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MOSCOW-BOISE-POCATELLO

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LEWIS AND OTHERS

Geologic Map of the Oden Bay Quadrangle, Bonner County, Idaho Disclaimer: This Digital Web Map is an informal report and may be revised and formally published at a later time. Its content and format may not conform to agency standards. Reed S. Lewis, Mark D. McFaddan, Roy M. Breckenridge, and Russell F. Burmester 2007 CORRELATION OF MAP UNITS Glacial and Related SYMBOLS **Qgf Glaciofluvial deposits (Pleistocene)**—Coarse silt, sand, and gravel deposits INTRODUCTION derived from glacial outwash. Mostly stratified sands and rounded gravels. Commonly occurs in channels within and interbedded with Qgl. Soils are Contact: line showing the boundary between one map unit and Quaternary deposits on this 1:24,000-scale Oden Bay quadrangle were gravelly silt loam to gravelly sand loam of Bonner —Kootenai series. Unified another; dashed where approximate. The location accuracy mapped in 1988-1989 and 2004-2006 by R.M. Breckenridge. Surficial Soil Classification GM, GP, and SM. Thickness a meter to over tens of meters. of contact is 80 feet or more on the ground. mapping of part of the quadrangle by A.F. Harvey III (1984b) aided our compilation. Bedrock was mapped in 2005-2006 by R.S. Lewis, M.D. igh-angle fault: ball and bar indicates downthrown side of a INTRUSIVE ROCKS McFaddan, and R.F. Burmester, and augmented by compilation from Harrison normal fault; dashed where approximately located; dotted and Schmidt (1971), Doughty (1995), and unpublished 1994 mapping by where concealed. Lamprophyre dikes (Eocene)—Biotite lamprophyre dikes with 1-2 mm biotite phenocrysts in a fine-grained groundmass. High magnetite content (magnetic · Fault, type unknown: dotted where concealed location inferred. susceptibility about 15-20 x 10⁻³ SI units). Low metamorphic grade metasedimentary rocks of the Belt-Purcell Supergroup, Precambrian in age, underlie much of the Oden Bay quadrangle. Granitic Dacite dikes (Eocene)—Hornblende-biotite dacite dikes, commonly porphyritic rocks of Cretaceous age increase eastward in the northern part of the with blocky phenocrysts of feldspar up to 3 cm and biotite and hornblende quadrangle and a small Eocene pluton is exposed in the western part. phenocrysts to 5 mm. High magnetite content (magnetic susceptibility 8-Numerous Eocene dacite dikes cut both Belt Supergroup and the granitic rocks. 12 x 10⁻³ SI units). Commonly light gray, resistant, and form cliffs and talus slopes. Dikes are a few meters wide; rarely 50. Some appear to continue for The geomorphic subsections of the quadrangle include parts of the Selle 100 to 1000 m but most are not exposed continuously enough to demonstrate Lowland, the Pend Oreille Lake basin, and the Talache Uplands (Savage, their extent. Age is about 48-52 Ma based on K-Ar and 40 Ar/39 Ar dating of 1967). During Pleistocene glaciations a lobe of the Cordilleran Ice repeatedly hornblende and biotite (Harrison and others, 1972; Miller and Engels, 1975; advanced southward from Canada along the Purcell Trench. Tributary valley - Strike and dip of bedding, ball indicates bedding known to be glaciers from the Selkirk Range on the west side of the trench and the Cabinet Range on the east side contributed to the main ice stream. The Pack River Quartz monzonite dikes (Eocene)—Fine-grained biotite-hornblende quartz drainage was the source of a major tributary valley glacier in the Selkirk Strike and dip of foliation monzonite grading to monzonite. Contains 14-18 percent acicular hornblende Range. The river flows across the Purcell Trench and drains into Lake Pend phenocrysts and lesser amounts of biotite (3-7 percent). High magnetite Strike and dip of cleavage. Oreille. East of this quadrangle the ice blocked the Clark Fork valley, formed content (magnetic susceptibility about 14-25 x 10⁻³ SI units). Dike west of Glacial Lake Missoula, and deeply scoured the Pend Oreille Lake basin to Pack River in the northeast part of section 36 contains small inclusions of Strike and dip of overturned bedding. the south. After retreat of the continental ice, alpine glaciers persisted until fine-grained syenite. nearly 10,000 years ago in the higher cirques of the Selkirk Range. Glacial Strike and dip of bedding. deposits fill the depression of the Purcell Trench and form the Selle Lowland. Tggd Granodiorite and granite (Eocene)—Hornblende-biotite granodiorite and granite. Holocene alluvium, colluvium, sand deposits, and lacustrine sediments are Strike of vertical bedding. Biotite 5-10 percent and hornblende 5-10 percent. Contains 0.5-1.5 cm mostly reworked glacial deposits. long plagioclase and potassium feldspar phenocrysts in a fine- to mediumgrained groundmass. High magnetite content (magnetic susceptibility about DESCRIPTION OF MAP UNITS 15-20 x 10⁻³ SI units). A sample from near Kootenai Point vielded a 49.8 Ma K-Ar age on biotite (Miller and Engels, 1975, recalculated using new decay constants). Intrusive rocks are classified according to IUGS nomenclature using normalized values of modal quartz (Q), alkali feldspar (A) and plagioclase (P) on a ternary Kbgd Biotite granodiorite (Cretaceous)—Massive biotite granodiorite intrusive into diagram (Streckeisen, 1976). Mineral modifiers are listed in order of increasing the Prichard Formation. Locally porphyritic with potassium feldspar phenocrysts abundance for both igneous and metamorphic rocks. Grain size classification up to 2 cm in length. Biotite 6-8 percent in conspicuous books. Unit contains of unconsolidated and consolidated sediment is based on the Wentworth subhedral epidote. Moderate magnetite content (magnetic susceptibility scale (Lane, 1947). Bedding thicknesses and lamination type are after McKee about 3-7 x 10⁻³ SI units). Mapped as the granodiorite of Rapid Lightning and Weir (1963), and Winston (1986). Thicknesses and distances are given Creek by Miller and others (1999). K-Ar ages on biotite range from 75 to 98 in abbreviation of metric units (e.g., dm=decimeter). Multiple lithologies Ma (Harrison and others, 1972; Miller and Engels, 1975). Wide range may REFERENCES within a rock unit description are listed in order of decreasing abundance. indicate unmapped intrusive phases or, more likely, differential uplift Soil series are from Weisel and others (1982). Unified Soil Classifications and cooling. of the surficial units are from Harvey (1984a). Anderson, H.E, and W.D. Goodfellow, 2000, Geochemistry and isotope chemistry Ymi Mafic intrusive rocks, undivided (Mesoproterozoic)—Medium-grained hornblende of the Moyie Sills: Implications for the early tectonic setting of the gabbro, biotite quartz diorite, biotite-hornblende quartz diorite and fine-Mesoproterozoic Purcell basin: in Lydon, J.W., T. Höy, J.F. Slack, and M.E. MAN-MADE DEPOSITS Knapp, The Geological Environment of the Sullivan deposit, British Columbia: grained diorite. Low magnetite content (magnetic susceptibility 0.2-0.7 x 10⁻³ SI units). Quartz diorite to quartz monzodiorite occurs as middle and Geological Association of Canada, Mineral Deposits Division, Special m Made land (historical)—Highway and railway fills and causeways across the upper parts of apparently differentiated mafic sills and as separate sills in Publication No. 1, p. 302-321. Pack River Flats. Numerous small fills along the shore of the lake are Bishop, D.T., 1976, Petrology and geochemistry of the Purcell sills, Boundary the south-central part of section 26 (west-southwest of Lost Lake), in the eastern part of section 31 (east of Pack River and Trout Creek), and in the County, Idaho and adjacent areas: Ph.D. thesis, University of Idaho, 147 p. Cressman, E.R., 1985, The Prichard Formation of the lower part of the Belt north-central part of section 29, west of Bottle Bay. All may exhibit some ALLUVIAL AND Supergroup, Proterozoic Y, near Plains, Sanders County, Montana: U.S. granophyric textures. Finer-grained varieties typically in thinner bodies. LACUSTRINE DEPOSITS Geological Survey Bulletin 1553, 64 p. Probably all are Moyie Sills similar to the sills described by Bishop (1976), Cressman, E.R., 1989, Reconnaissance stratigraphy of the Prichard Formation Höv (1989). Anderson and Goodfellow (2000), and Gorton and others Qal Alluvium (Holocene)—Varied silt, sand, and gravel deposits in modern stream (Middle Proterozoic) and the early development of the Belt Basin, Washington, (2000). Most are tholeites or differentiates from tholeitic magma and they drainages. Coarser toward Cabinet Mountains and finer in the Selle Lowland. intruded into middle and lower parts of the Prichard Formation. Intrusion Idaho, and Montana: U.S. Geological Survey Professional Paper 1490, 80 p. Moderately sorted to well sorted silt, sand and pebble and cobble gravels of many sills was at shallow levels closely following sedimentation (Cressman, Doughty, P.T., 1995, Tectonic evolution of the Priest River complex and the age with occasional boulders. Mostly reworked glacial deposits in the lowlands of basement gneisses: constraints from geochronology and metamorphic 1989; Sears and others, 1998). and post glacial colluvium in the mountains. Typical soils are silt loam to thermobarometry: Ph.D. thesis, Queen's University, 408 p. sandy- and gravelly loam. Unified Classification is GP-GM and SP-SM Soil Doughty, P.T., and R.A. Price, 2000, Geology of the Purcell Trench rift valley BELT-PURCELL SUPERGROUP series of Hoodoo and Wrencoe. Thickness is thin to several meters. and Sandpoint Conglomerate: Eocene en echelon normal faulting and synrift sedimentation along the eastern flank of the Priest River metamorphic Ypad Prichard Formation, members a, b, c and d (Mesoproterozoic)—Rusty weathering, Alluvium and deltaic deposits of the Pack River (Holocene)—Interbedded dark gray siltite and argillite couplets, siltite, and rare lighter quartzite. Low complex, northern Idaho: Geological Society of America Bulletin: v. 112, alluvium at the mouth of the Pack River and its delta in Pend Oreille Lake. no. 9, p. 1356-1374. Consists of soft clayey silt; at depth is locally underlain by late glacial magnetite content (magnetic susceptibility 0.02-0.4 x 10⁻³ SI units). All Fillipone, J.A., 1993, Tectonic and thermochronologic evolution of the Cabinet members a through d to the east in the Trout Peak quadrangle (Lewis and outwash, till, or Missoula Flood deposits. The pattern designates the distribution and Selkirk Mountains, northwest Montana and northeast Idaho: Ph.D. thesis, of the unit prior to construction of Albeni Falls Dam. others, 2006) contain mafic sills, as do the rocks assigned to this unit in the University of California at Los Angeles, 341 p. Oden Bay quadrangle. Couplets typically less than one cm thick are even Qbs Beach deposits (Holocene)—Coarse sand to silty sand and gravel deposited parallel, although some zones have undulating or uneven bedding, shallow Fillipone, J.A., and An Yin, 1994, Age and regional tectonic implications of Late along the shoreline of Lake Pend Oreille. Mostly are moderately sorted. Cretaceous thrusting and Eocene extension, Cabinet Mountains, northwest load casts, cross lamination and soft sediment features. Scattered intervals Forms accreted beaches, bars and spits in areas of lower wave energy along Montana and northern Idaho: Geological Society of America Bulletin, v. both north and south of highway 200 west of Pack River contain larger dmthe shore. Deposits are classified as GW-GP and SW-SP and lack soil cover. 106, p. 1017-1032. scale disrupted bedding associated with contorted argillite rip-up clasts. Thickness up to several meters. Gorton, M.P., E.S. Schandl, and T. Höy, 2000, Mineralogy and Geochemistry Argillite tops typically darker than siltite but locally are light weathering. 17' 30' of the Middle Proterozoic Moyie sills in southeastern British Columbia: in Siltite layers, both cm- and dm-scale, are typically dark gray, some weathering Qlm Lake deposits (Holocene)—Consists of soft clayey silt; at depth is locally underlain light gray. Scattered weathered surfaces of massive dm, rusty-weathering Lydon, J.W., T. Höy, J.F. Slack, and M.E. Knapp, The Geological Environment by late glacial outwash, till, or Missoula Flood deposits. The upper limit of siltite exhibit internal mm even laminations. Light gray to white weathering of the Sullivan Deposit, British Columbia, Geological Association of Canada, the unit and Lake Pend Oreille is controlled by Albeni Falls Dam. The quartzite as isolated dm-scale beds and dm- to rare m-scale beds amalgamated Mineral Deposits Division, Special Publication No. 1, p. 322-335. maximum water level is 631m (2071.7 feet) and the normal minimum is Harrison, J.E., and P.W. Schmidt, 1971, Geologic map of the Elmira quadrangle, up to a few meters thick contain rare medium-grained quartz sand both as 625 m (2051.0 ft). The unit thickens into Pend Oreille Lake basin. Soils Bonner County, Idaho: U. S. Geological Survey Geological Quadrangle Map basal lags and "floating" grains in a fine-grained matrix, especially in include Capehorn and Hoodoo series. Thickness 1-10 m. GQ-953, scale 1:62,500. exposures along the southern edge of the quadrangle. Both load features Harrison, J.E., M.D. Kleinkopf, and J.D. Obradovich, 1972, Tectonic events at Qaf Alluvial fan deposits (Holocene)—Mixed pebble to cobble gravel deposited as and scour surfaces on a cm scale are common at the bases of some quartzite the intersection between the Hope fault and the Purcell trench, northern beds. Most quartzite contains minor amounts of plagioclase feldspar and fans at the mouths of local drainages. Mostly subangular to angular clasts Idaho: U.S. Geological Survey Professional Paper 719, 24 p. locally 10-12 percent potassium feldspar. Cleavage moderately to poorly derived locally from colluvium and glacial deposits on steep slopes. Unified Harvey III, A. F., 1984a, Surficial geology of the Sandpoint area, Bonner Co. developed inconsistently across the area. Stratigraphic nomenclature from Classification is GM and SM. Soils mainly of the Colburn, Pend Oreille, and Idaho: Idaho Geological Survey Technical Report 84-4, scale 1:24,000. Cressman (1985). Units a-d mapped together because quality of exposures Bonners series. Thickness 1-10 m (3-33 feet). Harvey III, A.F., 1984b, Surficial and environmental geology of the Sandpoint or fault blocks precluded subdivision. Ypad in the Oden Bay quadrangle is area, Bonner County, Idaho: University of Idaho M.S. thesis, 136 p. thick and may extend down-section farther than Prichard units to the east **GLACIAL AND RELATED DEPOSITS** Höy, T., 1989, The age, chemistry and tectonic setting of the Middle Proterozoic in the Trout Peak quadrangle where stratigraphy is better constrained by Moyie sills, Purcell Supergroup, south-eastern British Columbia: Canadian confidence in recognition of Prichard unit C above Ypab (Lewis and others, Qglp Peat deposits (Pleistocene to Holocene)—Organic muck, mud and peat bogs Journal of Earth Sciences, v. 26, p. 2305-2317. 2006). May also extend lower than Plains, Montana section described by in poorly drained paleoglacial outwash channels and kettles of the Selle Cressman (1985). Lane, E.W., 1947, Report of the subcommittee on sediment terminology: Lowland. Interbedded with thin layers of fine sand, silt and clay. Soils of Transactions of the American Geophysical Union, v. 28, no. 6, p. 936-938. the Pywell series and Pt in the Unified Soil System. Thickness varies Lewis, R.S., R.M. Breckenridge, M.D. McFaddan and R.F. Burmester, 2006, STRUCTURE Geologic Map of the Trout Peak Quadrangle, Bonner County, Idaho, Idaho Qgl Glaciolacustrine deposits (Pleistocene to Holocene)—Massive to finely laminated Geologic Survey Digital Web Map 58, Scale: 1:24,000. clay, silt, and sand deposited in ice marginal and post glacial lakes (?) McKee, E.D., and G.W. Weir, 1963, Terminology for stratification and cross-HOPE FAULT stratification in sedimentary rocks: Geological Society of America Bulletin, occupying the Purcell Trench. Exhibits well developed rhythmites and beds of sand and silt. This unit includes deposits in the Selle Lowland and v. 64, p. 381-390. The Hope fault crosses the southern part of the Oden Bay quadrangle beneath discontinuous terraces in tributary valleys at about 732 m (2400 feet) and Miller, F.K., and J.C. Engels, 1975, Distribution and trends of discordant ages Lake Pend Oreille (Harrison and Schmidt, 1971; Harrison and others, 1972; as high as 792 m (2600 feet). Mostly well sorted and finely laminated. of the plutonic rocks of northeastern Washington and northern Idaho: Doughty and Price, 2000). Unlike to the southeast, relative motion on this Contorted bedding and loading structures are common. Overlain by Geological Society of America Bulletin, v. 86, p. 517-528. portion of the fault is apparently not large, as similar-looking rocks of the glaciofluvial outwash deposits on terraces and in tributary valleys. Soils are Miller, F.K., R.F. Burmester, R.E. Powell, D.M. Miller, and P.D. Derkey, 1999, Prichard Formation are present on both sides of the fault. Fillipone and Yin silt loam and silty sandy loams of the Mission-Cabinet-Odenson series. CL Digital geologic map of the Sandpoint 1- by 2-degree quadrangle, Washington, (1994) have suggested that east of the area near Clark Fork, the Hope fault to ML and SM classes in the Unified Soil Classification. Thickness tens of Idaho, and Montana: USGS Open-File Report 99-0144. has only down to the southwest normal motion documented during the meters to over hundreds of meters in drill holes of the Selle Lowlands. Savage, C. N., 1967, Geology and Mineral Resources of Bonner County, Idaho: Eocene. However, in the Oden Bay quadrangle, dacite dikes become Idaho Bureau of Mines and Geology County Report No. 6, 131 p. increasingly abundant and en echelon arrangement suggests that there was Qgu Glacial deposits, undivided (Pleistocene)—Mostly loose cobbly silty sand with Sears, J.W., K.R. Chamberlain, and S.N. Buckley, 1998, Structural and U-Pb a silty fine sand matrix; pebble-to boulder-sized gravel; includes deposits a component of right slip (Harrison and others, 1972). Displacement probably geochronological evidence for .47 Ga rifting in the Belt basin, western of till and associated proglacial outwash and glacial sediments. Occasional decreases westward and displacement on the Hope fault may be transferred Montana: Canadian Journal of Earth Sciences, v. 35, p. 467-475. north and south near its intersection with the Purcell trench fault, immediately large boulders on bedrock and in till. Unstratified to poorly bedded, unsorted Streckeisen, A.L., 1976, To each plutonic rock its proper name: Earth-Science west of the quadrangle. to moderately sorted. In tributary drainages and on slopes composed of Reviews, v. 12, p. 1-33. discontinuous remnants of till and kame terraces, on steeper unstable slopes Weisel, C.J., P.M. Hartwig, S.D. Keirn, and B.J. Turner, 1982, Soil Survey of may take the form of mass movements. May include some interbedded lake Bonner County Area, Idaho, Parts of Bonner and Boundary Counties, United sediments. Soils mainly silt loam of the Pend Oreille series. Thickness varies ACKNOWLEDGMENTS from several to tens of meters. Winston, Don, 1986, Sedimentology of the Ravalli Group, middle Belt carbonate, and Missoula Group, Middle Proterozoic Belt Supergroup, Montana, Idaho Ogg Deposits of glacial outwash gravels (Pleistocene)—Sandy cobble boulder gravel Steve Box of the U.S. Geological Survey provided field maps and thin sections and Washington, in S.M. Roberts, ed., Belt Supergroup: A Guide to Proterozoic from a traverse west of Boyer Slough at the western map boundary. The U.S. mostly preserved as terrace deposits from alpine valley glaciers in the Pack Rocks of Western Montana and Adjacent Areas: Montana Bureau of Mines River valley probably underlies *Qgl* in the Selle Lowland, includes kame Geological Survey Spokane Office provided vehicle and trailer support to and Geology Special Publication 94, p. 85-124. terraces of the Purcell Trench Lobe along the east slopes of the Selkirk the Idaho Geological Survey in 2005. Mountains. Soils of the Bonner-Kootenai series. SP-SM and ML classes in the Unified Soil Classification. Thickness varies; may exceed 50 m (160 Cogt Till deposits (Pleistocene)—Dense silt pebble and cobble till with local boulders deposited by the Purcell Trench Lobe of the Cordilleran Ice sheet. Poorly Field work conducted 2006 Base map scanned from USGS film-positive base, 1989. SCALE 1:24,000 stratified compact basal till includes ground moraine and some interbedded This geologic map was funded in part by the U.S. Geological Survey National Topography by photogrammetric methods from aerial photographs taken Cooperative Geologic Mapping Program, USGS Award No. 06HQAG0020. proglacial deposits. In this quadrangle mostly occurs in bedrock depressions 1986. Field checked 1987. Map edited 1989. and troughs Soils include silt loams and gravelly silt loams of the Pend Digital cartography by Jesse S. Bird and Jane S. Freed at the Idaho Geological Transverse Mercator. 1927 North American Datum. Oreille and Vay-Ardtoo series. Thickness varies; may exceed 50 m (160 feet). 10,000-foot grid ticks based on Idaho coordinate system, west zone. Note on printing: The map is reproduced at a high resolution of 600 dots per inch. The inks are resistant to run and fading but will deteriorate with long-1000-meter Universal Transverse Mercator grid ticks, zone 11. **Ogm Deposits of ground moraine (Pleistocene)**—Silty to sandy boulder till of poorly National geodetic vertical datum of 1929. stratified compact lodgment till includes ground moraine and some Contour interval 40 feet IDAHO interbedded. proglacial deposits. Extensive deposit occupies the Selle Lowland Depth curves and soundings in feet. Datum is lake elevation 2,048 feet. PDF map (Acrobat Reader) may be viewed at www.idahogeology.org. and probably underlies *Qgl*, includes kame terraces along the east slopes Map version 10-4-2007. QUADRANGLE LOCATION of the Selkirk Mountains. Soils include silt loams and gravelly silt loams of the Pend Oreille and Vay-Ardtoo series. Thickness varies; may exceed 50 m ┌─ Pack River Flats ┌─ — Pack River Flood Plain — Pack River Fault Lake Pend Oreille