn Mg Syndicate Inc.; Ram (105M 041, Yukon MINFILE, 1997), staked in 1966 by Kerr Addison Mines Ltd.; Hotspring (105M 042, Yukon MINFILE, 1997), staked in 1966 by H. Mauthner; and Friesen (105M 051, Yukon MINFILE, 1997), discovered in 1970 by United Keno Hill Mines Ltd., and staked in 1972 by E. Woolven and E. Friesen, and again in 1974 by G. Van Bibber. In 1997, Viceroy Resources Ltd. conducted a regional exploration program in the McArthur Wildlife Preserve, and identified targets for more advanced exploration. Withdrawal of the SMA land from disposition late in the 1997 field season terminated Viceroy's exploration program.

GEOLOGICAL SETTING OF DDHAW GHRO SMA

Roots (1997) mapped the Mayo map sheet (105M) at 1:100 000 scale, and compiled the maps at 1:250 000 scale. Gordey and Makepeace (1999) produced a digital compilation of the geology of the Yukon, from which geology of Ddhaw Ghro SMA is shown in Figure 2.

Ddhaw Ghro SMA is located in western Selwyn Basin, near the Tintina Fault. From Late Proterozoic through Siluro-Devonian time, easterly derived sediments were deposited in Selwyn Basin, a topographic low to the west of the ancient North American margin. In mid-Paleozoic time, Nogold Basin formed along a southeast-trending axis, on what is now the northern part of Ddhaw Ghro SMA. Hyland Group and younger rocks were reworked and their sediments redeposited mainly as grits and maroon and green shale in Nogold Basin (Roots, 1997). Visually, Nogold Unit and Hyland Group are identical,



LEGEND

Quaternary
unconsolidated sediments

Mid-Cretaceous Anvil plutonic suite
granite

Middle Devonian to Early Mississippian Earn Group
Portrait Lake Formation
black shale

Middle Paleozoic Nogold unit
marroon and green shale, grit, limestone

Ordovician to Silurian Road River Group (undivided)
black chert and shale

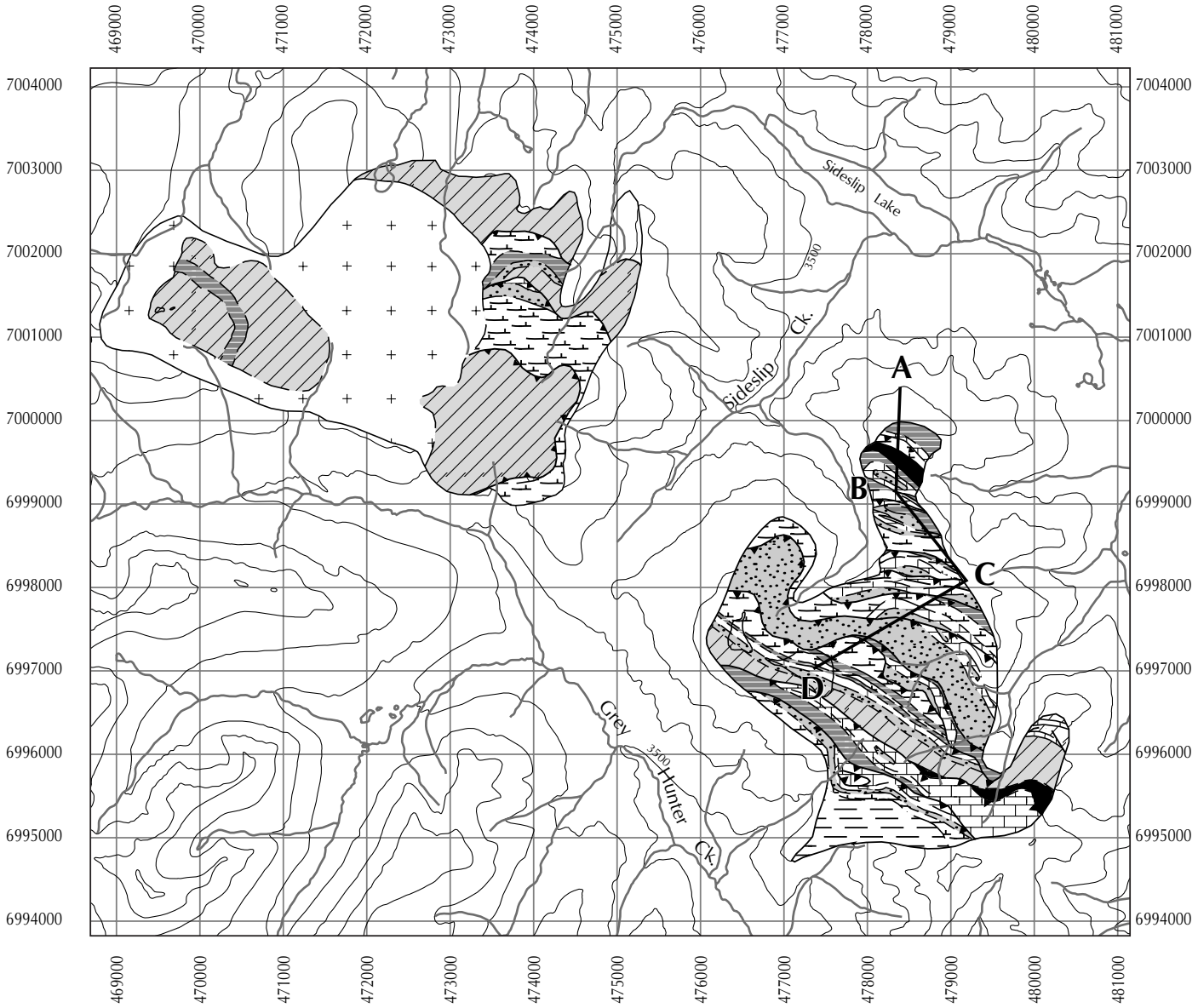
Cambrian Gull Lake Formation
khaki shale

Late Proterozoic to Early Cambrian Hyland Group
Narchilla Formation
maroon and green shale
Yusezyu Formation
grit, shale, limestone

Devonian to Mississipian Nasina Series (Yukon-Tanana Terrane)
metavolcanic, metaplutonic and metasedimentary rocks

fault

Figure 2. *Regional geology of Ddhaw Ghro Special Management Area (modified from Gordey and Makepeace, 1999).*



LEGEND

Mid-Cretaceous Anvil plutonic suite

++ biotite-quartz-monzonite

Middle Devonian to early Mississippian: Earn Group

dark grey subarkosic to arkosic sandstone and shale

Ordovician to Silurian: Road River Group

Silurian Steel Formation

dark grey to black chert and shale

orange-weathering, grey, wispy laminated calcareous shale

medium grey shale

tan-weathering subarkosic wacke

white-weathering, black limestone

Ordovician to Silurian Duo Lake Formation

black chert and dark grey shale, minor maroon and green shale

medium grey shale

black chert, minor grey shale

Duo Lake Formation, undivided

map limits

thrust fault

geological contact

cross-section line

Figure 3. *Geological map of southeastern Ddhaw Ghro.*

and the distinction is made based on fossil ages. In Devonian time, westerly and northwesterly derived Earn Group dark turbidites and minor chert deposited upon Selwyn Basin strata (Gordey, 1992).

Mesozoic deformation produced southeast-trending, southeast-plunging folds, and northeast-verging thrusts in the southern part of Mayo map area (Roots, 1997). Intrusion of Anvil plutonic suite McArthur Batholith took place between 90-95 Ma (Roots, 1997). Magmatism post-dated the penetrative deformation, and produced wide contact metamorphic aureoles that overprinted penetrative fabrics. Starting in the Eocene, dextral movement along Tintina Fault juxtaposed autochthonous rocks of Selwyn Basin (included in Ddhaw Ghro SMA) to allochthonous Yukon-Tanana Terrane rocks southwest of the fault.

PRELIMINARY GEOLOGY OF SOUTHEASTERN DDHAW GHRO SMA

The geology of southeastern Ddhaw Ghro SMA (Fig. 3) is dominated by the intrusion of McArthur Batholith. Intensely jointed, muscovite-biotite quartz monzonite is ubiquitous, but biotite quartz monzonite and pegmatitic dykes are common. More mafic enclaves are common, particularly along the margins of the batholith. McArthur Batholith contains large pendants reaching over 2 km in diameter. Rocks forming the northeastern-most pendant are resistant, rusty-weathering, pervasively hornfelsed quartz-arenite, siltstone, and shale, and calc-silicate-altered limestone.

Sedimentary rocks in the contact metamorphic aureole are rusty, pervasively hornfelsed or calc-silicate-altered, sub-arkosic to arkosic wacke, shale, siltstone, and minor calcareous siltstone. Primary features are often obliterated. Pervasive alteration precludes definitive stratigraphic correlations. The structurally highest rocks, located to the northeast beyond limits of hornfelsing, may either be part of Road River Group, or a thrust slice of Yusezyu Formation (Hyland Group) over typical Road River Group black shale, chert, and limestone. Hornfelsed siltstone and shale commonly have biotite and chlorite clots up to 5 mm in diameter.

Sedimentary rocks east of Grey Hunter Creek consist of a folded and thrust-imbricated sequence of Duo Lake Formation (dark grey to black chert, shale, and limestone, and minor tan-weathering, medium grey-brown subarkosic wacke), Steel Formation of Road River Group (orange-weathering, greenish-grey, bioturbated, wispy laminated calcareous shale), and Portrait Lake Formation of Earn Group (blue-black-weathering, dark grey to black arkosic wacke and shale). Hyland Group rocks may be present in the area as thin thrust sheets. A resistant, white-weathering, black limestone, interpreted here as the top of Duo Lake Formation, was previously correlated with Hyland Group (Roots, 1996), on the basis of similarity to the regional black limestone defining the contact between Yusezyu and Narchilla formations in Nahanni map sheet (Gordey, 1992). Conodonts from this unit yielded uncertain Paleozoic age (Roots, 1996). The authors of this report collected black limestone samples from five locations for conodont dating. A conspicuous, maroon-weathering, olive-green shale up to 12 m thick, and traced for a strike length of over 2 km, may represent a thin slice of Narchilla Formation thrust imbricated in Duo Lake Formation rocks. Alternatively, maroon and green shale may be part of Nogold Unit, which is visually indistinguishable from Hyland Group rocks, and coeval to upper Road River Group.

STRUCTURAL GEOLOGY

Two phases of deformation produced two penetrative foliations: west-trending folds, S_1 (1st phase, Fig. 4) and northwest-trending folds, S_2 (2nd phase, Fig. 5). Other

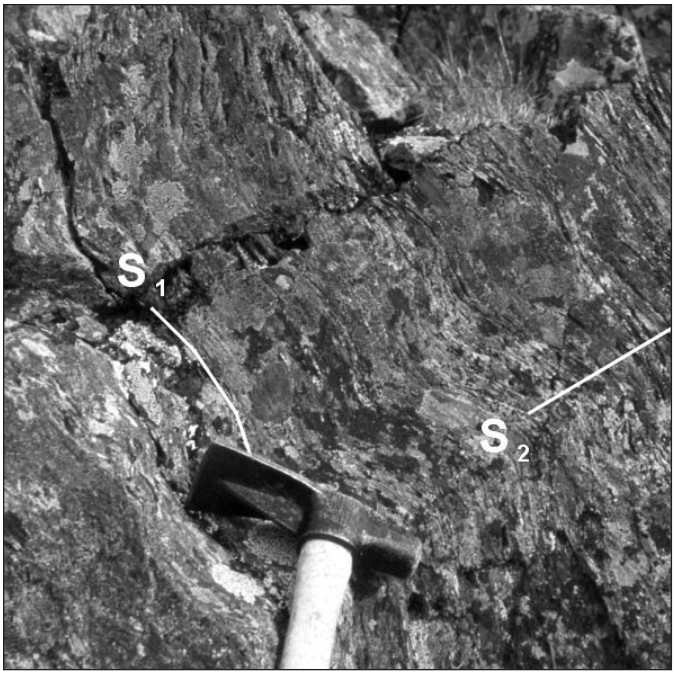


Figure 4. *Well developed first (S_1) and second (S_2) phase foliations in pelitic rocks of Road River Group.*

significant structures include boudinaged competent beds and veins, and north- to northeast-directed thrusting. Cross-section ABCD (Fig. 6) shows the interpreted structural style of the ridge northeast of Grey Hunter Creek. The contact between competent black limestone and incompetent dark grey shale of Duo Lake Formation represents a plane of weakness along which thrust sheets nucleated during the second deformation event.

CONTACT METAMORPHISM

Within the contact metamorphic aureole of McArthur Batholith, primary textures and foliations are strongly to pervasively overprinted by biotite-hornfels alteration. Small, stubby prismatic metamorphic minerals in aluminous rocks are likely andalusite. Oxidation is moderate to intense. The extent of the contact metamorphic aureole varies between 100 m to over 1 km.

MINERALIZATION

The Sideslip mineral occurrence (105M 039, Yukon MINFILE, 1997) is described as containing mineralized porphyry dyke float. During the 2000 field season, no mineralization associated with the batholith was found in

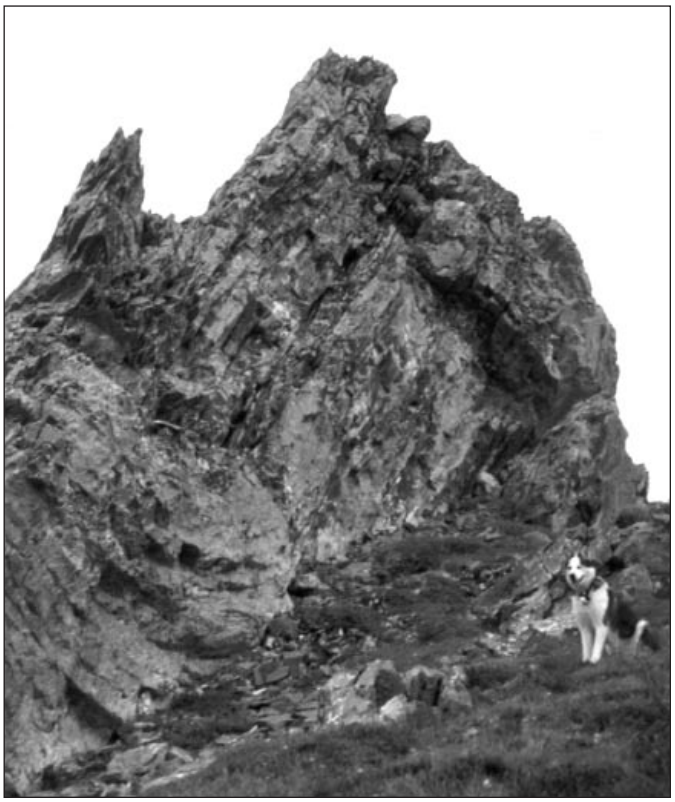


Figure 5. *Folded black limestone (Road River Group or Nogold unit), looking southeast.*

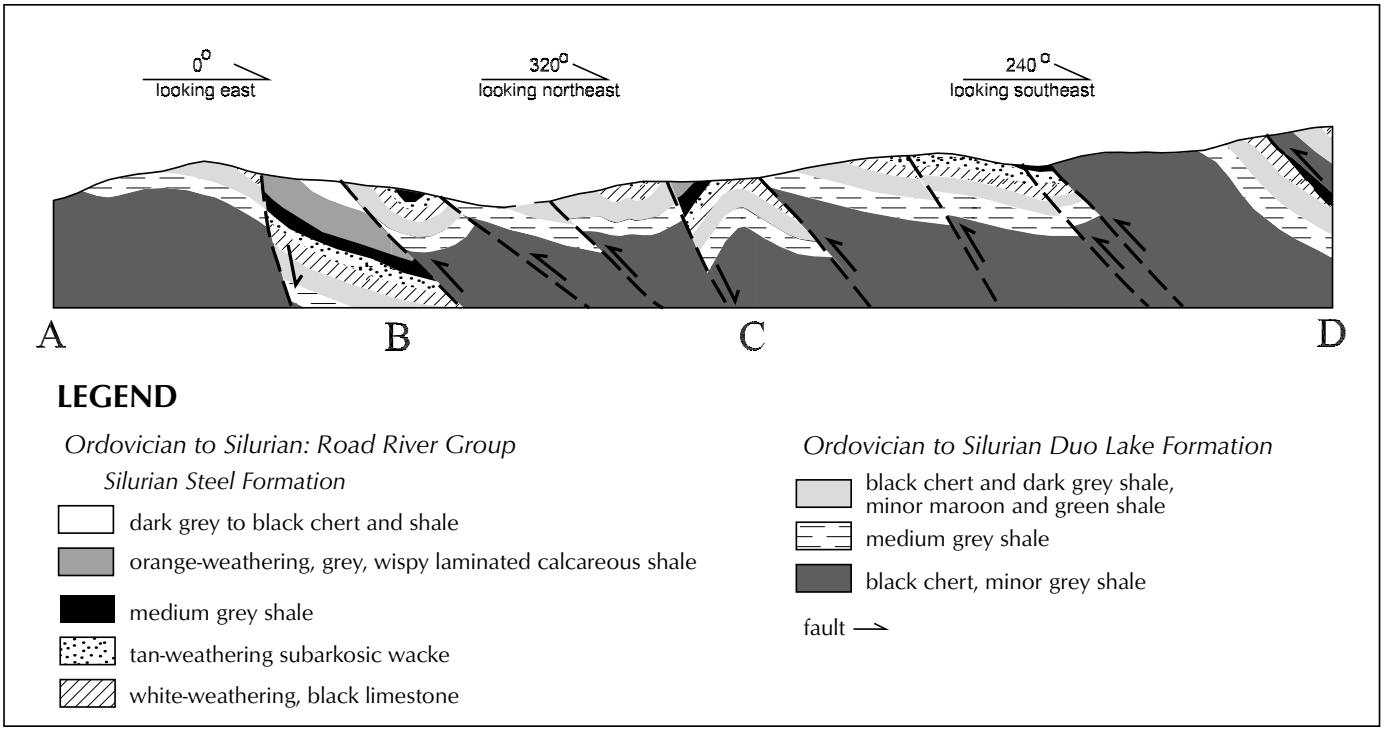


Figure 6. *Cross-section ABCD (Fig. 3) of the ridge northeast of Grey Hunter Creek.*

the Sideslip area. The slope southeast of where the Sideslip mineral occurrence is currently mapped contains skarn with up to 2% pyrrhotite. This mineralization is developed in black limestone interbedded with dark grey shale, in the footwall of an interpreted thrust. Locally, hornfelsed pendants contain up to 10% disseminated sulphides (pyrrhotite and pyrite). In one location, quartz-tourmaline veins crosscut pendant rocks.

SUMMARY AND CONCLUSIONS

The geology of southeastern Ddhaw Ghro SMA consists of folded and thrust-imbricated basinal rocks of Ordovician (Road River Group) to Early Mississippian (Earn Group) age. Some thrust sheets may contain rocks as old as Late Proterozoic to Early Cambrian (Hyland Group).

The mid-Cretaceous McArthur Batholith intruded, produced hornfels and skarn alteration, and obliterated most primary features of the basinal rocks. Plutonic-related mineralization such as intrusive-hosted gold, gold skarn, gold-copper skarn, tungsten skarn, sediment-hosted disseminated gold, and distal polymetallic veins are the most likely styles of mineralization in this geological setting.

Maroon and green shale occurs within typical Road River Group black chert and shale, grey shale and chert, and tan wacke, overlying the Silurian Steel Formation, along with the existence of shallower water facies (limestone) in the Road River Group. This suggests that there is a significant facies change in upper Road River Group in southwestern Mayo map area. It is uncertain whether the facies change results from Silurian rifting or if it represents a transition into a shallower environment to the southwest. New conodont ages and further 1:20 000-scale mapping to the northwest of the McArthur Batholith is necessary to shed light on the age and depositional environment of sedimentary rocks in the various thrust sheets, and to better characterize the deformation style and mineral deposit models applicable to rocks of Ddhaw Grho SMA.

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