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## GEOLOGICAL NOTES

(J.E. REESOR)

These notes accompany Open File maps for Boswell (82 F/7), Crawford Bay (82 F/10), and Kaslo (82 F/15). The above maps are part of a project of regional mapping in Nelson map-area 82 F, East Half. They are a compilation, in part from thesis studies and from earlier published work as well as from current field work in 1981-82 (see Legend for sources of information). Although released at 1:50,000 scale they are not the standard to be expected of Geological Survey formally published 1:50,000 Memoir or Bulletin Series. Some of the work is more detailed than can be shown on a final compilation for Nelson East-half but some is still only at a reconnaissance scale as a result of time limits imposed for regional mapping.

The three map-areas are underlain by successively younger strata from east to west, ranging from mid-Proterozoic Purcell Supergroup in the east, through upper Proterozoic Windermere Supergroup, Paleozoic, and finally, on the western edge of the map-areas, lower Mesozoic strata. All successions are cut by mid- to late-Mesozoic intrusive rocks showing great compositional and textural variations. Small stocks of early Tertiary age are the youngest rocks in this 1.5 billion year succession.

### Purcell Supergroup

The Legend accompanying these maps has been developed for Nelson East-half map-area as a whole. No rocks of Aldridge Formation are found within the limits of Boswell, Crawford Bay, or Kaslo map-areas and the oldest exposed rocks belong to the Creston Formation.

The Creston Formation occurs along the eastern limits of the map-areas ranging from a narrow zone east of Fry Creek Batholith in Kaslo map-area to a broad, folded and faulted zone north of Bayonne Batholith in Boswell map-area. Although Creston Formation was subdivided into three units in Grassy Mountain map-area, adjoining to the east (Reesor, 1981), only lower and middle Creston are found in Boswell map-area. Lower Creston ($Hc_1$) consists of successions of thinly laminated phyllite, grey, green, or rarely black, and phyllitic siltite, commonly grey or green. These successions alternate with siltites and argillaceous siltites in beds to 10 cm thick. In the thin-bedded successions it is not uncommon to find thin carbonate-bearing layers. Seldom are primary structures preserved and wavy bedding and mudcracks characteristic of this unit to the east are not found here.

There is an abrupt transition to quartzites and siltites of middle Creston ($Hc_2$). This is a much more resistant unit than lower Creston and forms high ridges such as Akokli Mountain and the region north of Bayonne Batholith as well as Snowcrest Mountain, Mount Rice and Hungry Peak farther north. Rocks of this unit are dominated by moderately thick-bedded siltites with thin phyllite interbeds. Characteristic purple laminae and mottling are found only along the ridge north of Snowcrest Mountain and in a few places on the high ridges to the north. Most commonly dark grey laminae are found in the lighter grey to green siltite. Few ripple marks or other primary structures, so common in the units farther east, are preserved here.

The zone mapped as Creston (Hc), undivided, consists of faulted and folded repetitions of both lower and middle Creston. The base of the Creston is nowhere exposed in these three map-areas. The contact with overlying Kitchener is abrupt above a succession dominated by white quartzite in beds up to 25 cm thick with minor argillite partings. In some places, for example on the ridge north of St. Mary River, there is a succession of carbonate-bearing pelites and quartzitic pelites approximately 100 m below the Creston-Kitchener contact.

The base of lower Creston is not exposed and no estimate of thickness can be given. In Grassy Mountain area to the east it is about 1000 m thick. The mapped thickness of middle Creston in Boswell and Crawford Bay map-areas may be as much as 1500 m, though these rocks are much more metamorphosed and internally deformed than equivalents to the east where middle Creston has a mapped thickness of about 1000 m (Reesor, 1981).

The Kitchener Formation (Hk) occurs in fold remnants and fault slices both north and south of Snowcrest Mountain (S.E. Crawford Bay map), and south of Bayonne Batholith in Boswell map-area. It occurs as well in a second belt farther west beginning with a fault slice north of Akokli Creek and continuing through Burdett Peak. This belt continues northward in a folded and faulted sequence to a point within Fry Creek Batholith (N.E. Kaslo map). In this entire belt there is only one locality in which a reasonably complete section of Kitchener Formation has been preserved. Along the ridge north of St. Mary River in the southeast



corner of Kaslo map-area, Kitchener Formation is well exposed and there appears to be a complete section from a point near the eastern boundary of the map-area to the saddle at the head of the middle branch of Office Creek. Although the formation is internally deformed, with much development of cleavage, and lies in the biotite zone of metamorphism this is nonetheless the best section available, even though there may be local repetitions or omissions resulting from small unrecognized faults.

The Kitchener has been divided into three sub-units. The lower unit ($Hk_1$), consists in its lowest part of a thin-bedded succession of brown to orange weathering, grey or white dolomite with interbeds of green to grey phyllite. This is succeeded by dolomitic beds interpersed with black phyllite with thin beds, up to a few centimeters, of white quartzite. Then follows a section of dolomite interbedded with thinly laminated silvery phyllite topped by 30 m or more of cream weathering white dolomite. Above this is a considerable thickness of silvery and green phyllite and some reddish weathering siltite, all with thin interbeds of brown weathering carbonate, in all forming perhaps 10% of the total. All beds are a few centimeters or less in thickness, and the various phyllitic and silty rock types occur in about equal amounts.

The above succession is overlain by the middle unit of the Kitchener ($Hk_2$) which consists of thinly laminated black phyllite and grey siltite with some of the siltite weathering to a medium brown colour. Individual beds in this succession range from 1-2 mm to 1/2 cm. There are no carbonate beds in this unit.

The upper unit of the Kitchener ($Hk_3$) consists of a thin-bedded succession of silvery phyllites, carbonate-bearing with some thin-bedded dark grey phyllite. Locally there are some successions of dark cream weathering, cream coloured, thin-bedded dolomite. This unit is topped by interbedded dolomite and white quartzite. The dolomite is thin-bedded, cream-coloured, and reddish buff to deep reddish brown weathering. At one locality stromatolite mounds are preserved. The quartzite interbeds in the dolomite are fine grained, white, and occur in beds up to 20 cm thick.

Only the lower portion of the lower Kitchener ($Hk_1$), as mapped here, is found beneath the Lower Cambrian unconformity in Grassy Mountain map-area (Reesor, 1981).

The Kitchener Formation throughout these three map-areas is internally folded and cleaved and in many places repeated or reduced in thickness by faults nearly parallel with the strike of the formation. An estimated mapped thickness of the Kitchener Formation is about 1800 m, which includes a thickness of about 250 m for middle Kitchener ($Hk_2$) and 250 m for upper Kitchener ($Hk_3$).

The Dutch Creek Formation (Hdc) occurs in a narrow, faulted and folded strip extending from Kootenay Lake north of Bayonne Batholith, north and north-northeast and ends in a salient within Fry Creek Batholith. Another small strip occurs in the southeast corner of Crawford Bay map-area, and again south of Bayonne Batholith in Boswell map-area. West of Kootenay Lake there is an extensive belt of highly metamorphosed Dutch Creek Formation (Leclair, 1982).

The Dutch Creek Formation occurs conformably and abruptly above the Kitchener Formation and has been subdivided into a lower and upper unit. The lower Dutch Creek Formation ($Hdc_1$) is essentially a black and grey unit consisting of thinly interbedded black phyllite and grey siltstone with beds averaging no more than 1 cm thick. The phyllite dominates the section, although there are interbeds of siltite within it up to 10 cm or more thick. These successions resemble the upper unit and in areas of poor outcrop it is difficult to distinguish between upper and lower units. Carbonate units are very rare in lower Dutch Creek Formation.

The upper Dutch Creek Formation ($Hdc_2$) occurs gradationally above the lower, and consists again of alternating black and grey units in which the grey siltstone is the dominant rock-type in beds ranging in thickness from 2 or 3 cm to 30 cm or more. The siltites are always interbedded with black phyllite. Although these rocks lie within the biotite zone and show considerable internal deformation nevertheless, in rare instances, load casts and flame structures are well preserved at the base of siltite units. Much of this unit is characterized by siltite in beds up to 10 cm thick succeeded by a few centimeters of black phyllite and grey siltite interlaminated on a scale of fractions of a centimetre. Toward the top of the formation a few lenses and layers of carbonate bearing siltite and phyllite form perhaps 10% of the section. The contact with the overlying Mount Nelson Formation (Hmn) is at the beginning of a section of more massive siltite and quartzite in beds much thicker than commonly encountered in the Dutch Creek.



The Dutch Creek Formation is intensely deformed and lies partly within both the biotite and garnet zones of regional metamorphism. In addition, faults nearly parallel with the strike of the beds are difficult to recognize with any certainty. Consequently an estimate of mapped thickness may be out by a factor of two or three. Nevertheless a maximum thickness is 2400 m east of the head of La France Creek, but true thickness may be much less.

The Mount Nelson Formation (Hmn) has been subdivided into four restricted contrasting units. This formation occurs in a narrow strip generally along or just east of the divide of the Purcell Mountains, as well as southeast of Bayonne Batholith. The total thickness of Mount Nelson Formation is approximately 1200 m, with each subdivision ranging from 250 to 350 m.

The lowermost unit of the Mount Nelson ($Hmn_1$) consists of quartzite, white, grey or green, in beds ranging in thickness from 10 cm to 70 cm with rare phyllitic laminae within beds and minor phyllitic partings between beds. The lower contact is at the beginning of a dominant quartzitic or silty succession with minor phyllite in contrast with the siltite of the Upper Dutch Creek in which the phyllitic component forms not less than 30% of the section. In the more metamorphosed section of Kaslo map-area a thin rusty weathering schist unit lies immediately below the quartzites of the lowest member of the Mount Nelson Formation.

The second member of Mount Nelson Formation ($Hmn_2$) lies conformably and abruptly above the lower member and consists of brown weathering impure carbonates with interbeds of black phyllites and some grey siltite. Beds are generally not over 2 cm thick. In the more metamorphosed section in Kaslo map-area this unit is largely a calcium silicate intermixed with pelitic and quartzitic schist. The third sub-unit of Mount Nelson Formation ($Hmn_3$) lies gradationally above the second and consists of interbedded black phyllite and grey siltstone in beds ranging from 2 mm to 2 cm in thickness.

The uppermost unit of the Mount Nelson ($Hmn_4$) begins with a thin succession of green phyllite and brown impure dolomite lying gradationally above unit 3. This is succeeded by thinly laminated and thin-bedded cream weathering dark dolomite in beds to 3 cm thick. Near the top of this unit a brown weathering, white dolomite is common. In some exposures, as for example south of Hooker Pass (Crawford Bay map-area) and again at the northern limit of this map-area, northwest of Sawyer Pass, a thin succession of black phyllite is interbedded with the dolomite.

The Mount Nelson Formation is unconformably overlain by the basal Windermere Toby Conglomerate. In different localities the upper unit of Mount Nelson Formation is variably preserved, in some cases it has been completely eroded and in others only a few thin beds remain. South of La France Creek the Toby Conglomerate rests on upper Dutch Creek strata and the entire Mount Nelson Formation is missing from the section.

The entire succession from the beginning of the Kitchener Formation through the Dutch Creek Formation consists of alternating successions of carbonates and striped phyllite and siltite. Subdivision of these faulted and folded, repeated sections is not easy, especially in areas of poor exposure. Divisions have been made at the most easily recognized horizons and are not necessarily consistent with the subdivisions made in earlier reconnaissance by Rice (1941). At this stage in the work precise correlations with similarly named units in Lardeau East-half map-area (Reesor, 1972) and Windermere District (Walker, 1928) cannot even be suggested. It may be, however, that rocks mapped here as Mount Nelson Formation may not be correlatives of Mount Nelson strata of Lardeau map-area to the north.

### Windermere Supergroup

The base of the Windermere is generally marked by the Toby Formation (Ht). This Formation occurs in a narrow strip along or close to the Purcell Divide. In Boswell and most of Crawford Bay map-areas the location of the Toby Formation has been taken from a field map of M.G. Lis (1972-3) and has not yet been re-examined in this study. The Toby conglomerate has also been found in a narrow, fault-bounded strip west of Sawyer Creek in northeastern Crawford Bay map-area. It has not been found in the Windermere (?) succession south of Bayonne Batholith. West of Kootenay Lake the Toby Formation (Leclair, 1982, 1983) extends from Next Creek in Boswell map-area northward to Sun Point (Crawford Bay map-area).

The Toby Formation is a polymict conglomerate consisting largely of quartzite and dolomite clasts ranging in size from a few millimeters to 40 cm. The matrix varies from quartzite to pelite to carbonate and changes rapidly from point to point along strike. The conglomerate ranges from one dominated by clasts to one in which pebbles and cobbles are scattered in a predominant matrix. The thickness varies up to several 10's of meters, with the thickest section mapped by Leclair (1982) in Boswell map-area west of Kootenay Lake where it is as much as 700 m. Along the Purcell Divide the Toby Formation has so far been examined only in a few localities. It is commonly thicker where it lies above the dolomite unit of the Mount Nelson Formation ($Hmn_4$) and has a dolomite matrix. Elsewhere it may be only a meter or two thick and lies on the pelitic unit of the Mount Nelson ($Hmn_3$). In Rose Pass the Toby Formation consists of about 10% dolomite and quartzite clasts, up to 15 cm, in a carbonate-bearing phyllitic matrix. About 2 kilometers northwest another conglomerate occurs (Hha). It consists of rounded, spherical cobbles, and some boulders, of quartzite in a tremolite carbonate matrix. Horsethief Creek Group rocks here are complexly folded and faulted and this may well be Toby Formation.

Toby Formation occurs also in a partly fault-bounded strip west of Sawyer Creek. There it consists of quartzite and dolomite clasts in a carbonate matrix and rests on a thin-bedded dolomite unit. The stratigraphic relationship of this dolomite unit is uncertain. Although it resembles the upper unit of Mount Nelson Formation and rocks of the lower Dutch Creek unit lie below, the other units of Mount Nelson have not been recognized. This may be a dolomitic unit within Dutch Creek or it may just be possible that it is related to and belongs with the Toby Formation. Unsorting these relationships requires further work in the stratigraphy of this succession.

The Irene Volcanic Formation (Hiv) occurs only west of Kootenay Lake and has been mapped by Leclair (1982, 1983) from Bayonne Batholith north to Kootenay Lake near Sun Point. Its thickness appears to vary from a few tens of metres to perhaps as much as 700 m. It consists of ... "fine-grained, dark bluish green mafic tuff and massive to schistose greenstone with minor intercalations of light grey phyllite..." (Leclair, 1982, p. 45).

The Horsethief Creek Group (Hh) occurs in a broad belt northerly along Kootenay Lake from Columbia Point to Gray Creek, thence northerly to Fry Creek Batholith in Kaslo map-area. Rocks of this unit also occur in Boswell map-area south of Bayonne Batholith and occur with the narrow strip of Toby Formation west of Sawyer Creek, northeast Crawford Bay map-area. Throughout most of its length from Kootenay Lake to Crawford Creek this unit has been mapped by Lis (1972-73) who divided it into sub-units $Hh_{1-7}$. This portion of the Horsethief Creek Group has not yet been re-examined in this study. Horsethief Creek Group equivalents west of Kootenay Lake, Monk Formation and (?) Three Sisters, have been mapped by Leclair (op. cit.).

South of Bayonne Batholith several of the lower units of the Horsethief Creek Group lie between units of Mount Nelson Formation and the granitic rocks. Even though Toby Formation has not yet been found, three units of Horsethief Creek are identified. These consist of a pelitic schist or phyllite with thin beds of brown weathering carbonate ($Hh_1$?), succeeded by an extensive siliceous orthoquartzite unit ($Hh_2$?), overlain in turn by a schist and calc-silicate unit ($Hh_3$?), not well exposed, above the granite contact.

North of Crawford Creek in Crawford Bay and Kaslo map-areas the undifferentiated Horsethief Creek Group consists of a succession of phyllites and schists with interbedded grey limestone and marble ($Hh_c$), pebble conglomerate ($Hh_b$) and one succession of cobble conglomerate ($Hh_a$) that could well be Toby Formation. No estimate of thickness is yet possible in this region. West of Kootenay Lake the equivalent Monk Formation consists of two phyllite units ($Hm_1$, $Hm_3$) separated by a laminated grey limestone ($Hm_2$) (Leclair, 1982). The Monk north of Laib Creek may be about 1000 m thick.

West of Kootenay Lake the Monk Formation is overlain by the Three Sisters Formation ($Hts_1$ to $Hts_3$), consisting of grits, grey cross-bedded quartzite and quartz-pebble conglomerate. Near the top of this formation there is a layer of polymict conglomerate ($Hts_2$) composed of clasts of grit, quartzite, shale and greenstone (Leclair, op. cit.). The contact with the overlying Quartzite Range Formation is gradational and is marked at a point where grit or pebble beds are no longer found. The total thickness of all members of the Three Sisters is approximately 1200 m. The Three Sisters Formation is not found north of the salient of granite at Hughes Creek. It may not have been deposited or may have been faulted out because all units north of this point are highly deformed and metamorphosed (Leclair, 1983). (Note, however, the discussion of Hamill Group rocks below).



### Paleozoic Units

The Paleozoic succession occurs in a complex folded and metamorphosed strip extending from the southwest corner of Boswell map-area, northward through Crawford Bay, thence along both sides of Kootenay Lake with extensive projections into Fry Creek Batholith. The region north of Crawford Creek, largely west of Fry Creek Batholith to Mount Kaslo, has been mapped by Höy (1980). The area west of Kootenay Lake was mapped by Fyles (1967). Although extensive published reports are available for these areas, the geology from them has been plotted here, along with the field work of Lis (1972-73), to show the relationships of their geology to geology currently being obtained in areas not re-mapped since the late 1930's (Rice, 1941).

Four main subdivisions of the Hamill Group, originally set-up by Höy (1980), have been retained here. The lowermost ($Є h_1$) has in turn been subdivided into two units. The lower unit ($Є h_{1a}$) consists of a succession of quartzites, commonly gritty and feldspathic and in many places includes thin schistose partings up to 10 cm thick. Quartzite beds commonly contain up to 20% of blue quartz, white quartz and porcelain-white feldspar particles, averaging 3-5 mm but locally up to 1 cm in grain size. A 15- to 25-metre conglomerate bed occurs above the middle of this unit. It contains clasts mostly of quartz or quartzite up to 5 cm, rarely larger. With the disappearance of the grits and conglomeratic beds and the appearance of uniform thin- to thick-bedded grey, white, and pink quartzites, the lower unit ($Є h_{1a}$) grades into the upper unit ($Є h_{1b}$). The quartzites in the upper unit are generally grey to white, rarely green or pink with, in some successions, thin partings of micaceous schist. The quartzites are in places crossbedded and the succession, although repeated by faulting, appears to be a consistently west-facing panel. The lower unit ($Є h_{1a}$) has an approximate mapped thickness of 700 to 800 m, and the upper an approximate thickness of 600 to 800 m.

The second unit ($Є h_2$) of the Hamill Group lies abruptly above the quartzite succession and consists of schists, quartzitic schist, quartzite, and amphibole bearing schist (greenstone?). Carbonate-bearing strata are found in the lower part of this unit and a thin marble unit ($Є h_{2b}$) has been mapped over a considerable distance. Höy estimates a thickness of 2000 m for this unit (op. cit. p.21).

Much of the remainder of the Hamill Group mapped in this project occurs in the large salient north of Powder Creek and consists of highly metamorphosed, deformed and granite penetrated metasediments.

West of Kootenay Lake and south of West Arm, rocks equivalent to the Hamill Group have been mapped by Leclair (1982, 1983). At this point in the project, rocks that are equivalent, at least in part, to Hamill Group south of the high angle 'thrust' fault south of Seeman Creek are called Quartzite Range Formation, consistent with names used in earlier work to the southwest (for example Little, 1960; Fyles and Hewlett, 1959). This formation consists of a basal unit of massive white, green, and pink orthoquartzites ($Є qr_1$), followed by a succession of brown micaceous quartzite ($Є qr_2$), then by a thin conglomerate unit ($Є qr_3$). The top of the unit consists of a white and bluish green quartzite with minor argillite ($Є qr_4$), (Leclair, 1982). The total mapped thickness is approximately 1800 m north of Cultus Creek.

North of Seeman Creek in a highly metamorphosed, attenuated and faulted sequence, correlations are tentatively made to similar highly metamorphosed and deformed Hamill Group rocks mapped by Hoy east of Kootenay Lake to the north. No equivalent to the Three Sisters Formation remains and other units consist of sheared quartzites, pelitic gneisses, marble, etc. (Leclair, 1983).

It is worth pointing out the similarity in lithology between the Three Sisters Formation ($Hts_1$ to $Hts_3$), as mapped in southwest Boswell map-area, and the lowermost Hamill ($Є h_{1a}$) mapped in Kaslo map-area. This similarity extends even to the occurrence of a marker horizon of conglomerate in both units, $Hts_2$ and $Є h_{1c}$. In the southwest the Three Sisters has traditionally been mapped as Windermere, whereas farther north Höy (1980) mapped the similar lithological unit ($Є h_{1a}$) in the vicintiy of Mount Crawford as Hamill Group. Similarly, in Lardeau map-area to the north of Fry Creek Batholith, this same basal unit was mapped as Hamill Group (Reesor, 1972, p. 55). The Three Sisters and the basal unit of the Hamill Group decrease in thickness from about 1800 m in Boswell map-area to about 800 m in Kaslo area and to less than 500 m north of Fry Creek Batholith. It is probable that $Hts_{1-3}$ and $Є h_{1a}$ are correlatives and that as a sedimentological unit they belong with the Hamill Group. The sharp break in lithology with the Windermere below is marked by phyllite and/or schist all along the belt from the International Boundary to a point well within Lardeau map-area (op. cit.) to the north.



The Lardeau Group (Index Formation, Pl) in the southwest corner of Crawford Bay map-area consists of highly metamorphosed and deformed schist, gneiss, and marble (Leclair, 1983). These rocks are correlated with the Lardeau as mapped by Höy (1980) rather than with the less metamorphosed assemblage of Lardeau rocks mapped to the west of Kootenay Lake by Fyles (1967).

The Milford Group (Mm) lies in fault-contact above the Lardeau Group in southwest Crawford Bay map-area. It consists of a lower unit of grey to black phyllite and schist and blue-grey laminated limestone, succeeded by a middle unit of greenstone and amphibolite. The upper unit consists of thin-bedded grey quartzite and chert with some intercalated greenstone and amphibolite (Leclair, 1983, p. 238). The Milford Group continues northward through Kaslo map-area where it has been mapped by Fyles (op. cit.).

### Mesozoic and Cenozoic Units

The Milford Group is succeeded to the west by a narrow strip of Kaslo Group, then by Slocan Group. The Kaslo Group (PTk) of Permian and/or Triassic age consists largely of dark greenstone and amphibolite with slivers of garnet-bearing schist (Leclair op. cit.). The Slocan Group (Ts) of Late Triassic age consists of a pelitic schist and white calcite marble, calc-silicate schist and micaceous quartzite.

### Granitic Rocks

The Mesozoic history in these map-areas is largely represented by a heterogeneous assemblage of granitic rocks. A preliminary subdivision has been attempted, based partly on compositional variations and partly on textural and structural variations.

Bayonne Batholith east of Kootenay Lake in Boswell map-area consists largely of granite with approximately equal amounts of quartz, potash feldspar, and plagioclase ($Kgr_1$). It is characterized by the presence of potash feldspar megacrysts up to 2 or 3 cm in length and by a biotite content of perhaps 10%. Variations from this rock type are commonly encountered near the boundaries of the mass where hornblende may be present as well as many 'diorite' inclusions. This portion of the Bayonne Batholith has a characteristic high aeromagnetic relief (Aeromagnetic Map 8476 G) and a suggested extension of the pluton in two lobes has been dotted into Kootenay Lake on Boswell map.

West of Kootenay Lake the 'Bayonne' batholith consists of a two-mica leucocratic medium-grained granite south of Cultus Creek, and a more mafic biotite granite north of Cultus Creek. Commonly along the lower slopes of the mountain-side both of these granitic masses show narrow zones of deformation, portrayed by a separate symbol on the map. Northward, beyond Rhinoceras point, the leucocratic two-mica granitic rocks continue along Kootenay Lake (Leclair, personal communication, 1982).

The small stock on Seeman Creek consists of a heterogeneous assemblage of leucocratic granitic rocks bounded, in the outer zones, by mafic-rich granodiorite. It is intensely foliated around the periphery of the mass. The strip of granodiorite immediately west and north of the Seeman Creek stock is of similar composition and is also strongly foliated. Many inclusions of metasediments are found within it, as shown by a separate symbol.

Throughout these units there are zones of heterogeneous composition, commonly mafic-rich, and in places with many inclusions of meta-sediments ($Kgr_4$, Kgd). It may be that this variation in composition simply reflects proximity to a contact zone near the periphery of the mass, near extensive roof pendents, or septa within the mass.

The strip of granitic rocks (J?gr) west and north of Mount Irvine consists of a foliated leucocratic granite (Leclair, personal communication, 1982). These rocks appear to be correlatives of granitic sills mapped in the Ainsworth district to the north (Fyles, 1967, p. 37-38).

A narrow strip of granitic rocks belonging to Nelson Batholith ($J(?)gd_3$) is shown along the western boundary of Crawford Bay and Kaslo map-areas. These granitic rocks are largely of biotite-hornblende granodiorite with megacrysts of potash feldspar, in places highly foliated, in places massive.



Fry Creek batholith east of upper Kootenay Lake consists largely of a leucocratic granitic rock with roughly equal amounts of potash feldspar, plagioclase and quartz. It is equigranular, fine to medium grained, and generally contains less than 5% biotite and near its western boundary may contain a few % of muscovite ($Kgr_3$). A number of small satellite bodies of similar composition are found in the general vicinity of Fry Creek batholith.

### Structure

Purcell Supergroup rocks occur generally east of the Purcell Mountains Divide in these three map-areas. They appear to be a generally west-dipping sequence with many repetitions and omissions resulting from isoclinal folding and faulting nearly parallel to the strike of the formations. All outcrops show open to isoclinal folds on scales ranging from the centimetre scale to several 10's of metres. Folds on a scale of several kilometres can sometimes be mapped. The more open folds, as for example north of St. Mary River in Kaslo map-area, commonly show synclines with steep to overturned east limbs and moderate to steep west limbs, thus folds commonly verge westward. Large isoclinal folds are mapped in southeast Crawford Bay map-area, but are now largely faulted remnants and strips. Cleavage is extremely well developed in all of these rocks and in large areas is very uniform and moderately east-dipping.

Much of this region exhibits a cross-folding, oriented commonly westerly to west-northwest. It varies in amplitude from less than a centimetre to 10's of metres. It clearly folds foliation and in places, where well developed, isoclinally refolds northerly trending earlier mesoscopic isoclines.

Faults that trend southerly are common throughout the map-areas. All are truncated by the Bayonne Batholith. The most extensive fault is the Redding Creek fault, found from Bayonne Batholith in Boswell map-area north to the small pluton near the south boundary of Kaslo map-area. This fault brings successively older rocks on the west against younger rocks on the east, with Lower Creston against Middle Creston at the south end and Dutch Creek Formation against Windermere Supergroup at the north end. The fault is difficult to identify farther north in rocks of the Dutch Creek Formation. An estimate of apparent movement on the fault is uncertain, it may have a component of right-lateral movement, but may have as much as 1000 m of reverse displacement, west-side up.

A series of faults cut a northwest-trending segment of folded Purcell strata in southeast Crawford Bay map-area. A second set of faults trend south and north from Burdett Peak in Crawford Bay map-area. Most appear to cut out stratigraphic section, and appear to be steeply dipping normal faults with an apparent stratigraphic separation up to 1000 m or more.

The Windermere strata south of Bayonne Batholith occur some 20 km southeast of basal Windermere at Columbia Point on Kootenay Lake. This indicates a considerable repetition of strata between these two points, now cut off by Bayonne Batholith. It may be noted that several, pre-batholithic faults are found along the north boundary of Bayonne Batholith. Also this southernmost occurrence of Windermere rocks lies on strike from a complex folded and faulted succession of upper Purcell Supergroup north of Bayonne Batholith from Haystack Mountain northerly through Snowcrest Mountain.

Basal Windermere near Sun Point, west of Kootenay Lake, lies a distance northwest of basal Windermere at Columbia Point equal to that separating the latter from Windermere south of Bayonne Batholith. Leclair (1983, p. 239) suggests this movement along Kootenay Lake may be the result of late displacement of approximately 25 km and notes that it truncates rocks of the Bayonne Batholith. In contrast the repetition noted above between Columbia Point and Windermere rocks to the southeast clearly predates the Bayonne Batholith of late Mesozoic age.

(Extensive, published discussions of structure in Riondel area east of upper Kootenay Lake and Ainsworth area west of the lake may be found respectively in Hoy, 1980, and Fyles 1967).

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