Ministry of Energy and Mines
Minerals Division
Geological Survey Branch

Geological Survey Branch

GEOSCIENCE MAP 2001-1

GEOLOGY OF THE SOUTHERN TOODOGGONE RIVER and NORTHERN McCONNELL CREEK MAP AREAS, NORTH-CENTRAL BRITISH COLUMBIA

PARTS OF NTS 94E/2, 94D/15 and 94D/16

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SCALE 1:50 000

0 1 2 3 4 5
Kilometres

LITHOSTRATIGRAPHY

QUATERNARY

Qal — Colluvium, alluvium and glacial drift.

UPPER CRETACEOUS

SUSTUT GROUP

S2 — Lacustine sandstone and siltstone: Grey, thinly bedded; composed of angular plagioclase, carbonate-altered pyroxene, sparse quartz and biotite grains. Abundant carbonaceous plant debris and rare reed stems, shell debris.

S1 — Conglomerate with sandstone lenses: Conglomerates are composed of well-rounded cobbles of Triassic basalts, vein quartz, granite and chert; thick, crudely layered and graded planar beds.

LOWER JURASSIC

Js — Shallow marine siltstone and sandstone: Drab olive green, thickly laminated to thinly bedded. Fossils include rare vertebrate fragments accompanied by the Jurassic bivalve, *Bositra*.

HAZELTON GROUP:

TOODOGGONE FORMATION - Exclusively subaerial, andesitic to dacitic pyroclastic rocks and subordinate lava flows. Sparse, trachyte pyroclastic rocks and basaltic hypabyssal intrusions.

H16 — Covered by vegetation, colluvium, alluvium or glacial drift; probably underlain by volcanic rocks of the Toodoggone formation.

KEMESS MEMBER

H15 — Hornblende-augite tuff breccia and lapilli tuff: reddish, oxidized, thickly bedded. (190.8 ± 2.0 Ma by $^{40}Ar/^{39}Ar$)

H14 — Trachyte tuffs and minor flows: **(H14a)** lapilli tuffs, tan-buff, flaggy weathering, moderately welded; corroded plagioclase and mafics impart a pitted appearance; **(H14b)** subordinate flows with faint laminae and rare lithophysae.

H13 — Dacitic crystal-ash tuff: light grey, composed of 15 % plagioclase, up to 3% biotite and trace quartz phenocrysts; a minor fragmental unit that depositionally overlies unit H12.

H12 — Dacitic lapilli tuff and crystal-ash tuffs: Oxidized with an orange mottled appearance, characterized by up to 15% hornblende crystals less than 1 mm long; lithologically resembles unit H6. (189.9 ± 2.0 and 191.1 ± 1.9 Ma by $^{40}Ar/^{39}Ar(h)$)

H11 — Intraformational oligomictic cobble conglomerate and interbedded sandstone; unconformably rests on unit H8 locally.

SAUNDERS MEMBER

H10 — Volcaniclastic-epiclastic deposits: Lapilli tuff, dark maroon, crudely layered thick beds that when exposed rapidly disintegrate due to probable swelling clay in the matrix, tuffs are dominated by light green, clay-altered vitriclasts and abundant plagioclase fragments; epiclastic intervals consist of feldspathic sandstones and siltstones that commonly contain abundant detrital pyroxene grains, lesser conglomerates and minor mudstones; (194 ± 0.6 Ma by U-Pb(z)); scarce interlayered, dark green aphanitic basalt flows or sills(?).

H9 — Crystal and ash tuffs: Green, platy weathering, contains plagioclase and trace amounts of quartz and biotite; depositionally overlies unit H8 locally.

H8 — Dacite ash-flow tuff: Generally grey-green but south of Attycelley Creek correlative ash-flow tuffs are oxidized to reddish colors, incipiently to densely welded, diagnostic pyroclasts consist of plagioclase, hornblende, biotite and quartz crystal fragments and distinctive flattened, clot-like porphyritic cognate vitriclasts; minor volcanic breccia. (192.6 ± 2.1 to 194.5 ± 1.9 Ma by $^{40}Ar/^{39}Ar(b,h)$)

H7 — Andesitic flows and tuffs: Maroon or green, dominated by plagioclase less than 2 mm long, differs from other Toodoggone units by the absence of visible quartz, biotite or hornblende; air-fall deposits may locally contain tear-shaped bombs, depositionally overlies unit H6 locally.

H6 — Dacitic crystal-ash and lapilli tuffs: Light green to light maroon; thick, crudely layered beds with platy weathering, characterized locally by up to 15 % minute vitreous hornblende averaging 1 mm long, biotite up to 5%, and lesser quartz phenocrysts. Circa 193 to 194 Ma by $^{40}Ar/^{39}Ar(h)$.

H5 — Intraformational oligomictic cobble-boulder conglomerate derived from andesite flows resembling unit H4; clasts are characterized by blocky feldspar, hornblende up to 5 mm long and augite; interbedded layered intervals are composed of pebble conglomerates and feldspathic sandstones.

METSANTAN MEMBER

H4 — Andesite flows, grey-green to light purple; 15-25 % blocky feldspar between 2 and 5 mm in length, chloritized biotite and hornblende (2 % combined), trace quartz; minor interflow tuff and monolithic debris flows; flows are similar in appearance and phenocryst mineralogy to those comprising unit A3a.

DUNCAN MEMBER

H3 — **(H3a)** Dacitic tuffs: Grey-green, medium-grained crowded texture with up to 40 % plagioclase, quartz to 5%, relict hornblende and biotite (up to 3 % combined), relatively sparse but widespread accidental lithic fragments include augite phyric and mega-plagiophyric basalts of unit T3, and a pink, porphyritic quartz-feldspar granitoid; interpreted as probable non-welded crystal-rich ash-flow tuffs; **(H3b)** minor bedded volcanic-epiclastic deposits. (199.1 ± 0.3 Ma by U-Pb(z))

H2 — **(H2a)** Lapilli tuffs with volcaniclastic-epiclastic interbeds: Reddish brown, less commonly green, massively bedded except for local, well layered epiclastic intervals; fragments are typically reddish brown, aphanitic or biotite-quartz-plagioclase phyric, lapilli mixed with varying proportions of broken phenocryst fragments; **(H2b)** volcaniclastic-epiclastic sections composed of sandstones, siltstone and maroon mudstones are typically planar bedded and internally graded; they provide local markers within the otherwise thick, monotonous tuffs. (200.4 ± 0.3 Ma by U-Pb(z))

H1 — Basal conglomerates and interbedded sandstones: **(H1a)** a lower oligomictic conglomerate is composed of hematized cobbles and boulders derived from Takla Group basalts of unit T3; **(H1b)** an overlying polymictic conglomerate is composed mainly of quartz and biotite-bearing lithologies derived from the Toodoggone formation, but it also contains granite and Takla basalt clasts; interbedded sandstones with a pink, laumontite-rich matrix; **(H1c)** light green quartz-biotite crystal-ash tuffs may underlie or interfinger these basal conglomerates.

UPPER TRIASSIC

TAKLA GROUP - An initial marine shale is stratigraphically overlain by subaerial basaltic flows with subordinate pyroclastic rocks and locally significant wacke intervals.

T4 — Covered by vegetation, colluvium, alluvium or glacial drift; probably underlain by strata of the Takla Group.

T3 — Basaltic flows and subordinate tuffs, and associated epiclastic rocks: Dark green to shades of maroon when oxidized, thick flows typically forming strongly fractured cliffs and craggy physiography. **(T3a)** Lava flows and tuffs characterized by augite and plagioclase phenocrysts; subordinate tuffs forming laterally discontinuous deposits are composed of aphanitic and porphyritic basaltic lapilli and uncommon blocks; **(T3b)** mega-plagiophyric basaltic flows containing distinctive plagioclase laths up to 2 cm long; **(T3c)** aphanitic basalts, lithologically indistinguishable from unit A1a; **(T3d)** sandstone and siltstone composed exclusively of augite and plagioclase grains, and minor oligomictic cobble-boulder conglomerate as alternating dark and lighter green layers occurring as interbeds within flows of unit T3a; vary from several metres thick to intervals up to 175 m thick; **(T3e)** chlorite schist, presumed to be derived from Late Triassic basalts.

T2 — Polymictic conglomerate: Granules and pebbles composed of chert, limestone and rare granite; locally underlies unit T3a west of Thutade Lake. (236.5 ± 4.5 Ma on granitic clast by $^{40}Ar/^{39}Ar$)

T1 — Calcareous mudstone and siltstone: Black, flaggy weathering; minor dark grey to black micritic limestone as pods and discontinuous beds up to 0.5 m thick. Limy horizons may contain the bivalve *Halobia*, scarce ammonite fragments and rare belemnoids.

MID-PENNSYLVANIAN TO LOWER PERMIAN

ASITKA GROUP - The stratigraphically lowest mafic volcanic succession passes locally into rhyolitic pyroclastic rocks overlain by andesitic flows containing sandstone and siltstone interbeds. A sedimentary-dominated upper succession has coralline limestone gradationally overlain by chert and intercalated siltstone and black siliceous mudstone.

A7 — Covered by vegetation, colluvium, alluvium or glacial drift; probably underlain by strata of the Asitka Group.

A6 — Undivided volcanic rocks of uncertain stratigraphic position: **(A6a)** basaltic to andesitic rocks, commonly chloritized and locally foliated; **(A6b)** dacitic to rhyolitic pyroclastic and flow rocks.

A5 — **(A5a)** Chert interlayered with siltstone and mudstone: Cherts are light green to grey and less commonly red jaspероidal varieties, well bedded in parallel layers between 2 and 15 cm thick; minor limestone interbeds similar to unit A4a; approaching the upper contact are light grey or black chert and interbedded siliceous black mudstone with diagnostic rusty weathering of authigenic disseminated pyrite; indeterminate bivalves are present in the black mudstones; **(A5b)** siliceous siltstone and feldspathic sandstone, light green, subordinate interbeds of thinly laminated coraline limestone, black argillite and aphanitic basalt; **(A5c)** rare, cobble conglomerate derived locally from unit A2b, passes upwards into feldspathic sandstone then into black rusty mudstone with grey-black limestone lenses containing solitary corals.

A4 — **(A4a)** Limestone; off white, light grey weathering, recrystallized, massive to thickly bedded; locally contains discontinuous chert beds, lenses and nodular layers; locally interlayered or intruded(?) by massive basaltic sills(?); **(A4ai)** limestone, light green weathering, thinly laminated; **(A4b)** interlayered fossiliferous limestone and calcareous lapilli tuffs, light green to dark maroon, thin to medium thickly bedded. Silicified solitary corals and crinoid debris are abundant in unit A4a and are accompanied by fusilinaceans.

A3 — **(A3a)** Andesite lava flows; medium green and less commonly maroon; sparse, but diagnostic quartz phenocrysts typically less than 2 mm in diameter and 15 to 25 % equidimensional blocky plagioclase phenocrysts between 3 and 4 mm; green, volcanic siltstone, sandstone to granule conglomerate are found as thinly bedded intervals within the flows; **(A3b)** rare ash and lapilli tuff layers containing trace quartz phenocrysts; closely resembles tuffs comprising the Toodoggone formation.

A2 — **(A2a)** Rhyolitic lapilli tuff and ash-flow tuff; off white to light grey, aphanitic and flow laminated rhyolitic pyroclasts, moderately welded zones contain chloritized fiamme; scarce intervals of green and maroon tuffs composed of ash, crystals and lapilli, rare blocks and accretionary lapilli, tuff intervals up to 25 m thick (308.4 ± 0.7 Ma by U-Pb(z)); **(A2b)** Rhyolite lava flows: grey, aphanitic with faint flow laminae (309.7 ± 3.6 Ma by U-Pb(z)); **(A2c)** lapilli and crystal-ash tuffs, grey, well bedded; less than 50 m thick; locally thermally metamorphosed near intrusive contacts.

A1 — **(A1a)** Basalt flows; dark green, massive and strongly fractured; generally aphanitic but may contain sparse, chloritized pyroxene phenocrysts; locally deformed to chlorite schist adjacent to the Ingenika Fault; may contain pods of grey weathering limestone and jaspероidal silica; **(A1b)** minor black mudstone alternating with feldspathic siltstone to coarse-grained sandstone; **(A1c)** metasedimentary rocks containing garnet and biotite and locally interlayered with comparatively undeformed and unmetamorphosed aphanitic basalts, foliated; **(A1d)** minor limestone, light grey to light green, massive to thinly laminated; minor garnet-bearing skarn; resembles units A4a and A4ai but appears to be bounded by basalts of unit A1a.

INTRUSIVE and METAMORPHIC ROCKS

EARLY JURASSIC

BLACK LAKE INTRUSIVE SUITE - Epizonal and sub-volcanic-emplaced biotite-hornblende-titanite-bearing stocks and smaller plutons of intermediate composition that are co-spatial and comagmatic with extrusive rocks of the Toodoggone Formation.

BL — Unnamed, isolated intrusions of the Black Lake suite: These intrusives vary in texture from inequigranular to equigranular, and less commonly porphyritic and contain variable amounts of hornblende, biotite and titanite. Granodiorite **(BLgd)**, hornblende diorite **(BLhd)**, pyroxene-quartz diorite **(BLqd)**, monzogranite **(BLmg)**, quartz monzonite **(BLqm)**, quartz monzodiorite **(BLqmd)**.

BLF — Fredrikson stock: Monzogranite, pink, medium to coarse grained, equigranular, 15 % combined horn-blende and biotite in roughly equal proportions. A similar monzogranite north-northeast of Serrated Peak (unit BLmg) is distinguished by 2-3% mafics that consist solely of chloritized biotite. (191.0 ± 0.4 Ma by U-Pb(z))

BLM — McConnell stock: Quartz monzonite, light pink, medium grained, inequigranular, approximately 10 % combined mafics with either hornblende or biotite dominant, rare potassium feldspar megacrysts; isolated plutons locally sheared adjacent to the Ingenika Fault; compositionally unclassified sheared granitoid **(BLsg)**.

BLD — Duncan stock: Quartz monzonite, light pink to greyish white, inequigranular randomly oriented medium to coarse grained subhedral plagioclase and fine intercrystalline quartz and potassium feldspar, 20 % combined mafics with modal hornblende greatly exceeding biotite. (197.3 +1.7/-0.9 Ma by U-Pb(z))

BLG — Giegerich pluton: Granodiorite, light pink, medium grained, equigranular, 15 to 25 % combined mafics with modal hornblende greatly exceeding biotite. Quartz monzodiorite and lesser quartz diorite phase, light grey to white, medium grained, predominantly unaltered green hornblende to 20 % and up to 2% chloritized biotite, 3-7% augite may be locally present in quartz diorites. (197.5 ± 2.0 Ma by U-Pb(z))

BLML — Maple Leaf sill: A tabular, southwest-inclined sill that hosts disseminated and fracture-controlled mineralization at the Kemess Au-Cu porphyry deposit; the hypogene zone **(BLMLh)** has extensive and intensive potassic alteration which obliterates primary mineralogy and texture, thus inhibiting classification of the original granitoid (199.6 ± 0.6 Ma by U-Pb(z)); supergene zone **(BLMLs)**.

BLS — Sovereign hypabyssal stock: Quartz monzonite porphyry, greyish pink, 3-5 % prismatic and resorbed quartz phenocrysts and about 10 % combined mafics, dominated by unaltered green hornblende and 1-2 % biotite. Probable subvolcanic feeder to volcanic rocks of unit H3a. (202.7 +1.9/-1.6 Ma by U-Pb(z))

BLJ — Jensen pluton: Quartz monzonite, white, medium to coarse grained, myrmekite, inequigranular, 5-7 % combined mafics comprised almost exclusively of unaltered green hornblende, rare potassium feldspar megacrysts. (201.2 ± 2.6 Ma by U-Pb(z))

DIKES

b,bp — Basalt dikes and rare plug: dark green; recessive weathering; typically less than 2 m wide; fine grained, aphanitic to sparsely porphyritic texture, 2-5 % chloritized pyroxene, sparse medium grained plagioclase phenocrysts, calcite-filled amygdules; rare, purple weathering basalt plug (subunit **bp**).

d — Andesitic to dacitic feldspar ± quartz porphyry: light pink, orange to brick red weathering, typically porphyritic due to 15-25% medium grained plagioclase, trace to 3% quartz and 5-10% combined hornblende and biotite phenocrysts, the latter generally altered to chlorite; range in width up to 30 m with the average less than 3 m.

r — Quartz rhyolite porphyry: conspicuous quartz phenocrysts as large as 1.5 cm in diameter (up to 20 %), off white to pale green groundmass; dikes up to 40 m wide; proximal to and possibly comagmatic with the Sovereign intrusion (unit BLS) except for a similar dike that cuts broadly folded Paleozoic rocks north of Serrated Peak dated at 195.7 ± 2.5 Ma by U-Pb(z).

LATE TRIASSIC

LTU — Alaskan-type ultramafic laccolith, plug and stock-size intrusions: undivided intrusive complexes **(LTU)**, or homogeneous phases composed of pyroxene diorite **(LTUd)**, hornblende gabbro **(LTUgb)**, biotite-hornblende clinopyroxenite **(LTUcpx)** and pyroxenite **(LTUpx)**; cut by multiple phases of mafic to felsic dikes.

LTd — Pyroxene diorite, medium grained, contains about 30 % augite; occupies the lower slope of Serrated Peak. Sheared diorite and monzodiorite adjacent to the Ingenika Fault near McConnell Lakes.

LTb — Mega-plagiophyric basalt hypabyssal intrusions.

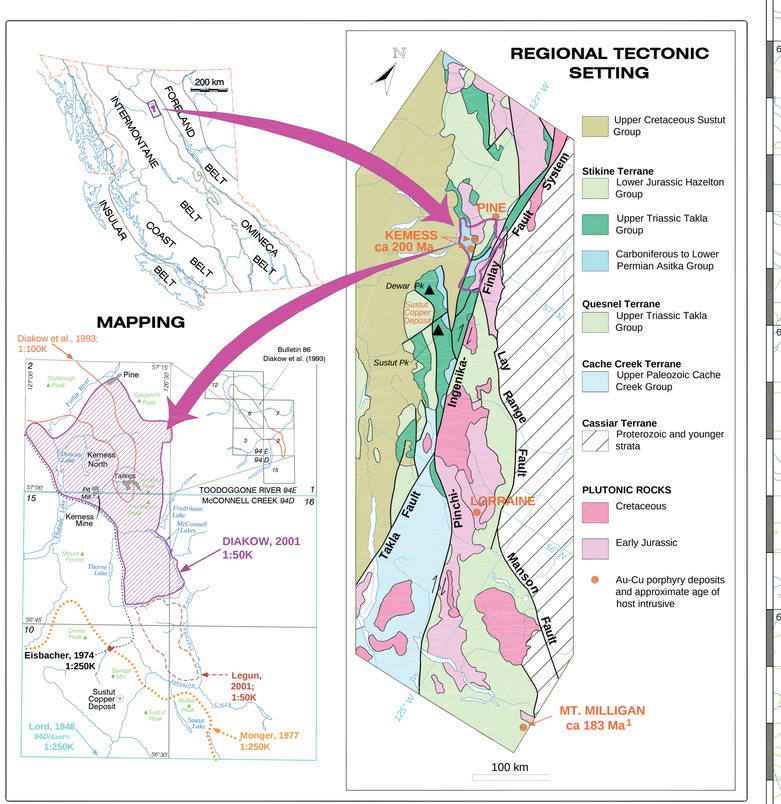
LTmv — Metavolcanic rocks: Amphibolite gneiss and chlorite schist adjacent to the margin of some ultramafic intrusions; the protolith is probable Upper Triassic volcanic rocks.

Symbols

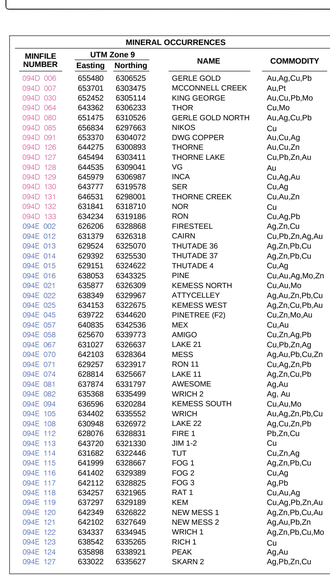
- Stratigraphic and/or intrusive contact (defined, approximate, inferred)
- Unconformity (defined, approximate, inferred)
- Bedding
- Foliation (inclined, vertical)
- Igneous layering
- Fold axis (antiform, synform)
- Fault (defined, approximate, inferred)
- Normal fault (defined, approximate, inferred)
- Thrust fault (defined, approximate, inferred)
- Strike-slip fault (defined, approximate, inferred)
- Fossil site and GSC collection number (C-211439)
  - Macrofossil (F) C-211429
  - Vertebrate (F) C-143742
  - Microfossil (f) C-203486
  - Palynomorph (f) C-211427
  - Conodont (f) C-211439
- Isotopic Age Determination
  - K/Ar (K) 189.0±5.0
  - Ar/Ar (Ar) 193.1±2.1
  - U-Pb (Z) 200.4±0.3
  - (Unreliable) (A)
- Field station location
- Limit of mapping
- Limit of outcrop
- Landslide (trace of headwall escarpment)
- Gossan (approximate extent)
- Regional Geochemical Survey (RGS; 94D and 94E) 3312 5058
- MINFILE occurrence and number (94D and 94E)
  - Developed prospect ■6 ■21
  - Showing ●30 ●45
  - Prospect ■80 ■70
  - Producer ▽94
  - Past producer ⊗7
  - Placer
- Mineral showing
  - Barite o ba
  - Chalcopyrite o cpy
  - Galena o gn
  - Malachite o ma
  - Quartz vein o qv
  - Specularite o spec
  - Sphalerite o sph
- Contours (100 metre intervals)
- Roads (Omineca Mining Road; mining)

Map Base Information
TRIM 1, 1:20000 scale topographic database produced by the B.C. Ministry of Environment, Lands and Parks. North American Datum (NAD) 83, Universal Transverse Mercator Projection, (UTM) Zone 9. Elevations in metres above sea level. Approximate mean magnetic declination (1996) between magnetic north and grid north is 23°16' decreasing 16.9' annually to 2005.

REGIONAL TECTONIC SETTING



MAPPING



MINERAL OCCURRENCES

MINFILE NUMBER	UTM Zone 9 Easting	Northing	NAME	COMMODITY
094D 006	655480	6306525	GERLE GOLD	Au,Ag,Cu,Pb
094D 007	653701	6303475	MCCONNELL CREEK	Au,Pt
094D 030	652452	6305114	KING GEORGE	Au,Cu,Pb,Mo
094D 064	643362	6306233	THOR	Cu,Mo
094D 080	651475	6310526	GERLE GOLD NORTH	Au,Ag,Cu,Pb
094D 089	656834	6297663	NIKOS	Cu
094D 091	653370	6304072	DWG COPPER	Au,Cu,Ag
094D 126	644275	6300893	THORNE	Au,Cu,Zn
094D 127	645494	6303411	THORNE LAKE	Cu,Pb,Zn,Au
094D 128	644535	6309041	VG	Au
094D 129	645979	6306987	INCA	Cu,Ag,Au
094D 130	643777	6319578	SER	Cu,Ag
094D 131	646631	6298001	THORNE CREEK	Cu,Au,Zn
094D 132	631841	6318710	NOR	Cu
094D 133	634234	6319186	RON	Cu,Ag,Pb
094E 002	626206	6328868	FIRESTEEL	Ag,Zn,Cu
094E 012	631379	6326318	CAIRN	Cu,Pb,Zn,Ag,Au
094E 013	629524	6325070	THUTADE 36	Ag,Zn,Pb,Cu
094E 014	629392	6325530	THUTADE 37	Ag,Zn,Pb,Cu
094E 015	629151	6324622	THUTADE 4	Cu,Ag
094E 016	638053	6343325	PINE	Cu,Au,Ag,Mo,Zn
094E 021	635877	6326309	KEMESS NORTH	Cu,Au,Mo
094E 022	638349	6329967	ATTYCELLEY	Ag,Au,Zn,Pb,Cu
094E 025	634153	6322675	KEMESS WEST	Ag,Zn,Cu,Pb,Au
094E 045	639722	6344620	PINETREE (F2)	Cu,Zn,Mo,Au
094E 057	640835	6342536	MEX	Cu,Au
094E 058	625670	6339773	AMIGO	Cu,Zn,Ag,Pb
094E 067	631027	6326637	LAKE 21	Cu,Pb,Zn,Ag
094E 070	642103	6328364	MESS	Ag,Au,Pb,Cu,Zn
094E 071	629257	6323917	RON 11	Cu,Ag,Zn,Pb
094E 074	628814	6325667	LAKE 11	Ag,Zn,Cu,Pb
094E 081	637874	6331797	AWESOME	Ag,Au
094E 082	635368	6335499	WRICH 2	Ag,Au
094E 094	636596	6320284	KEMESS SOUTH	Cu,Au,Mo
094E 105	634402	6335552	WRICH	Au,Ag,Zn,Pb,Cu
094E 108	630948	6326972	LAKE 22	Ag,Cu,Zn,Pb
094E 112	628076	6328831	FIRE 1	Pb,Zn,Cu
094E 113	643720	6321330	JIM 1-2	Cu
094E 114	631682	6322446	TUT	Cu,Zn,Ag
094E 115	641999	6328667	FOG 1	Ag,Zn,Pb,Cu
094E 116	641402	6329389	FOG 2	Cu,Ag
094E 117	642112	6328825	FOG 3	Ag,Pb
094E 118	634257	6321965	RAT 1	Cu,Au,Ag
094E 119	637297	6329189	KEM	Cu,Ag,Pb,Zn,Au
094E 120	642349	6326822	NEW MESS 1	Ag,Zn,Pb,Cu,Au
094E 121	642102	6327649	NEW MESS 2	Ag,Au,Pb,Zn
094E 122	634337	6334945	WRICH 1	Ag,Zn,Pb,Cu,Mo
094E 123	638542	6335265	RICH 1	Cu
094E 124	635898	6338921	PEAK	Ag,Au
094E 127	633022	6335627	SKARN 2	Ag,Pb,Zn,Cu

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Sources of Information:
Field data: Field data was acquired over 6 months from 1996 through 1998.

Fossil Identifications:
Macrofossils: E.W. Bamber, T.P. Poulton, L.Rui, *Paleontolgy Subdivision, Institute of Sedimentary and Petroleum Geology, Calgary* , and E.T. Tozer, *Geological Survey of Canada , Vancouver* .
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Geochronology:
U-Pb: Richard Friedman, *Department of Earth and Ocean Sciences, The University of British Columbia.*
40Ar/39Ar: Mike Villeneuve, *Geological Survey of Canada , Ottawa* .

Supplementary Datasets
Jackaman, W.(1997): British Columbia Regional Geochemical Survey, BC RGS 45, NTS 94D-McConnell Creek; *British Columbia Geological Survey Branch* .

Jackaman, W.(1997): British Columbia Regional Geochemical Survey, BC RGS 45, NTS 94E-Toodoggone River; *British Columbia Geological Survey Branch* .

Aeromagnetic Residual Total Field Survey of Toodoggone River (NTS 94E) and Ware (NTS 94F); *Geological Survey of Canada* , Open File 3495, 8 sheets at 1:100 000 scale.

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