Student Essay Competition, 1951
Undergraduate Section
Geology Division
#14

THE CANADIAN INSTITUTE OF MINING AND METALLURGY
RECEIVED
JAN 15 1951

A PRELIMINARY REPORT ON STRUCTURES OF THE WHITE CREEK BATHOLITH

An essay submitted during the
Third Year of the Course in
Applied Science at the University
of British Columbia

JACK GORDON SOUTHER
JGSouther
November 15, 1950

5516 Tower Crescent
University Hill
Vancouver, British Columbia
November 15, 1950

Dean
Faculty of Applied Science
University of British Columbia
Vancouver, British Columbia

Dear Sir:

I herewith submit an essay, A Preliminary Report on Structures of the White Creek Batholith, in partial fulfilment of the Third Year Course in Geological Engineering.

Respectfully,

JGSouther

J.G. Souther

EC9

Please return to H.C. Gunning, Department of Geology and Geography, University of B.C., at your earliest convenience.

CONTENTS

CONTENTS

ILLUSTRATIONS

(Appendix I)

PREFACE

The White Creek Batholith is an elliptical mass of granitic rock about 200 square miles in area. Slightly more than half of this lies within the east half of the Dewar Creek map-area, a rugged section of the Purcell Mountains, bounded by longitudes 116° 00' and 116° 15' and latitudes 49° 45' and 50° 00'.

The area was partially mapped by H.M. Rice in 1938, to a scale of four miles to the inch. This work was not, however, concerned with structural features of the intrusive.

Mapping to a scale of one mile to the inch was begun by the Geological Survey of Canada in 1950, and field work on the east half was completed during the same season. The field party, of which the writer was a member, was under the direction of Mr. J.E. Reesor, a graduate geologist of the University of British Columbia.

The material presented in this report was compiled by the author from field notes and maps as well as from personal observations. The Cloos method of study was rigidly adhered to in both field work and interpretation of data.

The writer's sincere thanks are due to Mr. Reesor whose advice, guidance, and keen interest in the problems have made this report possible.

A PRELIMINARY REPORT ON
STRUCTURES OF THE WHITE CREEK BATHOLITH

Purpose and Scope of this Essay

During the summer of 1950 the writer was a member of the geological survey party engaged in detailed geologic mapping of the east half of the Dewar Creek map-area. Much of this work was concerned with a structural study of the White Creek Batholith and the effect of its intrusion upon the country rock. It is this phase of the work that is presented here.

The various structural features are described and the possible origin of each is discussed. The Cloos method is used to relate the several structural elements to the dynamic history of the mass, and thus determine its mode of emplacement and three dimensional form.

Lithology, mineralization, and metamorphism are discussed on the basis of megascopic study in the field and, except where correlated with Rice's work, must be viewed as approximations.

The data have been condensed and in many cases generalized. This is particularly true of the map which, with the exception of stratigraphic divisions, is intended to show trends rather than actual measurements.

Interpretations of the structure and conclusions as to origin are largely those of the writer, and will undoubtedly differ in detail from the fuller treatment to be published shortly by Mr. Reesor.

Physical Features

The entire Dewar Creek area lies within the Purcell Mountain Range, immediately west of the Rocky Mountain Trench.

The northeastern corner of the area is accessible by private logging road from Torrent to Buhl Creek. The southeastern portion is reached by a Consolidated Mining and Smelting Company road from Kimberly to Mark Creek. Trails in the area are few and in poor condition, making travel by pack-horse difficult, and in many cases impractical.

Mountains in the southeastern portion of the area are under 7000 feet and well rounded to the summit. Farther west many rise to over 9000 feet and are extremely rugged, (fig.1). The granite particularly, forms narrow serrated ridges, spires, and steep walled cirques, which offer excellent rock exposure.

The area is drained by Skookumchuck and Buhl Creeks, tributaries of the Kootenay River. Both occupy deeply incised U-shaped valleys,(fig.2) from 4 to 5 thousand feet below the surrounding peaks.

General Geology and Lithology

Sedimentary Rocks

All stratified rocks in the area are late Precambrian sediments of the lower and upper Purcell. All formations of the lower Purcell except the Fort Steele are present but only the Dutch Creek formation of the upper Purcell occurs within the present map-area.

Table of Formations

Proterozoic	Upper Purcell	Purcell intrusives Mt. Nelson Formation Dutch Creek
	Lower Purcell	Siyeh Formation Kitchener Formation Creston Formation Aldridge Formation

These rocks have been fully described elsewhere[1] and will thus be only briefly mentioned here.

---

1. H.M.A. Rice, Nelson Map-Area, East Half, British Columbia Geol. Surv., Canada, Memoir No. 228, p. 33.

(a) Aldridge Formation

This is the oldest formation known to occur in the area. It contains some 14000 feet of grey, rusty weathering argillite and argillaceous quartzite. In Dewar Creek area primary features, other than bedding, are absent.

(b) Creston Formation

The Creston formation conformably overlies the Aldridge and consists of some 6300 feet of light green or purple argillaceous quartzite. It is distinguished from the Aldridge by the absence of rusty weathering,and the presence of many primary features indicative of shallow water deposition.

(c) The Kitchener formation is composed of about 5000 feet of variously colored calcareous and dolomitic argillites and some recrystallized limestone. These rocks are less resistant to deformation than other members of the Purcell Series, and have been highly folded near intrusive contacts.

(d) Siyeh Formation

Although not distinguished from the Kitchener by Rice in the Nelson area, the Siyeh was separated in the Dewar Creek area on the basis of lithology and the presence of tuff beds along the Kitchener-Siyeh contact. The formation is composed almost entirely of argillite and argillaceous quartzite.

(e) Dutch Creek Formation

This is the only member of the upper Purcell occuring in the Dewar Creek map-area. It is composed of about

4300 feet of slatey argillite, calcareous argillites and impure magnesian limestone. In Dewar Creek area the rock is characterized by a well-developed cleavage at right angles to the bedding planes.

Igneous Rocks

(a) Purcell Intrusives

A great many basic diorite sills occur throughout the Purcell series. They are particularly abundant in the Lower Aldridge though several were seen in Kitchener rocks. In Dewar Creek area they range in size from thin sheets to tabular bodies 600 feet or more thick. According to Rice they are of Keweenewan age.

(b) White Creek Batholith

The White Creek Batholith intrudes all the previously described formations. It is composed of coarse grained white, gray to pinkish granite. The mode of a typical hand specimen is given in appendix II.

Near the contacts and for a distance of two or three miles into the batholith the rock is commonly, but not always, coarsely porphyritic. Beyond this point phenocrysts, though individually well developed, become fewer, and some three or four miles from the contact the rock assumes a coarse to medium equi-granular texture.

The fine grained, non-porphyritic border phase described by Rice[2] along the southwestern margin of the body was not found to be consistant with observations made in

2. Op. cit., p. 33

Dewar Creek area. Chilled selvages were seen locally, but they seldom exceed more than a few feet, and in general coarse grained porphyritic granite is in contact with the country rock. In fact, feldspar phenocrysts up to three inches are commonly found in narrow lit-par-lit injections of the sediments.

According to Rice[3] orthoclase and microcline comprise the feldspar of the ground mass and of phenocrysts in the porphyritic types. Perthitic zoning of the two feldspars is clearly visible in many of the phenocrysts, and small amounts of biotite or quartz are often included within them.

In the eastern and southeastern portion of the body biotite is almost the only ferromagnesian mineral present, and commonly forms less than five percent of the rock. In the northern section, however, hornblende is present in appreciable amounts and locally constitutes the only mafic mineral. The non-porphyritic core contains muscovite and biotite in about equal proportions, which together form two to five percent of the rock; also, the core is considerably more acid, quartz forming up to 35% of the rock as compared with 10 to 15% or less in the porphyritic types.

Many dark inclusions (Fig.3) occur throughout the porphyritic phase and are especially abundant near the contacts. Most are disc or spindle-shaped and from a few inches to five feet or more in diameter. They are undoubtedly xenoliths derived from the country rock, but most are so

3. Op. cit., p. 33

severely altered that no semblence of their original form remains. Megascopically at least, xenoliths near one contact are indistinguishable from those derived from another lithologically different formation.

They all contain a high percentage of ferromagnesian minerals, the remainder being quartz and feldspar. Most contain metacrysts of feldspar, similar to, but smaller than phenocrysts in the surrounding granite. In other cases complete phenocrysts have passed from the unconsolidated granite into the inclusion,(Fig.4).

The xenoliths grade into rock indistinguishable from mafic-rich granite and from this into sheets of biotite schlieren.

Primary Flow Structures

Platy Flow Structure

A well developed, nearly vertical platy structure exists throughout most of the batholith,(Fig.5). It is shown by nearly perfect parallelism of mica flakes, flat feldspar phenocrysts, and disc-shaped inclusions.

According to Iddings[4], this structure is the result of friction between a moving fluid and a plane solid. The magmatic fluid encounters least resistance along planes parallel to the friction-exerting surface. Suspended particles are spread out along these planes and oriented so that the

[4] J.P. Iddings, The nature and origin of Lithophysae and the lamination of acid lavas, Am. Jour. Sci, Vol. 33 (1887) p. 44-45.

longer axes lie within the flow layers.

In the White Creek Batholith this structure is best shown by a planar orientation of biotite flakes, which contrast well with the light colored feldspars. The statistical orientation usually approaches one hundred percent, and is well developed even within the central core of the body.

Near the contacts, and in places up to half a mile into the batholith, flat feldspar phenocrysts show good foliation. Unlike the biotite, however, the percentage orientation decreases farther from the contacts. This is probably due to the smaller difference in axial lengths of the feldspar crystal, as compared with the very flat mica flakes.

Large concentrations of phenocrysts are common near the contacts. Most are lenticular masses within the planes of foliation, but spiral and irregular shapes, indicating local magma currents, are common.

Dark, basic clots, presumably xenoliths,are abundant throughout the porphyritic phase. Most are flattened in the plane of ~~the~~ foliation and consequently may offer the best means of determining attitude. The ratio of axis lengths varies from about 2:2:1 near the contacts to 10:10:1 farther into the batholith.

Schlieren,(Fig.6), or flow layers, are locally well developed, particularly along contacts which show considerable movement and fluidity of the magma—such as lit-par-lit injection and interfingering of the sediments and granite. These layers, usually rich in biotite, are probably the result of slight changes in magma composition due to assimilation of the country rock. This in turn has caused a difference of fluidity in portions of the magma, and hence differential rates of flow in layers parallel to the contact.

Micaceous schlieren are common in the transition zone between the porphyritic and non-porphyritic phases. It is significant that it is this zone in which the xenoliths disappear. Since the few xenoliths that do occur near the core are greatly flattened, the writer believes that the formation of this schlieren is simply an extension of the same flattening process, followed by complete assimilation within the core.

The foliation is everywhere steep, seldom deviating from the vertical by more than ten or fifteen degrees. This is in agreement with Balk[5], who says:

> In steep walled massifs of moderate size flow structures do not seem to culminate in the manner of a dome but retain steep dip or pitch throughout.

There is a remarkable coincidence between the strikes of foliation and contact planes. It is reasonable to suppose that there is a similar coincidence of dip and that the contacts extend downward almost vertically. In some places along the southeastern contact the foliation actually dips away from the wall rock, suggesting that the magma may have expanded laterally near the top and partially overlain the intruded strata.

---

5. R. Balk, Structural Behavior of Igneous Rocks, Geol. Soc. of Am., Memoir No. 5, p. 56.

Linear Flow Structure

Unlike the foliation planes, linear structures are not well developed in the White Creek Batholith. This is partially due to the limited distribution of prismatic minerals, such as hornblende, which are found only along the northern contact. The remainder of the batholith contains no visible particles with one axis appreciably longer than the other two, and hence no record of the stretching could be left. This, however, does not explain the behaviour of xenoliths; in most of the batholith they are distinctly disc-shaped, yet along the northern contact they are drawn out into long narrow "spindles".

This localization suggests that the total elongation in the northern part of the intrusive was upward, whereas the remainder of the magma moved about equally in vertical and horizontal directions. Had hornblende or some other elongated solid been present in the plastic magma, the direction of resultant motion would have been shown. The xenoliths, however, being about the same fluidity as the magma, deformed in the direction of each component motion rather than becoming oriented in the direction of resultant flow. In this case, therefore, spindle shaped xenoliths occur only where elongation of the magma has been in a single direction. Generally, they have been elongated in the direction of each component motion, resulting in disc-shaped bodies coincident with the flow planes.

Lineation along the northern contact is always vertical or nearly so, and slight variations from the vertical show no consistent direction of plunge.

Evidence of Primary Origin

The presence of a coarsely porphyritic shell, and the decrease in number of phenocrysts without a proportionate decrease in size near the centre of the batholith both suggest that the phenocrysts are of intratelluric origin; also, the deformation of wall rocks to conform with the surface of individual phenocrysts offers clear evidence that the feldspar was well crystallized while the magma was fluid. This being so, the flow structures must have originated within the plastic mass rather than by later recrystallization.

Since the orientation of xenoliths is in most cases the result of deformation rather than rotation, they cannot, in this instance, be used as a criterion of early origin. However, many elongated xenoliths are cut by aplite-filled cross joints which would indicate that they were deformed before the magma had consolidated sufficiently to carry a fracture.

The most striking evidence of early origin of the foliation is given by the presence of angular fragments of porphyritic granite included within several large aplite dikes near the head of Skookumchuck Creek,(Fig.7). Feldspar phenocrysts, mafic minerals, and basic clots within these cognate xenoliths are perfectly oriented and of different orientation in each fragment.

The flow structures do not continue through aplite or pegmatite dikes but are in fact truncated by flow layers coincident with the dikes,(Fig.8). Thus the flow structures must have been established at least before the second phase of intrusion.

Fracture Systems

General

The entire White Creek Batholith is cut by a complex system of primary joints. Many appear to have no systematic relation to either flow structure or to the shape of the intrusive. Even after plotting a great number of field determinations no system could be devised to accomodate about 50% of the attitudes. Locally, however, the jointing is less complex and the various fracture systems become more obvious; also, a statistical analysis of the joints reveals that at least three systems of joints are related to the flow structures.

Most of the joints show evidence of early origin such as veneers of hydrothermal minerals or filling by aplite, pegmatite or quartz.

Cross Joints and Tension Joints

The absence of linear features makes the identification of cross joints impossible in most of the Batholith. Near the northwestern contact, however, a well developed set of joints transects lineation at angles near 90 degrees. These fractures probably resulted from rupture of the solidifying magma under the same stresses that produced lineation in the plastic stage. They are therefore true cross joints; (Fig.9) their surfaces are smooth and flat, and usually carry a thin veneer of muscovite.

A system of nearly horizontal joints extends throughout the batholith even where lineation is not developed. They are similar in all respects to the cross joints described above, and the writer believes that they are an extension of the same system. Although of the same origin as the cross joints, they are not visibly associated with lineation and are, therefore, called tension joints.

Longitudinal Joints

Longitudinal joints constitute by far the most consistant set of fractures in the batholith. They are closely spaced vertical joints in the plane of foliation. In places, for instance near the head of Skookumchuck Creek, they form the only regular joint system, resulting in large flat slabs of granite and the formation of sheer vertical cliffs and narrow strike-ridges.(Fig.10) These joints probably follow planes of mechanical weakness introduced by the flow layers.

Marginal Fissures and Flat-lying Normal faults

Along the northeastern granite contact many aplite and pegmatite dikes dip gently into the batholith and extend outward into the wall rock. Similar, but less conspicuous joints occur along most of the other contacts. The writer believes that they represent a series of marginal fissures formed during the early stages of consolidation. They are truncated by pegmatite fillings in the longitudenal joints and thus represent one of the earliest fractures to develop.

Over the entire batholith there exists a system of joints dipping at angles of ten to forty-five degrees and having no preferred strike. Slight displacements, as shown by slickensiding and offsetting of xenoliths,(Fig.11) indicate a lateral widening of the intrusive body along these planes. Some of these, at least, represent low angle normal faults; however, the steeper joints may be inward dipping joints resulting from an upward stress.

Conbacts

Physical Features

With a few local exceptions, the intrusive contact is conformable with the bedding of the country rock and with the foliation planes of the granite. Normally flat or gently dipping strata have been thrust up to nearly vertical at the contacts,(Fig.12), and in most cases they have been moderately folded for a mile or more from the intrusive. Locally this folding is extremely intense, as in Aldridge sediments south-west of the batholith which have been thrust into tight isoclinal folds.

The contacts exhibit two distinct structural relations to the country rock. The first, and most common, is a simple upwarping of the strata along the intrusive margin. The average dip in this case is always away from the contact. In many instances, however, the stratified rocks appear to dip steeply into the granite, suggesting an unconformity or possible overthrusting of the magma. A closer examination reveals that sediments immediately at the contact are overturned and conformable with the granite flow layers. Some distance from the contact they are again upright and dip steeply away from the contact. This suggests a large, slightly overturned anticline, with a lower limb forming the granite contact. The structure probably resulted from lateral expansion of the intrusive mass.

In most instances the country rock has yielded by plastic deformation rather than rupture. Flow cleavage is well developed in the folded strata, whereas fracture cleavage appears only in the more massive beds of quartzite. Further evidence of the semi-fluid state of the bordering country rock is given by stringers of sedimintary rock that have been squeezed, or drawn out into the granite,(Fig.13) and by the presence of feldspar phenocrysts wholly or partially imbedded in the contact sediments.

Lit-par-lit injection of the sedimentshas occurred along all the contacts, but is best shown in the Aldridge. The injected granite is usually porphyritic and similar in composition to rock within the batholith. Aplitic and pegmatitic border phases are common and,where extensive, have caused the most severe alteration of the sediments.

A number of small roof pendants occur along both sides of the Skookumchuck Valley. Most are too small to map but they indicate that the present erosion surface is near the top of the intrusive. They consist mostly of argillaceous quartzite in which small clots of biotite have formed giving the rock a mottled appearance.

Metamorphism

Alteration of the country rock has, in general, been slight. Some biotite has formed in the more argillaceous beds of the Aldridge but usually the original features are ~~still~~ preserved. A strong platey cleavage has developed in the calcareous and dolomitic rocks of the Kitchener and Siyeh formations but little chemical alteration has occurred. Limestones have been recrystallized but no metamorphic minerals have formed at the contact.

The only contact metamorphic minerals found are associated with a small infold of limestone near the head of Skookumchuck Creek. The body is about one quarter of a mile long, unconformable with, and completely surrounded by the granite. The rocks are too severely altered to identify with certainty, but are probably impure magnesian limestones of the Kitchener or Siyeh. The limestone is completely recrystallized, and surrounded by four or five feet of skarn containing varrying amounts of massive garnet, crystalline epidote, calcite, and tremolite.

Pegmatite and Aplite Dikes

Pegmatite and aplite dikes are abundant throughout the granite and the contact rocks. The largest of these occur in the diorite sills of the Purcell intrusives. They can, however, be traced into the granite. The diorite, being more competent than the surrounding sediments, has yielded by fracturing rather than plastic deformation, thus providing a path for the injection of the pegmatitic and aplitic fluids.

A group of extremely large pegmatites occurs along the Aldridge contact north of Skookumchuck Creek. They follow the margins of several diorite sills, and outcrop intermittently for over two miles. They are usually ten to fifty feet thick, but in places have welled out into large irregular masses up to 700 feet across. Where this has occurred the neighbouring sediments are severely folded and fractured.

Most of the pegmatites contain small amounts of blue-green beryl and black tourmaline. The latter mineral is locally abundant, and occurs in crystals up to three inches in diameter and ten inches long,(Fig.14). Most of the crystals are badly fractured and of no commercial value.

Many of the dikes within the granite consist of layers of aplite and pegmatite in pairs symmetrical with the medial plane of the dike. Aplite usually forms the contacts, but dikes with outer margins of pegmatite and a central filling of aplite are not uncommon,(Fig.15). Several large dikes were found in which six or eight distinct layers occur in pairs. This is probably due to repeated injection along the same plane of weakness, the parting in each case having been along the medial plane of the previously injected dike.

Mode of Emplacement

The sharp contact between coarse grained porphyritic granite and slightly altered sediments, and the deformation of ~~the~~ sedimentary strata to conform with ~~the~~ igneous contacts, indicate that the batholith was forcefully injected into the overlying rocks. The possibility of origin by granitization is, in fact, so remote that it need not be considered.

The flow structures suggest that the initial intrusion issued from a source below the northeastern portion of the body. The magma rose as a vertical plug, warping the sedimentary strata upward and making room for itself by crowding the walls aside and possibly, in part, by upthrusting a roof that has since been eroded. More or less simultaneously, the magma pushed its way south and west, thrusting the sediments aside into large sub-isoclinal folds. This does not imply that the southwestern portion is underlain by a floor, but rather that the rift in the sediments has widened southward from an initial intrusion in the north.

The effects of this combined upward and lateral movement are clearly shown by deformation of the country rock.

Aldridge strata along the relatively stable northern contact are tipped up to conform with the intrusive, but otherwise are not greatly folded. The same formation west and south of the batholith is, however, complexly folded and faulted, suggesting that most of the lateral expansion of the massif was in a southwesterly direction.

Further evidence of a stable northern contact is given by the presence of vertically oriented, spindle-shaped xenoliths which are confined to this part of the batholith. In other parts of the body xenoliths have been elongated about equally in vertical and horizontil directions, resulting in disc-shaped clots.

The White Creek Batholith, unlike many other granitic intrusives of comparable size in southern British Columbia, appears to be a single intrusive mass. The composition is fairly consistent throughout and variations such as texture or acidity are gradual; also, the flow structures show approximately the same trend over the entire mass.

The extreme folding of some of the sediments without fracturing suggests that they were made plastic by heat from the intrusion, or that they were under a large confining pressure; probably both factors contributed, but without further evidence the relative importance of each cannot be determined. Many of the contact rocks show signs of softening and assimilation, such as small stringers of sedimentary rock interfingering the granite, and feldspar phenocrysts thrusting wholly or partially into the sedimentary rock. The absence of a chilled selvage and the presence of coarse grained granite in lit-par-lit injections suggest that the sediments were raised to nearly the same temperature as the molten magma. During the latter stages of the dynamic phase the wall rock undoubtedly moved as a unit, with the freezing magma.

The extent to which piecemeal stoping and assimilation have aided in emplacement is not clear. If any appreciable contact assimilation had occurred the granite near the contacts should show some difference in composition. This was observed locally, as along the northern Aldridge granite contact, where biotite schlieren ~~is~~ are abundant. In general, however, the contact granite is similar in all respects to that farther inside the batholith.

Piecemeal stoping, on the other hand, probably accounted for a considerable displacement of the country rock, particularly at the roof where the intruded rock was subject to the greatest tensile stress. Along most contacts between Purcell diorite and granite the older rock is shattered and interfingered with granite or aplite. The fragments are angular at the contact,(Fig.16) grading rapidly into masses of elliptical xenoliths,(Fig.17) a few feet within the granite. Xenoliths are equally abundant along other contacts; however, they can seldom be traced to angular fragments of sedimentary origin. A few exceptions were noted along the eastern Kitchener-granite contact, where discordant injections of granite and aplite contain fragments of the wall rock which can be traced to their original positions.(Fig.18)

The same dynamic forces which thrust the liquid magma upward persisted for some time after the mass had frozen. This has given rise to the various joint systems which are characteristic of dynamically aggressive intrusions.

APPENDIX I

PHOTOGRAPHS

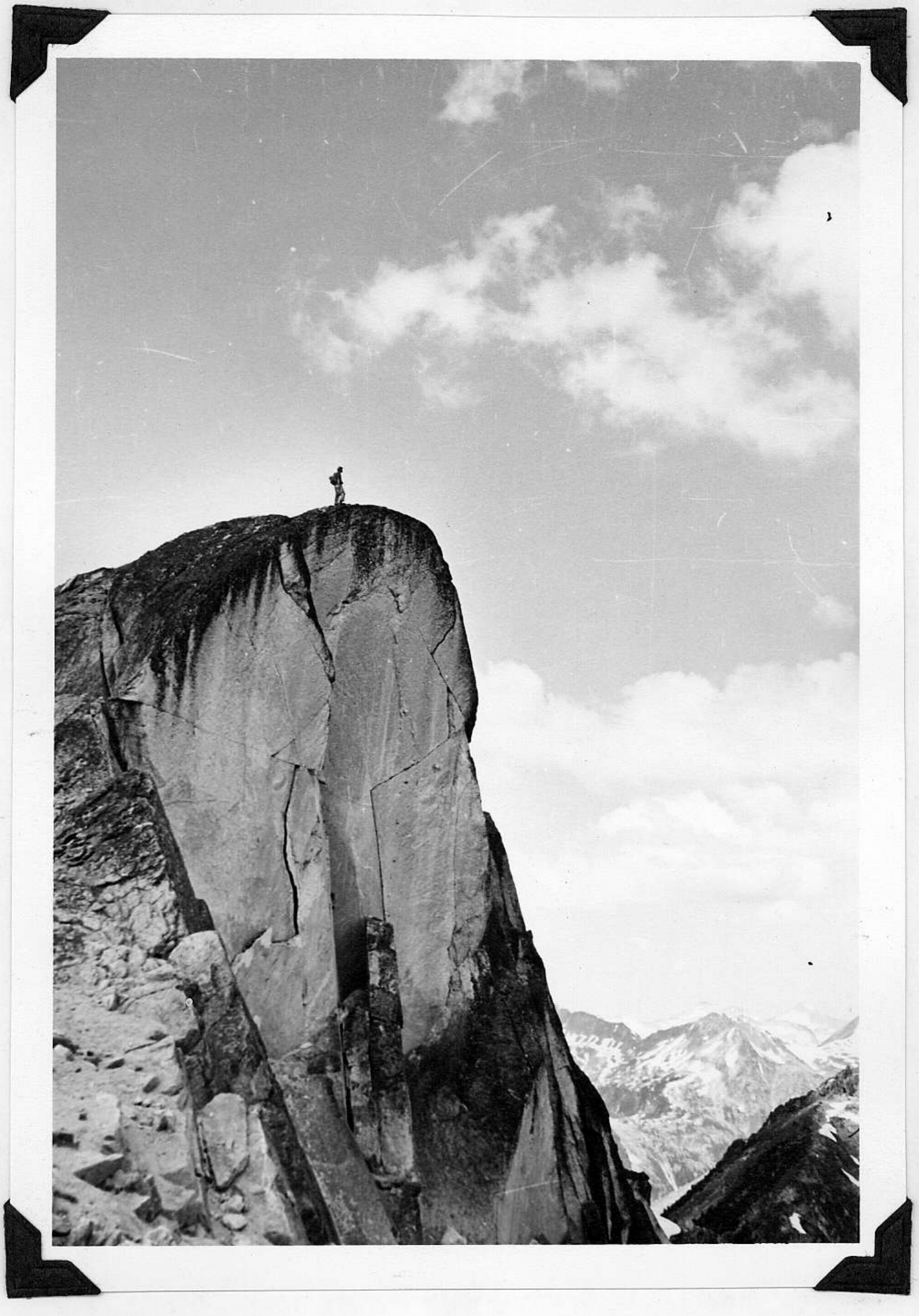


Fig. 1   Granite Peaks west of Buhl Creek.

Fig. 2 View looking west up Skookumchuck Creek.

Fig. 3 Disc-shaped xenoliths in porphyritic granite.

Fig. 4 Feldspar phenocrysts in an altered xenolith. Note that foliation planes within the xenolith are deflected around the phenocrysts.

Fig. 5 Trace of foliation planes (parallel to pencil) on a horizontal surface.

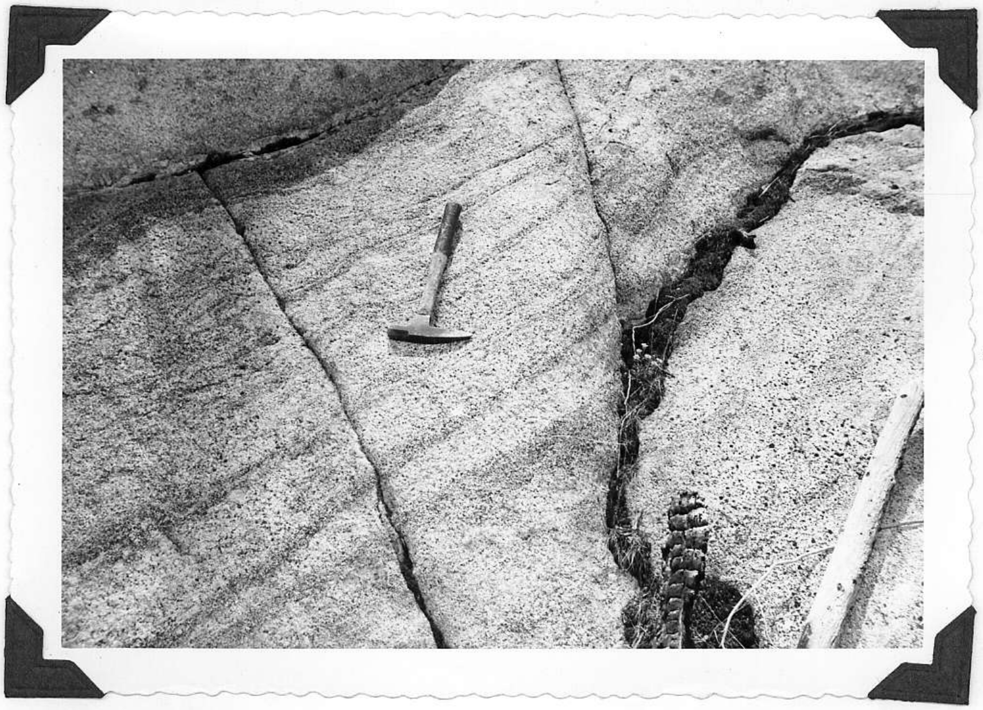


Fig. 6 Biotite Schlieren near northern granite-Aldridge contact.

Fig. 7 Cognate xenolith of porphyritic granite in a large aplite dike.

Fig. 8 Flow layers in an aplite dike cutting foliation planes of the granite.

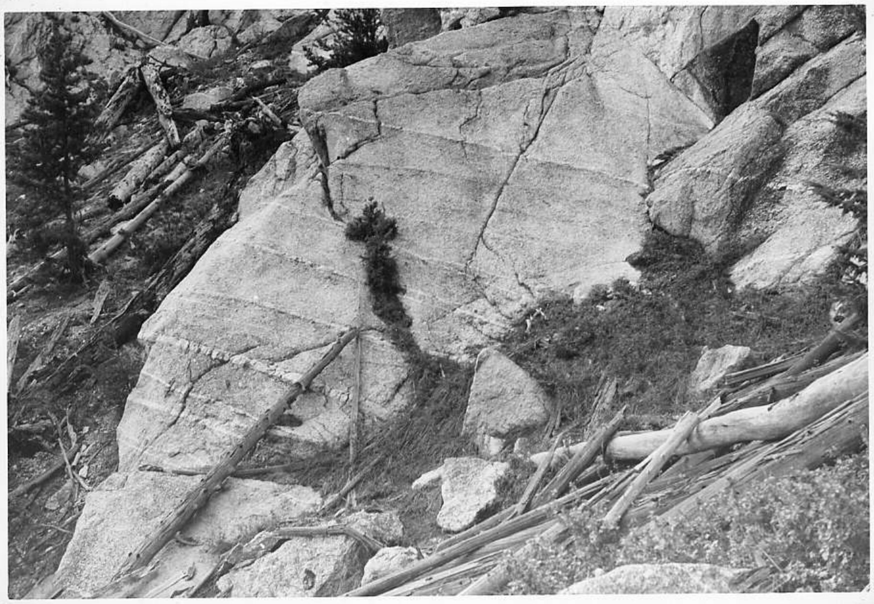


Fig. 9 Aplite filled cross joints near northern granite contact.

Fig. 10 Longitudinal joints near head of Skookumchuck Creek.

Fig. 11 Xenolith displaced by a low-angle reverse fault.

Fig. 12 Nearly vertical Aldridge strata (background) in contact with granite (upper right and foreground)

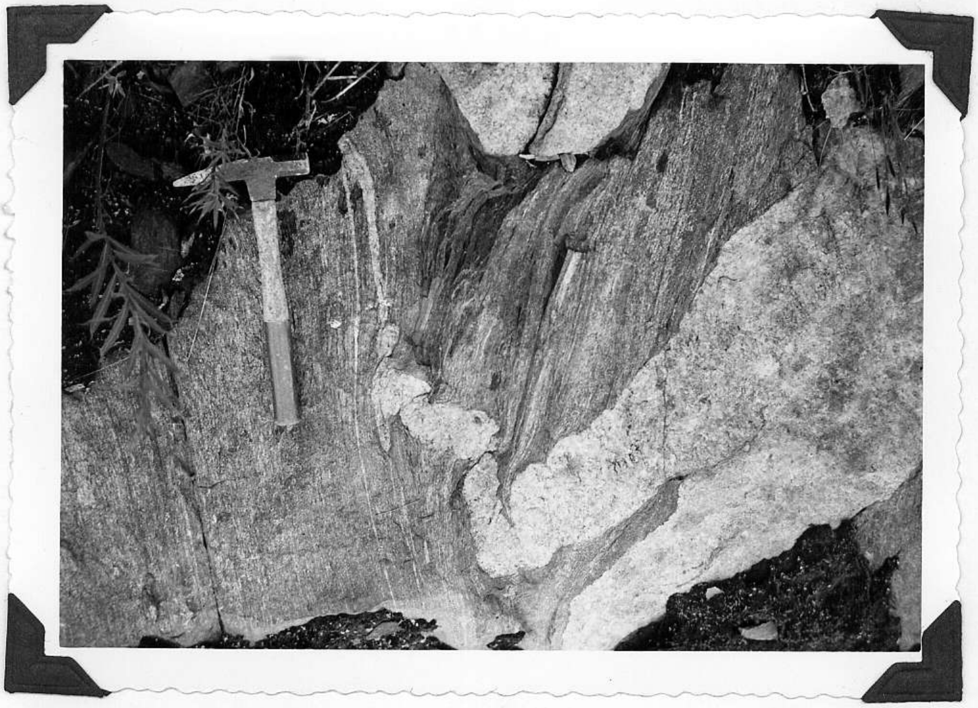


Fig. 13 Plastic deformation of sediments.

Fig. 14 Large tourmaline crystals in pegmatite.

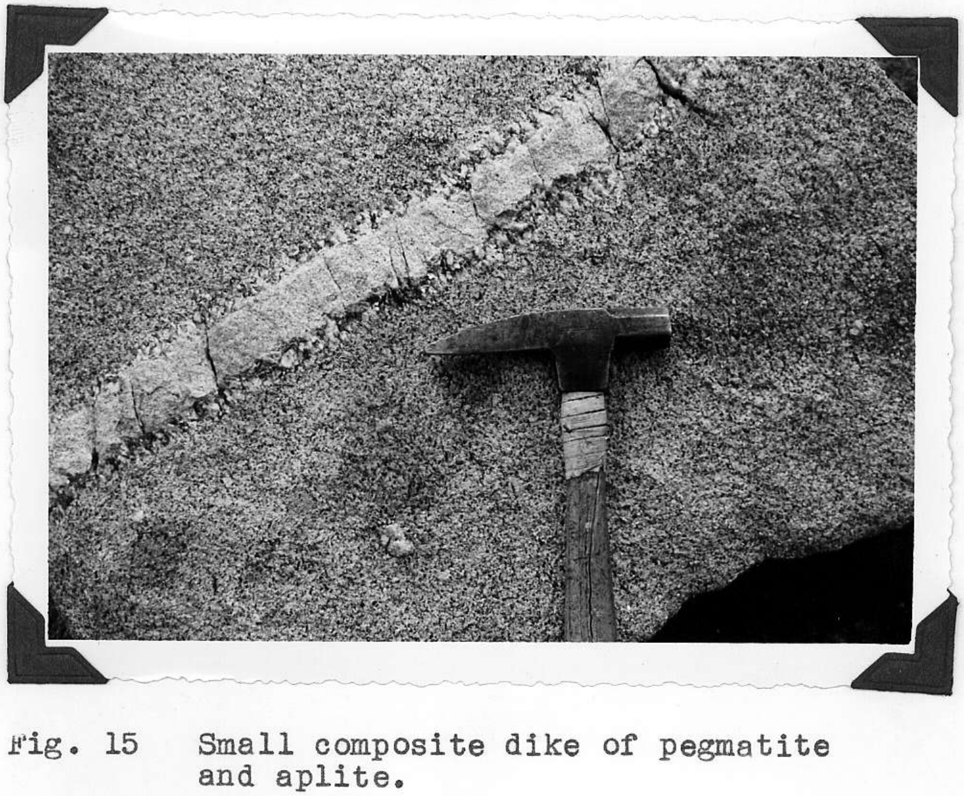


Fig. 15 Small composite dike of pegmatite and aplite.

Fig. 16 Brecciation of diorite at a granite contact.

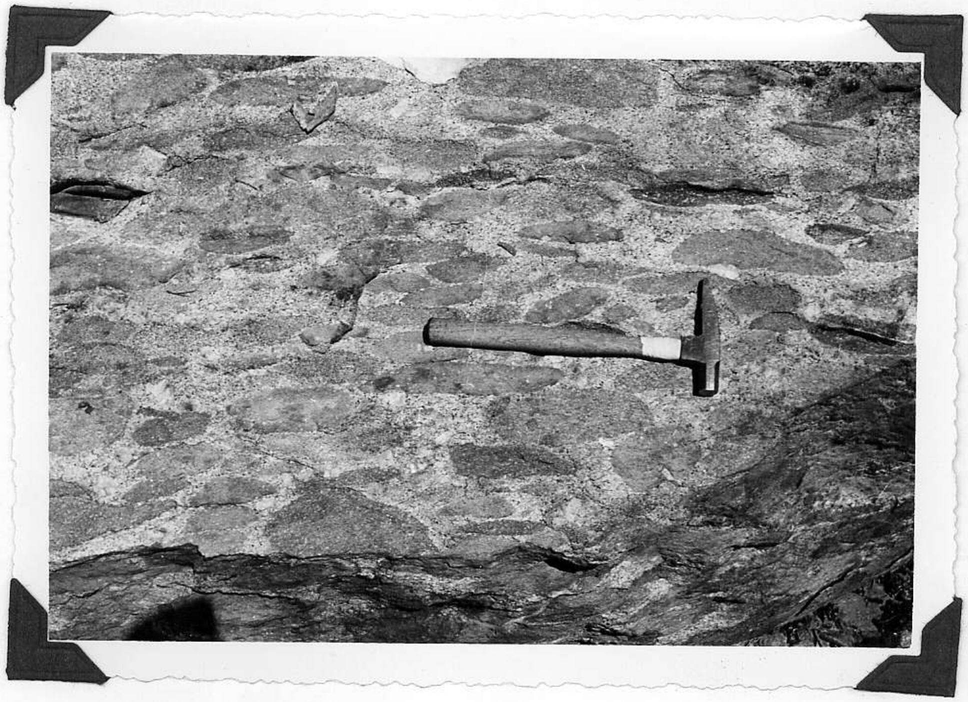


Fig. 17 Group of elliplical xenoliths fifty feet from a granite-diorite contact.

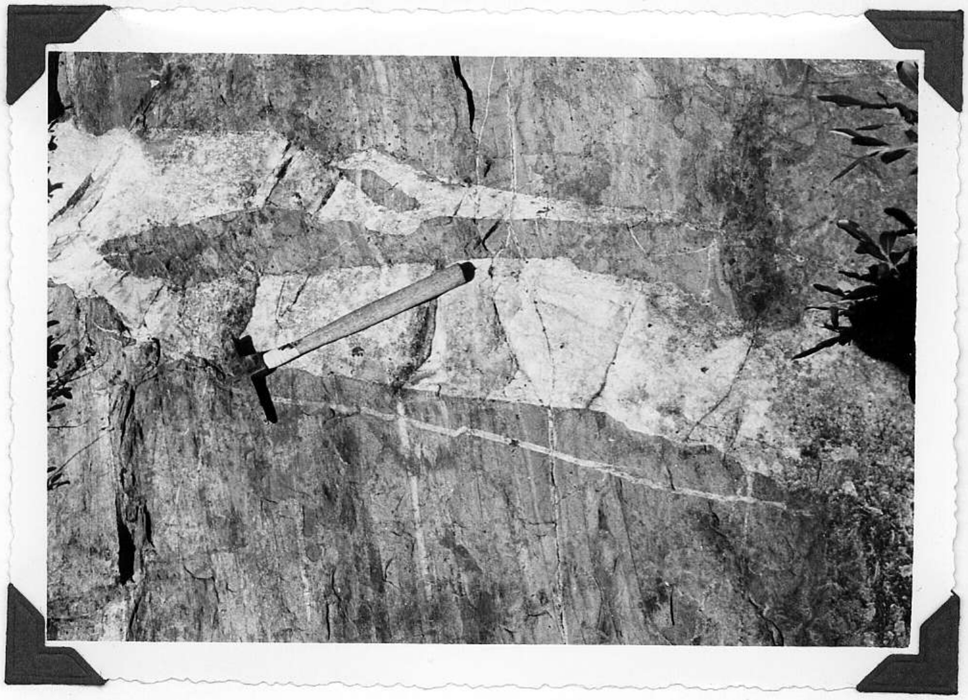


Fig. 18 Stoping of wall rock by a granite dike.

APPENDIX II

Mode of a Specimen from the White Creek Batholith
(After H.M. Rice*)

Locality:	Head of White Creek.
Appearance:	Light-colored, coarse-grained granite.
Analysis:	

Biotite	1
Quartz	31
Potash Feldspar	64
Plagioclase	3
Per cent An in	
Plagioclase	30
Accessories	1

---

* H.M.A. Rice, Nelson Map-Area, East Half, British Columbia Geol. Surv., Canada, Memoir No. 228, p. 39.

WORKS CONSULTED

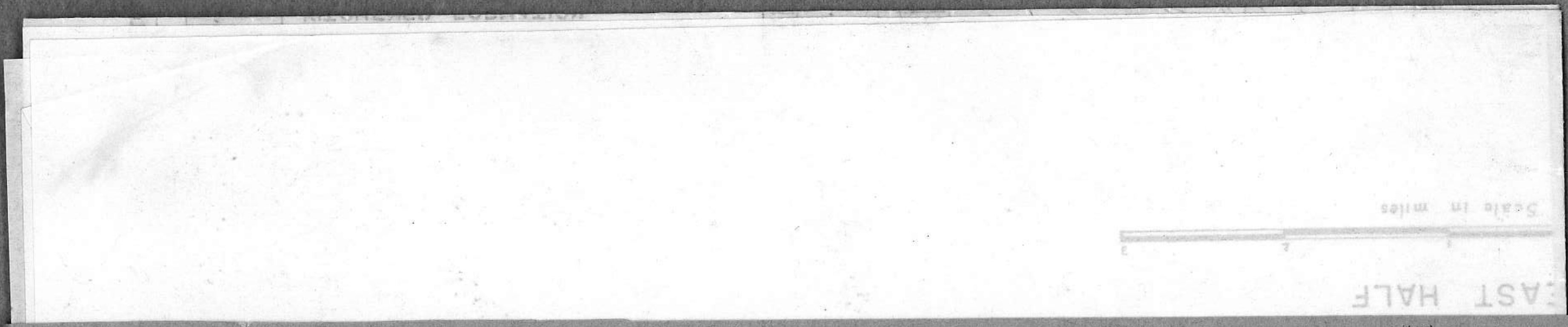
R. Balk, Structural Behavior of Igneous Rocks, Geol. Soc. of Am., Memoir No. 5 (1937).

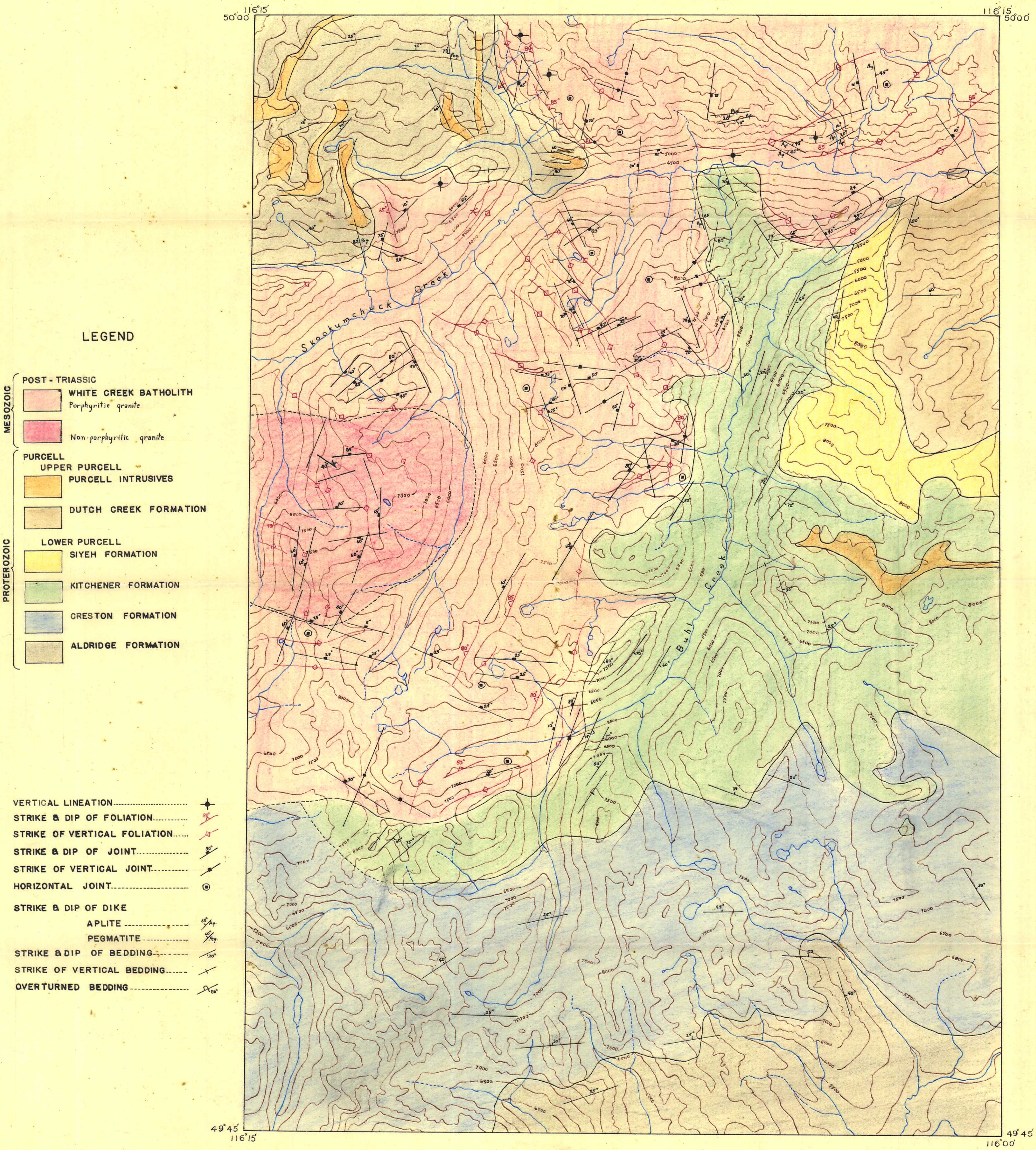
R. Balk & F.F. Grout, Structural study of the Snowbank stock, Geol. Soc. Am. Bull., Vol. 45 (1934) p. 621-634.

E. Cloos, The application of recent structural methods in the interpretation of the crystalline rocks of Maryland, Maryland Geol. Survey, Vol. 13, pp 25-108

H.M.A. Rice, Nelson Map-Area, East Half, British Columbia, Geol. Surv., Canada, Memoir No. 228.

APPENDIX III
MAP OF
DEWAR CREEK
EAST HALF





DEWAR CREEK

EAST HALF

Scale in miles