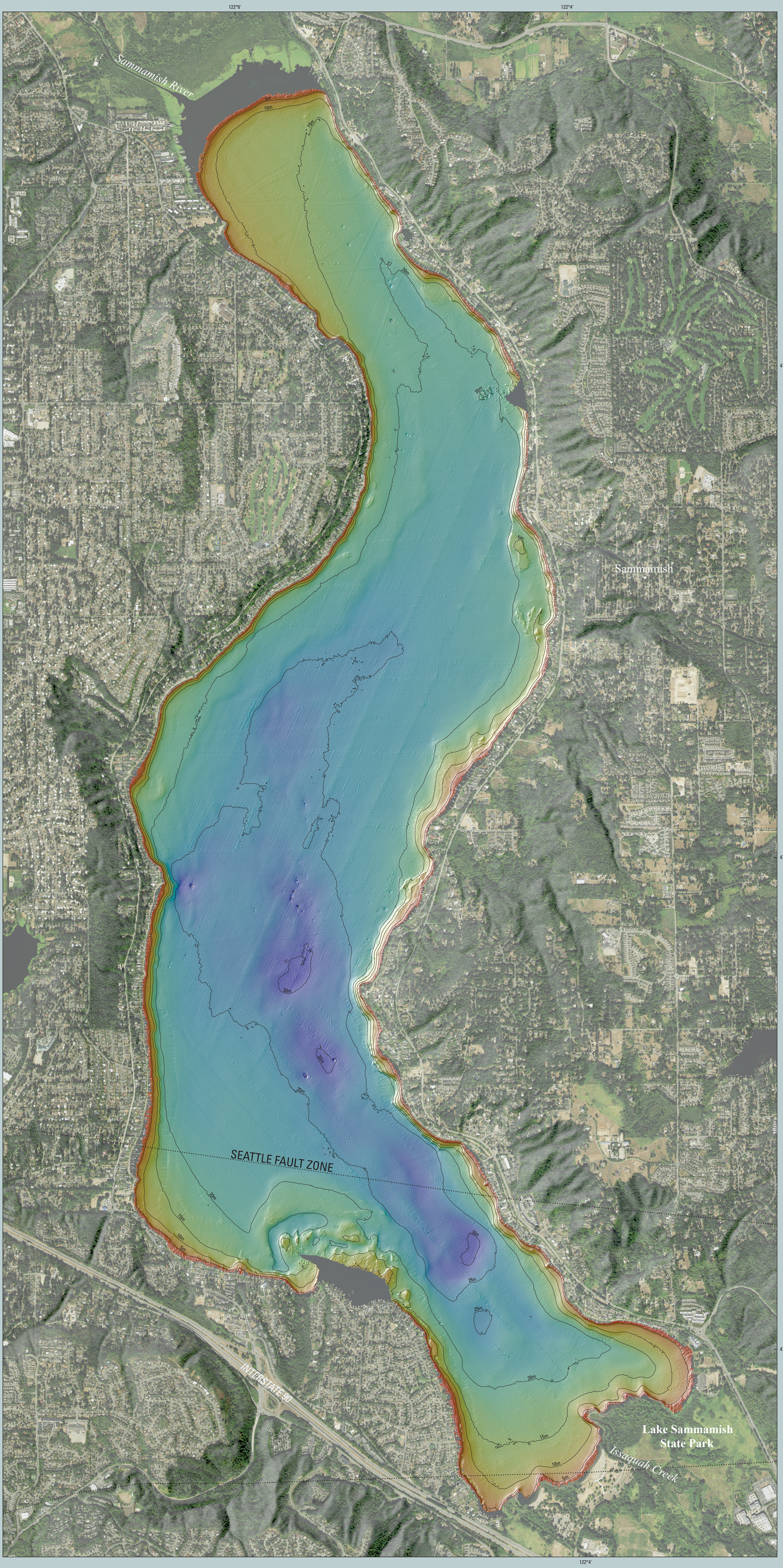
U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3537
Sheet 1 of 2



DISCUSSION

The Pacific Northwest of the United States lies within a seismically active convergent continental margin affected by earthquakes sourced from ruptures of several different fault types. Megathrust earthquakes along the offshore plate interface occur at large distances from the Puget Lowland, where most of the major population centers in Washington are located. Ruptures along more local crustal earthquakes may have the greatest potential to severely impact urban infrastructure and human health (Frankel and Stephenson, 2000). The Seattle Fault Zone (Johnson and others, 1994, 1999; Blakely and others, 2002; Liberty and Pratt, 2008; Stephenson and others, 2024), a shallow crustal fault structure that extends east-west under the populated Seattle region, has produced significant Holocene earthquakes (Nelson and others, 2003; Kelsey and others, 2008; Black and others, 2023). Evidence of strong earthquakes (such as underwater landslides and associated deposits) may be recorded within the lacustrine sediments of Pacific Northwest lakes (Karlin and others, 2004; Leithold and others, 2019; Brothers and others, 2024).

Underwater landslides and their associated deposits caused by past earthquakes are likely to be well preserved in relatively calm, natural lake environments. The floor of Lake Sammamish, Wash., an approximately 11 kilometer (6.8 mile) long, 2 kilometer (1.2 mile) wide, and 35 meter (114.8 feet) deep lake located in a populated region just east of Seattle, was mapped by the U.S. Geological Survey in November of 2021 to search for evidence of past earthquakes, building off early studies by Prunier (1998). Mapping was conducted using a similar method described in Dartnell and others (2024): a SWATHplus-M 234-kHz interferometric side-scan sonar system was pole-mounted on the U.S. Geological Survey research vessel *Parke Snavely*, and the system collected full-coverage bathymetric and acoustic backscatter data, which were processed to 2-meter spatial resolution (Dartnell and others, 2025a, 2025b). Two maps were created, a colored shaded-relief bathymetric map showing lake floor morphology (sheet 1), and an acoustic-backscatter map showing backscatter intensities (sheet 2). The results may then be utilized together to investigate past earthquake activity.

Some areas nearshore were not mapped owing to insufficient bathymetric data. Other gaps and lines in the colored shaded-relief map are due to data-collection or -processing artifacts.

REFERENCES CITED

Black, B.A., Pearl, J.K., Pearson, C.L., Pringle, P.T., Frank, D.C., Page, M.T., Buckley, B.M., Cook, E.R., Harley, G.L., King, K.J. and Hughes, J.F., 2023, A multifault earthquake threat for the Seattle metropolitan region revealed by mass tree mortality: Science advances, v. 9, no. 39, 9 p., https://doi.org/10.1126/sciadv.adh4973.

Blakely, R.J., Wells, R.E., Weaver, C.S. and Johnson, S.Y., 2002, Location, structure, and seismicity of the Seattle Fault Zone, Washington—Evidence from aeromagnetic anomalies, geologic mapping, and seismic-refection data: Geological Society of America Bulletin, v. 114, no. 2, p.169–177, https://doi.org/10.1130/0016-7606(2002)114<0169:LSASOT>2.0.CO;2.

Bowman, J. D., and Czajkowski, J. L., 2008, Washington State 1:100,000 scale surface geology features database—GIS data (version 5.0, February 2019): Washington State Department of Natural Resources, Washington Geological Survey Digital Data Series 1, accessed April 9th, 2025, at https://www.dnr.wa.gov/programs-and-services/geology/publications-and-data/gis-data-and-databases. [Supersedes version 4.1, released in 2016.]

Brothers, D.S., Sherrod, B.L., Singleton, D.M., Padgett, J.S., Hill, J.C., Ritchie, A.C., Kluesner, J.W., and Dartnell, P., 2024, Post-glacial stratigraphy and late Holocene record of great Cascadia earthquakes in Ozette Lake, Washington, USA: Geosphere, v. 20, no. 5, p. 1315–1346, https://doi.org/10.1130/GES02713.1.

Dartnell, P., Brothers, D., Ritchie, A.C., Sherrod, B., Currie, J.E., Dal Ferro, P., and Powers, D.C., 2024, Colored shaded relief bathymetry and acoustic backscatter of Ozette Lake, Washington: U.S. Geological Survey Scientific Investigations Map 3517, 2 sheets, scale 1:18,000, https://doi.org/10.3133/sim3517.

Dartnell, P., Brothers, D.S., Sherrod, B., Hatcher, G.A., Powers, D.C., Hill, J.C., Currie, J.E., and Dal Ferro, P., 2025a, Bathymetric and acoustic-backscatter mapping of Lake Sammamish, Washington, during USGS field activity 2021-656-FA: U.S. Geological Survey Data Report 1207, https://doi.org/10.3133/dr1207.

Dartnell, P., Brothers, D.S., Sherrod, B., Hatcher, G.A., Powers, D.C., Hill, J.C., Currie, J.E., and Dal Ferro, P., 2025b, Bathymetry and acoustic-backscatter data for Lake Sammamish, Washington collected during USGS field activity 2021-656-FA: U.S. Geological Survey data release, https://doi.org/10.5066/P1YKDHGC.

Frankel, A. and Stephenson, W., 2000, Three-dimensional simulations of ground motions in the Seattle region for earthquakes in the Seattle Fault Zone: Bulletin of the Seismological Society of America, v. 90, no. 5, p. 1251–1267, https://doi.org/10.1785/0119990159.

Johnson, S.Y., Potter, C.J. and Armentrout, J.M., 1994. Origin and evolution of the Seattle Fault and Seattle basin, Washington: Geology, vol. 22, no. 1, p. 71–74, https://doi.org/10.1130/0091-7613(1994)022<0071:OAEOTS>2.3.CO;2.

Johnson, S.Y., Dadisman, S.V., Childs, J.R. and Stanley, W.D., 1999, Active tectonics of the Seattle Fault and central Puget Sound, Washington—Implications for earthquake hazards: Geological Society of America Bulletin, v. 111, no. 7, p. 1042–1053, https://doi.org/10.1130/0016-7606(1999)111<1042:ATOTSF>2.3.CO;2.

Karlin, R.E., Holmes, M., Abella, S.E.B., and Sylwester, R., 2004, Holocene landslides and a 3500-year record of Pacific Northwest earthquakes from sediments in Lake Washington: Geological Society of America Bulletin, v. 116, nos. 1–2, p. 94–108, https://doi.org/10.1130/B25158.1.

Kelsey, H.M., Sherrod, B.L., Nelson, A.R. and Brocher, T.M., 2008, Earthquakes generated from bedding plane-parallel reverse faults above an active wedge thrust, Seattle Fault Zone: Geological Society of America Bulletin, v. 120, nos. 11–12, p. 1581–1597, https://doi.org/10.1130/B26282.1.

Leithold, E.L., Wegmann, K.W., Bohnenstiehl, D.R., Joyner, C.N. and Pollen, A.F., 2019, Repeated megaturbidite deposition in Lake Crescent, Washington, USA, triggered by Holocene ruptures of the Lake Creek-Boundary Creek Fault system: Geological Society of America Bulletin, v. 131, nos. 11–12, p. 2039–2055, https://doi.org/10.1130/B35076.1.

Liberty, L.M. and Pratt, T.L., 2008, Structure of the eastern Seattle Fault Zone, Washington State—New insights from seismic reflection data: Bulletin of the Seismological Society of America, v. 98, no. 4, p. 1681–1695, https://doi.org/10.1785/0120070145.

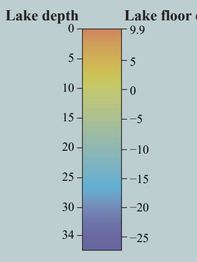
Nelson, A.R., Johnson, S.Y., Kelsey, H.M., Wells, R.E., Sherrod, B.L., Pezzopane, S.K., Bradley, L.A., Koehler III, R.D. and Bucknam, R.C., 2003, Late Holocene earthquakes on the Toe Jam Hill fault, Seattle Fault Zone, Bainbridge Island, Washington: Geological Society of America Bulletin, v. 115, no. 11, p. 1388–1403, https://doi.org/10.1130/B25262.1.

Prunier, C.F., 1998, Holocene faulting and landsliding in Lake Sammamish related to the Seattle Fault: University of Nevada, Reno, Master's thesis, 125 p.

Stephenson, W.J., Odum, J.K. and Pratt, T.L., 2024, Shallow faulting and folding beneath south-central Seattle, Washington State, from land-based high-resolution seismic-reflection imaging: The Seismic Record, v. 4, no. 3, p. 184–193, https://doi.org/10.1785/0320230050.

EXPLANATION OF MAP SYMBOLS

Lake floor elevation, lake depth, and illumination—Lake floor elevation is in meters relative to the North American Vertical Datum of 1988 (NAVD88). Lake depth is in meters relative to lake surface at the time of mapping (2021). Bright areas are illuminated, facing false sun; dark areas are in shadow, facing away from false sun



Lake floor elevation direction of illumination from false sun—Position of false sun is at 300° azimuth, 45° above horizon [arrow included as an explanation for illustration purposes only; not shown on map]

20m **Bathymetric contours**—Depth in meters relative to lake surface at time of mapping (2021). Derived and smoothed from 2-meter resolution bathymetric surface

Fault trace—Identity and existence certain, location concealed

Basemap image from U.S. Department of Agriculture National Agriculture Imagery Program 4-band 8 bit imagery, 2021
(available from National Oceanic and Atmospheric Administration's Digital Coast, https://coast.noaa.gov/dataviewer/#/)
and digital elevation model, 2023 (available from U.S. Geological Survey National Map, https://apps.nationalmap.gov/viewer/)
Universal Transverse Mercator, zone 10 north
North American Datum of 1983
NOT INTENDED FOR NAVIGATIONAL USE

SCALE 1:14 000
1/2 0 1/2 1 MILE
.5 0 .5 1 KILOMETER
BATHYMETRIC CONTOUR INTERVALS 5 METERS

Lake Sammamish bathymetric data collected by the U.S. Geological Survey in 2021
Bathymetric data processed by Peter Dartnell, 2021
GIS database and digital cartography by Peter Dartnell
Fault lines from Bowman and Czajkowski (2008)
Edited by Crystal Czarniecki; digital cartographic production by Amy Foxgrover
Manuscript approved for publication April 17 , 2025

Colored Shaded-Relief Bathymetry and Acoustic Backscatter of Lake Sammamish, Washington

By
Peter Dartnell, Daniel S. Brothers, Brian Sherrod, Gerry A. Hatcher, Daniel C. Powers, Jenna C. Hill, Jackson E. Currie, and Peter Dal Ferro

2025

ISSN 2329-132X (online)
https://doi.org/10.3133/sim3537

Digital files available at https://doi.org/10.3133/sim3537 and https://doi.org/10.5066/P1YKDHGC.

Suggested Citation: Dartnell, P., Brothers, D.S., Sherrod, B., Hatcher, G.A., Powers, D.C., Hill, J.C., Currie, J.E., and Dal Ferro, P., 2025, Colored shaded-relief bathymetry and acoustic backscatter of Lake Sammamish, Washington: U.S. Geological Survey Scientific Investigations Map 3537, 2 sheets, scale 1:14,000, https://doi.org/10.3133/sim3537.

Associated data for this publication: Dartnell, P., Brothers, D.S., Sherrod, B., Hatcher, G.A., Powers, D.C., Hill, J.C., Currie, J.E., and Dal Ferro, P., 2025, Bathymetry and acoustic-backscatter data for Lake Sammamish, Washington collected during USGS field activity 2021-656-FA: U.S. Geological Survey data release, https://doi.org/10.5066/P1YKDHGC.