BRITISH COLUMBIA DEPARTMENT OF MINES AND PETROLEUM RESOURCES

PRELIMINARY MAP No. 9

PRELIMINARY GEOLOGICAL MAP OF PART OF HOGEM BATHOLITH, DUCKLING CREEK AREA

0 1 2 3 4 5

SCALE - MILES

0 1 2 3 4 5 6 7 8

SCALE - KILOMETERS

GEOLOGY BY J. A. GARNETT

LEGEND

LOWER JURASSIC (?) TO LOWER CRETACEOUS

OMINECA INTRUSIONS [3 (?) to 9]

HOGEM BATHOLITH

9 — LATE DYKES, light brown, orange, grey, aphanitic to fine grained, commonly porphyritic; mainly latite, less commonly dacite, rhyodacite, rhyolite, fine-grained granite

8 — QUARTZ MONZONITE, pink to white, medium to coarse grained, leucocratic to holofelsic; mainly hypidiomorphic granular, but locally may be xenolithic, porphyritic; grades into granite in some areas

7 — GRANODIORITE, light grey to white, medium to coarse grained, leucocratic (amphibole > biotite), mainly hypidiomorphic granular

6 — DUCKLING CREEK SYENITE COMPLEX, great variety in texture and mafic content; contains both magmatic and metasomatic potash feldspar-rich rocks; although not mapped separately, the Complex consists of three main divisions

(i) brown to orange, medium to coarse-grained, leucocratic to holofelsic intrusive rocks, with pegmatitic and potash feldspar porphyries locally evident; coarser grained cores of this division commonly grade into fine-grained aplitic textured borders; quartz veins occasionally cut these rocks

(ii) dark grey-pink mottled, fine to medium-grained meso- to melanocratic hybrid potash feldspar rock, generally exhibiting streaky colour bands and distinct alignment of prismatic pyroxene/amphibole and/or potash feldspar phenocrysts

(iii) brown to orange, pegmatitic to aplitic dykes and stringers cutting the above divisions as well as Units 2 to 5

6A — POTASH FELDSPAR ENRICHED HYBRID MONZONITE, pink to orange/black mottled grading to grey/black mottled with orange patches and streaks, mainly fine to medium grained, leucocratic to mesocratic; mainly hypidiomorphic granular texture, but shows prismatic mafic alignment near borders with Unit 6 (pyroxene > amphibole > biotite); contacts with Unit 5 are gradational; quartz veins occasionally cut this unit

5 — MONZODIORITE-MONZONITE, grey/black mottled, fine to medium-grained, mesocratic (pyroxene > amphibole > biotite), hypidiomorphic granular textures common; quartz-bearing varieties are present; dykes of this unit cut Unit 2 along the Hogem-Takla contact area; accessory magnetite is common in Units 3, 4, and 5

4 — DIORITE, dark grey to black, medium-grained, mesocratic (pyroxene > amphibole), hypidiomorphic granular textures

3 — BIOTITE-POTASH FELDSPAR PYROXENITE, dark green/black mottled, coarse grained; occurs as lenses and irregularly shaped blocks within Units 6 and 6A

UPPER TRIASSIC TO LOWER JURASSIC

2 — TAKLA GROUP VOLCANIC ROCKS, mainly dark green tuffs and breccias of andesitic to basaltic composition; occasionally interbedded with flow rocks and cut by pyroxene and feldspar porphyry dykes of similar composition; interbedded dolomites were noted at one locality

AGE UNKNOWN

1 — FOLIATED 'BASEMENT' ROCKS, mainly amphibole-biotite-potash feldspar foliates, gneisses, and schists; some garnetiferous and calcareous mica schists have been noted; this unit appears at topographically lower levels enveloped and cut by Unit 6 foliates

SYMBOLS

Geological contacts
- approximate
- assumed
- gradational

Foliation zones

Foliations, measured
- inferred

Joints

Primary compositional layers

Pinchi fault zone

Fault, inferred

Air photograph linear

Fracture trace linear, inferred

Glacial linear

Dolomite layers .... Dol.

Takla volcanic inclusion zones within Hogem batholith .... V V

Potash feldspar enrichment .... K

Pyritized rusty zones .... Py

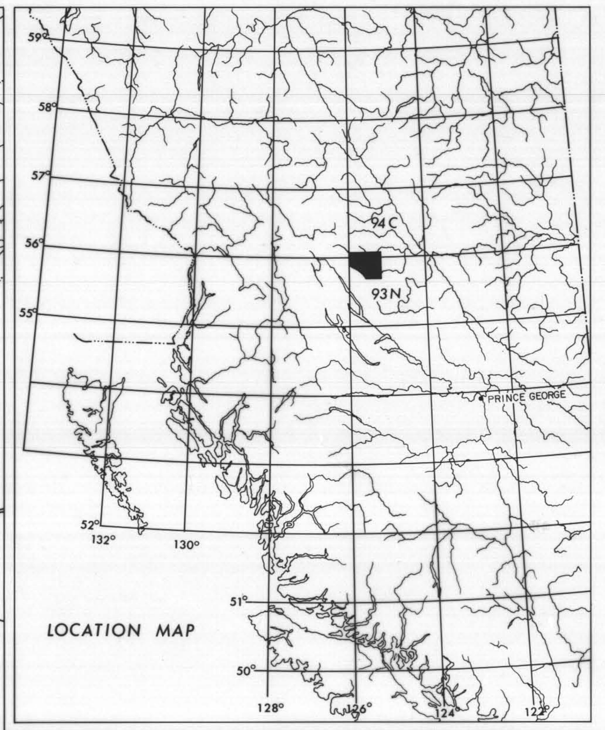
Copper prospect .... ▲7

Copper showing X

Department of Mines and Petroleum Resources Omineca Road

Four-wheel-drive vehicle road

Ridge lines



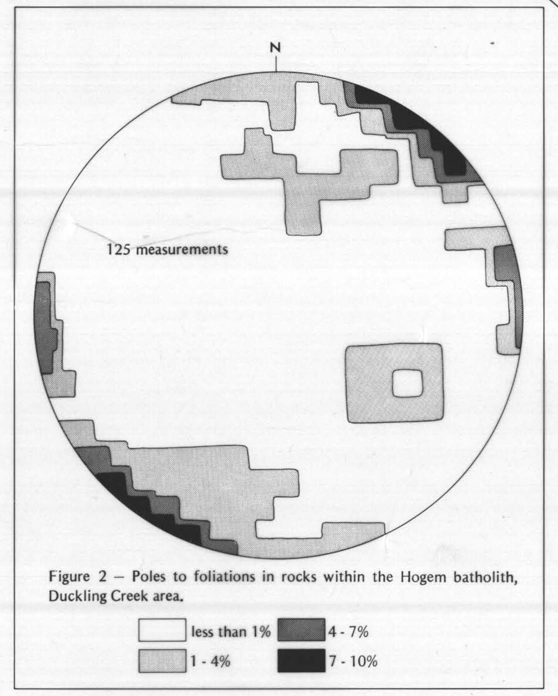


Figure 2 — Poles to foliations in rocks within the Hogem batholith, Duckling Creek area.

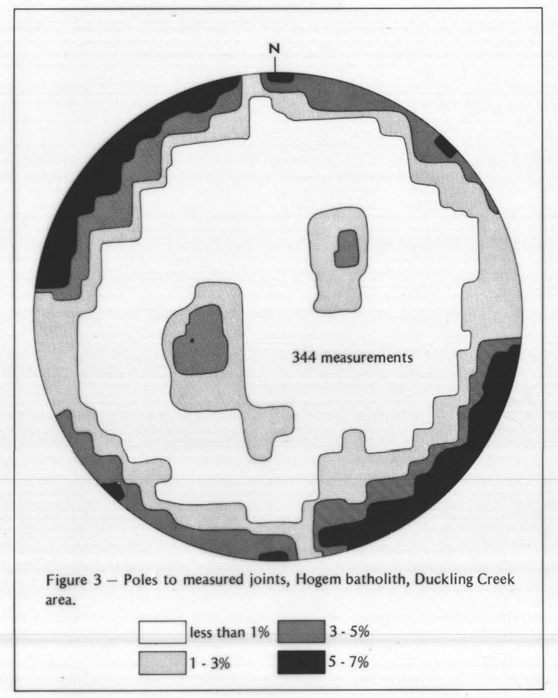
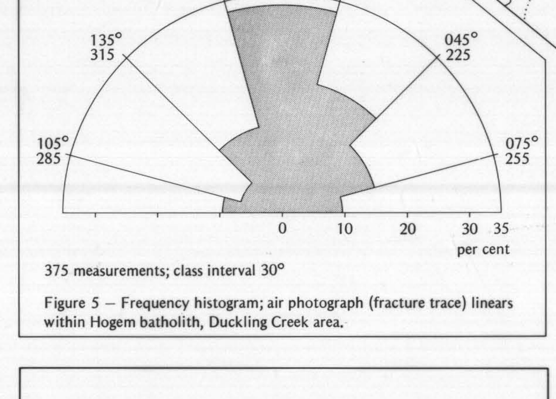


Figure 3 — Poles to measured joints, Hogem batholith, Duckling Creek area.



375 measurements; class interval 30°

Figure 5 — Frequency histogram; air photograph (fracture trace) linears within Hogem batholith, Duckling Creek area.

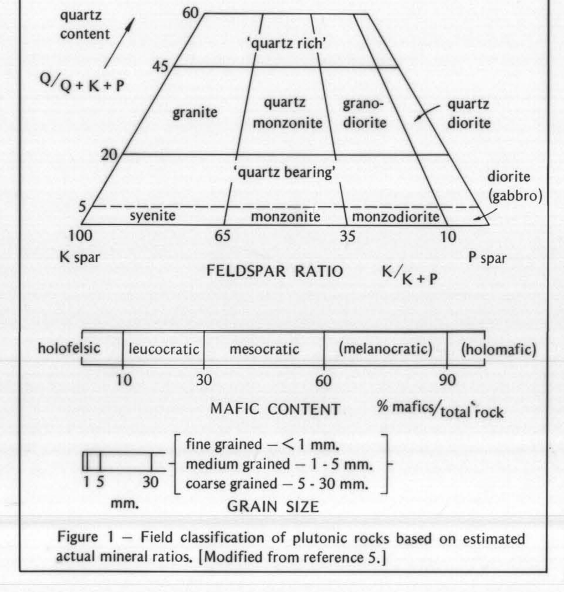
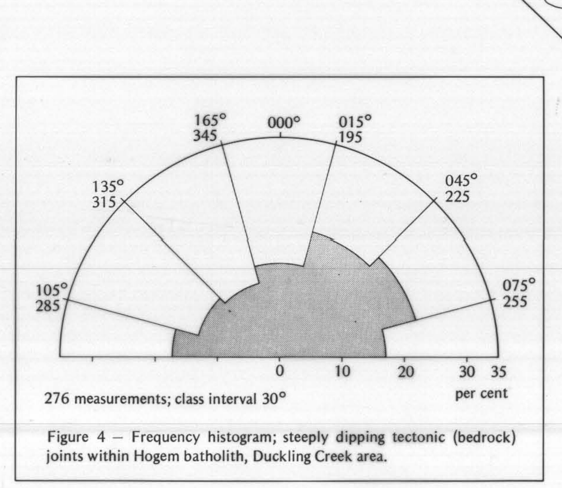


Figure 1 — Field classification of plutonic rocks based on estimated actual mineral ratios. [Modified from reference 5.]



276 measurements; class interval 30°

Figure 4 — Frequency histogram; steeply dipping tectonic (bedrock) joints within Hogem batholith, Duckling Creek area.

DRAFTING BY JOHN ARMITAGE

LOCATION AND ACCESS

The map-area covers approximately 240 square miles mainly in the northeast quadrant of the Manson River Sheet (NTS 93N/13, 14) and partly in the southwest corner of the Aiken Lake Sheet (94C/3, 4). The general area may be reached by the Department of Mines and Petroleum Resources Omineca Road, a good gravel road from Fort St. James through Germansen Landing (138 miles) to Aiken Lake (232 miles) and beyond. This road turns north to form the eastern boundary of the map-area at a point approximately 28 miles west of Germansen Landing. Roads suitable for four-wheel-drive vehicles provide further limited access into parts of the main map-area, but most active properties and field parties are serviced by helicopter from Germansen Landing.

PHYSIOGRAPHY

The map-area lies within the Swannell Range, a subdivision of the Omineca Mountains (1). High points in this part of the range are between 6,000 and 6,600 feet elevation. Valley bottoms lie between 3,000 and 4,000 feet elevation. Glacial effects are widespread. Peaks and ridges below 6,000 feet are rounded, whereas peaks at higher elevations are serrate. Cirques are common and best developed on north and northeast-facing ridges. The main valleys have U-shaped profiles and are drift covered. Easterly trending drumlins and troughs parallelling the direction of ice movement are apparent in the Omineca River Valley in the southern part of the map-area (2).

GEOLOGICAL SETTING

The core of the Swannell Range is made up of rocks of the Omineca intrusions, which form a composite batholith of Early Jurassic (?) to Early Cretaceous age that intrudes sedimentary, volcanic, and metamorphic rocks ranging from Proterozoic to Early Jurassic. The largest known body of the Omineca intrusions is the Hogem batholith, which extends from Chuchi Lake northwestward for 100 miles. It is bounded to the west by the Pinchi fault zone and varies from 4 to 25 miles wide. The map-area covers the portion of this body bounded roughly by the Omineca River and Pinchi fault, the Osilinka River, and the eastern boundary of the batholith, where Hogem rocks intrude volcanic rocks of the Takla Group. The geological map was produced principally by helicopter supported reconnaissance by the writer, and amplified by information from companies actively engaged in regional and property surveys in this area during the 1971 field season. Previous mapping by Armstrong (2) and Roots (3) and an unpublished thesis by Koo (4) together with assessment reports and information on file with the British Columbia Department of Mines and Petroleum Resources provided excellent background for the present study.

DETAILED GEOLOGICAL DESCRIPTION

The major feature of this portion of the Hogem batholith is an elongate body of syenite which intrudes basic rocks ranging from diorite to monzonite. Lenses of pyroxenite and older schists and gneisses are enveloped by the syenite intrusion. A large differentiated mass of grey to pink granodiorite, quartz monzonite, and granite, with smaller bodies of syenite and monzonite defined within it, lies adjacent to the syenite in the southwest part of the map-area. These major rock types are roughly divided on the map, and Figure 1 illustrates the descriptive nomenclature used, based on estimated proportions of quartz, potash feldspar, plagioclase, and per cent mafics as determined in the field (5).

The *Duckling Creek Syenite Complex* (Unit 6) displays a roughly elliptical shape trending northwest across the central part of the map-area. The Complex varies considerably in grain size, texture, mafic content, and specific mineralogy, the only consistent feature being the presence of microcline-perthite as the dominant feldspar in all thin sections investigated. Although the Complex is not subdivided on the map, three main divisions are indicated in the legend, and, of these, division (ii) correlates in general with mapped foliation zones within Unit 6.

Mappable lenses and small irregularly shaped bodies of pyroxenite (Unit 3) are enveloped and cut by Unit 6 rocks within some of the foliated zones. Unit 3 seems to be spatially associated with lenses of well-developed schists and gneisses* (Unit 1) which are also surrounded and intruded by foliated syenites. Outcrops of Unit 1 and Unit 3 are more evident at lower topographic levels, suggesting increased distribution at depth.

Unit 6 rocks clearly intrude a mesocratic diorite-monzodiorite-monzonite sequence in the northeastern quadrant of the area (Units 4 and 5) and Unit 5 monzonites change gradually into the bleached potash-enriched hybrid rocks of Unit 6A along the borders of the syenite complex. Accessory magnetite is common in all of these units.

Numerous dykes and apophyses of Units 4, 5, and 6 intrude the volcanic rocks of the Takla Group (Unit 2). Takla rocks in this vicinity of the eastern border of the Hogem batholith are mainly dark green tuffs and breccias of andesitic to basaltic composition, interbedded with basaltic flow rocks and cut by pyroxene and feldspar porphyry dykes of similar mineralogy. Primary layering was measured at a few localities striking northerly and dipping west into the batholith at shallow angles. Interbedded dolomite layers were noted north of prospect No. 2. Along the intrusive contact, the volcanics show greyish alteration, intense fracturing, and irregularly spaced pyritized zones.

Plutonic rocks in the southeastern portion of the area, bordering the Pinchi fault, are predominantly leucocratic to holofelsic granodiorites and quartz monzonites (Units 7 and 8). Within Unit 8 are three areas of syenite that are not well defined, and the relative intrusive relationships are unknown. Two areas of Unit 5 rocks are indicated in the northwest corner of the map-area, and a belt of unclassified foliated mesocratic rocks is shown immediately adjacent to the Pinchi fault zone. (This poorly exposed unit could represent a more basic phase of the Hogem batholith that has been cataclastically deformed during fault movements.)

Light-coloured felsic dykes of various compositions and textures (Unit 9) crosscut all other intrusive units. They are not distinguished with respect to composition on the map.

The regional foliation zones that are mainly parallel to the northwest trend of the Unit 6 syenite body are defined in a variety of ways. Unit 1 schists display microscopically penetrative planar fabrics defined by aligned biotite and perthitic feldspar laths. Gneisses show light and dark compositional layering. Steeply plunging lineations defined by elongate biotite clusters and by compositional streaking were measured in some exposures within this unit. In one locality north of Haha Creek, rocks exhibiting cross-bedded layers were classified as para-gneiss.

Near the border of Unit 6, Unit 6A rocks exhibit a foliation defined by alignment of prismatic pyroxene and/or potash feldspar phenocrysts. Within the Complex, foliations are similarly defined with the exception of some Unit 6 (ii) hybrid rocks, where irregular, streaky, migmatitic layers take the place of the previously described foliations. Northerly striking mineral alignment foliations were noted in intrusive rocks along the Hogem-Takla contact and also in intrusive rocks in the northwest quadrant of the map-area. Figure 2 illustrates these trends.

Measurements of joints in the plutonic rocks indicate no strong regional trends. Figure 3 shows a weak maximum of northeast trending, steeply dipping fractures. These steeply dipping fractures were replotted on a frequency histogram (Fig. 4) for direct comparison with the histogram of readily observed air photograph linears (Fig. 5). The strong northerly trend of the linears contrasts sharply with the more random distribution of measured joints.

Good criteria for faulting were rarely noted, and faults were mapped only where some evidence of brecciation, alteration, rock type change, or slickensides were observed.

*Gneiss herein refers to rocks exhibiting compositional layering; foliate refers to rocks with sub-parallel planar alignment of minerals; and schist refers to foliated rocks exhibiting fissility.

COPPER MINERALIZATION

Indications of mineralization in the form of malachite stained fractures and rare disseminated chalcopyrite grains are widespread in the vicinity of the Duckling Creek Syenite Complex. Because of this ubiquitous distribution, an attempt has been made to quantify the occurrences noted on the map. *Prospects* are numbered and indicate where mineralization has been extensive enough to warrant detailed development work in the past. *Showings* are marked with a cross and represent small mineral occurrences that may be worth more than a cursory examination. Numerous other localities displaying slight indications of copper mineralization have been omitted.

Two types of mineralization are evident. The first type is spatially associated with the Hogem-Takla contact zone and has copper mineralization in the form of massive stringers and disseminations in altered fractured zones within the volcanic rocks (No. 4, No. 5) as well as disseminations in syenite and monzonite dykes cutting Takla volcanics (No. 2). Both pyrite-chalcopyrite and chalcopyrite-bornite mineralization occurs. As previously mentioned, rusty pyritized zones within Takla volcanic rocks are quite common along this contact.

The second type is spatially associated with the Duckling Creek Syenite Complex and has disseminated sulphides occurring most commonly in Unit 6 (ii) hybrid rocks (No. 1, No. 3, No. 6) and in potash feldspar enriched stringers and fracture fillings cutting Units 6 and 6A. Chalcopyrite and less abundant bornite are dominant sulphides, and magnetite is a common accessory. Disseminated chalcopyrite and bornite grains show a strong affinity for mafic grains in thin section. Small faults within the Complex exhibit malachite-azurite stained fractures and sparsely distributed chalcopyrite mineralization in fault breccias (No. 8). Other fractured zones have minor pyrite-chalcopyrite mineralization in quartz veins and fine leuco-syenite stringers (No. 7). Abundant disseminated pyrite occurs in Unit 1 schists immediately north of prospect No. 1. Chalcocite was identified at the showing northwest of prospect No. 3. Covellite, chrysocolla, and cuprite have also been reported. Brief reports on some of these occurrences are contained in the 1949 Annual Report of the Minister of Mines (6).

REGIONAL IMPLICATIONS

The consistent northwest parallelism exhibited on an outcrop scale by Unit 6 foliations and on a regional scale by foliation belts associated with Unit 6 borders and areas around Unit 1 foliates, together with the northwest elongate configuration of the syenite body, suggest that its emplacement was controlled by an underlying pre-existing structural trend. This direction correlates with linear magnetic highs on the aeromagnetic map (7) available for part of the area.

The presence of the older rocks of Unit 1 can be interpreted in many ways. Takla volcanic xenoliths of various sizes have been recorded within the intrusive rocks of the map-area, and it is possible that Unit 1 represents pendant-type bodies of similar age. However, the Unit 1 schists and gneisses show strong planar and linear, microscopically penetrative fabrics that are best interpreted as tectonic in origin, and indicative of deformation much stronger than is evident in Takla Group rocks. Also, the consistent regional trend of Unit 1 lenses and their exposure only in topographically low areas suggests an alternative interpretation, in that Unit 1 could represent inliers of an extensive underlying sequence, originally enveloped by the Hogem batholith, and now partially exposed by erosion through the base of the intrusion. The relative stratigraphic position of such older rocks is unknown, but it is interesting to note that the strike, dip, and plunge of Unit 1 fabrics parallel the direction of the isoclinally folded Cache Creek layers immediately west of the Pinchi fault.

The northwest trend demonstrated by foliations is not reflected in the air photograph linear analysis, where a strong northerly maximum is evident (Fig. 5). *Fracture trace linears* indicated on the map were inferred from connecting shorter linear segments and from limited geologic information. These linears do not appear to offset the continuity of Hogem rocks. Also, the air photograph linear pattern does not correlate with the bedrock joint pattern measured in the intrusive rocks. It is possible that the linear maximum is in part defined by upward transmission of brittle structural features that are part of the structural regime of 'basement' rocks underlying this portion of the Hogem batholith.

Only one absolute age date is available at present from within the map-area. J. H. Koo (4) separated biotites from a mafic rich portion of Unit 6 rocks immediately north of prospect No. 1 which gave a K-Ar date of 170±8 million years (Early Jurassic). This was interpreted as representing the minimum age of the syenitic rocks and the maximum age of sulphide mineralization at the Lorraine property. He also suggested that this date marked the division of two separate phases of the Hogem batholith.

The existence of two distinct phases in this area remains a valid hypothesis in the light of the recent mapping. Units 4 to 6 could represent an alkaline magma differentiation, culminating in syenite intrusions and potash enrichment of wallrocks and accompanied by deuteric copper mineralization. The Unit 3 pyroxenites could be a cumulate phase of such a sequence. It should be noted that syenite dykes cut other syenites throughout Unit 6, indicating at least two separate pulses of syenite intrusive activity. Units 7 and 8 could represent a later differentiated intrusion, less mafic and more quartz rich than Units 4 to 6, and essentially barren of copper mineralization.

The mixed potash feldspar-rich rocks of Unit 6, the potash enrichment within adjacent units, and the presence of soda pyroxene (aegirine-augite) as the dominant mafic in certain syenites, have led to the interpretation that the syenite complex around the Lorraine property was formed by alkali metasomatic processes (fenitization) (4). Fenitization commonly affects country rocks around carbonatite-alkaline complexes. Carbonates are occasionally noted as accessory minerals in Unit 6 rocks, and some Unit 1 schists are calcareous. A carbonatite-fenite petrogenesis could evolve from the incorporation of older formations containing calcareous members by an alkaline magma.

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LIST OF PROSPECTS

1. Lorraine (Granby, Kennco)
2. Rondah (Cominco, Tyee)
3. Misty (El Paso)
4. Duckling (Donna)
5. Betty (Croydon)
6. Tam (Union Miniere)
7. Dorothy (Kennco)
8. Elizabeth (Kennco)