Glaciofluvial Deposits

Coastal glacial outwash plain, Svalbard

Brian Romans, Virginia Tech

Deposition from glacial meltwater

- **On, within or beneath a glacier**
- **In front of a glacier**
  - Proximal zone (10s to 100s of m)
  - Medial zone (100s m to 10s km)
  - Distal zone (10s to 100s of km)

- **The Quadra Sand**
- **The Nanaimo River valley GF deposits**

Glaciofluvial sedimentation is generally similar to fluvial sedimentation, except where it is in contact with the ice.

Another difference is that the water is generally colder and denser, and also more viscous, so particles behave differently.

Finally, glacial outflows can be highly seasonal, even more than fluvial flows in our wet-dry climate. And of course outburst floods (Jökulhlaups) can be an influence.

Sedimentation on or within a glacier

- Supraglacial and englacial channels may have little friction, so sediments tend to move through quite readily (in any case we don't typically get to see these types of deposits)
- Subglacial channels typically have much higher friction (like regular streams)
- Subglacial streams are generally confined to tunnels, so can't spread out like regular streams. Eskers are the result.

http://www.nichols.edu/

Sinuous esker ridge of classic form that has melted out of glacier ice in 1992. The bouldery ridge in the background is the inner face of the substantial lateral moraine surrounding the rapidly retreating Stagnation Glacier. The landform is actually composed mostly of glacial ice preserved by the insulating cover of a meter, more or less, of bouldery esker gravel. (Photograph taken by Christian Zdanovich.) (W. Shilts, http://www.prairie.illinois.edu)

Manitoba

Northern Canada

Proximal zone (10s to 100s of m)

- Coarse materials (coarse sand, gravel, pebbles and cobbles)
- Chaotic depositional patterns
- Rugged topography leads to mud and debris flows
- Deposition on buried ice is common and leads to post-depositional collapse and deformation
- Braided streams are the norm
- May be highly influenced by seasonal variations

Downcutting through end-moraine deposits, Thompson Glacier, Canadian Arctic, http://libwiki.mcmaster.ca

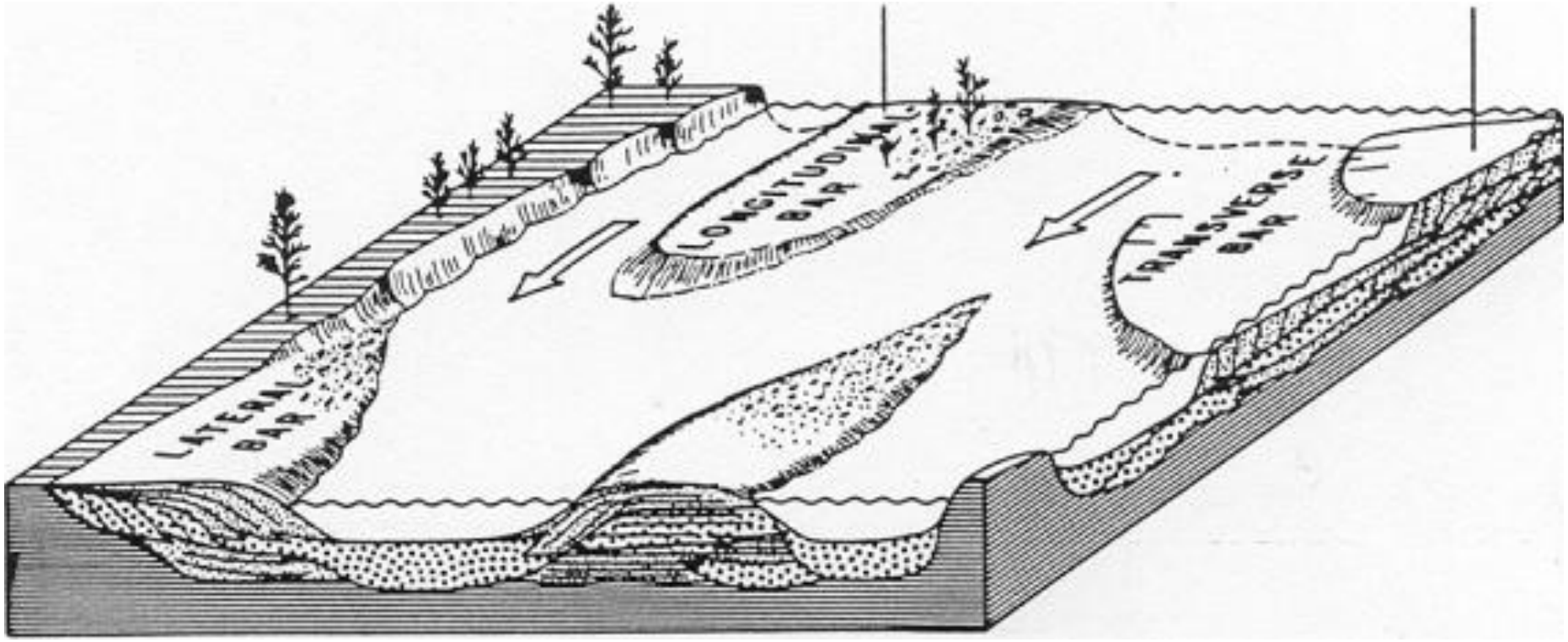
W.W. Shilts, http://www.prairie.illinois.edu

Greenland, K. Tinto
http://www.ldeo.columbia.edu/research/blogs/arctic-thaw-measuring-change,

Medial zone (100s of m to several km)

- Braided streams (sand and gravel)
  - Longitudinal bars (coarsest)
  - Transverse bars
  - Point bars (finer, with cross-bedding common)

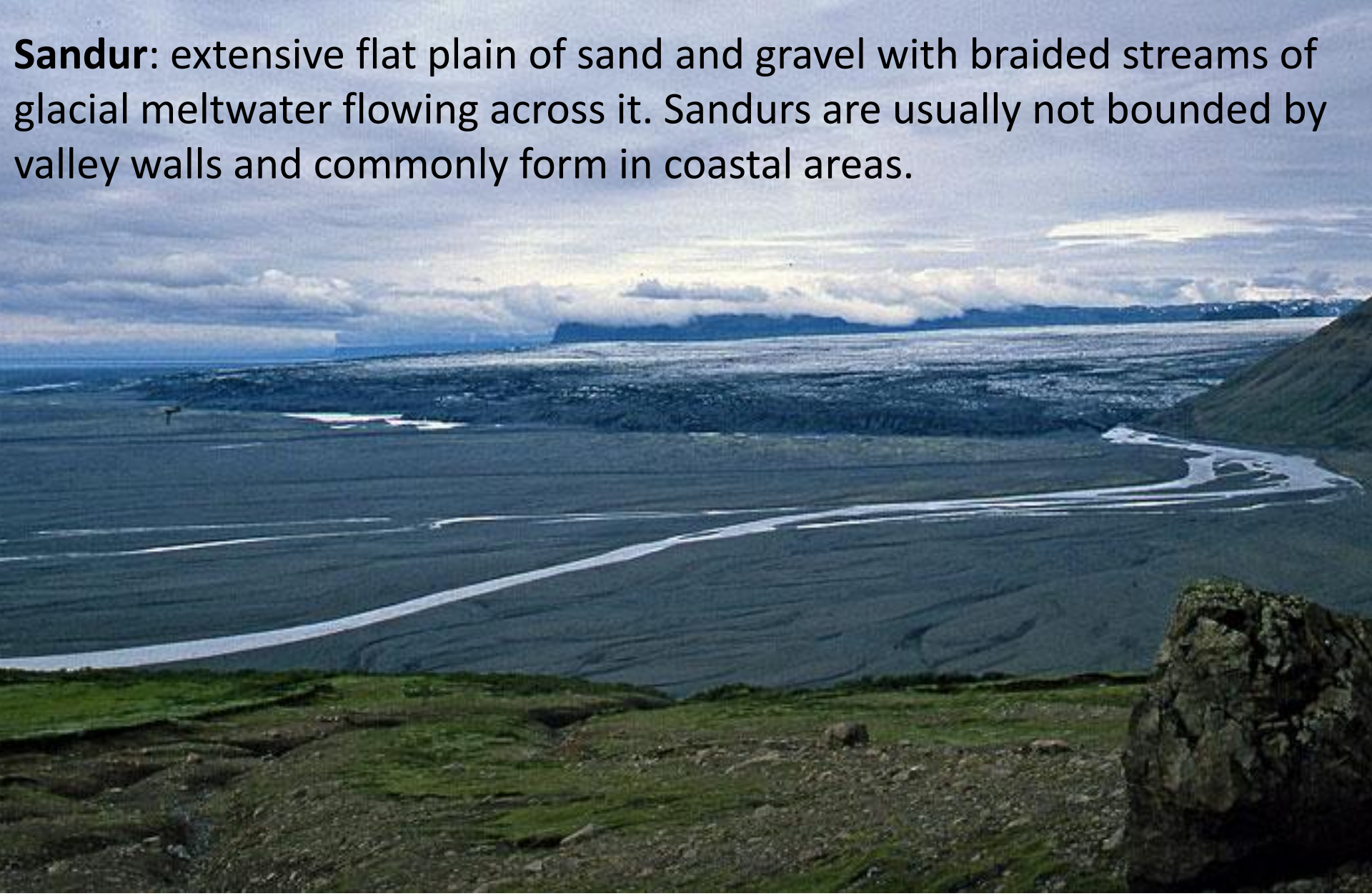
- Grain size decreases down stream


LATERAL BAR
LONGITUDINAL BAR
TRANSVERSE BAR

Brahmaputra River, Tibet http://c-p-d-studio.blogspot.ca

Dibang River, Arunachal Pradesh, India
http://c-p-d-studio.blogspot.ca

Sandur: extensive flat plain of sand and gravel with braided streams of glacial meltwater flowing across it. Sandurs are usually not bounded by valley walls and commonly form in coastal areas.



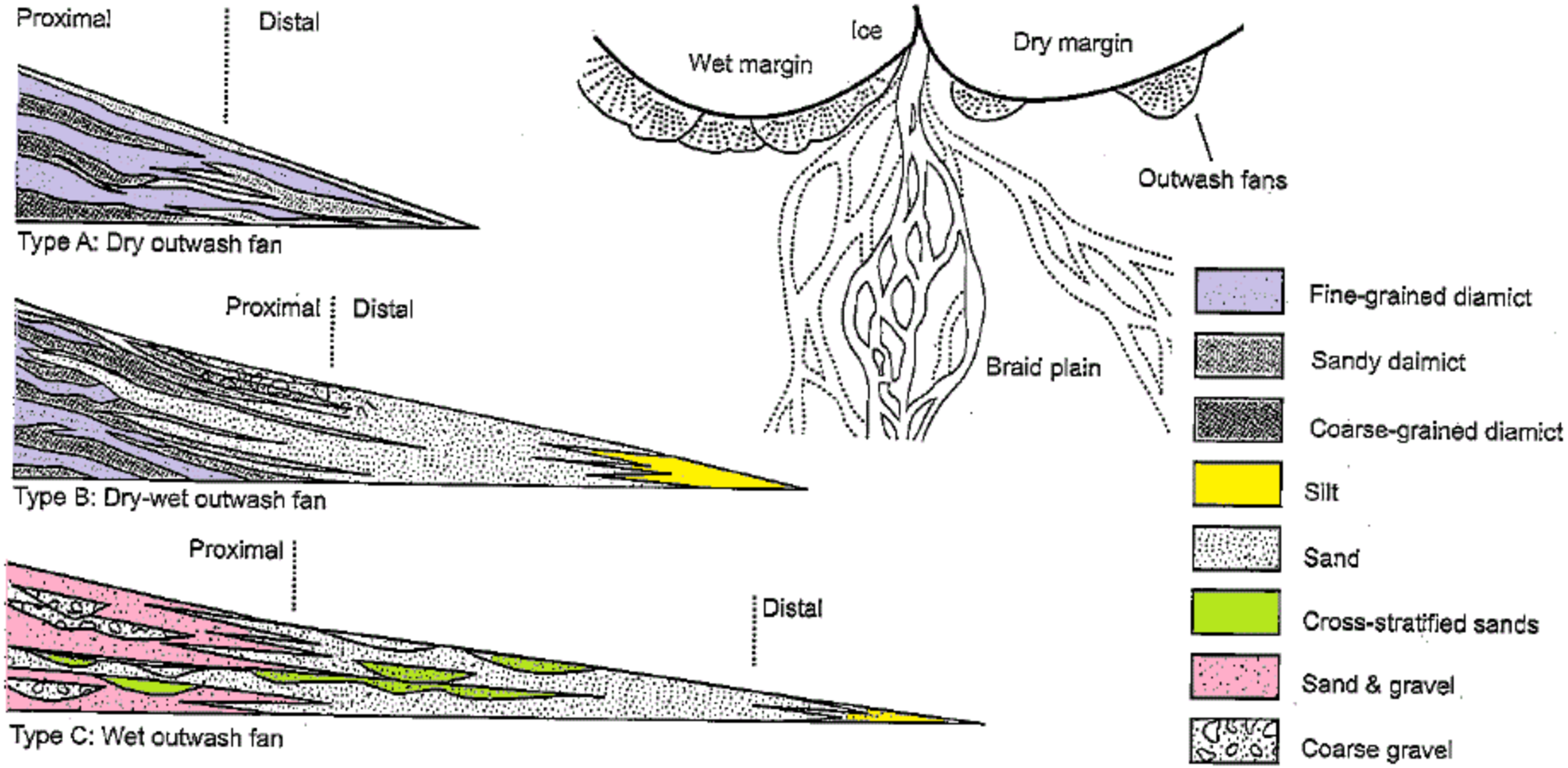
Sandur in southern Iceland, south of Vatnajökull ice cap. Photo: J. Alean, 1978
http://www.swisseduc.ch/glaciers/glossary/sandur-en.html

Robson Glacier, BC, August 2012

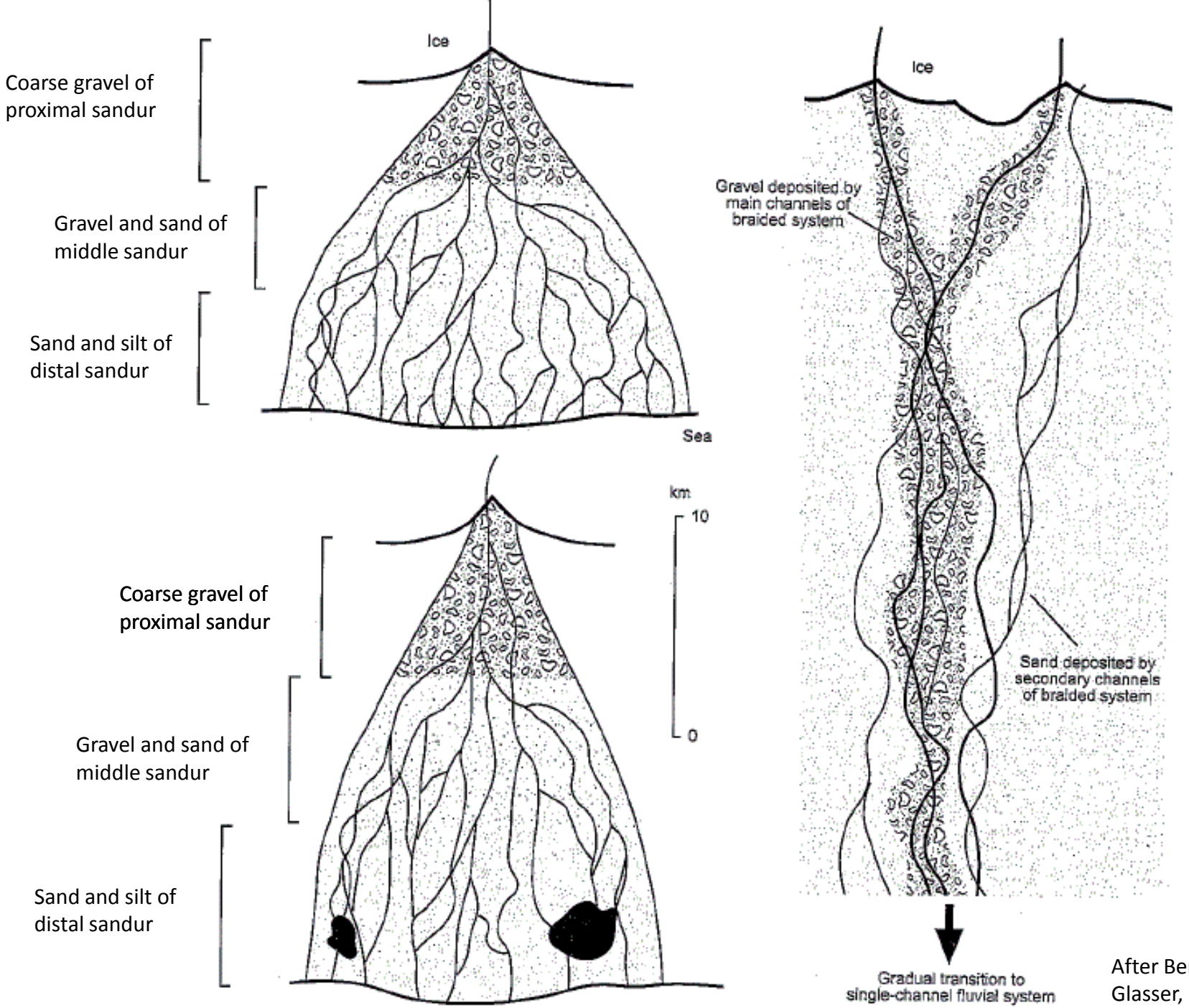
Distal zone (10s of km)

- Mostly sand
- Under normal discharge the flow is confined to a single channel
- Decreased glacial influence, less seasonal
- Transition to a conventional river system (i.e., from predominantly braided to predominantly meandering)

Tasman River, South Island, New Zealand, fed by Tasman Glacier off the picture to the right, and the Hooker and Mueller glaciers in the valley in the centre background. Photo M. J. Hambrey.
http://www.swisseduc.ch/glaciers/glossary/braided-stream-en.html



From Bennett and Glasser, 2009



After Bennett and Glasser, 2009

Criteria for recognition of glaciofluvial deposits

Code	Facies description	Interpretation
Gm	Massive, matrix-supported gravel	Debris flow
Gms Gmi	Massive crudely bedded gravel, horizontal bedding, clast imbrication	Longitudinal bars, channel lag deposits
Gt	Stratified gravel with trough cross beds	Minor channel fills
Gp	Stratified gravel with planar cross beds	Transverse or linguoid bars
St	Medium to coarse sand, pebbles, with trough cross beds	Dunes
Sp	Fine to very coarse sand, pebbles, with planar cross beds	Transverse or linguoid bars
Sh	Fine to very coarse sand, pebbles, with horizontal laminations	Planar bed flow, high flow regime
Ss	Fine to very coarse sand, pebbles, with horizontal laminations	Minor channels or scour hollows
Fl	Sand, silt and mud with ripple marks	Waning flood deposits and overbank deposits
Fm	Mud and silt with dessication cracks	Deposits formed in pools

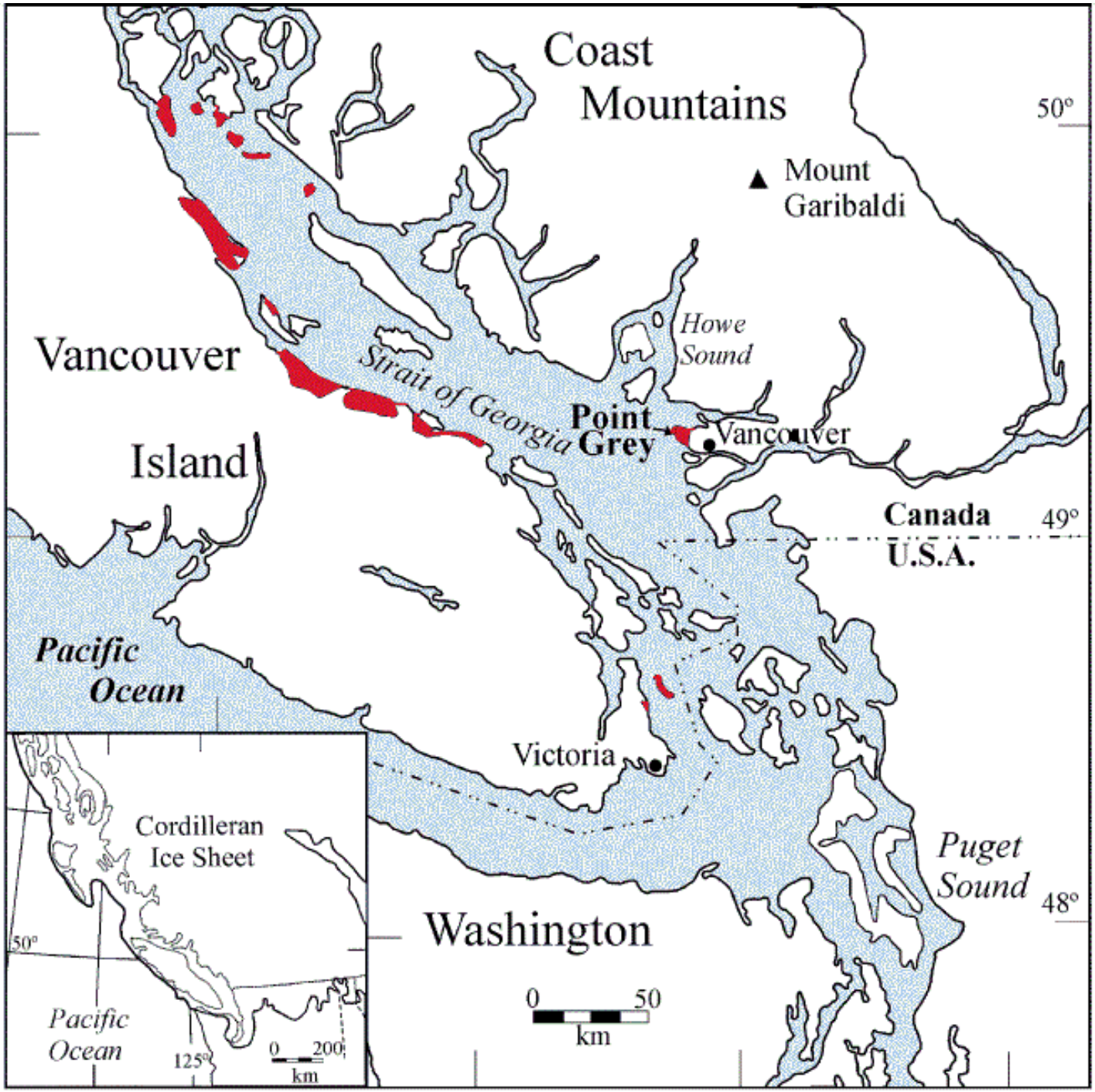
After Bennett and Glasser, 2009

Characteristics of Jökulhlaup Deposits

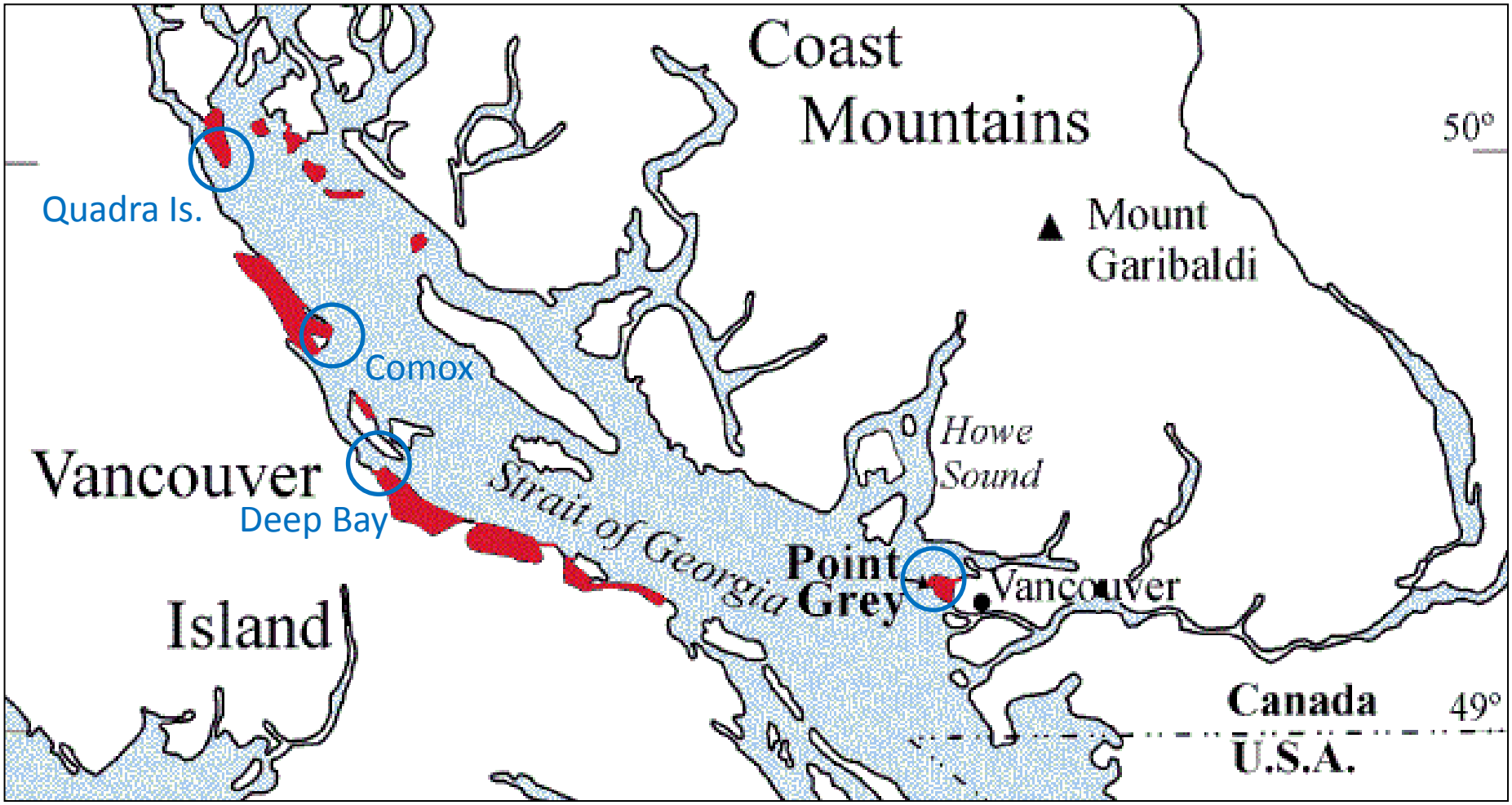
Dominant facies	Secondary facies	Depositional environment
Guc, Guf, Gxp, Gxt, Blg	Gh, Sh, Suf, Go, St, Sp, Fl	Jökulhlaup drainage from ice-dammed or subglacial lake
(uc: upward coarsening, uf: upward fining, xp, xt: large-scale planar and trough cross beds, Go: open work gravels)		
Gm, Gx, Gh, Sm, Suc, Guc	Guf, Suf, Gt, Gp, St, Sp, Sh, Fl, Bm	Jökulhlaup drainage during subvolcanic eruption

After Maizels, 1997


Quadra Sand



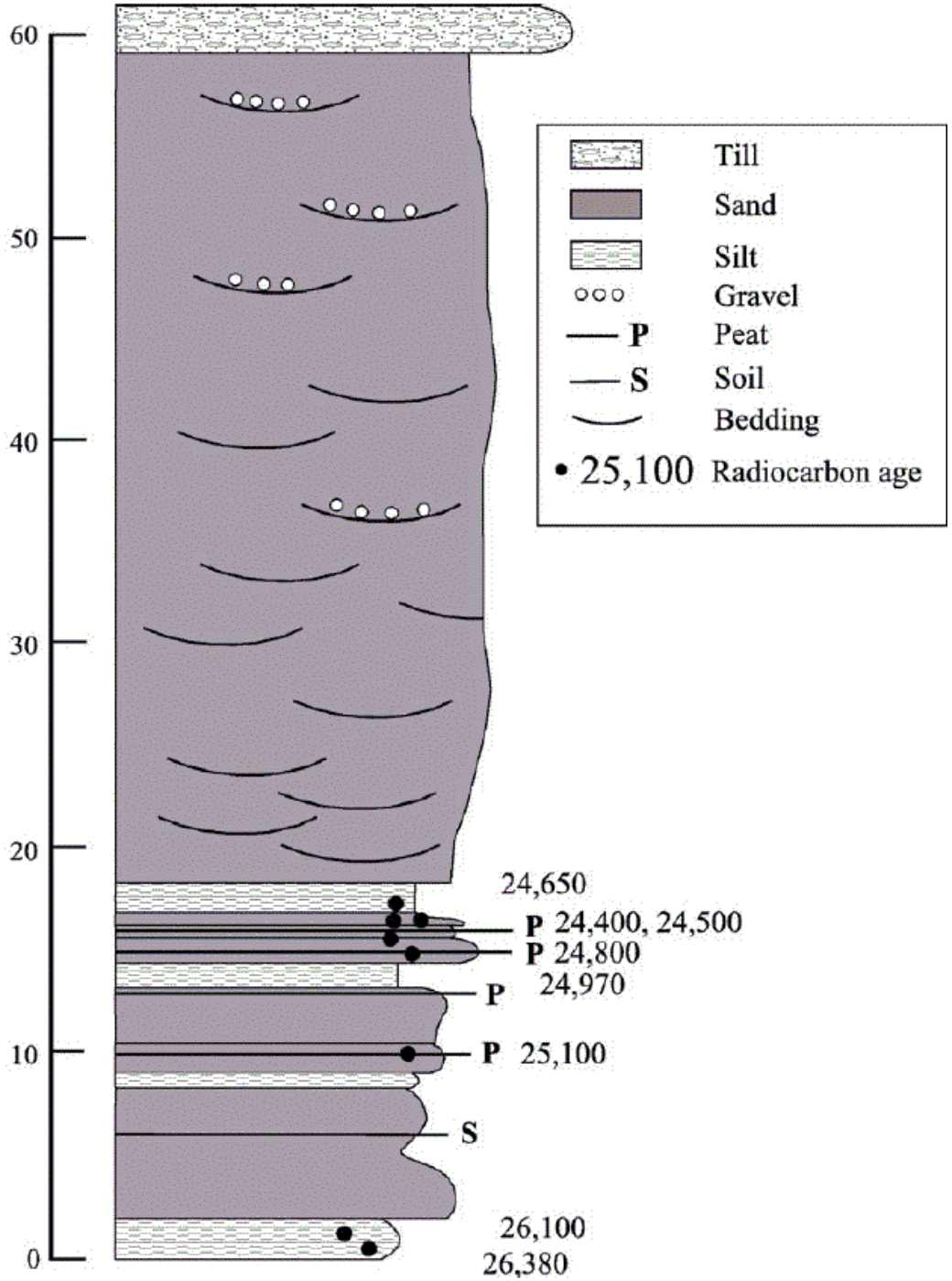
After Clague et al., 2004



After Clague et al., 2004

Quadra Sand at Point Grey

After Clague et al., 2004



Quadra Sand at Point Grey

After Clague et al., 2004

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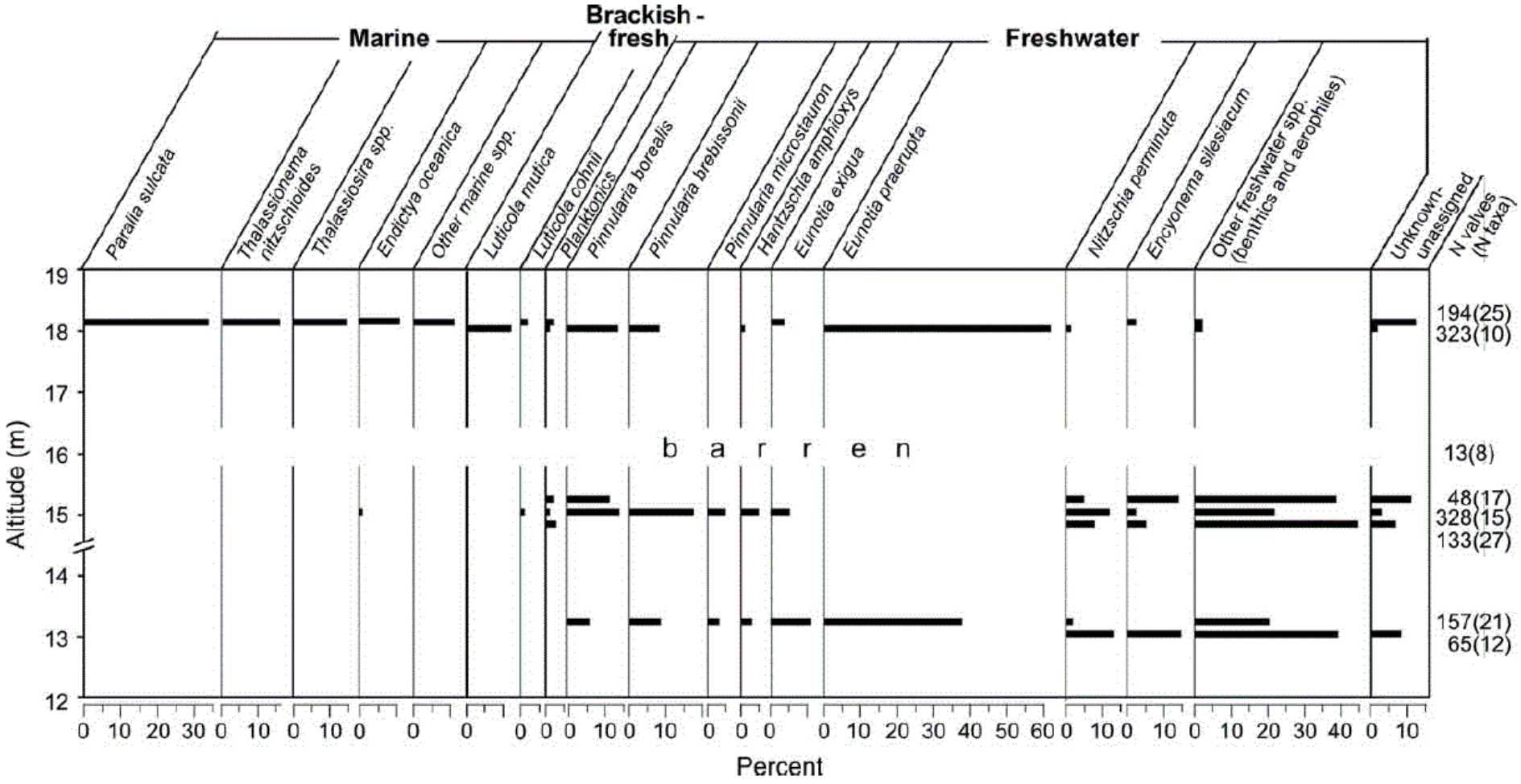
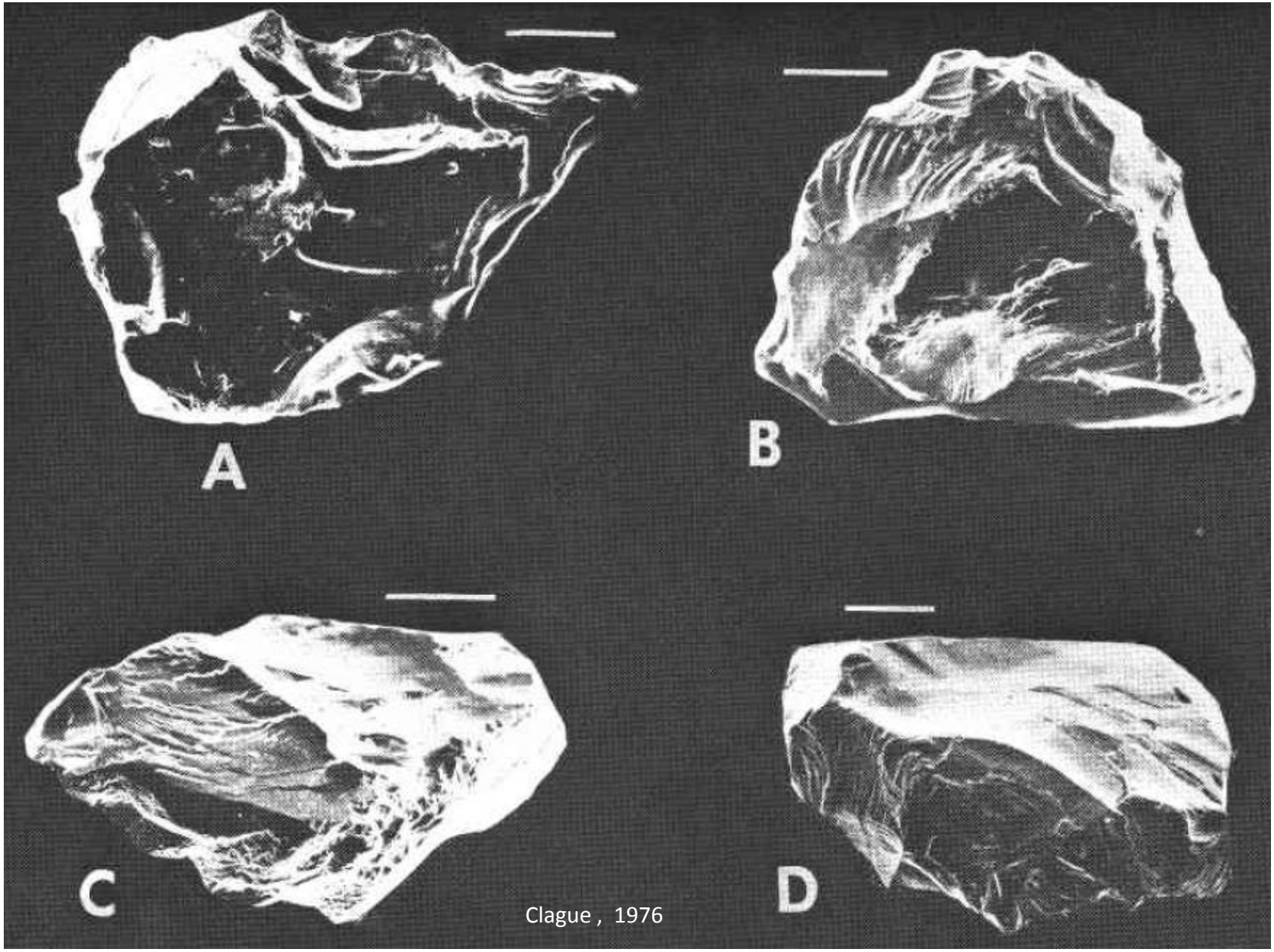
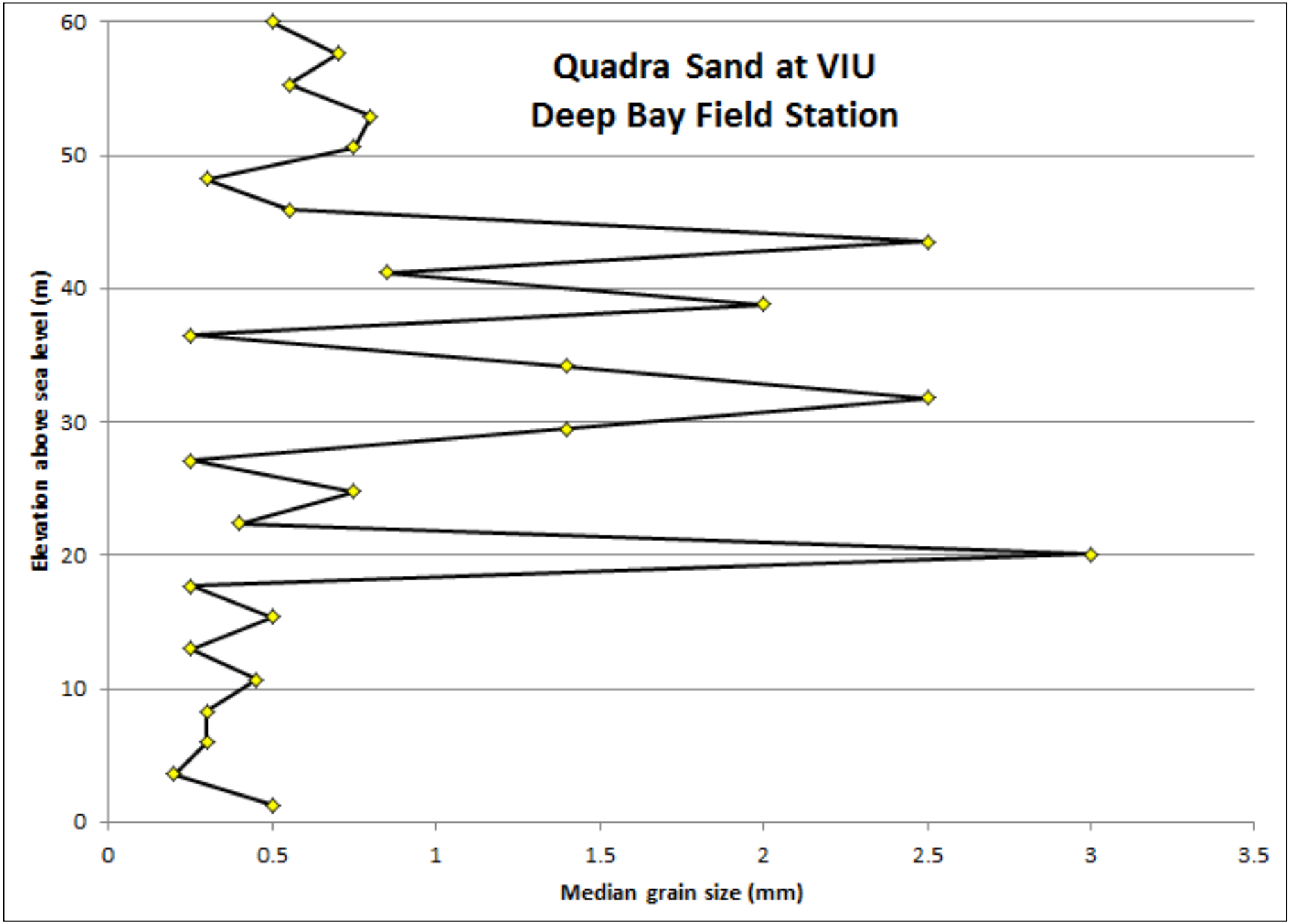


After Clague et al., 2004

Quadra Sand at Point Grey



Clague , 1976



After May, 2007, VIU GEOL-490

Quadra Sand at Comox

Fisher, 2009, U. Vic. MSc.


Unit 5
Unit 4

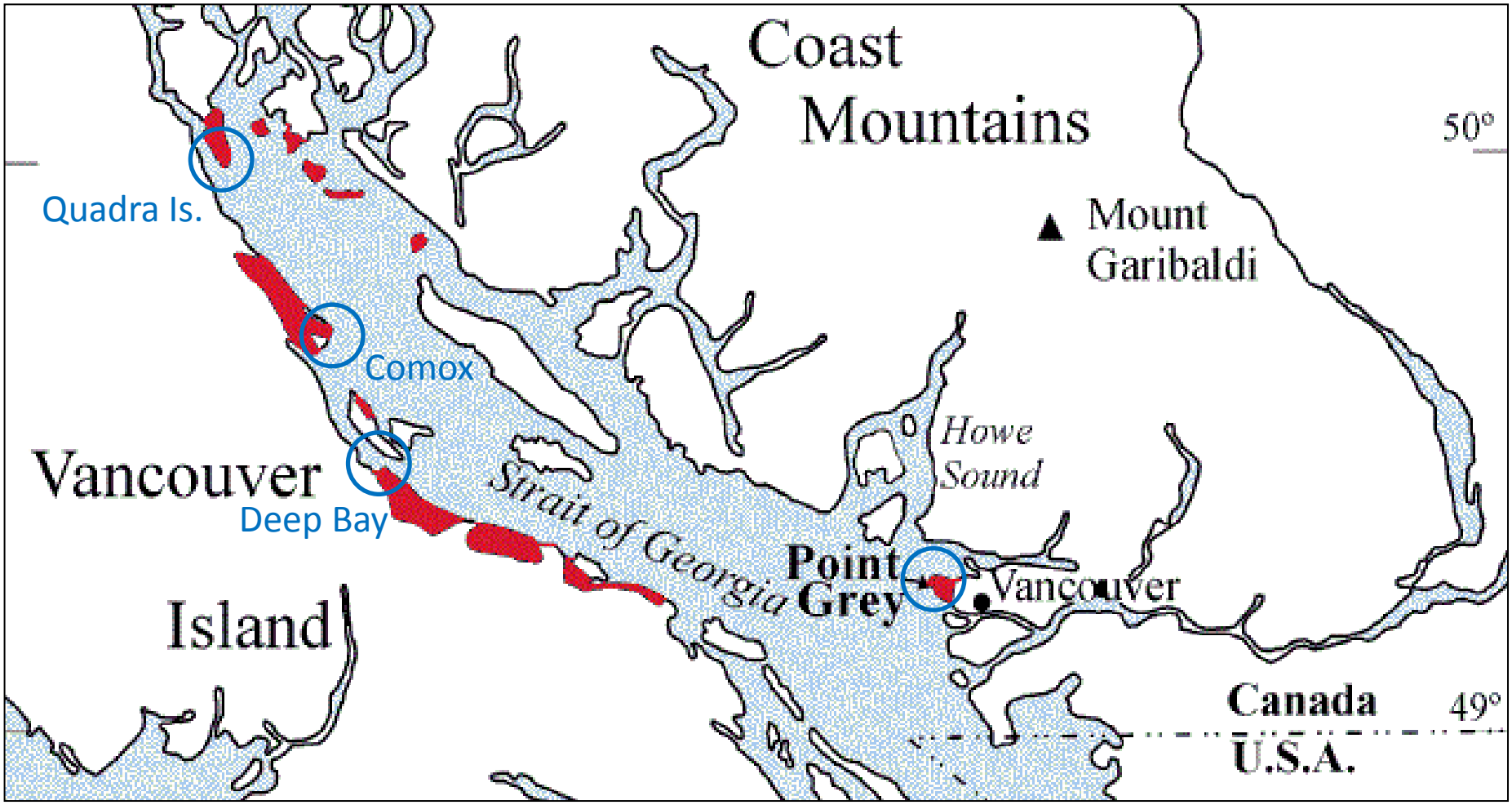
Unit 3


Unit 3


Unit 3
Unit 2


Unit 2


Quadra Island



After Clague et al., 2004

Hub City Gravel Pit

Nick's annotation

Nanaimo River Valley at last deglaciation?

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