
Curriculum Vitae

Edward J. Brook

College of Earth, Ocean, and Atmospheric Sciences
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EDUCATION

Education

Ph.D. Chemical Oceanography, 1993. MIT/Woods Hole Oceanographic Institution.
M.S. Geology, 1988. University of Montana.
B.S. Geology, 1985. Duke University.

EMPLOYMENT

2008-present Professor, Oregon State University, College of Earth Ocean, and Atmospheric Sciences).

2004-2008 Associate Professor, Oregon State University, Department of Geosciences

2002-2004 Associate Professor, tenured (2002), Washington State University, Department of Geology and Program in Environmental Science and Regional Planning.

1996-2002 Assistant Professor, Washington State University, Department of Geology (50%) Program in Environmental Science and Regional Planning (50%).

1996-1996 Post-Doctoral Investigator, Graduate School of Oceanography, University of Rhode Island. Supervisor: Dr. Michael Bender.

1993-1995 NOAA Climate and Global Change Post-Doctoral Fellow, Graduate School of Oceanography, University of Rhode Island. Supervisor: Dr. Michael Bender.

1988-1993 Research Assistant, MIT/Woods Hole Oceanographic Institution. Supervisor: Dr. Mark Kurz.

1985-1993 Teaching Assistant/Research Assistant, Geology Department, University of Montana.

HONORS

Outstanding Promise in Geology Award, Duke University Department of Geology, 1985.
Bertha Morton Graduate Scholarship, University of Montana, 1987.
Geological Society of America Outstanding Research Grant Proposal, 1988.
National Defense Science and Engineering Graduate Fellowship, 1988-1992.
NOAA Global and Climate Change Post-Doctoral Fellowship, 1993-1995.
Dean's Award for Research Excellence, WSU Vancouver, 1999.
Editor's Citation for Excellence in Reviewing, *Journal of Geophysical Research*, 2001.
Invited Participant, National Academy of Sciences Frontiers in Science Symposium, 2002.
Gary Comer Foundation Abrupt Climate Change Fellowship, 2004.
Brook Glacier, Antarctica, named in my honor for scientific service, 2006.
Aldo Leopold Leadership Fellowship, 2008.
Milton Harris Award for Basic Research, OSU College of Science, 2009
Google Science Communication Fellowship, 2011.
Fellow of the American Association for the Advancement of Science, 2012.
Jack Dymond Memorial Excellence in Mentoring Award, CEOAS-OSU, 2013.
Fellow of the American Geophysical Union, 2014.

PROFESSIONAL SOCIETIES

American Geophysical Union
American Association for the Advancement of Science
European Geophysical Union

GRADUATE ADVISEES AND CURRENT POSITION

Brent Goehring	M.S. 2004-2006	Assistant Professor, Tulane University
Logan Mitchell	Ph.D. 2007-2012	Postdoc, University of Utah
Thomas Bauska	Ph.D. 2007-2013	Postdoc, Cambridge University
Julia Rosen	Ph.D. 2008-present	Independent Journalist
Jon Edwards	Ph.D. 2011-present	
James Lee	Ph.D. 2011-present	
Andy Menking	Ph.D. 2013-present	

POSTDOCTORAL ADVISEES AND CURRENT POSITION

Susan Harder	1997-2002	Research Scientist, WSU, Retired
Henriette Linge	2002-2003	Asst. Professor, Univ. of Bergen, Norway
Hinrich Schaefer	2005-2007	Atmospheric Scientist, NIWA, New Zealand
Jinho Ahn	2005-2008	Asst. Professor, Seoul National Univ., Korea
Alexi Grachev	2005- 2008	Asst. Professor, Siberian Federal Univ.
Shaun Marcott	2011-2014	Asst. Professor, University of Wisconsin
Adrian Schilt	2012-2014	Swiss Federal Institute for the Environment
Thomas Bauska	2014-2015	Postdoc, Cambridge University
Rachael Rhodes	2011-2015	Marie Curie Fellow, Cambridge University
Christo Buizert	2012-present	
Aron Buffen	2015-present	

UNDERGRADUATE ADVISEES

Vanessa Stevens	1998-1999	Unknown
Kim Guess	1999-2000	Unknown
Aaron Goldner	2005-2006	PhD. Purdue, AAAS Postdoctoral Fellow
Logan Mitchell	2005-2006	Ph. D., OSU, Postdoc, University of Utah
Jeremy Vore	2006-2007	Mining industry
Lauren Foiles	2009-2010	Mining industry
Lacey Little	2010-2011	Senior Wellsite Geologist, Columbine Logging
Kurt Winner	2012- 2013	MS Student, Northern Arizona University
Nicole Rocco	2013-present	
Victoria Scherelis	2014-present	

HIGH SCHOOL ADVISEES

Claire Rodman	summer 2012	Santa Clara University
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MAJOR PROFESSIONAL SERVICE

U.S. Ice Core Working Group 2000-2002 (Chair, 2001-2002).
International Partnerships in Ice Core Sciences, Steering Committee, 2003-present.
Co-Chair, International Partnerships in Ice Core Sciences, 2005-present.
West Antarctic Ice Sheet Divide Site Ice Core Project Executive Committee, 2004-present.
NSF Earth System History Panel for Abrupt Climate Change Research Plan, Oct. 20-21
2004.

Editor, Ice Core Section, Encyclopedia of Quaternary Sciences, 2005-2006. 2010-2011.
Associate Editor, *Climate of the Past Discussions* (EGU Journal), 2005-present.
Associate Editor, *Quaternary Science Reviews*, 2005-2010.
Steering Committee, NSF Workshop on Paleoclimate Proxies, 2005.
Lead Author, for US Climate Change Science Program Synthesis and Assessment Product 3.4, Abrupt Climate Change, Chapter 5, Abrupt Changes in Atmospheric Methane.
NSF Office of Polar Programs Advisory Committee, 2005-2008.
Ice Drilling Program Office, Senior Advisory Board, 2008-Present. (Chair from 2015-2017).
NEEM Ice Core Steering Committee, co-chair Gas Consortium, 2007-present.
Lead PI, NSF PIRE Award: International Collaboration and Education in Ice Core Sciences, 2010-2016.

INVITED PRESENTATIONS AND KEYNOTE TALKS

AMQUA 1998 Biennial Meeting. Puerto Vallarta. "Interhemispheric correlation of ice core records using atmospheric gas records: methods and recent results." Sept. 5-7, 1998.
American Museum of Natural History, Conference on Biodiversity and Climate Change: Conservation in the Face of an Uncertain Future. "Polar Ice Sheet Archives of Natural Climate Change." April 30-May 1, 1999.
Berkeley Atmospheric Sciences Center Atmospheric Sciences Symposium. "The Ice Core Record of Greenhouse Gases and Climate." Nov. 9, 2001.
Beckman/National Academy of Sciences 14th Annual Frontiers in Science Symposium. "Abrupt climate change, the record from ice cores." Nov. 14-16, 2002.
University of South Florida, Eminent Scholars Lecture Series on Abrupt Climate Change. "Abrupt Climate Change: The View from the Ice." Jan 27-28, 2004.
Ecological Society of America Annual Meeting, Symposium on Frontiers in the Biogeosciences: Ecology and the Earth Sciences. "What caused pre-industrial atmospheric methane variations?" August, 2004.
University of Helsinki, invited speaker, Symposium on Past, Present and Future Climate Dynamics, Feedback Mechanisms, and Land – Atmosphere Interactions, Helsinki, Finland, Oct. 22-23, 2007.
Brook, E., L. Mitchell, J. Severinghaus and S. Harder, 2008, Ice core records of the evolution of atmospheric methane during the Holocene, *Eos Trans. AGU*, 89(53), Fall Meet. Suppl., Abstract U33B-02.
Leverhulme Symposium on Climate Change, invited speaker, Cambridge and London, UK, March 10-13 2008.
Seoul National University, South Korea, Distinguished Visiting Lecturer, May 2013.
Brook, E., T. Blunier, J. Chappellaz, David Etheridge, H. Fischer, T. Sowers, J. White, E. Wolff, 2013, Long Term Trends and Abrupt Perturbations in the late Quaternary Atmospheric Methane Budget. Invited presentation at 2014 AGU Fall Meeting.
2015 Lifto Amundson Phi Beta Kappa Memorial Lecture, University of South Dakota, April 20, 2015.
Brook, E., R. Rhodes, S. Marcott, T. Bauska, J. Edwards, J. Rosen, J. Ahn, J. Severinghaus, V. Petrenko, A. Menking, M. Kalk, 2015, Links between abrupt change in tropical hydroclimate, high-latitude climate change, and atmospheric greenhouse gases during the last ice age. Invited presentation at 2015 AGU Fall Meeting.

PUBLICATIONS

Publications in Peer Reviewed Journals and Books (Brook Graduate Student and Postdoc Authors in Bold, *=student or postdoc collaborator for whom Brook was not major advisor).

Higgins, J. A., A. V. Kurbatov, N. E. Spaulding, E. Brook, D. S. Introne, L. M. Chimiak, Y. Yan, P. A. Mayewski and M. L. Bender, 2015, Atmospheric composition 1 million years ago from blue ice in the Allan Hills, Antarctica, *Proceedings of the National Academy of Sciences*: 201420232.

Rhodes, R. H., E. J. Brook, J. C. Chiang, T. Blunier, O. J. Maselli, J. R. McConnell, D. Romanini and J. P. Severinghaus, 2015, Enhanced tropical methane production in response to iceberg discharge in the North Atlantic, *Science* **348**(6238): 1016-1019.

WAIS Divide Community Members (OSU post doc Christo Buizert first author, includes E. Brook), 2015, Precise inter polar phasing of abrupt climate change during the last ice age, *Nature* **520**(7549): 661-665.

Buizert, C., K. Cuffey, J. Severinghaus, D. Baggenstos, T. Fudge, E. Steig, B. Markle, M. Winstrup, **R. Rhodes** and E. Brook, 2015, The WAIS Divide deep ice core WD2014 chronology—Part 1: Methane synchronization (68–31 ka BP) and the gas age–ice age difference, *Climate of the Past* **11**(2): 153-173.

Bauska, T. K., F. Joos, A. C. Mix, R. Roth, J. Ahn and E. J. Brook, 2015, Links between atmospheric carbon dioxide, the land carbon reservoir and climate over the past millennium, *Nature Geoscience*.

Marcott, S., Bauska, T., Buizert, C., Steig, E., **Rosen, J.**, Cuffey, K., Fudge, T.J., Severinghaus, J., Ahn, J., Kalk, M., McConnell, J., Sowers, T., Taylor, K., White, J. and Brook, E., 2014, Centennial-scale changes in the global carbon cycle during the last deglaciation, *Nature*, **514**, 616-619.

Bauska, T.K., E. J. Brook, A. C. Mix, and A. Ross, 2014, High precision dual-inlet IRMS measurements of the stable isotopes of CO₂ and the N₂O/CO₂ ratio from polar ice core samples, *Atmos. Meas. Tech. Discuss.* **7**, 6529-6564, 2014.

Schilt, A., E. J. Brook, **T. K. Bauska**, D. Baggenstos*, H. Fischer, F. Joos, V. V. Petrenko, H. Schaefer, J. Schmitt and J. P. Severinghaus, 2014, Isotopic constraints on marine and terrestrial N₂O emissions during the last deglaciation, *Nature* **516**(7530): 234-237.

Buizert, C., V. Gkinis, J.P. Severinghaus, F. He, B. S. Lecavalier, P. Kindler, M. Leuenberger, A. Carlson, B. Vinther, V. Masson-Delmotte, J.W.C. White, Z. Liu, B. Otto-Bliesner and E.J. Brook, 2014, Greenland temperature response to climate forcing during the last deglaciation, *Science*, **45**, 1093-1208.

Buizert, C., D. Baggenstos, W. Jiang, R. Purtschert, V. V. Petrenko, Z.-T. Lu, P. Müller, T. Kuhl, J. Lee and J. P. Severinghaus, 2014, Radiometric ⁸¹Kr dating identifies 120,000-year-old ice at Taylor Glacier, Antarctica, *Proceedings of the National Academy of Sciences* **111**(19): 6876-

6881.

Carlson, A. E., K. Winsor, D. J. Ullman, E. J. Brook, D. H. Rood, Y. Axford, A. N. LeGrande, F. S. Anslow and G. Sinclair, 2014, Earliest Holocene south Greenland ice sheet retreat within its late Holocene extent, *Geophysical Research Letters* **41**(15): 5514-5521.

Seierstad, I. K.,* P. M. Abbott, M. Bigler, T. Blunier, A. J. Bourne, E. Brook, S. L. Buchardt, C. Buizert, H. B. Clausen and E. Cook, 2014, Consistently dated records from the Greenland GRIP, GISP2 and NGRIP ice cores for the past 104 ka reveal regional millennial-scale $\delta^{18}\text{O}$ gradients with possible Heinrich event imprint, *Quaternary Science Reviews* **106**: 29-46.

Ahn, J. and E.J. Brook, 2014, Siple Dome ice reveals two modes of millennial CO_2 change during the last ice age, *Nature Communications*, 5, 3723, doi:10.1038/ncomms4723.

Ahn, J., E.J. Brook, and **C. Buizert**, 2014, Response of atmospheric CO_2 to the abrupt cooling event 8200 years ago, *Geophysical Research Letters*. 41, 604–609.

WAIS Divide Project Members, 2013, Onset of deglacial warming in West Antarctica driven by local orbital forcing. *Nature*, 500, 440-444. (Includes Brook and many members of OSU lab group).

Rosen, J., E. Brook, J. Severinghaus, T. Blunier, **L. Mitchell**, **J. Lee**, **J. Edwards**, and V. Gkinis, 2014, An ice core record of near-synchronous global climate changes at the Bolling transition, *Nature Geoscience*, 6, 459-463.

Fischer, H. Jeff Severinghaus, Ed Brook, Eric Wolff, Mary Albert, Olivier Alemany, Rob Arthern, Charles Bentley, Donald Blankenship, Jerome Chappellaz, Timothy Creyts, Dorthe Dahl-Jensen, Michael Dinn, Massimo Frezzotti, Shuji Fujita, Hubert Gallee, Richard Hindmarsh, Don Hudspeth, Gerard Jugie, Kenji Kawamura, Vladimir Lipenkov, Heinz Miller, Hideaki Motoyama, Rob Mulvaney, Frank Pattyn, Catherine Ritz, Ted Scambos, Jakob Schwander, Daniel Steinhage, Tas van Ommen, Frank Wilhelms, 2013, Where to find 1.5 million yr old ice for the IPCS" Oldest-Ice" ice core, *Climate of the Past*, 9(6).

Chappellaz, J., C. Stowasser*, T. Blunier, D. Baslev-Clausen, E.J. Brook, R. Dallmayr, X. Fain, J.E. Lee, **L.E. Mitchell**, O. Pascual, D. Romanini, **J. Rosen**, and S. Schupbach*, 2013, High-resolution glacial and deglacial record of atmospheric methane by continuous-flow and laser spectrometer analysis along the NEEM ice core, *Climate of the Past*, 9, no. 6.

Mitchell, L., Ed Brook, **James E. Lee**, **Christo Buizert**, and Todd Sowers, 2013, Constraints on the Late Holocene Anthropogenic Contribution to the Atmospheric Methane Budget, *Science*, 342 (6161), 964-966.

Rasmussen, S.O., P Abbott, T Blunier, A Bourne, E Brook, SL Buchardt, **C Buizert**, J Chappellaz, HB Clausen, E Cook, D Dahl-Jensen, S Davies, M Guillevic, S Kipfstuhl, T Laepple, **IK Seierstad***, JP Severinghaus, JP Steffensen, C Stowasser, A Svensson, P Vallelonga, BM Vinther, F Wilhelms, M Winstrup, 2013, A first chronology for the NEEM Core, *Climate of the Past Discussions*, 9(3), 2817-2857.

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- X Faïn, J Chappellaz, **RH Rhodes**, **C Stowasser***, T Blunier, JR McConnell, EJ Brook, S Preunkert, M Legrand, T Desbois, D Romanini, 2013, High resolution measurements of carbon monoxide along a late Holocene Greenland ice core: evidence for in-situ production, *Climate of the Past Discussions*, 9(3), 2817-2857.
- Brook, E.J., 2013, Leads and lags at the end of the last ice age, *Science*, 339 (6123), 1042-1043.
- Landvik, J., E. Brook, L. Gualtieri, H. Linge, G. Raisbeck, and O. Salvigsen, 2013, ¹⁰Be exposure age constraints on the Late Weichselian ice sheet geometry and dynamics in inter ice-stream areas, western Svalbard, *Boreas*, 42, 43-56
- Rhodes, R.**, X. Fain, C. Stowasser, T. Blunier, J. Chappellaz, J. McConnell, **L. Mitchell**, and E. Brook, 2013, Continuous ice core methane measurements from a late Holocene Greenland ice core: atmospheric and in-situ signals, *Earth and Planetary Science Letters*, 368, 9–19
- NEEM Project Members (includes Ed Brook, **Julia Rosen**, **Christo Buizert** and **Adrian Schilt** from OSU), 2013, Eemian interglacial reconstructed from Greenland folded NEEM ice core strata, *Nature* 493, 489-494.
- Ahn, J.**, Brook, E. J., Schmittner, A., & Kreutz, K., 2012, Abrupt change in atmospheric CO₂ during the last ice age, *Geophysical Research Letters* 39(18), L18711.
- Ahn, J.**, E. Brook , L. Mitchell , **J. Rosen** , J. McConnell , K. Taylor , D. Etheridge , and M. Rubino, 2012, Atmospheric CO₂ over the last 1000 years: A high-resolution record from the West Antarctic Ice Sheet (WAIS) Divide ice core. *Global Biogeochemical Cycles* 26.2 (2012): GB2027.
- Clark, P.U., **Shakun, J.D.***, Baker, P.A., Bartlein, P.J., Brewer, S., Brook, E.J., Carlson, A.E., Cheng, H., Kaufman, D.S., Liu, Z., Marchitto, T.M., Mix, A.C., Morrill, C., Otto-Bliesner, B., Pahnke, K., Russell, J.M., Whitlock, C., Adkins, J.F., Blois, J.L., Clark, J., Colman, S.C., Curry, W.B., Flower, B.P., He, F., Johnson, T.C., Lynch-Stieglitz, J., Markgraf, V., McManus, J.F., Mitrovica, J.X., Moreno, P.I., Williams, J.W., 2012, Global climate evolution during the last deglaciation. *Proceedings of the National Academy of Sciences*, 109(19), E1134-E1142.
- Buizert, C.**, Petrenko, V. V., Kavanaugh, J. L., Cuffey, K. M., Lifton, N. A., Brook, E. J., & Severinghaus, J. P., 2012, In situ cosmogenic radiocarbon production and 2-D ice flow line modeling for an Antarctic blue ice area. *Journal of Geophysical Research*, 117(F2), F02029.
- Brook, E., 2012, Correlations Between Greenland and Antarctic Ice Core Records, in Elias, S. (ed.), *Encyclopedia of Quaternary Science 2nd ed.*, Elsevier.
- Brook, E., 2012, Overview of ice core research, in Elias, S. (ed.), *Encyclopedia of Quaternary Science 2nd ed.*, Elsevier.

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- Brook, E. and J. Severinghaus, 2011, Comment on "Methane emissions from extinct Megafauna, by F. Smith, S. Elliott, and S. Lyons, *Nature Geoscience* 4, 271–272 doi:10.1038/ngeo1140.
- Mitchell, L.**, E. Brook, T. Sowers, J. McConnell, and K. Taylor, 2011, Multidecadal variability of atmospheric methane, 1000-1800 C.E, *Journal of Geophysical Research* 116, G02007, doi:10.1029/2010JG001441.
- Severinghaus, J., E. W. Wolff, and E. J. Brook, 2010, Searching for the Oldest Ice, *EOS Transactions* 91, 357-358.
- Brook, E., M. Kurz, and J. Curtice, 2009, Flux and size fractionation of ^3He in interplanetary dust from Antarctic ice core samples, *Earth and Planetary Science Letters* 286, 565-569.
- Brook, E., 2009, Atmospheric carbon footprints, *Nature Geoscience* 2, 170-172.
- Liu, B. L. Otto-Bliesner, F. He, E. C. Brady, R. Tomas, P. U. Clark, A. E. Carlson, J. Lynch-Stieglitz, W. Curry, E. Brook, D. Erickson, R. Jacob, J. Kutzbach, and J. Cheng, 2009, Transient Simulation of Last Deglaciation with a New Mechanism for Bølling-Allerød Warming, *Science* 325, 310-314, doi:10.1126/science.1171041.
- Severinghaus, J., R. Beaudette, **M. Headly***, K. Taylor, and E. Brook, 2009, Oxygen-18 of O_2 records the impact of abrupt change on the terrestrial biosphere, *Science* 324, 5933, 1431-1434, doi:10.1126/science.1169473.
- Petrenko, V***, V., A. M. Smith, E. J. Brook, D. Lowe, K. Riedel, G. Brailsford, Q. Hua, H. Schaefer, N. Reeh, R. F. Weiss, D. Etheridge and J. P. Severinghaus, 2009, $^{14}\text{CH}_4$ measurements in Greenland ice: investigating last glacial termination CH_4 sources, *Science* 324, 506-508.
- Grachev, A.**, E. Brook, J. Severinghaus, and N. Piasias, 2009, Relative timing and variability of atmospheric methane and GISP2 oxygen isotopes between 68 and 86 ka, *Global Biogeochemical Cycles* 23, GB2009, doi:10.1029/2008GB003330.
- Schaefer, H., V. Petrenko***, E. Brook, J. Severinghaus, N. Reeh, J. Melton, and L. Mitchell, 2009, Ice stratigraphy at the Pakitsq ice margin, West Greenland, derived from gas records, *Journal of Glaciology* 55, 191, 411-421.
- Ahn, J.** and E. Brook, 2008, Atmospheric CO_2 and Climate on Millennial Time Scales During the Last Glacial Period, *Science* 322, doi:10.1126/science.1160832.
- Brook, E., 2008, Windows on the greenhouse, *Nature* 453, 291-292.
- Ahn, J., Headly, M***, Wahlen, M., Brook, E.J., Mayewski, P.A., and Taylor, K.C., 2008, CO_2 diffusion in polar ice: observations from naturally formed CO_2 spikes in the Siple Dome (Antarctica) ice core, *Journal of Glaciology* 54, 685-695.
- Petrenko, V***, J. P. Severinghaus, E.J. Brook, J. Mühle, M. Headly, C. M. Harth, H. Schaefer, N. Reeh, R. F. Weiss, D. Lowe and A. M. Smith, 2008, A novel method for
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obtaining very large ancient air samples for analyses of methane radiocarbon, *Journal of Glaciology* 54, 185, 233-244.

Petrenko, V.*, A. M. Smith, G. Brailsford, K. Riedel, Q. Hua, D. Lowe, J. P. Severinghaus, V. Levchenko, T. Bromle, R. Moss, J. Mühle and E. J. Brook, 2008, A new method for analyzing ^{14}C of methane in ancient air extracted from glacial ice, *Radiocarbon*, 50, 53-73.

Goehring, B.M., Brook, E.J., **Linge, H.C.**, and Raisbeck, G.M., 2008. Beryllium-10 Exposure ages of erratic boulders in southern Norway and implications for the history of the Fennoscandian Ice Sheet. *Quaternary Science Reviews* 27, 320-336.

Rinterknecht, V. R.*, I.E. Pavlovskaya, P.U. Clark, G.M. Raisbeck, G. M., F. Yiou, and E.J. Brook, 2007, Timing of the last deglaciation in Belarus. *Boreas* 36, 307-313.

Grachev, A., E. Brook and J. Severinghaus, 2007, Abrupt changes in atmospheric methane at the MIS 5b-5a transition, *Geophysical Research Letters* 34, L20703, doi:10.1029/2007GL029799.

Carlson, A.*, P. U. Clark, G. Raisbeck and E. Brook, 2007, Rapid Holocene deglaciation of the Labrador Sector of the Laurentide Ice Sheet, *Journal of Climate* 20, 5126-5133.

Schmittner, A., E. Brook and **J. Ahn**, 2007, Impact of the ocean's overturning circulation on atmospheric CO_2 , in Schmittner et al. (eds.), *Ocean Circulation: Mechanisms and Impacts*, *Geophysical Monograph Series 173*, American Geophysical Union, Washington D.C.

Linge, H., L. Olsen, E. Brook, **J. Darter***, D. Mickelson, G. Raisbeck and F. Yiou, 2007, Cosmogenic exposure ages from Nordland, northern Norway: implications for deglaciation in a coast to inland transect, *Norwegian Journal of Geology* 87, 269-280.

Carlson, A.*, P.U. Clark, B.A. Haley, G.P. Klinkhammer, K. Simmons, E. Brook, and K. Meissner, 2007, Geochemical proxies of North American freshwater routing during the Younger Dryas, *Proceedings of the National Academy of Sciences* 104, 6556-6561.

Ahn, J. and E. Brook, 2007, Atmospheric CO_2 and climate from 65 to 30 ka B.P., *Geophysical Research Letters* 34, L10703, doi:10.1029/2007GL029551.

Kobashi, T.*, J. Severinghaus, E. Brook, J.M. Barnola and A. Grachev, 2007, Precise timing and characterization of abrupt climate change at 8.2k B.P. from air trapped in polar ice *Quaternary Science Reviews* 26, 1212-1222.

Harder, S., D.T. Schindell, G.A. Schmidt and E. Brook, 2007, A GCM study of CH_4 emissions during the Holocene and glacial-interglacial transitions constrained by ice core data, *Global Biogeochemical Cycles* 21, GB1011, doi:10.1029/2005GB002680, 2007.

Nesje, A., S.O. Dahl, C. Ballantyne, **H. Linge**, D. McCarroll, E.J. Brook, G. Rasibeck, and F. Yiou, 2007, The surface geometry of the Last Glacial Maximum ice sheet in the Andøya Skaånland region, northern Norway, constrained by surface exposure dating

and clay mineralogy, *Boreas* 36, 1-13.

Rinterknecht, V.R.*, P. U. Clark, G. M. Raisbeck, F. Yiou, A. Bitinas, E. J. Brook, L. Marks, V. Zelc̃s, J.-P. Lunkka, I. E. Pavlovskaya, J. A. Piotrowski and A. Raukas, 2006, The Last Deglaciation of the Southeastern Sector of the Scandinavian Ice Sheet, *Science* 311, 1449-1452.

Fjellanger, J.*, L. Sørbel, **H. Linge**, E. Brook, G. M. Raisbeck and F. Yiou, 2006, Glacial survival of blockfields on the Varanger Peninsula, northern Norway, *Geomorphology* 82, 255-272.

Linge, H., E. Larsen, K. Kjaer, I. Demidov, E. Brook, G. Raisbeck and F. Yiou, 2006, Cosmogenic ¹⁰Be exposure age dating across Early to Late Weichselian ice-marginal zones in northwestern Russia, *Boreas* 35, 10.1080/03009480600781909.

Petrenko, V.* J. Severinghaus, E. Brook, N. Reeh and **H. Schaefer**, 2006, Gas records from the west Greenland ice margin covering the last glacial termination: a horizontal ice core, *Quaternary Science Reviews* 25, 865–875.

Suwa, M.*, J. von Fischer, M. Bender, A. Landais and E. Brook, 2006, Chronology reconstruction for the disturbed bottom section of the GISP2 and the GRIP ice cores: Implications for Termination II in Greenland, *Journal of Geophysical Research* 111, D02101, doi:10.1029/2005JD006032.

Brook, E., 2006, Using stable isotopes for climate reconstruction in ice cores, in Elias, S. (ed.), *Encyclopedia of Quaternary Science*, Elsevier.

Brook, E., 2006, Correlations Between Greenland and Antarctic Ice Core Records, in Elias, S. (ed.), *Encyclopedia of Quaternary Science*, Elsevier.

Brook, E., 2006, Overview of ice core research, in Elias, S. (ed.), *Encyclopedia of Quaternary Science*, Elsevier.

Schaefer, H., M. Whiticar, E. Brook, V. Petrenko, D. Ferretti and J. Severinghaus, 2006, Ice record of δ¹³C for atmospheric methane across the Younger Dryas-Pre Boreal Transition, *Science* 313, 1109-1112.

Linge, H., E. Brook, A. Nesje, G. Raisbeck, F. Yiou, and H. Clark 2007, In situ ¹⁰Be exposure ages from southeastern Norway: implications for the geometry of the Weichselian Scandinavian ice sheet, *Quaternary Science Reviews* 25, 1097-1109.

Brook, E., 2005, Tiny Bubbles Tell All, *Science* 310, 1285-1287.

Rinterknecht V.R.*, L. Marks J.A. Piotrowski, G.M. Raisbeck G.M., F. Yiou F., E.J. Brook, and P.U. Clark, 2005, Cosmogenic ¹⁰Be ages on the Pomeranian Moraine, Poland, *Boreas* 34, 186-191.

Brook, E., J.W.C. White, **A. Schilla***, M. Bender, B.A. Barnett, J. Severinghaus, K.C. Taylor, R.B. Alley and E.J. Steig, 2005, Timing of millennial-scale climate change at

Siple Dome, West Antarctica, during the last glacial period, *Quaternary Science Reviews* 24, 1333-1343.

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Research Grants Pending

Collaborative Research: Investigating Biomass Burning and Biogeochemistry using Continuous Aerosol and Gas Measurements in SPICE Core, NSF Antarctic Glaciology, 1/16 to 12/18. Co-PI with Joe McConnell, Desert Research Institute, Brook budget \$354,994

Research Grants Awarded

Collaborative Research: Inert gas and methane based climate records throughout the South Pole deep ice core , NSF Arctic Natural Sciences, 1/15 to 12/17. Co-PI with Jeff Severinghaus, Scripps Institution of Oceanography and Todd Sowers, Penn State University, Brook budget \$166, 785.

Carbon dioxide and nitrous oxide dynamics during the Holocene Epoch, NSF Arctic Natural Sciences, 4/15 to 3/18. Brook budget \$432,111.

Collaborative Research: POISE (Petermann Ocean Ice Shelf Experiment)-Paleo Context for Ocean Ice Interactions, NSF Arctic System Science, 8/13 to 7/17. Brook budget \$358,802.

Completing the WAIS Divide CO2 record, NSF Polar Programs, 1/2013 to 12/2016, \$479,981.

Collaborative Research: The Taylor Glacier, Antarctica, horizontal ice core: exploring changes in the natural methane budget in a warming world and expanding the paleo-archive, NSF Polar Programs, 7/2013 to 6/2017 \$394,742.

Collaborative Research: Investigating the potential of carbon-14 in polar firn and ice as a tracer of past cosmic ray flux and an absolute dating tool, NSF Polar Programs, 7/12 to 6/16, \$184,061. Co PI with Vas Petrenko, University of Rochester and Jeff Severinghaus, UC San Diego.

Collaborative Research: Continuous records of greenhouse gases and aerosol deposition over the Holocene epoch: testing the fidelity of new methods for reconstructing atmospheric change, NSF Polar Programs, 10/12 to 9/15, \$263,141. Co PI with Joe McConnell Desert Research Institute.

Collaborative Research: Investigating Upper Pleistocene Rapid Climate Change using Continuous, Ultra-High-Resolution Aerosol and Gas Measurements in the WAIS Divide Ice Core, NSF Polar Programs, 9/2012 to 8/2015, \$80,027. Co-PI with Joe McConnell, Desert Research Institute.

Collaborative Research: Applications of advanced laser spectroscopy to the ice core record of changes in climate and methane biogeochemistry, NSF Polar Programs, 1/10 to 12/13, \$670,020.

Collaborative Research: Ice core studies reconstructing Greenland climate during the Eemian and beyond, NSF Polar Programs, 7/11 to 6/14, \$85,397 to OSU. Co-PI with Michael Bender, Princeton University.

Collaborative Research: Replicate Coring at WAIS Divide to Obtain Additional Samples at Events of High Scientific Interest, NSF Polar Programs, 7/11 to 6/15, \$327,079 to OSU. Co-PI with Jeff Severinghaus, UC San Diego.

Collaborative Research: Completing an ultra-high resolution methane record from the WAIS Divide ice core, NSF Polar Programs, 1/11 to 12/13, \$351,834 to OSU. Co-PI with Todd Sowers, Penn State University.

PIRE: ICE-ICS: International Collaboration and Education in Ice Core Science, NSF Partnerships in International Research and Education, 9/1/10 to 8/31/15, \$4,500,000.

Collaborative Research: Deglaciation of the Ross Sea Embayment, constraints from Roosevelt Island, NSF Office of Polar Programs, 9/1/10 to 8/31/13, \$200,729. Co PI with Ed Waddington and Howard Conway, University of Washington.

Toward a Glacial-Interglacial Record of $\delta^{13}\text{C}$ of Atmospheric CO_2 from the WAIS Divide Ice Core. Gary Comer Foundation, 6/15/08 to 6/14/10, \$50,678.

Developing a record of the stable carbon isotopic composition of atmospheric CO_2 from the LGM to the Holocene, NSF Office of Polar Programs, 1/1/09-12/31/12, \$411,238 (A Mix at OSU is a co-PI).

Collaborative Research: A "horizontal ice core" for large-volume samples of the past atmosphere, Taylor Glacier, Antarctica, NSF Office of Polar Programs, 7/1/09 to 6/30/12, \$294,755 Co-PI with Jeff Severinghaus, UC San Diego.

IPY: Collaborative Research: The NEEM Deep Ice Core. NSF OPP, 5/08-4/13, \$517,034 to OSU (collaborative effort with University of Colorado, Scripps Institution of Oceanography, Penn State University).

Atmospheric carbon dioxide and climate change: the WAIS Divide record, NSF Office of Polar Programs, 1/08-12/10, \$708,340.

Developing a Rapid Method for Measuring Greenhouse Gases (CO₂, CH₄, N₂O) in Ice Cores, OSU College of Science Ventures Fund, \$10,370. Co-PI with Alexi Grachev, OSU.

Collaborative Research: Project PALEOVAR -- Past Climate Variability: Understanding Mechanisms and Interactions with the Mean State, NSF-ATM, 6/06-5/11, \$228,693 to Brook. Co-PI with P. Clark, A. Mix, A. Schmittner, N. Piasis, S. Hostetler at OSU, P. Bartlein, U of O, and Larry Edwards, Univ. of Minn. Total award to OSU=\$3,100,000.

Ice core trace gas records and abrupt climate change, Gary Comer Science and Education Foundation, 3/06-2/08, \$220,000.

Collaborative Research: Constructing an ultra-high resolution atmospheric methane record for the last 140,000 years from the WAIS Divide Ice Core, NSF Office of Polar Programs, 9/06 to 8/10, \$274,466. Co PI with Todd Sowers, Penn State.

Acquisition of a Noble Gas Mass Spectrometer at Oregon State University, MRI from NSF OCE, 9/06-8/08, \$611,930. Co-PI with D. Graham, J. Lupton, and R. Duncan, OSU.

REU Supplement: High Resolution Records of Atmospheric Methane in Ice Cores and Implications for Late Quaternary Climate Change, \$4,035, 4/10/05 to 4/09/06.

Collaborative Research: New insights into the Holocene methane budget from dual isotope systematics and the inter-polar gradient, NSF Office of Polar Programs, 8/15/05-8/15/08. \$149,085 to OSU, \$382,391 total. Co-PI with Todd Sowers, Penn State.

Collaborative research: Gases in firn air and shallow ice at the proposed WAIS drilling site, NSF Office of Polar Programs, 6/1/05-5/31/07. \$176,706 to WSU, ~\$1M total (Collaboration with Todd Sowers, Penn State, Eric Saltzman, UCI, Jeff Severinghaus, UCSD, Mark Battle, Bowdoin College, and Jim White, CU).

Constraining natural changes in the methane budget through stable isotope analysis, Petroleum Research Fund of the American Chemical Society, \$80,000, 4/1/05-8/31/07.

Improving ice core records of greenhouse gas variations, Gary Comer Foundation, 8/04-7/07, \$330,000.

Developing dry extraction of ice core gases and application to millennial-scale CO₂ variability, NSF Office of Polar Programs, 6/04-5/07, \$444,125.

Collaborative Research: Determining methane sources during the last deglaciation with large-volume air samples from Pakitsoq, West Greenland, NSF Office of Polar Programs, 1/02–12/05, \$175,474 to WSU, \$445,000 total. Co PI with J. Severinghaus, Scripps Institute of Oceanography.

Global Climate Change: A Workshop for 6-12 Teachers (with S. Harder, WSU), Eisenhower Professional Development Program, 12/1/02-8/31/02, \$30,365.

Measurement of Carbon Dioxide in Ice Cores (with Kirk Soule, Sunset High School, Portland, OR), Murdoch Charitable Trust Partners in Science Program, 6/02-6/04, \$14,000.

High-resolution records of atmospheric methane in ice cores and implications for late Quaternary climate change, NSF, Office of Polar Programs, Antarctic Glaciology Program, 1/02-12/05, \$304,701.

Ice core records of atmospheric carbon monoxide, NSF, Office of Polar Programs, Antarctic Glaciology Program, 1/02-12/02, \$98,128.

Collaborative research: Development of an in situ fossil air melt extraction device (proto-INFAMED) for recovering large volumes of air and microparticles from polar ice sheets, NSF, Office of Polar Programs, Polar Instrumentation and Technology Development Program, 1/01-12/02, \$66,059 to WSU, \$137,300 total. Co PI with J. Severinghaus, Scripps Institute of Oceanography.

Collaborative Research: Thickness, extent, and basal conditions of the Scandinavian Ice Sheet around the time of the last glacial maximum NSF Geology and Paleontology Program, 5/01-4/04, \$40,441 to WSU, \$333,341 total. Co PI with D. Mickelson, University of Wisconsin.

Collaborative Research: Developing an improved chronology of the southern margin of the Fennoscandian ice sheet, NSF Paleoclimatology Program, 7/99-6/02, \$74,295 to WSU, \$350,935 total. Co PI with Peter Clark, OSU.

Collaborative Research: Accretion of interplanetary dust: a new record from 3-He in polar ice cores (Collaboration with M. Kurz, WHOI), NSF Office of Polar Programs, Antarctic Glaciology Program, 1/00-12/0, \$49,478 to WSU \$123,653 total.

Accretion of interplanetary dust: a new record from 3-He in polar ice cores, and, Climate change workshop for K-12 teachers, NASA Cosmochemistry Program, 1/00-12/01, \$60,000.

Ice Core Records of Atmospheric Carbon Monoxide, NSF Earth System History Program 6/99-5/01, \$169,730.

Collaborative Research: Thermal Fractionation of firn air and the ice core record of abrupt interstadial climate change, NSF Office of Polar Programs, Antarctic Glaciology Program, 1/98-1/01, \$72,711 to WSU, \$408, 607 total. Co PI with Jeff Severinghaus, UC San Diego.

Atmospheric methane variations from 800-1800 AD, NSF Office of Polar Programs, REU Supplement, 9/98-8/99, \$5,883.

Collaborative Research: Testing models of Fennoscandian Ice Sheet Thickness Using Cosmogenic Nuclides, NSF, Division of Earth Sciences, Geology and Paleontology Program, 1/98-1/01, \$152,234 to WSU, \$202, 291 total. Co PI with Scott Lehman, University of Colorado.

Collaborative Research: Cosmogenic nuclide chronology of ice sheet boundaries and weathering limits in the Torngat Mountains, northern Labrador: a pilot study, NSF Office of Polar Programs, Arctic Natural Sciences Program, 6/96-6/98, \$43,322 to URI/WSU, \$72,151 total. Co PI with Peter Clark, OSU.

Climate studies using Antarctic deep ice cores and firn air samples, NSF Office of Polar Programs, Antarctic Glaciology Program 4/95-4/00, \$725,000. Co PI with Michael Bender, University of Rhode Island, Graduate School of Oceanography.

Scandinavian Ice Sheet History using Cosmogenic Nuclides, National Geographic Society, 4/95-4/98, \$26,743.

Exposure Age Dating of Late Weichselian Ice Sheet Boundaries in Western Norway, NSF International Programs, 1993-1994, \$10,000.

Collaborative measurements of ^{10}Be , ^{26}Al , and ^3He in Antarctic Glacial Deposits, NSF International Programs, 1992-1993, \$12,100. Co PI with Mark Kurz, Woods Hole Oceanographic Institution.