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SURFICIAL GEOLOGY OF THE DUNCAN AREA

NTS 92B/13

Geology by H.E. Blyth and N.W. Rutter

1:50 000

Miles 1 0 1 2 3 Miles
Metres 1000 0 1000 2000 3000 4000 Metres

For an overview of the surficial geology of the Duncan map area please refer to the report entitled "Surficial Geology of Southern Vancouver Island and Gulf Islands" by H.E Blyth and N.W. Rutter *in* Geological Fieldwork 1992, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1993-1. Geology based on air photo interpretation followed by ground verification. Fieldwork completed in 1992. Any revisions or additional geological information would be welcomed by the authors.

TERRAIN UNIT LETTER NOTATION

surficial material — texture — gFt — surface expression

COMPOSITE UNITS

Cv/Mb The component (C v) above the symbol stratigraphically overlies the one below (Mb)

Mb/R The component (M b) in front of the symbol is more extensive than the one that follows (R)

SURFICIAL MATERIALS

C	colluvial	Diamicton with variable structure and texture; includes talus, avalanche, landslide, debris flow and other mass wastage products and weathered bedrock.
F	fluvial	Gravel, sand or silt deposited by streams and rivers; includes floodplain, river terrace, delta and alluvial fan sediments.
F^G	glaciofluvial	Fluvial sediment deposited in association with glacier ice; generally consists of gravel and sand; includes kettled outwash, kame terraces and eskers.
L	lacustrine	Sediment deposited in lakes or around lake shorelines; generally consists of sand, silt and clay; includes beach and lacustrine terrace deposits.
L^G	glaciolacustrine	Lacustrine sediment deposited in association with glacier ice; similar to lacustrine deposits but displays features such as slump structures, ice-rafted stones and kettles.
M	morainal	Diamicton (till) deposited directly by glaciers; generally consists of well-compacted material with variable structure and texture; includes moraine, till plain and drumlin features.
O	organic	Material resulting from the accumulation and decay of vegetative matter; generally consists of peat; includes bogs, swamps and marshes.
R	bedrock	Outcrops and rock covered by less than 10 cm of unconsolidated material.
W	marine	Sediment deposited in marine waters or along coastlines; generally consists of clay, silt, sand or gravel; includes beaches and deeper water deposits.
W^G	glaciomarine	Sediment deposited in a marine environment in close proximity to glacier ice; generally poorly sorted and stratified or massive; includes glaciomarine deltas and deeper water deposits.

ON-SITE SYMBOLS

Drumlin, crag and tail (ice flow direction inferred; unknown)
Striae, grooves (ice flow direction known, unknown; older, younger)
Ice flow indicators (ice flow direction known; unknown)
Moraine ridge
Esker (flow direction known; unknown)
Meltwater channel
Escarpment
Cirque
Gravel pit; mine or quarry
Strandline
Landslide (headwall scar)
Field station — △ HB92-10
Stop site — •

SURFACE EXPRESSION

b	blanket (> 1 metre)
f	fan
h	hummocky
p	plain
r	ridged
s	steep slope (>35°)
t	terraced
v	veneer (< 1 metre)

TEXTURES

c	clay
$	silt
s	sand
g	gravel = granual to pebble
k	cobble
b	boulder
d	diamicton

GEOLOGICAL BOUNDARIES

Defined
Approximate

QUATERNARY HISTORY

The Quaternary history of southeastern Vancouver Island involves the interactive growth and decay of the Vancouver Island and Cordilleran ice sheets which resulted in deposition of thick sequences of glacial and interglacial deposits. Excluding the sediments of the last glaciation (Vashon till) most of the deposits have been eroded by subsequent glacial events, however, in some protected valleys and coastal lowlands extensive stratigraphic sequences have been preserved. These sequences reveal a history of up to three glacial and three interglacial eventss.

The oldest record can be found at Muir Point, in Sooke. This section contains material interpreted to be a pre-Sangamon (>125 000 years B.P.) glacial event originating from the northwest yet containing lithologies that indicate Cordilleran ice influence from the northeast. Unconformably overlying these sediments, is a succession of partly fossiliferous, nonglacial, fluvial sediment interpreted to be Sangamon age (~125 000 years B.P.) which form the Muir Point Formation (Hicock and Armstrong, 1983).

Directly overlying the Muir Point Formation and underlying the nonglacial Cowichan Head formation is the Early to Mid-Wisconsin Dashwood drift. This unit, which was first formalized by Fyles (1963) near Qualicum Beach, B.C., is a till with associated lenses of clay, silt, sand and gravel. It is found in contact with underlying Mapleguard sediments (Muir Point equivalent) and overlying Quadra sediments (the nonglacial Cowichan Head Formation equivalent; Clague, 1977).

The Mid-Wisconsin (~65 000 - 29 000 years B.P.) nonglacial sediments of the Cowichan Head Formation vary from a lower marine, clay, silt member to an upper estuarine and fluvial member rich in organics and indicative of a climate that was a little cooler but quite similar to the present (Armstrong and Clague, 1977).

Following the deposition of the nonglacial Cowichan Head Formation climatic cooling resulted in the onset of the Fraser Glaciation approximately 29 000 years ago (Howes and Nasmith, 1983). Advancing ice from the alpine areas of the Coast and Vancouver Island Mountains made its way through the Strait of Georgia and deposited proglacial outwash termed the Quadra Sand (Clague, 1976 and 1977). The Quadra sand was deposited in the Victoria area no earlier than 22 600 +/- 300 years B.P. (Alley, 1979; Clague, 1977) and is best exposed at Cordova Bay, Cowichan Head, James and Sidney Island and at the base of the Trio gravel pit. The deposition of the Quadra sands was followed by the deposition of proglacial sands and gravels from both the Vancouver Island (mainly Cowichan valley) and the Cordilleran Ice sheets. As these ice sheets built up in the Georgia depression they split into two lobes; one flowed south towards the Puget lowlands and the other flowed westward towards the continental shelf. The deposition of Vashon till from the Fraser Glaciation did not occur in the Victoria area until after 17 000 years ago (Howes and Nasmith, 1983) and it reached its maximum thickness of approximately 1500 metres in the Victoria area about 15 000 years ago (Clague *et. al.*, 1980).

The southern Vancouver Island area was free of Vashon ice by approximately 13 000 years ago (Alley and Chatwin, 1979) but around 12 000 years ago a minor resurgence of ice produced ice dammed lakes in many of the major coastal Valleys on southern Vancouver Island; for example the upper Cowichan Valley and the Parry Bay area. Glaciomarine silts deposited in the Victoria area have been dated at 12 100 +/- 160 years B.P. (Nasmith, 1971). In addition to these silts, the upper limit of the Colwood delta (the modern Metchosin/Colwood area) shows that isostatic depression and marine inundation, just after deglaciation on southeastern Vancouver Island, was approximately 75 metres above the modern sea level (Mathews *et. al.* ,1970). The deposits formed at this time are part of the Capilano post glacial sediments of Late Wisconsin and Early Holocene (~13 000 to 5000 years B.P.) age and include the silty diamicton locally known as the Victoria clay.

Sea level, which had been much higher than at present as a result of isostatic depression, eventually reached its present elevation approximately 11 700 years ago. These transgressions left behind numerous wave cut platforms and raised beaches throughout the Gulf Islands and southern Vancouver Island. However, between 9 250 and 5 000 years ago sea level dropped to more than 4 metres below present (Clague *et. al.*, 1980).

SURFICIAL GEOLOGY

Diamicton:

Much of the low-lying coastal areas, including Ladysmith and Chemainus, are draped by up to twelve metres of sandy diamicton **(sdMb)**. In areas of little relief this till forms a hummocky blanket interspersed with swamps **(dMbh/$Op)** showing probable ice stagnation in the area.

Upland Colluvium:

In the mountainous regions, for example the northwest of this map sheet, the till and colluviated bedrock form a colluvial veneer to blanket over bedrock **(Cv/Cb over R)** with clear bedrock **(R)** showing only in the steepest areas. Reworked or redeposited till is interpreted as colluvial diamicton **(Cb)** when found to be relatively unconsolidated, contain numerous angular and local clasts and shows signs of crude stratification.

Sand and Gravel:

On the coast the till is found either directly over bedrock or over what appears to be glaciofluvial sand and gravel channel to deltaic sediments **(sgF^G/sgF^Gf)** as found in the Chemainus and north Duncan areas. These are thick, aggradational sequences of steeply dipping (23-25°) sands and gravels overlain by channelled, cut-and-fill sands and gravels resembling those of glaciofluvial deltaic and braided stream environments, respectively. They were most likely deposited during the advancing phase of the last glaciation. Holocene fluvial processes now dominate the modern Cowichan valley **(sgF)** and the Cowichan river delta **($sFf)**.

Note: The rose diagrams at sections HB92-64 and 41 are both from diamictons at surface. The diagrams are weighted to their direction of source.

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