

Port Townsend's Water Street Bluffs

The bluffs along the main street by the ferry dock and east are made up of till, a jumbled deposit smeared along the surface at the base of a moving mass of ice. It is not classic till; it is more properly 'flow till' because we can see some bedding in it. However, it was thoroughly compacted by the weight of the ice that passed over it as it was deposited, and it remains standing in those vertical sections like a 'normal' till. It weathers into slabs that parallel the free face. Every so often a slab falls off - hence the concrete barrier at the road level.

The straight 'edge' of the till that we see along the road to the ferry dock is a remnant of sluicing, done years ago to provide more land for the port buildings. The city expected to become the premier port for the area, and it created a swath of fill where the main "down town" street is. This presents the town with the same 'hazard' as exist in parts of San Francisco created by debris placed after the 1906 earthquake. One big earthquake here (perhaps on the Cascadia Subduction Zone or the South Whidbey Island fault), and a lot of the town would crumble and slide south on the failing fill. Note the condition of the mortar in the fine old brick buildings...

The till's age here is about 14,000 years. It represents the Vashon ice advance, the Vashon being the last major pulse of the Fraser Glaciation. Ice was about 4,000 feet thick here when the ice lobe was at its maximum extent about 16,000 years ago. At that time the ice front was a little south of Olympia. Vashon ice sheet moved quite rapidly south, then was cut off from its ice supply, and 'retreated' by simply melting in place. (The movement of ice on the western margin of the continent was not in sync with that of the more eastern continental ice sheet or the area's alpine glaciers.)

Above the till is a thin dark brown wind-deposited fine sediment called loess; that covers a cobble lag layer that sits directly on the till surface. The lag tells us that there was some period of erosion that removed finer material between the end of till deposition and the time at which the loess was laid down. There is carbon in the loess to give it the color, but no one has yet been able to get enough C together to do an AMS radiocarbon dating. (Or perhaps the cost of the dating is daunting enough.) The loess is quite widespread here; it is also present on Protection Island.

Below the till, but not exposed along Water Street, are older glacial deposits. Their record is incomplete in in the Port Townsend area, and the oldest exposed deposit in the area is till of the Double Bluff Glaciation, 180 to 250 thousand years old. That is exposed at beach level at Ebey's Landing on Whidbey Island. The last 'Ice Age' extends back to nearly 2 million years ago, and very few traces of all that ice are actually visible in this area.

After the ice melted away, there was regional land-surface uplift, just as there has been and is around Hudson's Bay and in the Baltic Sea area. Geologists relate it to rebound as the weight of the ice was removed. There is at least 150 feet of rebound documentable here. We base that estimate on a deposit called glaciomarine drift (gmd) - a massive buff silt/clay that weathers in a hackly manner. Because it is marine (deposited under ice directly on top of the till and containing rare foraminiferans and shells), it marks the local seafloor. Today we find the gmd at bluff tops whose height tells us about something about the amount of uplift. Measurement of maximum uplift is vastly complicated by (1) the concurrent rise in sea level, which stabilized here about 5000 years ago, (2) neotectonic regional warping, and (3) whatever the under-ice topography/bathymetry might have been. We also find the same gmd at current sea level, so there must have been a fair amount of relief on the seafloor here. KMR3/12