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Figure 4. Cross Section A-A' was constructed using Snohomish

County Public Works geotechnical data (collected in February,

Suiattle River

Thickness Elev

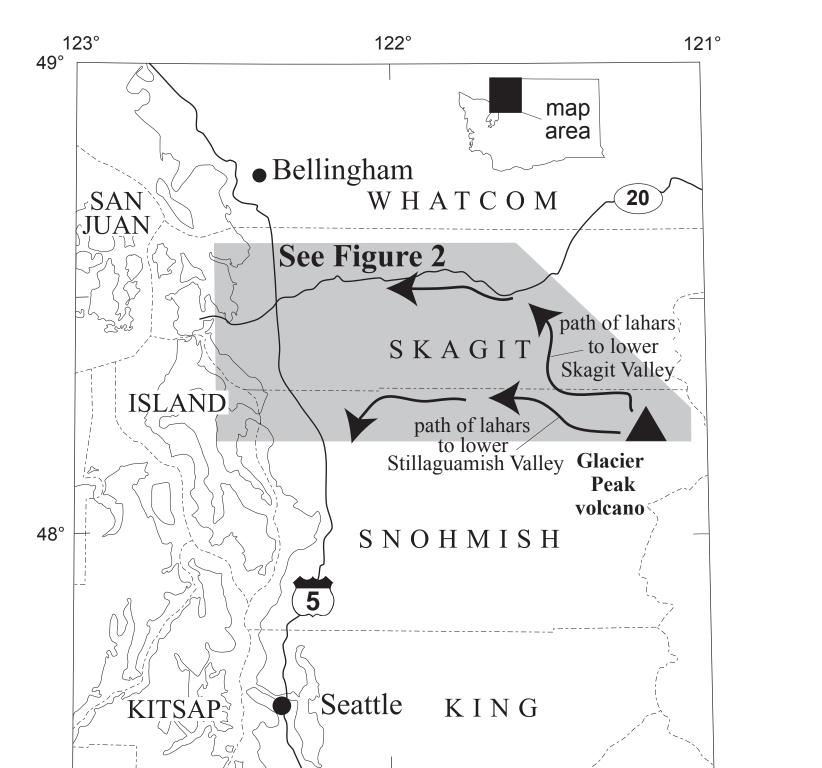


Figure 1. Location of the study area as shown by the gray-shaded area (Figure 2). The arrows depict the paths of Glacier Peak lahars and lahar runout that inundated the Skagit and Stillaguamish River valleys. The dashed lines are county borders.

Approximate mid-Holocene

sea level and location of the

Skagit delta front at about

Volcanic hazards in the Pacific Northwest are typically associated with more visible stratovolcanoes, such as Mount Rainier. Glacier Peak, a North Cascade dacitic stratovolcano near Darrington, Washington, has produced at least three large eruptive episodes since the culmination of the last continental glaciation with each episode likely lasting a few hundred years. Data from recent detailed geologic mapping, new ¹⁴C ages, stratigraphic relations, clast petrographic analyses, geochemical analyses, and laharic sand composition indicate that three large eruptive episodes occurred in the latest Pleistocene and Holocene—the information refines and expands on the pioneering work of Beget (1981). These voluminous events traveled up to 135 km downvalley of the edifice and reached the Puget Sound via the ancient Skagit and Stillaguamish deltas. Glacier Peak has erupted dacite of similar composition throughout its history. Hypersthene-hornblende-(augite)-phyric vesicular lahar clasts found from Glacier Peak to La Conner, Washington have similar geochemistry to dacite flows sampled on the volcano. Radiocarbon dating of the White Chuck assemblage shows an eruptive episode of ~11,900 yrs B.P. This implies ice occupation during part of the White Chuck event and is further supported by mapped deposits of the White Chuck assemblage that directly overlic recessional outwash along high inset terraces. Charcoal obtained from the Kennedy Creek assemblage yielded ¹⁴C ages of ~5,000 yrs B.P. Near La Conner, Washington, the Kennedy Creek lahar runout is locally interbedded with mid-Holocene estuarine and deltaic sediments of the Skagit delta. The Chocolate Creek assemblage yielded many ¹⁴C ages of ~1,800 yrs B.P. This assemblage occurs as the lowest and most inset lahar terrace near Darrington. Log-bearing flood deposits near Padilla Bay are 120 km from the edifice and contain dacitic sands and silts. This may be the most distal deposit of the Chocolate Creek complex. Many cities downvalley of Glacier Peak are built on river t

DESCRIPTION OF MAP UNITS

QUATERNARY SEDIMENTARY

AND VOLCANIC DEPOSITS

Alluvium, undivided

Late Pleistocene and Holocene Glacier

Peak Volcanic and Sedimentary Deposits

Volcanic assemblages, undivided,

including lahar and pyroclastic

(Pleistocene to Holocene)

Dacite flows, domes, breccia,

and tephra deposits (Qvp) east

of the Suiattle River near Glacier

Chocolate Creek Assemblage

Kennedy Creek Assemblage

Peak (Pleistocene to Holocene?)

(Holocene)—Non-cohesive lahar

(Holocene)—Volcanic sediments,

and non-cohesive lahar; tentaively

correlates hyperconcentrated flood

deposits and volcanic alluvium in

the lower Skagit valley

White Chuck Assemblage

(late Pleistocene)—Volcanic

Pleistocene Glacial Deposits

sediments and non-cohesive lahar

Deposits of the Fraser glaciation

and older glacial and nonglacial

deposits, undivided

TERTIARY INTRUSIVE AND MESOZOIC

Bedrock, undivded

TO PALEOZOIC LOW-GRADE

METAMORPHIC ROCKS

deposits near Glacier Peak edifice

Holocene Nonglacial Deposits

Figure 2. This geologic map of the study area illustrates the extent of

of the lahar assemblages in the Darrington vicinity.

exposed Glacier Peak lahar assemblages. The area bounded by the

rectangle represents Figure 3, which provides a more complete picture

1:106,667

Radiocarbon age sites; locations

with "CS" followed by a number

refer to critical age sites referenced

Figure 6 for locations of other

radiocarbon sites.

(City or town.

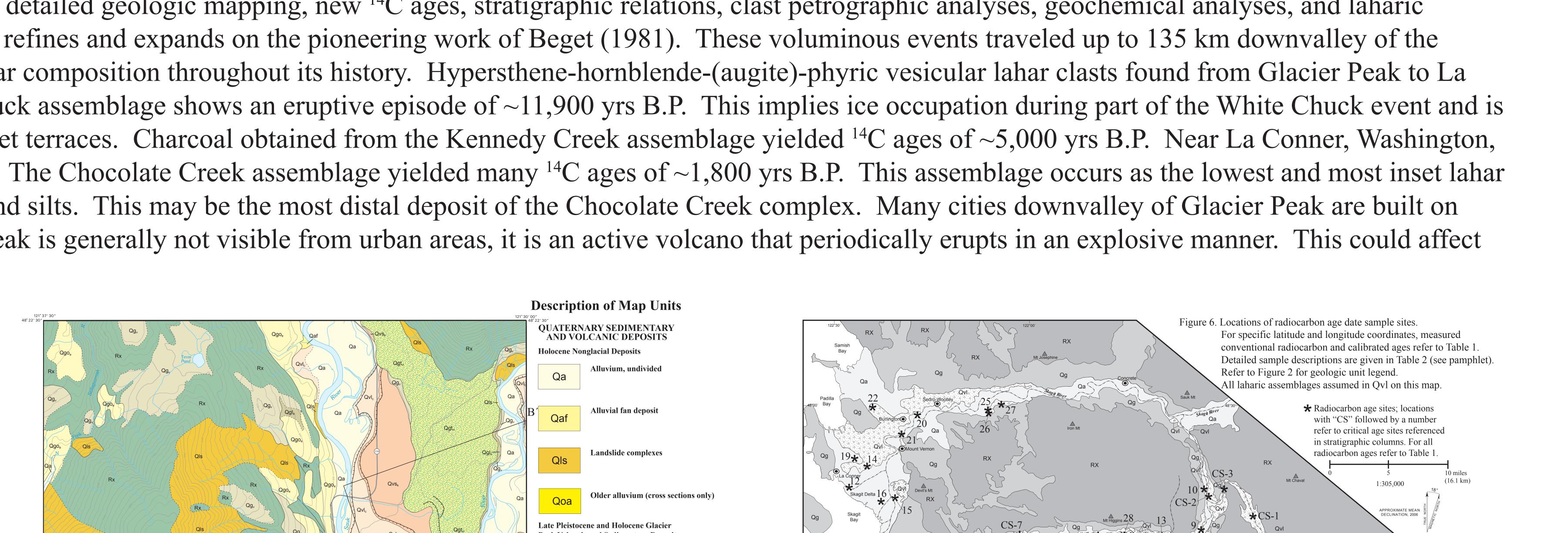
Mt Chaval

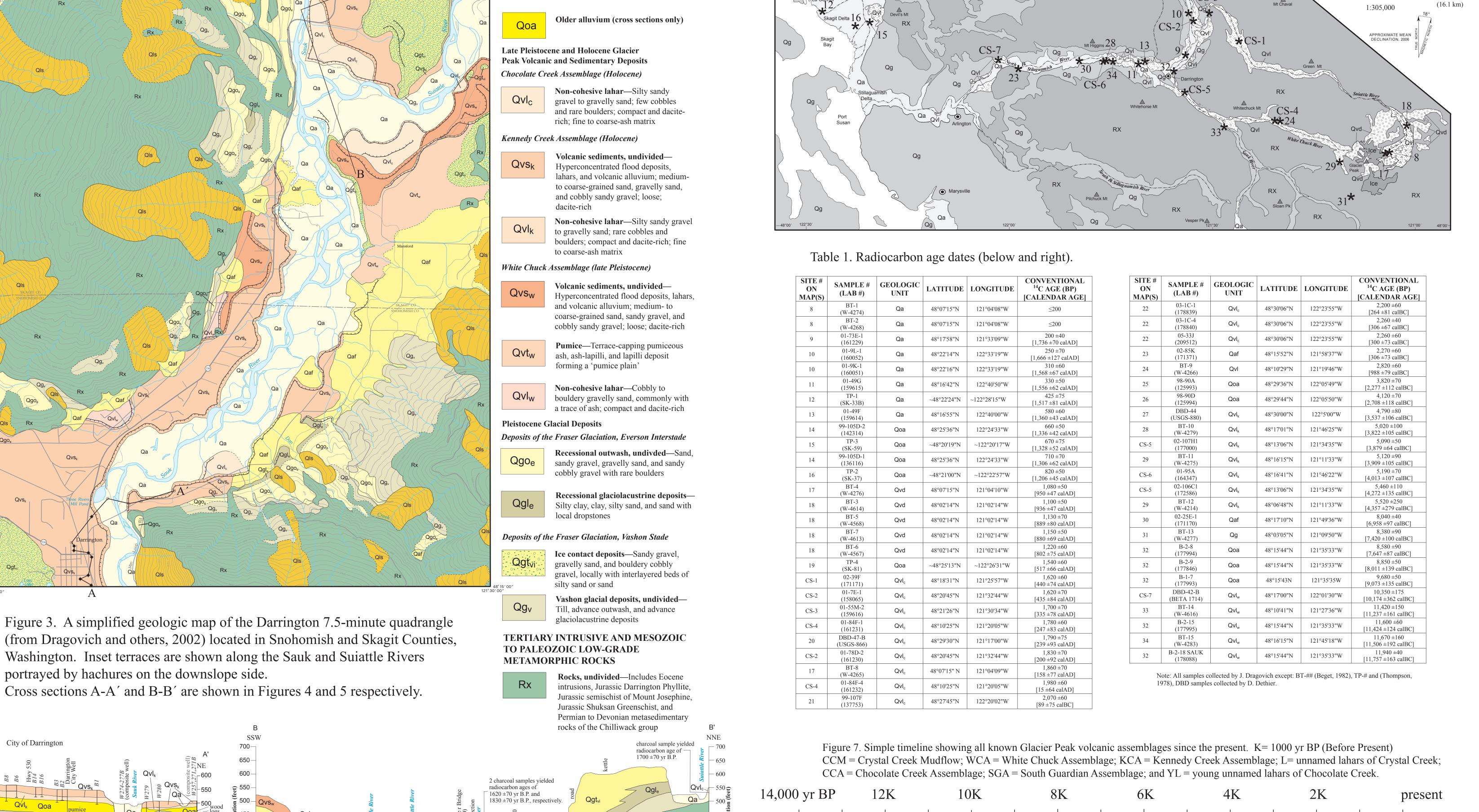
Mountain or Peak

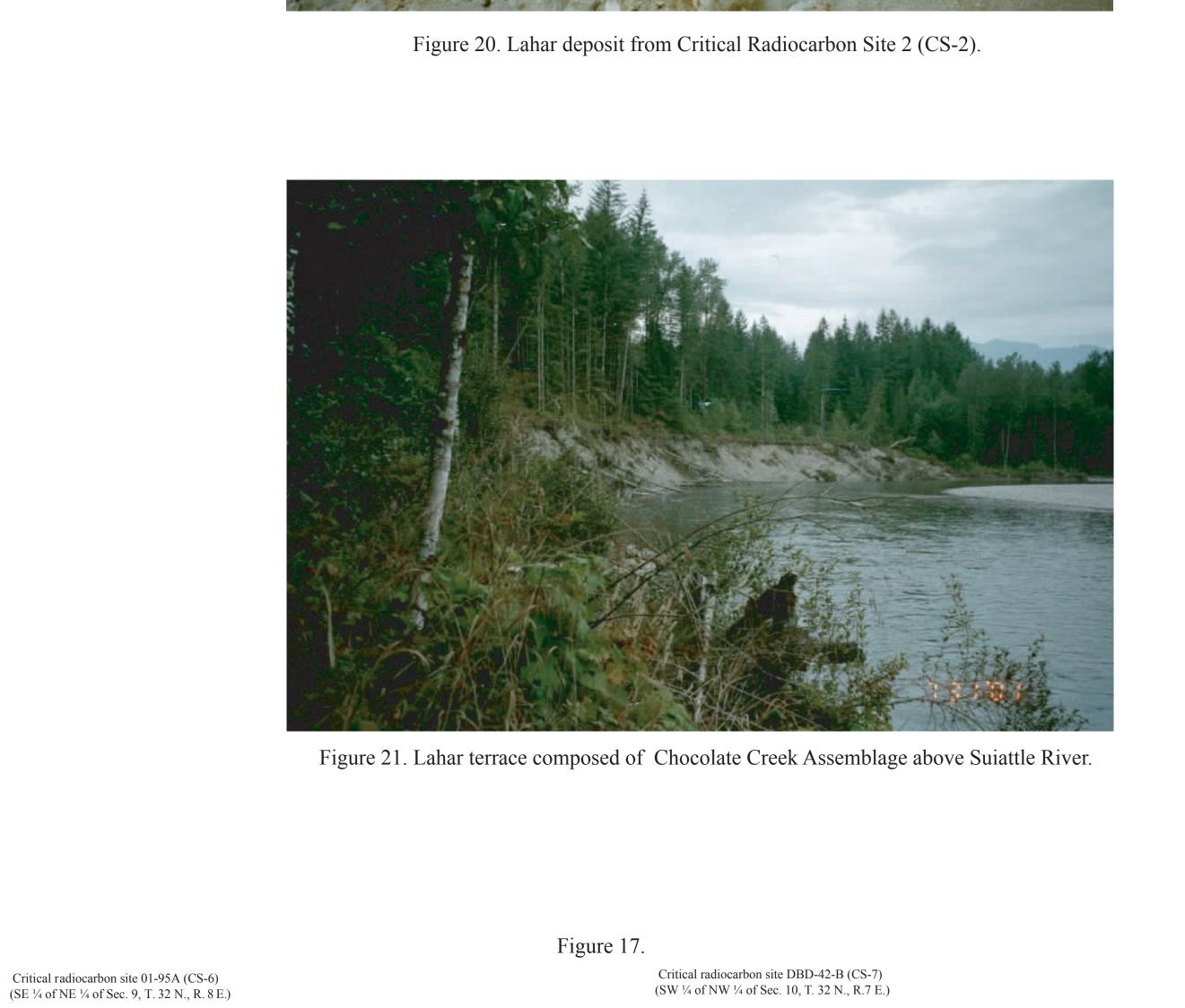
in stratagraphic columns (1-7); see

APPROXIMATE MEAN

DECLINATION, 2006







Fill: silty sand with wood, organic material and

Pumiceous silt to silty sand; probable

radiocarbon age of 5,190 \pm 70 yr B.P.

catostrophic flood deposit related to QvI_k

Glacial outwash (Qgo_e): bouldery to cobbly

gravels with interbeds and lenses of sand;

localized cross-bedding

Continues approximately 23m to sand and gravel

approximately 1 km north

Lahar (Unit Qlv_w): subangular, gray dacit

in a fine sand to gravel matrix with white gravel-sized pumice and subangular cobb

sized lacustrine ripups; a charcoal sam

Glacial outwash (Unit Qgo_e): cobbly

gravelly sand to sandy gravel; some cross

Glaciolacustrine (Unit Qgl_e): clay; finely

fill (Unit Qg): clayey, sitly, pebbly sand with

laminated with rare dropstones; gray

cobbles and boulders, gray-blue

obtained in a pumice-rich diamicton likely associated with this terrace to the north had

a minimum radiocarbon age of $10,350 \pm 17$

Figure 18. Glacier Peak edifice as viewed aerially from the nort

Figure 19. Suiattle fill as viewed aerially from the southwes

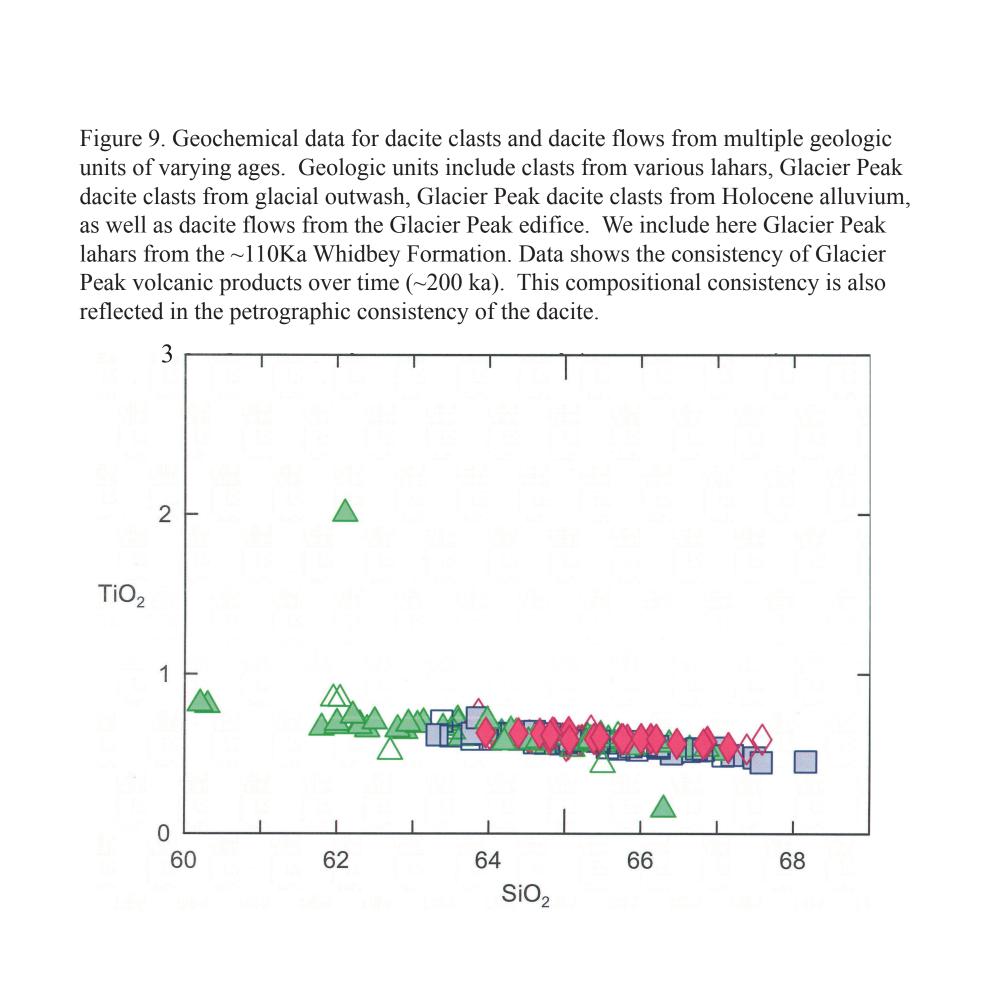
Figure 8. Sample site locations of dacite clasts or tephra deposits analyzed for glass compositions. For specific latitude and longitude coordinates and weight percentages see Table 3 in pamphlet. For sample descriptions see Table 4 in pamphlet. For sample descriptions see Table 4 in pamphlet. All laharic assemblages subsumed into QvI on this map.

Glass probe locations, refer to Table 3 for results (see pamphlet). The center of the square is the approximate sample site location.

The camer of the square is the approximate sample site location.

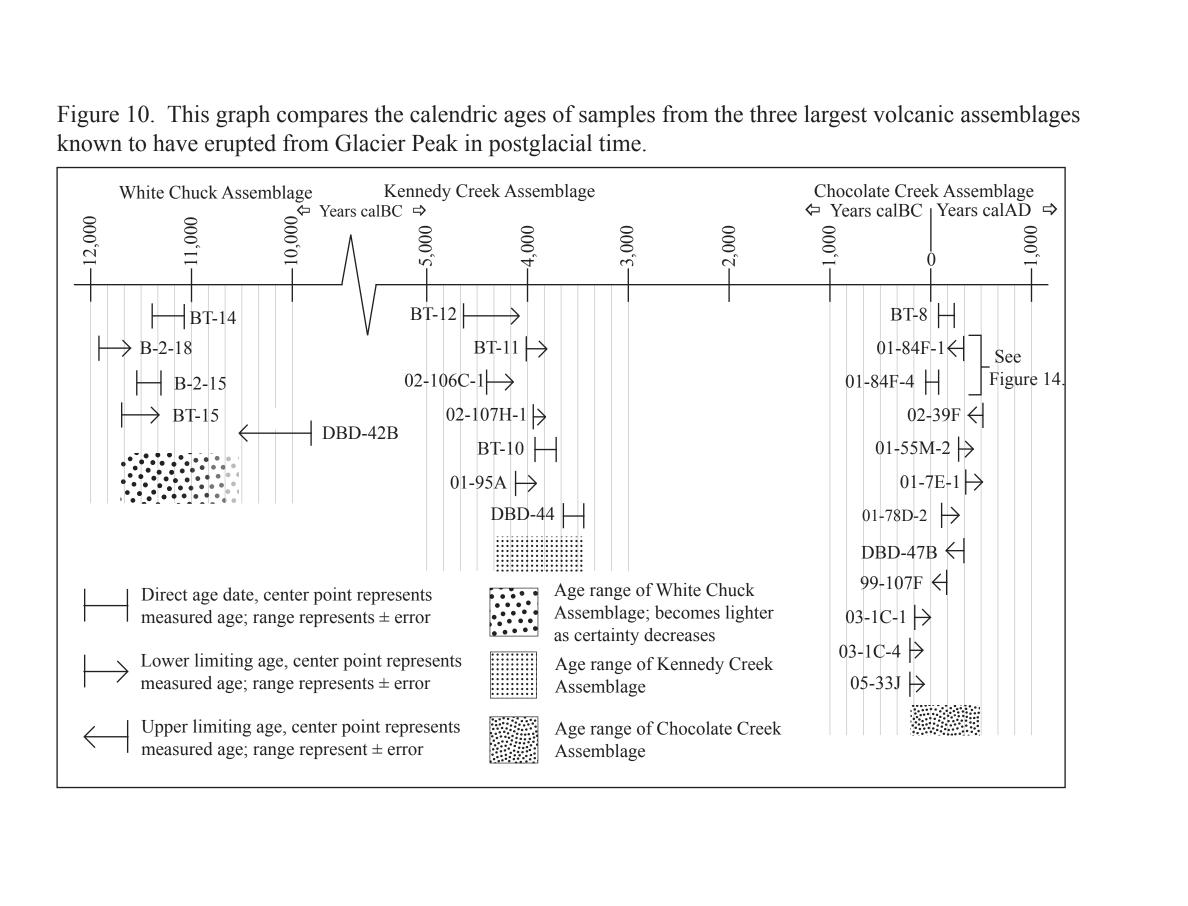
The camer of the square is the approximate sample site location.

The camer of the square of t



Whitehorse Mt

several downstream communities and disrupt Interstate 5.



1.	Figure 12.	Figure 13.	Figure 14.	Figure 15.	Figure 16.
Critical radiocarbon site 02-39F (CS-1) (NW ½ of NE ¼ of Sec. 31, T. 33 N., R. 11 E.)	Critical radiocarbon sites 01-7E-1 and 01-78D-2 (CS-2) (NE ¼ of SW ¼ of Sec.17, T. 33 N., R.10 E.)	Critical radiocarbon site 01-55M (CS-3) (SE ½ of SW ¼ of Sec. 10, T. 33 N., R.10 E.)	Critical radiocarbon site 01-84F-1 and 01-84F-4 (CS-4) (NW ¼ of SW ¼ of Sec. 13, T. 31 N., R.11 E.)	Critical radiocarbon sites 02-106C-1 and 02-107H-1 (CS-5) (SE ½ of SE ½ of Sec. 25, T. 32 N., R. 9 E.)	Criti (SE ¹ /
Alluvium (Unit Qa): sand with wood, roots, and some charcoal Alluvium (Unit Qa): silty clay, mottled brown with roots and trace of cobbles Paleosol: charcoal in a matrix of silt; a sample of charcoal had a radiocarbon age of 1,620 ±60 yr B Alluvium (Unit Qa): Silty clay, mottled brown with Alluvium (Unit Qa): Sandy gravel to sand Lahar (Unit Qvl _o): Subangular gravel to cobbles (1x boulder 0.5m) in a matrix of ashy fine to coarse sand; consists mostly of semivesicular red dacite; crude normal grading	Thickness Elevation (m) 115.8 1.5m 1.5m 1.5m 1.5m 1.5m 1.5m 1.5m 1.0m 1.5m 1.0m Terrace top Lahar (Unit Qlv _c): angular, gray, gravel to cobble-sized dacite in a matrix of sand; white pumice prevalent Paleosol: charcoal in a matrix of orange silt to silty fine sand; a sample of charcoal had radiocarbon age of 1,620 ±70 yr B.P.; another sample of charcoal yielded an age of 1,830 ± 70 yr B.P. Alluvium (Unit Qa): fine to coarse sand; planar cross-bedded	Thickness Elevation (m) Terrace top 158.2 Lahar (Unit Qlv ₆): angular to subangular, red and gray gravel- to cobble-sized dacite in a matrix of sand Paleosol: charcoal in a matrix of orange silt; a sample of charcoal had a radiocarbon age of 1700 ± 70 yr B.P. Older alluvium (Unit Qoa): silty sand; planar bedding Older alluvium (Unit Qoa): cobbly sandy gravel to sandy gravel; planar cross-bedded; discontinuous sand lenses notable	Thickness Elevation (m) 548.5 1.5m Fill: gravelly sand Forest duff; localized Lahar (QVI _o): angular, red and gray gravelto boulder-sized dacite in a matrix of sand and silt Paleosol: peat; logs and sticks and brown peaty mats; a sample of peat had a radiocarbon age of 1,780 ±60 yr B.P. Lahar (QVI _o): subangular gravel to cobblesized white pumice in an ashy matrix; becomes angular to subrounded, red and gray, gravel to boulders of dacite in a fine to coarse sand and ash matrix; coarsening downwards Paleosol: wood and peat in ash; a sample of peat had a radiocarbon age of 1,990 ±60 yr B.P.	183.0 183.0 Lahar (Unit QVI _k): subangular gravel to cobbles in a matrix of ashy fine to coarse sand; consists mostly of vesicular red dacite Paleosol or overbank organic silt: charcoal in a matrix of sandy silt; a sample of charcoal had a radiocarbon age of 5,460 ±110 yr B.P.; another sample had a radiocarbon age of 5,090 ±50 yr B.P. Older alluvium (Unit Qoa): sandy to cobbly gravel; clast supported with a dacite concentration	Thickness Elevation 115.0 -
		Unknown; covered by slough to Suiattle River (~7m)	2.8m Lahar (Unit QvI): angular to subrounded, red and gray, gravel- to boulder-sized dacite in a matrix of silt and sand; grades to clast-supported; pumice fragments noted	Unknown; covered by slough	>2m
		147.6		6.1m total Unknown; covered by slough	

Figure 5. Cross-section B- B' shows the relationship of inset terraces along the Sauk River and also

illustrates ice blockage during the eruption of the White Chuck Assemblage.

CCM WCA

approximately 30m below

L CCA SGA YL

Flaciolacustrine (Unit Qg): clay; laminated

and convoluted, blue-gray

Sauk River