

## VITA

Philip E. Wannamaker

POSITION: Research Professor, Energy & Geoscience Institute, University of Utah, Salt Lake City, Utah  
Adjunct Professor, Department of Geology and Geophysics, University of Utah

EDUCATION: B.Sc., Engineering Geology, Queen's University, Kingston, Canada, 1976  
Ph.D., Geophysics, University of Utah, Salt Lake City, Utah, 1983

### RESEARCH INTERESTS:

Electromagnetic (EM) theory and practice, numerical modeling, inverse theory, relation of resistivity structure to physico-chemical conditions of the Earth, global tectonism, geothermal systems development, ore deposits.

SOCIETY MEMBERSHIPS: American Geophysical Union (AGU)  
Society of Exploration Geophysicists (SEG)  
Geothermal Resources Council (GRC)  
Geological Society of America (GSA)  
Association for Women Geoscientists (AWG)  
Australian Society of Exploration Geophysicists (ASEG)

### HONORS, AWARDS AND RESPONSIBILITIES:

Board of Directors, Incorporated Research Institutions in Seismology (IRIS), Elected, 2020-2022  
Invited Opening Oral Review Presentation, EM Induction Session, 100<sup>th</sup> Anniversary American Geophysical Union Annual Meeting, December 10, 2019  
Outstanding Reviewer for American Geophysical Union, 2015  
Fellow, Geological Society of America, Elected, 2011  
Awardee, New Zealand Geophysics Prize, 2009  
Trustee and Treasurer, Gerald W. Hohmann Memorial Trust for Teaching and Research in Electromagnetic Geophysics, 1995-present  
Review Panelist for National Atmospheric and Space Administration/Solar System Workings (2016), National Science Foundation/Continental Dynamics (1998-2002), Department of Energy/OBES (1994-1996)  
Search Committee, Arthur L. Day Medal, Geological Society of America, 2007-10  
Chair, IRIS/Earthscope Electromagnetic Working Group (EMWoG), 2007-09  
Scientist-in-Charge, EMSOC National Instrumentation Facility, 1997-2007  
General Meeting Co-Chair, 2nd Quad. Symposium on Three-Dimensional Electromagnetics, Salt Lake City, October 27-29, 1999.

Associate Editor (Electromagnetics), Journal of Geophysical Research (Solid Earth and Planets): 1990-1996, 2002-2005

Associate Editor (Electromagnetics), Pure and Applied Geophysics: 1998-2000

Associate Editor (Electromagnetics), Geophysics: 1991, 1993-1995

Green Foundation Scholarship, Scripps Institution of Oceanography, 1990

Cover figure of EOS Trans., 69 (7), showed finite element resistivity cross section for the Juan de Fuca subduction zone derived from EMSLAB group MT data.

Outstanding Ph.D. Research Award, Dept. of Geology and Geophysics, University of Utah, 1983

ASARCO Fellowship in Geophysics, Dept. of Geology and Geophysics, University of Utah, 1977-1978

First Class Honors, Faculty of Applied Science, Queen's University, 1976

ADVISORS: Stanley Ward (deceased), William Sill, Gerald Hohmann (deceased), William Parry, David Chapman

COLLABORATORS: Paul Bedrosian, Gary Egbert, Rob Evans, James Faulds, Graham Hill, B. Mack Kennedy, Joseph Moore, Yasuo Ogawa, Adam Schultz, Martyn Unsworth

ADVISEES: Kim Kariya, Jeff Johnston, Louise Pellerin, Randall Mackie (MIT), Patricia Lugao, William Doerner, Fang Sheng, Darrell Hall, Carl Nettleton (SDSU), Todd Ehlers, Efthemios Tartaras, Gabor Hursan, Victor Gonzalez (SDSU), Weidong Li, Tim Sodergren, Imam Raharjo (M.S.), Derrick Hasterok (M.S.), Virginie Maris (Ph.D), Imam Raharjo (Ph.D), Derrick Hasterok (Ph.D), Michal Kordy (Ph.D), Virginie Maris (post-doc), Christopher Volk, Michal Kordy (post-doc), Andrew Trow (informal), Kevin Mendoza

#### SELECT PUBLICATIONS:

Wannamaker, P. E., J. A. Stodt, G. J. Hill, V. Maris and M. A. Kordy, Thermal regime and state of hydration of the Antarctic upper mantle from regional-scale electrical properties, Invited chapter, *in* The Antarctic Mantle, Geological Society of London Memoir Series, ed. by A. Martin and W. van der Wal, v. M56, in press, doi: 10.1144/M56-2020-4, 2021.

Wannamaker, P.E. , J. A. Stodt, G. J. Hill, V. Maris, and M. A. Kordy, Thermal Regime, Legacy Structures, Upper Mantle Hydration and Lithospheric-Scale Magmatic Processes of the Antarctic Interior from Regional-Scale Electrical Properties: American Geophysical Union 2020 Fall Meeting, Session T008-05, December 8, <https://doi.org/10.1002/essoar.10505070.1>, 2020.

Wannamaker, P. E., S. F. Simmons, J. J. Miller, C. L. Hardwick, B. A. Erickson, S. D. Bowman, S. M. Kirby, K. L. Feigl and J. N. Moore, Geophysical Activities over the Utah FORGE Site at the Outset of Project Phase 3, Proc. 45th Workshop Geothermal Reservoir Engineering, Stanford University, Stanford, CA, SGP-TR-216, 14 pp., 2020.

- Wannamaker, P. E., Development and prospects of continental-scale resistivity surveying for orogenic processes and resource controls: Invited oral review presentation, American Geophysical Union 2019 Fall Meeting, 100<sup>th</sup> Anniversary of AGU, San Francisco, CA, USA, December 10, <https://doi.org/10.1002/essoar.10502046.1>, 2019.
- Wannamaker, P. E., J. E. Faulds, B. M. Kennedy, V. Maris, D. L. Siler, C. Ulrich, and J. N. Moore, Integrating magnetotellurics, soil gas geochemistry and structural analysis to identify hidden, high enthalpy, extensional geothermal systems: Proc. 43rd Workshop Geothermal Reservoir Engineering, Stanford University, Stanford, CA, SGP-TR-214, 19 pp., 2019.
- Trow, A. J., H. Zhang, A. Record, K. A. Mendoza, K. L. Pankow, and P. E. Wannamaker, Microseismic event detection using multiple large-N geophone arrays in central Utah: *Seismological Research Letters*, 89(5), doi: 10.1785/0220180065, 11 pp., 2018.
- Wunderman, R. L., P. E. Wannamaker, and C. T. Young, Architecture of the hidden Penokean terrane suture and Midcontinent Rift System overprint in eastern Minnesota and western Wisconsin from magnetotelluric profiling: *Lithosphere*, doi: 10.1130/L716.1, 10 pp., 2018.
- Wannamaker, P. E., G. Hill, J. Stodt, V. Maris, Y. Ogawa, K. Selway, G. Boren, E. Bertrand, D. Uhlmann, B. Ayling, A. M. Green and D. Feucht, Uplift of the Central Transantarctic Mountains: Article, *Nature Communications*, doi: 10.1038/s41467-017-01577-2, 11 pp., 2017.
- Wannamaker, P. E., J. N. Moore, K. L. Pankow, S. F. Simmons, G. D. Nash, V. Maris, A. Trow, and C. L. Hardwick, Phase II of Play Fairway Analysis for the Eastern Great Basin extensional regime, Utah: status of indications: *Geothermal Resources Council Transactions*, 41, 2368-2382, 2017.
- Peacock, J. R., M. T. Mangan, D. McPhee, and P. E. Wannamaker, Three-dimensional electrical resistivity model of the hydrothermal system in Long Valley Caldera, California, from magnetotellurics: *Geophysical Research Letters*, 43, 7953–7962, 2016.
- Wannamaker, P. E., A. J. Meigs, J. D. Trimble, E. A. Lamont, B. M. Kennedy, J. N. Moore, V. Maris, E. L. Sonnenthal and G. D. Nash, Play Fairway Analysis for Structurally Controlled Geothermal Systems in the Central Cascades Arc-Backarc Regime, Oregon: Proc. 41st Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, CA, February 22-24, 18 pp., 2016.
- Kordy, M. A., E. Cherkaev, and P. E. Wannamaker, Null space correction and adaptive model order reduction in multi-frequency Maxwell's problem: *Advances in Computational Mathematics*, 42, 1-23, doi: 10.1007/s10444-016-9482-z, 2016.
- Kordy, M. A., E. Cherkaev, and P. E. Wannamaker, Adaptive model order reduction for the Jacobian calculation in inverse multi-frequency problem for Maxwell's equations: *Applied Numerical Mathematics*, doi: 10.1016/j.apnum.2016.02.010, 19 pp., 2016.
- Wannamaker, P. E., K. L. Pankow, J. N. Moore, G. D. Nash, V. Maris, S. F. Simmons and C. L. Hardwick, Play Fairway Analysis for Structurally Controlled Geothermal Systems in the Eastern Great Basin Extensional Regime, Utah: Proc. 41st Workshop Geothermal Reservoir Engineering, Stanford University, Stanford, CA, SGP-TR-209, 17 pp., 2016.

- Kordy, M. A., P. E. Wannamaker, V. Maris, E. Cherkaev, and G. J. Hill, Three-dimensional magnetotelluric inversion using deformed hexahedral edge finite elements and direct solvers parallelized on SMP computers, Part I: forward problem and parameter jacobians: *Geophysical Journal International*, 204, 74-93, 2016a.
- Kordy, M. A., P. E. Wannamaker, V. Maris, E. Cherkaev, and G. J. Hill, Three-dimensional magnetotelluric inversion using deformed hexahedral edge finite elements and direct solvers parallelized on SMP computers, Part II: direct data-space inverse solution: *Geophysical Journal International*, 204, 94-110, 2016b.
- Kordy, M. A., E. Cherkaev, and P. E. Wannamaker, Variational formulation for Maxwell's equations with Lorenz gauge: existence and uniqueness of solution: *International Journal of Numerical Analysis and Modeling*, 12, 731-749, 2015.
- Wannamaker, P. E., R. L. Evans, P. A. Bedrosian, M. J. Unsworth, V. Maris, and R. S. McGary, Segmentation of plate coupling, fate of subduction fluids, and modes of arc magmatism in Cascadia, inferred from magnetotelluric resistivity: *Geochemistry, Geophysics, Geosystems*, 15, doi:10.1002/2014G204, 2014.
- McGary, R. S., R. L. Evans, P. E. Wannamaker, J. Elsenbeck, and S. Rondenay, Subducting slab to surface pathway for melt and fluids beneath Mount Rainier: *Nature*, 511, 338-341, doi: 10.1038/nature13453, 2014.
- Siler, D. L., B. M. Kennedy, and P. E. Wannamaker, Regional lithospheric discontinuities as guides for geothermal exploration: *Geothermal Resources Council Transactions*, 38, 39-47, 2014.
- Wannamaker, P. E., and J. Legault, Two-dimensional joint inversion of ZTEM and MT plane-wave EM data for near surface applications: *Proc. 27th Symposium on the Application of Geophysics to Engineering and Environmental Problems*, Boston, MA, March 16-20, 134-139, 2014.
- Forson, C., J. Faulds, and P. Wannamaker, Prospecting for a blind geothermal system utilizing geologic and geophysical data, Seven Troughs Range, northwestern Nevada: *Geothermal Resources Council Transactions*, 38, 369-376, 2014.
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- Evans, R. L., P. E. Wannamaker, R. S. McGary, and J. Elsenbeck, Electrical structure of the central Cascadia subduction zone: the EMSLAB Lincoln line revisited, *Earth and Planetary Science Letters*, doi 10.1016/j.epsl.2013.04.021, 2014.
- Wannamaker, P. E., V. Maris, and C. Hardwick, Basin and rift structure of the central Black Rock Desert, Utah, and initial thermal implications, from 3D magnetotellurics: *Geothermal Resources Council Transactions*, 37, 41-44, 2013.
- Kordy, M., V. Maris, P. Wannamaker, and E. Cherkaev, 3D edge finite element solution for scattered electric field using a direct solver parallelized on an SMP workstation, *Proc. 5<sup>th</sup> International Symposium on Three-Dimensional Electromagnetics*, Sapporo, May 7-9, 4 pp., 2013.
- Wannamaker, P. E., V. Maris, J. Sainsbury, and J. Iovenitti, Intersecting fault trends and crustal-scale fluid pathways below the Dixie Valley geothermal area, Nevada, inferred from 3D magnetotelluric surveying, *Proc. 38th Workshop on Geothermal Reservoir Engineering*, Stanford, CA, SGP-TR-198, 9 pp, 2013.

- Maris, V., P. E. Wannamaker, and J. Moore, 3-D inversion of MT data from the Raft River geothermal field – preliminary results: *Geothermal Resources Council Transactions*, 36, 939-942, 2012.
- Wannamaker, P. E., V. Maris, D. Hasterok, and W. Doerner, Crustal Scale Resistivity Structure, Magmatic-Hydrothermal Connections, and Thermal Regionalization of the Great Basin: *Geothermal Resources Council Transactions*, 35, 1787-1790, 2011.
- Wannamaker, P. E., Legacy of Luiz Rijo in MT Exploration at the University of Utah and Beyond: Two-Dimensional Inversion and Frontier Solid-Earth Investigations, Expanded Abstract, Biennial Mtg of the Brazilian Geophysical Society, Rio de Janeiro, 5 pp., 2011.
- Maris, V., and P. E. Wannamaker, Parallelizing a 3D Finite Difference MT Inversion Algorithm on a Multicore PC using OpenMP: *Computers & Geosciences*, doi: 10.1016/j.cageo.2010.03.001, 5 pp., 2010.
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- Wannamaker, P., P. Rose, W. Doerner, B. Berard, J. McCulloch, and K. Nurse, Magnetotelluric surveying and monitoring at the Coso geothermal area, California, in support of the Enhanced Geothermal Systems concept: survey parameters, initial results: Proc. 29th Workshop on Geothermal Reservoir Engineering, Stanford, CA, SGP-TR-175, 8 pp., 2004.
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- Upton, P., D. Craw, T. G. Caldwell, P. O. Koons, Z. James, P. E. Wannamaker, G. R. Jiracek, and C. P. Chamberlain, 2003, Upper crustal fluid flow in the outboard region of the Southern Alps, New Zealand: *Geofluids*, 3, 1-12.
- Wannamaker, P. E., and Y. Sasaki, Three-dimensional electromagnetic inversion combining a finite difference forward solver with integral equations jacobians: Proc. 3<sup>rd</sup> Quad. Symp. 3DEM, ed. by J. Macnae and G. Liu, ASEG, Adelaide, 2003, 5 pp.
- Wannamaker, P. E., and W. M. Doerner, 2002, Crustal structure of the Ruby Mountains and southern Carlin trend region, northeastern Nevada, from magnetotelluric data: *Ore Geology Reviews*, 21, 185-210.
- Zhdanov, M. S., and P. E. Wannamaker, eds., 2002, Three-dimensional electromagnetics, Proc. 2nd Quad. Int. Symp.: Methods in geochemistry and geophysics, Elsevier, Amsterdam, 290 pp.
- Wannamaker, P. E., G. R. Jiracek, J. A. Stodt, T. G. Caldwell, A. D. Porter, V. M. Gonzalez, and J. D. McKnight, 2002, Fluid generation and movement beneath an active compressional orogen, the New Zealand Southern Alps, inferred from magnetotelluric (MT) data: *Journal of Geophysical Research*, 107(B6), ETG 6 1-22.
- Wannamaker, P. E., J. M. Bartley, A. F. Sheehan, C. H. Jones, A. R. Lowry, T. A. Dumitru, T. A. Ehlers, W. S. Holbrook, G. L. Farmer, M. J. Unsworth, D. B. Hall, D. S. Chapman, D. A. Okaya, B. E. John, and J. A. Wolfe, Great Basin-Colorado Plateau transition in central Utah: An interface between active extension and stable interior: *in* The Geological Transition: Colorado Plateau to Basin and Range, Proc. J. Hoover Mackin Symposium, ed. by M. C. Erskine, J. E. Faulds, J. M. Bartley and P. Rowley, UGA/AAPG Guideb. 30/GB78, Cedar City, Utah, September 20-23, 1-38, 2001.
- Wannamaker, P. E., 2000, Comment on "The petrologic case for a dry lower crust", by B. D. Yardley and J. W. Valley: *Journal of Geophysical Research*, 105, 6057-6064.
- Wannamaker, P. E., J. B. Hulen, and M. T. Heizler, 2000, Early Miocene lamproite from the Colorado Plateau tectonic province, Utah: *Journal of Volcanology and Geotherm. Research*, 96, 176-191.

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