RADIOCARBON DATES, STRATIGRAPHIC SECTIONS, AND SAMPLE LOCATION DATA FOR SAMPLES COLLECTED AT PAVLOF VOLCANO AND VICINITY, ALASKA

Christopher F. Waythomas, Pavel E. Izbekov, Jessica F. Larsen, Katherine M. Mulliken, and Valerie K. Wasser

Raw Data File 2025-26

2026
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Suggested citation:
Waythomas, C.F., Izbekov, P.E., Larsen, J.F., Mulliken, K.M., and Wasser, V.K., 2026, Radiocarbon dates, stratigraphic sections, and sample location data for samples collected at Pavlof Volcano and vicinity, Alaska: Alaska Division of Geological & Geophysical Surveys Raw Data File 2025-26, 30 p. https://doi.org/10.14509/31733

RADIOCARBON DATES, STRATIGRAPHIC SECTIONS, AND SAMPLE LOCATION DATA FOR SAMPLES COLLECTED AT PAVLOF VOLCANO AND VICINITY, ALASKA

Christopher F. Waythomas[1], Pavel E. Izbekov[2], Jessica F. Larsen[2], Katherine M. Mulliken[2], and Valerie K. Wasser[2]

INTRODUCTION

This report presents the results of radiocarbon dating and stratigraphic studies of volcanic ash deposits in the area around Pavlof Volcano, Alaska (fig. 1). We collected samples for radiocarbon dating during 10-day-long field excursions to the area in 2017–2022. In addition to collecting soil-organic matter samples for dating, we recorded stratigraphic profiles in field notebooks and documented them with digital photographs. The goal of this work is to establish the stratigraphic framework of tephra-fall deposits from Pavlof Volcano to aid in documenting the Holocene eruptive history of the volcano as recorded by the tephra deposits. These data consist of a .csv file, annotated photographs, and line drawings of stratigraphic profiles. The information is provided as a Raw Data File under an open end-user license and are available on the DGGS website http://doi.org/10.14509/31733.

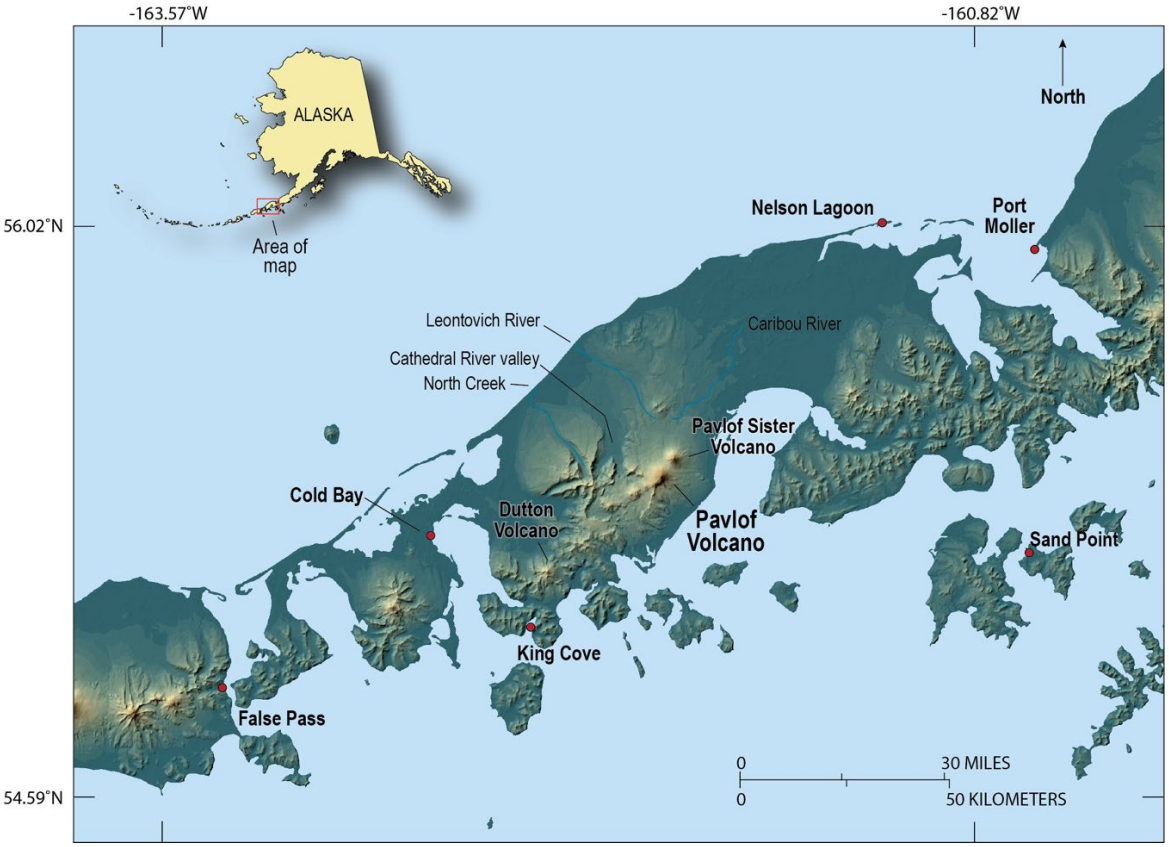


Figure 1. Location map showing Pavlof Volcano and the prominent places in the region

[1]U.S. Geological Survey Alaska Volcano Observatory, 4230 University Drive, Suite 100, Anchorage, AK 99508
[2]University of Alaska Fairbanks, Department of Geosciences, P.O. Box 755790, Fairbanks, AK 99775
[3]U.S. Geological Survey Hawaii Volcano Observatory, 1266 Kamehameha Ave., Suite A-8, Hilo, HI 96720

METHODS

Radiocarbon Dating

We sampled buried soils at 26 sites stratigraphically below prominent tephra-fall deposits with field implements (trowels, knives, shovels) and stored them in plastic ziploc bags. After returning from fieldwork, we air-dried the samples in the lab, weighed, repackaged, and shipped them to the University of Georgia, Center for Applied Isotope Studies (CAIS). CAIS used the following procedure to extract the humic-acid fraction of soil organic matter, which was used exclusively for dating.

Modern rootlets were removed from the bulk soil samples by sieving through a 125 μm nylon screen. After one hour of acid treatment with 1N hydrochloric acid at 80°C, humic acid was extracted with a 0.5 M Na4P2O7 plus 0.1 M NaOH solution for 24 hours at room temperature. Humic acid precipitation occurred in acid conditions, and concentrated hydrochloric acid separation of the precipitant was completed by centrifuging, rinsing with Milli-Q water, and drying the humic-acid fraction at 105°C overnight.

Peat samples were treated with 1N HCl at 80°C for one hour to remove any carbonate material, then washed with deionized water using a centrifuge until the solution reached a pH of 4–5, dried at 60°C, and then combusted at 900°C in an evacuated, sealed quartz ampoule in the presence of CuO. Graphite $^{14}C/^{13}C$ ratios were measured using the CAIS 0.5 MeV accelerator mass spectrometer and compared with those from the Oxalic Acid II (NBS SRM 4990C) standard. The sample $^{13}C/^{12}C$ ratios were measured separately using a stable isotope ratio mass spectrometer and expressed as δ13C with respect to the Pee Dee Belemnite PDB standard, with an error of less than 0.1 percent. The quoted uncalibrated dates are given in radiocarbon years before 1950 (yrs. BP), using the ^{14}C half-life of 5,568 years. The error is quoted as one standard deviation and reflects both statistical and experimental errors. The dates for all samples have been corrected for natural isotope fractionation.

The radiocarbon dates are reported as percent modern and yr. BP. Percent modern indicates the proportion of radiocarbon atoms in the sample compared to modern samples in 1950. A date reported in yr. BP is directly derived from the percent modern value, assuming a radiocarbon half-life of 5,568 years and a constant radiocarbon concentration in the atmosphere.

The reported radiocarbon dates were calibrated using the CALIB 7.1 calibration routine (Stuiver and Reimer, 1983; http://calib.org/calib/). Radiocarbon measurements on tree rings and other samples of known age (including speleothems, marine corals, and samples from sedimentary records with independent dating) are compiled into calibration curves, which are the basis for the calibrations performed by programs like CALIB.

The calibrated radiocarbon date is expressed in terms of cal BC, cal AD, or cal BP. The cal prefix indicates that the dates are calibrated using tree-ring data, and the values should correspond exactly to normal historical years BC and AD. Cal BP is the number of years before 1950 and can be directly compared to calendar years.

There are two methods used for calculating age ranges from the calibration curve: (1) the intercept method, which is accomplished by drawing intercepts on a graph, and indicates the years in which the radiocarbon concentration of tree rings is within two standard deviations of the measured value (e.g., between 2940 BP and 3060 BP for the measurement 3000 ± 30 BP); and (2) the probability method, used in this report, which gives the time range that has a 95 percent certainty (2σ) that the true age of the sample lies within this range.

Stratigraphy

Stratigraphic profiles were selected for study in the field. They consisted of natural stream bank exposures or hand-dug pits (fig. 2). We scraped exposure surfaces clean with shovels and trowels to better expose the tephra deposits and associated buried soils, recorded the apparent vertical thickness of each unit, and collected samples of tephra and soil-organic matter for later analysis.

Figure 2. AVO geologist Katie Mulliken prepares to sample tephra deposits and soil-organic matter at a typical bank exposure near Pavlof Volcano, Alaska. The dark layers in the photograph are scoriaceous lapilli tephra deposits erupted from Pavlof Volcano. We sampled organic matter for radiocarbon dating from immediately below the tephra layers, assuming that soil development was arrested at the time of the tephra-fall event. Photo by Jess Larsen, UAF-GI and AVO, July 22, 2018.

Sample Locations

Our field team reached areas near Pavlof Volcano by helicopter. Sample site locations (fig. 3) were determined with hand-held GPS devices and recorded in field notebooks.

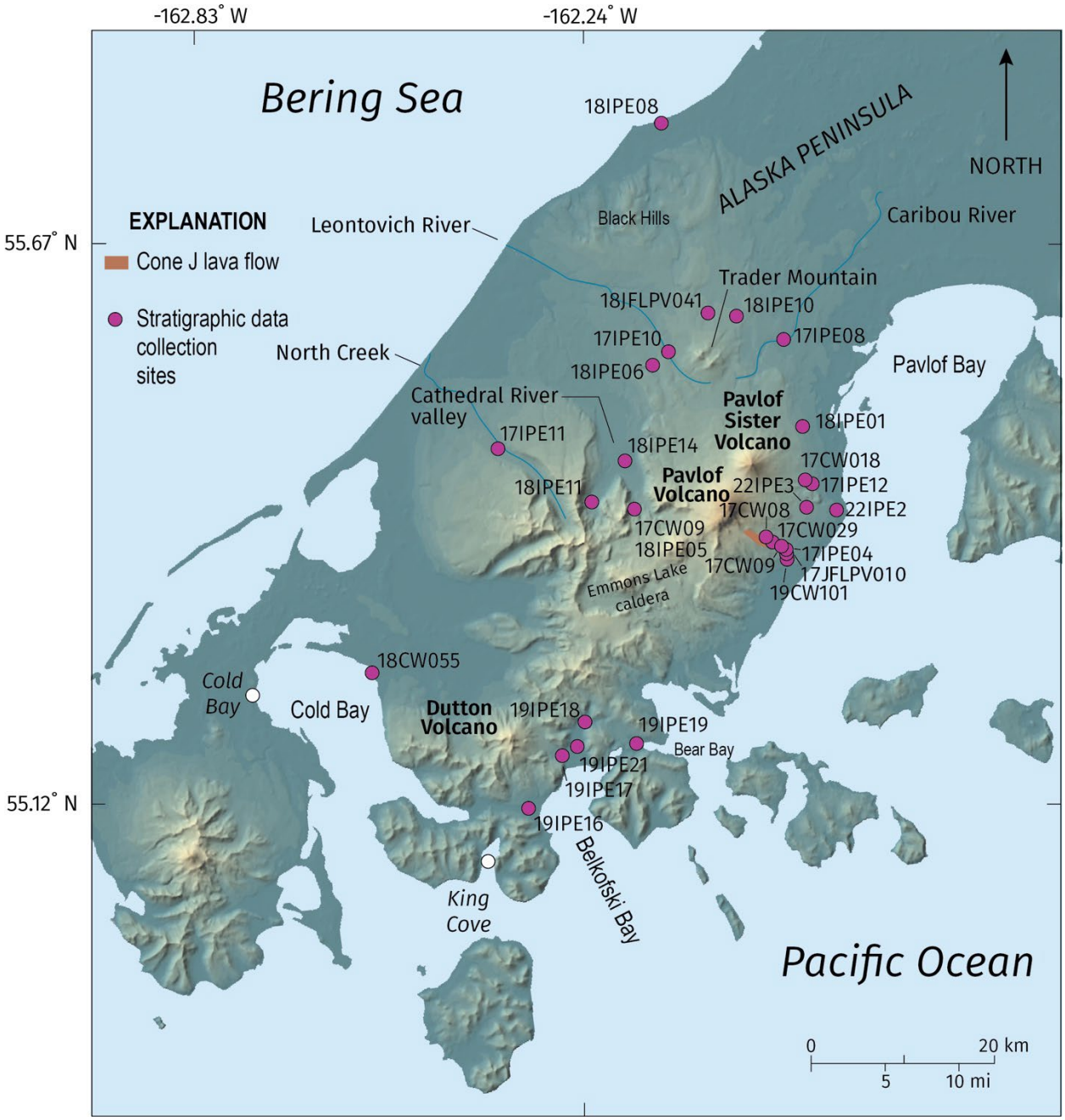


Figure 3. Location map showing sample sites in the study area. The color-shaded relief map is a 100-meter-resolution color-sliced elevation image in an Albers Equal-Area Conic projection, with relief shading to accentuate terrain features. The image was produced by combining the 100-meter-resolution color-sliced elevation dataset and the grayscale shaded relief datasets distributed by the U.S. Geological Survey (https://apps.nationalmap.gov/services/). The color-shaded relief data were derived from the National Atlas 100-meter resolution elevation data. The elevation data were derived from the National Elevation Dataset (NED).

DATA FILES

The .csv files associated with this data release include the radiocarbon dating metadata (46 entries) from 26 sites. At some sites, more than one sample was dated, but at other sites no samples were dated.

ACKNOWLEDGEMENTS

This report is based on work supported by the U.S. Geological Survey in a cooperative agreement with the University of Alaska Fairbanks Geophysical Institute and under Cooperative Agreement No. G22AC00137 with the Alaska Division of Geological & Geophysical Surveys. Radiocarbon ages were determined by the University of Georgia Center for Applied Isotope Studies under contract to the U.S. Geological Survey Alaska Volcano Observatory. Lodging provided by Mary Martin at the Cold Bay Lodge in Cold Bay, Alaska, was greatly appreciated. Maritime Helicopters and Egli Air Haul. Pilots Jared Berman and Sam Egli provided efficient, safe, and professional transportation in the field areas.

REFERENCES

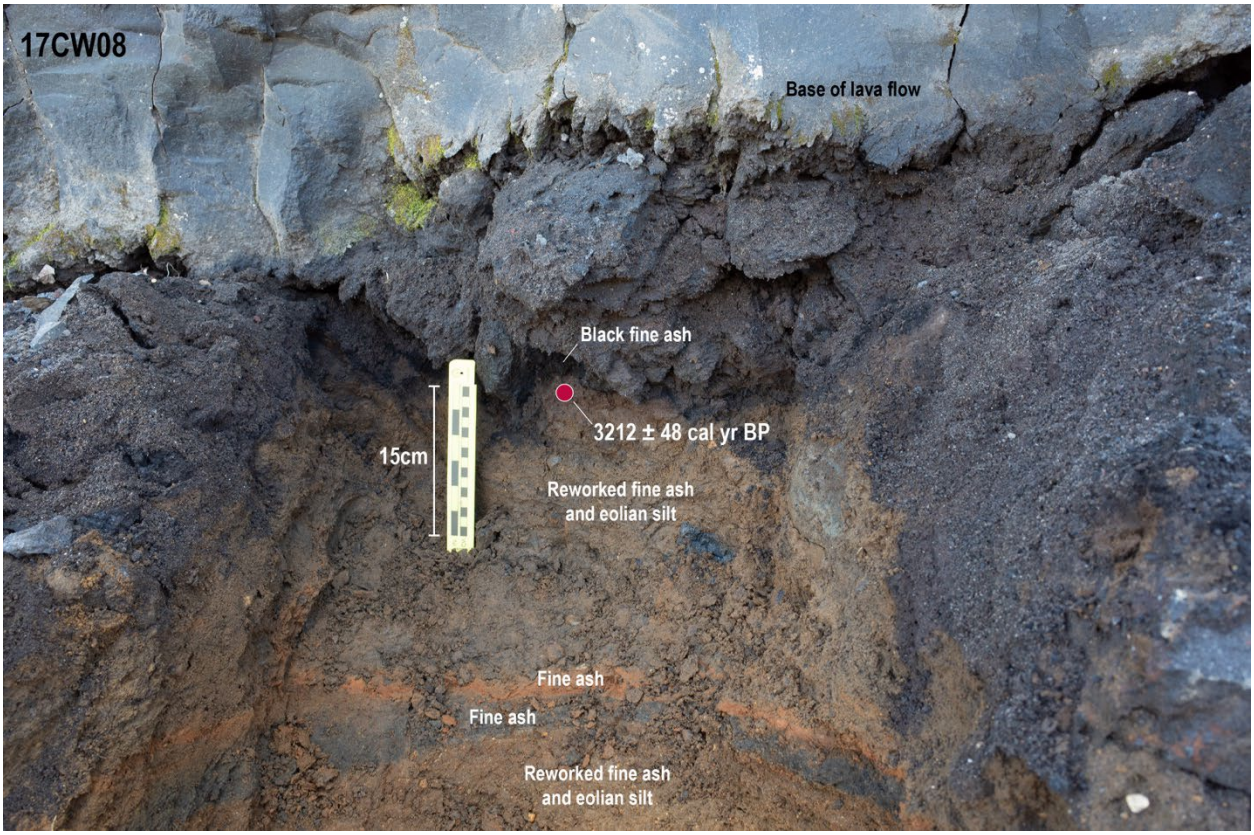
Stuiver, M., and Reimer, P.J., 1993, Extended 14C database and revised CALIB 3.0 14C age calibration program: Radiocarbon, v. 35, p. 215–230.

APPENDIX A: STRATIGRAPHIC PROFILES AND PHOTOGRAPHS

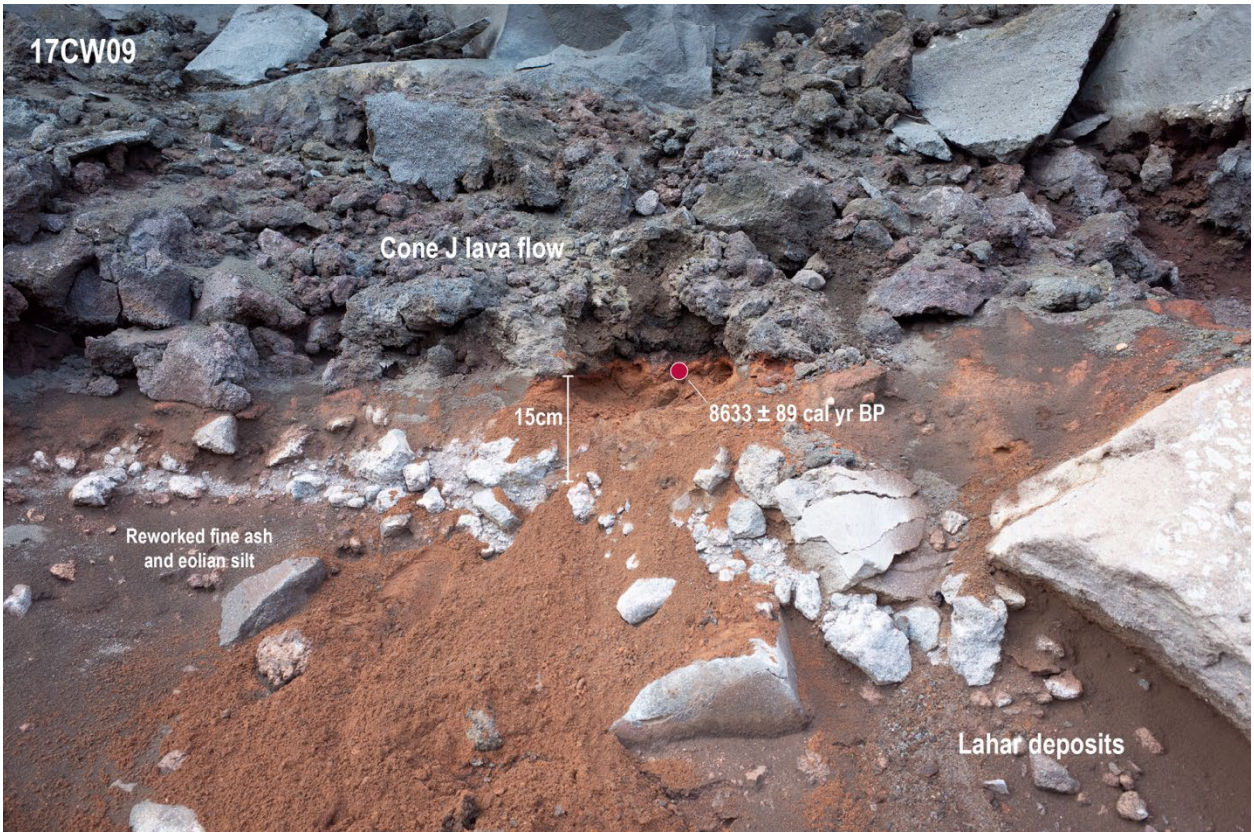
On the following stratigraphic profiles and annotated photographs, we indicate where radiocarbon and tephra samples were collected. Available radiocarbon dates are shown on the photographs or with the stratigraphic descriptions. The dates shown are calibrated 2 sigma median ages.

- Site 17CW08: Photo of stream bank exposure of Cone J lava flow on distal south flank of Pavlof Volcano.
- Site 17CW09: Photo of stream bank exposure of Cone J lava flow on distal south flank of Pavlof Volcano.
- Site 17CW018: Photo of stream bank outcrop of clastogenic lava flow overlying reworked fine ash and eolian silt on southeast distal flank of Pavlof Volcano.
- Site 17IPE04: Stratigraphic profile of stream bank exposure near Cone J lava flow on distal south flank of Pavlof Volcano.
- Site 17IPE08: Stratigraphic profile of stream bank exposure along the Caribou River, northeast of Pavlof Volcano.
- Site 17IPE10: Stratigraphic profile of bank exposure along the Leontovich River, north of Pavlof Volcano.
- Site 17IPE11: Stratigraphic profile of bank exposure along North Creek, northwest of Pavlof Volcano.
- Site 17IPE12: Stratigraphic profile of bank exposure on the east-southeast flank of Pavlof Sister.
- Site 17JFLPV010: Stream bank exposure of Cone J lava flow on distal south flank of Pavlof Volcano.
- Site 17CW029: Photo of stream bank exposure of Cone J lava flow on distal south flank of Pavlof Volcano.
- Site 18CW055: Photo of deposits exposed along the northeast shoreline of Cold Bay.
- Site 18IPE01: Stratigraphic profile of exposure on the northeast flank of Pavlof Sister Volcano.
- Site 18IPE05: Stratigraphic profile of bank exposure along the upper Cathedral River.
- Site 18IPE06: Stratigraphic profile of peat deposits on divide west of Leontovich River.
- Site 18IPE08: Stratigraphic profile of deposits exposed along the Bering Sea Coast north of the Black Hills area.
- Site 18IPE10: Stratigraphic profile of stream bank exposure northeast of Trader Mountain.
- Site 18IPE11: Stratigraphic profile of stream bank exposure along west branch of the upper Cathedral River, northwest of Pavlof Volcano.
- Site 18IPE14: Stratigraphic profile of deposits exposed in a stream bank in the Cathedral River Valley west-northwest of Pavlof Volcano.

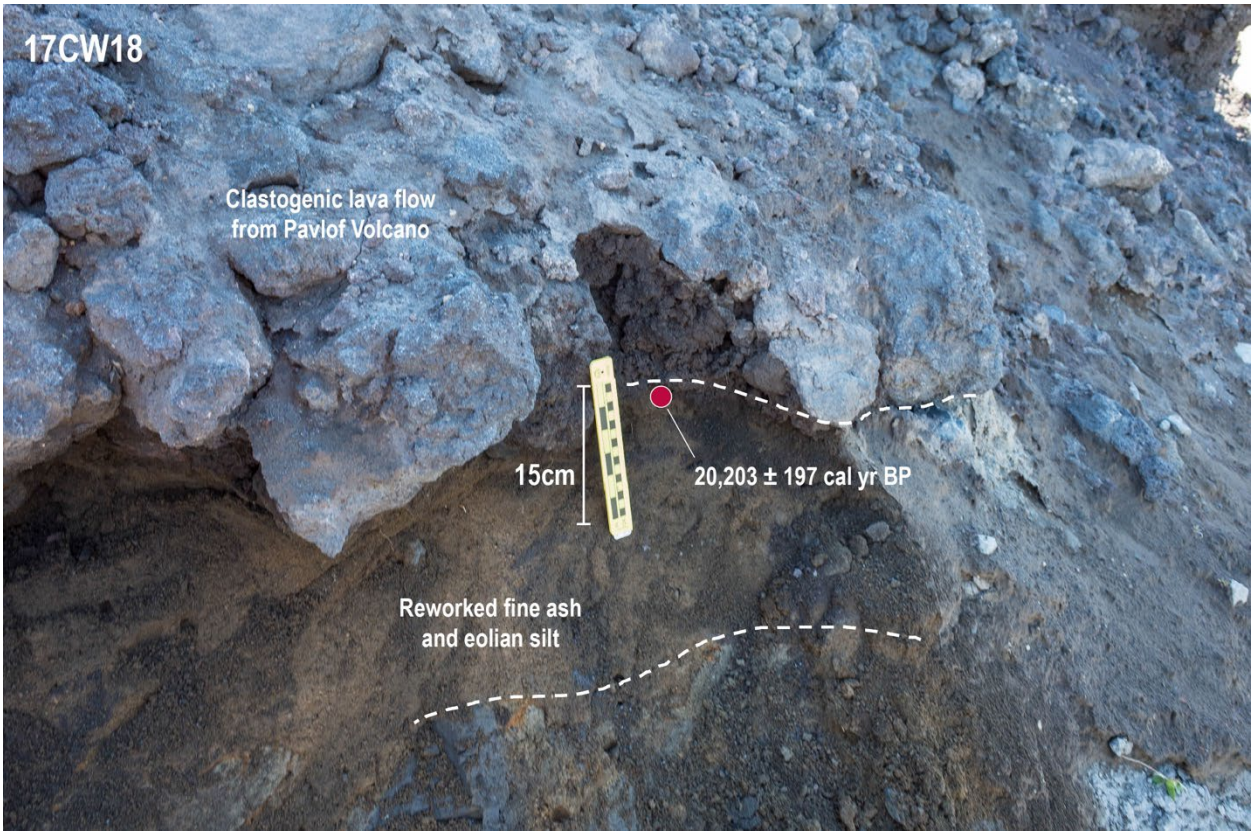
- Site 19CW101: Photo of stream bank exposure along unnamed drainage on distal south flank of Pavlof Volcano.
- Site 19IPE16: Photo of stream exposure within avalanche deposits on south flank of Dutton Volcano. Possible ash beds from Pavlof Volcano are preserved in eolian deposits that overlie the avalanche debris.
- Site 19IPE17: Stratigraphic profile of stream bank exposure in valley at head of Belkofski Bay about 7 km southeast of Dutton Volcano.
- Site 19IPE18: Photo of stream bank exposure at north end of unnamed valley, north of Belkofski Bay, about 9 km east of Dutton Volcano.
- Site 19IPE19: Photo of stream bank exposure at the west end of Bear Bay, about 14 km east of Dutton Volcano.
- Site 19IPE21: Photo of exposure about 32 km southwest of Pavlof Volcano.
- Site 22IPE2: Photo of exposure on the east flank of Pavlof Sister Volcano.
- Site 22IPE3: Stratigraphic profile of deposits exposed on the southeast flank of Pavlof Volcano.



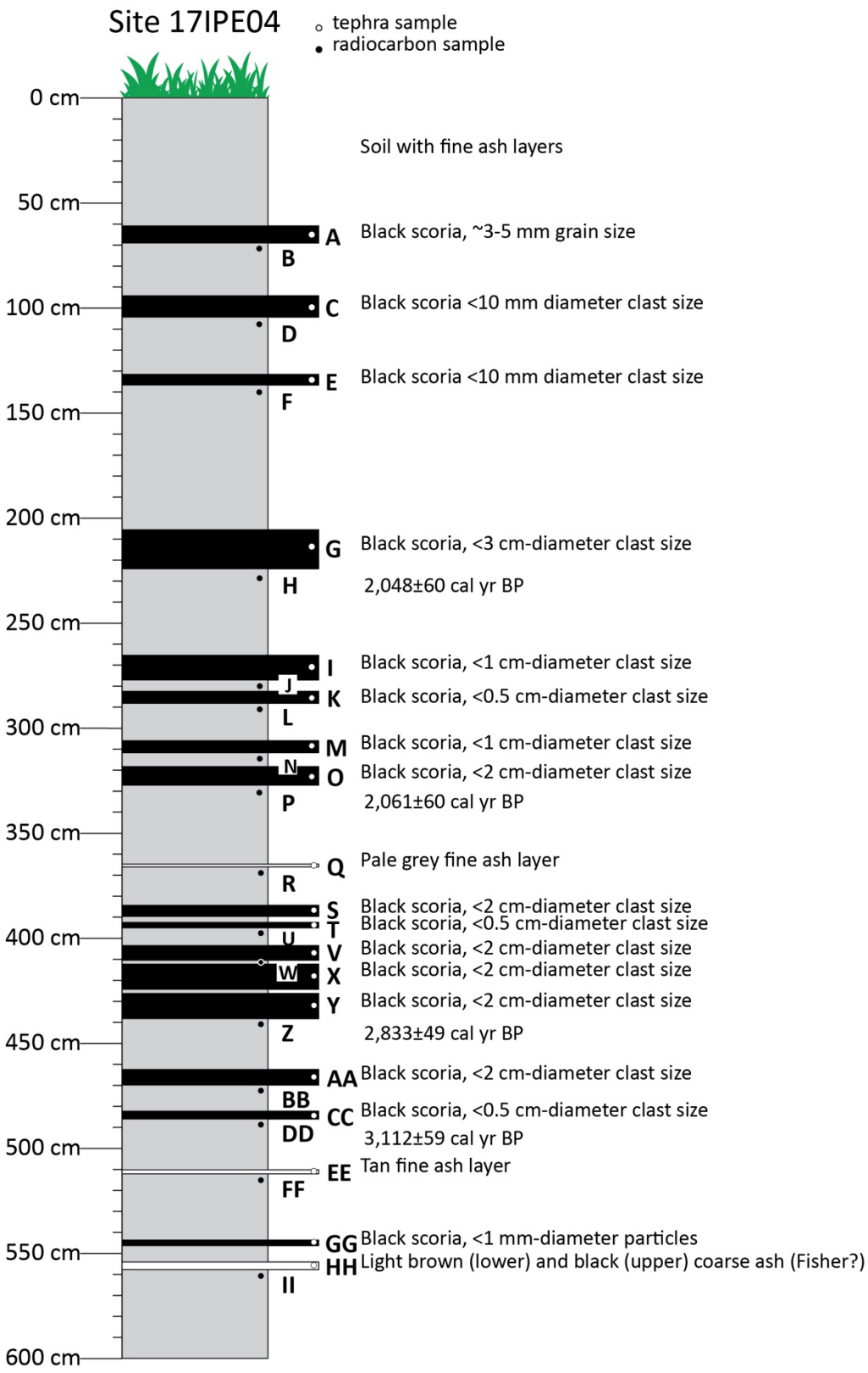
Site 17CW08. Stream bank exposure of Cone J lava flow on distal south flank of Pavlof Volcano.



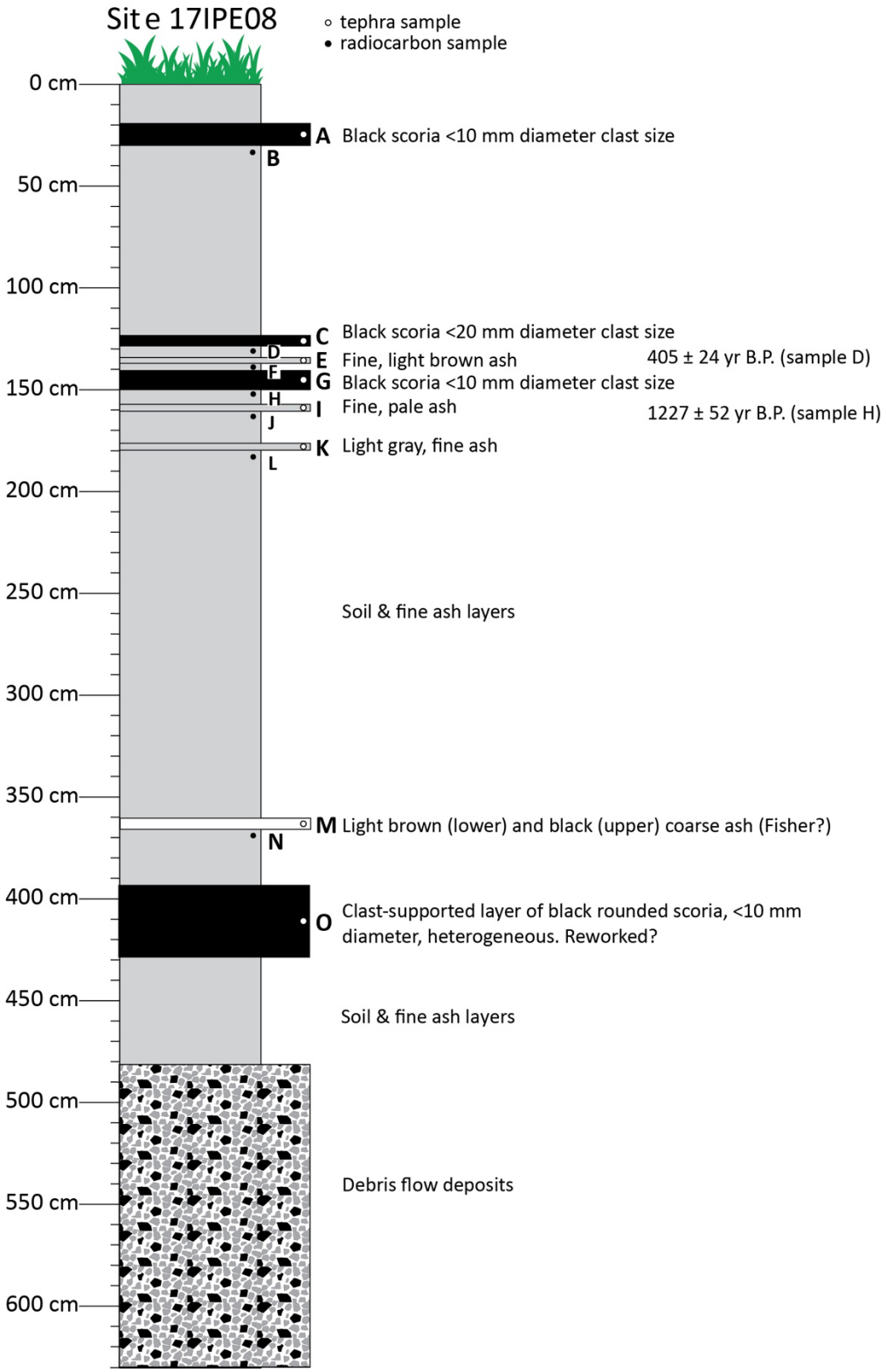
Site 17CW09. Stream bank exposure of Cone J lava flow on distal south flank of Pavlof Volcano.



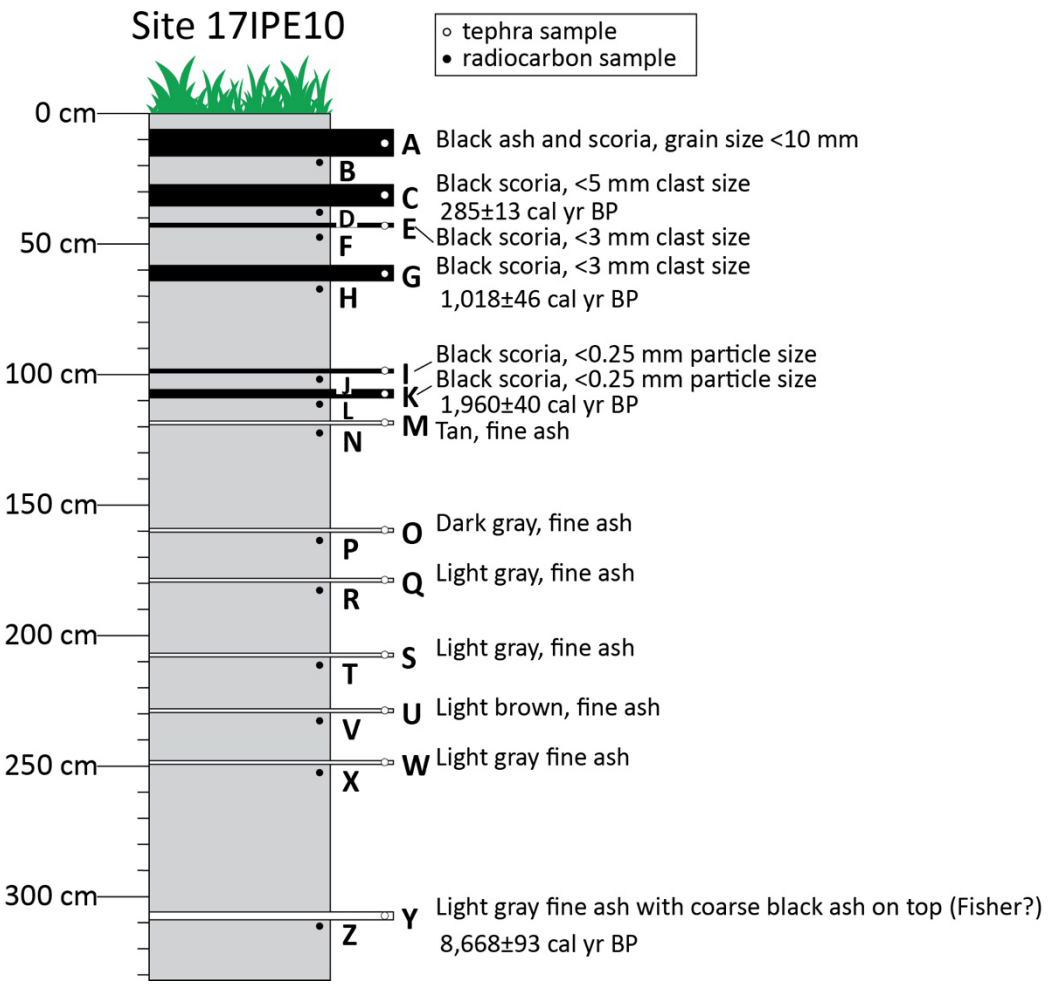
Site 17CW018. Stream bank outcrop of clastogenic lava flow overlying reworked fine ash and eolian silt on southeast distal flank of Pavlof Volcano.



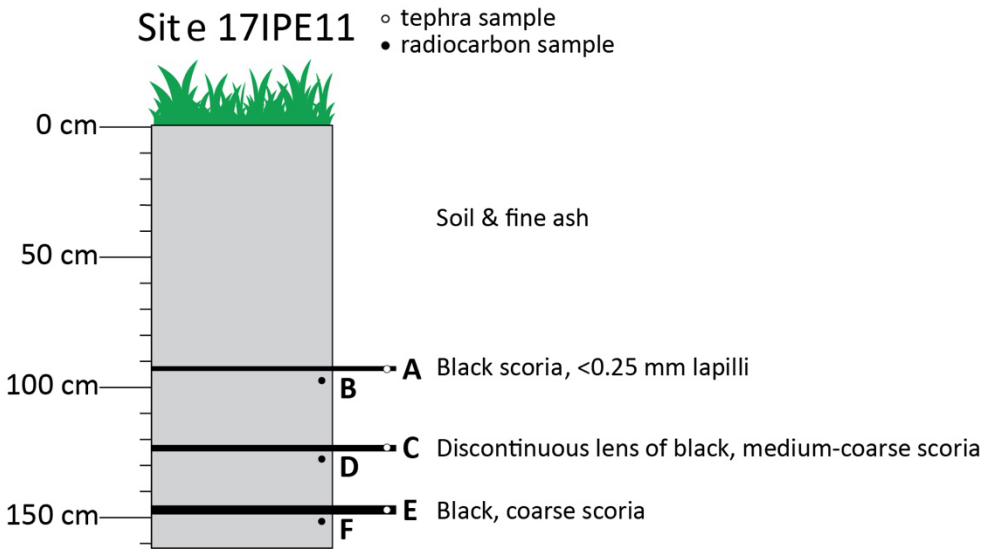
Site 17IPE04. Stream bank exposure near Cone J lava flow on distal south flank of Pavlof Volcano.



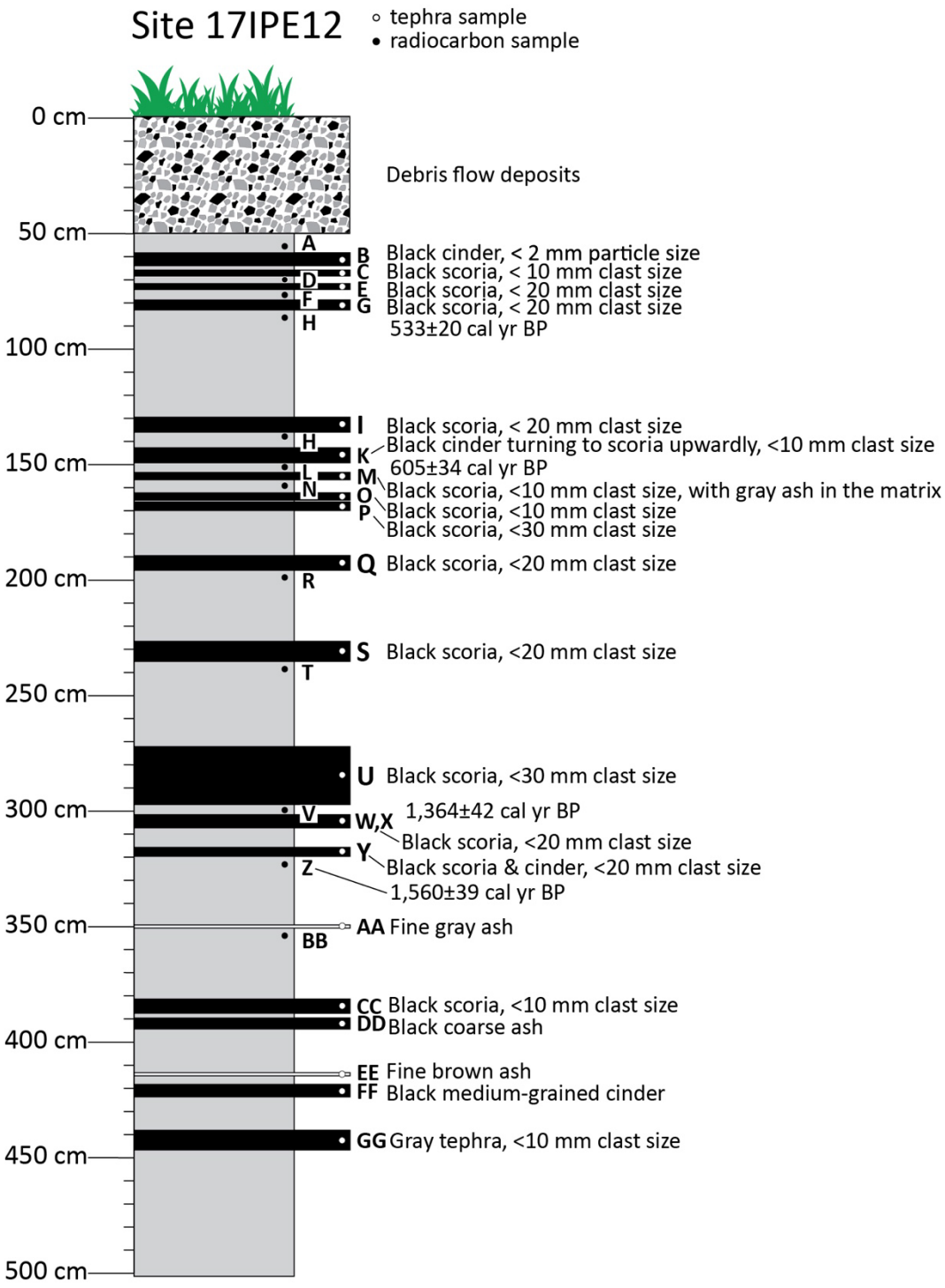
Site 17IPE08. North flank of Pavlof Volcano.



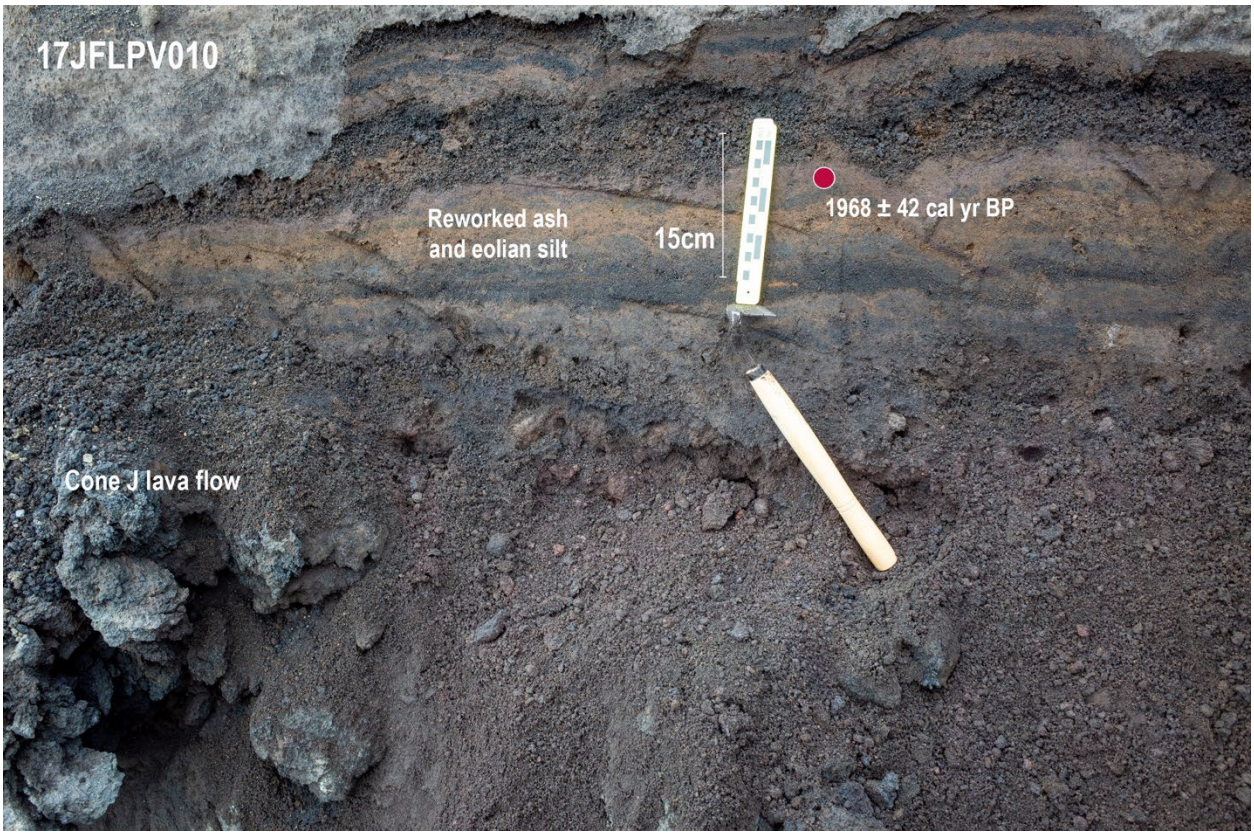
Site 17IPE10. Bank exposure along the Leontovich River, north of Pavlof Volcano.



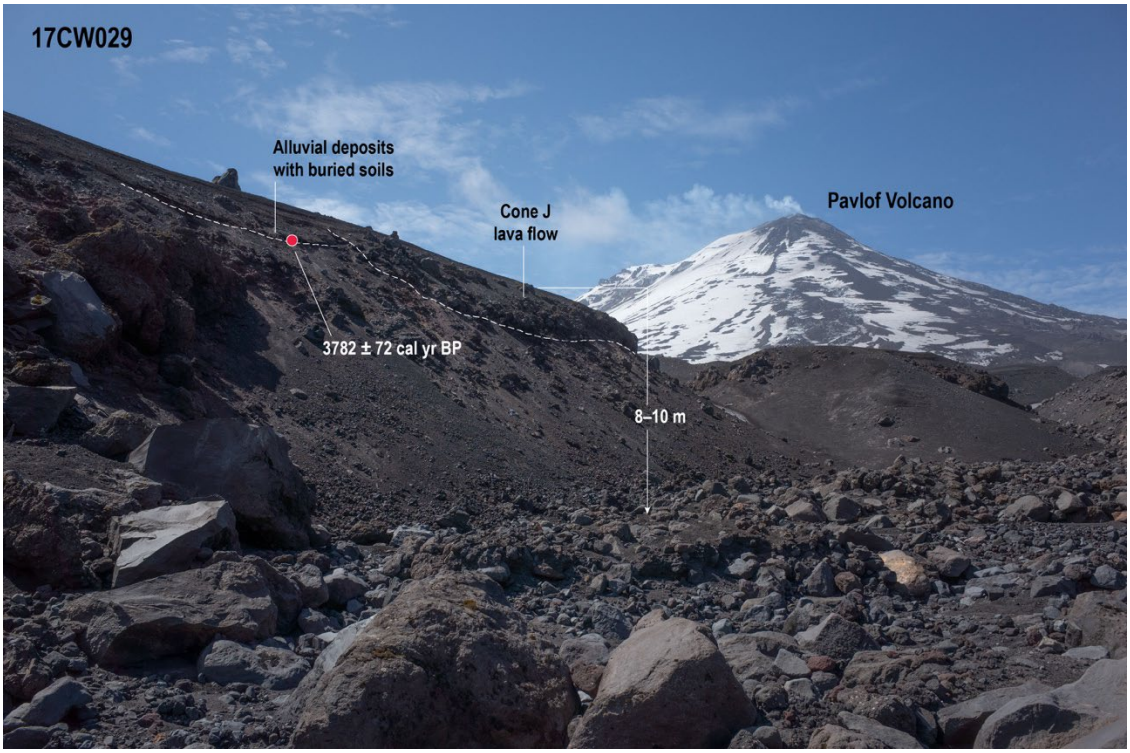
Site 17IPE11. Stream bank exposure along North Creek, northwest of Pavlof Volcano.



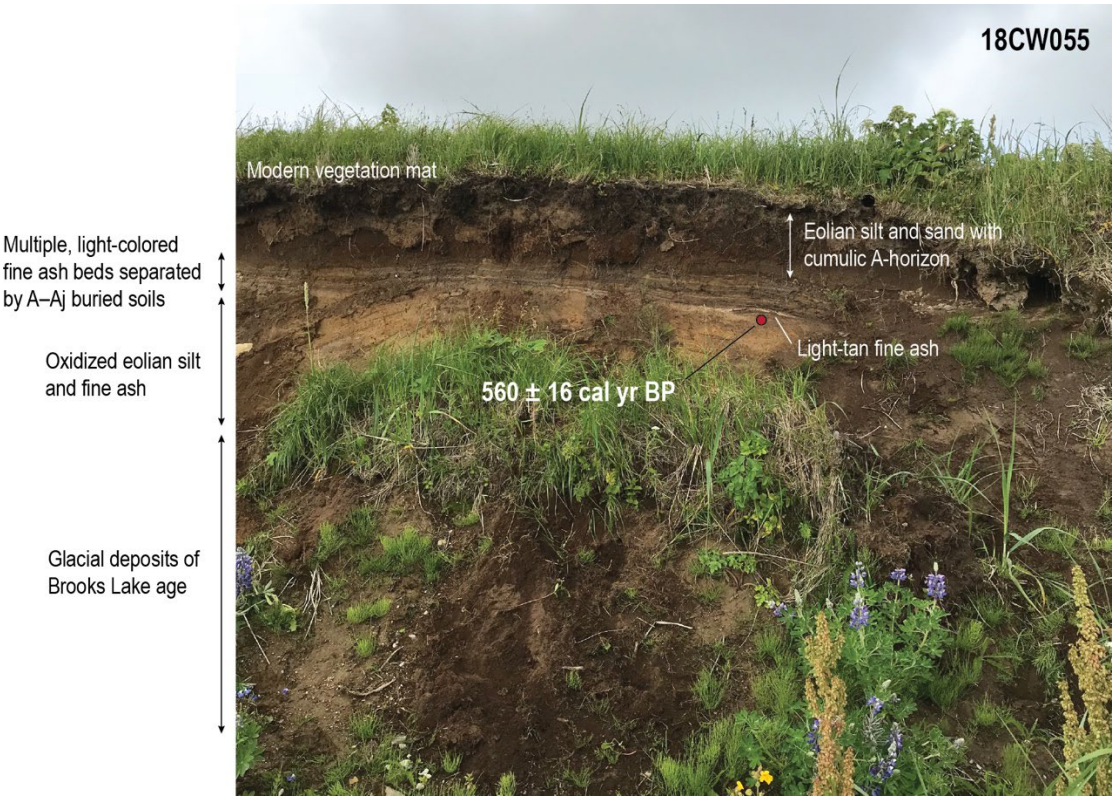
Site 17IPE12. Site on east-southeast flank of Pavlof Sister.



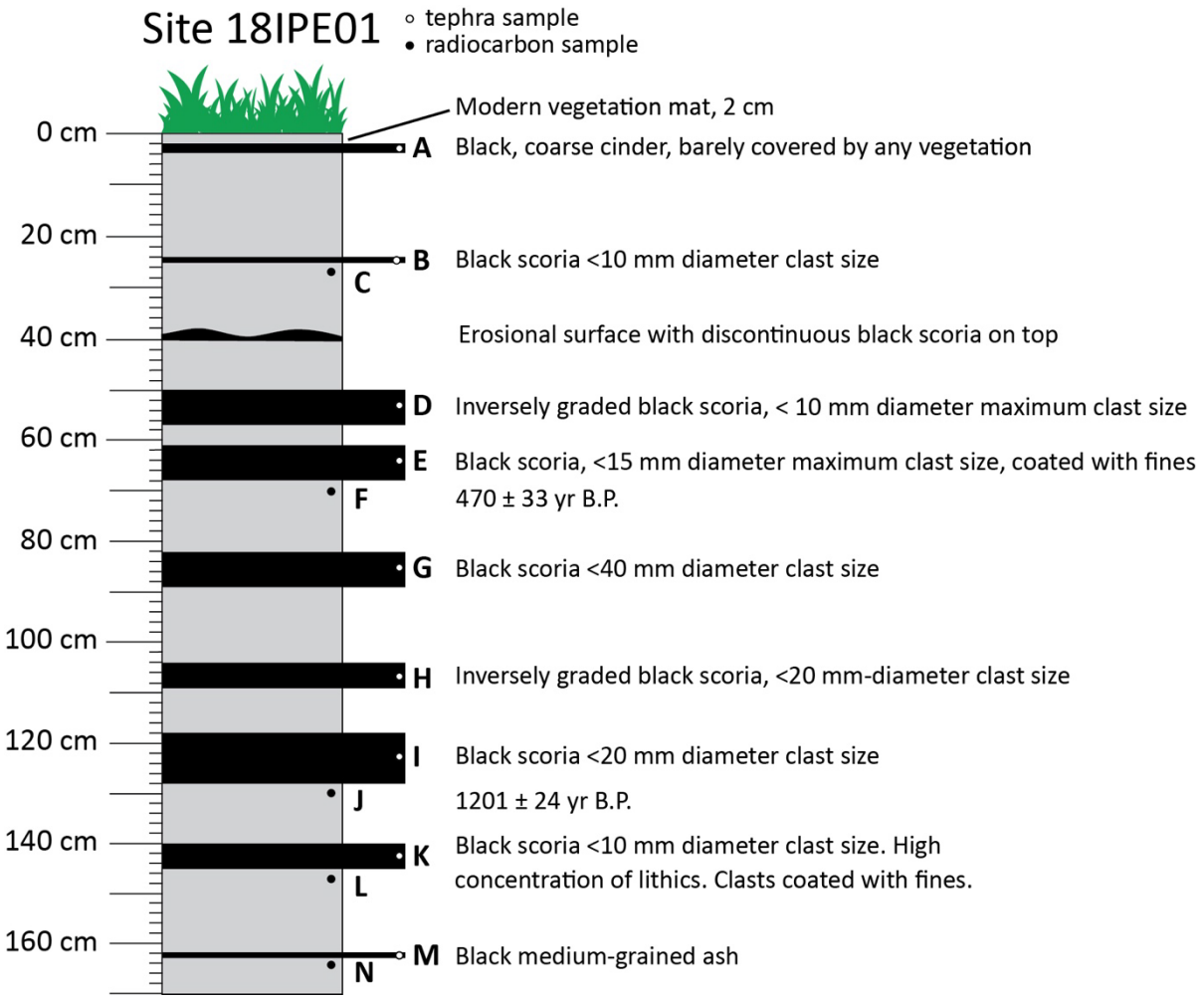
Site 17JFLPV010. Stream bank exposure of Cone J lava flow on distal south flank of Pavlof Volcano.



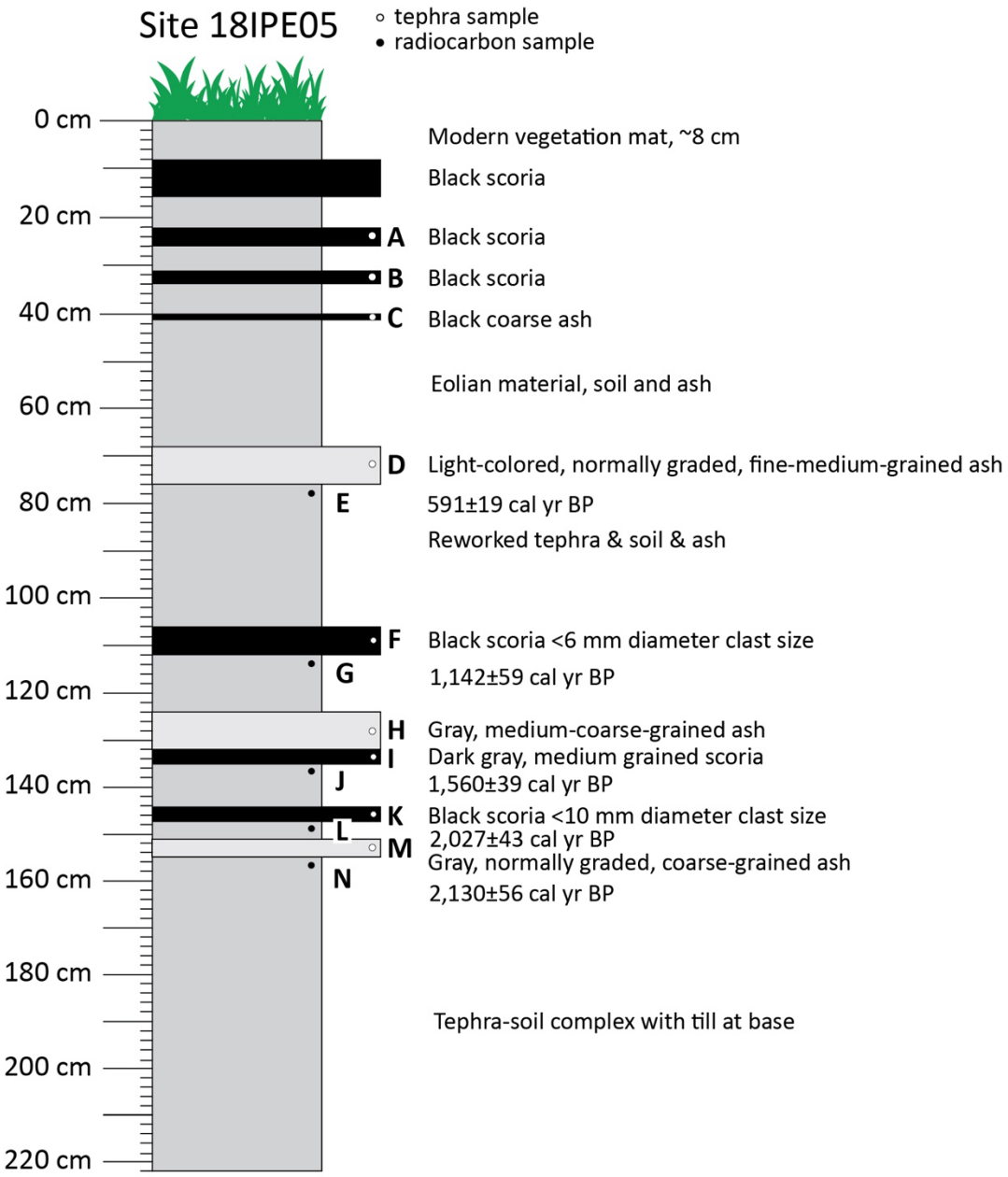
Site 17CW029: Stream bank exposure of Cone J lava flow on distal south flank of Pavlof Volcano.



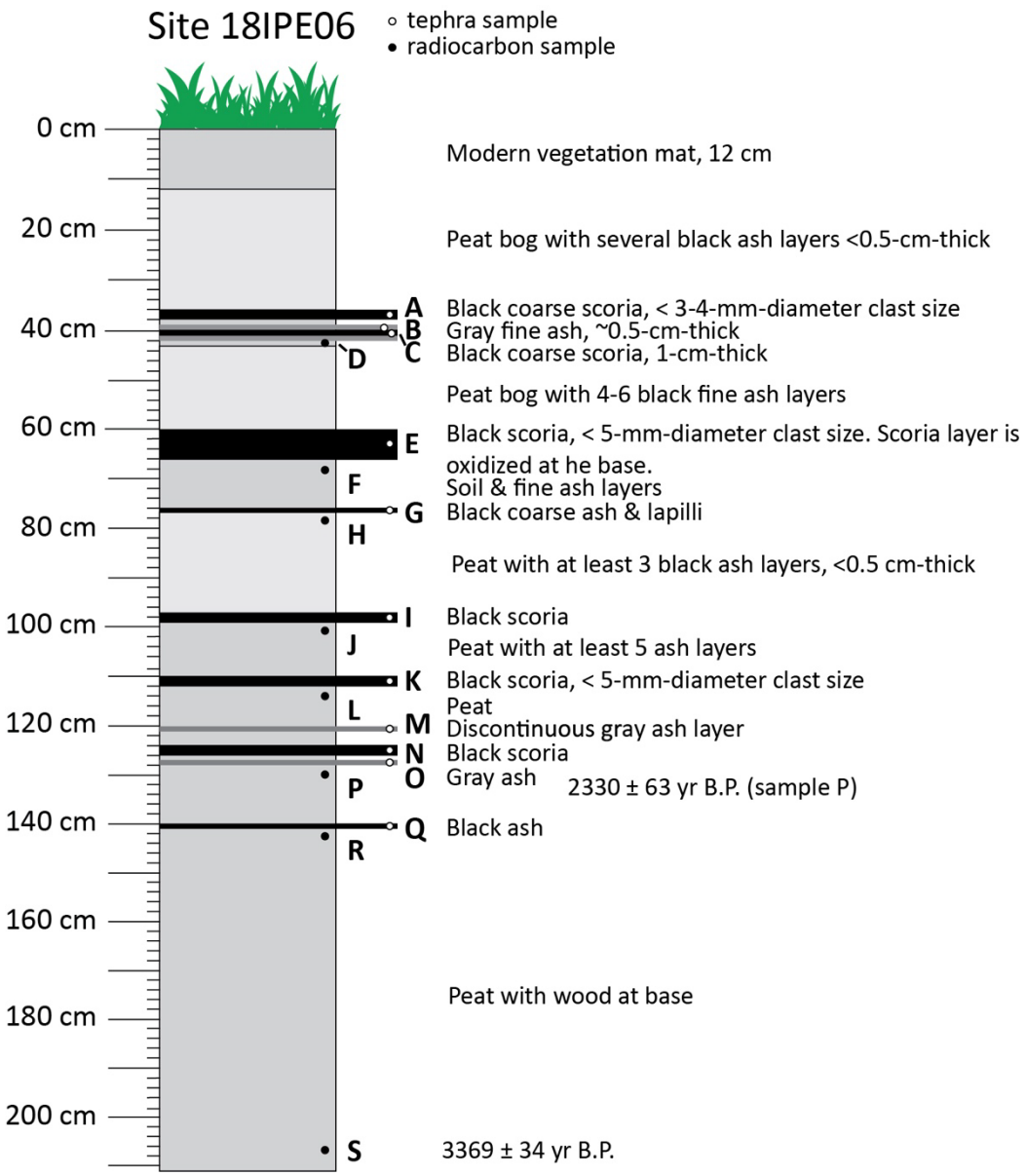
Site 18CW055. Bank exposure along the northeast shoreline of Cold Bay.



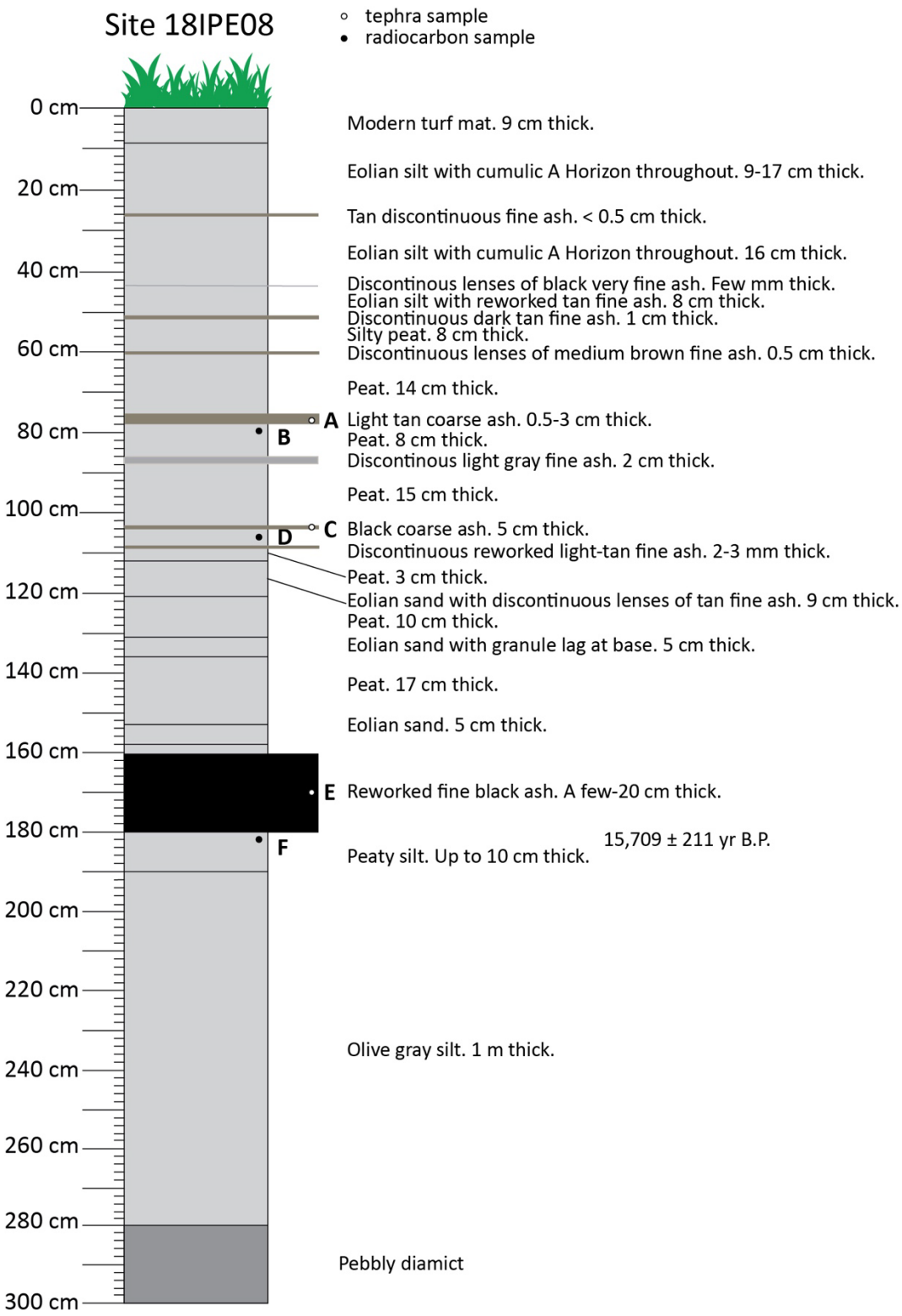
Site 18IPE01. Stratigraphic section of sedimentary and pyroclastic deposits 8.5 km northeast of Pavlof Sister Volcano.



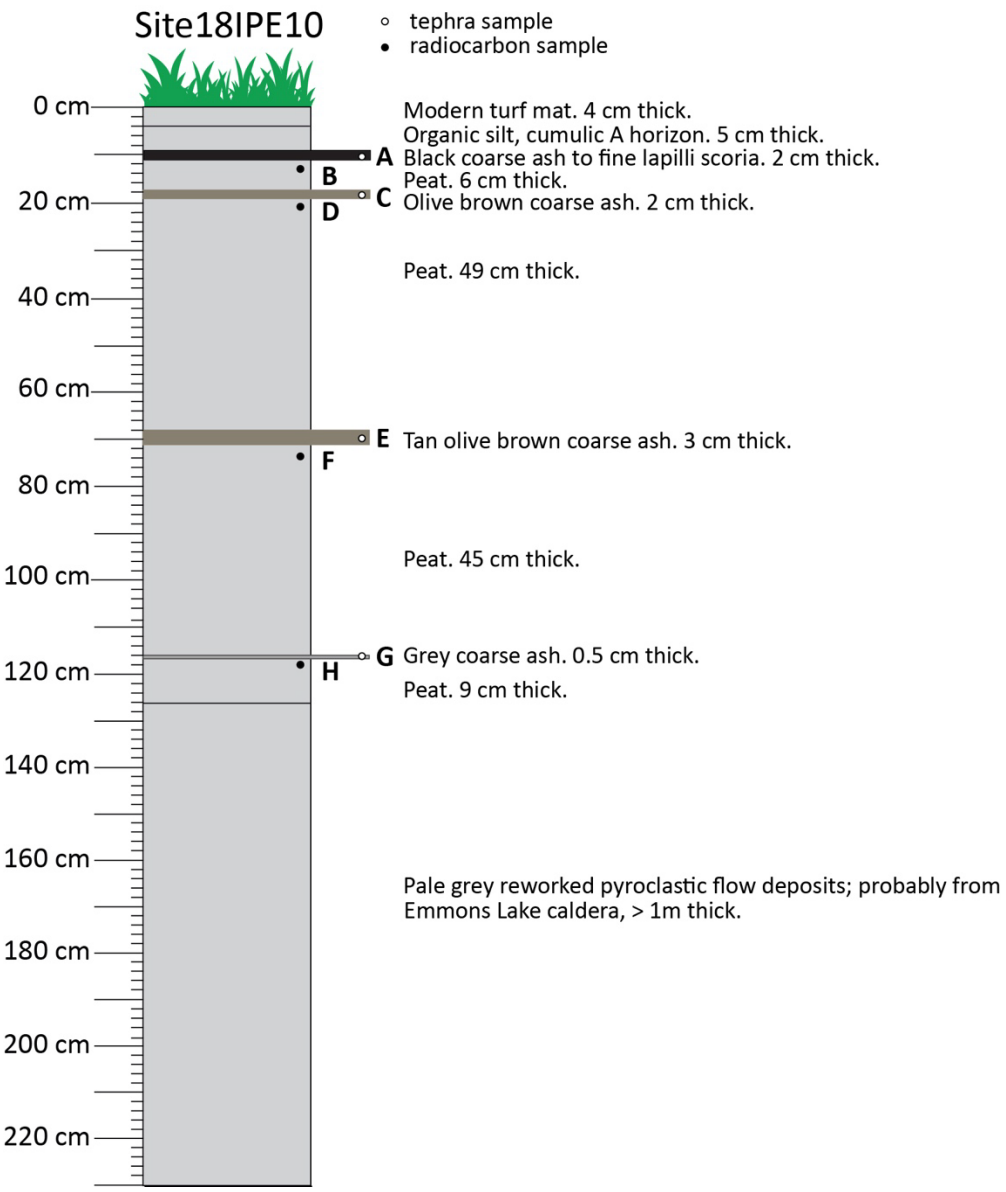
Site 18IPE05. Stream bank exposure in the upper Cathedral Valley, about 10 km east of Pavlof Volcano.



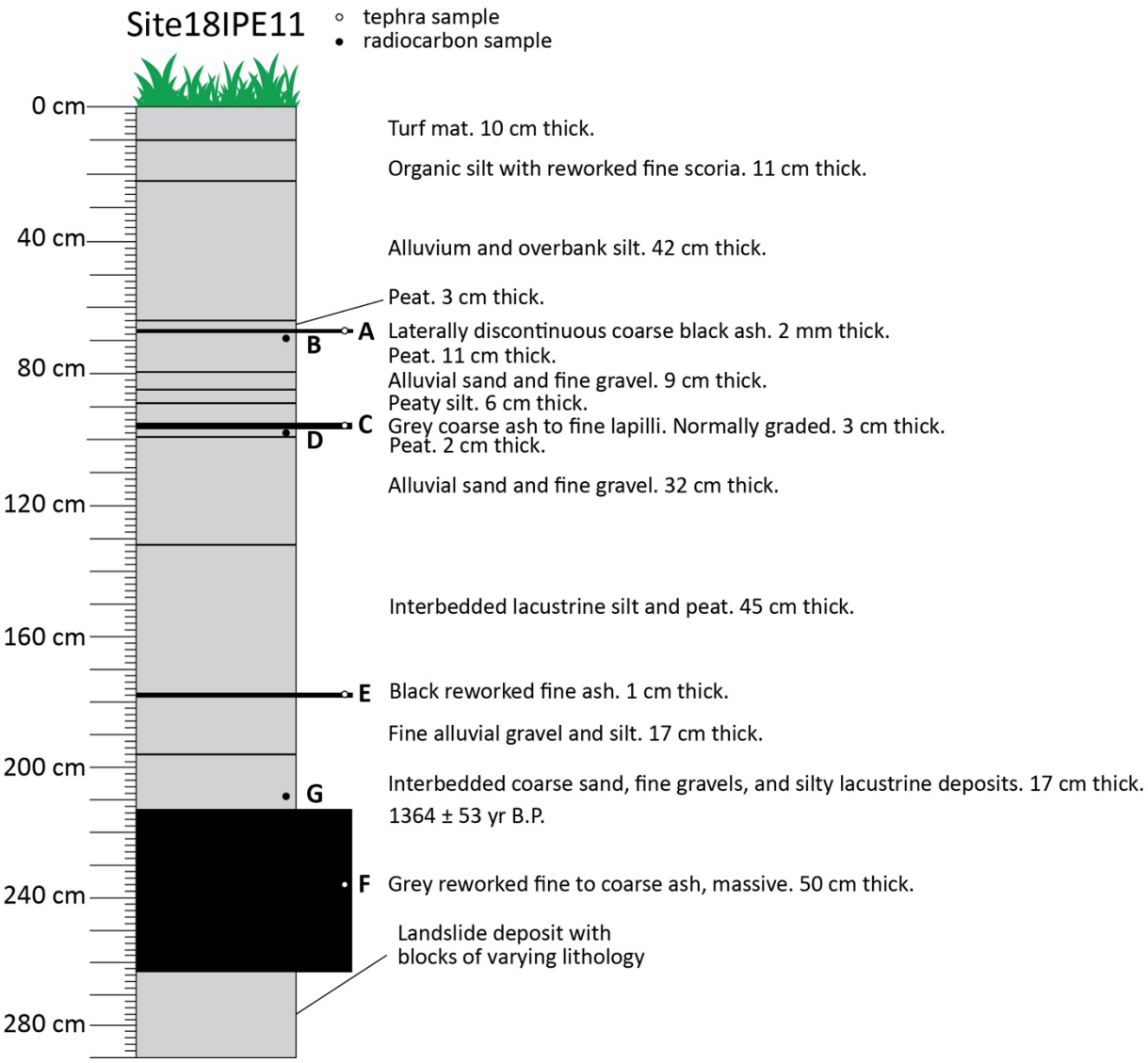
Site 18IPE06. Stratigraphic section of a peat and tephra deposits near Trader Mt, about 18 km north of Pavlof Volcano.



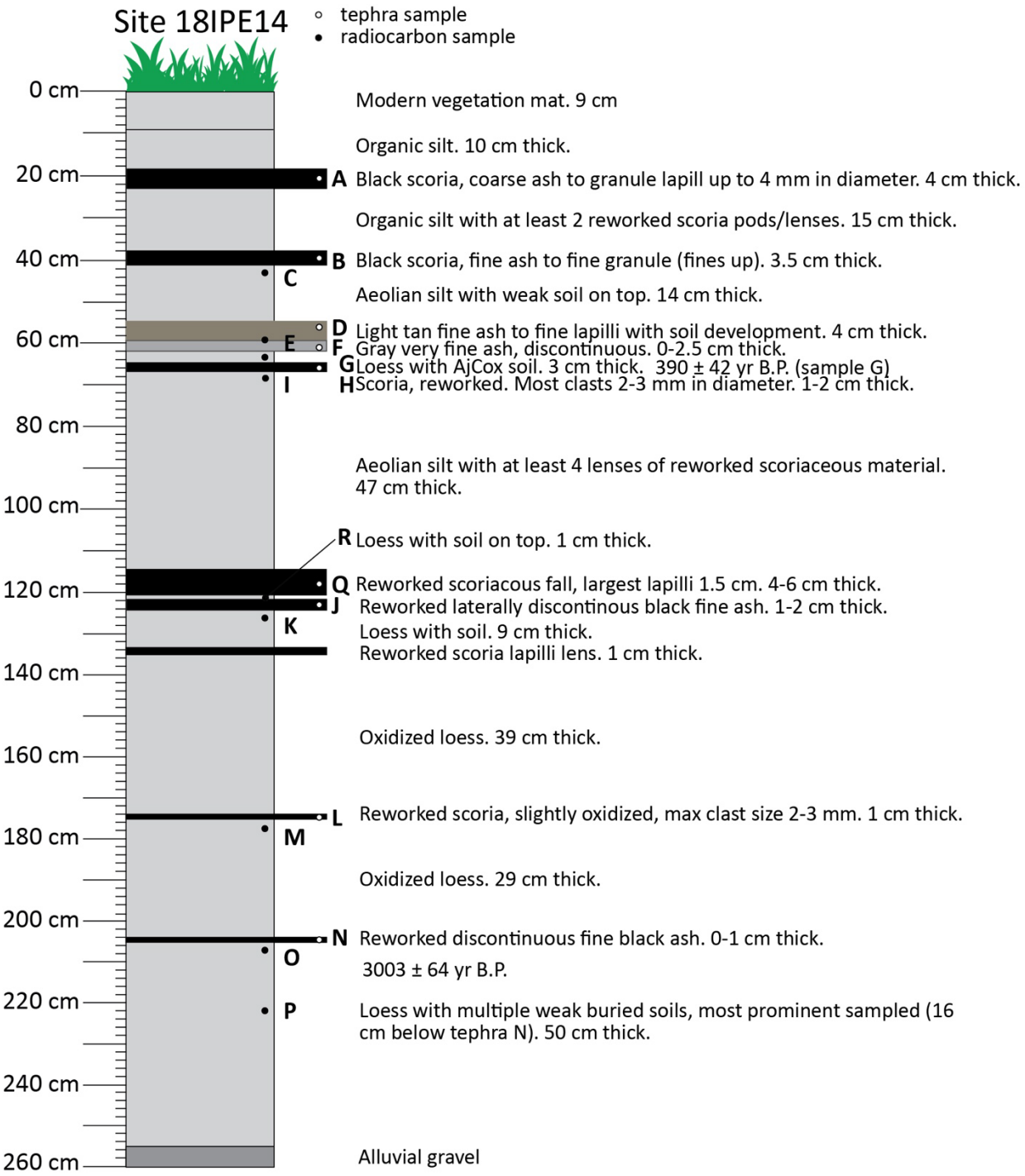
Site 18IPE08. Stratigraphic section of the sedimentary deposits exposed in a sea bluff, about 40 km north of Pavlof Volcano.



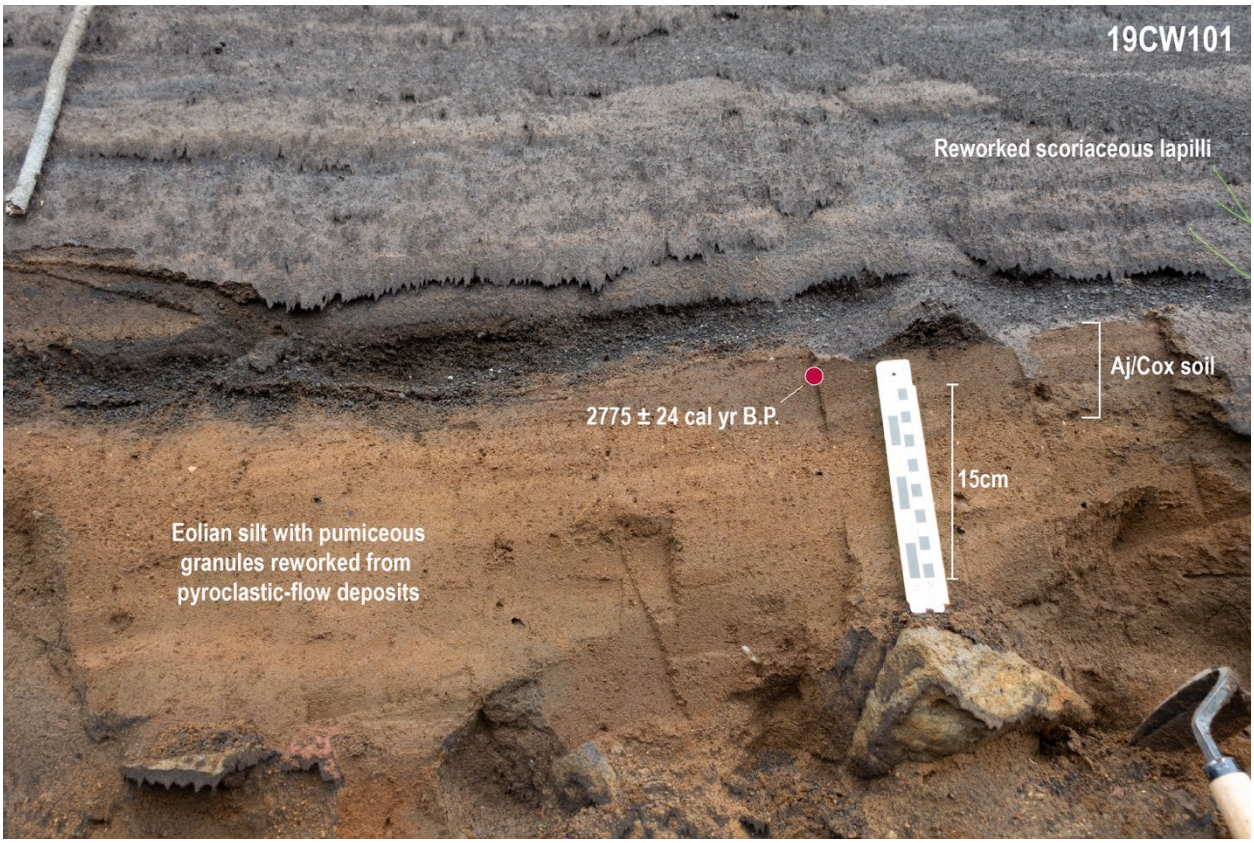
Site 18IPE10. Stratigraphic cross section of the sedimentary deposits, northeast of Trader Mountain, about 20 km north of Pavlof Volcano.



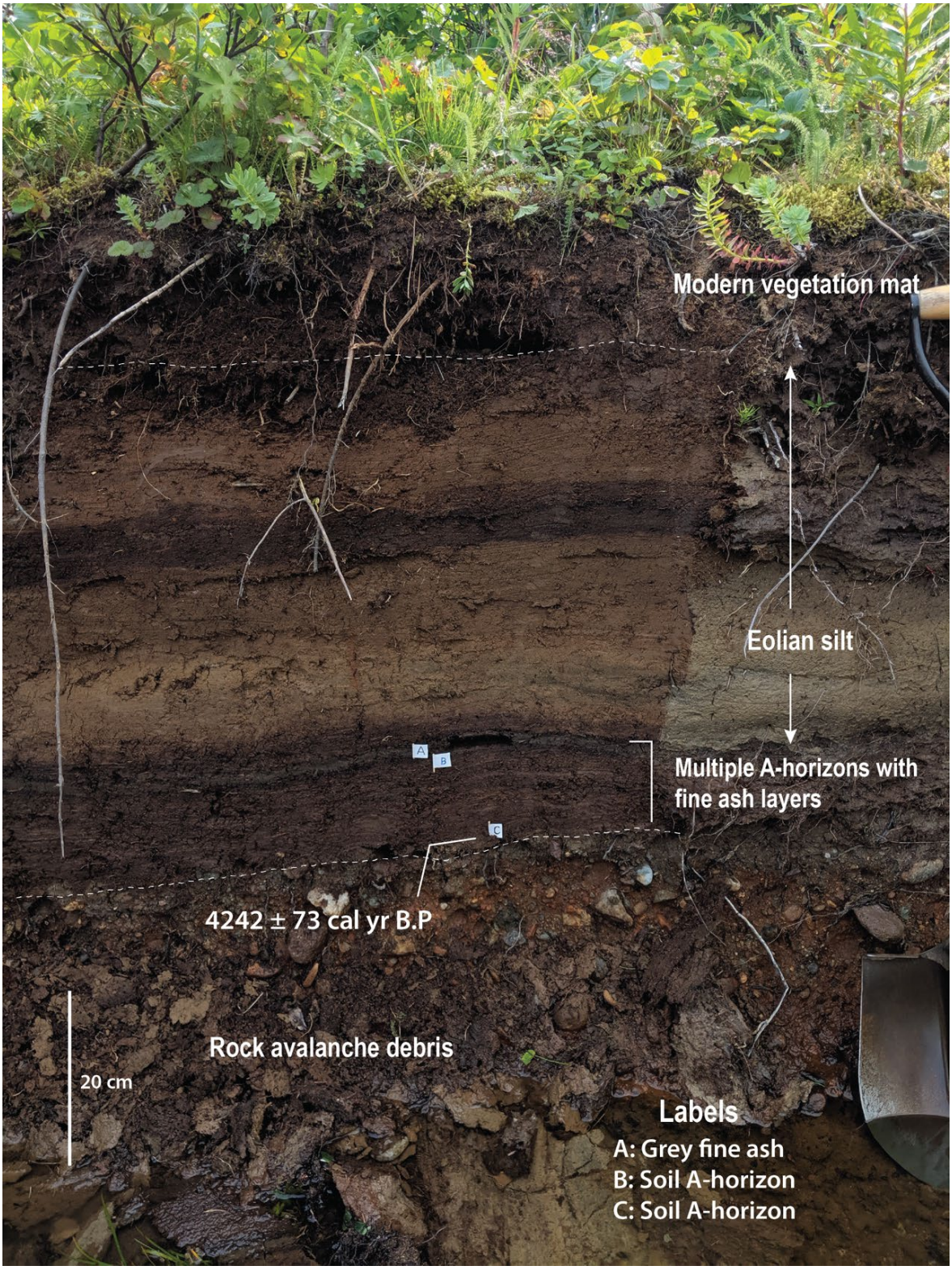
Site 18IPE11. Stratigraphic cross section of the sedimentary deposits in the upper Cathedral River valley, 15 km northwest of Pavlof Volcano.



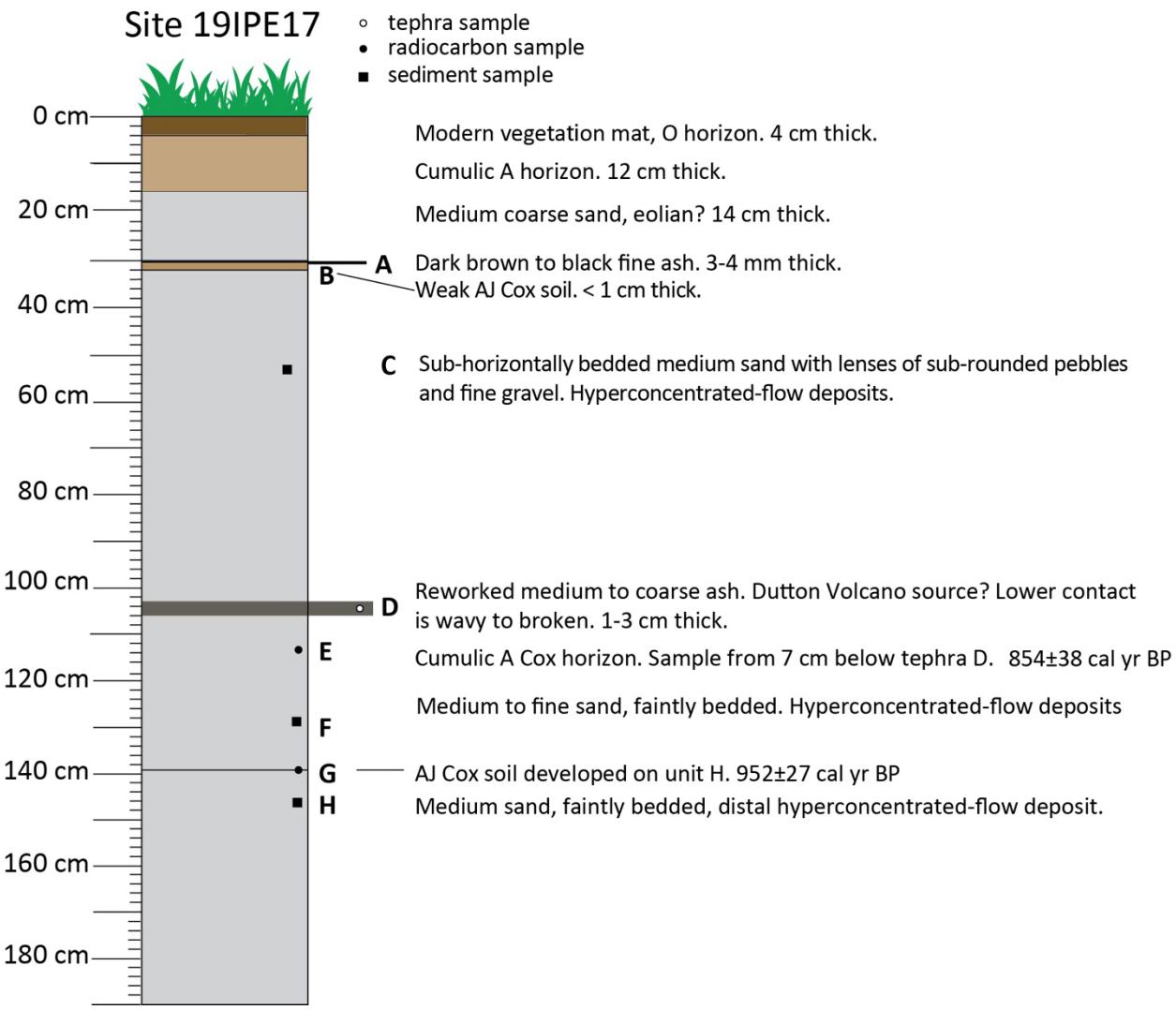
Site 18IPE14. Stratigraphic cross section of the sedimentary deposits in a bank exposure in the Cathedral River valley, about 13 km northwest of Pavlof Volcano.



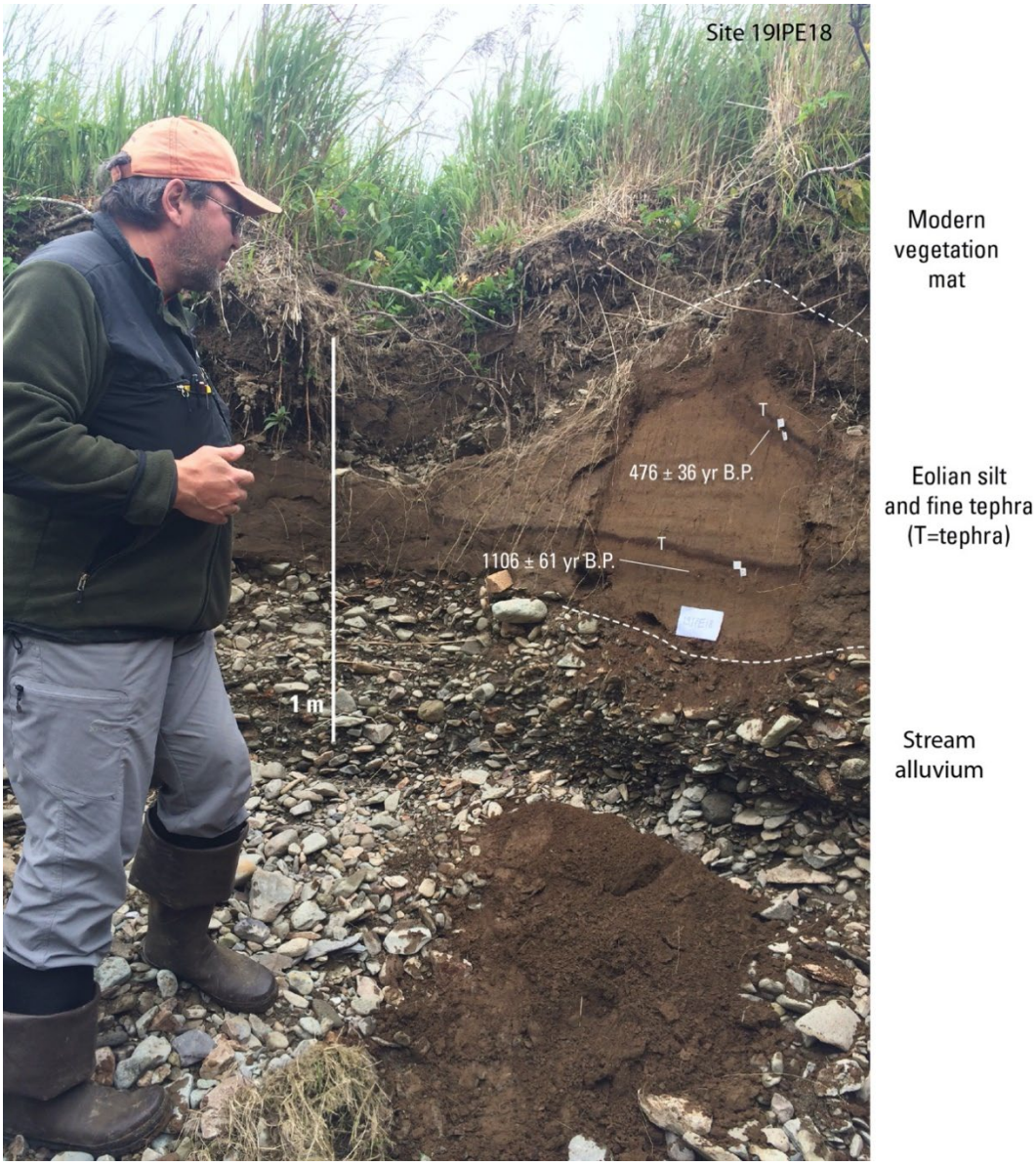
Site 19CW101. Bank exposure in unnamed drainage on distal south flank of Pavlof Volcano.



Site 19IPE16. Stream bank exposure within avalanche deposits on south flank of Dutton Volcano. Possible ash beds from Pavlof Volcano are preserved in loess deposits that overlie avalanche debris from Dutton Volcano.

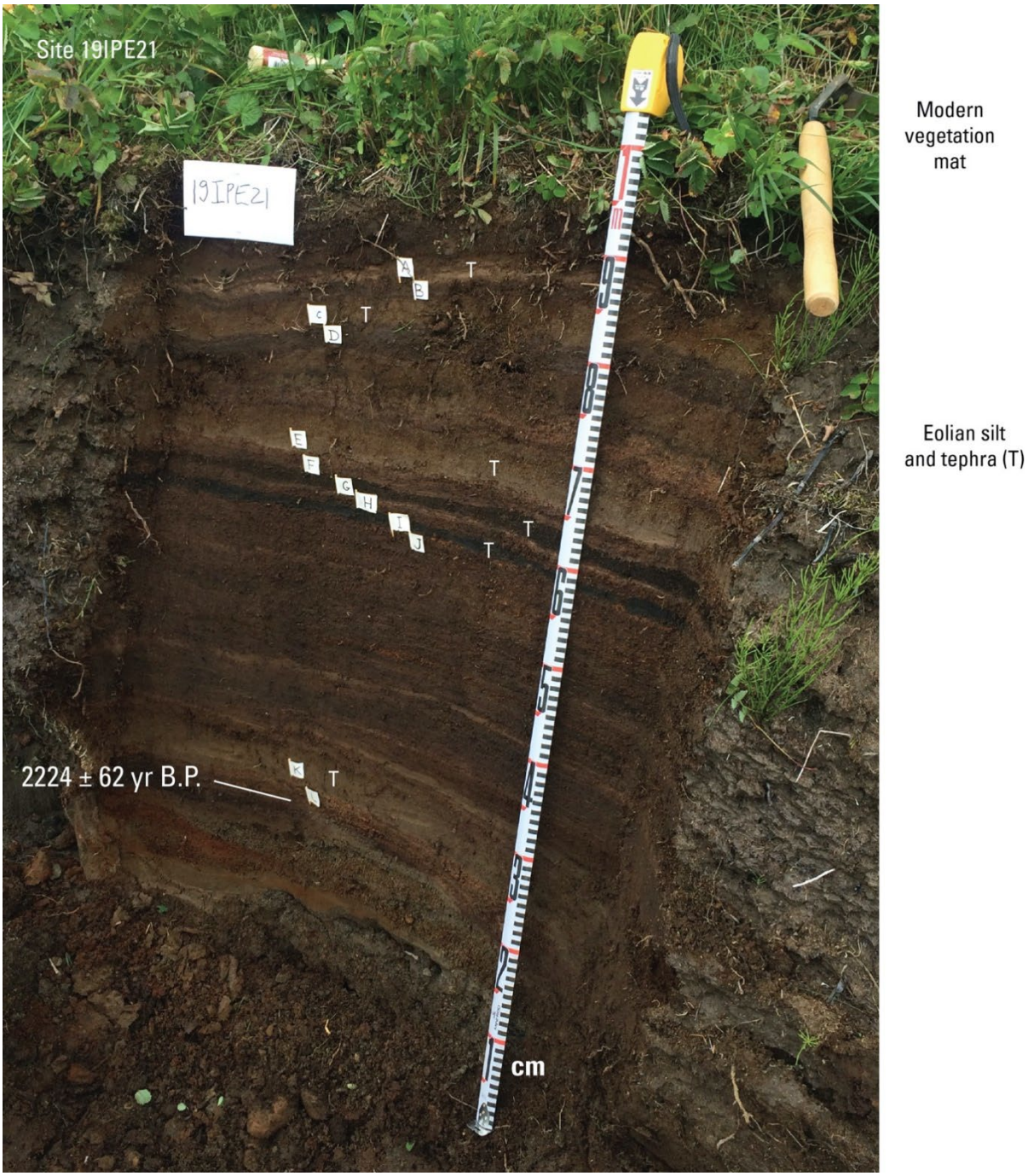


Site 19IPE17. Stream bank exposure in unnamed valley at the head of Belkofski Bay about 7 km southeast of Dutton Volcano.

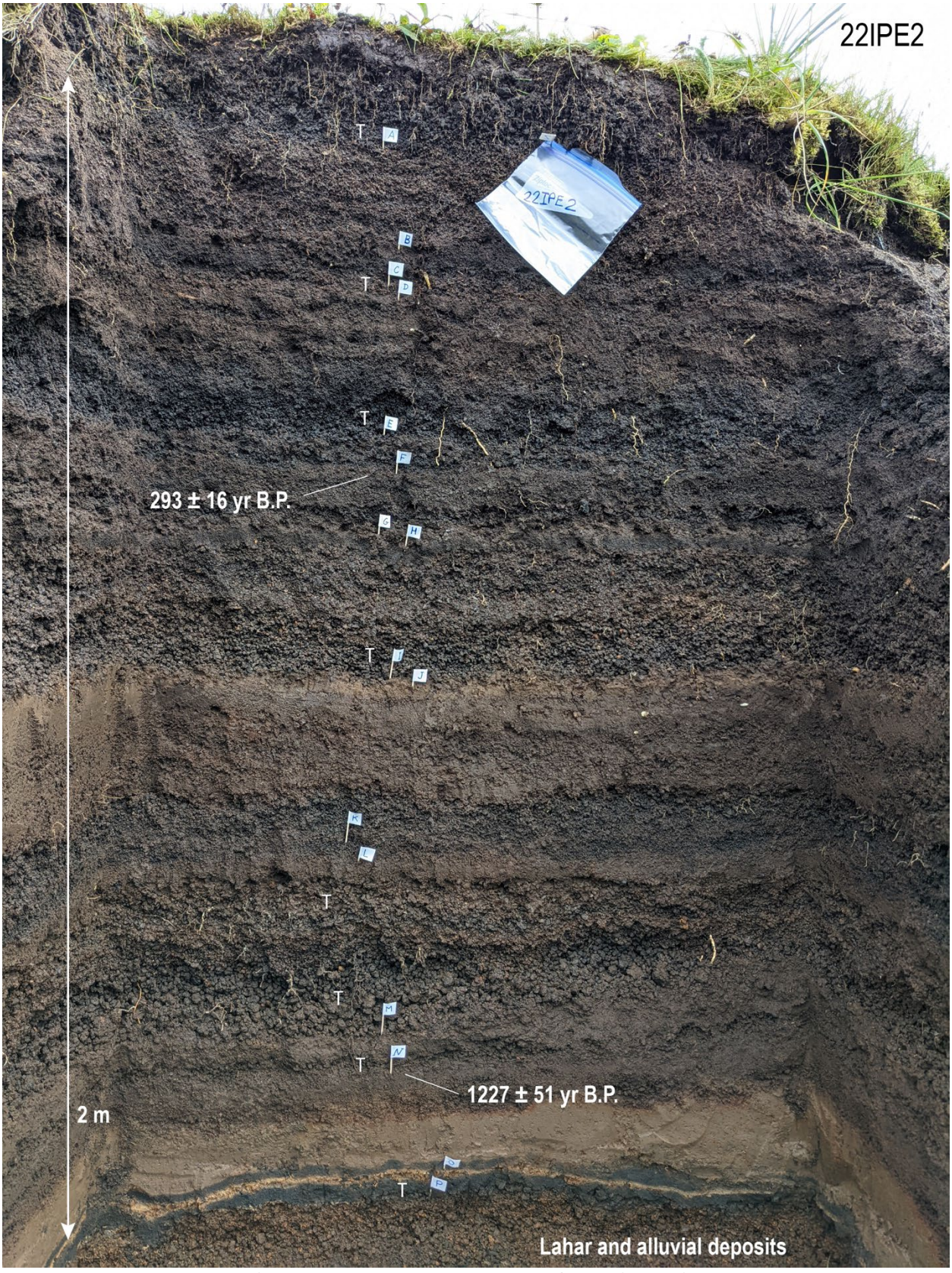


Site 19IPE18. Stream bank exposure at north end of unnamed valley, north of Belkofski Bay, about 9 km east of Dutton Volcano.

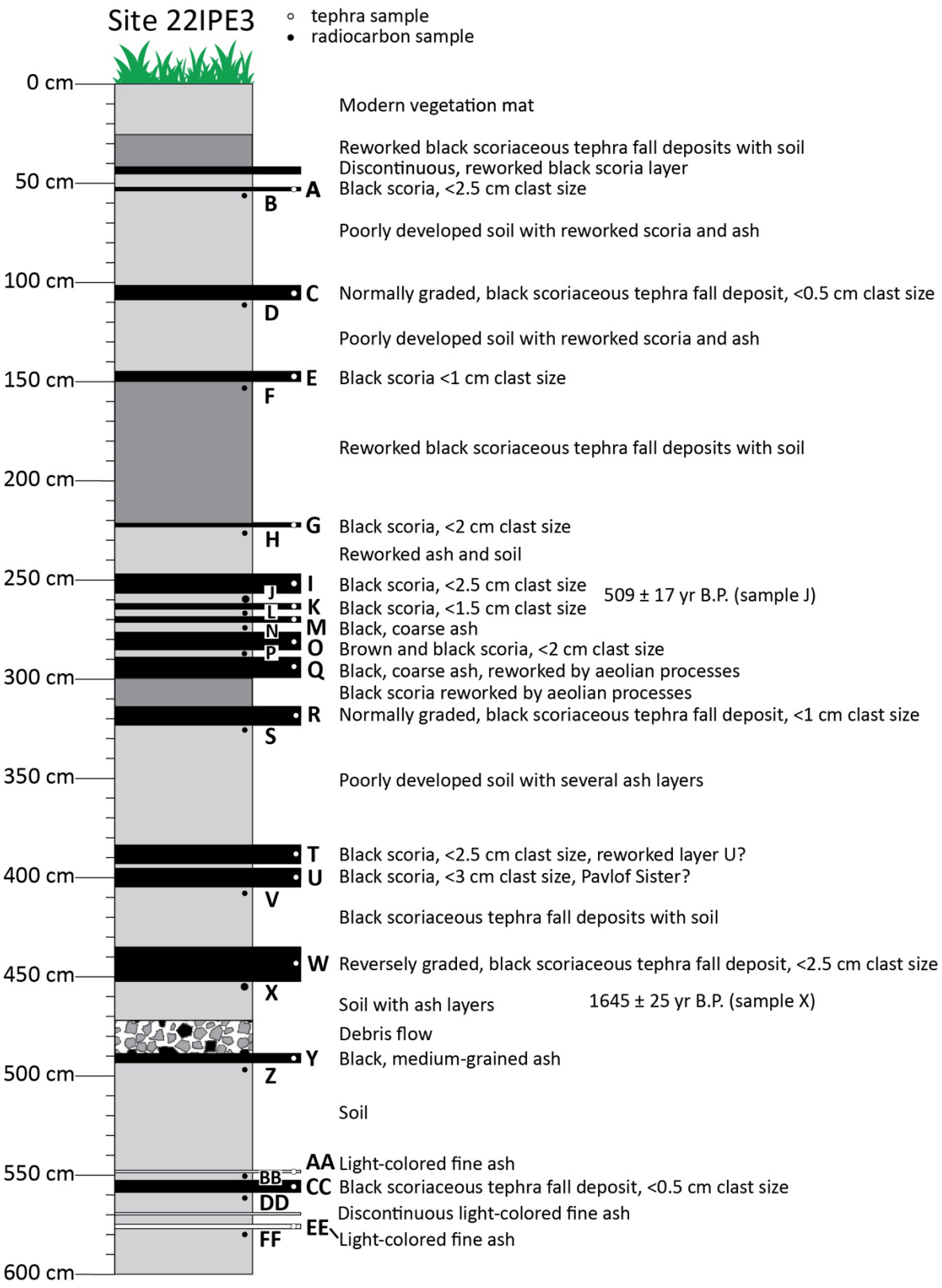
Site 19IPE19. Stream exposure at the west end of Bear Bay, about 14 km east of Dutton Volcano.



Site 19IPE21. Tephra section in stream bank exposure in unnamed valley, about 32 km southwest of Pavlof Volcano.



Site 22IPE2. Tephra section from site on the distal southeast flank of Pavlof Sister Volcano.



Site 22IPE3. Tephra section at site on the southeast flank of Pavlof Volcano.