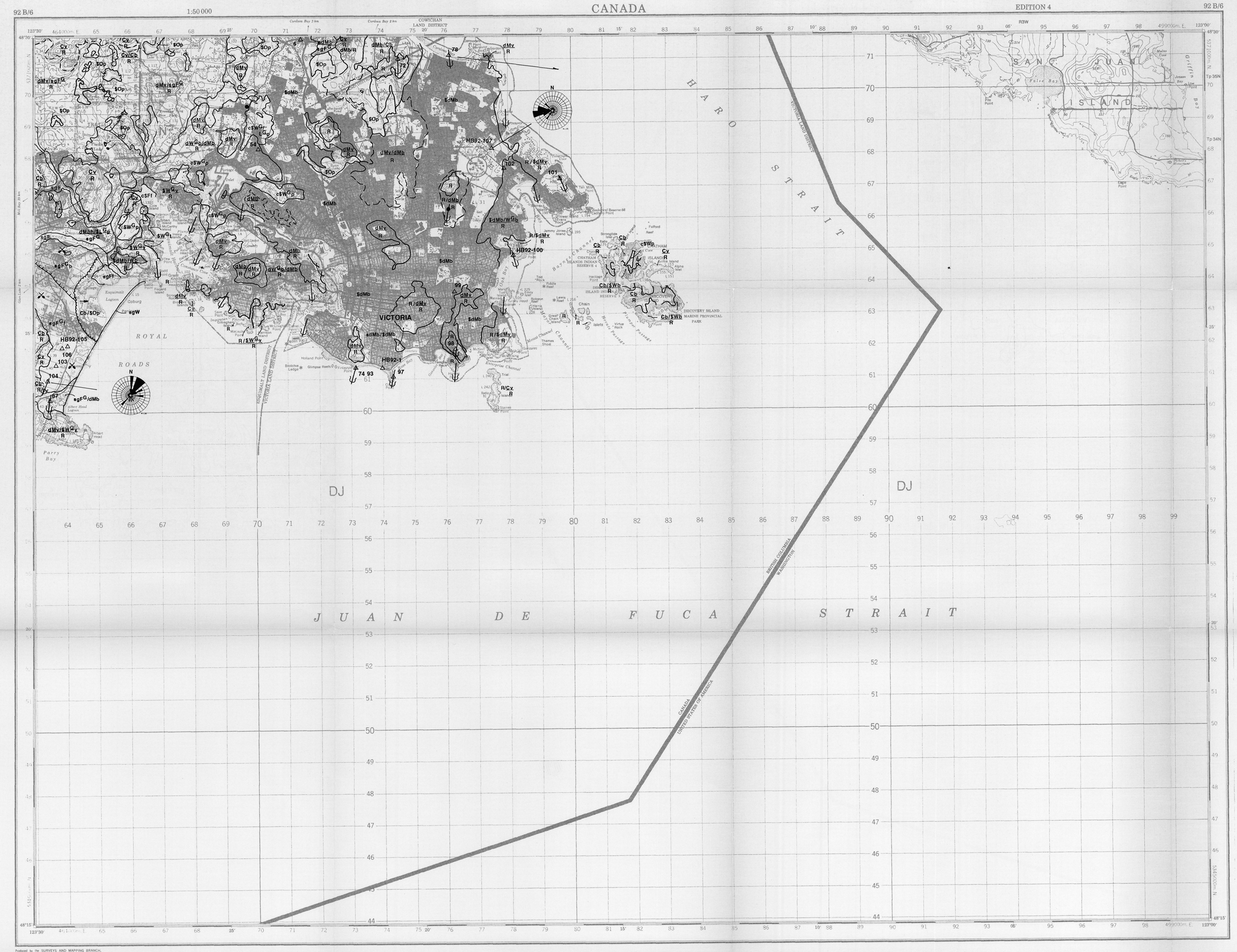

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SURFICIAL GEOLOGY OF THE VICTORIA AREA

NTS 92B/6

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

1:50 000

For an overview of the surficial geology of the Victoria 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 ——— surface expression
texture ——— gFt

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 abrupt fan sediments.
fG	glaciofluvial	Fluvial sediment deposited in association with glacier ice; generally consists of gravel and sand; includes kame terrace, kame terraces and esker.
L	lacustrine	Sediment deposited in lakes or around lake shorelines; generally consists of sand, silt and clay; includes beach and lacustrine terrace deposits.
LG	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; included 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.
WG	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	A 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 = granuled 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 has resulted in thick sequences of both glacial and interglacial deposits. Excluding the sediments of the last glaciation (Vashon till) most of these 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 periods.

The oldest record can be found at Muir Point, in Sooke. This section contains material interpreted to be of a pre-Sangamon (>125 000 years B.P.) glacial event originating from the northwest yet includes 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 of Sangamon age (~125 000 years B.P.) which form the Muir Point Formation (Hicock and Armstrong, 1983).

Directly overlying the Muir Point Formation and directly 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 - 26 000 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, 1977). The Quadra sand was deposited in the Victoria area no earlier than 22 600 ± 300 years B.P. (Alley, 1979 and 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 directly 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 the isostatic depression and marine inundation, just after deglaciation on southeastern Vancouver Island, to have been 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 the Late Wisconsin and Early Holocene (~13 000 to 5000 years B.P.) and include the silty diamicton locally known as the Victoria clays.

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. This can be seen on the modern landscape in the form of numerous wave cut platforms and raised beaches throughout the Gulf Islands and southern Vancouver Island, all within 1 to 4 metres of present mean high tide. 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 Victoria, the Saanich Peninsula, and James and Sidney islands are draped by 1 to 2 metres of silty diamicton **(sdMb)**. It is usually deposited directly over bedrock or silty clay. The clast content of this silty diamicton ranges from 5 per cent at the base to 30 per cent at the top. Maximum clast size also increases toward the surface. The diamicton is generally well indurated and a grey, to dark greyish brown colour (Munsell code 2.5Y 4/2, moist). From lithological and striae data it appears to have both Cowichan Valley and Coast Mountain sources. At lower elevations (from sea level to ~90 m) throughout the southeastern Vancouver Island area outcrops of an unconsolidated, sandy, poorly bedded diamicton can be found **(sdM)**. These deposits are most often found in association with glaciofluvial sediments. For example, this sandy diamicton can be found at the top of the Cordova Bay, Trio gravel pit and the Butler Brother's gravel pit sections. This sandy diamicton is most likely a result of recessional downwasting in a glaciofluvial environment. Other surficial deposits of sandy diamicton should be viewed as possible targets for sand and gravel exploration.

Sand and Gravel:

Surface concentrations of sand and gravel **(sgF^G or sgF)** exist in the Metchosin, Langford and Goldstream areas 15 kilometres west of Victoria. They are thick, aggradational sequences of steeply dipping (25-28°) 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 in the recessional phase of the last glaciation.

Upland Colluvium:

The mountainous inland areas of southeastern Vancouver Island appear to have been completely covered by ice during the last glaciation. The surficial materials in this part of southeastern Vancouver Island consist mainly of colluviated bedrock and till over bedrock, either as a blanket or a veneer **(Cb or Cv/R)**. Colluvium is defined by its relatively unconsolidated texture, numerous angular and local clasts, and crude stratification.

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