BRITISH COLUMBIA

BRITISH COLUMBIA GEOLOGICAL SURVEY

Open File 1998-07

Geological Maps of the Nanaimo and Comox Coalfields

by: C.G. Cathyl-Bickford and G.L. Hoffman

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GEOLOGY OF THE QUINSAM RIVER AREA, COMOX COALFIELD, BRITISH COLUMBIA

NTS 92F/14; 92K/3

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2 kilometres

Stratigraphic Legend

Upper Cretaceous

Nanaimo Group

Campanian

TRENT RIVER FORMATION:

- 10b — OYSTER RIVER MEMBER: sandstone; minor conglomerate
- 9 — ROYSTON MEMBER: shale and siltstone
- 8 — TSABLE MEMBER: conglomerate and sandstone (not exposed within map-area)
- 7 — BROWNS MEMBER: sandstone and siltstone; minor shale and coal
- 4 — PUNTLEDGE MEMBER: siltstone; minor sandstone

COMOX FORMATION:

- 3 — DUNSMUIR MEMBER: sandstone; minor siltstone; shale, conglomerate and coal

Santonian

- 2 — CUMBERLAND MEMBER: siltstone, shale, coal and sandstone; may include tongues of Benson conglomerate near base

Santonian?

- 1 — BENSON MEMBER: conglomerate; red shale and siltstone

Upper Triassic

Vancouver Group

- V — KARMUTSEN FORMATION: massive and pillowed basaltic flows

Notes: Units 5 and 6 are not recognised within the map-area. Unit 8 is not exposed within the map-area, but it may locally be present in the subsurface. Unit 10a is not recognised within the map-area; the age relationship between it and Unit 10b is not known.

Symbols

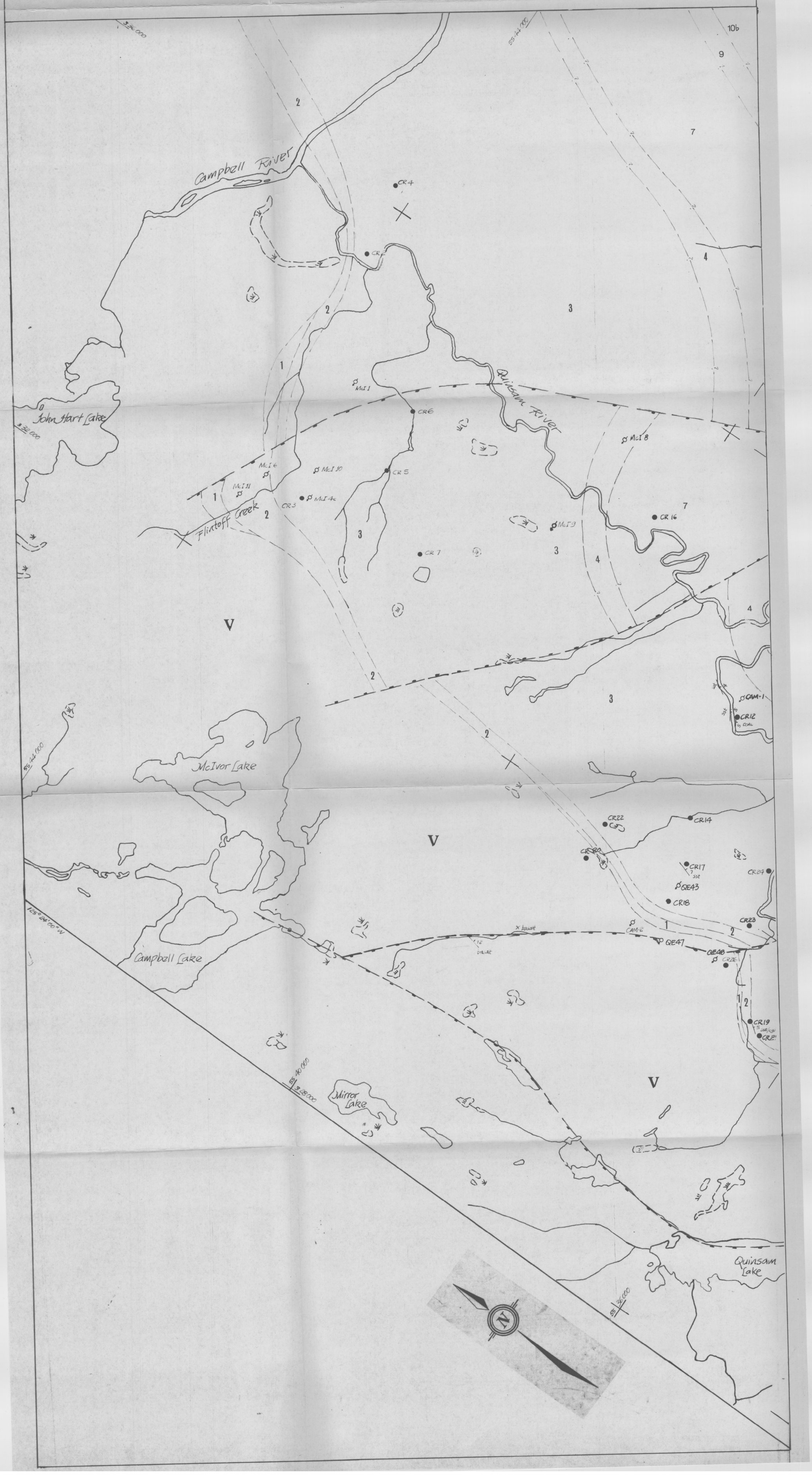
Bedding orientation

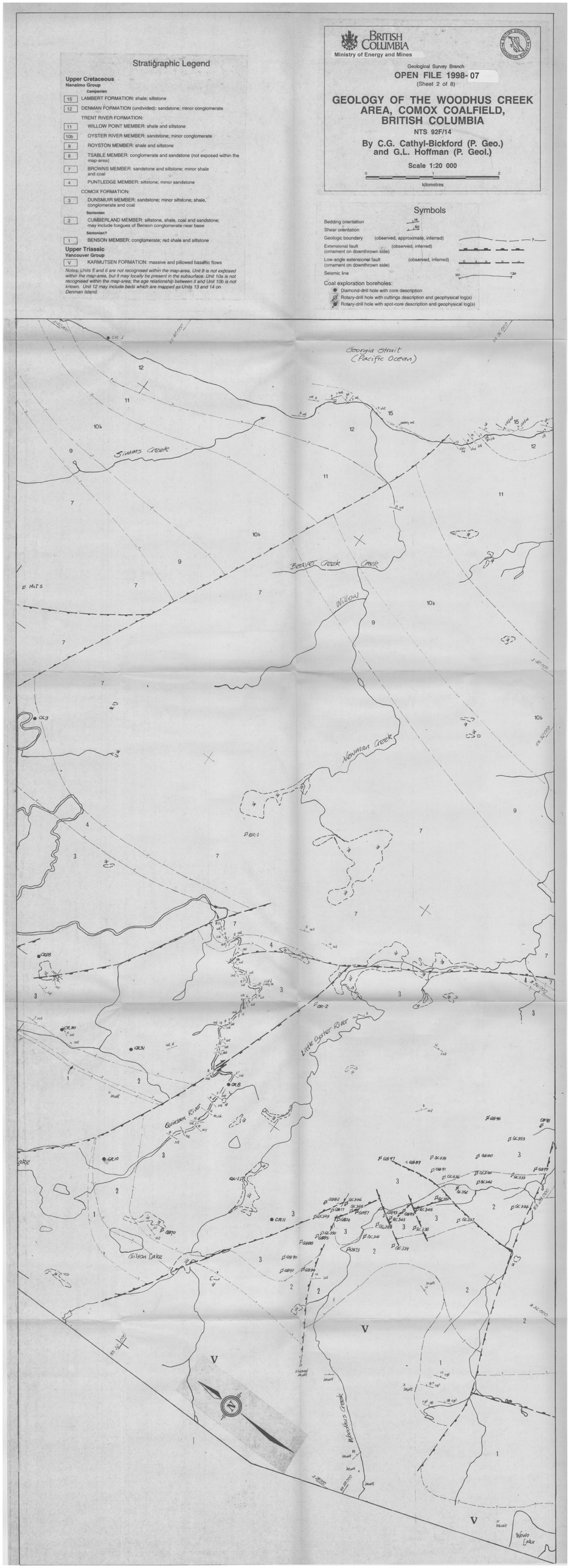
Geologic boundary (observed, approximate, inferred)

Extensional fault (observed, inferred) (ornament on downthrown side)

Coal exploration boreholes:

- Diamond-drill hole with core description
- Rotary-drill hole with cuttings description and geophysical log(s)




Stratigraphic Legend
Upper Cretaceous
Nanaimo Group
Campanian
15 LAMBERT FORMATION: shale; siltstone
12 DENMAN FORMATION (undivided): sandstone; minor conglomerate
TRENT RIVER FORMATION:
11 WILLOW POINT MEMBER: shale and siltstone
10b OYSTER RIVER MEMBER: sandstone; minor conglomerate
9 ROYSTON MEMBER: shale and siltstone
8 TSABLE MEMBER: conglomerate and sandstone (not exposed within the map-area)
7 BROWNS MEMBER: sandstone and siltstone; minor shale and coal
4 PUNTLEDGE MEMBER: siltstone; minor sandstone
COMOX FORMATION:
3 DUNSMUIR MEMBER: sandstone; minor siltstone; shale, conglomerate and coal
Santonian
2 CUMBERLAND MEMBER: siltstone, shale, coal and sandstone; may include tongues of Benson conglomerate near base
Santonian?
1 BENSON MEMBER: conglomerate; red shale and siltstone
Upper Triassic
Vancouver Group
V KARMUTSEN FORMATION: massive and pillowed basaltic flows
Notes: Units 5 and 6 are not recognised within the map-area. Unit 8 is not exposed within the map-area, but it may locally be present in the subsurface. Unit 10a is not recognised within the map-area; the age relationship between it and Unit 10b is not known. Unit 12 may include beds which are mapped as Units 13 and 14 on Denman Island.
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GEOLOGY OF THE WOODHUS CREEK AREA, COMOX COALFIELD, BRITISH COLUMBIA
NTS 92F/14
By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)
Scale 1:20 000
0 1 2
kilometres
Symbols
Bedding orientation
Shear orientation
Geologic boundary (observed, approximate, inferred)
Extensional fault (observed, inferred)
(ornament on downthrown side)
Low-angle extensional fault (observed, inferred)
(ornament on downthrown side)
Seismic line
Coal exploration boreholes:
Diamond-drill hole with core description
Rotary-drill hole with cuttings description and geophysical log(s)
Rotary-drill hole with spot-core description and geophysical log(s)
Georgia Strait
(Pacific Ocean)
Simms Creek
Beaver Creek
Willow Creek
Newman Creek
Little Oyster River
Quinsam River
Gilson Lake
McPhail Creek
Wokas Lake
CR 1
CR 9
CR 25
CR 30
CR 31
CR 8
CR 10
CR 11
MLT 5
GR-1
GR-2

Stratigraphic Legend

Quaternary

D — DRIFT: unconsolidated sand, silt, clay, gravel and till; mapped only where it completely obscures underlying units.

Eocene to Oligocene
Mount Washington Intrusive Suite

T — sills and dikes of dacite and quartz diorite

Upper Cretaceous
Nanaimo Group

Campanian

15 — LAMBERT FORMATION: shale; siltstone

12 — DENMAN FORMATION (undivided): sandstone; minor conglomerate

TRENT RIVER FORMATION:

11 — WILLOW POINT MEMBER: shale and siltstone

10b — OYSTER RIVER MEMBER: sandstone; minor conglomerate

9 — ROYSTON MEMBER: shale and siltstone

8 — TSABLE MEMBER: conglomerate and sandstone (not exposed within the map-area)

7 — BROWNS MEMBER: sandstone and siltstone; locally glauconitic

4 — PUNTLEDGE MEMBER: siltstone; minor sandstone

COMOX FORMATION:

3 — DUNSMUIR MEMBER: sandstone; minor siltstone; shale, conglomerate and coal

Santonian

2 — CUMBERLAND MEMBER: sandstone, siltstone, shale and coal

Santonian?

1 — BENSON MEMBER: conglomerate and sandstone; red shale and siltstone

Upper Triassic
Vancouver Group

V — KARMUTSEN FORMATION: massive and pillowed basaltic flows

Notes: Units 5 and 6 are not recognised within the map-area. Unit 8 is not exposed within the map-area, but it may locally be present in the subsurface. Unit 10a is not recognised within the map-area; the age relationship between it and Unit 10b is not known. Unit 12 may include beds which are mapped as Units 13 and 14 on Denman Island.

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GEOLOGY OF THE BLACK CREEK AREA, COMOX COALFIELD, BRITISH COLUMBIA

NTS 92F/11E, 14

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2 kilometres

Symbols

Bedding orientation

Shear orientation

Geologic boundary (observed, approximate, inferred)

Extensional fault (observed, inferred) (ornament on downthrown side)

Low-angle extensional fault (observed, inferred) (ornament on downthrown side)

Seismic line

Coal exploration boreholes:

- Diamond-drill hole with core description
- Rotary-drill hole with cuttings description and geophysical log(s)
- Drillhole, location reported but no other information available

Coalbed gas wells:

- Abandoned; with geophysical logs and summary cuttings description

Water wells:

- Rotary-drill hole with driller's log (selected wells only shown)

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GEOLOGY OF THE CUMBERLAND AREA, COMOX COALFIELD, BRITISH COLUMBIA

NTS 92F/10W, 11E, 14E

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Eocene to Oligocene
Mount Washington Intrusive Suite
- T — sills and dikes of dacite and quartz diorite

Upper Cretaceous
Nanaimo Group
Campanian
TRENT RIVER FORMATION:
- 11 — WILLOW POINT MEMBER: shale and siltstone; minor sandstone
- 9 — ROYSTON MEMBER: shale and siltstone
- 8 — TSABLE MEMBER: conglomerate and sandstone; minor siltstone and shale
- 7 — BROWNS MEMBER: sandstone and siltstone; locally glauconitic
- 4 — PUNTLEDGE MEMBER: siltstone and shale; minor sandstone

COMOX FORMATION:
- 3 — DUNSMUIR MEMBER: sandstone; siltstone, shale and coal; minor conglomerate

Santonian
- 2 — CUMBERLAND MEMBER: siltstone and sandstone; coal and shale

Santonian?
- 1 — BENSON MEMBER: conglomerate and sandstone; red shale and siltstone

Upper Triassic
Vancouver Group
- V — KARMUTSEN FORMATION: massive and pillowed basaltic flows; basaltic breccia

Notes: Units 5 and 6 are not recognised within the map-area. Units 10a and 10b are probably not present within the map-area.

Symbols

- Bedding orientation
- Shear orientation
- Geologic boundary (observed, approximate, inferred)
- Extensional fault (ornament on downthrown side) (observed, inferred)
- Strike-slip or tear fault (arrows indicate offset) (observed, inferred)
- Anticline, surface trace (observed)
- Syncline, surface trace (observed)
- Seismic line

Coal exploration boreholes:
- Diamond-drill hole with core description; 'u' indicates underground drillsite
- Diamond-drill hole with incomplete core description; 'u' indicates underground drillsite
- Rotary-drill hole with cuttings description and geophysical log(s)

Coalbed gas wells:
- Abandoned; with geophysical logs and summary cuttings description

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GEOLOGY OF THE HAMILTON LAKE AREA, COMOX COALFIELD, BRITISH COLUMBIA

NTS 92F/10W, 11E

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Upper Cretaceous
Nanaimo Group
Campanian
TRENT RIVER FORMATION:
- 9 ROYSTON MEMBER: shale and siltstone
- 8 TSABLE MEMBER: conglomerate and sandstone; minor siltstone
- 7 BROWNS MEMBER: sandstone and siltstone (not exposed in map-area)
- 4 PUNTLEDGE MEMBER: siltstone; minor sandstone

COMOX FORMATION:
- 3 DUNSMUIR MEMBER: sandstone; minor siltstone, shale and coal

Santonian
- 2 CUMBERLAND MEMBER: shale, sandstone, siltstone and coal

Santonian?
- 1 BENSON MEMBER: conglomerate; red shale and siltstone; kaolinitic claystone

Upper Triassic
Vancouver Group
- V KARMUTSEN FORMATION: massive and pillowed basaltic flows; basaltic breccia

Notes: Units 5 and 6 are not recognised within the map-area. Unit 7 is not exposed within the map-area, but it may be locally present in the subsurface.

Symbols

- Bedding orientation
- Geologic boundary (observed, approximate, inferred)
- Extensional fault (ornament on downthrown side) (observed, inferred)
- Low-angle extensional fault (ornament on downthrown side) (observed, inferred)
- Strike-slip or tear fault (arrows indicate offset) (observed, inferred)
- Anticline, surface trace (observed)
- Syncline, surface trace (observed)

Coal exploration boreholes:
- Diamond-drill hole with core description
- Diamond-drill hole with missing or incomplete core description
- Rotary-drill hole with cuttings description and geophysical ldg(s)

0 1 2 3 4 Km

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GEOLOGY OF THE TSABLE RIVER AREA, COMOX COALFIELD, BRITISH COLUMBIA

NTS 92F/7W, 10W

By C.G. Cathyl-Bickford (P. Geo.)
and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Upper Cretaceous
Nanaimo Group
Campanian

DENMAN FORMATION:

12 MADIGAN MEMBER: sandstone; minor conglomerate and siltstone

TRENT RIVER FORMATION:

11 WILLOW POINT MEMBER: mudstone and siltstone; minor conglomerate

10a BAYNES SOUND MEMBER: sandstone and siltstone; minor conglomerate

9 ROYSTON MEMBER: mudstone and siltstone; minor sandstone and argillaceous limestone

8 TSABLE MEMBER: conglomerate, mud-matrix conglomerate; minor sandstone and pebbly siltstone

7 BROWNS MEMBER: sandstone; minor siltstone

6 PUNTLEDGE MEMBER: siltstone; minor sandstone

5 COWIE MEMBER: sandstone; minor siltstone

4 COUGARSMITH MEMBER: mudstone and siltstone; minor sandstone

COMOX FORMATION:

3 DUNSMUIR MEMBER: sandstone; minor siltstone and coal

Santonian

2 CUMBERLAND MEMBER: siltstone, shale and coal; minor sandstone and gritstone

Santonian?

1 BENSON MEMBER: conglomerate; minor gritstone, red shale and siltstone

Upper Triassic
Vancouver Group

V KARMUTSEN FORMATION: massive and pillowed basaltic flows; basaltic breccia; tuff

Note: Unit 10b is not recognised within the map-area; the age relationship between it and Unit 10a is not known.

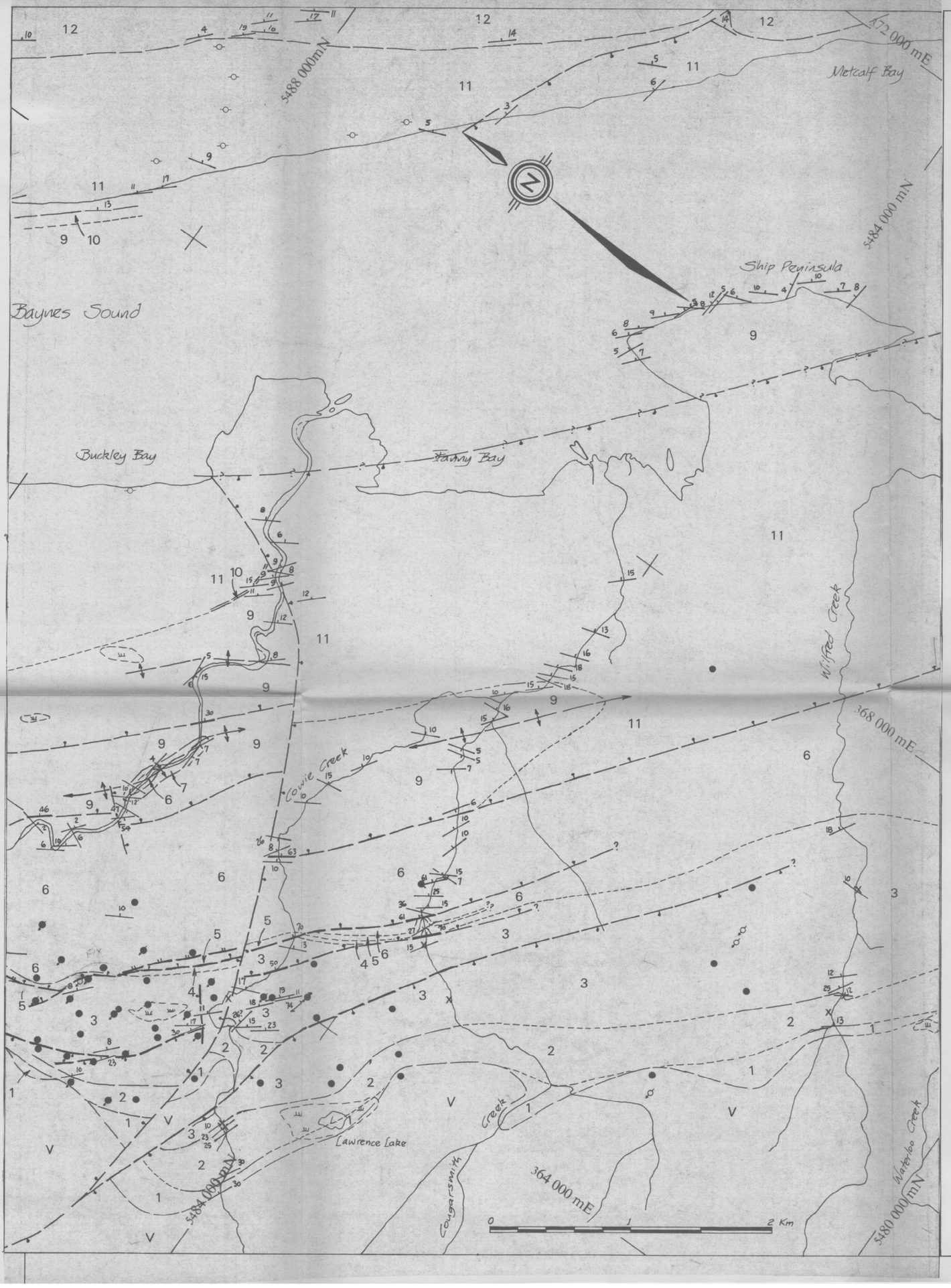
Symbols

Bedding orientation
Shear orientation
Geologic boundary (observed, approximate, inferred)
Extensional fault (observed, inferred)
(ornament on downthrown side)
Low-angle extensional fault (observed, inferred)
(ornament on downthrown side)
Strike-slip or tear fault (observed, inferred)
(arrows indicate offset)
Anticline, surface trace (observed)
Syncline, surface trace (observed)
Trend and plunge of minor folds
Adit or tunnel
Prospect pit

Coal exploration boreholes:

- Diamond-drill hole with core description
- Diamond-drill hole with core description and geophysical log(s)
- Diamond-drill hole with missing or incomplete core description
- Rotary-drill hole with cuttings description and geophysical log(s)

Universal Transverse Mercator Grid (Zone 10U)



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GEOLOGY OF THE COWIE CREEK AREA, COMOX COALFIELD, BRITISH COLUMBIA

NTS 92F/7W, 10W

By C.G. Cathyl-Bickford (P. Geo.)
and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Upper Cretaceous
Nanaimo Group
Campanian

DENMAN FORMATION:

12 MADIGAN MEMBER: sandstone; minor conglomerate and siltstone

TRENT RIVER FORMATION:

11 WILLOW POINT MEMBER: mudstone and siltstone; minor conglomerate

10a BAYNES SOUND MEMBER: sandstone and siltstone; minor conglomerate

9 ROYSTON MEMBER: mudstone and siltstone; minor sandstone and argillaceous limestone

8 TSABLE MEMBER: conglomerate, mud-matrix conglomerate; minor sandstone and pebbly siltstone (not exposed within the map-area)

7 BROWNS MEMBER: sandstone; minor siltstone

6 PUNTLEDGE MEMBER: siltstone; minor sandstone

5 COWIE MEMBER: sandstone; minor siltstone

4 COUGARSMITH MEMBER: mudstone and siltstone; minor sandstone

COMOX FORMATION:

3 DUNSMUIR MEMBER: sandstone; minor siltstone and coal

Santonian

2 CUMBERLAND MEMBER: siltstone, shale and coal; minor sandstone and gritstone

Santonian?

1 BENSON MEMBER: conglomerate; minor gritstone, red shale and siltstone

Upper Triassic
Vancouver Group

V KARMUTSEN FORMATION: massive and pillowed basaltic flows; basaltic breccia; tuff

Notes: Unit 8 is not exposed within the map-area. It may be locally present in the subsurface. Unit 10b is not recognised within the map-area; the age relationship between it and Unit 10a is not known.

Symbols

Bedding orientation
Shear orientation

Geologic boundary (observed, approximate, inferred)

Extensional fault (ornament on downthrown side) (observed, inferred)

Low-angle extensional fault (ornament on downthrown side) (observed, inferred)

Strike-slip or tear fault (arrows indicate offset) (observed, inferred)

Anticline, surface trace (observed)

Syncline, surface trace (observed)

Trend and plunge of minor folds

Adit or tunnel

Prospect pit

Coal exploration boreholes:

- Diamond-drill hole with core description
- Diamond-drill hole with core description and geophysical log(s)
- Diamond-drill hole with missing or incomplete core description
- Rotary-drill hole with cuttings description and geophysical log(s)

Water wells:

- Rotary-drill or cable-tool well with driller's log (selected wells only shown)

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GEOLOGY OF THE DENMAN ISLAND AREA, COMOX COALFIELD, BRITISH COLUMBIA

NTS 92F/7, 10

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Stratigraphic Legend

Upper Cretaceous

Nanaimo Group:

Campanian

16 GEOFFREY FORMATION: conglomerate and sandstone

15 LAMBERT FORMATION: mudstone and siltstone; minor sandstone and argillaceous limestone

DENMAN FORMATION:

14 NORMAN POINT MEMBER: sandstone; minor siltstone

13 GRAHAM MEMBER: conglomerate; minor sandstone and siltstone

12 MADIGAN MEMBER: sandstone; minor conglomerate and siltstone

TRENT RIVER FORMATION:

11 WILLOW POINT MEMBER: mudstone and siltstone; minor conglomerate

10a BAYNES SOUND MEMBER: sandstone and siltstone; minor conglomerate

9 ROYSTON MEMBER: mudstone and siltstone; minor sandstone and argillaceous limestone

Note: Strata below Unit 8 do not outcrop within the map-area. Unit 10b is not recognised within the map-area; the age relationship between it and Unit 10a is not known.

Scale 1:20 000

0 1 2 3 Km

Symbols

Bedding orientation

Shear orientation

Geologic boundary (observed, approximate, inferred)

Extensional fault (observed, inferred)
(ornament on downthrown side)

Strike-slip or tear fault (observed, inferred)
(arrows indicate offset)

Anticline, surface trace (observed)

Syncline, surface trace (observed)

Trend and plunge of minor folds

Coal exploration boreholes:

Diamond-drill hole with core description

Water wells:

Rotary-drill or cable-tool hole well (selected wells only shown)

Komas Bluffs

Lambert Channel

Shingle Spit

Phipps Point

Ford Cove

Norman Point

Norris Rock

Eagle Rock

Boyle Point

Gravelly Bay

Whalebone Point

Henry Bay

RAUCH FAULT

Chicadee Lake

MIDDLE FARM FAULT

Graham Lake

DUNSMUIR FAULT

Repulse Point

Metcalf Bay

Denman Point

Baynes Sound

Ship Peninsula

Base Flat

Fanny Bay

Buckley Bay

Mud Bay

370 000 mE

372 000 mE

374 000 mE

376 000 mE

378 000 mE

380 000 mE

366 000 mE

368 000 mE

5496 000 mN

5494 000 mN

5492 000 mN

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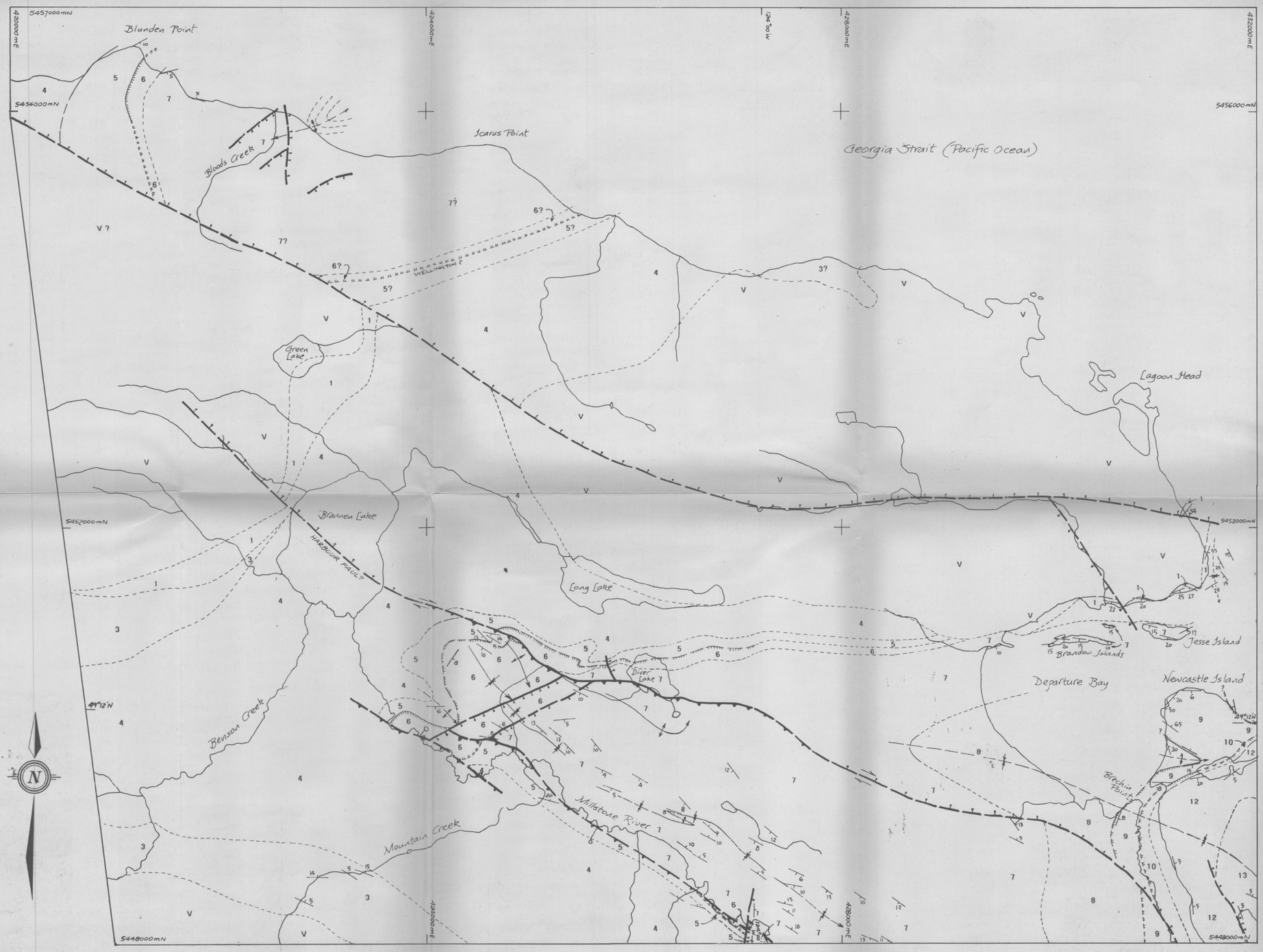
5486 000 mN

5484 000 mN

5482 000 mN

5480 000 mN



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GEOLOGY OF THE WELLINGTON AREA, NANAIMO COALFIELD, BRITISH COLUMBIA

NTS 92F/1E, 8E; 92G/4W

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Upper Cretaceous
Nanaimo Group
Campanian

PROTECTION FORMATION:

- 13 RESERVE MEMBER: sandstone, siltstone, shale and coal
- 12 CASSIDY MEMBER: sandstone and gritstone; minor siltstone and coaly shale

PENDER FORMATION:

- 11 NEWCASTLE MEMBER (undivided): shale and siltstone; minor sandstone
- 10 SOUTHFIELD BEDS: shale; minor sandstone, gritstone and conglomerate
- 9 DOUGLAS BEDS: conglomerate and gritstone; carbonaceous shale and coal (Douglas Seam at top, Newcastle Seam at base)
- 8 CRANBERRY MEMBER: shale and siltstone; conglomerate and sandstone

EXTENSION FORMATION:

- 7 MILLSTREAM MEMBER: conglomerate and gritstone; minor sandstone, siltstone, carbonaceous shale and coal
- 6 NORTHFIELD MEMBER: siltstone, carbonaceous shale and coal (Wellington Seam at base); locally contains lenses of conglomerate and sandstone
- 5 EAST WELLINGTON FORMATION: sandstone; minor gritstone and siltstone

Santonian to Campanian

- 4 HASLAM FORMATION: siltstone, with sandstone interbeds at top; grades down to black silty shale at base

Turonian? to Santonian

COMOX FORMATION:

- 3 DUNSMUIR MEMBER: sandstone; minor siltstone
- 2 CUMBERLAND MEMBER: sandstone, siltstone and coal
- 1 BENSON MEMBER: conglomerate, red shale and siltstone; minor calcarenite

Upper Triassic
Vancouver Group

- V KARMUTSEN FORMATION: massive and pillowed basaltic flows; hyaloclastite breccia

Notes: Unit 2 is not known to be present within the map-area; it may be locally present in the subsurface. Unit 11 is not recognised within the map-area; strata within this interval are mapped as Units 9 and 10.

Symbols

Bedding orientation	
Geologic boundary	(observed, approximate, inferred)
Reverse fault	(observed, approximate, inferred)
Normal fault	(observed, approximate, inferred)
Anticline, surface trace	(observed, approximate, inferred)
Syncline, surface trace	(observed, approximate, inferred)
Coal seam trace	(observed, approximate, inferred)

Geological interpretation is based on fieldwork by C.G. Cathyl-Bickford (1977 to 1995), assisted by C.R. Day, G.L. Hoffman and V. Slater. Additional information was obtained from water-well logs, mine plans, coal-exploration borehole logs and geotechnical test pits. Offshore projections of geology are based on offshore boreholes and mine plans of submarine workings. Map coordinates are UTM grid, based on NAD 83.

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(Sheet 2 of 6)

GEOLOGY OF THE WESTWOOD LAKE AREA, NANAIMO COALFIELD, BRITISH COLUMBIA

NTS 92F/1E; 92G/4W

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Upper Cretaceous
Nanaimo Group
Campanian

PROTECTION FORMATION:

13 RESERVE MEMBER: sandstone, siltstone, shale and coal

12 CASSIDY MEMBER: sandstone and gritstone; minor siltstone

PENDER FORMATION:

11 NEWCASTLE MEMBER (undivided): shale and siltstone; minor sandstone

10 SOUTHFIELD BEDS: shale; minor sandstone, gritstone and conglomerate

9 DOUGLAS BEDS: conglomerate and gritstone; carbonaceous shale and coal (Douglas Seam at top, Newcastle Seam at base)

8 CRANBERRY MEMBER: shale and siltstone; conglomerate and sandstone

EXTENSION FORMATION:

7 MILLSTREAM MEMBER: conglomerate and gritstone; minor sandstone, siltstone, carbonaceous shale and coal

6 NORTHFIELD MEMBER: siltstone, carbonaceous shale and coal (Wellington Seam at base); locally contains lenses of conglomerate and sandstone

5 EAST WELLINGTON FORMATION: sandstone; minor gritstone and siltstone

Santonian to Campanian

4 HASLAM FORMATION: siltstone, with sandstone interbeds at top; grades down to black silty shale at base

Turonian? to Santonian

COMOX FORMATION:

3 DUNSMUIR MEMBER: sandstone; minor siltstone

2 CUMBERLAND MEMBER: sandstone, siltstone and coal

1 BENSON MEMBER: conglomerate, red shale and siltstone

Upper Triassic
Vancouver Group

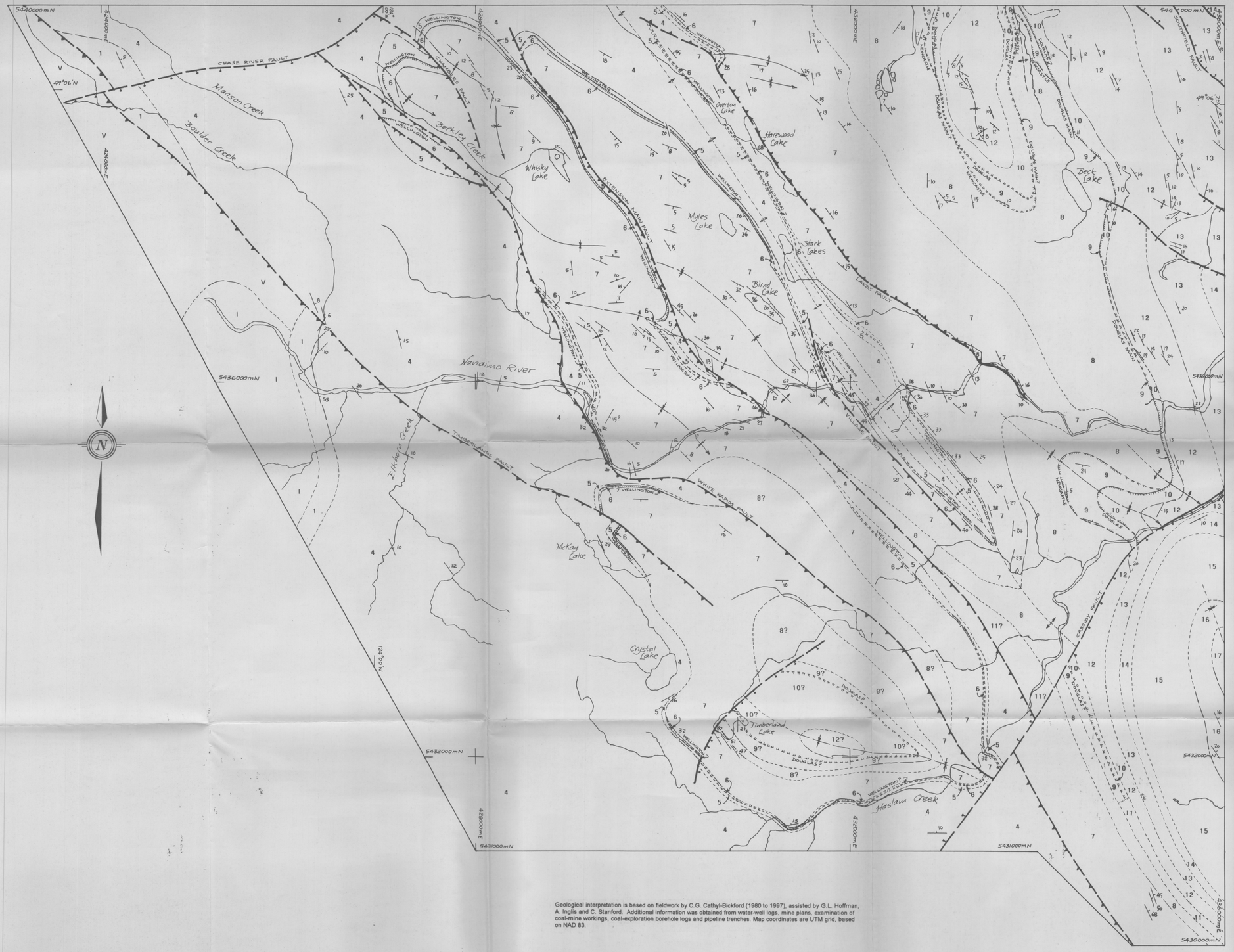
V KARMUTSEN FORMATION: massive and pillowed basaltic flows; hyaloclastite breccia

Notes: Unit 2 is not known to be present within the map-area; it may be locally present in the subsurface. Unit 11 is not recognised within the map-area; strata within this interval are mapped as Units 9 and 10.

Symbols

Bedding orientation		10
Geologic boundary	(observed, approximate, inferred)	
Reverse fault	(observed, approximate, inferred)	
Normal fault	(observed, approximate, inferred)	
Anticline, surface trace	(observed, approximate, inferred)	
Syncline, surface trace	(observed, approximate, inferred)	
Coal seam trace	(observed, approximate, inferred)	

Geological interpretation is based on fieldwork by C.G. Cathyl-Bickford (1980 to 1997), assisted by J.S.Harrow, G.L. Hoffman, A. Inglis and V. Slater. Additional information was obtained from water-well logs, mine plans and coal-exploration borehole logs. Map coordinates are UTM grid, based on NAD 83.



Geological interpretation is based on fieldwork by C.G. Cathyl-Bickford (1980 to 1997), assisted by G.L. Hoffman, A. Inglis and C. Stanford. Additional information was obtained from water-well logs, mine plans, examination of coal-mine workings, coal-exploration borehole logs and pipeline trenches. Map coordinates are UTM grid, based on NAD 83.

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Ministry of Energy and Mines

Geological Survey Branch

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GEOLOGY OF THE NANAIMO RIVER AREA, NANAIMO COALFIELD, BRITISH COLUMBIA

NTS 92F/1E; 92G/4W

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Upper Cretaceous
Nanaimo Group
Campanian

CEDAR DISTRICT FORMATION:

17 HOLDEN-CORSO MEMBER: shale and siltstone; minor sandstone
16 OYSTER HARBOUR MEMBER: sandstone and siltstone
15 GRANBY MEMBER: shale and siltstone; minor sandstone

PROTECTION FORMATION:

14 McMILLAN MEMBER: sandstone; minor siltstone
13 RESERVE MEMBER: sandstone, siltstone, shale and coal
12 CASSIDY MEMBER: sandstone and gritstone; minor siltstone

PENDER FORMATION:

11 NEWCASTLE MEMBER (undivided): shale and siltstone; minor sandstone
10 SOUTHFIELD BEDS: shale; minor sandstone, gritstone and conglomerate
9 DOUGLAS BEDS: conglomerate and gritstone; carbonaceous shale and coal (Douglas Seam at top, Newcastle Seam at base; these coal beds locally coalesce to form the Douglas Main Seam)
8 CRANBERRY MEMBER: shale and siltstone; conglomerate and sandstone

EXTENSION FORMATION:

7 MILLSTREAM MEMBER: conglomerate and gritstone; minor sandstone, siltstone, carbonaceous shale and coal
6 NORTHFIELD MEMBER: siltstone, carbonaceous shale and coal (Wellington Seam at base)
5 EAST WELLINGTON FORMATION: sandstone; minor gritstone and siltstone

Santonian to Campanian

4 HASLAM FORMATION: siltstone, with sandstone interbeds at top; grades down to black silty shale at base

Turonian? to Santonian

COMOX FORMATION:

3 DUNSMUIR MEMBER: sandstone; minor siltstone
2 CUMBERLAND MEMBER: sandstone, siltstone and coal
1 BENSON MEMBER: conglomerate, red shale and siltstone

Early to Middle Jurassic
Island Plutonic Suite

I NANAIMO RIVER BATHOLITH: quartz diorite

Upper Triassic
Vancouver Group

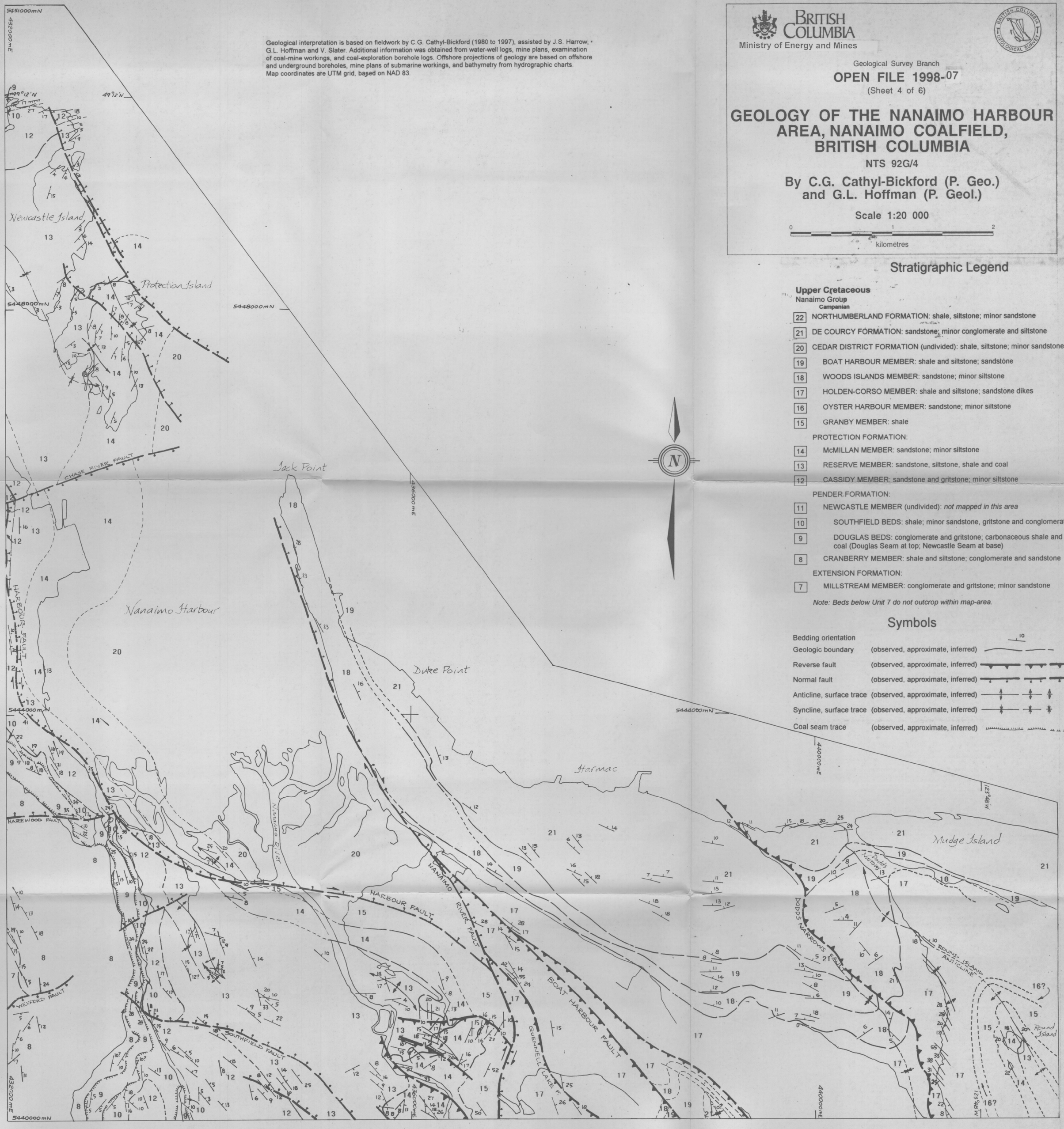
V KARMUTSEN FORMATION: pillowed basaltic flows; hyaloclastite breccia

Notes: Units 2 and 3 are present in subsurface only. Strata between the Douglas Seam and Newcastle Seam locally pinch out; in such areas, Unit 9 consists solely of the Douglas Main Seam.

Symbols

Bedding orientation		25
Geologic boundary	(observed, approximate, inferred)	
Lateral boundary between stratigraphic units	(approximate)	
Reverse fault	(observed, approximate, inferred)	
Normal fault	(observed, approximate, inferred)	
Anticline, surface trace	(observed, approximate, inferred)	
Syncline, surface trace	(observed, approximate, inferred)	
Coal seam trace	(observed, approximate, inferred)	

Geological interpretation is based on fieldwork by C.G. Cathyl-Bickford (1980 to 1997), assisted by J.S. Harrow, G.L. Hoffman and V. Slater. Additional information was obtained from water-well logs, mine plans, examination of coal-mine workings, and coal-exploration borehole logs. Offshore projections of geology are based on offshore and underground boreholes, mine plans of submarine workings, and bathymetry from hydrographic charts. Map coordinates are UTM grid, based on NAD 83.



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GEOLOGY OF THE NANAIMO HARBOUR AREA, NANAIMO COALFIELD, BRITISH COLUMBIA

NTS 92G/4

By C.G. Cathyl-Bickford (P. Geo.)
and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Upper Cretaceous
Nanaimo Group
Campanian

- 22 NORTHUMBERLAND FORMATION: shale, siltstone; minor sandstone
- 21 DE COURCY FORMATION: sandstone; minor conglomerate and siltstone
- 20 CEDAR DISTRICT FORMATION (undivided): shale, siltstone; minor sandstone
- 19 BOAT HARBOUR MEMBER: shale and siltstone; sandstone
- 18 WOODS ISLANDS MEMBER: sandstone; minor siltstone
- 17 HOLDEN-CORSO MEMBER: shale and siltstone; sandstone dikes
- 16 OYSTER HARBOUR MEMBER: sandstone; minor siltstone
- 15 GRANBY MEMBER: shale

PROTECTION FORMATION:

- 14 McMILLAN MEMBER: sandstone; minor siltstone
- 13 RESERVE MEMBER: sandstone, siltstone, shale and coal
- 12 CASSIDY MEMBER: sandstone and gritstone; minor siltstone

PENDER FORMATION:

- 11 NEWCASTLE MEMBER (undivided): *not mapped in this area*
- 10 SOUTHFIELD BEDS: shale; minor sandstone, gritstone and conglomerate
- 9 DOUGLAS BEDS: conglomerate and gritstone; carbonaceous shale and coal (Douglas Seam at top; Newcastle Seam at base)
- 8 CRANBERRY MEMBER: shale and siltstone; conglomerate and sandstone

EXTENSION FORMATION:

- 7 MILLSTREAM MEMBER: conglomerate and gritstone; minor sandstone

Note: Beds below Unit 7 do not outcrop within map-area.

Symbols

Bedding orientation		10
Geologic boundary	(observed, approximate, inferred)	
Reverse fault	(observed, approximate, inferred)	
Normal fault	(observed, approximate, inferred)	
Anticline, surface trace	(observed, approximate, inferred)	
Syncline, surface trace	(observed, approximate, inferred)	
Coal seam trace	(observed, approximate, inferred)	

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GEOLOGY OF THE QUENNELL LAKE AREA, NANAIMO COALFIELD, BRITISH COLUMBIA

NTS 92G/4

By C.G. Cathyl-Bickford (P. Geo.)
and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2
kilometres

Stratigraphic Legend

Upper Cretaceous
Nanaimo Group
Campanian

21 DE COURCY FORMATION: sandstone; minor conglomerate and siltstone

CEDAR DISTRICT FORMATION:

19 BOAT HARBOUR MEMBER: shale and siltstone; sandstone

18 WOODS ISLANDS MEMBER: sandstone; minor siltstone

17 HOLDEN-CORSO MEMBER: shale and siltstone; sandstone dikes

16 OYSTER HARBOUR MEMBER: sandstone; minor siltstone

15 GRANBY MEMBER: shale

PROTECTION FORMATION:

14 McMILLAN MEMBER: sandstone; minor siltstone

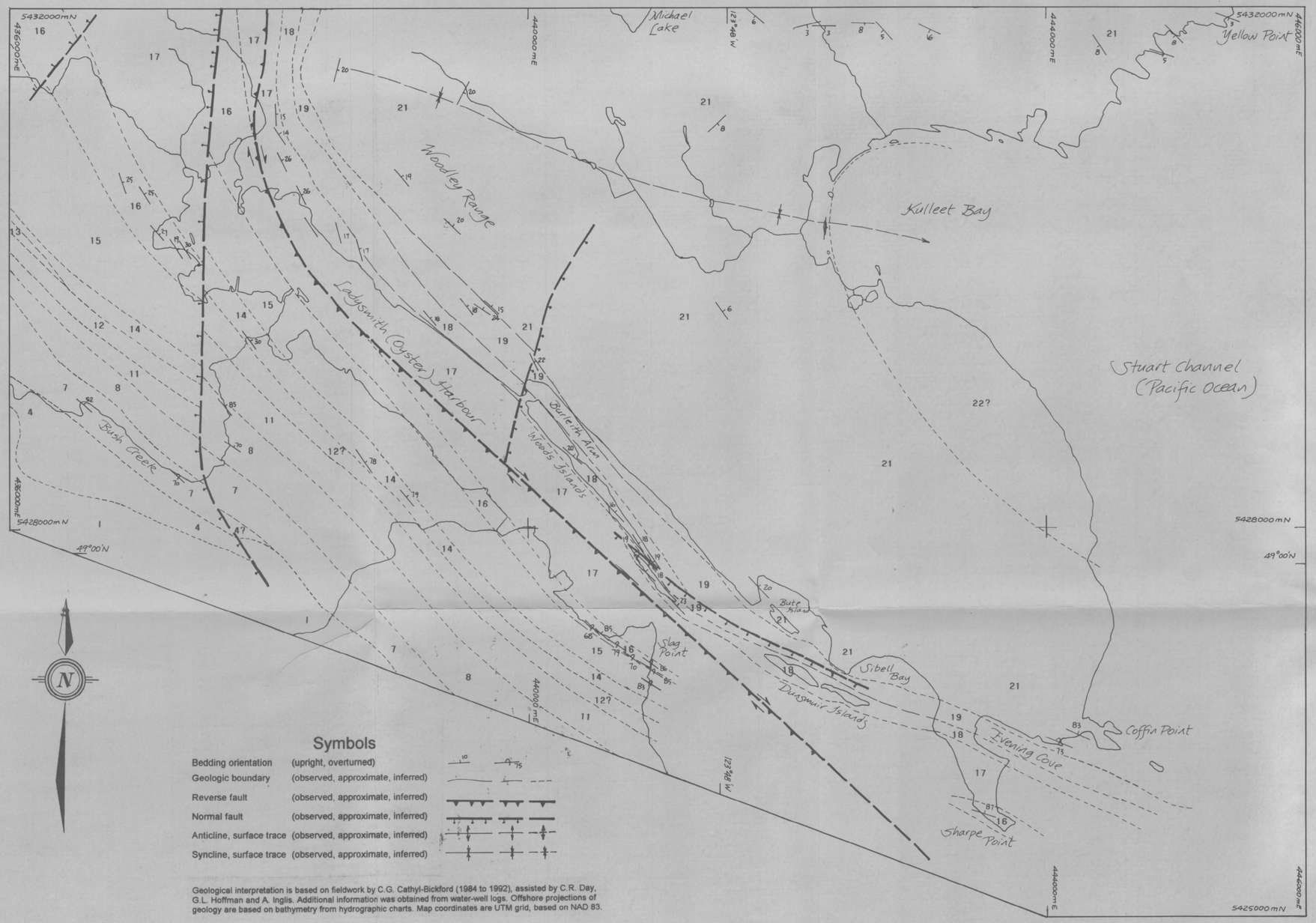
13 RESERVE MEMBER: sandstone, siltstone, shale and coal

Note: Beds below Unit 13 do not outcrop within the map-area. Unit 20 is not recognised; strata within this interval are represented by Units 15 through 19.

Symbols

Bedding orientation		10
Geologic boundary	(observed, approximate, inferred)	
Reverse fault	(observed, approximate, inferred)	
Normal fault	(observed, approximate, inferred)	
Anticline, surface trace	(observed, approximate, inferred)	
Syncline, surface trace	(observed, approximate, inferred)	

Geological interpretation is based on fieldwork by C.G. Cathyl-Bickford (1984 to 1996), assisted by G.L. Hoffman and A. Inglis. Additional information was obtained from water-well logs, coal-exploration borehole logs and pipeline trenches. Map coordinates are UTM grid, based on NAD 83.



Symbols

Bedding orientation	(upright, overturned)	
Geologic boundary	(observed, approximate, inferred)	
Reverse fault	(observed, approximate, inferred)	
Normal fault	(observed, approximate, inferred)	
Anticline, surface trace	(observed, approximate, inferred)	
Syncline, surface trace	(observed, approximate, inferred)	

Geological interpretation is based on fieldwork by C.G. Cathyl-Bickford (1984 to 1992), assisted by C.R. Day, G.L. Hoffman and A. Inglis. Additional information was obtained from water-well logs. Offshore projections of geology are based on bathymetry from hydrographic charts. Map coordinates are UTM grid, based on NAD 83.

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Ministry of Energy and Mines

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GEOLOGY OF THE OYSTER HARBOUR AREA, NANAIMO COALFIELD, BRITISH COLUMBIA

NTS 92B/13W; 92G/4

By C.G. Cathyl-Bickford (P. Geo.) and G.L. Hoffman (P. Geol.)

Scale 1:20 000

0 1 2

kilometres

Stratigraphic Legend

Upper Cretaceous

Nanaimo Group

Campanian

22 NORTHUMBERLAND FORMATION: shale, siltstone; minor sandstone

21 DE COURCY FORMATION: sandstone and conglomerate; minor siltstone

20 CEDAR DISTRICT FORMATION (undivided): shale, siltstone; minor sandstone

19 BOAT HARBOUR MEMBER: shale and siltstone; minor sandstone

18 WOODS ISLANDS MEMBER: sandstone; minor siltstone

17 HOLDEN-CORSO MEMBER: shale and siltstone; minor sandstone

16 OYSTER HARBOUR MEMBER: sandstone and siltstone

15 GRANBY MEMBER: shale and siltstone; minor sandstone

PROTECTION FORMATION:

14 McMILLAN MEMBER: sandstone; minor siltstone

13 RESERVE MEMBER: sandstone, siltstone, shale and coal

12 CASSIDY MEMBER: sandstone

PENDER FORMATION:

11 NEWCASTLE MEMBER: shale and siltstone; minor sandstone and coaly shale

8 CRANBERRY MEMBER: shale and siltstone; minor sandstone

EXTENSION FORMATION:

7 MILLSTREAM MEMBER: conglomerate and gritstone; minor sandstone

Santonian to Campanian

4 HASLAM FORMATION: siltstone, with sandstone interbeds at top; grades down to black silty shale at base

Turonian? to Santonian

COMOX FORMATION:

3 DUNSMUIR MEMBER: sandstone; minor siltstone

2 CUMBERLAND MEMBER: sandstone, siltstone and coal

Early to Middle Jurassic

Island Plutonic Suite

1 NANAIMO RIVER BATHOLITH: quartz diorite

Notes: Units 2 and 3 are present in subsurface only. Units 1, 5 and 6 are not present in the map-area. Units 9 and 10 are not recognised within the map-area; strata within this interval are mapped as Unit 11.