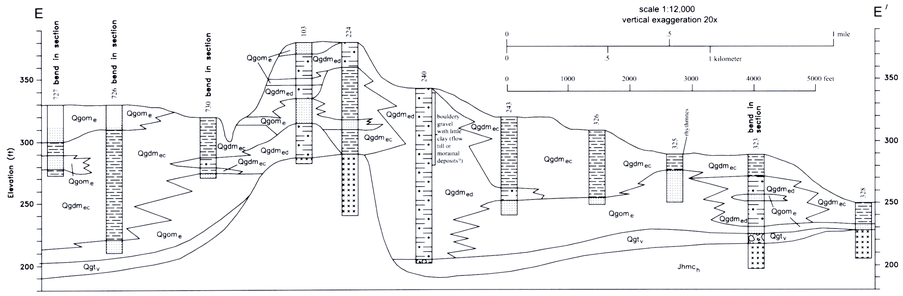
WASHINGTON STATE DEPARTMENT OF
Natural Resources
Jennifer M. Belcher - Commissioner of Public Lands

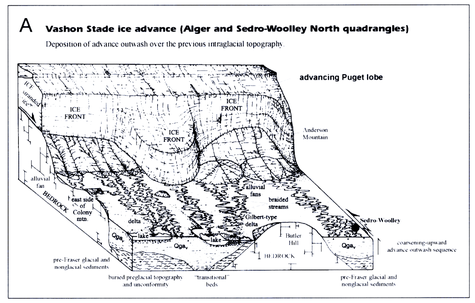
Produced in cooperation with the U.S. Geological Survey
National Cooperative Geologic Mapping Program
Agreement Number 98HQAG2062

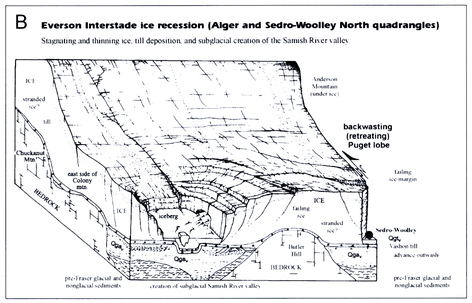
WASHINGTON DIVISION OF GEOLOGY AND EARTH RESOURCES
Raymond Lasmanis, State Geologist

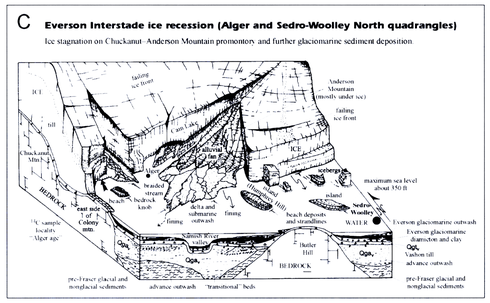
PLATE 4
OPEN FILE REPORT 99-3
GEOLOGIC MAP OF THE SEDRO-WOOLLEY NORTH AND LYMAN 7.5-MINUTE QUADRANGLES, WESTERN SKAGIT COUNTY, WASHINGTON

GLACIAL UPLANDS CROSS SECTIONS, continued from Plate 3

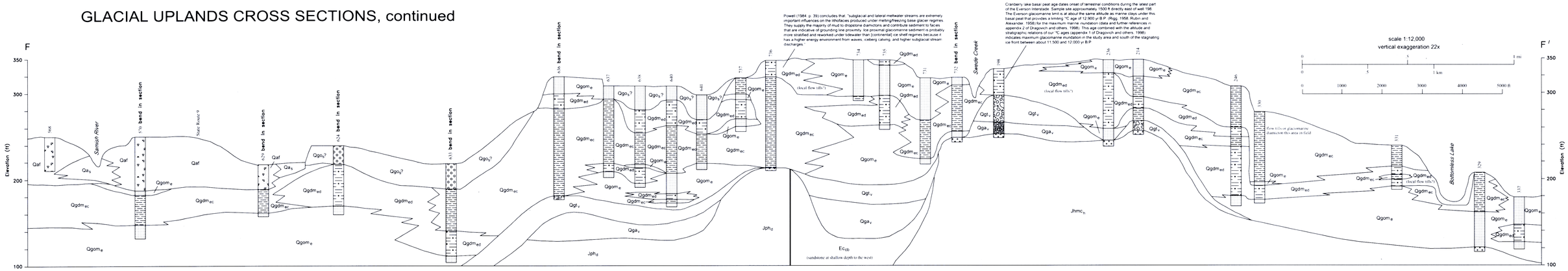








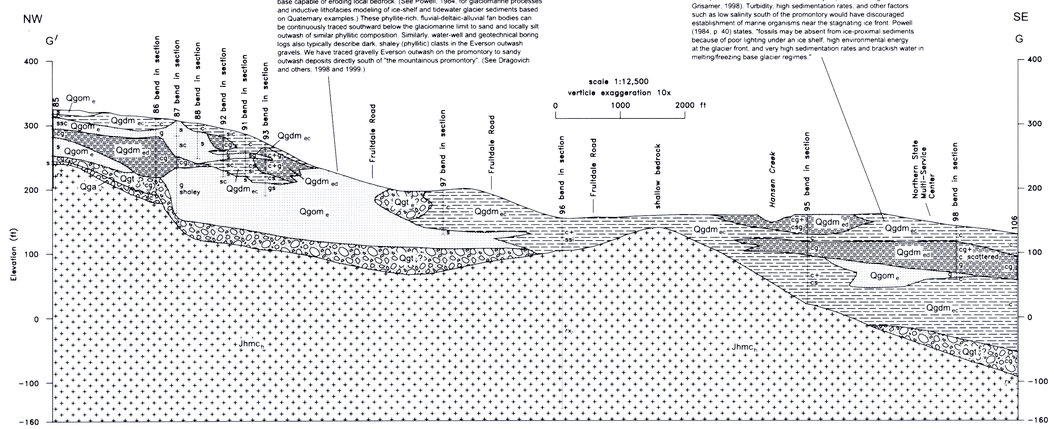
GLACIAL UPLANDS CROSS SECTIONS, continued

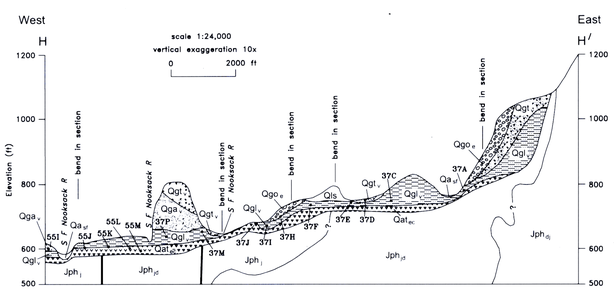


Distinct lobes of terrestrial to marine outwash grade south from nonmarine, gravelly, glacial outwash above the glaciomarine limit and on the promontory to sandy gravels to sands and sandy silts ("fining" trend) south of the promontory. These sands and silts are locally rhythmically bedded and may record turbidite-style deposition as described by Domack (1984). Everson outwash contains a high proportion of angular to subrounded phyllite and vein quartz detritus, indicating its local basal-ice source. Local clast derivation provides evidence for a mostly unfrozen, meltwater-rich ice base capable of eroding local bedrock. (See Powell, 1984, for glaciomarine processes and inductive lithofacies modeling of ice-shelf and tidewater glacier sediments based on Quaternary examples.) These phyllite-rich, fluvial-deltaic-alluvial fan bodies can be continuously traced southward below the glaciomarine limit to sand and locally silt outwash of similar phyllitic composition. Similarly, water-well and geotechnical boring logs also typically describe dark, shaley (phyllitic) clasts in the Everson outwash gravels. We have traced gravelly Everson outwash on the promontory to sandy outwash deposits directly south of "the mountainous promontory". (See Dragovich and others, 1998 and 1999.)

Marine clay sedimentation implies a more distal setting but not necessarily low sedimentation rates. Given the relatively short time span (~2,500 yr) of the Everson Interstade, high sedimentation rates are inferred from field observations and several wells that contain thick (locally more than 300 ft) accumulations of diamicton and clays. (Also see Dragovich and Grisamer, 1998). Turbidity, high sedimentation rates, and other factors such as low salinity south of the promontory would have discouraged establishment of marine organisms near the stagnating ice front. Powell (1984, p. 40) states, "fossils may be absent from ice-proximal sediments because of poor lighting under an ice shelf, high environmental energy at the glacier front, and very high sedimentation rates and brackish water in melting/freezing base glacier regimes."

GLACIAL UPLANDS CROSS SECTIONS, continued



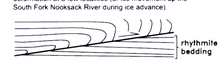


NOTES

Site numbers below (for example, 37A) are our field site numbers. Many of the sites are from steep river-cut exposures adjacent to the South Fork Nooksack River and are thus projected below the surface where the cross section line lies away from the river.

37A. Dense, phyllite-rich sand with contorted to overturned silt rhythmite beds (varves).

37C. Gently northwest-dipping, dense silt rhythmites with plane-bedded, phyllite-rich sand interlayers, overturned drag folds associated with internal thrust planes in the silt beds suggest top-to-the-east ice shear deformation at a few localities (or ice movement up the South Fork Nooksack River during ice advance).



37D. Dense polymictic till (probable Vashon till; unit Qgt_v) overlying dense, silty rhythmites with interlayered, moderately to thickly bedded, cobbly sandy gravel advance outwash of probable northern provenance (unit Qgl_v).

37E. Dense silt rhythmites in unit Qgl_v (varve layers contain thin, very fine sand laminae).

37F. Dense, fluvial gravelly sands overlying dense, varved silts or silts with rip-up rhythmite clasts; section is upward coarsening; gravels are polymictic and of a probable northern provenance.

37H. Loose sands and sandy gravels with lesser soft silts (unit Qgo_e) overlies dense silt rhythmites with local dropstones.

37I. Dense silts and silty sands.

37J. Dense till (dunite-rich); till occurs as a river pavement at or below low river level (unit Qat_{ec}); field relations (for example, unit altitudes) indicate that the till unit underlies the glacial lake deposits (unit Qgl_v).

37M. Very dense silt rhythmites (varves) with interlayered, thinly to thickly bedded, medium-grained sands and lesser pebbly gravels (unit Qgl_v); locally overturned folds of silt bedding are the result of soft sediment deformation and are similar to site 37C (sketch); sills locally contain dropstones; lowermost massive silt unit contains abundant rip-up clasts of silt rhythmites in a silt matrix.

37P. Moderately to thinly bedded silt rhythmites (locally contain dropstones) with sands, sandy gravels or pebbly sands; sands and gravels locally trough to low-amplitude planar-foreset bedded.

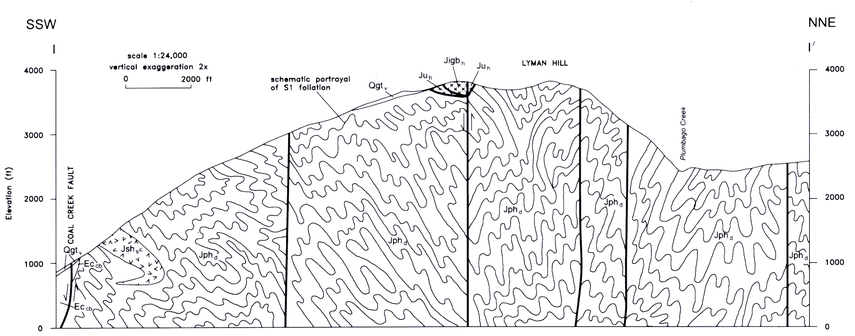
55I. Dense, sandy cobbly gravel or gravelly sand (40-60 ft thick) with high-amplitude (30+ ft high), northeast-dipping, foreset beds (unit Qga_v, deltaic deposits); foreset beds overlain by about 10 ft of trough cross-bedded, fluvial advance-outwash sandy gravels (topset beds), locally with scoured bases; phyllite-rich gravels of a probable northern provenance; this advance outwash unit locally contains striated rip-up clasts of silt rhythmites (unit Qgl_v).

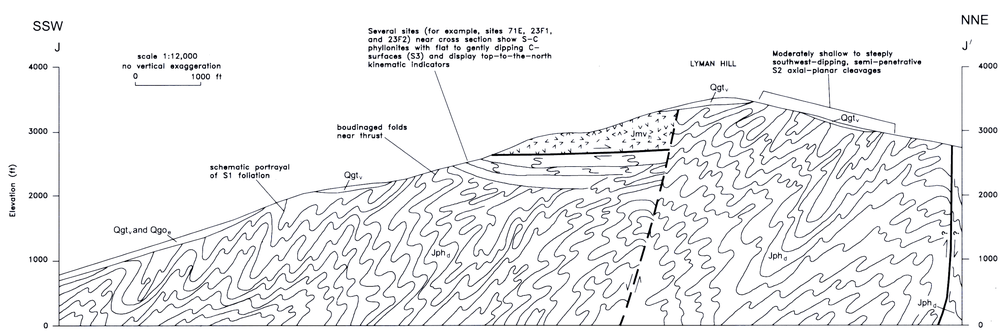
55J. Dense, east-derived till (unit Qat_{ec}) underlying silt rhythmites (unit Qgl_v); till clasts are matrix-supported and include angular to subrounded dunite, pyroxenite, slate, phyllite, semischist, andesite, and vein quartz; till occurs as a river pavement near or below low river level.

55K + 55L. Till (unit Qat_{ec}) occurs as a river pavement below well-bedded, dense silt rhythmites interbedded with lesser sands and gravels (unit Qgl_v); Qgl_v/Qat_{ec} contact occurs near low river level.

55M. Dense east-derived till (unit Qat_{ed}) with rare deformed sand lenses.

BEDROCK CROSS SECTIONS





Cartographic design and production by Keith G. Ikerd,
Washington Division of Geology and Earth Resources