UNITED STATES DEPARTMENT OF THE INTERIOR
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Preliminary Geologic Map of the Eastport Area Idaho and Montana

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Introduction

The Eastport area map is the northeasternmost of a series of 1:48,000 scale preliminary geologic maps covering the Sandpoint 2° quadrangle. This series is a byproduct of the Sandpoint 2° project, conducted under the auspices of the regional framework studies program and the Branch of Western Regional Geology. The topographic base for this map, as for most maps in this series, consists of a photographically mosaiced 15' sheet compiled from existing 7.5' topographic quadrangles. The series is designed to fill out areas within the Sandpoint 2° quadrangle not covered by geologic mapping at a scale of 1:62,500 or larger. Maps of this series are intended to provide geologic information as the project progresses; hence persons interested in specific areas need not wait until the entire 2° sheet is completed. In addition, this map series presents more information on a more detailed base than will be possible on the final 2° compilation.

The maps in this 1:48,000 scale series are both more detailed and more accurate than reconnaissance maps. Nevertheless, because they are an outgrowth of 2° mapping and are subject to the haste inherent in covering so large an area in a reasonable length of time, they are of a somewhat lesser quality than many U.S.G.S. maps released in more formal publication series. Coverage is relatively complete in areas of good exposure but almost reconnaissance in nature where vegetation or cover make detailed mapping unacceptably time consumming. Nomenclature applied to the upper part of the Belt Supergroup is currently under revision, and some of the names used in the report probably will not survive. Moreover, correlations of formations in the Missoula group presented here are tentative, pending revised correlations currently underway by workers throughout the Belt basin.

Description of Map Units

Qa — ALLUVIAL MATERIAL (Quaternary)--Includes alluvial material in modern drainages, on active floodplains and on alluvial fans

Qt — TALUS (Quaternary)--Vegetation-free talus and scree (rare) below oversteepened cirque headwalls and other steep slopes; locally derived. Age younger than last glaciation

Qg — GLACIAL MATERIAL (Quaternary)--Drift from both alpine and continental glaciations; also includes older alluvium and tan weathering silt. Most drift locally derived during late alpine glaciation. Older alluvium topographically higher and generally coarser grained than alluvium in modern drainages may represent relatively distal glacial outwash. Silt interpreted as lacustrine material deposited in glacial or post glacial lakes. Alluvium and silt most abundant in the south central part of map near the confluence of Deer Creek and Moyie River

Kg — GRANITIC ROCKS (Cretaceous ?)--Chiefly coarse-grained hornblende granodiorite in outer parts of pluton, grading to biotite granodiorite in central part. Variably porphyritic with microcline phenocrysts 3 to 8 cm in length. Color index 10 to 20; average nearer mafic end of range. Accessory magnetite (2%), sphene (1%), minor epidote; biotite, partly chloritized; minor plagioclase sericitization. Incipient foliation enhanced locally by rare mafic inclusions. Undated within map area but similar to and probably continuous with dated Upper (?) Cretaceous rocks west of area that yield biotite and hornblende K-Ar apparent ages from 80 to 98 m.y. (Miller and Engles, 1975)

Trsw — SYENITE OF WALL MOUNTAIN (Triassic ?)--Medium gray to blue-gray hornblende quartz syenite. Highly variable texture, fine- to coarse-grained, equigranular to porphyritic and hypidiomorphic to idiomorhic granular. Accessory epidote (5%), magnetite (3%) and sphene (1%). Foliation, well defined by tabular carlsbad-twinned alkali feldspar, is parallel with contact where syenite intrudes Belt rocks but truncated by Kg at one location where contact is exposed near northwestern limit of unit. Occurs only as single, small, elongate stock near western edge of map, north of Wall Mtn. Hornblende K-Ar apparent age of 131 m.y. probably represents minimum age due to cooling history or effect of younger intrusive rocks. Probably Triassic age due to similarity with alkalic bodies of Triassic age throughout the western cordillera (Miller, 1977)

Ꞓd — DOLOMITE (Cambrian ?)--Dark gray to gray irregularly thin-bedded to laminated dolomite with sulfurous-petroliferous odor when freshly broken. Dark gray zones have irregular white spots. Lighter gray beds are plane parallel laminated. Fault bounded occurrence only in south-central map area along Moyie-Leonia Fault. Tentative age assigned on basis of similarity with dark gray limestones and dolomites in surrounding areas, e.g., the Lakeview Limestone 83 km to the south (Harrison and Jobin, 1965), an unnamed dolomite 84 km to the east (Johns, 1970), and the Metaline Limestone 92 km to the west (Dings and Whitebread, 1965). Based on apparent geometry of faults and attitude of beds, dolomite is part of plate east of Moyie-Leonia Fault

BELT SUPERGROUP (Proterozoic Y)

MISSOULA GROUP

Yms_2 MOUNT SHIELDS FORMATION, SILTITE AND ARGILLITE--Green siltite and argillite. Exposures restricted to south-center area of map east of and bounded by Moyie-Leonia Fault. Typically, unevenly bedded depositional couplets of dark green siltite grading upward to locally carbonatic light green argillite tops; couplets average several millimeters to several centimeters in thickness. Some red argillite tops contain mudcracks, mudchip breccias and salt casts. Top is faulted. Minimum thickness 300 m

Yms_1 MOUNT SHIELDS FORMATION, QUARTZITE, SILTITE AND ARGILLITE--Green carbonate-bearing siltite, maroon and green argillite, red and green quartzite and siltite, tan limestone. Top is 30 to 60 cm thick beds of pale green quartzite with ripple-marked tops. Underlying this is massive-parting tan- to cream weathering limestone and silty carbonate with algal-mound structures and interbedded maroon argillite. Maroon argillite with dessication-cracked surfaces continues downward, interbedded with pale maroon micaceous quartzite and siltite commonly with mud chips. Top placed above highest thick quartzite. Thickness approximately 200 m

Ysh_2 SHEPARD FORMATION, SILTITE AND ARGILLITE--Black to gray argillite, green argillite, green siltite and micaceous quartzite. Argillite and siltite in plane parallel laminated couplets 1 to 5 mm thick that fine upward. Some wavy bedding due to differential compaction around green siltite and quartzite beds or lenses 1 to 40 cm thick. South of area 18 km, includes small, isolated stromatolites and carbonatic siltite horizons. Top placed at base of lowest maroon argillite. Thickness approximately 120 m

Ysh_1 SHEPARD FORMATION, CARBONATE--Green carbonatic siltite and argillite, white quartzite and red-tan weathering dolomite. Lenticular to pinch and swell, grayish blue-green carbonate-free siltite commonly grades upward to yellowish-orange to tan weathering dolomitic argillite to form wavy, laminated couplets a few mm to 1 cm thick. Siltite cross laminated; dolomitic argillite at top of couplets broken by dessication and water-escape structures. Cross laminated dolomite and pyrite-bearing white quartzite as starved ripples and beds to

30 cm thick occur throughout. Red-tan weathering medium- to dark-gray laminated dolomite with vertical calcite ribbons is concentrated in middle. Southernmost outcrops show deformation increasing westward with 1 m wavelength folds giving way to intense cleavage development and transposed bedding which prevent accurate estimate of thickness. South of area 16 km, thickness 400 to 500 m. Top placed below lowest occurrence of black argillite

Ysn — SNOWSLIP FORMATION, SILTITE AND ARGILLITE--Laminated to very thin bedded, black to green argillite and green to white siltite, black slate, carbonatic zones and pyritiferous white quartzite. Rare pale purple argillite. Some quartzite and siltite interbeds show fine scour and fill and cross lamination structures. Dessication cracks on parting surfaces of green argillite. Green and red laminae slightly undulatory. Black beds plane parallel. Strong cleavage and transposed bedding produced locally by intense shearing. Thickness estimated at 900 m but unit may be tectonically thinned. Top placed at base of carbonate-rich material

Yw_2 — WALLACE FORMATION, SILTITE, ARGILLITE AND CARBONATE--White dolomitic quartzite and siltite, laminated, dark bluish gray dolomite and limestone, black argillite, green-gray siltite and argillite. Most dolomite and dolomitic beds weather red-tan. Siltite and quartzite beds commonly cross laminated, and grade upward to carbonate free black argillite; beds pinch and swell irregularly; thickness ranges from one to 10 cm. Bedding plane partings typically show water escape and dessication structures. Pyrite cubes occur throughout. Dark bluish gray to black dolomite, parallel laminated, typically silty, calcareous toward top; commonly full of calcite ribbons. Middle of unit, typically thinly-laminated wavy beds of pale greenish gray siltite and argillite in graded couplets with carbonatic tops, lacks blacks argillite. Top of unit placed at top of highest black argillite. Maximum thickness of 700 m in area unreliable in view of poor exposures and likelihood of faulting. Thickness may be 1200 m, 11 km to the south

Yw_1 — WALLACE FORMATION, SILTITE AND ARGILLITE--Green siltite and argillite, locally carbonatic. Carbonate-free zones of finely laminated to thin bedded, medium-green siltite and lighter green argillite in rarely-graded couplets. Wavy, nonparallel bedding due to ripples and starved ripples. Carbonate in siltites more commonly dolomite than calcite; most carbonate-bearing beds weather orange-tan but some bleach white. Carbonate pods and beds in lower part of unit weather out to produce elongate or irregular-shaped holes. Ripple-marked parting surfaces abundant; minor purple beds especially near base; includes dessication cracks and mud chip breccias. Upper contact placed at lowest occurrence of black argillite. Thickness approximately 300 m

RAVALI GROUP

Ysr SAINT REGIS FORMATION--Interbedded maroon argillite, siltite and green argillite. Thin- to very-thin-bedded maroon argillite commonly shows mudcracks and mudchip breccias on platy partings; pale red purple siltite laminae and rare quartzite beds 10 cm in thickness are interbedded. Upper contact placed below dominantly green rock, below lowest carbonate bed or where carbonate-bearing rocks become a consistent part of the sequence. Due to stratigraphic variations along strike, placement of upper contact may differ from place to place, so variation in thickness from 400 to 600 m may be due in part to inconsistent contact criteria. Deformation of argillite and internal faulting recognized north of Soloman Mountain contribute to apparent variation of thickness

Yr REVETT FORMATION--Medium- to thick-bedded quartzite with interbedded maroon argillite and green siltite. Quartzite generally white. Lacks large crossbeds; rare ball and pillow structures as found in Clark Fork area to the south (Edmunds and Bishop, 1973). Purple banding in some beds mimics form of graded bedding and cross lamination. Purple beds generally thicker and more coarsely laminated but otherwise indistinguishable from quartzite beds in middle part of underlying Burke Formation. Revett Formation grades irregularly up into overlying Saint Regis Formation with decreasing thickness and abundance of quartzite beds. Upper contact mapped as top of highest concentration of thick white quartzite beds. Variation in thickness from 400 to 700 m probably due to lateral lensing of quartzite beds in middle of Ravalli Group but may have contribution from tectonic thinning

Yb_2 BURKE FORMATION, QUARTZITE AND ARGILLITE--Purple laminated quartzite, purple and green argillite, and green siltite. Quartzite very fine-grained, slabby to platy, thin- to medium-bedded with rarer planar cross laminae enhanced by purple hematite concentrations. Interbeds of purple argillite similar to argillites of Saint Regis Formation were noted in part, but poorly exposed. Minor green to gray siltite occurs throughout. Macroscopic magnetite octahedra typical but not ubiquitous. Top placed at base of first thick-bedded gray to white quartzite. Thickness 600 to 700 m

Yb_1 BURKE FORMATION, SILTITE--Green to gray-green siltite. Medium to thin bedded, typically slabby parting. Magnetite octahedra up to 1 mm across locally abundant. Minor carbonate near base occurs as very thin beds and scattered nodules less than 1 cm in length. Top placed at bottom of first purple quartzite bed. Thickness about 700 m

LOWER BELT

Ypt PRICHARD FORMATION, TRANSITION ZONE--Gray siltite, black argillite and white quartzite. Grades downward from Burke siltite through decreasing bed thickness and increasing abundance and thickness of black argillite interbeds. Flaggy to slabby parting with dessication cracks on bedding surfaces. Lower siltite beds irregular in thickness due to pinching and swelling of cross laminated ripple and minor cut and fill structures. Lower part of unit includes medium to thick beds of fine-grained white quartzite. Pyrite throughout produces rusty weathered surfaces. Upper contact placed at lowest occurrence of carbonate or magnetite or, lacking those, above the highest black argillite. Thickness about 600 m

Ypl — PRICHARD FORMATION, LINED ARGILLITE--Dark- to medium-gray argillite, white siltite and quartzite. Characteristically plane parallel laminated argillite and siltite, with one to 5 mm siltite lamellae appearing as white lines on rocks. Parting platy to flaggy. Medium to thick quartzite beds occur throughout as minor components. Upper contact placed at lowest occurrence of abundant quartzite beds and wavy bedding. Thickness approximately 450 m

Ypq — PRICHARD FORMATION, QUARTZITE--Interbedded quartzite, siltite and argillite. Proportions of constituent lithologies vary widely in unit. Upper part is pyritiferous turbidite sequence with rare load and flute casts, graded bedding with black argillite tops, and cross lamination in tops of quartzite beds. Lower part in southeastern part of map area has 4 to 6 zones of medium- to thick-bedded quartzite with a few interbeds of argillite or siltite. These zones are on the order of 100 m in thickness and extend 3 to 6 km along strike. Some lower quartzite beds are quite pure in contrast with typical metagraywacke of turbidites. Between these zones, siltite-dominated turbidites and interturbidite deposits contain only minor component of quartzite. Siltite is thin to thick bedded, gray to cream, and rusty weathering in upper part but includes less pyritiferous, wavy bedded, cross laminated siltite and argillite and rare intra-formational conglomerate in lower part. As a lithologic package, interturbidite siltites are similar to but thinner than the argillite and siltite unit of the Prichard Formation (described below). Rarely, siltites and argillites are disrupted by soft sediment slumping, scour and fill. Massive graywacke with rimmed tabular clasts 3 to 10 cm in length and anomalously abundant pyrite lies in apparent gradational contact above a metadiabase sill low in the section in central east side of the map. All rocks recrystallized. Most have obvious sericite, biotite and chlorite. Siltite in one outcrop south of Canuck Pass in the northeast quarter of map area (kinematically?) metamorphosed to fine-grained garnetiferous mica schist. Top of unit placed below first thick zone of quartz-free argillite. Maximum thickness of incomplete exposed section east of Moyie-Leonia Fault is 3000 m exclusive of argillite and siltite unit (described below) and sills

Ypa PRICHARD FORMATION, ARGILLITE AND SILTITE--Black argillite, light- and dark-gray carbonaceous siltite. Includes interturbidite layer reported to extend over 100 km along strike (Huebschman, 1973). Slabby to platy parting, rusty weathering due to pyrrhotite in carbonaceous laminae. Some argillite has visible biotite and sericite on pale lavender subphyllitic surfaces. Soft sediment deformation common as in fine grained layers of other Prichard units. Unit forms 200-250 m thick zone 600 to 700 m below lined argillite east of Moyie-Leonia Fault. Argillite and siltite unit not recognized west of Moyie-Leonia Fault suggesting section there is lower part of Prichard Formation

Yd METADIABASE--Diabase to gabbro, but includes hornblendite, fine-grained diorite, quartz diorite and granophyre differentiates. Generally concordant as sills with constant thickness, but locally changes thickness, crosscuts strata, and forms complex intrusions. Most contacts covered; observed ones have chilled margins and some sills show internal chilled contacts indicating multiple intrusion of magma. Contact of thin sill 1 km SSW of Canuck Pass mottled by felsic material giving rock appearance of flow breccia, possibly from intrusion into wet sediment. Gradational upper contact of sill in central east side of map area and tabular clasts in overlying massive metagraywacke may also be due to intrusion into wet sediment. Quartz-rich lithologies occupy upper part of sills consistent with gravitational separation from mafic magma but variable proportions of lithologies along and between sills rules out *in situ* differentiation. Zircons from samples of thickest sill exposed in southwestern corner of area (Crossport C sill, Bishop, 1973) have concordant uranium-lead ages of 1433±10 m.y. (Zartman et al., 1982). The similar age and stratigraphic position of the large sill below the Sullivan Mine, Kimberly, B.C., and interpretation that the Sullivan deposit formed in sediment that accumulated during convective cooling of the sill (Hamilton, 1984) suggest that the Crossport C sill was syndepositional. Stratigraphically higher sills, therefore, must be younger. Some may be related to the Purcell Lava, exposed 50 km southeast. Samples of hornfels produced by Purcell Lava east northeast of area have K-Ar apparent ages of 1075±(6%) m.y. (Hunt, 1962)

STRUCTURE

The Eastport area is characterized by a relatively simple structural setting with local complexities in the northcentral, northwestern and southcentral parts of the area. East of the Moyie River, beds typically strike north-northwest and dip to the west. Farther northeast, strata in the lower part of the Prichard Formation are deformed into broad, open folds. North of east-west faults in the northern part of the map, these folds extend farther west and the beds strike more nearly north. West of the Moyie River, strikes swing from north-northeast in the south to north-northwest in the north with dips typically to the east. This simple pattern is interupted in the north by north-plunging synclines west of vertical faults and by Mesozoic intrusions that in part crosscut and in part deform the invaded beds.

The Moyie-Leonia fault, the major structural feature within the map area, separates the two areas of oppositely dipping beds along the Moyie River. South of the Eastport area, Calkins and MacDonald (1909) named this structure the Lenia Fault and recognized it as a high angle, westward dipping overthrust fault with the downthrown side to the east. North of the map area, the fault is a steeply dipping curvilinear structure called the Moyie Fault (Schofield, 1915). Kirkham and Ellis (1926) recognized the continuity of the structure and called it the Moyie-Lenia overthrust fault. Stratigraphic displacement diminishes from about 10700 m (35,000 feet) of Belt strata plus about 3050 m (10,000 feet) of metadiabase sills near Cranbrook British Columbia to 7925 m (26,000 feet) in the northwest corner of the Libby Quadrangle (Erdmann, 1941). Johns (1970) speculates that Lenia was a misspelling of Leonia, a town near its best exposure nine km south of the map area. In order to minimize any persisting ambiguity, this structure is referred to here as the Moyie-Leonia Fault.

Near the south edge of the map area, Belt strata as young as the Mount Shields Formation are exposed on the east side of the Moyie-Leonia fault, and a sliver of possibly Cambrian dolomite crops out adjacent to the fault. Northward, a minimum of 5600 m of section is progressively cut out until near the north edge of the map area, the Moyie-Leonia fault cuts as deep as the lined argillite unit of the Prichard Formation. Still farther north the structure is more complicated and nearly vertical beds of purple banded siltite and quartzite of the middle Burke occur immediately east of the major trace of the fault.

All of the rocks adjacent to the Moyie-Leonia fault on its west side are mapped with the quartzite unit of the Prichard Formation or as the metadiabase included within it. The argillite and siltite unit of the Prichard formation occurs near the fault immediately south of the map area. The stratigraphic throw in the south, therefore, is the sum of thicknesses of formations between this argillite and siltite unit and the Mount Shields Formation--approximately 6870 to 8220 meters (using the extremes of estimated thicknesses in the Description of Map Units). Farther north, absence of the argillite and siltite unit and presence of metadiabase next to or near the Fault indicate that the Fault cuts down section northward as it does on the east side. On the east, no more than 1000 meters of the Prichard Formation quartzite unit are known between the argillite and siltite unit and the zone in which sills are concentrated. If the sections on both sides of the fault are comparable, the stratigraphic throw near the north edge of the map may be no more than the thickness of the Prichard Formation between the transition zone and the top of sills-- or less than 1000 m. Therefore, the stratigraphic throw apparently decreases northward along most of the fault within the map area, and it appears to be less than reported elsewhere (Erdmann, 1941).

The attitude of the fault is steep but imprecisely known. Specifically, the trend of the fault trace shows no deflection where it crosses topography and in the northern part of the area nearly vertical beds of middle Burke Formation include nearly vertical shear zones. Nine km south of the map area, westward facing beds of Mount Shields Formation are overturned and faulted against metaigneous rock in the Prichard Formation. The associated shear zone, which shows discoloration of the rocks probably due to frictional heating, appears to dip steeply eastward parallel to bedding in the Mount

Shields Formation.

Sense of movement on the Moyie-Leonia fault is up on the west. This is indicated by exposures all along the west side of the fault of rocks consistently older than those along the east. Local east dips in fault slivers and folds along the east side of the fault are consistent with west-side-up drag. Southeast plunge of minor folds about 10 km south of Eastport at the north edge of the map suggest that motion there had a component of left slip.

The Moyie-Leonia Fault is paralleled on both sides by what appear to be vertical or near vertical faults that in any case dip more steeply than bedding. In the northwest corner of the map, synclinal structures west of one such fault are consistent with drag of the east side up-- in other words, motion opposite to that of the main fault. The most continuous fault in the eastern half of the map dips steeply west and appears to cut out section in a manner consistent with east-side-up motion.

The timing of motion along the faults and development of the folds is poorly constrained. Motion of the Moyie-Leonia Fault is bracketed only by involvement of the probable Cambrian dolomite, and overlap by Quaternary deposits, so motion almost anytime in the Phanerozoic cannot be ruled out. Both of the intrusive rocks along the west edge of the map appear to crosscut faults and inclined strata without themselves showing evidence of later deformation. Thus the development of the eastward dip there and probably the up to the east fault north of the intrusion most likely predates the mid-Cretaceous and may be Triassic in age. If the Moyie-Leonia Fault is related to the folding and faulting on the west, it too should predate the mid-Cretaceous and possibly the Triassic.

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