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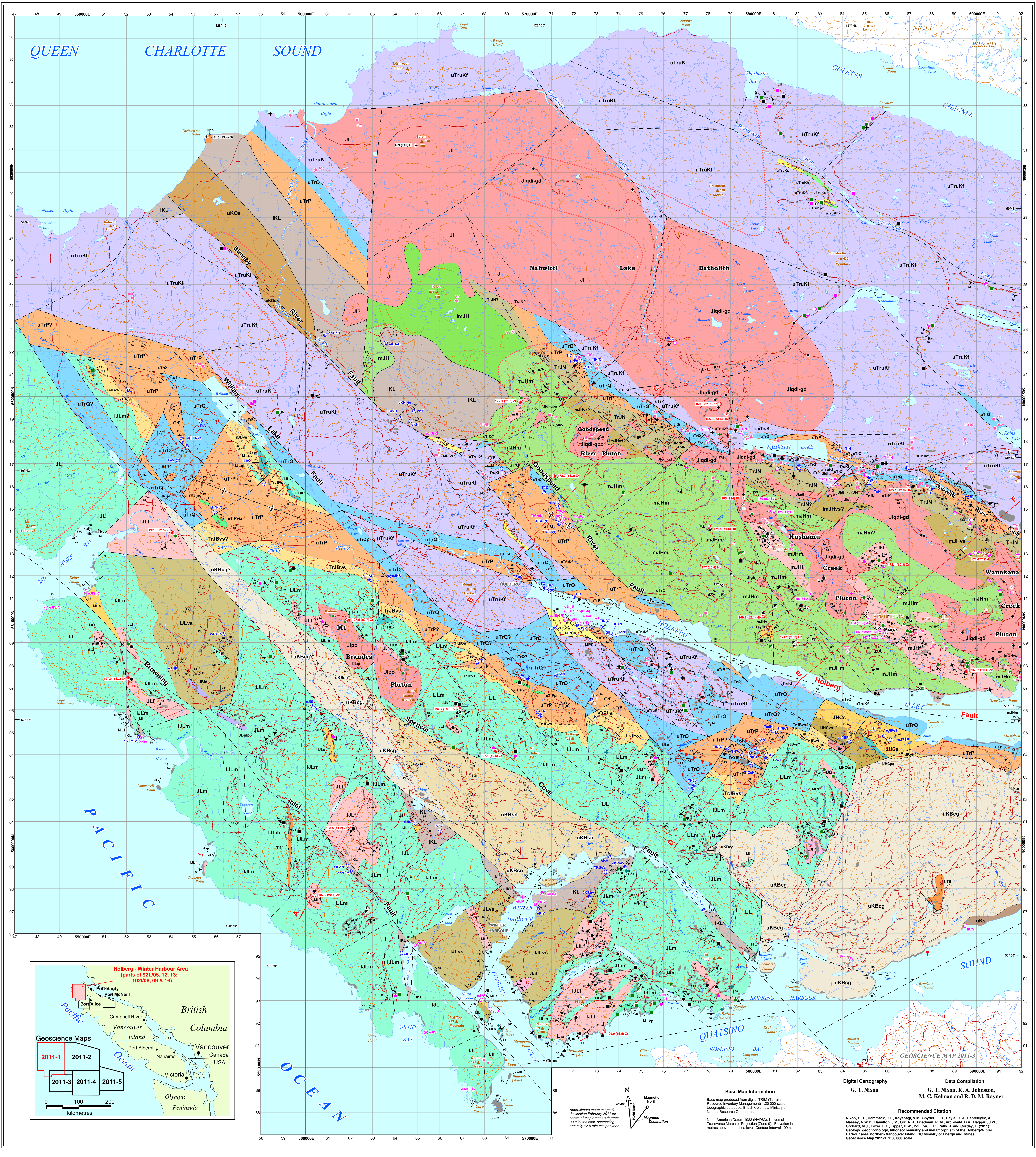
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Geology, Geochronology, Lithochemisrtry and Metamorphism of the Holberg-Winter Harbour Area, Northern Vancouver Island

Parts of NTS 092U05, 12, 13; 102U08, 09 & 16

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Scale 1:50 000
0 2 4
Kilometres

LAYERED ROCKS

UPPER CRETACEOUS
QUEEN CHARLOTTE GROUP EQUIVALENTS (IN PART)
Blumberg Formation
uKbSs: Massive to thin bedded lithic to arkosic sandstone with minor pebbles to cobble conglomerate
uKbGc: Massive conglomerate with minor lenses of coarse-grained lithic sandstone

Lower Jurassic (Hettangian to Sinemurian)
PEGATEM CREEK SILTSTONE
uLPCs: Dark grey to greenish grey, basaltic siltstone and mudstone with minor shaly mudstone; possibly also occurs north of the Holberg-Stratby River faults

UPPER TRIASSIC (Rhoetian) to possibly Lower Jurassic (Hettangian)
VOLCANICLASTIC-SEDIMENTARY UNIT
uTrJvs: Interbedded volcanoclastic and sedimentary strata (predominantly subhorizontal) but to grey-green, thin to very thick bedded, calcareous to non-calcareous, volcanic tuff and tuffaceous sandstone, siltstone and limestone, locally containing volcanic clasts, lapilli tuff and reworked equivalents, and minor vitric tuff; pebbly sandstone, siltstone, and volcaniclastic siltstone and mudstone may include black carbonaceous shale, mudstone, siltstone and limestone (locally containing equivalent to unit TrJ in the Mackenzie-Alice Lake area (Geoscience Map 2011-3 and 2011-4))

UPPER TRIASSIC (Carnian to Rhoetian)
PARSON BAY FORMATION
uTrP: Medium grey to black, thin to medium bedded, impure limestone, calcareous to non-calcareous mudstone, siltstone and shale intercalated with variable proportions of grey green to black tuffaceous siltstone and calcareous sandstone; locally contains pebbly sandstone and conglomerate; zone locally contains rare argillaceous limestone (Moresse zone); limestone locally contains rare argillaceous limestone (Gaston limestone equivalent - see below) near the top of the succession

UPPER TRIASSIC (Carnian to Rhoetian)
KARMTUSEN FORMATION
uTrK: Undifferentiated, dark grey-green basalt flow/volcanoclastic flow lava (outside the map area)

UPPER KAMTUSEN FORMATION: Flow Member
uTruKf: Dark grey-green, aphanitic to plagioclase-phyric basalt flows, commonly amygdaloidal and locally exhibiting better flow features (vesiculate trachyte) and pipe vesicles; may include intercalated flow lava and hydrothermalite

uTruKx: Dark grey-green, plagioclase-megacrystic (1-2 cm) basalt flows, commonly amygdaloidal and locally exhibiting better flow features (vesiculate trachyte) and pipe vesicles; may include intercalated flow lava and hydrothermalite

uTruKs: Small outcrop of plagioclase-megacrystic (1-2 cm) basalt flow, commonly amygdaloidal and locally exhibiting better flow features (vesiculate trachyte) and pipe vesicles; may include intercalated flow lava and hydrothermalite

uTruKt: Dark grey-green, massive to laminated, basaltic breccia and hyaloclastite sandstone

uTruKp: Dark grey-green, closely packed, pillowed basalt flows, aphanitic and vesiculate sandstone

uTruKq: Plagioclase-megacrystic (2-20 cm) basaltic basalt flows

uTruKd: Thin (0.5-5 m) beds and lenses of pale to medium grey, micritic to rarely biotitic or oolitic limestone intercalated with basalt near the top of the flow succession

uTruKc: Thin (0.5-5 m) beds and lenses of inter-volcanic limestone of unit uTruKs

UPPER TRIASSIC (Norian) to Lower Jurassic (Sinemurian or younger)
NAHWITTI RIVER SILTSTONE-WACKE
uTrN: Dark grey to grey-green, medium bedded to thin laminated, siliceous siltstone, mudstone and hydrothermalite; thin wackes, locally contain massive beds of basaltic to andesitic volcanoclastic breccia and thin mylonitic tuff beds

UPPER TRIASSIC (Carnian to Rhoetian)
PARSON BAY FORMATION
uTrP: Similar lithologies as those found south of the Holberg-Stratby River fault system; coarser sedimentary and volcanoclastic deposits appear to be less common and Parson Bay limestone equivalent has not been observed

BONANZA GROUP - SOUTH OF HOLBERG FAULT
Lower Jurassic (Upper Pliensbachian)
HATHAWAY CREEK VOLCANIC-SEDIMENTARY UNIT
uLHCvs: Dark grey to greenish grey, massive to medium bedded, heterolithic volcanic breccia, lithic sandstone and siltstone
uLHCp: Dark grey to grey-green, pillowed to massive, plagioclase-megacrystic (2-20 cm) basaltic to andesitic flows, texturally similar to units uLXLuLp
uLHCs: Dark grey-green, massive to medium bedded and locally laminated, weakly calcareous, lithic sandstone, siltstone, mudstone and minor shale, volcanic breccia and water-washed, basaltic lapilli tuff; carbonized wood fragments and locally fossiliferous

Lower Jurassic (Hettangian to Upper Sinemurian)
LE MAIRE LAKE VOLCANIC UNIT
uLm: Undifferentiated basaltic to hyaloclastic flows and pyroclastic rocks (mainly subhorizontal), includes ash flow and rare airfall tuff and reworked equivalents, minor pillow lava, pillow breccia, hyaloclastite and rare pyroclastic surge deposits, locally interbedded with minor airfall tuff, andesitic and basaltic breccia, wackes, siltstone, mudstone, impure limestone and debris flow deposits
uLm: Dark grey-green, basaltic to andesitic flows with minor intercalated volcanoclastic and sedimentary lithologies similar to unit uLm; locally includes minor pillow lavas, pillow breccia, hyaloclastite and rare pyroclastic surge deposits, locally interbedded with minor airfall tuff, andesitic and basaltic breccia, wackes, siltstone, mudstone, impure limestone and debris flow deposits
uLm: Medium grey, hyaloclastic to dacitic flows, flow domes and/or pyroclastic rocks, including flow and pyroclastic breccias, welded to non-welded crystal tuff lapilli and rare airfall tuff, andesitic and basaltic breccia, locally may include thin sedimentary deposits, high-silica andesite and basaltic breccia
uLm: Dark grey-green, plagioclase-megacrystic (0.5-20 cm), variably amygdaloidal basaltic to andesitic flows, locally intercalated with aphanitic and plagioclase-phyric flows; texturally similar to plagioclase-megacrystic Karmtusen basaltic units uTruKf uTruKp
uLm: Small outcrop of plagioclase-megacrystic basaltic to andesitic flows of unit uLm
uLm: Dark grey-green, plagioclase-megacrystic basaltic to andesitic pillowed flows; texturally equivalent to units uLXLuLp
uLm: Grey-green sedimentary strata including impure limestone, calcareous to non-calcareous mudstone, shale, siltstone, andesite and siliceous equivalents; may include minor intercalated tuff and volcanoclastic breccia
uLm: Interbedded volcanoclastic and sedimentary strata (predominantly subhorizontal) but to grey-green, thin to very thick bedded, calcareous to non-calcareous, volcanic tuff and tuffaceous sandstone, siltstone and limestone, locally containing volcanic clasts, lapilli tuff and reworked equivalents, pyroclastic and apicalitic volcanic breccia, sandstone, siltstone, mudstone, and minor siltstone flow and pyroclastic deposits; may include minor lava flows
uLm: Dark grey-green, basaltic to andesitic lapilli tuff, tuff-breccia and reworked equivalents locally interbedded with pillow lava, pillow breccia, fine-grained hyaloclastite and minor lava flows

WHOLE-ROCK GEOCHEMISTRY LEGEND

Classification	(MgO+2 wt %)/SiO ₂ wt %	Basaltic	Basaltic Andesite	Andesite	Dacite	Phyritic Rocks
	≤ 53	53-57	57-63	63-68	≥ 68	Major Intrusions

Geochronology
 U/Pb zircon date (Ma, 2 sigma error), 2nd, dental zircon (determined by R. M. Friedman)
 K/Ar data (Ma, 2 sigma error), Bi, biotite (determined by M. J. Orchard and Mortensen, 2004)
⁴⁰Ar/³⁹Ar data (Ma, 2 sigma error), Hb, hornblende (determined by D. A. Archibald)
⁴⁰Ar/³⁹Ar data (Ma, 2 sigma error), Hb, hornblende, C, cordillerite, Al, alunite (Bretzinger and Mortensen, 2004; Panteleyev et al., 1995)

Metamorphism
 Hornblende hornfels facies: hornblende-plagioclase-epidote-quartz
 Uppre greenschist facies: actinolite-chlorite-albite-epidote-quartz-actinolite
 Phyllo-pumpellyite facies: many pumpellyite-epidote-quartz-albite-actinolite-epidote-quartz-calcite
 Zeolite facies and sub-sulphate alteration assemblages: Lm, burtonite; Al, alunite; Zn, zincite; Mn, manganite; Rz, corundum; Py, pyrophyllite; Ss, stilpnoite (X-ray diffraction determinations by M. Chauray); maximum regional zeolite grade metamorphism developed in Middle Jurassic Holberg volcanic rocks north of the Holberg-Stratby fault system (determination by M. Chauray)

Mineralization
 Retrograde zeolite mineral assemblages: Lm, burtonite (X-ray diffraction determination by M. Chauray)

Topography
 MNFLE locality (902, 052102 014)
 Flooded (blue)
 Labeled land (brown)
 Stream or river (blue line)
 Contour (100m) (brown dashed line)
 Spot height (m) (black dot)
 Road (gravel) (red line)

Notes
 All isotopic dates are calculated using the decay constants recommended by Steiger and Jager (1977) except estimates of K-Ar decay constants which were calculated using the decay constants recommended by Chappell and Dalrymple (1972). All ages are given as 2-sigma error (19% confidence interval). Geochronology in remote areas and outside the limits of mapping are complete (100% of available samples) or incomplete (less than 100% of available samples). U/Pb zircon dates are from the Geology Survey of Canada, passed away recently their contribution to the geochronology of the study area will be sorely missed.

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