Province of
British Columbia
Ministry of Mines and
Petroleum Resources

NOTES TO ACCOMPANY PRELIMINARY MAP NO. 26

IRON MASK BATHOLITH

(92I/10E, 9W)

BY K. E. NORTHCOTE

REGIONAL SETTING

The Iron Mask batholith is a multi-unit intrusion composed of Iron Mask Hybrid, Pothook, Sugarloaf, and Cherry Creek units, each of which has several varieties. The rocks are fine grained and porphyritic to coarse grained, and are silica-poor, ranging from gabbro to syenite with diorite-monzodiorite-monzonite compositions predominating.

Major systems of northwesterly and northeasterly trending recurring fractures or faults controlled emplacement of various units of the Iron Mask batholith. The batholith was emplaced in a high level volcanic to subvolcanic environment and is comagmatic with Nicola volcanic rocks and coeval with part of the upper Nicola succession. The batholith intruded volcanic and sedimentary rocks of the lower Nicola, but the Cherry Creek unit occurs both as fragments in and is in intrusive contact with Nicola rocks.

The Nicola and Iron Mask rocks are unconformably overlain by Tertiary sedimentary and volcanic rocks of the Kamloops Group. In many places along the flanks of the batholith, the pre-Tertiary erosion surface seems nearly to coincide with the present day erosion surface. Erosional remnants of Tertiary volcanic rocks cap the higher hills and occur in places along their flanks. This pre-Tertiary erosional surface appears to have been very irregular although post-Tertiary faulting may have accentuated this apparent irregularity and resulted in local preservation of post-batholithic rocks within the batholith.

The distribution of the rock units and linears from air photographs are shown on Preliminary Map No. 26.

GEOLOGY

Rock descriptions are based on field observations of texture, composition, and kind and intensity of alteration.

NICOLA GROUP

The Iron Mask batholith is flanked on both sides by Nicola volcanic and volcaniclastic sedimentary rocks which are lithologically dissimilar to overlying Tertiary volcanic and volcaniclastic rocks.

Nicola rocks on the southwestern flank consist predominantly of well-indurated, weakly metamorphosed, massive and bedded tuffs, breccias (some of which are probably lahars), and interbedded flows and monomictic flow breccias. Most of these rocks are of a fairly uniform green-grey colour. A well-indurated exposure of bedded tuff and breccia similar to those on the southwestern flank crops out between Knutsford and Knutsford Hill.

Nicola rocks on the northeast flank are mainly tuff and tuff breccia which are, for the most part, less well indurated and less altered than on the southwest flank. Adjacent to Iron Mask batholith contacts, however, the Nicola rocks are well indurated, altered mainly by epidotization, and locally contain mineralization. The tuff breccias contain fragments of many colours and locally commonly contain intrusive Cherry Creek unit fragments. In some places these tuff breccias are abundantly hematitic.

Refractive indices of 90 samples of Nicola volcanic rocks taken from the north side of the batholith are shown on Figure 1. Composition ranges from basalt through trachyandesite to trachyte-dacite fields. The distribution pattern of refractive indices for these Nicola rocks corresponds closely to that of the Central and Eastern Belt Nicola volcanic rocks for which silicate analyses indicate compositions for basalt through trachyandesite showing high $Na_2O + K_2O$ content and widely ranging Al_2O_3/SiO_2 ratios (Preto, personal communication).

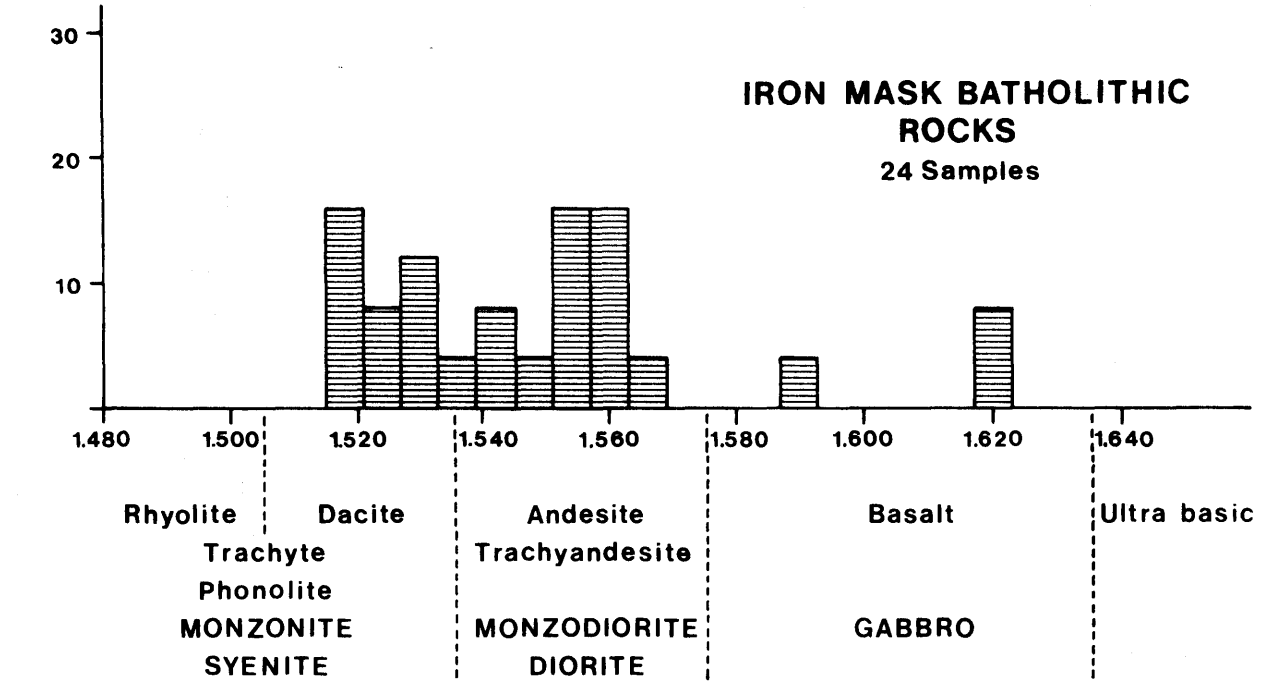
The weathered tuffs and tuff breccias containing fragments of Cherry Creek rocks that occur along the northeast flank of the batholith have been previously mapped by others variously as Cretaceous Kingsvale or Tertiary Kamloops Groups to explain the presence of batholithic fragments and apparent lack of hydrothermal alteration which would be expected to result from intrusion by the batholith. An increasing amount of evidence suggests that these weathered, volcanic rocks containing batholith fragments may be the volcanic equivalent of some of the batholithic rocks and therefore the two may be comagmatic and coeval.

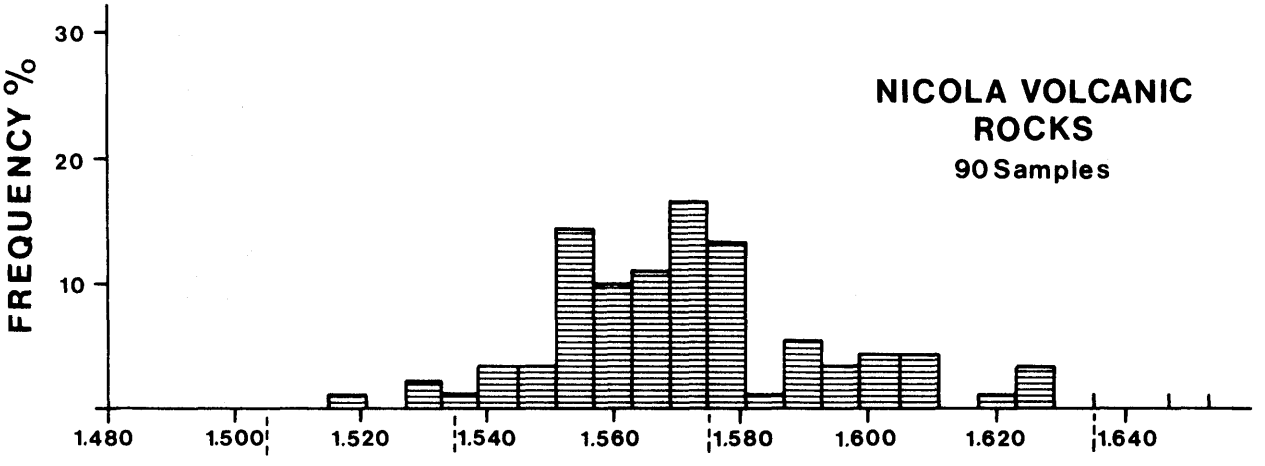
The Nicola rocks on both flanks of the batholith contain augite porphyry and augite porphyry breccia which, on the north side of Jacko Lake, has been metamorphosed along the intrusive contact. Nicola rocks along the southwestern flank and at the southeast tip of the batholith contain distinctive augite-hornblende porphyries which are identical to varieties of the Sugarloaf unit which also occurs predominantly along the southwest flank of the batholith.

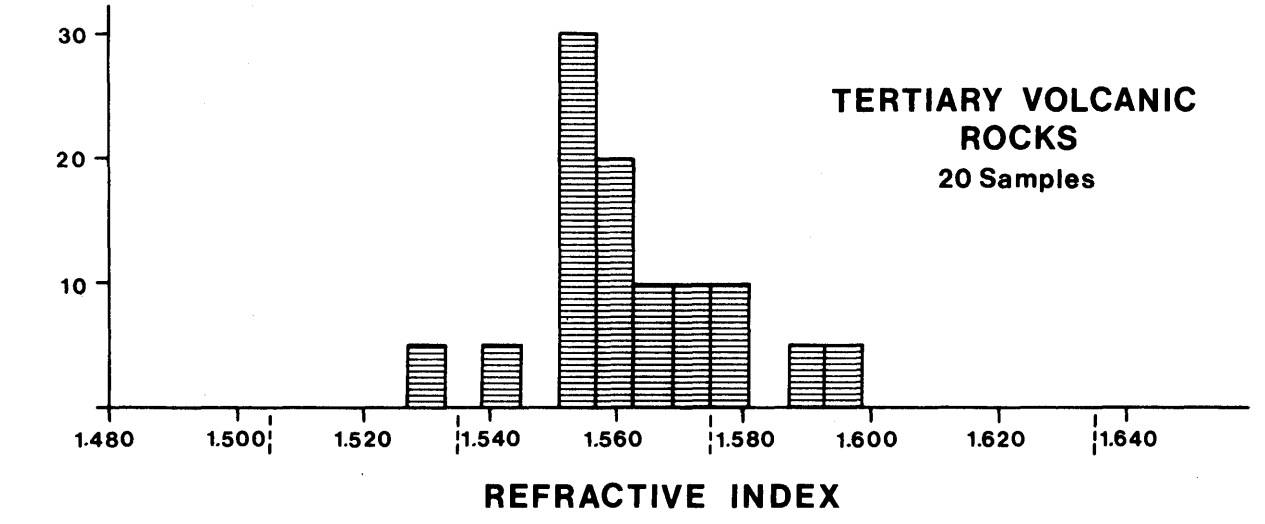
INTRUSIVE ROCKS OF THE IRON MASK BATHOLITH

All intrusive units of the Iron Mask batholith with the exception of the Picrite unit are thought to be genetically related. However the relationship between Sugarloaf unit and other units is not clear. Most units everywhere show some degree of alteration and/or contamination which may be intense in some places. In most cases, however, original textures are still visible and are used as the main criteria for distinguishing among units and varieties.

REFRACTIVE INDICES







Refractive indices of selected samples of fine-grained Iron Mask batholithic rocks (*see* Fig. 1) indicate that compositions range from gabbro to monzonite and syenite. Frequencies of indices on this diagram, however, are not indicative of bulk composition of the batholith. Silicate analyses of samples collected by Preto in 1967 of Cherry Creek and Hybrid rocks are shown on variation diagram Figure 2. These rocks range in composition in terms of volcanic rocks from basalt and andesite to trachyandesite as compared to more basic basalts, basaltic andesite, and $Na_2O + K_2O$-rich andesites or trachyandesites of the Central Nicola belt (Preto, personal communication).

IRON MASK HYBRID UNIT

The Iron Mask Hybrid unit occurs in the central and eastern part of the northwest half of the batholith and forms a margin about 1.2 kilometres wide along the southwest side of the southeast half. An elongate pendant or screen of Iron Mask Hybrid rocks approximately 3.2 kilometres long occurs in Cherry Creek rocks and extends from east of Coal Hill southeasterly toward Knutsford Hill.

Most outcrops of the Hybrid unit can best be described as a melange of intrusive rock varieties. The rocks range from fine to coarse melanocratic and mesocratic diorite, fine to coarse-grained hornblendite, coarse-grained magnetite-rich gabbro, and xenoliths of recrystallized Nicola. All of the Iron Mask Hybrid varieties contain magnetite and, with the exception of the obvious xenoliths of crystallized Nicola, none of the Hybrid varieties bear any physical resemblance to the surrounding Nicola rocks. The melange of hybrid varieties appears to have been emplaced as intrusive breccias cut by and healed by interstitial mesocratic to leucocratic diorite. Some of the crosscutting rocks are recognizable as Cherry Creek varieties, particularly near mutual contacts.

Mineralization is fairly ubiquitous in Hybrid rocks with notable concentrations of magnetite and copper. The Iron Mask mine is located in this rock unit but is also associated with picrite.

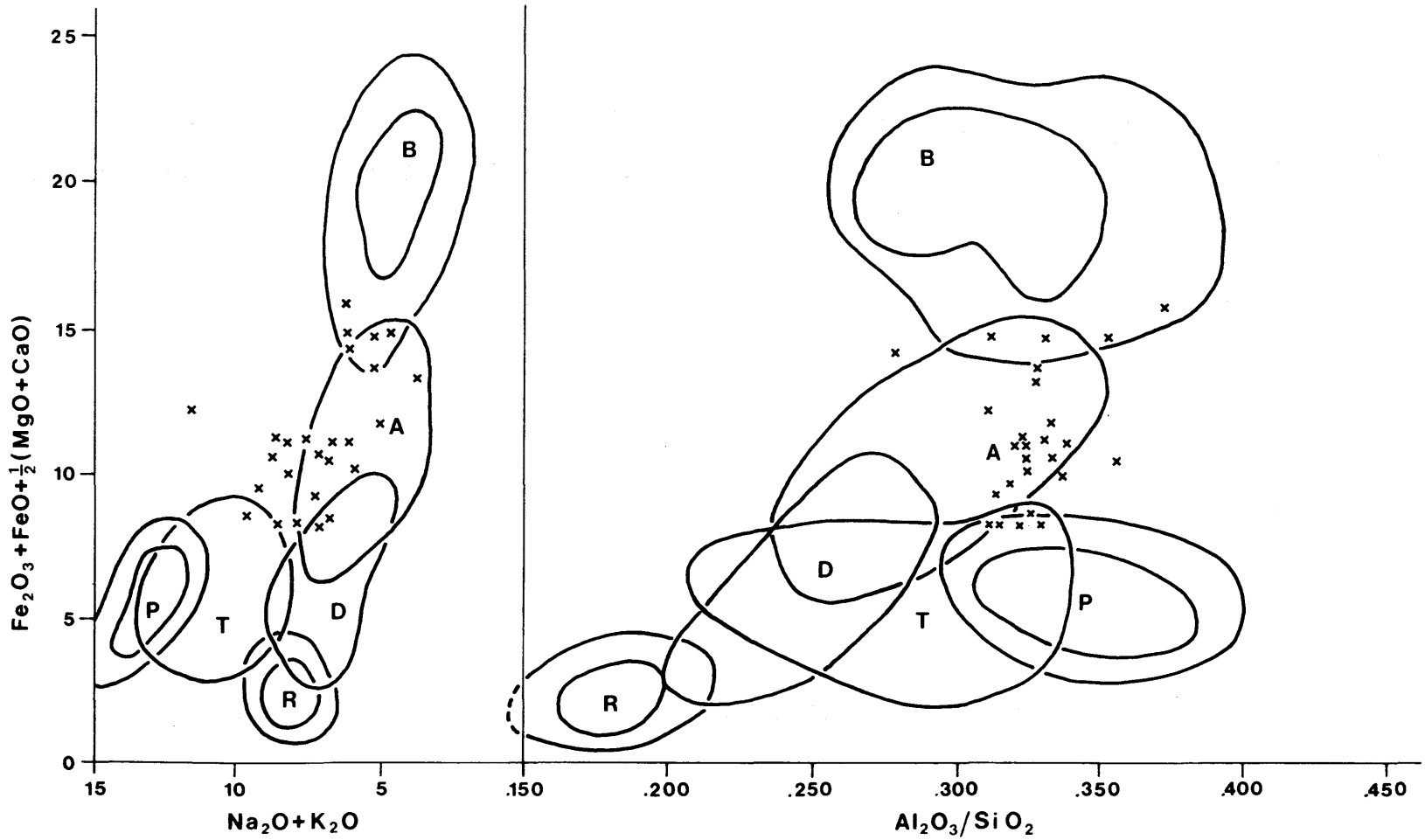
POTHOOK UNIT

The Pothook unit occurs mainly in the northwest sector of the batholith and is less prevalent in the southeast. This unit appears as narrow, mafic-rich, gradational zones between Iron Mask Hybrid and Cherry Creek units. The rock is more uniform in texture and composition than Hybrid rocks. At the northwest end of the batholith where the Pothook unit is most extensive it is of dioritic composition except near Cherry Creek contacts, is medium to coarse grained, and is mafic-rich. Commonly coarse interstitial masses of biotite 2 or 3 centimetres across are visible in this unit. Near Cherry Creek contacts the Pothook unit commonly shows an increase in K-feldspar content.

Copper and iron mineralization is prevalent in many places in the Pothook unit with notable magnetite occurring in uniformly dipping veins south and southeast of Afton.

There appears to be a gradation from the melange of Iron Mask varieties through mafic-rich Pothook varieties to the Cherry Creek unit showing an increasing degree of differentiation to more K-feldspar-rich varieties (*see* Fig. 2), however intrusive contacts between these units are also evident.

Fields of rock composition from Washington's Tables



IRON MASK INTRUSIVE ROCKS

Collected by Preto 1967

After Church 1975, Church and Wilson,1971

PICRITE UNIT

The origin and age of the Picrite unit remains unresolved. Carr (1956), Preto (1967), and Carr and Reed (1976) described the picrite to be of basaltic composition with abundant serpentinized olivine. Picrite bodies appear to be associated with recurring, northwesterly trending fracture systems and are found in many parts of the batholith commonly in association with mineralization (Carr, 1956; Carr and Reed, 1976). The unit is cut by clean fine-grained rocks akin to the Cherry Creek unit. Inclusions of picrite have been reported in the Iron Mask Hybrid unit (C. Godwin, personal communication).

CHERRY CREEK UNIT

The name Cherry Creek is retained for the unit of rocks which extends along the north margin of the batholith (Preto, 1967) and is applied to equivalent rocks underlying Iron Mask Hill and brecciated, ankeritic rocks east of Galaxy. Mapping during the 1976 field season has shown that this same unit of Cherry Creek rocks forms the eastern half of the southeastern part of the batholith. A pendant or screen of Iron Mask Hybrid unit occurs within this unit extending from east of Coal Hill and projecting southeasterly toward Knutsford Hill. A body of Sugarloaf-like rocks extends up the north side of the Knutsford ski hill and heals brecciated fragments of Cherry Creek rocks.

There is a wide variety of Cherry Creek rocks which are all characterized by a speckled texture resulting from a clustering of fine-grained mafic minerals with indistinct outline. The rocks are commonly weakly porphyritic to porphyritic, are fine grained, and range in composition from diorite to syenite. They include varieties which can be termed diorite, microdiorite, micromonzonite, microsyenite, and Cherry Creek porphyry (Carr, 1956; Preto, 1967, 1973). The wide variety of Cherry Creek rock types may be the result of tapping of magma at different stages of differentiation with emplacement and crystallization occurring under varied conditions of pressure, temperature, and volatile content during intermittent venting in a subvolcanic environment.

Copper and lesser iron mineralization is prevalent in the Cherry Creek unit, particularly in zones of intense brecciation and K-feldspathization. Preto (1967) points out the significance of the brecciation and K-feldspathization. Similar brecciation to that reported by Preto (1967) and Northcote (1974) in Cherry Creek rocks along the north side of the batholith occurs in Cherry Creek rocks on the Kimberley copper property northwest of Knutsford (Preto, 1967). A breccia consisting largely of Cherry Creek fragments also occurs on the extreme southeastern tip of the batholith.

SUGARLOAF UNIT

The Sugarloaf unit occurs mainly along the southwest side of the batholith and as small bodies within the batholith such as on the north flank of Knutsford ski hill and at the southeastern tip of the batholith. Several varieties were noted which are mainly the result of differences in grain size. Almost everywhere the unit is of fairly uniform andesitic composition and is medium green in colour. The distinguishing characteristic of this unit is the persistent presence of hornblende and/or augite phenocrysts. Identical rocks were observed within the Nicola Group. Their relationship to Nicola rocks was not determined but they probably occur as dykes or sills.

Conflicting age relationships were observed where Cherry Creek rocks appeared to cut rocks of the Sugarloaf unit in one area and breccia fragments of Cherry Creek rocks were healed by a matrix of Sugarloaf-like rocks in another area.

Copper mineralization occurs within Sugarloaf rocks in several localities, notably at the Ajax property east of Jacko Lake where Sugarloaf rocks are brecciated and albitized (Preto, 1967).

KAMLOOPS VOLCANIC AND SEDIMENTARY ROCKS

Early Tertiary volcanic and sedimentary rocks unconformably overlie the batholith and Nicola rocks. The Kamloops volcanic rocks in the Iron Mask area are mainly of andesitic composition (*see* Fig. 1) and occur as vesicular flows, flow breccias, and vent breccias. The present erosion surface fairly closely approximates the pre-Tertiary erosion surface so that erosional remnants of Tertiary rocks are prevalent capping the tops of some of the higher hills on the batholith, in former depressions on the pre-Tertiary erosion surface, and in down-faulted blocks both within and flanking the batholith.

ALTERATION

Most of the batholithic rocks show some degree of saussuritization which locally may be very intense. Some K-feldspathization is evident locally in most rock units but is most abundant in Cherry Creek rocks where the relatively high K-feldspar was introduced into the rocks through processes of normal crystallization of potassium-rich magma and by alteration of previously crystallized dioritic to monzonitic rocks by introduction of potassium-rich solutions.

ENVIRONMENT OF EMPLACEMENT OF THE BATHOLITH

An increasing amount of evidence suggests a shallow subvolcanic to volcanic environment of emplacement especially for Cherry Creek varieties and a comagmatic and partly coeval relationship between Nicola volcanic rocks and units of the Iron Mask batholith.

Cherry Creek rocks at the north end of the batholith occur as criss-crossing dyke-like bodies of varied grain size and composition. Their fine-grained texture suggests near surface conditions and, as noted by Carr (1957), the Cherry Creek unit had previously been mapped as volcanic rocks. Intrusive brecciation associated with K-feldspathization is prevalent in many places particularly in a narrow zone extending westerly from a point near Iron Mask Lake to the Afton orebody. This brecciation appears to involve mainly varieties of Cherry Creek although fragments of Iron Mask Hybrid or Pothook are also visible in drill core. The brecciation may have been the result of venting at a slightly higher level. Fragments of Cherry Creek rocks and other rocks resembling them occur in tuff breccia of the Nicola which indicates that some of the Cherry Creek rocks are older than some of the Nicola. However, intrusive contacts between these same Nicola volcanic rocks and Cherry Creek rocks indicate the opposite relationships; some Cherry Creek rocks are younger than some of the Nicola rocks they intrude. Intense epidotization of Nicola rocks which contained Cherry Creek fragments and some mineralization were noted at the north edge of the batholith which suggests that volcanic-plutonic processes were going on simultaneously.

It is unnecessary to postulate three separate magmatic events: one for Nicola volcanism, a second to emplace the Iron Mask batholith, and a third for later volcanism to explain Cherry Creek fragments in volcanic rock described as being identical to Nicola (Cockfield, 1948). The observed geologic features and relationships would be consistent with a single but pulsating comagmatic and partly coeval volcanic-plutonic system operating in a subvolcanic to shallow volcanic environment.

IRON MASK AGE DETERMINATIONS

K-Ar age determinations on samples collected by Preto in 1967 and analysed for K-Ar isotopes by J. Harakal, University of British Columbia, indicate Cherry Creek, Pothook, and Iron Mask Hybrid rocks are isotopically the same age as the table shows.

Sample No.	Age	Rock Type	Location
VP 72 KA–3	197 ±6 m.y.	Cherry Creek micromonzonite porphyry	Near east end Iron Mask Lake
VP 72 KA–5	190 ±6 m.y.	Pothook	Afton
VP 72 KA–4	205 ±6 m.y.	Cherry Creek micromonzonite porphyry	Near Iron Mask Lake
VP 72 KA–1	201 ±6 m.y.	Iron Mask Hybrid	Gas pipeline near Ajax property
VP 72 KA–2	198 ±6 m.y.	Hydrothermal biotite Cherry Creek microdiorite	Near Iron Mask Lake

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Geological Division
Mineral Resources Branch
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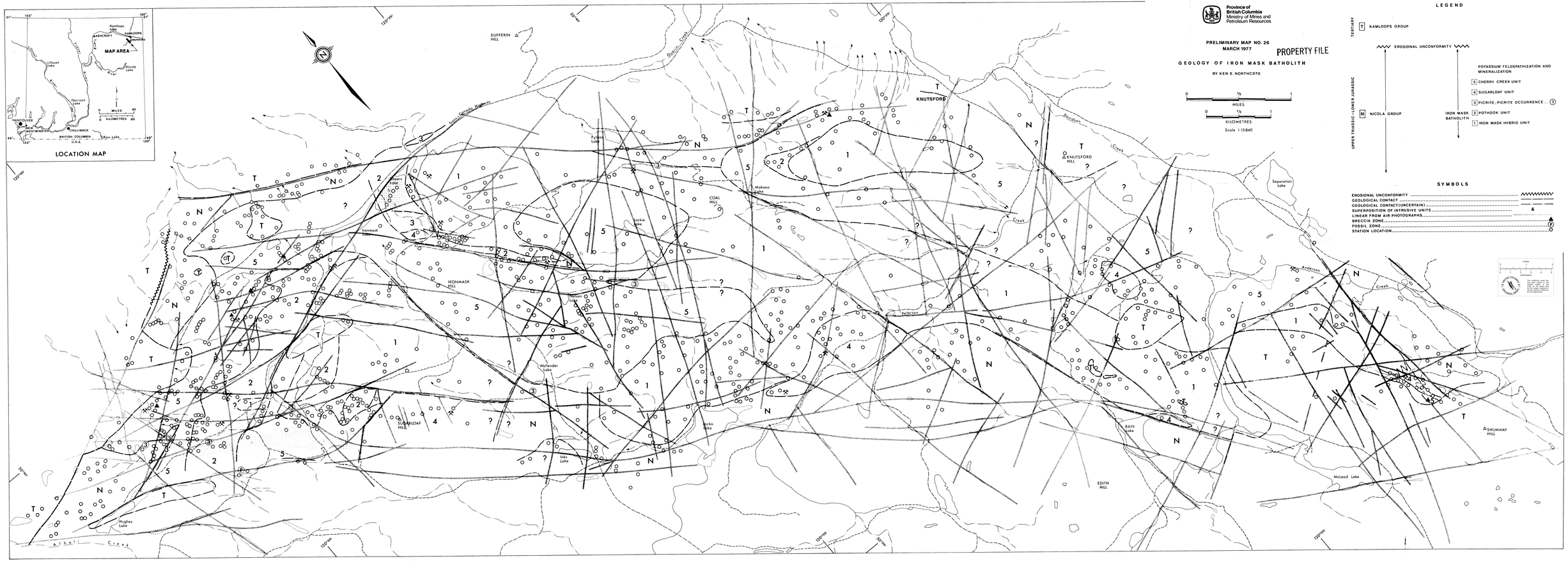

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Ministry of Mines and Petroleum Resources

PRELIMINARY MAP NO. 26
MARCH 1977

PROPERTY FILE

GEOLOGY OF IRON MASK BATHOLITH

BY KEN E. NORTHCOTE

MILES

KILOMETRES

Scale 1:15840

LEGEND

TERTIARY
- T KAMLOOPS GROUP

EROSIONAL UNCONFORMITY

UPPER TRIASSIC–LOWER JURASSIC
- N NICOLA GROUP

IRON MASK BATHOLITH
- POTASSIUM FELDSPATHIZATION AND MINERALIZATION
- 5 CHERRY CREEK UNIT
- 4 SUGARLOAF UNIT
- 3 PICRITE, PICRITE OCCURRENCE ... ③
- 2 POTHOOK UNIT
- 1 IRON MASK HYBRID UNIT

SYMBOLS

- EROSIONAL UNCONFORMITY
- GEOLOGICAL CONTACT
- GEOLOGICAL CONTACT (UNCERTAIN)
- SUPERPOSITION OF INTRUSIVE UNITS
- LINEAR FROM AIR PHOTOGRAPHS
- BRECCIA ZONE
- FOSSIL ZONE
- STATION LOCATION