Lillooet Natural History

A geomorphic perspective

(geo=earth, morph=form)

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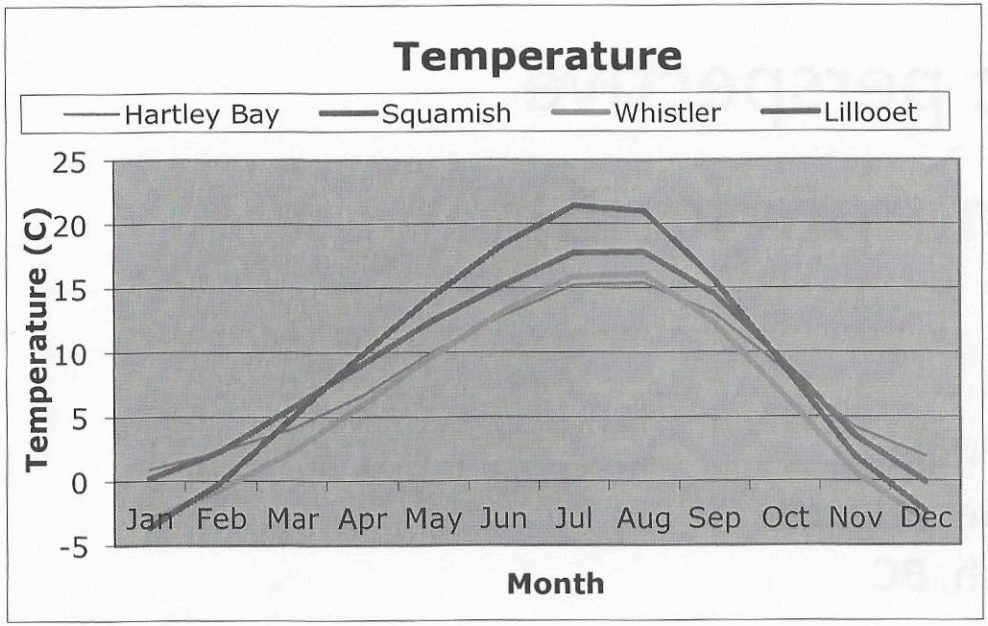
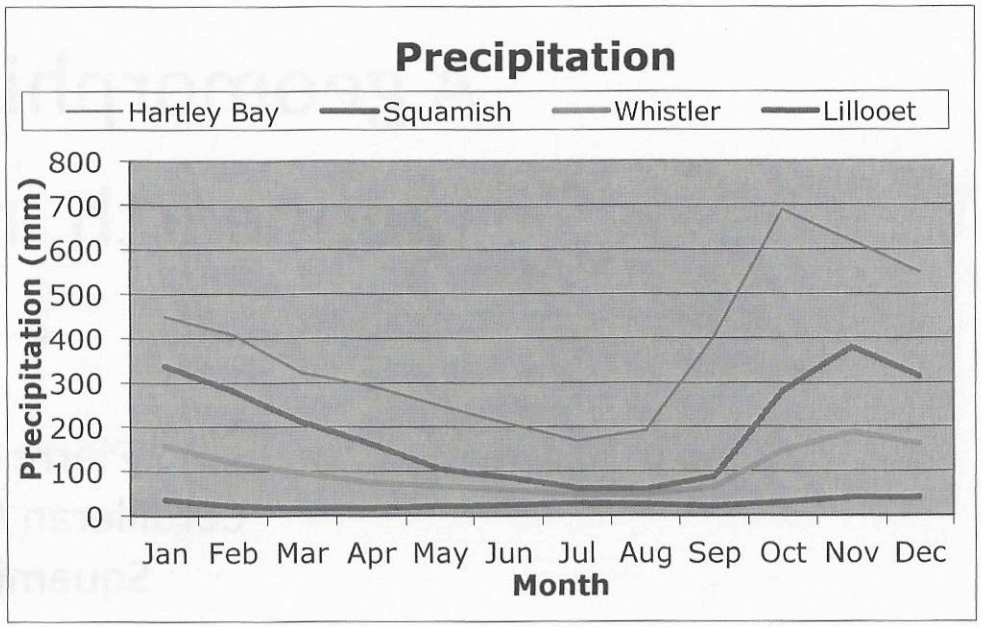
May 5, 2017

Climate

Leeward of Coast Mountains – rain shadow.
Continental versus Maritime
Dry year round, slight winter precipitation peak, cool winters, warm summers.



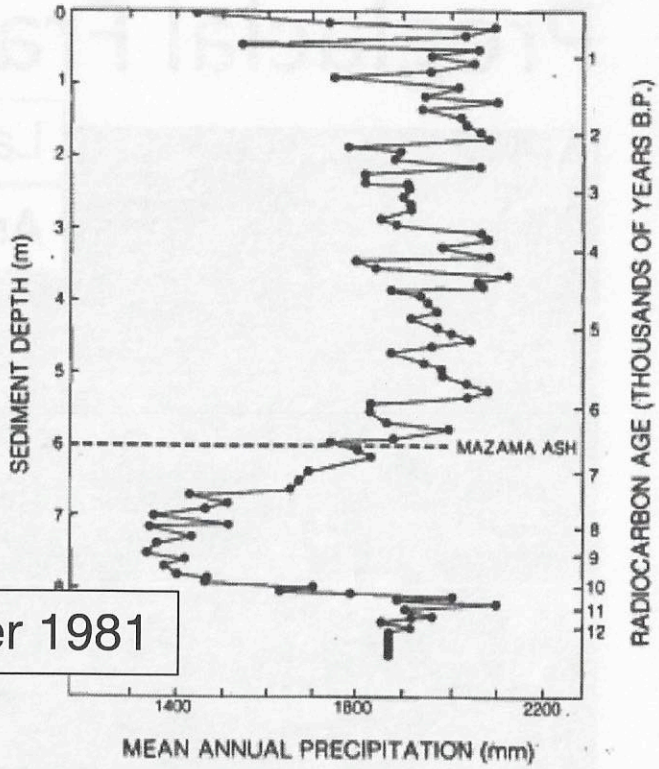


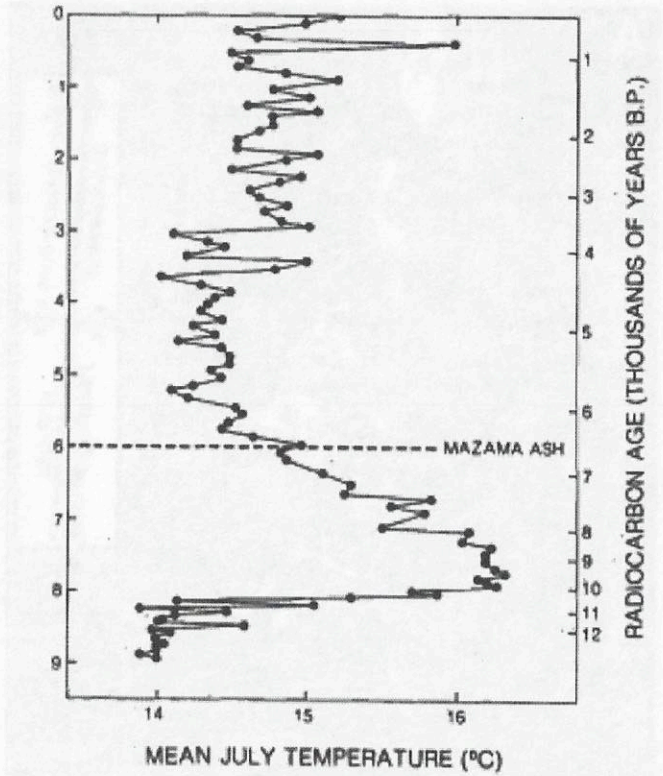
Mean Annual Precipitation

Hartley Bay	4550 mm
Squamish	2370 mm
Whistler	1230 mm
Lillooet	330 mm

Marion Lake
UBC Research Forest

Mathewes and Heusser 1981





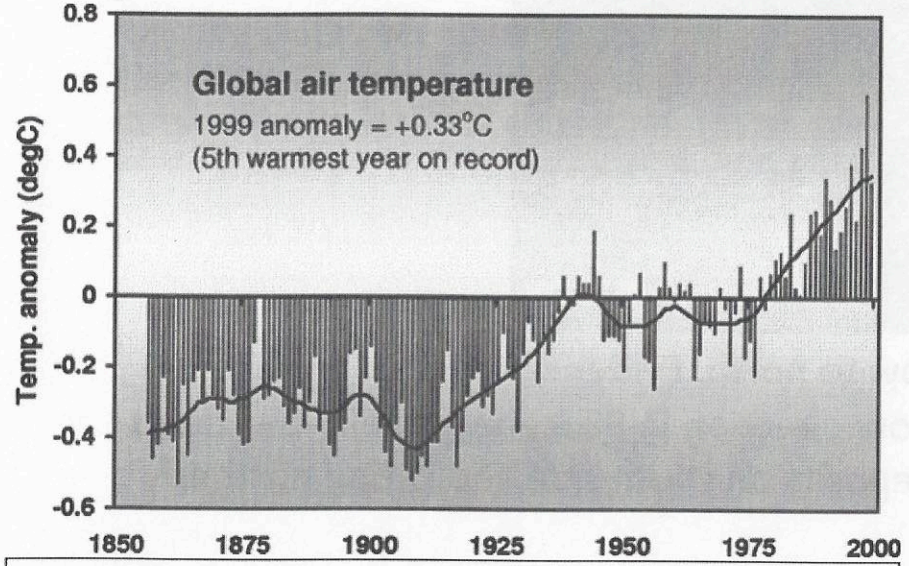
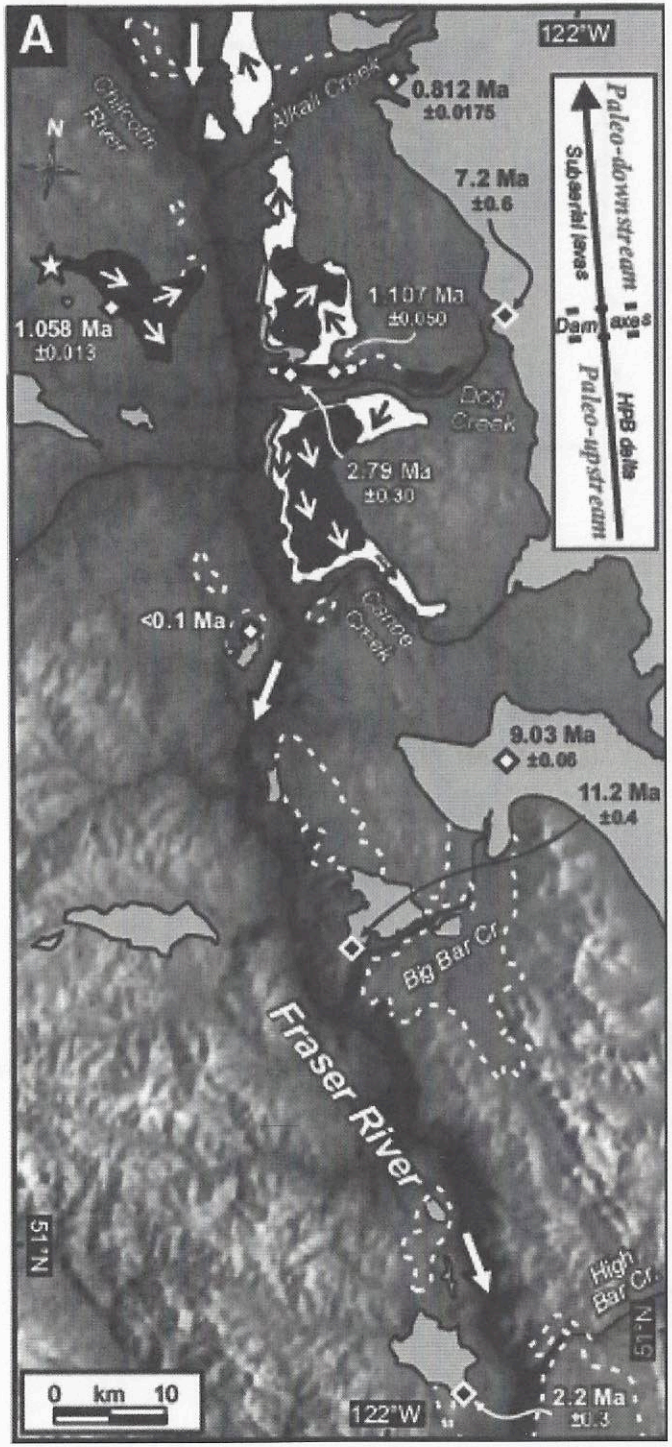


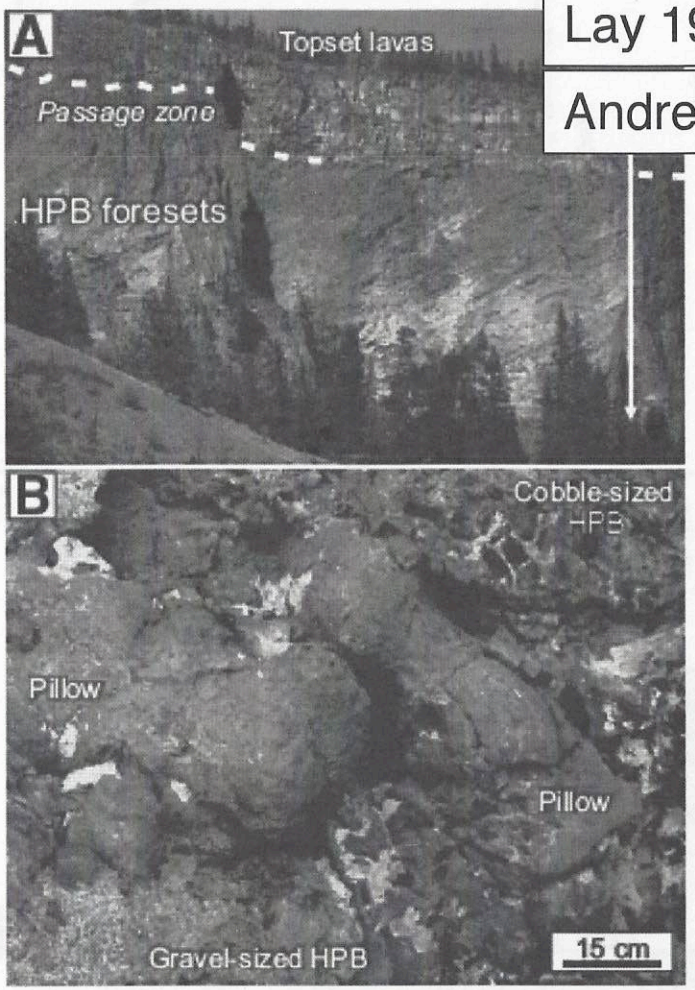
Figure 1. Global air temperature for the period 1860-1999. Both land and marine air temperatures are included. Relatively few climate stations existed in the late 1800s and early 1900s compared to the last 50 years.

Paleo Climate

Vancouver Airport

Preglacial Fraser River





Lay 1941

Andrews et al., 2012

- Preglacial flow to north. Evidence: uplifted terrace remnants, flow direction in Pliocene gravels, lava dams with delta deposits on south side, indicating northerly flow.
- Southern flow and carving of Fraser Canyon after 1Ma, due to coastal headwater capture of Ancestral Fraser River.

Model of Glaciation

a-b) Glacial buildup – starting ca 29000 years ago - proglacial outwash fills valleys.

c) Glacial Lake Camelsfoot – outwash or ice blocks Fraser River drainage near Lillooet forming lake upstream.

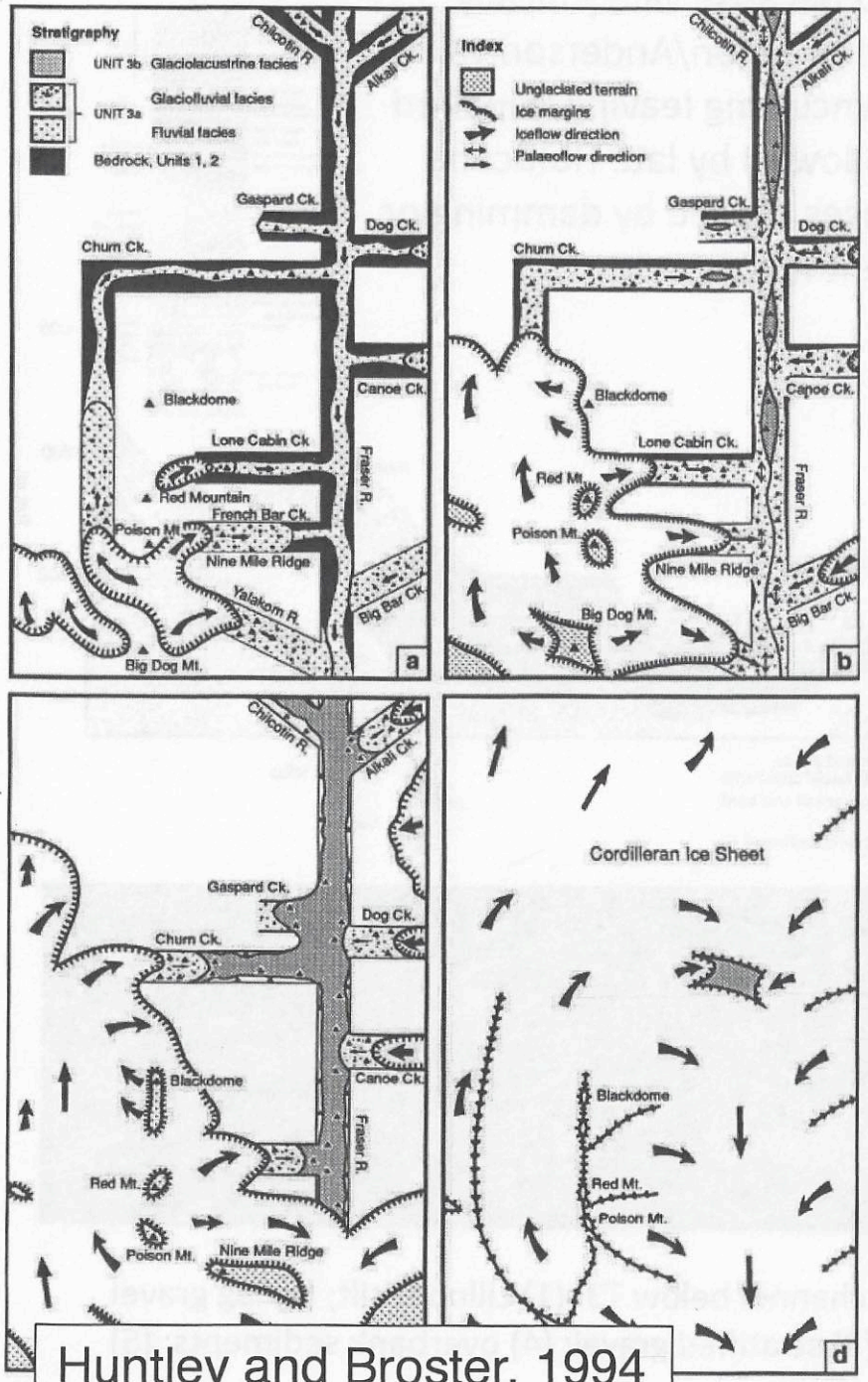
d) Glacial maximum – ca 14000 years ago.

e) Ice melted out by ca 10000 years ago

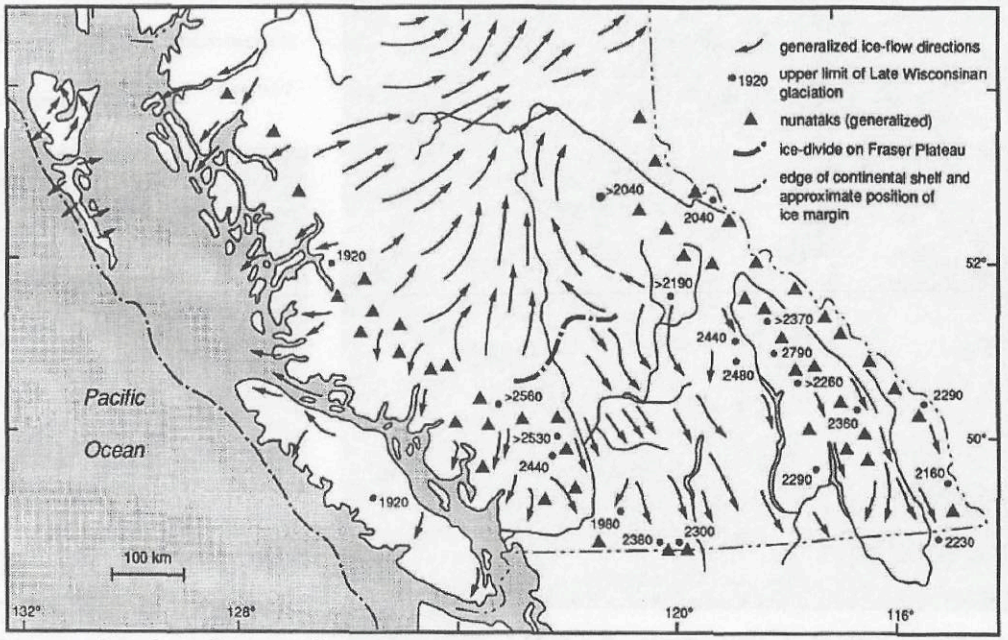
Sequence Stratigraphy – top down

Till, advance lacustrine, advance outwash.

May be more than one cycle preserved.



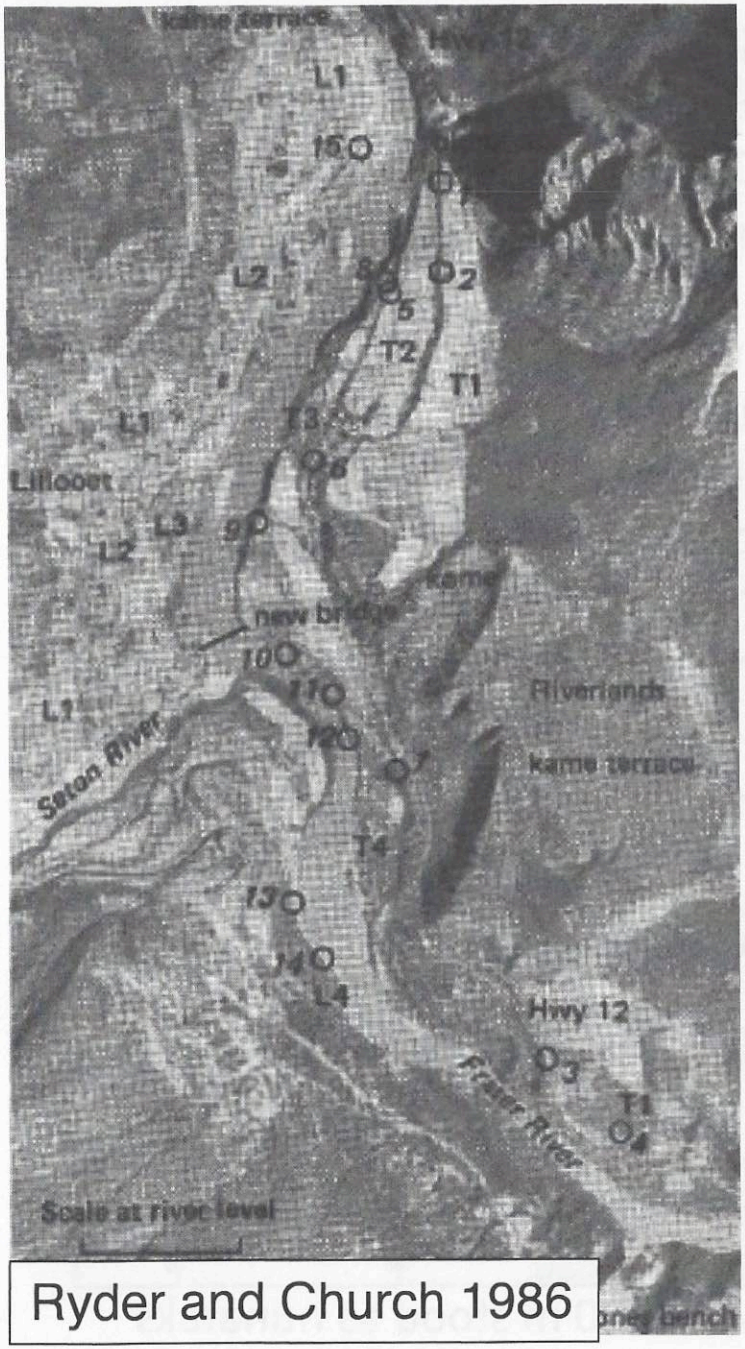
Huntley and Broster, 1994



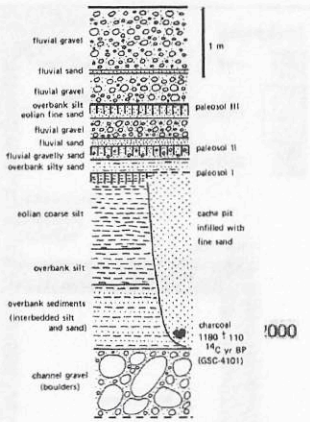
Peaks higher than 2500 m stood as nunataks

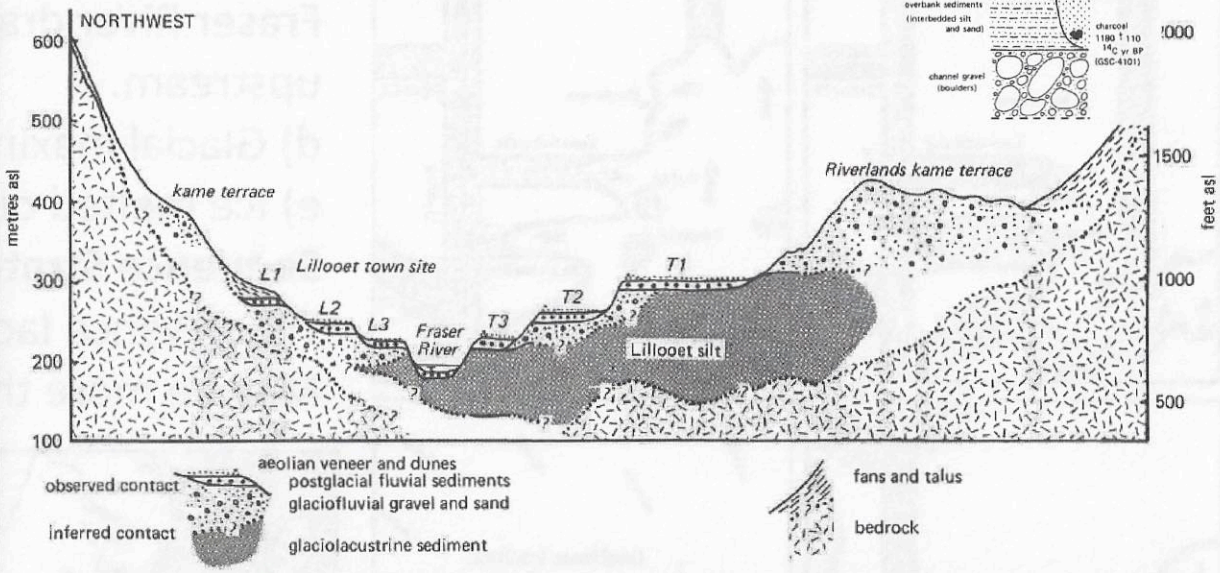
Lillooet Terraces:

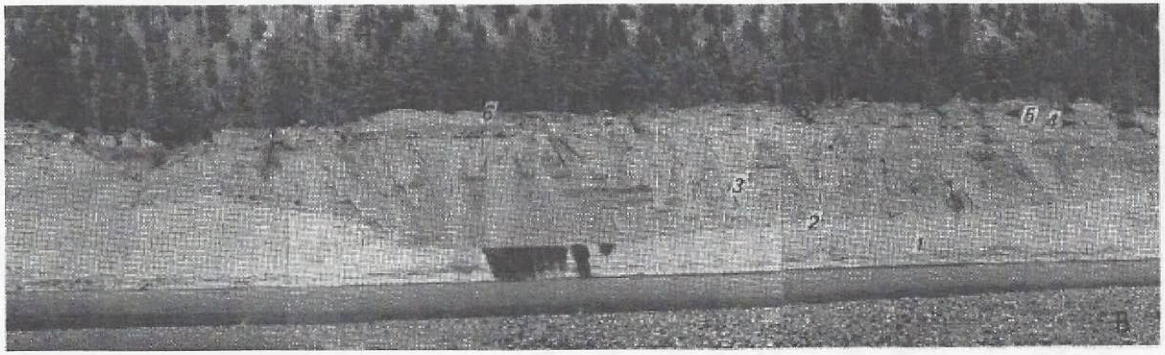
Special: Preserved because valley locally widened at mouth of Seton/Anderson valley.
Record: rapid downcutting leaving unpaired upper terraces, followed by late Holocene aggradational phases caused by damming or neoglacial sediment flux.



Section 15







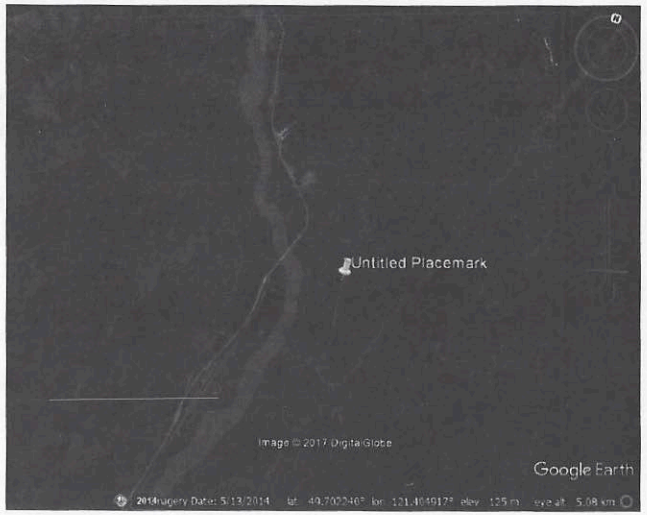
Section 11, infilled channel below T3: (1) Lillooet silt; (2) lag gravel (row of boulders); (3) stratified gravel; (4) overbank sediments; (5) aeolian veneer; (6) dunes.

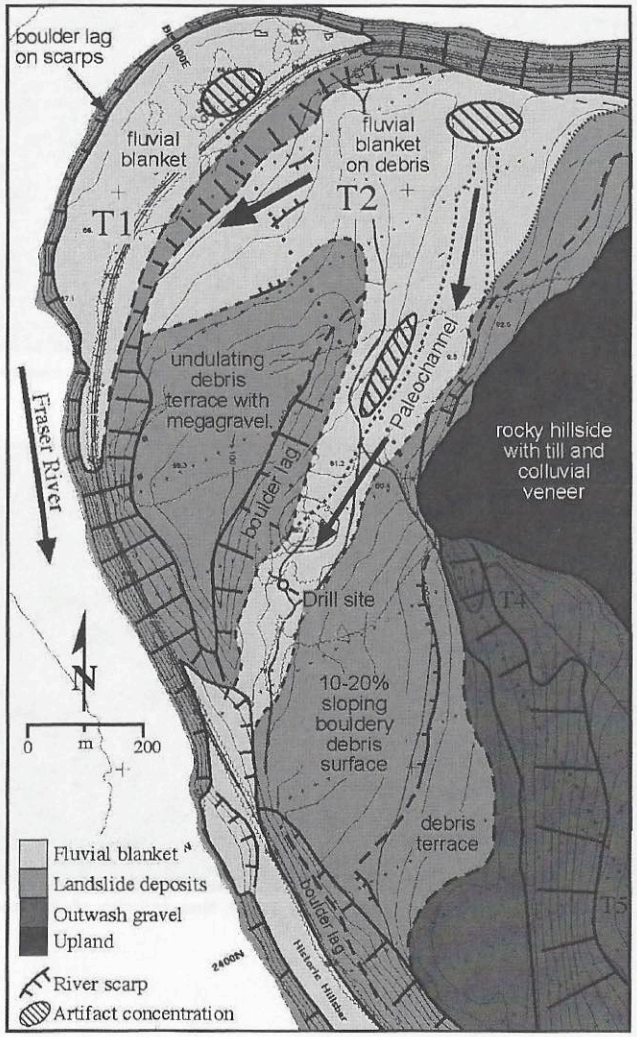
Glacial Lake Camelsfoot Outburst Flood

Alexandria Bar

Clague et al., unpublished

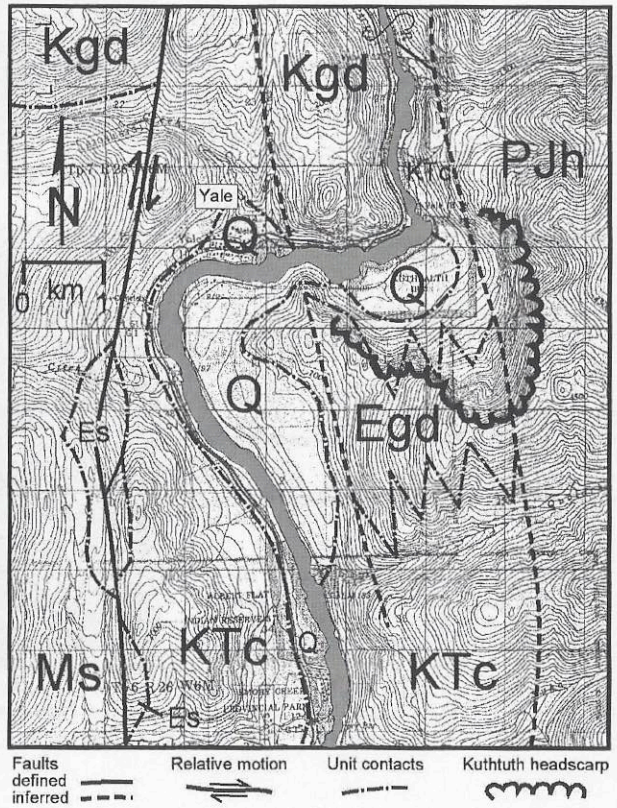
Megagravel deposits

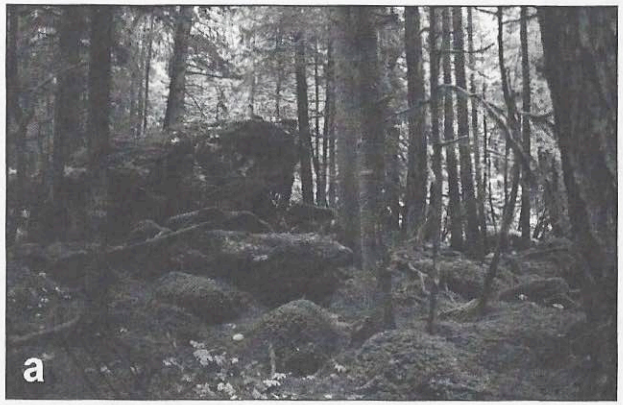


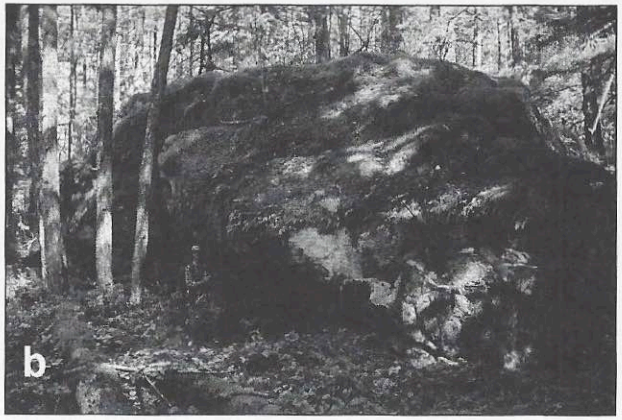


Friele, 2017

South Yale Block field







Interior BC Alluvial Fans – The Paraglacial Paradigm

"Post glacial sedimentation conditioned by glaciation"

Ryder 1971

Church and Ryder 1972

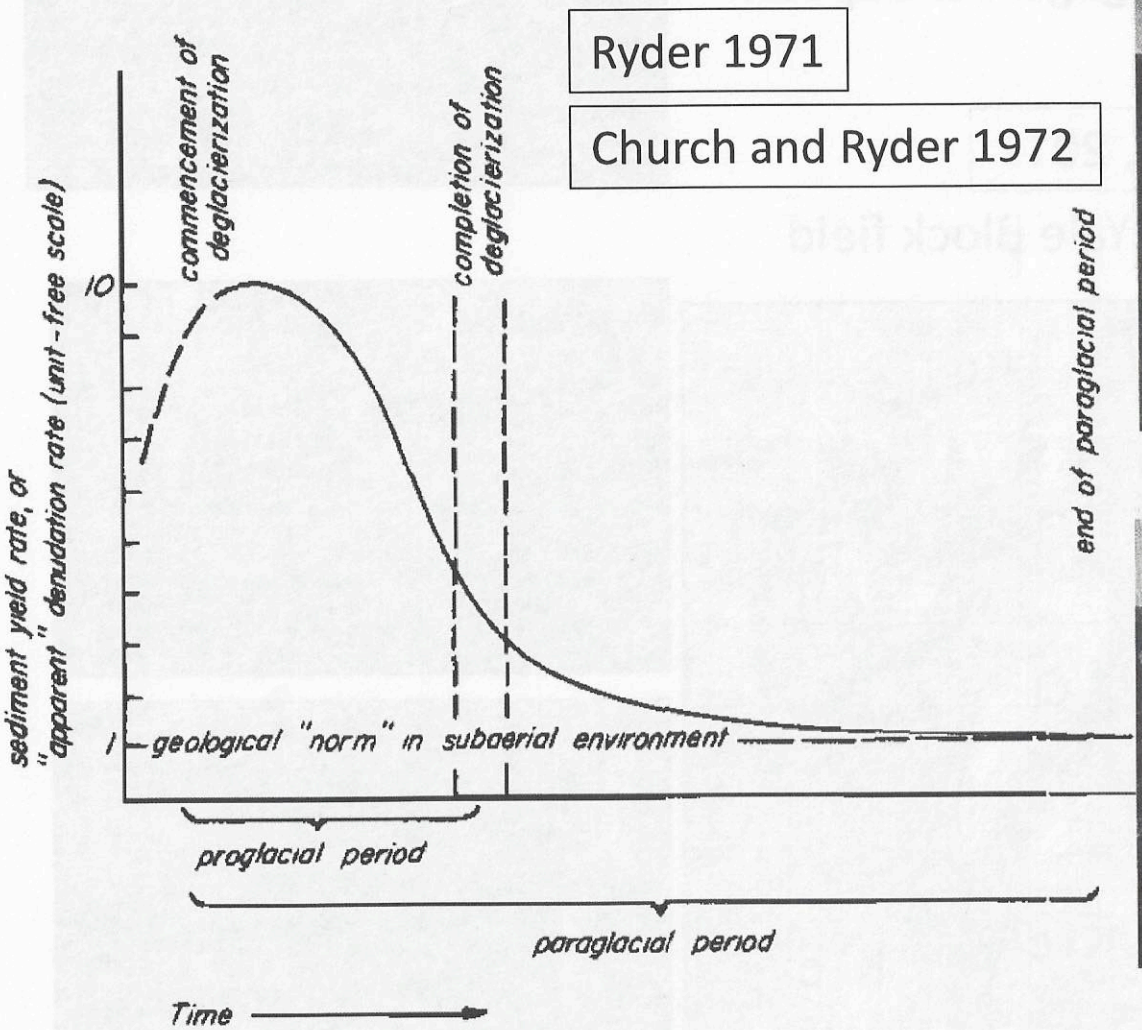


FIG. 9. Toe-section in the Keatley fans of the Fraser Valley. The gently dipping mudflow gravels of the fans form a thin veneer upon the gravels and silt of the valley fill.

FIG. 10. Transverse section in McGillivray fan, Fraser Valley. Note variation of dip directions, lensing, and possible channel infillings of silt and sand.

Climate and Glacial Legacy

Rex Peak Nunatak and Rock Glacier

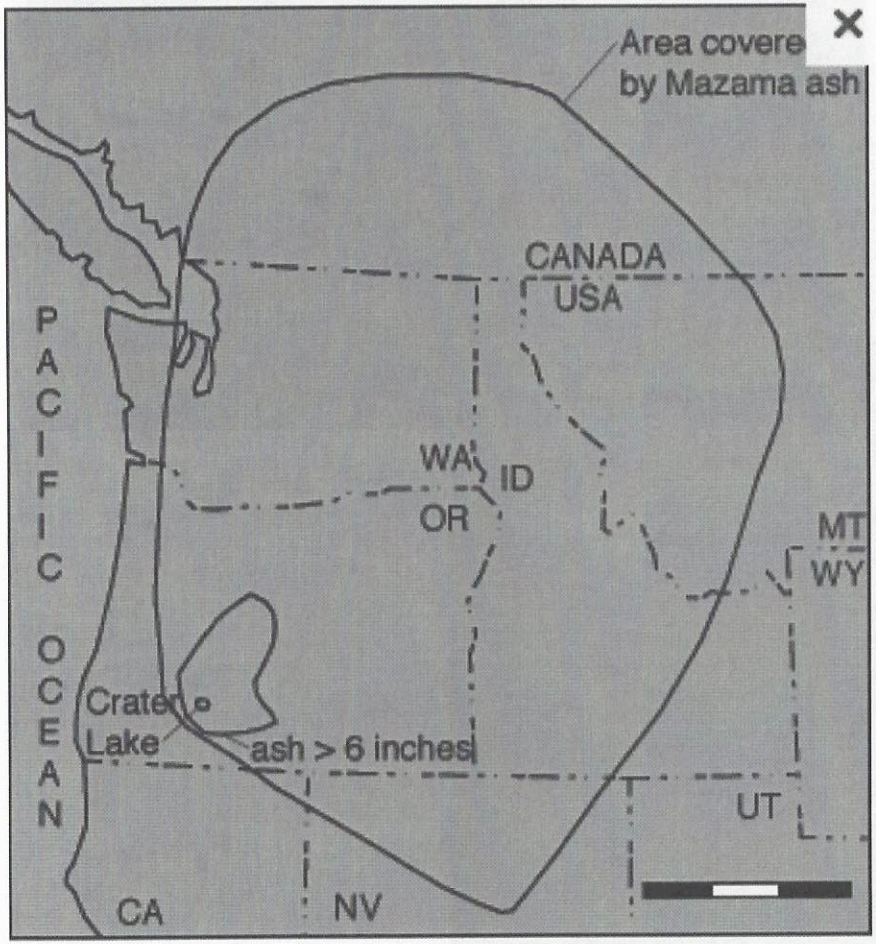
9-Mile Ridge patterned ground

Shulaps Range solifluction lobes

Tephras – time markers

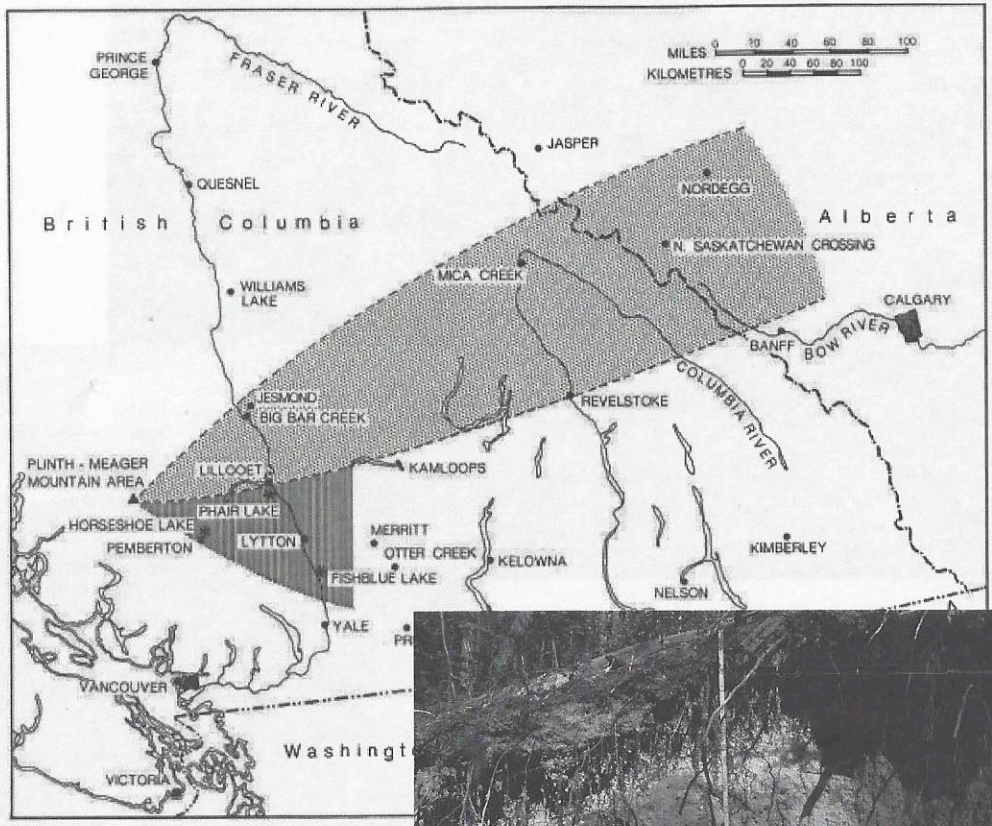
Zdanowicz et al., 1995

Mazama tephra – 7680 years ago
Typically seen buried in fan sediments



Nasmith and Rouse 1967; Clague et al., 1995

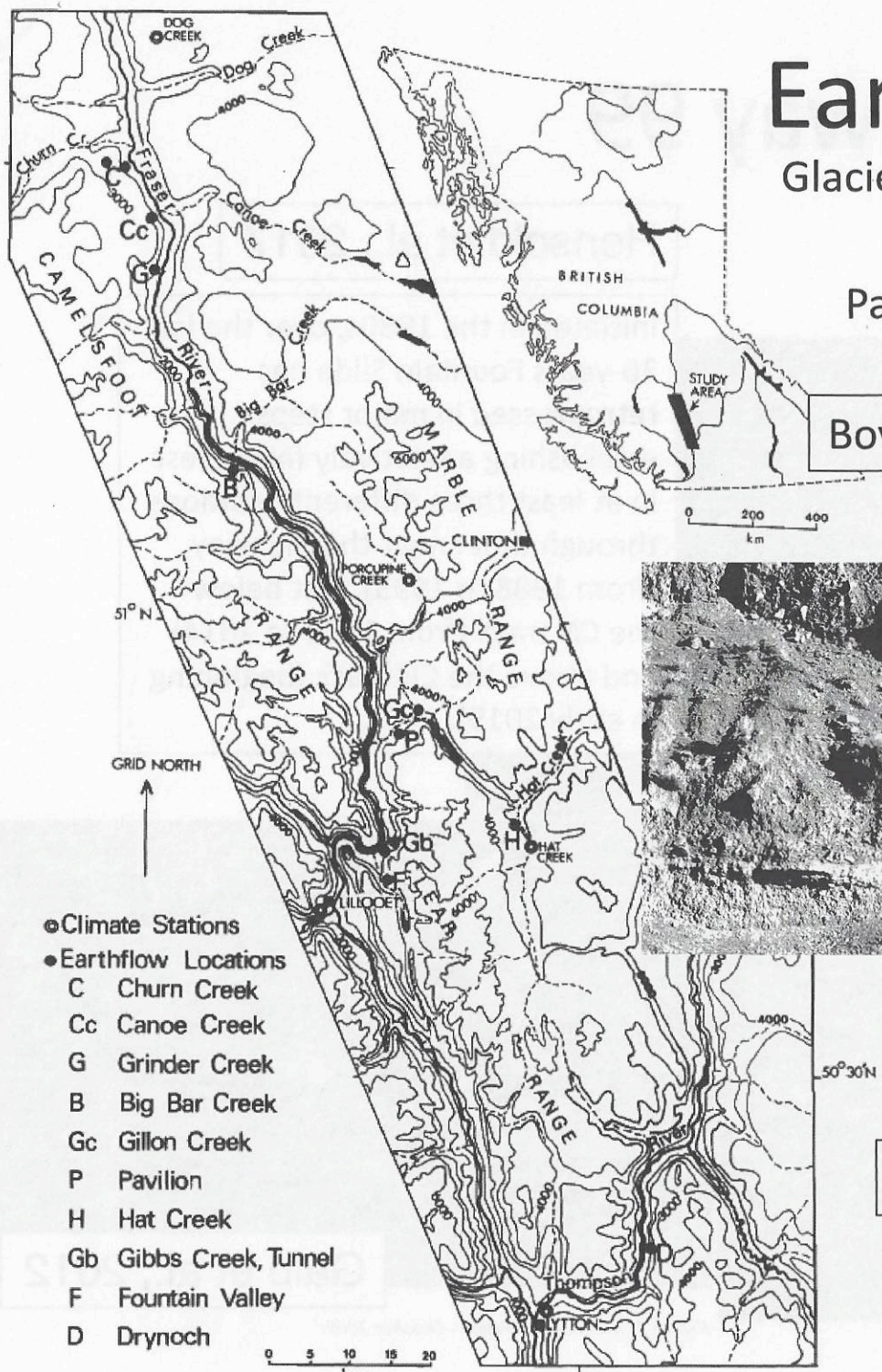
Bridge River tephra – 2360 years ago
Found at the surface throughout Goldbridge area



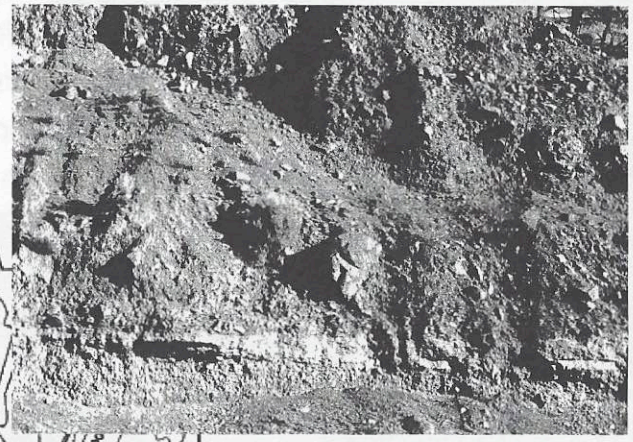
Bridge River tephra at Gun Lake

Earthflows

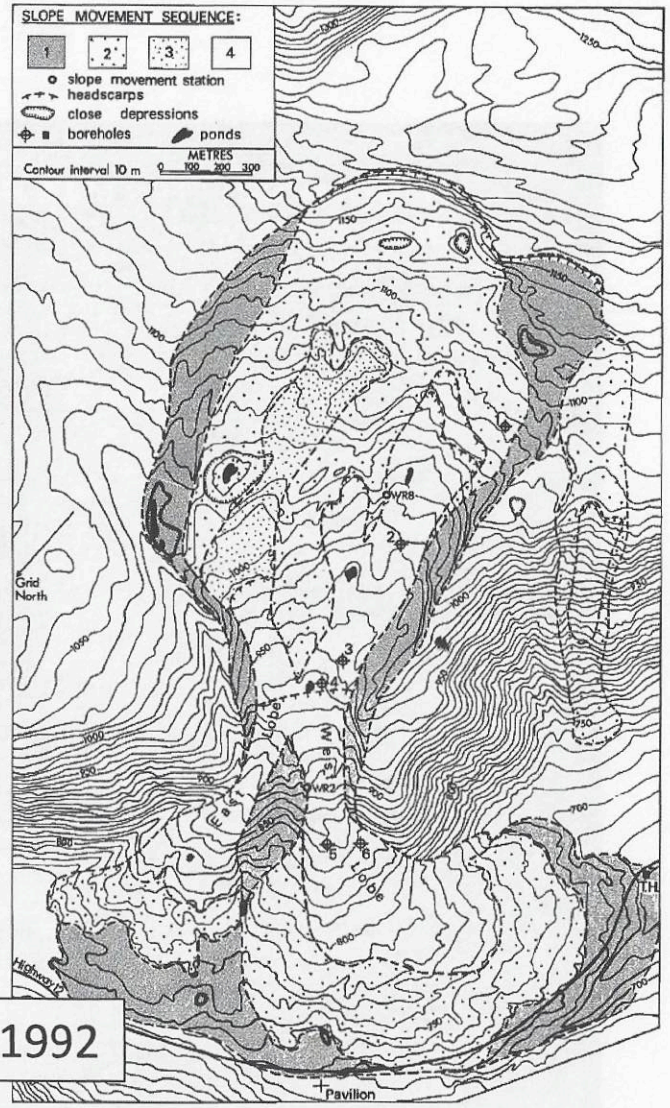
Glacier-like flows of weak rock and earth



Bovis 1985



Pavillion Earthflow



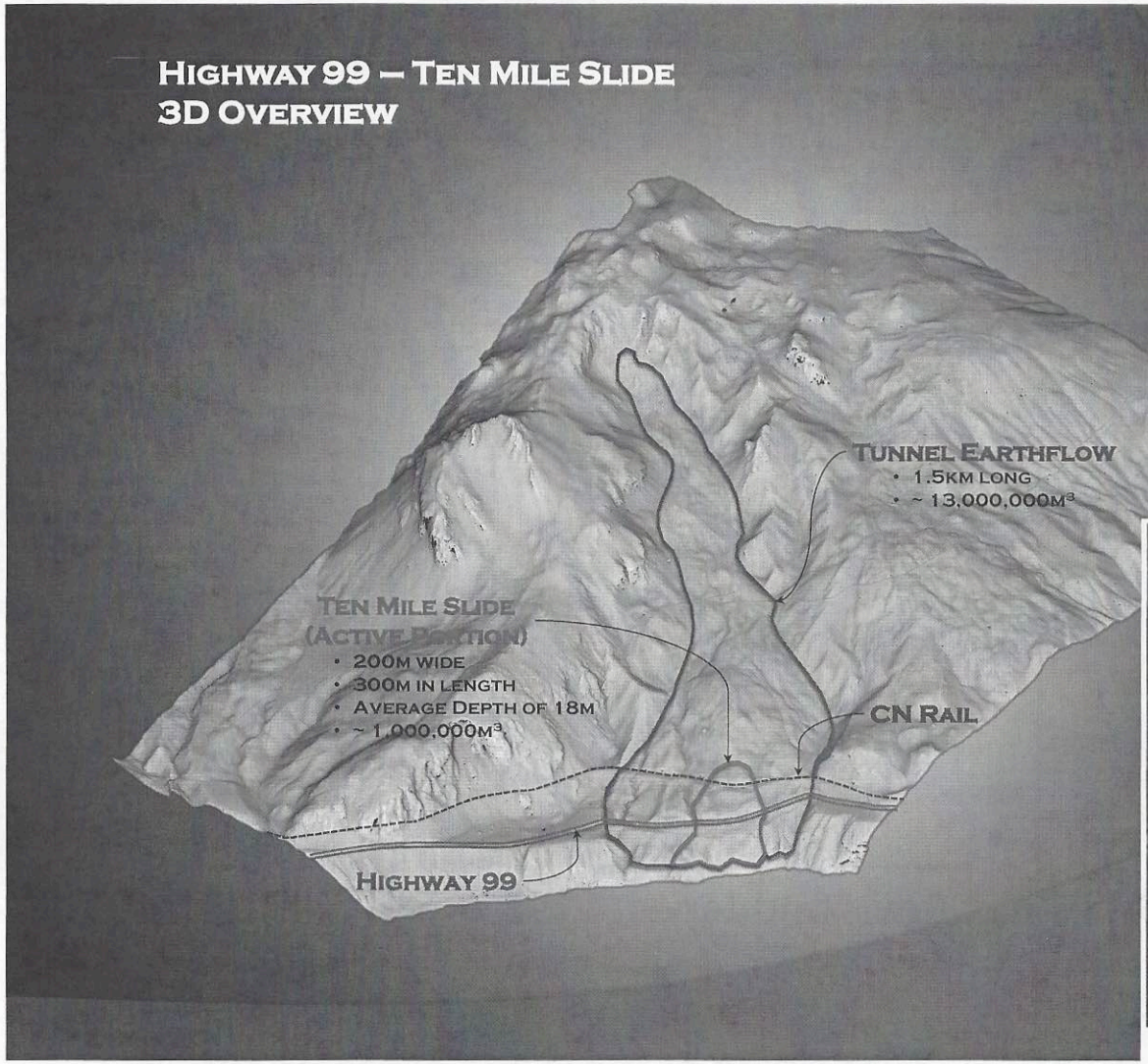
Bovis and Jones, 1992

Recent (Holocene) movement indicated by over riding of loess and Mazama tephra.

Fountain Slide, Highway 99

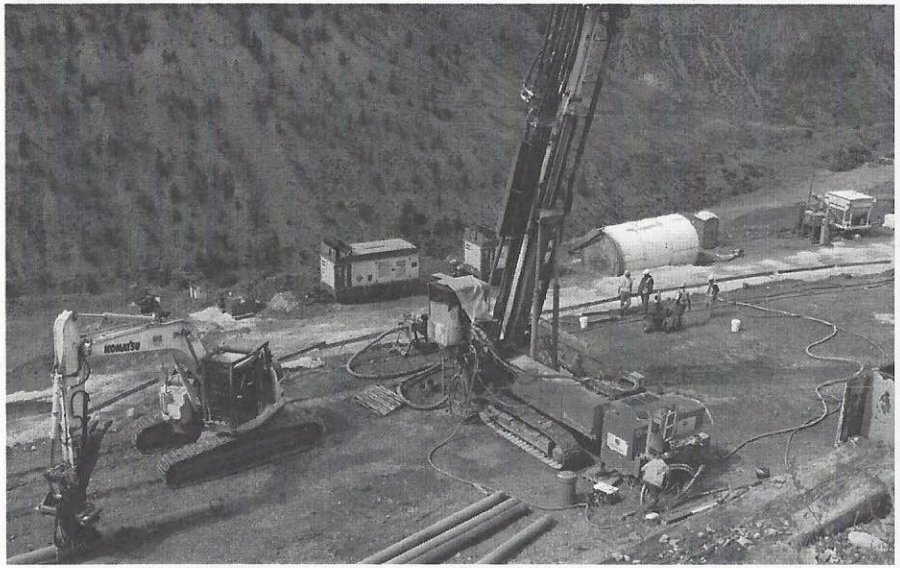
Hensold et al., 2017

Initiated in the 1980s, over the last 30-years Fountain Slide has retrogressed in major steps, establishing a relatively fixed crest in at least three different positions through time: near the highway (from 1988 to 1995), just below the CN track (from 1996 to 2014) and above the CN track (beginning in early 2015).



Gaib et al., 2012

Figure 3: Aerial view of slide - October 2009:[1]



Fountain Slide Remediation I

Gaib et al., 2012

Layout of Drilled “Barrette” stiffeners

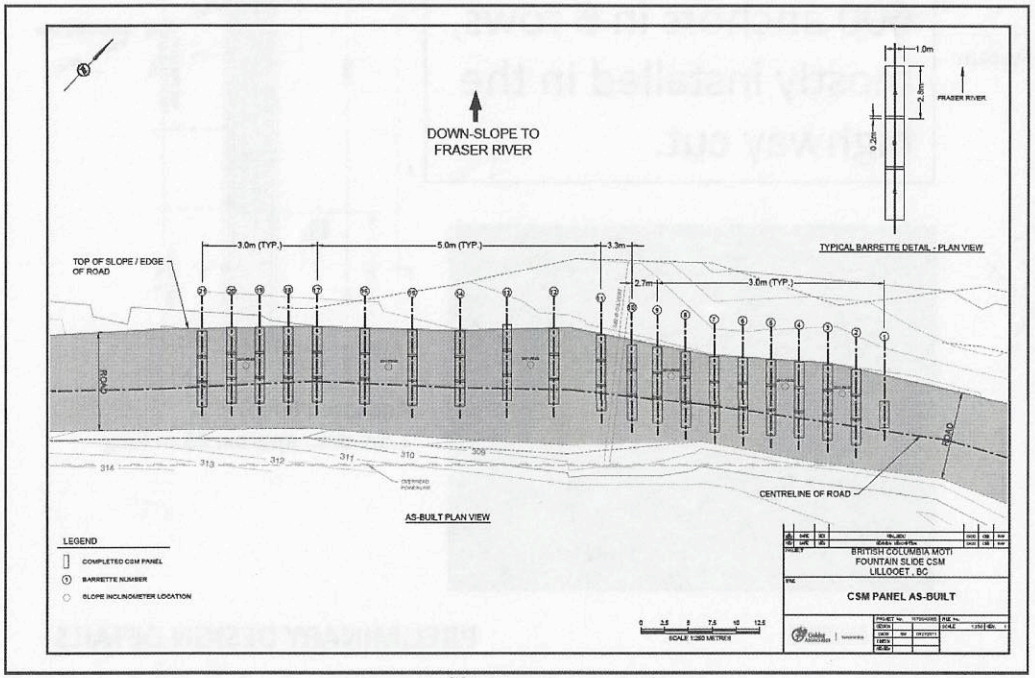


Figure 7: CSM Barrette Layout Plan

ISSMGE - TC 211 International Symposium on Ground Improvement IS-GI Brussels 31 May & 1 June 2012

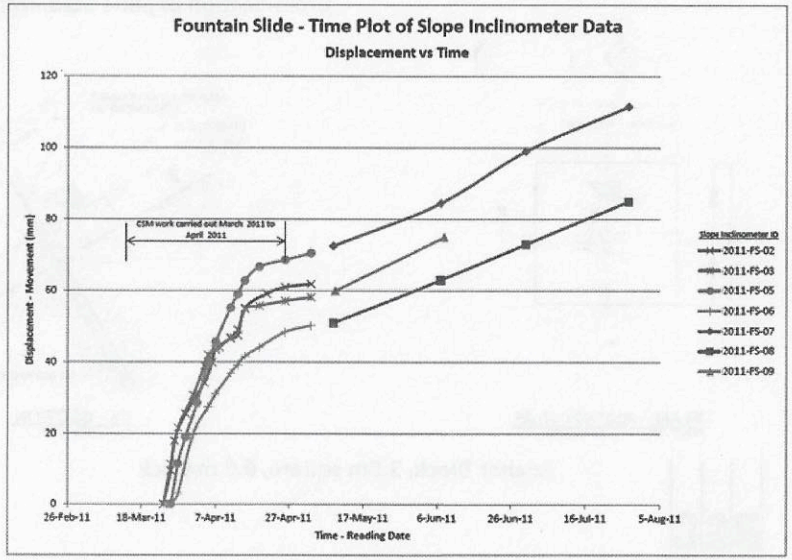
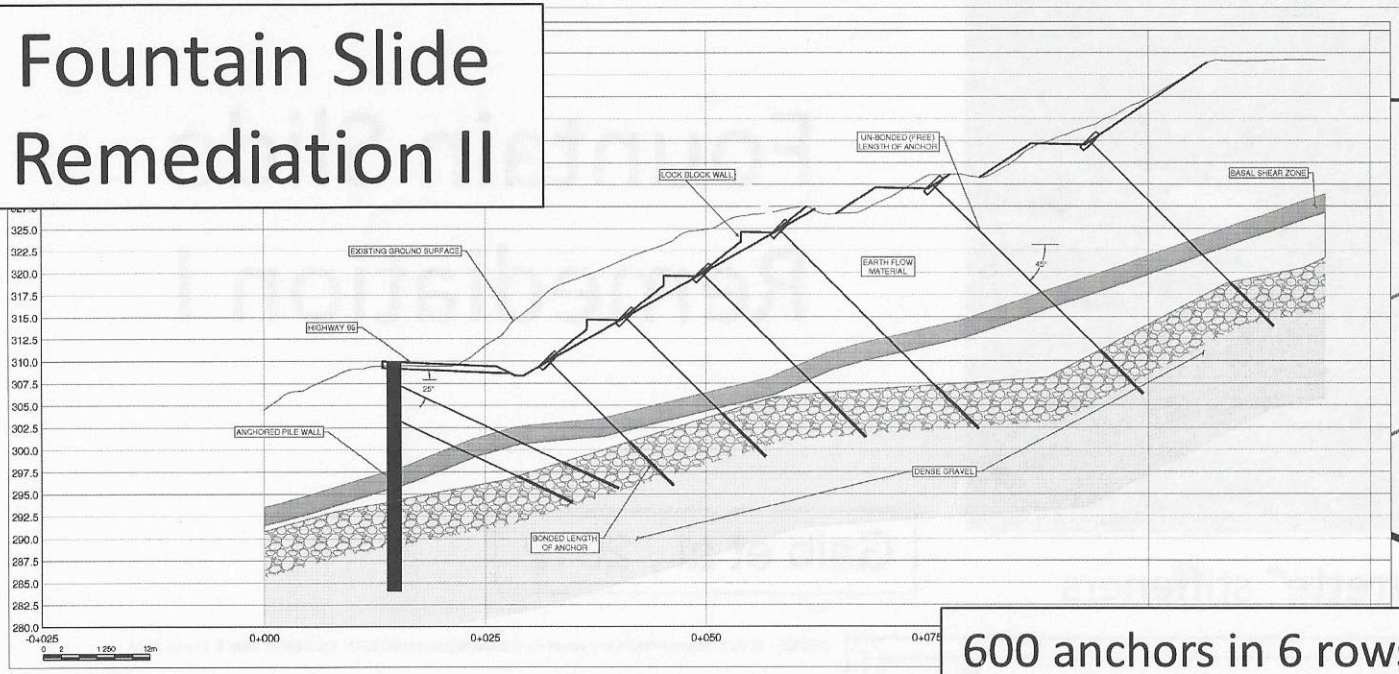
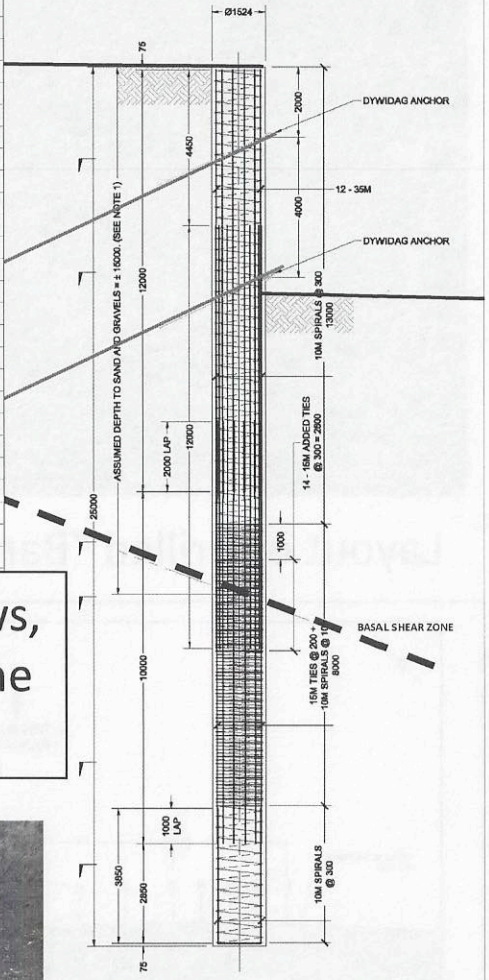


Figure 8: Slope Inclinometer Data

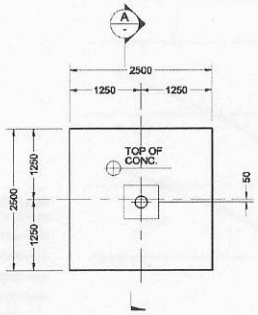
Fountain Slide Remediation II



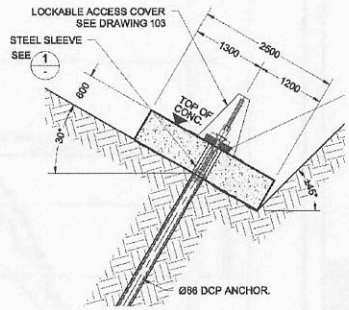
Cross-Section of Slide Stabilization System



600 anchors in 6 rows, mostly installed in the highway cut.



PLAN - FOOTING OUTLINE
SCALE: 1:50 (ON SLOPE)



A SECTION
SCALE: 1:50

Anchor Block, 2.5m square, 0.6 m thick

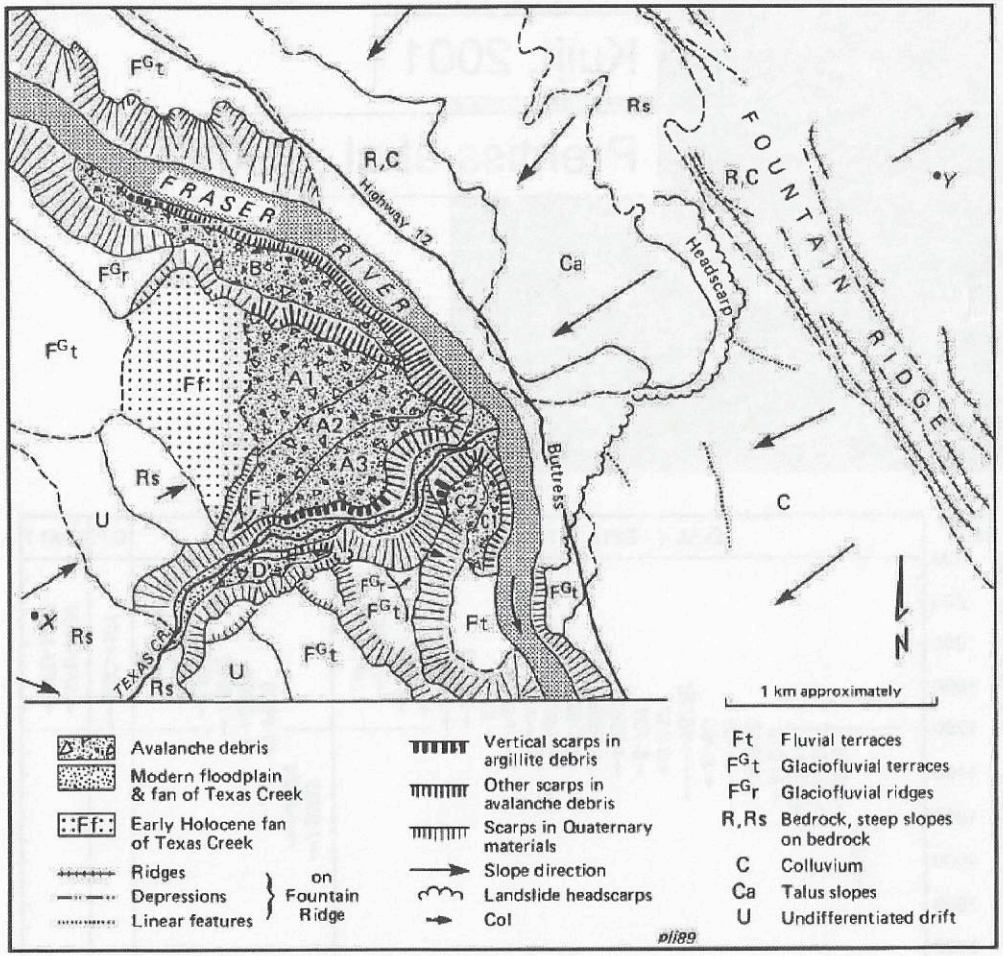
Anchored Pile,
1.5m dia., approx. 25 m long

BGC

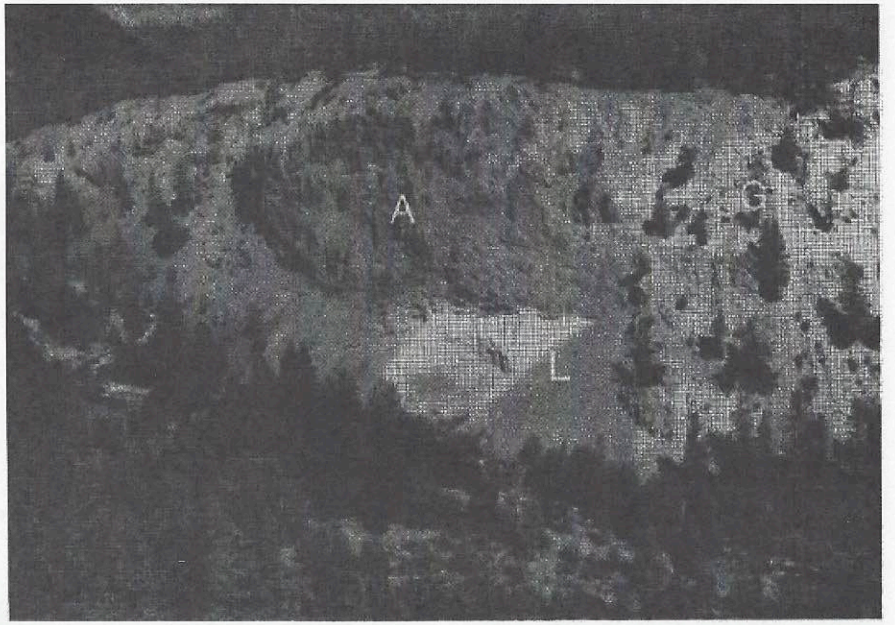
GEA Gygax Engineering Associates Ltd.

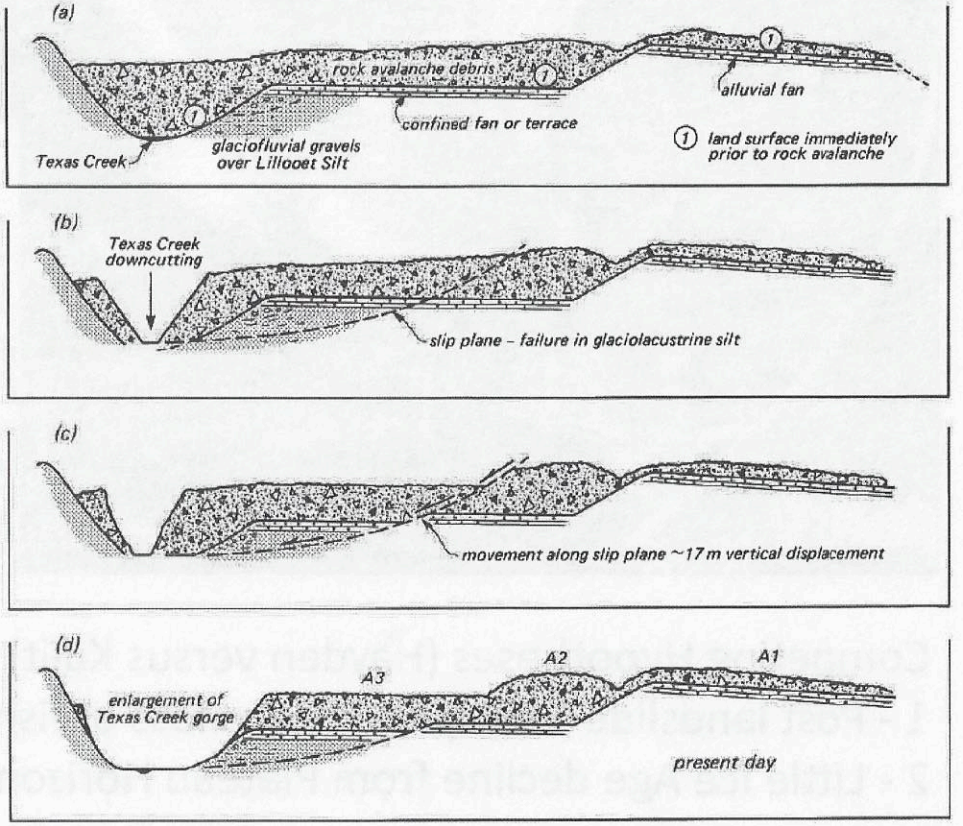
PRELIMINARY DESIGN DETAILS

Texas Creek Landslide

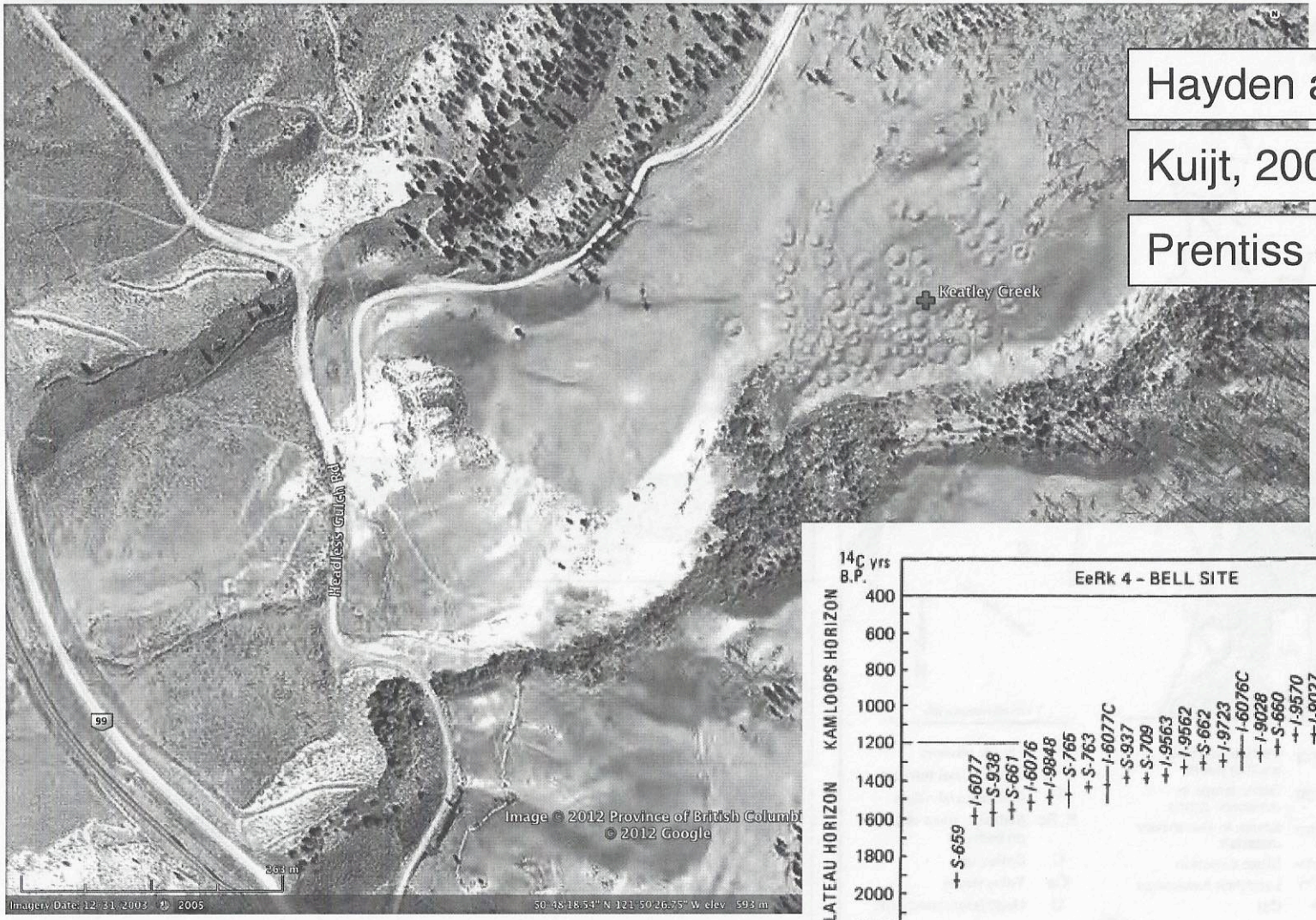


Ryder et al., 1990





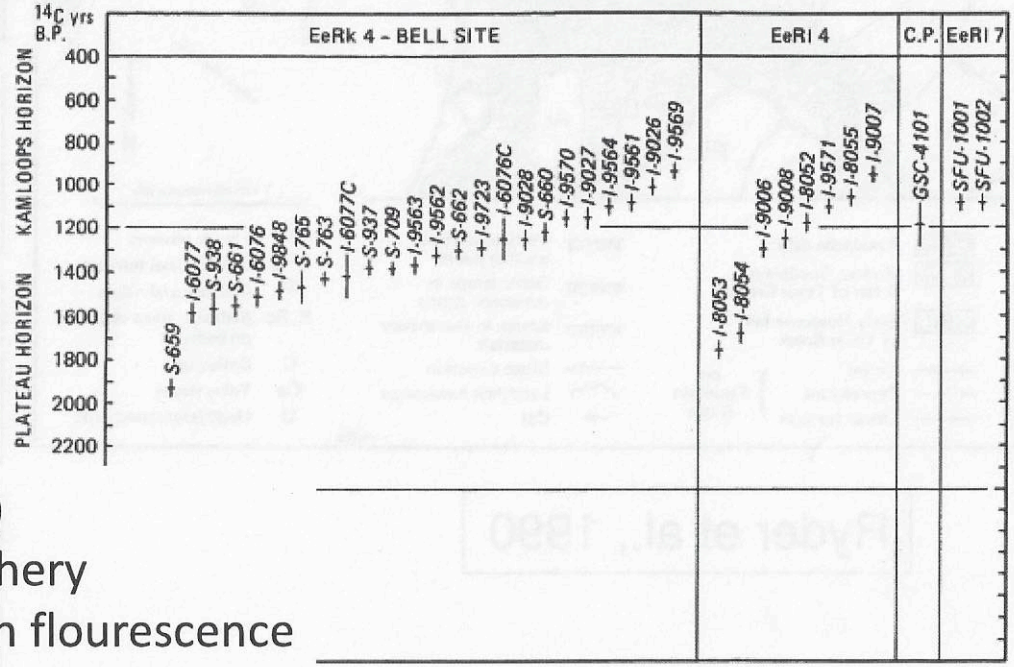
Cultural change ca 1000 years ago



Hayden and Ryder, 1991

Kuijt, 2001

Prentiss et al., 2003

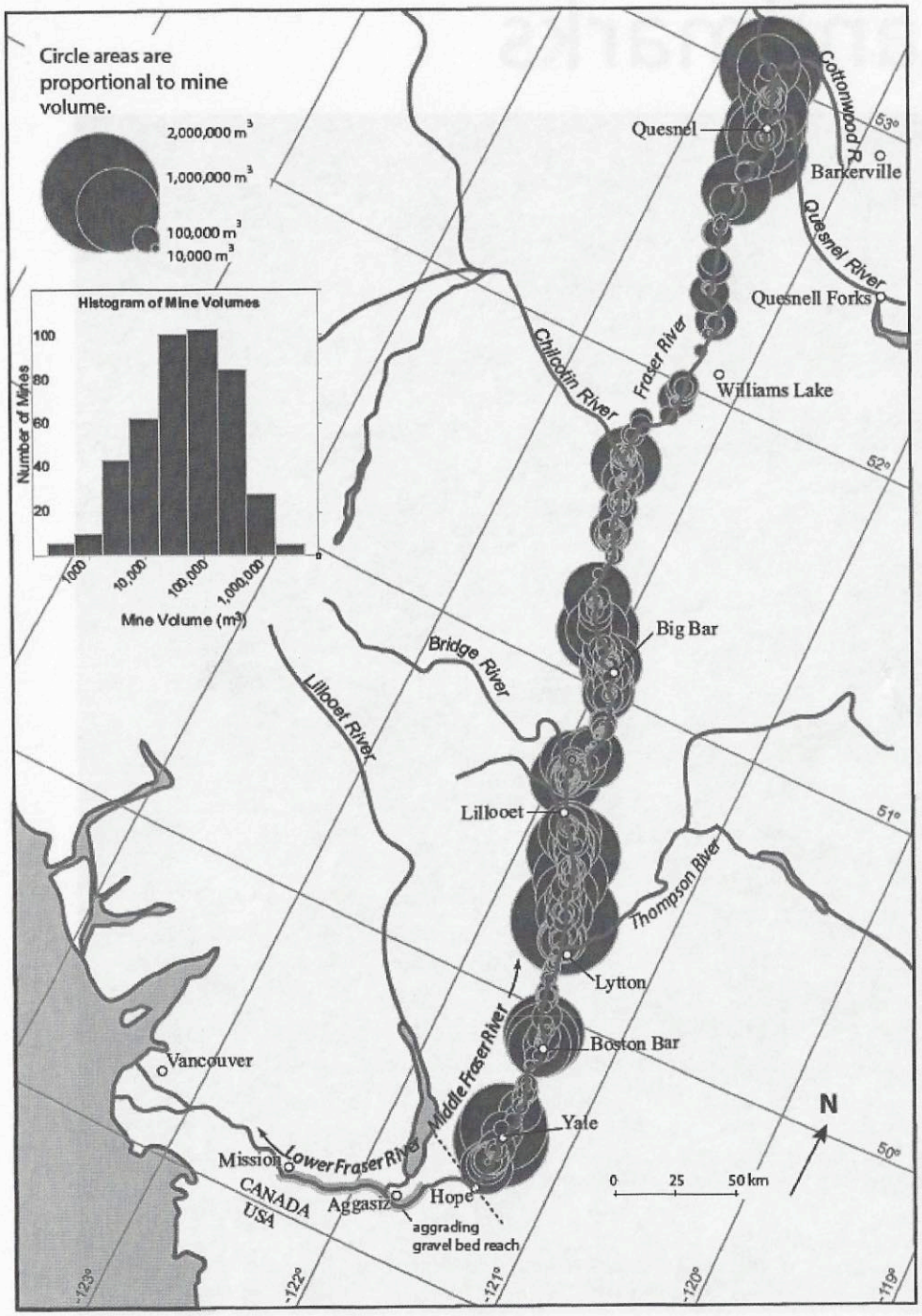


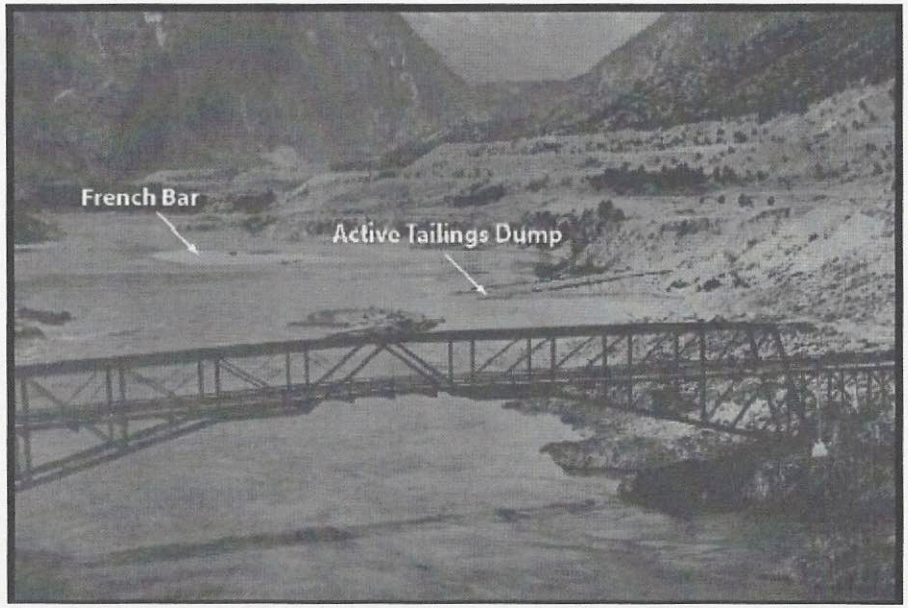
Competing Hypotheses (Hayden versus Kuijt)

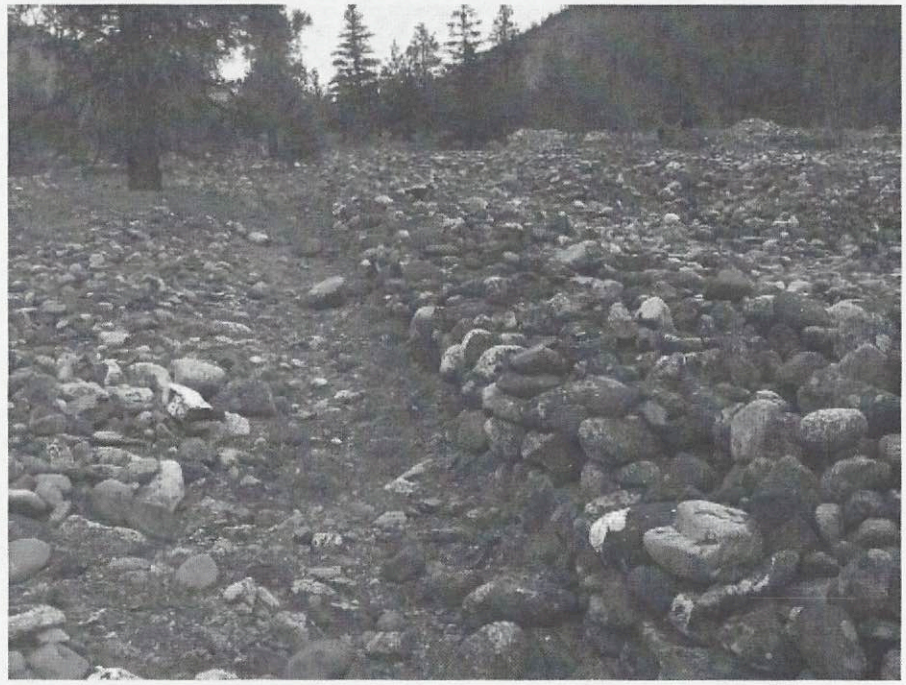
1 - Post landslide "collapse" due to loss of fishery

2 - Little Ice Age decline from Plateau Horizon flourescence

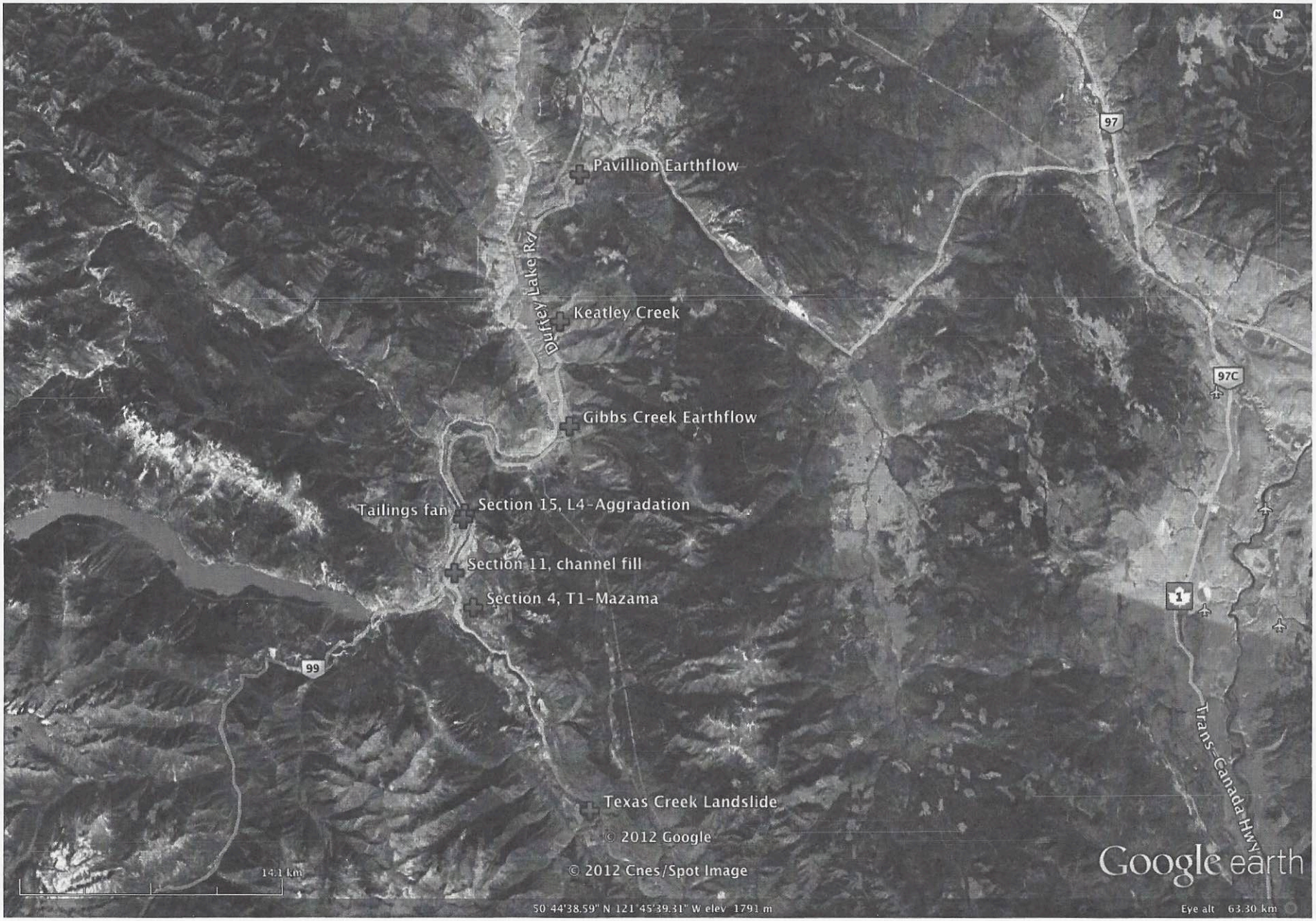
Placer Mining







Field Trip Landmarks



Lillooet Geomorphology References

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