MIKE WEI
For 1983 GAC Field Trip

Hydrogeology of Saltspring Island

Two main assemblages of rocks directly underly Saltspring Island. The Nanaimo Group of Upper Cretaceous age comprising sedimentary rocks lies in the northern half and the Sicker "Group" of Lower Jurassic to Lower Cretaceous age comprising metavolcanic, metasedimentary, and intrusive rocks lies in the more mountainous southern half of the Island. To conform with Best's map, the Lower Cretaceous Tyee Quartz-feldspar Porphyrite and Sicker Gabbro-diorite Porphyrite mapped by Clapp have been grouped with the Lower and Middle Jurassic Sicker Volcanics and Sicker Sediments and together are refered to collectively as the Sicker "Group". The Nanaimo Group appears to represent sediments deposited through a series of marine transgressive cycles each with a coarser-grained sedimentary formation leading stratigraphically upwards to a finer-grained sedimentary formation; four such cycles may be observed on Saltspring Island. The general direction of younging is northeastward.

Both groups have undergone deformation. The Sicker Volcanics and Sicker Sediments were involved in an earlier phase of deformation probably in Upper Jurassic time before the Nanaimo Group was deposited and just before the intrusion of the Tyee Quartz-feldspar Porphyrite and the Sicker Gabbro-diorite Porphyrite. The resulting main fold axes trend northwest-southeast. Both groups underwent a later phase of deformation probably during Upper Eocene time. This phase of deformation is pervasive in the Nanaimo Group; the Sicker "Group" does not appear to have been much affected by this later deformation phase. Again the main fold axes trend northwest-southeast. Major fold structures on Saltspring Island resulting from this later deformation phase include the Long Harbour and Kulleet Synclines, synclines at Ganges Harbour and Walker Hook, and an anticline at Southey Point.

Till, glaciofluvial gravel and sand, and glaciomarine clay deposits as well as recent colluvial and bog deposits comprise the unconsolidated deposits on Saltspring Island. Till and glaciofluvial gravel and sand deposits occur up to 700 feet and 500 feet above sea level respectively and occupy the lowlands northwest of St. Mary Lake and along valley bottoms and partially up valley sides between Booth Bay and Ganges Harbour and between Burgoyne Bay and Fulford Harbour and were probably formed when the last ice sheet occupied the area about 12,000+ years ago. Glaciomarine clay deposits generally occupy lowlands and valley bottoms north and south of St. Mary Lake and in areas between Ganges Harbour and Fulford Harbour to 300 feet above sea level and were probably formed after the ice sheet retreated and while the area was still submerged. The location of the glaciomarine clay deposits suggests the sea level at the time the clay was deposited was probably greater than 300 feet above the present sea level. Recent colluvial deposits lie in scattered areas while bog deposits lie in low depression areas throughout the Island.

The sequence of geologic events on Saltspring Island appears to be as follows:

1) deposition of Sicker Volcanics and Sicker Sediments

2) deformation of these rocks

3) intrusion of the Tyee Quartz-feldspar Porphyrite and Sicker Gabbro-diorite Porphyrite

4) low grade metamorphism of the Sicker Volcanics and Sicker Sediments

5) erosion/nondeposition-unconformity

6) deposition of Nanaimo Group through four marine transgressive cycles

7) deformation of both groups of rocks

8) erosion/nondeposition-unconformity

9) glaciation
deposition of glacial deposits

10) deglaciation

11) uplift of more than 300 feet

12) deposition of recent unconsolidated deposits.

Most wells are located in the denser populated central part of Saltspring Island but also in the north and south parts of the Island as well. The Sicker "Group" and the Nanaimo Group supply water to most of these wells. Specifically, the fractures, faults, and bedding surfaces-the discontinuities of the rocks-provide the main source of groundwater to wells; primary porosity of these rocks is negligible. Hydraulically, Saltspring Island can be envisaged, in very general terms, as a freshwater mound resting atop a seawater basement with the water in the mound continually being recharged by precipitation falling directly on the Island and discharging out to the sea.

The above brief description is based on published reports by Clapp(1917), Clapp(1913), Day et al.(1959), and Muller and Jeletzky(1970), unpublished maps and reports by R.V. Best and R.A. Freeze, and my own field observations in Spring 1981.

Mike Wei.

Historical Geology of Southeast Vancouver Island

- Interpreted by Clapp

deposition in marine environment

(1.) - deposition of Leech River formation
- shales and shaly sandstones

explosive vulcanism

(2.) - deposition of Malahat Volcanics
- intermediate lavas
- continuous minor deposition of detrital sediments to form argillites and cherts

erosion and/or non-deposition - unconformity

submarine and deep-water vulcanism

(3.) - deposition of Vancouver Volcanics
- basic lavas
- minor deposition of fine-grained sediments to form chery tuffs
- lava accumulated to form volcanic island in places

4. - deposition of Sutton formation
- coral deposits near the volcanic islands
- small pods and masses

change in geological environment during this period of vulcanism to bring about deposition of fine-grained sediments as well

(5.) - deposition of Sicker Volcanics and Sicker Sediments
- andesites, tuffs, cherty tuffs, and shales

end of vulcanism

thick underlying assemblage of rocks (about 25,000 feet thick) caused strong crustal movements resulting in deformation - main axis of deformation is about 120^{o}

igneous intrusions into existing rocks during and after this period of deformation

(6.) - intrusion of Wark and Colquitz gneisses during the last stages of deformation

(7.) - intrusion of Tyee Quartz - feldspar Porphyrite, Sicker Gabbro-diorite Porphyrite, and Saanich Granodiorite and younger dykes after deformation

8. - metamorphism of Leech River formation, Malahat Volcanics, Sutton formation, and Sicker Sediments

psion - unconformity

9. - deposition of Nanaimo Group
   - Marine transgressive sequences
   - sediments derived from underlying metamorphic, volcanic, sedimentary, and intrusive rocks
   - deposited in a structural basin of the previous period of deformation

uplift and submarine vulcanism - unformity (?)

10. - deposition of Metchosin Volcanics
    - basalts

end of period of submarine vulcanism and start of last period of deformation - main axis of deformation is again about 120°

11. - formation of Sooke Intrusives

erosion, deposition, and uplift - unconformity

first period of glaciation wiped most of the existing unconsolidated deposits

nonglaciation period

last period of glaciation (Fraser Glaciation)

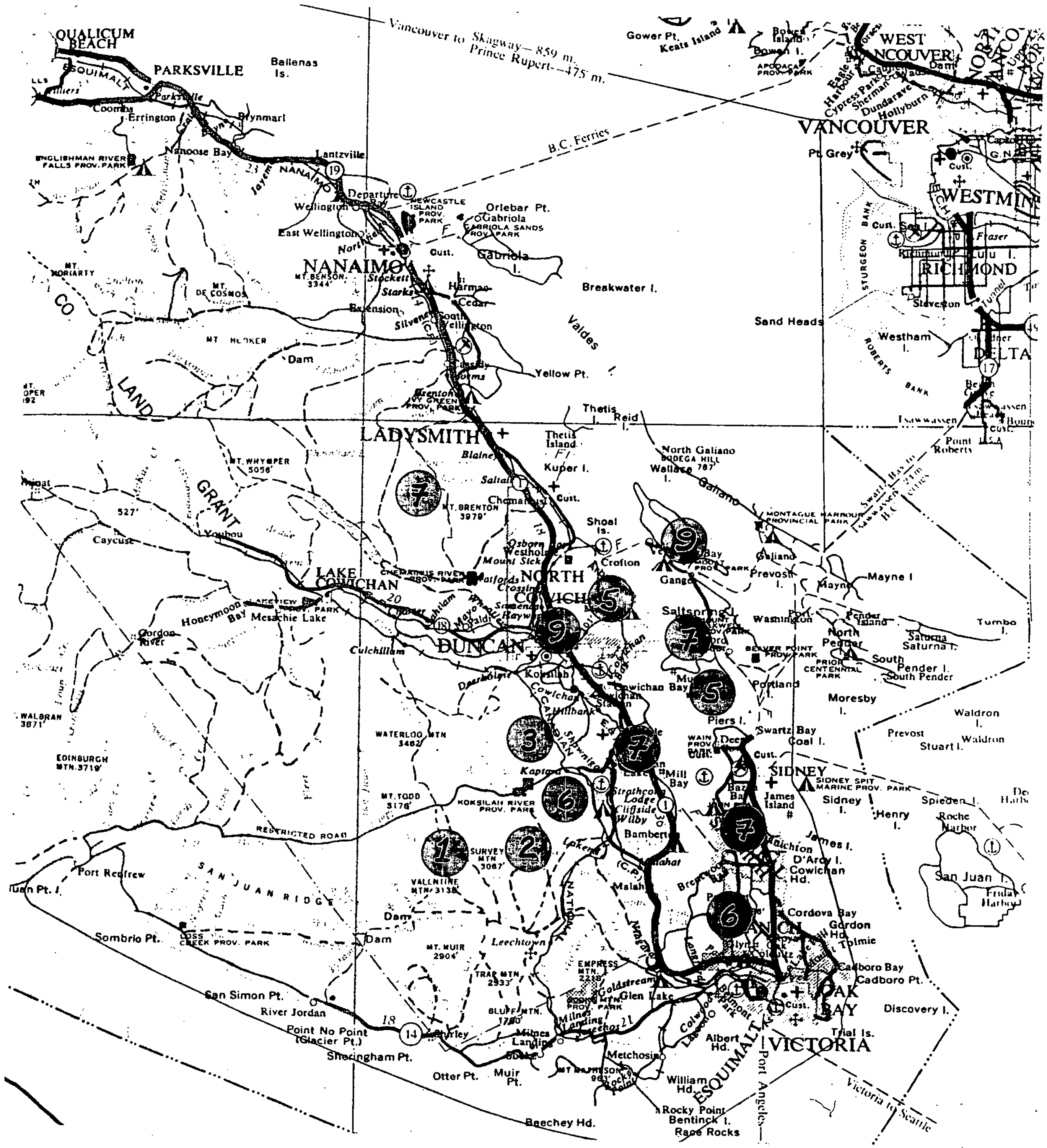
12. - deposition of Vashon Drift

deglaciation

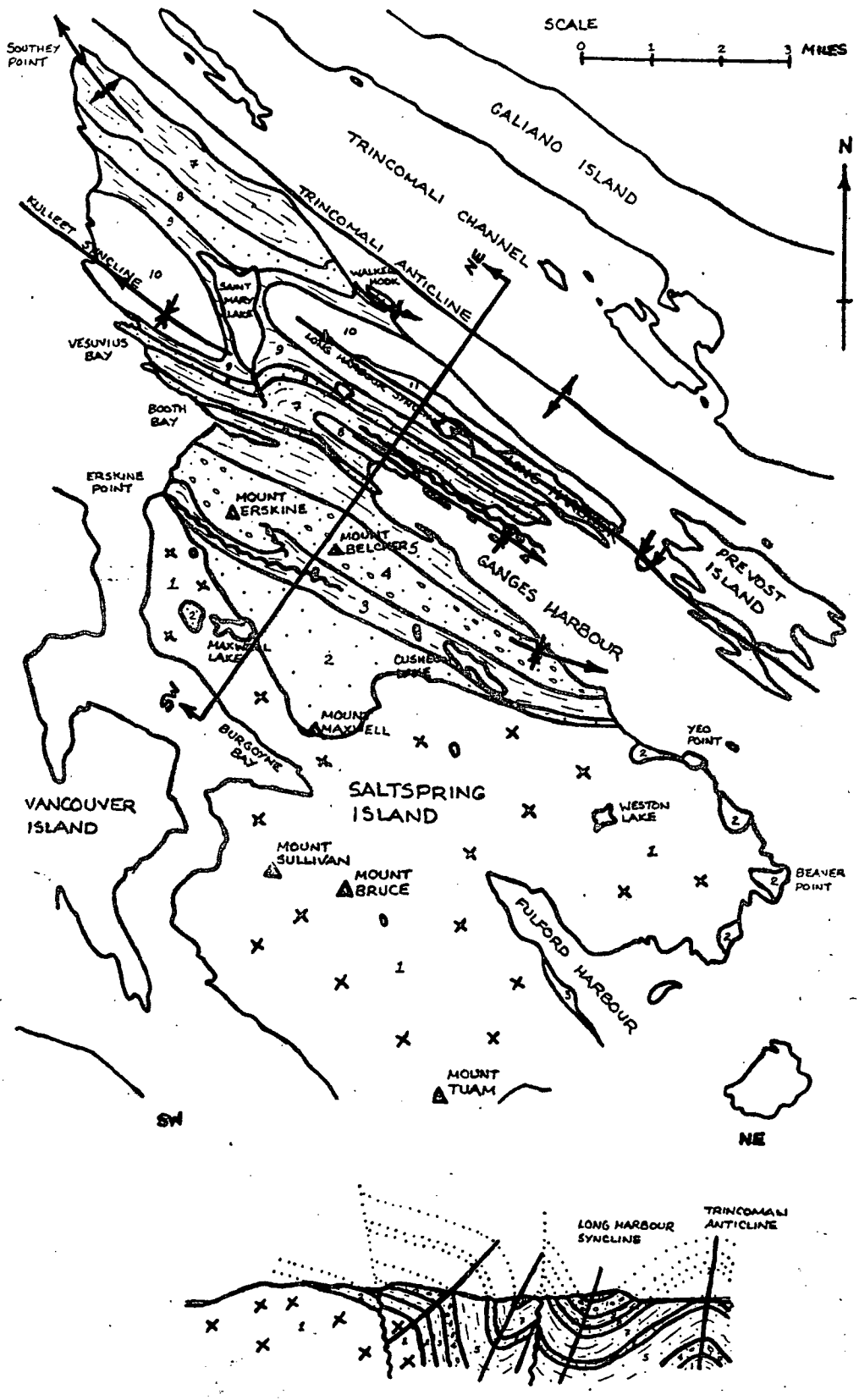
13. - deposition of glaciofluvial and glaciomarine sediments

uplift of several hundreds of feet

RECENT ← QUATERNARY ← LOWER OLIGOCENE ← UPPER EOCENE ← UPPER CRETACEOUS



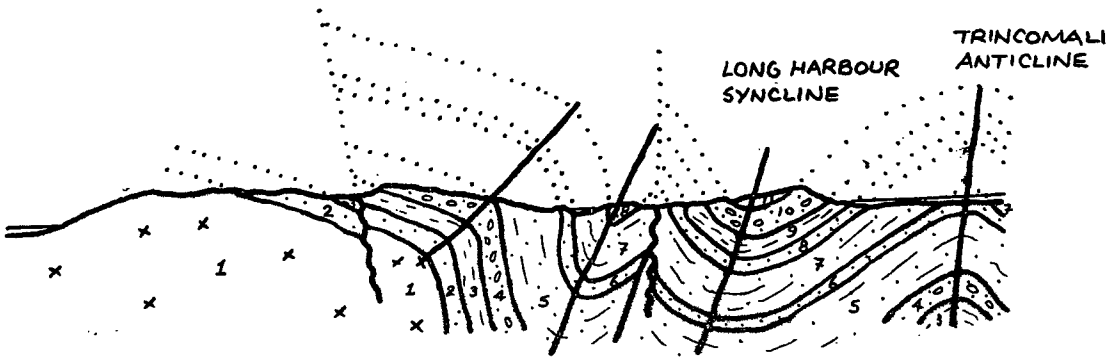
QUALICUM BEACH
PARKSVILLE
Ballenas Is.
Vancouver to Skagway—859 m.
Prince Rupert—475 m.
Gower Pt.
Keats Island
WEST VANCOUVER
VANCOUVER
Pt. Grey
WESTMIN
RICHMOND
Steveston
Sand Heads
Westham I.
DELTA
Tsawwassen
Point Roberts
Coombs
Errington
Brynmarl
Nanoose Bay
Lantzville
NANAIMO
ENGLISHMAN RIVER FALLS PROV. PARK
B.C. Ferries
Departure Bay
NEWCASTLE ISLAND PROV. PARK
Wellington
East Wellington
Orlebar Pt.
Gabriola
GABRIOLA SANDS PROV. PARK
Gabriola I.
Breakwater I.
MT. BENSON 3344'
MT. DE COSMOS
MT. MORIARTY
Extension
Cedar
South Wellington
Valdes
Yellow Pt.
Dam
Thetis I.
Reid I.
Thetis Island
LADYSMITH
Kuper I.
Chemainus
Saltair
North Galiano
BODEGA HILL 787'
Wallace I.
Galiano
MONTAGUE HARBOUR PROVINCIAL PARK
MT. WHYMPER 5056'
MT. BRENTON 3979'
GRANT
Caycuse
Youbou
LAKE COWICHAN
Honeymoon Bay
Mesachie Lake
Gordon River
Shoal Is.
Crofton
Ganges
NORTH COWICHAN
Westholme
Mount Sicker
Saltspring I.
Prevost I.
Mayne I.
Mayne
Pender Island
North Pender
Saturna
Saturna I.
Tumbo I.
South Pender I.
South Pender
PRIOR CENTENNIAL PARK
BEAVER POINT PROV. PARK
Washington
DUNCAN
Culchillum
Koksilah
Cowichan Bay
Portland
Moresby I.
Piers I.
Waldron I.
Prevost
Stuart I.
Swartz Bay
Coal I.
WALBRAN 3871'
EDINBURGH MTN. 3719'
WATERLOO MTN 3462'
Kapton
Mill Bay
SIDNEY
Sidney I.
SIDNEY SPIT MARINE PROV. PARK
James Island
Henry
Spieden I.
Roche Harbor
MT. TODD 3176'
KOKSILAH RIVER PROV. PARK
Strathcona Lodge
Cliffside
Wilby
Bamberton
RESTRICTED ROAD
James I.
D'Arcy I.
Cowichan Hd.
San Juan I.
Friday Harbor
Port Renfrew
SAN JUAN RIDGE
SURVEY MTN 3087'
VALENTINE MTN 3138'
Malahat
Brentwood Bay
Cordova Bay
Gordon Hd.
Tolmie
Dam
Leechtown
Sombrio Pt.
LOSS CREEK PROV. PARK
MT. MUIR 2904'
TRAP MTN 2933'
EMPRESS MTN. 2230'
Goldstream
Glen Lake
Cadboro Bay
Cadboro Pt.
OAK BAY
Discovery I.
San Simon Pt.
River Jordan
BLUFF MTN. 1750'
Point No Point (Glacier Pt.)
Shirley
Milnes Landing
Sooke
Sheringham Pt.
Otter Pt.
Muir Pt.
Metchosin
Albert Hd.
ESQUIMALT
VICTORIA
Trial Is.
William Hd.
Rocky Point
Bentinck I.
Race Rocks
Beechey Hd.
Port Angeles
Victoria to Seattle



AFTER BEST, 1973

SW

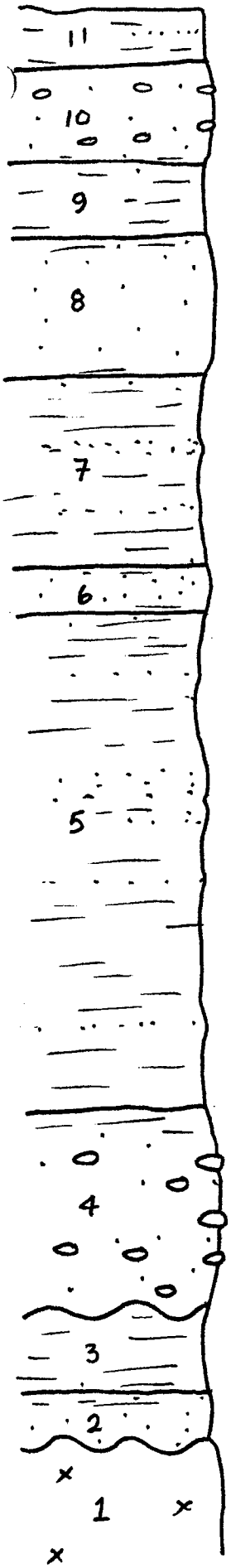
NE



SCALE

0 1 2 3 MILES

AFTER BEST, 1973



NANAIMO GROUP

11. SPRAY FORMATION: TURBIDITE, MUDSTONE

10. GEOFFREY FORMATION: CONGLOMERATE, SANDSTONE

9. NORTHCUMBERLAND FORMATION: MUDSTONE, SHALE

8. DE COURCY FORMATION: SANDSTONE, CONGLOMERATE

7. CEDAR DISTRICT FORMATION: TURBIDITE, MUDSTONE

6. PROTECTION FORMATION: SANDSTONE

5. GANGES FORMATION: TURBIDITE, MUDSTONE

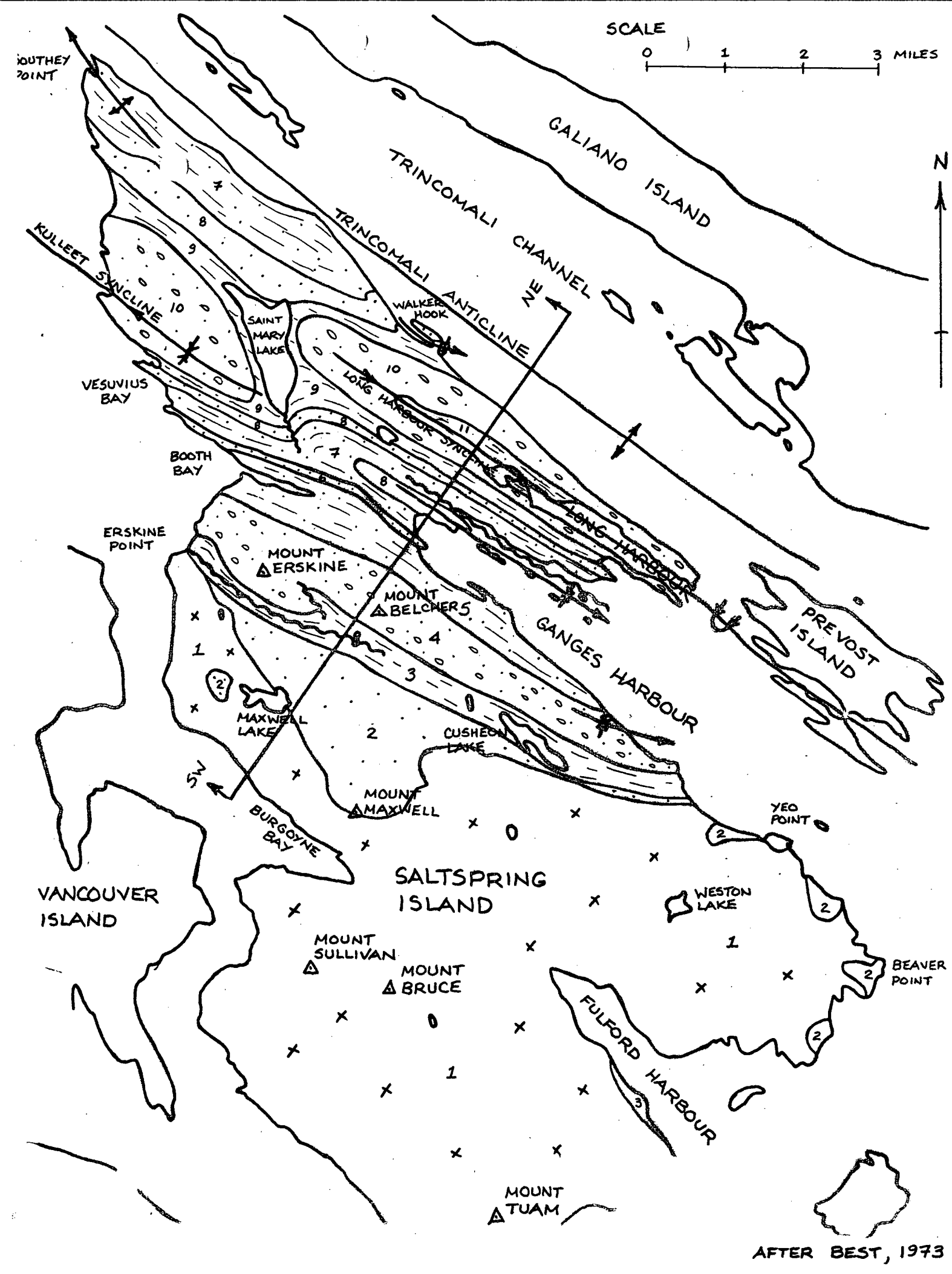
4. EXTENSION FORMATION: CONGLOMERATE, SANDSTONE

3. HASLAM FORMATION: MUDSTONE

2. COMOX FORMATION: SANDSTONE

SICKER GROUP

1. METAVOLCANIC, METASEDIMENTARY ROCKS


SCALE
0 1 2 3 MILES
N
SOUTHEY POINT
GALIANO ISLAND
TRINCOMALI CHANNEL
TRINCOMALI ANTICLINE
KULLEET SYNCLINE
WALKER HOOK
SAINT MARY LAKE
VESUVIUS BAY
LONG HARBOUR SYNCLINE
BOOTH BAY
ERSKINE POINT
MOUNT ERSKINE
MOUNT BELCHER
LONG HARBOUR
PREVOST ISLAND
GANGES HARBOUR
MAXWELL LAKE
CUSHEON LAKE
MOUNT MAXWELL
YEO POINT
BURGOYNE BAY
VANCOUVER ISLAND
SALTSPRING ISLAND
WESTON LAKE
MOUNT SULLIVAN
MOUNT BRUCE
BEAVER POINT
FULFORD HARBOUR
MOUNT TUAM
AFTER BEST, 1973