Vancouver (NM 9/10)
LEGEND FOR QUATERNARY OF CANADIAN CORDILLERA
R.J. Fulton

HOLOCENE

Made-land: mixed texture materials dumped to provide additional unsable land or built during disposal of waste materials; includes mill tailings dumps and spoil ground.

Alpine glaciers and ice caps: ice and debris covered ice; includes minor associated glacial deposits and small areas of rock (mainly nunataks).

Organic deposits: peat, mucky peat and muck; brown to black in color; in many places underlain by grey to light brown muck consisting largely of fine grained carbonate mud and mollusc fragments. Occurs in shallow depressions and poorly drained areas. Thickness generally 1-4 m but rarely to 15 m.

Landslide: rubble and diamicton with texture dependant on the composition of the material in which the slope failure occurred. In mountainous terrain, slides generally are small rockfalls and result in small piles of rubble; locally large landslides have occurred resulting in hummocky valley fills and large fans of rubble. Slope failures in Quaternary sediments and poorly consoliated or highly altered older rocks result in earthflows with a diamicton texture. Thicknesses are variable and may be up to 80 m.

Figure Fluvial sand, silt, and gravel: medium grained sand and gravel and fine grained sand and silt occurring as modern and Holocene floodplain, terrace and fan deposits. Thickness 2 to 10 m but where streams enter lakes fluvial sediments overlie with gradational contact, deltaic fill sequences as thick as 200 m.

Fc, dominantly channel sands and gravels and associated sand and gravel terraces. Clasts commonly rounded and lithologies mixed and variable, reflecting the composition of local bedrock and glacial deposits. Sediments generall well stratified with cut-and-fill structures and cross bedding. Texture varies vertically and laterally but individual beds are generally well sorted. A capping of silt to medium grained sand <1 m thick is common.

Fo, dominantly fine grained sand and silt overbank deposits including associated organic materials and channel deposits. Characterized by horizontal and ripple laminations which in many places may have been destroyed by plant rooting activities. Sediments generally occur in upward fining units. May enclose sinuous bodies of channel sands and gravels but these are a minor part of the map unit.

Ff, diamicton and gravel occurring as alluvial fan deposits. Consist of thickly bedded, internally massive units and cross bedded units characterized by cut-and-fill structures. Texture varies vertically and laterally with a general decrease in grain size from fan head to fan toe. Sorting is generally poor but locally may be good. Lithologies reflect local bedrock or glacial deposits. Clasts are generally subangular to subrounded but may be well rounded where they are derived from pre-existing fluvial gravels.

Fx, a complex of channel and overbank deposits, and intertonguing colluvial and alluvial fans (this unit is commonly used in mountain valleys). Consists of units Fc, Fo and Ff in addition to rubble in the form of colluvial fans and cones. The typical map unit occupies the floor of a mountain valley in which the stream is overwhelmed by a large supply of fluvial and colluvial materials. Deposits on the valley floor include colluvial and alluvial fan materials from tributary valleys and gullies, channel gravels and sands where the stream flows over fan deposits, sand and silt overbank deposits and peats in reaches partly dammed by the infringing fans and rubble at the toes of the impinging colluvial aprons and cones. This is also used in parts of the Fraser, Thomson and Nicola valleys which are occupied by a complex of alluvial fans, terraces, floodplain 'deposits and remnants of thick valley fill.

Lt Lx Lacustrine silt, clay and sand: commonly light grey in color; dominantly rhythmites consisting of thick silt (<1 m) and thin (<1 cm) clay couplets. Gradational increase in grain size in most thick sequences.

Lt, thick lacustrine deposits generally seen as a terrace or partly dissected valley fill but also often underlies Holocene fluvial deposits. Thickness <100 m.

Lx Lx, lacustrine silt, sand and clay and minor ice contact sand and gravel: Stratification generally parallel but contorted and faulted due to melting of buried ice. Thickness <10 m. Locally includes lenses of gravel and sand. Generally occurs as low relief hummocky landform.

HOLOCENE AND FRASER

Wt Wb

Wv

Marine and glaciomarine deposits: clay, silt, sand, gravel, and diamicton deposited in lowland areas transgressed by the sea during latest Pleistocene and Holocene time. Coarse littoral sediments commonly veneer glaciomarine and glacial sediments.

Wt

Thick marine and glaciomarine deposits masking details of relief of underlying units, and with surface expression reflecting genesis of deposit. Dominantly silt, clay and stony silt and clay. Thicknesses locally as great as 200 m.

Marine and glaciomarine deposits thick enough to mask minor irregularities in the underlying units, but which still conform to the general underlying topography (1-3 m).

Discontinuous, thin marine and glaciomarine deposits; relief details of underlying units generally visible; outcrops of underlying units may be common. Dominantly sand and gravel occurring as a lag on glacial or glaciomarine sediments and glaciomarine stony silt and clay. Thickness generally <2 m.

Gt Gx Glaciofluvial sand and gravel: dominantly coarse grained sand, pebbly sand and fine gravel but locally poorly sorted and bouldery. Texture varies laterally and vertically. Clasts generally subrounded to well-rounded and lithologies reflect local bedrock and till.

Gt, sand and gravel in the form of terraces and deltas associated with the ice retreat drainage regime. Generally well stratified with cross bedding and cut-and-fill structures common. Sorting within individual sediment units generally good. Thickness <10 m.

Gx, sand and gravel in the form of ridges and hummocks (kames, kame complexes and eskers) and other features associated with deposition of sand and gravel in contact with ice. Generally well stratified but stratification in many places contorted and faulted by the melting of buried ice. Sorting variable. May include lenses of diamicton. Thickness <50 m.

Loamy till: Olive-brown, brown, grey-brown or reddish brown till. Slightly to moderately calcareous. Texture generally loam, sandy loam to silty clay loam; locally stony to bouldery. Generally compact. Clast lithologies variable and chiefly argillite, greenstone, granitics and crystalline metamorphics in areas underlain by sandstones and shales; dominantly basalt and dacite in areas underlain by volcanic rocks. Areas mapped as this unit are largely underlain by weakly consolidated sandstones and shales and unmetamorphosed basalts and dacites.

1Mt 1Mb: continuous till cover with thickness >10 m on valley floors and lower slopes, 1-3 m in most other areas (1Mb).

1Mv: thin to discontinuous till with scattered outcrops; thickness generally >2 m.

Sandy loamy till: olive-grey, olive, olive-brown, grey-brown, grey and pale olive till. Generally moderately calcareous but strongly calcareous in areas of limestone and slightly calcareous in areas where till overlies or was derived from ice advance sediments. Textures generally sandy loam, loam, sandy clay loam, loam, loamy sand and locally sand or silt loam were derived from unconsolidated sediments. Generally compact and commonly stony. Clast lithologies variable reflecting diverse bedrock lithologies from which till was derived and diverse clast composition of overridden outwash. Areas mapped as this unit are largely underlain by argillite, greywacke, limestone, quartzite, arkase, agglomerate, greenstone, andisite and other medium grade metamorphic sediments and by pre-last ice advance sands, gravels and silts.

dMt dMb: continuous till cover with thicknesses >10 m on valley walls and lower slopes, 1-3 m in most other areas (dMb).

dMv: thin to discontinuous till was scattered outcrops; thickness generally <2 m.

Sandy till: olive grey, grey and pale olive till. Weakly to noncalcareous. Textures generally loamy sand, sandy loam and sand. Generally gravelly, cobbley or bouldery. Clast lithologies variable reflecting local bedrock which is chiefly grandorite, dorite, quartzdorite, quartzmonzonite and a variety of crystalline metamorphic lithologies. Areas mapped as this unit are largely underlain by acid igneous intrusives and associated igneous rocks.

sMt sMb: continuous till cover with thicknesses up to 10 m on valley floors and lower slopes, 1-3 m in most other areas (sMb).

sMv: thin to discontinuous till with scattered outcrops; thickness

Rock with discontinuous colluvium and till — alpine mountains: major rock landforms consist of arêtes, cirques, glaciated valleys and various other alpine glacial forms. A discontinuous mantle of colluvial rubble is present on most slopes and aprons and cones of colluvial debris occur at the toes of many slopes. A till veneer (dMv sMv) is present on lower parts of valley walls with thicker till occurring locally in valley bottoms and thin discontinuous till present at higher elevations. Colluvium and till are generally <2 m thick. Valleys are generally occupied by complexes of colluvial debris, channel sediments, overbank deposits and low gravel terraces (Fx) which locally may be as much as 10 m thick but are too small to map at this scale.

Rs

Rock with discontinuous colluvium and till — steep slopes: rock landforms consist dominantly of steep slopes. Discontinuous colluvial rubble is present on most slopes with thicker accumulations near slope. toes. Thin patches of till are locally present. Unconsolidated sediments are generally <2 m thick.

Rock with minor colluvium and till — low relief: flat to gently rolling areas of rock. Bare rock locally covered by patches of peat, colluvium and till.

Qv Quaternary volcanics: lava flows, breccia and ash, dominantly basaltic and andesitic composition but locally includes more acidic material; consists of flows and cinder cones.

Geology compiled by R.J. Fulton and J.J. Clague, Geological Survey of Canada and J.M. Ryder, British Columbia Department of the Environment. Compilation co-ordination by R.J. Fulton.

SYMBOLS

© Cirque or group of cirques (not shown in areas of Ra).

Direction of ice movement: erosional features (grooves, striae, chattermarks etc).

Drumlin or group of drumlins.

Senses of ice movement; depositional feature other then drumlins.

Streamlined topography indicating direction of ice movement (includes grooves in drift, drumlinoid ridges etc.).

Crest of transverse till ridges.

Esker or ice fracture filling.

Abandoned channel; includes meltwater channels and underfit streams.

Spillway threshold of glacial lake.

Deltas too small to appear as a map unit.

Surface unit overlies a thick (<600 m) of Quaternary

Surface unit overlies a thick (<600 m) of Quaternary sediments.

Volcanic ash locality (Bridge River, St. Helen's Y, Mazama),

Olympia "Interglacial").

Important stratigraphic section (brief description

given in Table II).
Important radiometric date locality (date and brief

explanation given in Table 1).

Armstrong, J.E. 1979: Surficial geology Vancouver, British Columbia: (92 G3); Geol. Surv. Can., Map 1486A (1:50 000).

1980ª: Surficial geology New Westminster, British Columbia: (92 G2); Geol. Surv. Can., Map 1484A (1:50 000).

Amstrong, J.E. 1980^b: Surficial geology Mission, British Columbia: (92 G1); Geol. Surv. Can., Map 1485A (1:50 000).

Armstrong, J.E.
1980^C: Surficial geology Chilliwack, British Columbia: (92 H4W); Geol. Surv.
Can., Map 1487A (1:50 000).

Armstrong, J.E.
1981: Post-Vashon Wisconsin glaciation, Fraser Lowland, British Columbia:
Geol. Surv. Can., Bull. 322, 34 p.

Armstrong, J.E. and Clague, J.J.
1977: Two major Wisconsin lithostratigraphic units in southwestern British
Columbia; Can. Jour. Earth Sci., Vol. 14, p. 1471-1480.

Clague, J.J., Armstrong, J.E. and Mathews, W.H.
1980: Advance of the Late Wisconsin Cordilleran ice sheet in southern
British Columbia since 22 000 yr. B.P.; Quat. Res., Vol. 13, p. 322-326.

Dyck, W. and Fyles, J.G.
1962: Geological Survey of Canada radiocarbon dates I; Geol. Surv. Can.,
Paper 63-21, p. 1-14.

Dyck, W., Lowdon, J.A., Fyles, J.G. and Blake, W., Jr.
1966: Geological Survey of Canada radiocarbon dates V: Radiocarbon, Vol. 8,
p. 96-127.

Fulton, R.J.
1971: Radiocarbon geochronology of southern British Columbia; Geol. Surv.
Can., Paper 71-37, p. 28.

Fulton, R.J.
1975: Quaternary geology and geomorphology, Nicola-Vernon Area, British Columbia, 82 LW½ and 92 IE½; Geol. Surv. Can., Memoir 380, 50 p. (1:126 720).

Fulton, R.J. and Smith, G.W.
1978: Late Pleistocene stratigraphy of south-central British Columbia
Can. Jour. Earth Sci., Vol. 15, p. 971-980.

Fyles, J.G. 1959: Surficial geology, Oyster River, British Columbia (92 F/14); Geol. Surv. Can., Map 49-1959 (Scale 1:63 360).

Tyles, J.G.
1960: Surficial geology, Courtenay, British Columbia (92F 11E + 10W)
Geol. Surv. Can., Map 32-1960. (1:63 360).

Fyles, J.G.
1963: Surficial geology of Horne Lake and Parksville map-areas, Vancouver Island, British Columbia; Geol. Surv. Can., Memoir 318, 142 p.
(Scale 1:63 360, 92F/7, 92F/8).

Green, A.J. and Lord, T.M.
1979: Soils of the Princeton area of British Columbia: (92 H sw)
Agriculture Canada, British Columbia Soil Survey Report 14.
(1:125 000).

Halstead, E.C.
1963: Surficial geology, Nanaimo British Columbia: (92 G4, 92 F 1E)
Geol. Surv. Can., Map 27-1963. (1:63 360).

Halstead, E.C.
1966^a: Surficial geology Duncan area, British Columbia: (92 B/13)
Geol. Surv. Can., Map 14-1965. (1:63 360).

Halstead, E.C.
1966^b: Surficial geology Shawnigan area, British Columbia: (92 8/12)
Geol. Surv. Can., Map 15-1965. (1:63 360).

Heginbottom, J.A.
1972: Surficial geology of Taseko Lakes map-area, British Columbia (92 0)
Geol. Surv. Can., Paper 72-14. (1:250 000).

Hicock, S.R.
1980: Pre-Fraser Pleistocene stratigraphy, geochronology, and paleoecology of the Georgia Depression, British Columbia; Dept. of Geology, University of Western Ontario, London, Ont. Unpub. Ph.D. Thesis.

Hicock, S.R. and Armstrong, J.E.
1981: Coquitlam Drift: a pre-Vashon Fraser glacial formation in the Fraser
Lowland, British Columbia: Can. Jour. Earth Sci. Vol. 18, p. 1443-1451.

Howes,D.E.
1981: Terrain inventory and geological hazards; northern Vancouver Islands:
British Columbia Ministry of Environment, APD Bulletin 5, 105 p.

Lord, T.M. and Green, A.J.
1974: Soils of the Tulameen area of British Columbia: (92 H NE)
Agriculture Canada, British Columbia Soil Survey Report No. 13,
(1:125 000).

Lowdon, J.A., Robertson, I.M. and Blake, W. Jr.
1977: Geological Survey Survey of Canada radiocarbon dates XVII; Geol. Surv.
Can. Paper 77-7, 25 p.

Mathewes, R.W., Borden, C.E. & Rouse, G.E.
1972: New radiocarbon dates from the Yale Area of the Lower Fraser River
Canyon, British Columbia; Can. Jour. Earth Sci., V. 9, p. 1055-1057.

Ministry of Environment
Unpublished: Terrain and landform maps. British Columbia Ministry of
Environment, Assessment and Planning Division Manuscript Maps,
Map Library 765 Broughton St., Victoria, British Columbia. (1:50 000).

Roddick, J.A., Muller, J.E. and Okulitch, A.V. 1979: Fraser River, British Columbia-Washington; Geological Survey of Canada, Geological Atlas Series, Scale 1:1 000 000, sheet 92, Map 1386 A.

Ryder, J.M.
1976: Terrain inventory and Quaternary geology Ashcroft, British Columbia:
(92 I NE); Geol. Surv. Can., Paper 74-49 (1:126 720).

Ryder, J.M.
1982: Terrain inventory and Quaternary geology Lytton area, British Columbia:
(92 I SW); Geol. Surv. Can., Paper 79-25. (1:126 720).

ipper, H.W.
1971^a: Surficial geology, Mount Waddington, British Columbia (92 N); Geol.
Surv. Can., Map 1291 A (1:250 000).

Tipper, H.W.
1971^b: Surifcial geology, Taseko Lakes, British Columbia (92 0): Geol.
Surv. Can. Map 1292 A (Scale 1:250 000).

Tipper, H.W. 1971^C: Surficial geology Bonaparte Lake, British Columbia (92 P); Geol. Surv. Can., Map 1293 A (scale 1:250 000)

Valentine, K.W.G. and Schori, A.
1980: Soil association map of the Lac la Hache-Clinton area, British
Columbia: (92 P W); Agriculture Canada, British Columbia Soil Survey
Report, No. 25 (1:125 000).

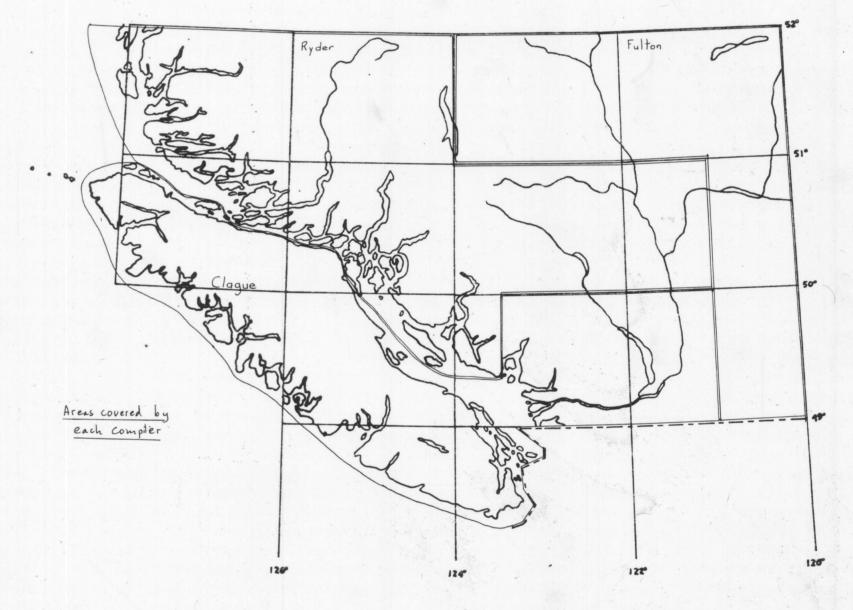
			RADIUMETRIC	DATES	
Locality		Date	Material	Significance	Reference
1	GSC-948 GSC-938	2225 ± 130 2940 130	peat peat	Neoglacial advance Neoglacial advance	Fulton, 1971 Fulton, 1971
2	I-6057	11 430 ± 1.50	gyttja	Fraser retreat	Mathewes et al., 1972
3	GSC-38	12 360 140	shells	Fraser retreat	Dyck & Fyles, 1962
4	GSC-389	12 740 170	worm tubes	Fraser retreat	Dyck et al., 1966
5	GSC-2193	12 900 170	shells	Fraser retreat	Lowdon et al., 1977
6	GSC-2768	16 700 500	wood	Fraser, advance	Clague et al., 1980
7	GSC-2297 GSC-2416	17 800 ' 150 21 700 130	wood	Fraser advance Coquitlam ice advance	Clague et al., 1980 Hicock & Armstrong, 1981
8	GSC-2344	18 700 170	wood	Youngest Quadra Sand	Armstrong & Clague,
	GSC-2273	25 800 310	wood .	Youngest Cowichan Head Formation	Armstrong & Clague,
	GSC-2167	40 500 1700		Oldest Cowichan Head Formation	Armstrong & Clague,
9	GSC-95	28 800 740		Oldest Quadra	Armstrong & Clague,

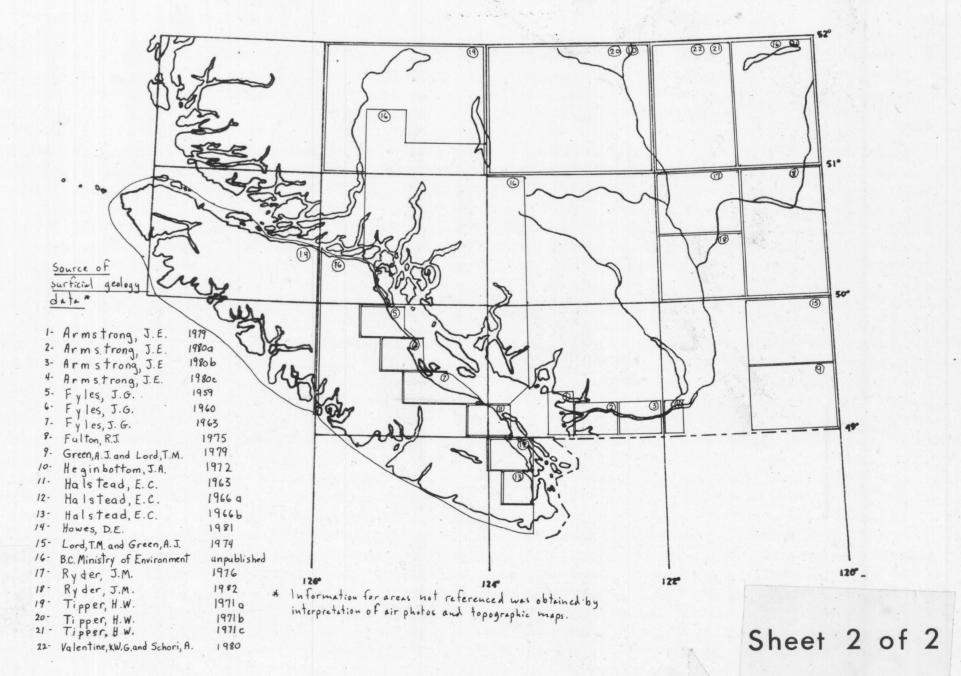
Table I

PADIOMETRIC DATES

Table II IMPORTANT STRATIGRAPHIC SECTIONS

	THPURTAN	1 STRATIGRAPHIC SECTIONS		
ocality	Sig	nificance	Reference	
A	Type section:	Quadra Sand	Armstrong & Clague, 1977	
В	Type section:	Mapleguard Sediments and Dashwood Drift	Fyles, 1963	
С	Type section:	Cowichan Head Formation	Armstrong & Clague, 1977	
D	Type section:	Capilano Sediments	Armstrong, 1981	
E	Type section:	Coquitlam Dirft	Hicock & Armstrong, 1981	
F	Type section:	Fort Longley Formation	Armstrong, 1981	
G.	Type section:	Sumas Drift	Armstrong, 1981	
н .	Type section:	Semiahmoo Drift	Armstrong, 1975	
I	Type section:	Muir Point Formation	Hicock, 1980	





OPEN FILE
DOSSIER PUBLIC
837
1982
GEOLOGICAL SURVEY
COMMISSION GÉOLOGIQUE
OTTAWA