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Post-mortem of the southern Cordilleran Ice Sheet

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Abstract:

Lidar topography, bathymetry, analysis of deep-sea cores, and geochronology along the south margin of the late Pleistocene Cordilleran Ice Sheet (CIS) demonstrate multiple causes of ice retreat.

Throughout northeastern Washington and northern Idaho, abundant inset recessional moraine crests and ice-marginal drainage channels suggest down-wasting of active ice, driven by a warming and(or) drying climate. This was an ordinary death for a glacier.

In contrast, the Juan de Fuca lobe (JdFL) floated away. Grounded ice, with its base below sea level, reached the edge of the continental shelf and then retreated ca. 200 km to a buttress at the Coupeville moraine south of the San Juan Islands. I infer that onset of ice retreat corresponds to floating of the tip of the JdFL. Floating required ice thinning and(or) sea-level rise. Thinning of the JdFL was not likely the result of regional warming or reduced snowfall, because the adjacent Puget lobe, which shared ice sources with the JdFL, did not thin at the same time. I suggest that sea-level rise initiated the JdFL collapse. The submarine floor of the JdFL likely sloped east, towards the ice source, thus floating of its terminus would have initiated a positive feedback loop that hurried retreat. Collapse of the JdFL may have taken less than two centuries.

Wasting of the Puget lobe followed when upstream ice was diverted into the hole left by collapse of the JdFL. Lack of recessional moraine crests, widespread preservation of subglacial features, and a handful of critical radiocarbon ages indicate marginal stagnation and rapid retreat of the Puget lobe from its maximum extent south of Olympia to a stillstand at the Coupeville moraine. This was quickly followed by further retreat from the San Juan Islands and Georgia Strait.

Subsequent Sumas-stade readvance of the CIS in the Fraser Lowland may reflect stabilization of the remnant CIS by grounding as local sea level fell in response to the loss of the CIS load, followed by progressive climate-driven retreat.



Biography:

Ralph is a Seattle native, with BS and MS degrees from Western Washington University and a PhD from the University of Washington. He began his career looking deep in the Earth's crust at gneiss and tonalite in the North Cascades, moved on to study turbidites, then glacial till, and now spends much of his time looking at lidar topography. He is employed by the USGS and lives in Wenatchee, Washington.