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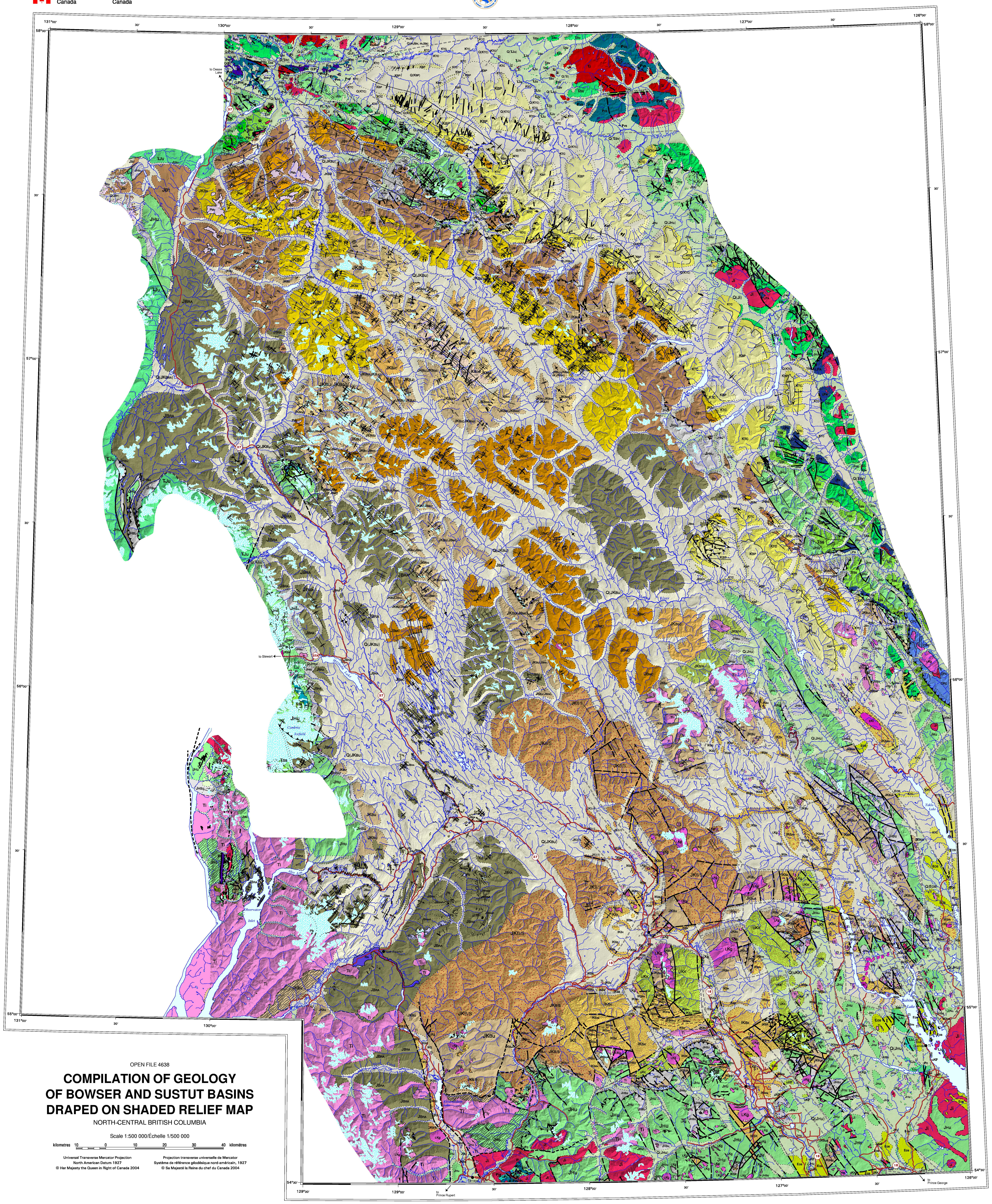

OPEN FILE 4638

COMPILATION OF GEOLOGY OF BOWSER AND SUSTUT BASINS DRAPED ON SHADED RELIEF MAP

NORTH-CENTRAL BRITISH COLUMBIA

Scale 1:500 000/Échelle 1/500 000

kilometres 10 0 10 20 30 40 kilomètres

Universal Transverse Mercator Projection
North American Datum 1927

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1927

Colours on the map may appear darker than colours in the legend due to modification by the shaded relief digital data.

STRATIFIED ROCKS

CENOZOIC

QUATERNARY
PLEISTOCENE AND RECENT

Q — *Glacial till, alluvium, colluvium; unit designators in parentheses are the inferred underlying bedrock units of Bowser and Sustut basins.*

Q — *Glacial till, alluvium, colluvium; unit designators in parentheses are the inferred underlying bedrock units of intrusive rocks and stratigraphic basement to Bowser and Sustut basins.*

RA — *Aiyansh basalt flows and pyroclastic cones.*

PLEISTOCENE

Pb — *Basaltic (basanite) intrusion east of Spatsizi River, too small to show on map (1.3 Ma (K-Ar)); pillow basalt in upper Nass Valley; basalt or andesite flows and minor breccia in lower Nass Valley and east of Alice Arm (175,000 years).*

TERTIARY
PLIOCENE

PMv — *MAITLAND VOLCANICS: olivine basalt necks and flows; columnar jointed, with rare pillows and breccia; 5.2 to 4.6 Ma (K-Ar).*

EOCENE AND YOUNGER

TEv — *Mount Edziza Volcanic Complex, undivided.*

EOS — *Eocene or younger, sandstone, siltstone, conglomerate, shale, coaly shale, and coal; lesser interbedded tuff, tuffaceous siltstone, and fanglomerate; continental, fluvial. Eocene OOTSA LAKE GROUP: rhyolite to rhyodacite flows, ash flows, breccia, tuff; subordinate andesite, basalt, and intercalated volcaniclastic sediments; includes some subvolcanic intrusive rocks. NEWMAN VOLCANICS: dacite to andesite hornblende, biotite, feldspar porphyry flows, breccia, and tuffs. ENDAKO GROUP: andesite and basalt flows and breccia. Miocene basalt in Bulkley Valley. Miocene or younger rocks overlying early Tertiary granite east of Portland Canal.*

PALEOCENE (?) AND EOCENE

lTsv — *Sandstone, conglomerate, siltstone, shale, and coal; subordinate epiclastic volcanic sedimentary rocks; most clasts are andesitic and dacitic volcanics similar to the Kasalka Group. Andesite flows and flow breccia.*

UPPER CRETACEOUS TO PALEOCENE

uKP — *Volcanic and sedimentary rocks.*

MESOZOIC

CRETACEOUS
UPPER CRETACEOUS
KASALKA GROUP

uKK — *Hornblende-feldspar-porphyritic andesite-dacite flows, flow breccia, breccia; rhyolite to dacite flows and ash flow tuff, breccia; minor basalt and andesite feldspar porphyry; intercalated lacustrine, fluvial, and lahar volcaniclastic sedimentary rocks and tuffaceous sedimentary rocks; includes sills, dykes, and intrusive domes.*

UPPER LOWER AND UPPER CRETACEOUS
SUSTUT GROUP
CAMPANIAN AND MAASTRICTIAN

KBP — *BROTHERS PEAK FORMATION: sandstone, siltstone, conglomerate, and tuff; sandstone and siltstone are cream–and grey-weathering; tuff is cream-weathering; conglomerate in laterally continuous sheets is most common near base.*

APTIAN OR ALBIAN TO CAMPANIAN

KTC — *TANGO CREEK FORMATION: micaceous sandstone, siltstone, mudstone, and minor quartz grit and pebble conglomerate; sandstone is grey–and green-weathering, occurring as laterally continuous sheets and as lenses; siltstone and mudstone are grey-, black-, and maroon-weathering.*

LOWER AND (?)UPPER CRETACEOUS
SKEENA GROUP
HAUTERIVAN, ALBIAN AND (?)CENOMANIAN

lKS, **lKSRV** — *Undivided sedimentary and volcanic rocks (unit lKS); RED ROSE FORMATION: sandstone, siltstone, argillite, chert-pebble conglomerate, reddish sandstone, gritty mudstone; mainly fluvial, common detrital muscovite, partly coeval with unit KTC (unit lKSRS); 'Rocky Ridge formation': subaerial, alkaline, basaltic and andesitic augite-feldspar-porphyry flows, tuff, breccia, lahar, and intercalated volcaniclastic sedimentary rocks (unit lKSRV); Subaqueous greenstone, coarse–to fine-grained breccia, tuff, and volcaniclastic sedimentary rocks; interbedded with unit lKSS (unit lKSV); Chert-pebble conglomerate (unit lKSC); Black shale, thin-bedded sandstone and siltstone; commonly concretionary and pyritiferous (unit lKSS); KITSUNS CREEK FORMATION: feldspathic and volcanic sandstone, siltstone, shale, polymictic volcaniclastic conglomerate, coal, and carbonaceous sedimentary rocks (unit lKSK).*

LOWER CRETACEOUS
BOWSER LAKE GROUP

KBDC — *DEVILS CLAW FORMATION: conglomerate, sandstone, and siltstone; high proportion of pebble conglomerate (30–80%) in laterally continuous, grey-weathering sheets with large-scale crossbedding; conglomerate forms bases of fining-upward cycles with medium-grained sandstone, fine-grained sandstone, carbonaceous siltstone, and minor coal; sandstone is dark green–and grey-weathering with platy and trough crossbedding; fossil plants common; marine fossils absent.*

JURASSIC AND CRETACEOUS
UPPER JURASSIC AND LOWER CRETACEOUS

JKB/S — *Undivided Bowser Lake and Skeena groups.*

BOWSER LAKE GROUP

JKBU — *Undivided Bowser Lake Group; in NTS mapsheets 93 L, 93 M, 103-I: includes 'Thomlinson Assemblage' black pencil shale; conglomerate (unit JKBUC); TROUT CREEK FORMATION: a range of clastic lithofacies (unit JKBUT) and ASHMAN FORMATION: a range of clastic lithofacies (unit JKBUA).*

JKBJC — *JENKINS CREEK ASSEMBLAGE (nonmarine assemblage): mudstone, siltstone, fine-grained sandstone, medium-grained sandstone, and rare conglomerate and coal, commonly arranged in fining-upward cycles; sandstone is grey-, green-, and brown-weathering, and occurs as laterally continuous sheets, discontinuous sheets, and lenses; lenses are planar and trough crossbedded; fossil plants abundant, including in situ roots, and plants with delicate structure; marine fossils absent.*

JKBEC — *ENDLESS CREEK (nonmarine assemblage): siltstone with <20% sandstone interbeds; siltstone is brown-gray and massive to poorly laminated, but includes dark grey carbonaceous layers with abundant plant fragments in mats; sandstone is commonly tuffaceous, fine–to rarely medium-grained and locally organized into thin fining upward successions, with internal ripples, plane beds and rare trough crossbeds; rare in situ rooted horizons; marine fossils are absent. A tentative new assemblage; preliminary detrital zircon work suggests an earliest Cretaceous or younger age.*

JKBGG — *GROUNDHOG-GUNANOOT ASSEMBLAGE (deltaic assemblage): sandstone, siltstone, and carbonaceous and calcareous mudstone, with minor conglomerate and coal, locally arranged in fining-upward cycles; sandstone is fine–to medium-grained with planar bedding and planar-tabular crossbedding; large proportion of sandstone is thin–and thick-bedded, medium-grained, recessive drab green–or brown-weathering wacke; resistant and light grey-weathering arenite is less common and forms discontinuous sheets and lenses; finer grained strata are thinly bedded and locally include densely packed plant fossils; conglomerate sheets and lenses, which constitute 10% of the unit, are light grey-weathering, with large-scale crossbedding; plant fossils common and include in situ trees; marine fossils rare.*

JKBS — *SKELHORNE ASSEMBLAGE (deltaic assemblage): thinly intermixed and varicoloured siltstone, sandstone, and conglomerate (with or without coal), commonly arranged in coarsening–and thickening-upward cycles; common features of sandstone are parallel bedding, crossbedding, ripples, burrows, bivalve coquina, and brown-, green-, and grey-weathering; conglomerate is rusty–and grey-weathering, but constitutes a lower proportion (15–30%) of the unit than in the Eaglenest assemblage; conglomerate units, up to 50 m thick, cap cycles up to 70 m thick, and tops locally have megaripples; plant and marine fossils are ubiquitous, and trace fossils including* Skolithus *and* Diplocraterion *are present, as are tree fragments several metres long.*

UPPER MIDDLE TO UPPER JURASSIC
BOWSER LAKE GROUP

JBN — *NETALZUL FORMATION: feldspar-hornblende-porphyritic andesite flows, breccia, tuff, and lahar; intercalated volcaniclastic sedimentary rocks.*

JBE — *EAGLENEST ASSEMBLAGE (deltaic assemblage): conglomerate, sandstone, siltstone, mudstone, and rare coal, arranged in coarsening–and fining-upward cycles of mudstone to pebble or cobble conglomerate; prominently rusty-weathering and 30 to 80% conglomerate; sheets of conglomerate, up to 50 m thick, include planar beds, tabular-planar cross-stratification and trough cross-stratification, with sets locally up to tens of metres thick; sandstone is green-, brown-, and grey-weathering, and has planar cross-stratification and hummocky cross-stratification; sparse marine fossils, but abundant plant fossils, including silicified tree fragments.*

JBMC — *MUSKABOO CREEK ASSEMBLAGE (shelf assemblage): sandstone, siltstone, and conglomerate; primary lithofacies is sandstone, forming laterally continuous thin–to thick-bedded sheets; less common are siltstone interbedded with sandstone, and lenses of conglomerate; sandstone is green-, brown-, and grey-weathering, thin–to thick-bedded, and locally arranged in coarsening-upward cycles; includes burrows, bivalve coquina, and other marine fossils, common ripple marks and crossbedding, and local hummocky cross-stratification; conglomerate increases in proportion and thickness upsection.*

JBT — *TODAGIN ASSEMBLAGE (slope assemblage): siltstone, fine-grained sandstone, and conglomerate; mainly laminated siltstone and/or fine-grained sandstone, which is dark grey–to black-weathering and includes thin, orange-weathering claystone beds and syndepositional faults and folds; chert-pebble conglomerate occurs as lenses; marine fossils.*

JBRA — *RITCHIE-ALGER ASSEMBLAGE (submarine fan assemblage): sandstone, siltstone, and rare conglomerate; approximately equal proportions of sheet-like intervals, up to 50 m thick, dominated either by siltstone, shale, and very fine-grained sandstone (unit JBRAsh), or by medium-grained sandstone (unit JBRAss); siltstone and/or fine-grained sandstone is dark grey–and black-weathering, sandstone is medium–and light-grey-weathering; abundant turbidite features (e.g. Bouma cycles, flame structures, flute-and-groove casts); conglomerate includes debris-flow units; marine fossils.*

JB/H — *Undivided Bowser Lake Group and upper Hazelton Group clastic rocks.*

LOWER MIDDLE JURASSIC
BOWSER LAKE GROUP

mJBv — *Maroon plagioclase porphyry flows and breccia, green and grey-green aphyric and plagioclase porphyry flows, breccia and tuff.*

mJBs — *Maroon sandstone and siltstone, chert pebble conglomerate, local grey and green sandstone.*

LOWER AND LOWER MIDDLE JURASSIC
HAZELTON GROUP

JHu — *Undivided volcanic and intercalated clastic rock of the Hazelton Group; includes subaerial and marine mafic volcanic rocks and epiclastic rocks; felsic volcanic rocks include sills, dykes, welded and nonwelded ignimbrite, airfall tuff breccia; epiclastic and bioclastic rocks, includes lahar, breccia, conglomerate, siltstone, shale, and limestone.*

JHsu — *Undivided clastic rocks of Spatsizi, Salmon River, and Smithers formations and related volcanic rocks; dominated by siltstone and shale, including siliceous well bedded tuffaceous(?) siltstone, limy siltstone, calcareous to siliceous organic shale, calcareous to siliceous siltstone, fine-grained sandstone; minor constituents are mudstone, limestone, conglomerate, coarse grained arkose, basalt, and rhyolite.*

UPPER TRIASSIC TO LOWER JURASSIC
CARNIAN(?) AND NORIAN(?) TO HETTANGIAN AND/OR LOWER SINEMURIAN

TrJc — *Conglomerate, sandstone, shale, mafic to intermediate volcanic breccia, and olistostrome; conglomerate clasts are mainly hornblende and plagioclase porphyry andesite, but include augite-phyric mafic lava and other volcanic rocks, felsic to intermediate granitoid rocks, and limestone.*

TrJu — *Undivided Triassic and Jurassic volcanic and epiclastic rocks.*

TRIASSIC
STUHINI AND TAKLA GROUPS

TrSv — *Augite–and coarse bladed feldspar-phyric mafic lava flows, minor conglomerate, sandstone, mudstone, limestone and olistostrome.*

TrSs — *Mudstone, shale, sandstone and olistostrome; minor conglomerate and mafic lava, minor limestone.*

TrSu — *Undivided volcanic and clastic rocks.*

PERMIAN TO TRIASSIC (CACHE CREEK TERRANE)
SITLIKA GROUP

PJs — *Metapelite and metavolcanics; arc volcanic rocks.*

TRIASSIC OR OLDER

PTrb — *Dark green, resistant and poorly stratified, crowded feldspar-phyric trachybasalt; commonly contains discontinuous, irregularly-oriented, crowded trachytic fabric outlined by tabular, fine–to medium-grained plagioclase feldspar phenocrysts.*

PALEOZOIC

PERMIAN
LOWER PERMIAN
ASITKA GROUP

LPA — *Argillite, chert, basalt, tuffaceous and argillaceous carbonate and calcareous tuff, sericite and chorlite phyllite, greenstone amphibolite .*

CARBONIFEROUS TO PERMIAN

Pc — *Marble and limestone.*

CARBONIFEROUS AND PERMIAN (may include UPPER TRIASSIC)
CACHE CREEK GROUP

CPc — *Serpentinite, interbedded shale, chert, limestone, and greenstone.*

LOWER CARBONIFEROUS AND OLDER?

Pvs — *Metavolcanic and metasedimentary rock: includes green chlorite phyllite, brown phyllitic argillite, grey-green to tan quartz-sericite schist (felsic metavolcanic rocks in 104H are ca. 342 Ma U-Pb); minor chert, rare limestone.*

DEVONIAN AND LOWER CARBONIFEROUS

DMSv — *Mafic to intermediate plagioclase-pyroxene phyric lapilli tuff, lapilli tuff-breccia, and flows; plagioclase-phyric amygdaloidal andesite(?) flows; rhyolite and rhyodacite lapilli tuff-breccia.*

INTRUSIVE ROCKS

CENOZOIC

TERTIARY

Ti — *Undivided early Tertiary intrusive rocks; includes tonalite, granodiorite, granite, diorite, monzogranite, monzodiorite; includes Babine and Kastberg plutonic suites in the southeast (NTS 93 M).*

MESOZOIC

CRETACEOUS

LKg — *BULKLEY PLUTONIC SUITE: mainly granodiorite; lesser tonalite, quartz monzonite, quartz diorite; minor diorite and granite; feldspar-, feldspar-hornblende-biotite, and feldspar-quartz-eye porphyry; Poison Pluton 84.1 +/–0.5 Ma (U-Pb on zircon).*

EKi — *Gabbro, diorite, monzodiorite, monzonite, and granodiorite.*

JURASSIC OR CRETACEOUS

JKBP — *BEAR PASS PLUTON; biotite (?-) hornblende quartz monzodiorite or granodiorite; fractured and altered.*

JURASSIC

Ji — *Undivided Jurassic intrusive rocks; includes granite, granodiorite, tonalite, diorite, quartz diorite, monzonite, quartz monzonite; includes Topley plutonic suite in NTS 93 M.*

TRIASSIC OR JURASSIC

TrJi — *Undivided Triassic and Jurassic intrusive rocks.*

TRIASSIC

Tri — *Undivided Triassic intrusive rocks; includes metagranite, metadiorite, metagabbro, granite, diorite and foliated granodiorite, quartzmonzonite and monzodiorite; minor ultramafic intrusions.*

PALEOZOIC

PALEOZOIC

Pi — *Undivided Paleozoic intrusive rocks; includes Carboniferous (ca. 342-353 Ma) granodiorite, quartz diorite, diorite, quartz monzonite and tonalite; and mylonitic to massive leucogranite, leucogranodiorite, quartz diorite, and minor gabbro of uncertain age.*

Highly strained and/or greenshchist facies rocks (currently applied only to some Jurassic strata in the west and southwest).

Geological contact (defined, approximate, assumed)

Fault, sense of displacement unknown (defined, approximate, assumed)

Fault, normal (ornament on down thrown side; defined, approximate, assumed)

Fault, contractional (teeth on hanging wall; defined, approximate, assumed)

Fault, reverse (defined, assumed)

Fault, ductile, ductile normal (approximate)

Fault, assumed under Quaternary

Anticline (trace of axial surface; upright or inclined, overturned)

Syncline (trace of axial surface; upright or inclined, overturned)

Axial Surface trace (type of fold unknown, interpreted from aerial photographs)

Highway, road

DESCRIPTIVE NOTES

The purpose of this map is to provide an overview of Bowser and Sustut basins geology. It is an interim product of the Integrated Petroleum Resource Potential and Geoscience Studies of the Bowser and Sustut Basins project, British Columbia, a collaborative project between the Geological Survey of Canada and the British Columbia Ministry of Energy and Mines. The map is intended to show the current status of knowledge of the basins as a work in progress. As such, many map boundary problems have not yet been resolved, stratigraphic terminology is not consistent across the basin region, and not all recent work of sub-basin geology has been incorporated. The map is meant to focus on geology of the Bowser and Sustut basins, therefore geology of underlying strata and intrusive rocks is generalized. For example, the four formations of clastic rock at the top of the Hazelton Group around the Bowser Basin are grouped into one generalized clastic unit. The legend gives names of specific formations for most of the generalized units. The paucity of structures in some other areas reflects either a more regional scale of mapping or the incomplete state of compilation (e.g. NTS 94 D).

Sources of information for compilation:

93L	Richards and Tipper, 1976
93M	Richards, 1990 (minor changes from MacIntyre and Villeneuve, 2001)
94D	Eisbacher, 1974; Richards, 1976; Evenchick *et al.* 2003
94E	Eisbacher, 1974; Gabrielse *et al.*, 1977; Evenchick, 1997a,b,c
103I	Hutchison, 1979; Gareau *et al.*, 1997; G.J. Woodsworth, unpublished data
103P	Evenchick 1996a,b,c; Evenchick *et al.*, 1997; Haggart, 1998; Evenchick *et al.*, 1999; van der Heyden *et al.*, 2000
104A	Evenchick *et al.*, 2000 (includes information from Greig and Evenchick 1993; Greig *et al.*, 1994)
104B	Lewis, 1996; R.G. Anderson, unpublished data (compiled in Evenchick *et al.*, 2001)
104G	Souther, 1972; C.A. Evenchick, unpublished data (compiled in Evenchick *et al.*, 2001)
104H	Evenchick and Thorkelson, 1993 (revised map in press; includes information from Eisbacher, 1974; Read, 1984; Read and Psutka, 1990; Ash *et al.*, 1997)

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1976 Geology of Smithers map-area, British Columbia; Geological Survey of Canada, Open File 351, map scale 1:250 000.

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2000 Reconnaissance geological mapping in southwest Nass River map area, British Columbia; *in* Current Research 2000-A, 9 p.

Critical review by H. Gabrielse, Geological Survey of Canada

Digital cartography by C.L. Wagner, Earth Sciences Sector Information Division (ESS Info) and K. Buddell, Geological Survey of Canada

Digital base map from data compiled at 1:250 000 scale by Geomatics Canada, modified by ESS Info

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

Mean magnetic declination 2004, 26°59′E, decreasing 14.2′ annually. Readings vary from 21°46′E in the southeast corner to 23°59′E in the northwest corner of the map

Digital elevation model derived from BC TRIM data sets. Shaded relief image generated using an illumination source with a southeast azimuth and altitude 45° above the horizon

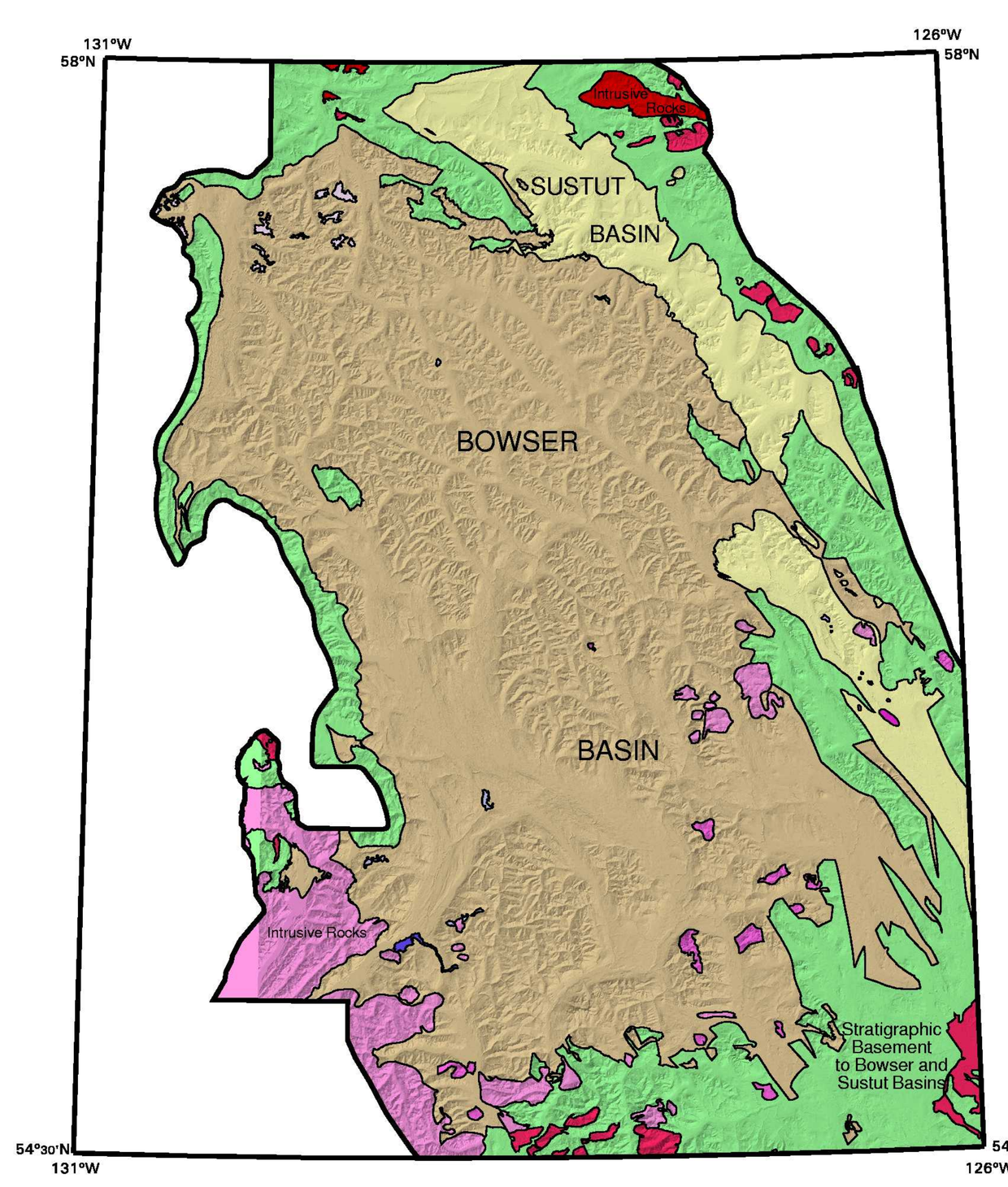
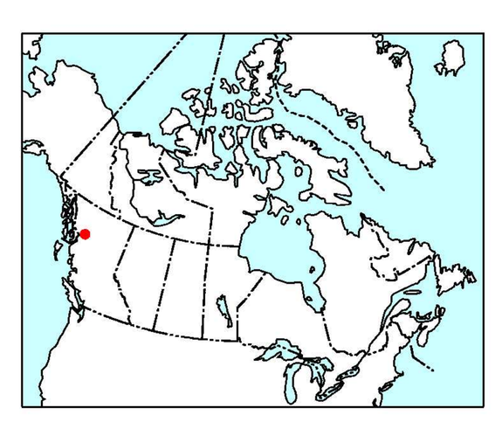
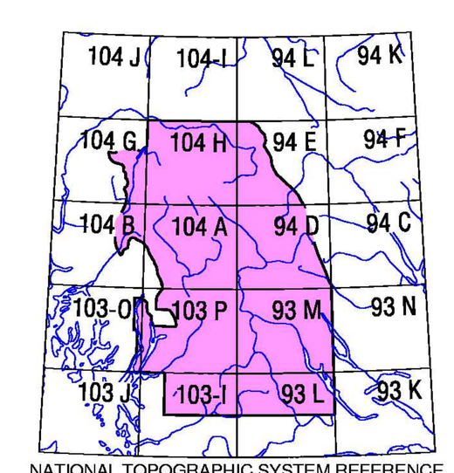


Figure 1. Generalized Distribution of Bowser and Sustut Basins



LOCATION MAP



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British Columbia — Ministry of Energy and Mines, Resource Development and Geoscience Branch