Formation of Puget Sound and the Olympic Peninsula

Learning objectives:

Understand how the Olympic Peninsula and the Puget Lowland likely formed

Understand the formation of Puget Sound based on the paper by Derek Booth (1994)

Juan de Fuca Ridge – Cascade Range

Evolution of fore-arc basins and continental crust.

1: Fore-arc basin
   oceanic arc and marginal basin

2: Transitional fore-arc

3: Arc terrane accreted onto continental crust
Resulting geology

Blakely Harbor Formation: turbidites and siltstones
Blakely Formation: sandstones

Advance of Vashon Stade of the Puget Lobe of the Cordilleran glacier dated by $^{14}$C content of wood found above and below glacial till.

Half-life: 5730 y

Findings:
Advance rate: 135 m/y
Arrival in Seattle: ~17,400 ya
Duration: ~2000 y
Retreat rate: ~500 m/y (calving)

Animation of last glaciation

Observable sediments in Puget Lowland

Vashon Till (deposited by overriding by ice and ice retreat)

Advance outwash
(Esperance Sand from proglacial river deltas)

Interbedded sand and silt

Lawton Clay (proglacial lake deposits)

What did the glacier do as it advanced into the Puget Lowland?
Puget Lowland Deposits

Landscape of Puget Lowland

Glacial advance outwash plain

Flutes

Trough

How were the troughs cut?

Formation of Puget Sound basins

1: Old View: Backward-cut fjord

2: Recent view (Booth 1994): Basins carved by sub-glacial melt water as glacier melted during ice occupation

Meltwater channel draining into a Moulin in Greenland (NASA image)
Pressure under ice can force meltwater channels to move uphill.

Model of subglacial meltwater channel formation in Antarctica

From Le Brocq et al. 2013 *Nature Geosciences*
- Glacier advance deposited the "Great Lowland Fill" (~ 140 m thick)

- Subglacial water eroded the fill (about 1000 km$^3$) to create the linear lakes and basins of Puget Sound.

Sediments of Puget Sound beaches are typically composed of material (mud, sand, gravel, cobbles, boulders) Glacial Till + Advance Outwash (Esperance Sand).