

Curriculum Vitae

MICHAEL H. RITZWOLLER

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Citizenship: U.S.
Date of Birth: July 29, 1954

Research Interests

Theoretical, computational, and observational seismology, geophysical imaging and inversion, ambient noise and earthquake tomography, cross-disciplinary tomographic methodology, seismic surface waves and normal modes, modeling the Earth's crust and mantle, use of seismology in nuclear monitoring, shallow subsurface imaging using seismic waves and surface NMR, computational and observational ocean acoustics, X-ray tomographic imaging.

Education

1976 A.B. Marquette University
1980 M.A. University of Illinois, Chicago
1982 M.S. University of Wisconsin, Madison
1987 PhD University of California, San Diego

Position Held

2003 to present Professor, Department of Physics, University of Colorado, Boulder
1999 to present Director, Center for Imaging the Earth's Interior
1997 – 2003 Associate Professor, Department of Physics, University of Colorado, Boulder
1990 – 1998 Fellow, CIRES, University of Colorado, Boulder
1991 – 1993 Co-Director, Joint Seismic Program Center, University of Colorado, Boulder
1990 – 1997 Assistant Professor, Department of Physics, University of Colorado, Boulder
1987 – 1990 Post-Doctoral Fellow, Department of Earth and Planetary Sciences, Harvard University
1987 Post-Doctoral Researcher, Institute of Geophysics and Planetary Physics, UCSD
1982 – 1987 Research Assistant, Institute of Geophysics and Planetary Physics, UCSD
1980 – 1982 Research Assistant, Department of Geology and Geophysics, University of Wisconsin, Madison

Research Mentors

M.S. Charles Bentley (Wisconsin)
Ph.D. Guy Masters, Freeman Gilbert (UCSD, Scripps Institution of Oceanography)
Post-Doc John Woodhouse (Harvard)

Awards

2013	Gutenberg Lecturer, American Geophysical Union
2012	Geophysical Journal International, Reviewer of the Year
2005	American Geophysical Union, Fellow
2005 – 2006	University of Colorado Faculty Fellowship
1998 – 1999	University of Colorado Faculty Fellowship
1990	Fellow, Institute for Theoretical Physics, University of California, Santa Barbara
1982 – 1983	University of California Regents' Fellowship
1982 – 1983	Scripps Director's Fellowship

Professional Societies

American Association for the Advancement of Science
American Geophysical Union, Fellow
Royal Astronomical Society
Seismological Society of America
Society for Exploration Geophysicists
American Physical Society

Select Recent National and International Service

2018 -- 2019	AGU Gutenberg Lecture Selection Committee
2018 --	Associate Editor, Science Advances
2018	Advisory Board, Earth and Planetary Physics
2014	APS Communication Committee, Topical Group on the Physics of Climate
2013 – 2018	Associate Editor, Geochemistry, Geophysics, Geosystems
2013 --	Editor, Geophysical Journal International
2013 -- 2014	AGU Seismology Section Honors Nominating Committee
2012 – 2013	AGU Seismology Section Fellows Committee
2013	Convener, AGU Fall Meeting, Comparative Structural Seismology of China and the US: Recent Advances and Future Directions
2012	Convener, AGU Fall Meeting, Lithospheric Structure and Tectonics of Eastern Tibet, East China, Indochina, and Adjacent Seas
2009 – 2012	Incorporated Research Institutions for Seismology (IRIS) Polar Networks Standing Committee
2007 – 2010	Incorporated Research Institutions for Seismology (IRIS) Data Management System Standing Committee
2007	Organizing Committee, CIG/SPICE Joint Workshop, Jackson, NH Oct 2007.
2006	Organizing Committee, EarthScope/CIG Computational Seismology Workshop, St Louis, MO Oct 21-Nov 2 2006.
2005 – 2008	Incorporated Research Institutions for Seismology (IRIS) Transportable Array Working Group
2004 – 2011	Associate Editor, Journal of Geophysical Research Solid Earth
2005 – 2008	Computational Seismology Working Group of the Computational Infrastructure for Geodynamics

- 2004 Organizing Committee, Summer School on Mathematical Geophysics and Uncertainty in Earth Models, Golden, CO, June 14-25, 2004.
- 2004 – 2007 Incorporated Research Institutions for Seismology (IRIS) Global Seismic Network Standing Committee
- 2004 Lecturer, Abdus Salam International Centre for Theoretical Physics, Seventh Workshop on 3-D Modeling of Seismic Wave Generation, Propagation and their Inversion, Trieste, Italy, October, 2004.
- 2003 Organizing Committee (Chair), Structure and Evolution of the Antarctic Plate 2003 Workshop, Boulder, CO, March, 2003.
- 2002 Organizing Committee, Ocean Mantle Dynamics Workshop, Snowbird, UT, September, 2002.
- 2001 Colorado School of Mines, Geophysics Department, Advisory Committee
- 2001 Steering Committee, International Workshop on Seismic Tomography and Event Location: Reviews and Latest Developments, Umbria, Italy, June, 2001.
- 2000 Lecturer, Abdus Salam International Centre for Theoretical Physics, Fifth Workshop on 3-D Modeling of Seismic Wave Generation, Propagation and their Inversion, Trieste, Italy, September, 2000.
- 1999 Steering Committee, International Workshop on Tomographic Imaging of 3-D Velocity Structure and Accurate Earthquake Location, Paphos, Cyprus, 5-9 July, 1999.
- 1999 Chair, Workshop on Eurasian Tomography, Boulder, CO, February, 1999.
- 1998 Co-Chair, Workshop on the U.S. Use of Surface Waves for CTBT Monitoring, Boulder, CO, March, 1998.
- 1996 - 1997 American Geophysical Union, Editorial Search Committee
- 1996 Lecturer, Abdus Salam International Centre for Theoretical Physics, Third Workshop on 3-D Modeling of Seismic Wave, Generation, Propagation and their Inversion, Trieste, Italy, September, 1996.
- 1996 USGS, Albuquerque Data Collection Center Evaluation Committee
- 1996 - 2001 Associate Editor, Reviews of Geophysics
- 1994 - 2007 IRIS, Board of Directors and later Institutional Representative

Selected Bibliography for Michael H. Ritzwoller

Pdfs of most publications can be found at: ciei.colorado.edu/ritzwoller .

Google Scholar statistics (Mar 2019): Citations: 13,782, h-index: 60, i10-index: 109.

Thomson Reuters Web of Science (Mar 2019, All Databases): Citations: 9,349, h-index: 49.

Refereed Publications Sorted by Year

1. Wu., M., M.P. Barmin, R.K. Andrew, P.B. Weichman, A.W. White, E.M. Lavelly, M.A. Dzieciuch, J.A. Mercer, P.F. Worchester, and M.H. Ritzwoller, Deep water acoustic range estimation based on an ocean general circulation model: Application to PhilSea10 data, *J. Ac. Soc. Amer.*, submitted, 2019.
2. Ritzwoller, M.H. and L. Feng, Overview of pre- and post-processing of ambient noise correlations, In N. Nakata, L. Gualtieri, and A. Fichtner (Eds.), *Ambient Seismic*

- Noise* (pp. 144-187), Cambridge, Cambridge University Press, doi:10.1017/9781108264808.007, 2019.
3. Levshin, A., W. Shen, M. Barmin, and M.H.Ritzwoller, Surface wave studies of the Greenland upper lithosphere using ambient seismic noise, *Pure and Applied Geophys.*, submitted, 2018.
 4. Levshin, A., W. M.P. Barmin, and M.H.Ritzwoller, Tutorial review of seismic surface waves phenomenology, *J. Seismol.*, 22(2), 519-537, doi:10.1007/s10950-017-9716-7, 2018.
 5. Feng, L. and M.H.Ritzwoller, The effect of sedimentary basins on surface waves that pass through them, *Geophys. J. Int.*, 211(1), 572-592, doi:10.1093/gji/ggx313, 2017.
 6. Tian, Y. and M.H.Ritzwoller, Improving ambient noise cross-correlations in the noisy ocean bottom environment of the Juan de Fuca plate, *Geophys. J. Int.*, 210(3), 1787-1805, doi.org/10.1093/gji/ggx281, 2017.
 7. Xie, J., M.H. Ritzwoller, W. Shen, and W. Wang, Crustal anisotropy across Eastern Tibet and surroundings modeled as a depth-dependent tilted hexagonally symmetric medium, *Geophys. J. Int.*, 209, 466-491, doi: 10.1093/gji/ggx004, 2017.
 8. Kang, D., W. Shen, J. Ning, and M.H. Ritzwoller, Seismic evidence for lithospheric modification associated with intra-continental volcanism in Northeastern China, *Geophys. J. Int.*, 204(1), 215-235, doi:10.1093/gji/ggv441, 2016.
 9. Shen, W. and M.H. Ritzwoller, Crustal and uppermost mantle structure beneath the United States, *J. Geophys. Res. Solid Earth*, doi:10.1002/2016JB012887, 2016.
 10. Shen, W., M.H. Ritzwoller, D. Kang, Y. Kim, J. Ning, F.-C. Lin, W. Wang, Y. Zheng, and L. Zhou, A seismic reference model for the crust and uppermost mantle beneath China from surface wave dispersion, *Geophys. J. Int.*, 206(2), doi:10.1093/gji/ggw175, 2015.
 11. Deng, Y., W. Shen, T. Xu, and M.H. Ritzwoller, Crustal layering in northeastern Tibet: A case study based on joint inversion of receiver functions and surface wave dispersion, *Geophys. J. Int.*, 203(1), 692-706, doi:10.1093/gji/ggv321, 2015.
 12. Ye, T. and M.H. Ritzwoller, Directionality of ambient noise on the Juan de Fuca Plate: Implications for source locations of the primary and secondary microseisms, *Geophys. J. Int.*, 429-443, 2015.
 13. Xie, J., M.H. Ritzwoller, S. Brownlee, and B. Hacker, Inferring the oriented elastic tensor from surface wave observations: Preliminary application across the Western US, *Geophys. J. Int.*, 201, 996-1021, 2015.
 14. Hacker, B.R., M.H. Ritzwoller, and J. Xie, Central Tibet has a partially melted, mica-bearing crust, *Tectonics*, 33, doi:10.1002/2014TC003534, 2014.
 15. Levandowski, W., C. Jones, W. Shen, M.H. Ritzwoller and V. Schulte-Pelkum, Crustal and upper mantle density variations beneath the western US: compositional topography, thermal topography, and gravitational potential energy, *J. Geophys. Res.*, *J. Geophys. Res.*, 119, 2375-2396, doi: 10.1002/2013JB010607, 2014.
 16. Kao, H., Y. Behr, C. Currie, R. Hyndman, J. Townend, F.-C. Lin, M.H. Ritzwoller, S.-J. Shan, and J. He, Ambient seismic noise tomography of Canada and adjacent regions: Part I Crustal structures, *J. Geophys. Res.*, 118, 5865-5887, 2013.
 17. Shen, W., M.H. Ritzwoller, and V. Schulte-Pelkum, Crustal and uppermost mantle structure in the central US encompassing the Midcontinental Rift, *J. Geophys. Res.*, 118, 4325-4344, doi:10.1002/jgrb.50321, 2013.

18. Xie, J., M.H. Ritzwoller, W. Shen, Y. Yang, Y. Zheng, and L. Zhou, Crustal radial anisotropy across eastern Tibet and the western Yangtze craton, *J. Geophys. Res.*, 118, 4226-4252, doi:10.1002/jgrb.50296, 2013.
19. Ye, T., W. Shen, and M.H. Ritzwoller, Crustal and uppermost mantle shear velocity structure adjacent to the Juan de Fuca Ridge from ambient seismic noise, *Geochem. Geophys. Geosyst.*, 14(8), 3221-3233, doi:10.1002/ggge.20206, 2013.
20. Shen, W., M.H. Ritzwoller, V. Schulte-Pelkum, F.-C. Lin, Joint inversion of surface wave dispersion and receiver functions: A Bayesian Monte-Carlo approach, *Geophys. J. Int.*, 192, 807-836, doi:10.1093/gji/ggs050, 2013.
21. Shen, W., M.H. Ritzwoller, and V. Schulte-Pelkum, A 3-D model of the crust and uppermost mantle beneath the central and western US by joint inversion of receiver functions and surface wave dispersion, *J. Geophys. Res.*, 118, 1-15, doi:10.1029/2012JB009602, 2013.
22. Levshin, A.L., M.P. Barmin, M.P. Moschetti, C. Mendoza, and M.H. Ritzwoller, Refinements to the method of epicentral location based on surface waves from ambient seismic noise: Introducing Love waves, *Geophys. J. Int.*, doi: 10.1111/j.1365-246X.2012.05631.x, 2012.
23. Lin, F.-C., V. Tsai, and M.H. Ritzwoller, The local amplification of surface waves: A new observable to constrain elastic velocities, density, and anelastic attenuation, *J. Geophys. Res.*, 117, B06302, doi:10.1029/2012JB009208, 2012.
24. Yang, Y., M.H. Ritzwoller, Y. Zheng, A.L. Levshin, and Z. Xie, A synoptic view of the distribution and connectivity of the mid-crustal low velocity zone beneath Tibet, *J. Geophys. Res.*, 117, B04303, doi:10.1029/2011JB008810, 2012.
25. Zheng, Y., J. Li, Z. Xi, and M.H. Ritzwoller, 5 Hz GPS seismology of the El Mayor-Cucapah earthquake: Estimating the earthquake focal mechanism, *Geophys. J. Int.*, 190, 1723-1732, doi: 10.1111/j.1365-246X.2012.05576.x, 2012.
26. Zhou, L., J. Xie, W. Shen, Y. Zheng, Y. Yang, H. Shi, and M.H. Ritzwoller, The structure of the crust and uppermost mantle beneath South China from ambient noise and earthquake tomography, *Geophys. J. Int.*, 189, 1565-1583, doi:10.1111/j.1365-246X.2012.05423.x, 2012.
27. Zheng, Y., W. Shen, L. Zhou, Y. Yang, Z. Xie, and M.H. Ritzwoller, Crust and uppermost mantle beneath the North China Craton, northeastern China, and the Sea of Japan from ambient noise tomography, *J. Geophys. Res.*, 116, B12312, doi:10.1029/2011JB008637, 2011.
28. Barmin, M.P., A.L. Levshin, Y. Yang, and M.H. Ritzwoller, Epicentral location based on Rayleigh wave empirical Green's functions from ambient seismic noise, *Geophys. J. Int.*, 184 (2), 869-884, 2011.
29. Lin, F.C., M.H. Ritzwoller, Y. Yang, M.P. Moschetti, and M.J. Fouch, Complex and variable crustal and uppermost mantle seismic anisotropy in the western United States, *Nature Geoscience*, Vol 4, Issue 1, 55-61, Jan 2011.
30. Lin, F.C., M.H. Ritzwoller, and W. Shen, On the reliability of attenuation measurements from ambient noise cross-correlations, *Geophys. Res. Letts.*, 38, L11303, doi:10.1029/2011GL047366, 2011.
31. Lin, F.C. and M.H. Ritzwoller, Helmholtz surface wave tomography for isotropic and azimuthally anisotropic structure, *Geophys. J. Int.*, 186, 1104-1120, doi: 10.1111/j.1365-246X.2011.05070.x, 2011

32. Lin, F.C. and M.H. Ritzwoller, Apparent anisotropy in inhomogeneous isotropic media, *Geophys. J. Int.*, 186(3), 1205-1219, 2011.
33. Ritzwoller, M.H., F.C. Lin, and W. Shen, Ambient noise tomography with a large seismic array, *Compte Rendus Geoscience*, 13 pages, doi:10.1016/j.crte.2011.03.007, 2011.
34. Yang, Y., W. Shen and M.H. Ritzwoller, Surface wave tomography in a large-scale seismic array combining ambient noise and teleseismic earthquake data, *Earthquake Science*, 24, 55-64, 2011.
35. Yang, Y., M.H. Ritzwoller, and C.H. Jones, Crustal structure determined from ambient noise tomography near the magmatic centers of the Coso region, southeastern California, *Geochem. Geophys. Geosyst.*, 12, Q02009, doi:10.1029/2010GC003362, 2011.
36. Levshin, A.L., X. Yang, M.P. Barmin, and M.H. Ritzwoller, Mid-period Rayleigh wave attenuation model for Asia, *Geochem. Geophys. Geosyst.*, 11(8), Q08017, doi:10.1029/2010GC003164., 20 August 2010.
37. Lin, F.C. and M.H. Ritzwoller, Empirically determined finite frequency sensitivity kernels for surface waves, *Geophys. J. Int.*, 182, 923-932, doi: 10.1111/j.1365-246X.2010.04643.x, 2010.
38. Moschetti, M.P., M.H. Ritzwoller, F.C. Lin, and Y. Yang, Crustal shear velocity structure of the western US inferred from ambient noise and earthquake data, *J. Geophys. Res.*, 115, B10306, doi:10.1029/2010JB007448, 2010.
39. Sun, X., X. Song, S. Zheng, Y. Yang, M. Ritzwoller, Three dimensional shear velocity structure of the crust and upper mantle beneath China from ambient noise surface wave tomography, *Earthquake Science*, 23, 449-463, doi:10.1007/s11589-010-0744-3, 2010.
40. Yang, Y., et al., Rayleigh wave phase velocity maps of Tibet and the surrounding regions from ambient seismic noise tomography, *Geochem., Geophys., Geosyst.*, 11(8), Q08010, doi:10.1029/2010GC003119, 6 August 2010.
41. Zheng, Y., Y. Yang, M.H. Ritzwoller, X. Zheng, X. Xiong, Z. Li, Crustal structure of the northeastern Tibetan Plateau, the Ordos Block and the Sichuan Basin from ambient noise tomography, *Earthquake Science*, 23, 465-476, doi:10.1007/s11589-010-0745-3, 2010.
42. Moschetti, M. P., M. H. Ritzwoller, and F. C. Lin, Seismic evidence for widespread crustal flow caused by extension in the western USA, *Nature*, 464, Number 7290, 885-889, 8 April 2010.
43. Bensen, G. D., M. H. Ritzwoller, and Y. Yang, A 3D shear velocity model of the crust and uppermost mantle beneath the United States from ambient seismic noise, *Geophys. J. Int.*, 177(3), 1177-1196, 2009.
44. Lin, F.-C., M.H. Ritzwoller, and R. Snieder, Eikonal Tomography: Surface wave tomography by phase-front tracking across a regional broad-band seismic array, *Geophys. J. Int.*, 177(3), 1091-1110, 2009.
45. Bensen, G.D., M.H. Ritzwoller, and N.M. Shapiro, Broad-band ambient noise surface wave tomography across the United States, *J. Geophys. Res.*, 113, B05306, 21 pages, doi:10.1029/2007JB005248, 2008.

46. Lin, F., M.P. Moschetti, and M.H. Ritzwoller, Surface wave tomography of the western United States from ambient seismic noise: Rayleigh and Love wave phase velocity maps, *Geophys. J. Int.*, doi:10.1111/j.1365-246X.2008.03720.x, 2008.
47. Shapiro, N.M., M.H. Ritzwoller, and E.R. Engdahl, Structural context of the great Sumatra-Andaman Island earthquake, *Geophys. Res. Lett.*, 35, L05301, doi:10.1029/2008GL033381, 2008.
48. Yang, Y. and M.H. Ritzwoller, The characteristics of ambient seismic noise as a source for surface wave tomography, *Geochem., Geophys., Geosys.*, 9(2), Q02008, 18 pages, doi:10.1029/2007GC001814, 2008.
49. Yang, Y., A. Li, and M.H. Ritzwoller, Crustal and uppermost mantle structure in southern Africa revealed from ambient noise and teleseismic tomography, *Geophys. J. Int.*, doi:10.1111/j.1365-246X.2008.03779.x, 2008.
50. Yang, Y. and M.H. Ritzwoller, Teleseismic surface wave tomography in the western US using the Transportable Array component of USArray, *Geophys. Res. Letts.*, 5, L04308, doi:10.1029/2007GL032278, 2008.
51. Yang, Y., M.H. Ritzwoller, F.-C. Lin, M.P. Moschetti, and N.M. Shapiro, The structure of the crust and uppermost mantle beneath the western US revealed by ambient noise and earthquake tomography, *J. Geophys. Res.*, 113, B12310, 2008.
52. Zheng, S., X. Sun, X. Song, Y. Yang, and M. H. Ritzwoller (2008), Surface wave tomography of China from ambient seismic noise correlation, *Geochem. Geophys. Geosys.*, 9, Q0502, doi:10.1029/2008GC001981, 2008.
53. Bensen, G.D., M.H. Ritzwoller, M.P. Barmin, A.L. Levshin, F. Lin, M.P. Moschetti, N.M. Shapiro, and Y. Yang, Processing seismic ambient noise data to obtain reliable broad-band surface wave dispersion measurements, *Geophys. J. Int.*, 169, 1239-1260, doi: 10.1111/j.1365-246X.2007.03374.x, 2007.
54. Levshin, A.L., J. Schweitzer, C. Weidle, N.M. Shapiro, and M.H. Ritzwoller, Surface wave tomography of the Barents Sea and surrounding regions, *Geophys. J. Int.*, doi:10.1111/j.1365-246X.2006.03285.x, 2007.
55. Lin, F., M.H. Ritzwoller, J. Townend, M. Savage, S. Bannister, Ambient noise Rayleigh wave tomography of New Zealand, *Geophys. J. Int.*, 18 pages, doi:10.1111/j.1365-246X.2007.03414.x, 2007.
56. Moschetti, M.P., M.H. Ritzwoller, and N.M. Shapiro, Surface wave tomography of the western United States from ambient seismic noise: Rayleigh wave group velocity maps, *Geochem., Geophys., Geosys.*, 8, Q08010, doi:10.1029/2007GC001655.
57. Yang, Y., M.H. Ritzwoller, A.L. Levshin, and N.M. Shapiro, Ambient noise Rayleigh wave tomography across Europe, *Geophys. J. Int.*, 168(1), page 259, 2007.
58. Villasenor, A., Y. Yang, M.H. Ritzwoller, and J. Gallart, Ambient noise surface wave tomography of the Iberian Peninsula: Implications for shallow seismic structure, *Geophys. Res. Lett.*, 34, L11304, doi:10.1029/2007GL030164.
59. Zhong, S., M.H. Ritzwoller, N.M. Shapiro, W. Landuyt, J. Huang, and P. Wessel, Bathymetry of the Pacific Plate and its implications for the thermal evolution of lithosphere and mantle dynamics, *J. Geophys. Res.*, 112, B06412, doi:1029/2006JB004628, 1007.
60. Lin, F., M. H. Ritzwoller, and N. M. Shapiro, Is ambient noise tomography across ocean basins possible?, *Geophys. Res. Lett.*, 33, L14304, doi:10.1029/2006GL026610, 2006.

61. Shapiro, N.M., M.H. Ritzwoller, and G.D. Bensen, Source location of the 26 sec microseism from cross correlations of ambient seismic noise, *Geophys. Res. Lett.*, 33, L18310, doi:10.1029/2006GL027010, 2006.
62. Shapiro, N.M. M. Campillo, L. Stehly, and M.H. Ritzwoller, High resolution surface wave tomography from ambient seismic noise, *Science*, 307(5715), 1615-1618, 11 March 2005.
63. van Hunen, J., S. Zhong, N.M. Shapiro, and M.H. Ritzwoller, New evidence for dislocation creep from 3-D geodynamic modeling of the Pacific upper mantle, *Earth Planet Sci. Lett.*, doi:10.1016/j.epsl.2005.07.006, 10 pps., 2005.
64. Yang, X., A.R. Lowry, A.L. Levshin, and M.H. Ritzwoller, Toward a Rayleigh wave attenuation model for Eurasia and calibrating a new M_s formula, *Proceedings of the 27th Seismic Research Review -- Ground-Based Nuclear Explosion Monitoring*, Palm Springs, CA (Sept 20 - 22, 2005), 2005.
65. Levin, V., N.M. Shapiro, J. Park, and M.H. Ritzwoller, The slab portal beneath the Western Aleutians, *Geology*, 33(4), 253-256, 2005.
66. Levshin, A.L., M.P. Barmin, M.H. Ritzwoller, and J. Trampert, Minor-arc and major-arc global surface wave diffraction tomography, *Phys. Earth Planet. Int.*, 149, 205-223, 2005.
67. Levshin, A.L., M.H. Ritzwoller, and N.M. Shapiro, The use of crustal higher modes to constrain crustal structure across Central Asia, *Geophys. J. Int.*, 160, 961-972, 2005.
68. Shapiro, N.M. M.H. Ritzwoller, J.C. Mareschal, and C. Jaupart, Lithospheric structure of the Canadian Shield inferred from inversion of surface-wave dispersion with thermodynamic a priori constraints, *Geol. Soc. Lond. Spec. Publ., Geological Prior Information: Informing Science and Engineering*, ed. R. Wood and A. Curtis, 239, 175-194, 186239-171-8/04/\$15.00, The Geological Society of London, 2005.
69. Smith, D.B., M.H. Ritzwoller, and N.M. Shapiro, Stratification of anisotropy in the Pacific upper mantle, *J. Geophys. Res.*, 109, B11309, doi:10.1029/2004JB003200, 2004.
70. Butler, R. T. Lay, K. Creager, P. Earl, K. Fischer, J. Gaherty, G. Laske, B. Leith, J. Park, M. Ritzwoller, J. Tromp, and L. Wen, The global seismic network surpasses its design goal, *Eos.*, 85(23), 8 June 2004.
71. Ritzwoller, M.H., N.M. Shapiro, S. Zhong, Cooling history of the Pacific lithosphere, *Earth Planet. Sci. Letts.*, 226, 69-84, 2004.
72. Shapiro, N.M. and M.H. Ritzwoller, Thermodynamic constraints on seismic inversions, *Geophys. J. Int.*, 157, 1175-1188, doi:10.1111/j.1365-246X.2004.02254.x, 2004.
73. Shapiro, N.M., M.H. Ritzwoller, P. Molnar, and V. Levin, Thinning and flow of Tibetan crust constrained by seismic anisotropy, *Science*, 305, 233-236, 9 July 2004.
74. Shapiro, N.M. and M.H. Ritzwoller, Inferring surface heat flux distributions guided by a global seismic model: Particular application to Antarctica, *Earth Planet. Sci. Lett.*, 223, 213 - 224, 2004.
75. Yang, X., I. Bondar, J. Bhattacharyya, M. Ritzwoller, N. Shapiro, M. Antolik, G. Ekstrom, H. Israelsson, and K. McLaughlin, Validation of regional and teleseismic travel-time models by relocation of GT events, *Bull. Seis. Soc. Am.* 94(3), 897-919, 2004.

76. Ritzwoller, M.H., N.M. Shapiro, and G.M. Leahy, A resolved mantle anomaly as the cause of the Australian-Antarctic Discordance, *J. Geophys. Res.*, 108, no. B12, 2559, doi:10.1029/2003JB002522, 2003.
77. Ritzwoller, M.H., N.M. Shapiro, A.L. Levshin, E.A. Bergman, and E.R. Engdahl, The ability of a global 3-D model to locate regional events, *J. Geophys. Res.*, 108, no. B7, 2353, ESE 9-1 - ESE 9-24, 2003.
78. Levin, V., N.M. Shapiro, J. Park, and M.H. Ritzwoller, Seismic evidence for catastrophic slab loss beneath Kamchatka, *Nature*, 418, 763-767, 15 Aug 2002.
79. Levshin, A.L. and M.H. Ritzwoller, Application of a global-scale 3-D model to improve regional locations, *Stud. Geophys. Geod.*, 46, 283-292, 2002.
80. Ritzwoller, M.H. and A.L. Levshin, Estimating shallow shear velocities with marine multi-component seismic data, *Geophysics*, 67 (6), 1991-2004, 2002.
81. Ritzwoller, M.H., N.M. Shapiro, M.P. Barmin, and A.L. Levshin, Global surface wave diffraction tomography, *J. Geophys. Res.*, 107(B12), 2335, 2002.
82. Ritzwoller, M.H., M.P. Barmin, A. Villasenor, A.L. Levshin, and E.R. Engdahl, Pn and Sn tomography across Eurasia, *Tectonophys.*, 358 (1-4), 39-55, 2002.
83. Shapiro, N.M. and M.H. Ritzwoller, Monte-Carlo inversion for a global shear velocity model of the crust and upper mantle, *Geophys. J. Int.*, 151, 88-105, 2002.
84. Villasenor, A., M.P. Barmin, M.H. Ritzwoller, and A.L. Levshin, Computation of regional travel times and station corrections for three-dimensional velocity models, report.
85. Weichman, P.B., Lun, D.R., M.H. Ritzwoller, and E.M. Lavelly, Study of surface nuclear magnetic resonance inverse problems, *J. Appl. Geophys.*, 50, 129-147, 2002.
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Grants and Contracts While at CU

- *IRIS' Joint Seismic Program Center*; IRIS, PI M. Ritzwoller, Co-PI D. Harvey, \$192,000; 8/1/91-12/31/91.
- *IRIS' Joint Seismic Program Center*; IRIS, PI M. Ritzwoller, Co-PI D. Harvey, \$400,000; 1/1/92-12/31/92.
- *Theoretical and Observational Studies of Giant Cell Convection with Helioseismology*; NSF, Atmospheric Sciences, Solar Terrestrial Program, ATM-9122571, PI M. Ritzwoller, \$96,929, 5/15/92-5/14/94.
- *IRIS' Joint Seismic Program Center*; IRIS, PI M. Ritzwoller, Co-PI D. Harvey, \$550,000; 1/1/93-12/31/93.
- *Operational and Programmatic Research in Support of the Joint Seismic Program*, IRIS, PI C. Archambeau, Co-PI M. Ritzwoller, \$213,282, 7/1/94-6/30/95.
- *Eurasian Surface Wave Phenomenology and Inversion for Crustal and Upper Mantle Structures*, AFOSR, PI M. Ritzwoller, Co-PI A. Levshin, \$186,724, 4/1/95-10/31/96.
- *Development of Discrimination, Detection and Location Capabilities in Central and Southern Asia Using Middle-Period Surface Waves Recorded by a Regional Array*, AFOSR -AFTAC, PI M. Ritzwoller, Co-PI A. Levshin, \$133,573, 6/1/95-5/30/97.
- *Normal Mode Studies of Even and Odd Degree Elastic and Anelastic Structures of the Mantle and Core*, NSF-Earth Sciences-Geophysics, PI M. Ritzwoller, \$109,991, 6/1/95-5/30/97.
- *Surface Wave Stacking of JSP Data*, IRIS, PI M. Ritzwoller, \$19,400, 7/1/95-6/30/96.
- *Modeling and Analysis of GONG Lineshapes*, NSF-Solar and Stellar Astrophysics, PI M. Ritzwoller, Co-PI R. Stebbins, \$248,000, 4/1/96-3/30/99.
- *Seismic Source Studies for Monitoring a Comprehensive Test Ban Treaty*, NATO Linkage Grant, \$20,000, PI and Project Director, M. Ritzwoller, Co-PI's: Anatoli Levshin (Project Coordinator) and B.G. Bukchin, Lead Researcher from the Russian Academy of Sciences, 6/1/96-6/30/98.
- *Acquisition of a Global Geophysics Computer Server*, NSF-Facilities and Instrumentation, PI M. Ritzwoller, Co-PI JohnWahr, \$34,200, 1/1/97-12/31/97.
- *The Structure of the Crust and Lithosphere of the Antarctic Plate*, NSF-Office of Polar Programs, PI M. Ritzwoller, \$180,000, 3/1/97-12/31/99.
- *Normal Mode Studies of the Mantle and Core*, NSF-Earth Sciences-Geophysics, PI M. Ritzwoller, \$120,000, 6/1/97-5/30/99.
- *Discrimination, Detection, Depth, Location, and Wave Propagation Studies Using Intermediate Period Surface Waves in the Middle East, Central Asia, and the Far East*, DSWA, PI M. Ritzwoller, Co-PI Anatoli Levshin, \$362,000, 10/1/97-9/30/00.
- *Feasibility of Use of 3D Models to Improve Regional Locations in W. China, C. Asia, and Parts of the Middle East*, DTRA, PI M. Ritzwoller, \$625,000, 2/12/99-8/31/02.
- *Surface Wave Tomography of the Arctic*, NSF-OPP (Arctic), \$199,000, PI M. Ritzwoller, 3/1/99-3/28/02.
- *Improvement of Detection and Discrimination Using Short Period (7-15s) Surface Waves in W. China, N. India, Pakistan, and Environs*, DTRA, PI M. Ritzwoller, Co-PI Anatoli Levshin, \$414,000, 3/1/00-2/28/03.
- *IMS Location Calibration - W.Asia and Africa*, DTRA subcontract from SAIC, PI M.

- Ritzwoller, \$499,000, 3/1/01-12/31/02.
- *Collaborative Research: Active Tectonics at the Aleutian-Kamchatka Corner: A Lithospheric Perspective*, NSF-OPP (Arctic), PI M. Ritzwoller, Co-PI N. Shapiro, \$60,000, 3/1/02-2/28/04.
 - *Refinements and Interpretation of Images of the Antarctic Crust and Upper Mantle*, NSF-OPP (Antarctic), PI M. Ritzwoller, Co-PI N. Shapiro, \$240,000, 6/1/02-5/30/05.
 - *Modeling the Middle American Lithosphere: Illuminating the Enigma of Cocos Plate Subduction*, NSF-EAR, PI M. Ritzwoller, Co-PI N. Shapiro, \$60,000, 7/1/02-6/30/03.
 - *Structure and Evolution of the Antarctic Plate (SEAP) 2003 Workshop*, NSF-OPP (Antarctic), PI M. Ritzwoller, \$53,000, 8/1/02-7/31/03.
 - *CMG Training: Summer School on Mathematical Geophysics and Uncertainty in Earth Models*, PI R. Snieder (Colorado School of Mines), Co-PI M. Ritzwoller, NSF-ATM, \$180,000, 2/1/04-1/31/05. (All money to Colorado School of Mines to run the summer school.)
 - *Structure of the Tibetan Crust and Upper Mantle and its Geodynamic Implications*, NSF-EAR, PI M. Ritzwoller, \$240,000, 1/1/04-12/31/06.
 - *Seismic and Geodynamic Investigation of the Interaction Between the Oceanic Lithosphere and Upper Mantle*, NSF joint award from EAR and OCE, PI M. Ritzwoller, \$230,000, 7/1/04-6/30/07.
 - *New Physics-Based Methodology for Optimizing Tracking ATR Performance Via Feature Level Fusion of Multi-Sensor Data*, subcontract from AlphaTech Inc., PI Ritzwoller, \$110,000, 6/1/04-12/31/05.
 - *New Method of Calibrating Surface-Wave Path Effects in North Africa, the Middle East, and Central Asia*, DoE/NNSA, PI Ritzwoller, \$303,488, 6/1/05-5/31/08. (Collaborative proposal with Lawrence Livermore National Laboratory.)
 - *Rayleigh Wave Attenuation Model for Eurasia and Calibrating a New M Formula*, DoE/NNSA, PI Ritzwoller, \$300,520, 6/1/05-5/31/08. (Collaborative proposal with Los Alamos National Laboratory.)
 - *Seismic Observations from the Random Wave Field: A New Tool for High-Resolution Seismology in the Context of EarthScope*, NSF-EAR (EarthScope), PI Ritzwoller, \$245,000, 5/1/05-4/30/08.
 - *Surface Wave Dispersion Measurements and Tomography from Ambient Seismic Noise in China*, DoE/NNSA, PI Ritzwoller, sub-contract from University of Illinois (X.Song, PI), \$115,429, 12/20/06-12/15/09.
 - *Acquisition of a PC Cluster for Geophysical Modeling*, NSF-EAR, Co-PI Ritzwoller, \$90,940, 5/1/07-4/30/10.
 - *Ambient Noise and Teleseismic Tomography to Infer the Physical State and Structure of the Crust and Upper Mantle in the Western US*, NSF-EAR-0711526, PI Ritzwoller, \$276,554, 7/1/07-5/31/11.
 - *A US-China Partnership in Research and Education on Intraplate Earthquakes*, NSF-PIRE, PI Ritzwoller, sub-contract from University of Missouri (M. Liu, PI), \$100,729, 8/1/07-7/31/10.
 - *Crustal Structure of the Iran Region from In-Country and Ground Truth Data*, Co-PI Ritzwoller, \$613,239, 4/21/08-4/20/11.

- *Subsurface Characterization Beneath the Coso Geothermal Field by Ambient Noise and Coda Wave Interferometry*, DoD-Navy, PI Ritzwoller, \$254,223, 7/3/08-3/31/10.
- *Crustal and Uppermost Mantle Anisotropy from Seismic Ambient Noise Data Observed on EarthScope/USArray*, NSF-EAR, PI Ritzwoller, \$234,830, 1/1/09-12/31/11.
- *A Novel Method of Regional Location and Discrimination Based on Empirical Green's Functions from Ambient Noise*, DOE/NNSA, PI Ritzwoller, \$365,826, 6/1/09-5/31/12.
- *Crustal and Uppermost Mantle Anisotropy Beneath Tibet: New Constraints on Deformation*, NSF-EAR-0944022, PI M. Ritzwoller, \$284,088, 1/1/10-12/31/13.
- *Ambient Noise Cross-Correlation Waveform Database for the TA in the Western US*, Incorporated Research Institutions for Seismology (IRIS), PI M. Ritzwoller, \$24,049, 5/1/11-4/30/12.
- *Development of the Use of Ambient Noise Cross-Correlations to Improve Location Capabilities*, United States Geological Survey, NEHRP, PI M. Ritzwoller, \$104,495, 1/1/12-12/31/13.
- *The Seismic Structure, Thermal State, and Anisotropy of the Crust and Uppermost Mantle Beneath the Contiguous US*, NSF-EarthScope, EAR-1252085, PI M. Ritzwoller, \$263,625 4/1/13-3/31/16.
- *Understanding the Physical Cause of Surface Wave Amplitude Variations in Order to Improve Ms Estimates Across East Asia*, AFRL, PI M. Ritzwoller, CU: \$397,231, 9/1/13-8/31/16. (Additional subcontract to LLNL (M. Pasyanos PI), \$193,916).
- *Crustal Anisotropy Across Tibet: Implications for the Existence of Partial Melt and the Vertical Coherence of Deformation*, NSF-Geophysics, EAR-1246925, PI M. Ritzwoller, \$145,000, 7/1/13-6/30/15.
- *The Use of Surface Waves to Improve Earthquake Locations Across the US*, United States Geological Survey, NEHRP, PI M. Ritzwoller, \$49,271, 1/1/14-12/31/14.
- *A Synoptic View of the Formation, Evolution, and Shallow Subduction of the Juan de Fuca and Gorda Plates*, National Science Foundation, OCE 1537868, PI Michael Ritzwoller, \$274,530, 9/1/15-8/31/17.
- *Crustal and Uppermost Mantle Anisotropy Across Tibet and East China*, National Science Foundation, EAR 1645269, PI Michael Ritzwoller, \$290,325, 1/1/17-12/31/19.
- *Non-Destructive Statistical Estimation of Nanoscale Structures and Electronics (NSENSE)*, IARPA Subcontract from BAE to CU, CU PI Michael Ritzwoller, \$234,865, 9/1/17-8/31/18.
- *Seismic interferometry and data assimilation for lithospheric structure and anisotropy across Alaska*, National Science Foundation, Geophysics, PI Michael Ritzwoller, \$296,167, 9/1/19-8/31/22. (PENDING)

Local Service

University and Departmental Committees:

1990-1991: Graduate Committee (Phys), Geophysics Committee (Phys), Recruitment Committee (Phys, Nauenberg, Chair), CIRES Fellows Committee

1991-1992: Computer Committee (Phys), Geophysics Committee Chair (Phys), Condensed Matter Search Committee (Phys), Reappointment Committee (CIRES), Promotion Committee (Phys), CIRES Fellows Committee

1992-1993: Computer Committee (Phys), Geophysics Committee Chair (Phys), Geophysics Comprehensive Exam Committee Chair (Resovsky, Solheim), CIRES Fellows Committee

1993-1994: Geophysics Committee Chair (Phys), Junior Faculty Steering Committee (Phys), CIRES Fellows Committee

1994-1995: Geophysics Committee, Chair (Phys), Junior Faculty Steering Committee (Phys), CIRES Fellows, Physics Faculty Evaluation Committee (Phys), Physics Graduate Committee (Phys), Chair's Special Committee on the Future of Computing (Phys.)

1995-1996: Graduate Committee, Chair (Phys), Geophysics Committee, Chair (Phys), Junior Faculty Steering Committee (Phys), CIRES Fellows, Plasma Physics Junior Faculty Search Committee (Phys)

1996-1997: Graduate Committee, Chair (Phys), Geophysics Committee, Chair (Phys), Junior Faculty Steering Committee (Phys), CIRES Fellows, Reappointment Committee (CIRES), Boulder Faculty Committee on Classified Research

1997-1998: Graduate Committee, Physics Faculty Evaluation Committee, Physics Reallocation /Reinvestment Committee, Physics H-Wing Committee, CIRES Fellows, Boulder Faculty Committee on Classified Research

1998-1999: Faculty Evaluation Committee, Boulder Faculty Committee on Classified Research

1999-2000: Geophysics Faculty Search Committee (Chair), Boulder Faculty Committee on Classified Research

2000-2001: Chair's Advisory Committee (CAC), Colloquium Committee, Boulder Faculty Committee on Classified Research

2001-2002: Colloquium Committee (Chair), Boulder Faculty Committee on Classified Research

2002-2003: High Energy Theory Faculty Search Committee, Boulder Faculty Committee on Classified Research

2003-2004: Faculty Evaluation Committee, Honors and, Boulder Faculty Committee on Classified Research

2004-2005: Faculty Evaluation Committee (Chair), Honors and (Chair), Boulder Faculty Committee on Classified Research

2005-2006: Boulder Faculty Committee on Classified Research

2006-2007: Undergraduate Committee (Chair), Physics Evaluation Committee

2007-2008: High Energy Faculty Search Committee, Physics Self-Study Committee (Chair)

2008-2009: Chair's Advisory Committee, Geophysics Faculty Search Committee

2009-2010: Physics Dept Teaching Evaluation Committee, Physics Department Self-Study Committee

2010-2011: Faculty Evaluation Committee

2011-2012: Physics Dept Teaching Evaluation Committee, Physics Dept Chair Search Committee

2012-2013: Boulder Faculty Assembly, Faculty Compensation and Benefits Committee, Boulder Campus Research Review Board, Physics Evaluation Committee, Physics Dept Comps II Committee

2013-2014: Boulder Faculty Assembly, Faculty Compensation and Benefits Committee, Boulder Campus Research Review Board, Geophysics Search Committee

2014-2015: Boulder Faculty Assembly, Boulder Campus Research Review Board, Geophysics Search Committee, Teaching Evaluation Committee

2015-2016: Physics Dept Evaluation Committee, Chair

2016-2017: Physics Dept Evaluation Committee (Chair, Fall), Physics Dept Research Strategic Planning Committee (Chair, Fall), Physics Honors Program, Chair

2017-2018: Physics Dept Executive Committee, Physics Education Research Faculty Search Committee, Physics Honors Program

2018-2019: Physics Dept Executive Committee, Physics Dept Teaching Evaluation Committee (Fall)

Thesis Committee Membership and Advising

Graduated

1991 – M. Glaser (Physics).

1993 – B. Kohl (Physics), M. Kohl (Physics), D. Han (Geophysics), A. Rodgers (Physics)

1994 – F. Creamer (Geology), E. Perlman (APAS)

1995 – B. Hindman (APAS), J. Orrey (Physics, Titular Advisor), H. Bump (Geology, M.S.)

1996 – J. Worden (Physics), S. Makoski (Physics, M.S.)

1997 – J. Resovsky (Geophysics, Advisor), B. Williams (Physics, Titular Advisor), J. Schneider (Geology, M.S.)

1998 – J. Garten (Physics)

1999 – O. Vdovin (Physics, Advisor), M. James (Physics, Advisor, M.S.), S. Kraut (Physics, Titular Advisor), M. Gourley (Physics)

2000 – M. Tamisiea (Physics), G. Francis (Physics)

2008 – G. Bensen (Geophysics, Advisor), Rachelle Richmond (Geophysics, Advisor, M.S.)

2009 – F.C. Lin (Geophysics, Advisor)

2010 – Morgan M. Moschetti (Geophysics, Advisor), Wei Leng (Geophysics)

2011 – Nan Zhang (Geophysics), Matthew Radway (Electrical Engineering)

2012 – Ye Yu (Physics, Titular Advisor)

2013 – A Geruo (Physics)

2014 – Matthew Aitken (Physics, Titular Advisor), Weisen Shen (Geophysics, Advisor)

2015 – Brandon Ruzic (Physics), Chuan Qin (Physics)

2016 – Justin Ball (Geophysics), Jiayi Xie (Geophysics, Advisor), Xi Liu (Geophysics)

2017 -- Ye Tian (Geophysics, Advisor)

2018 – Jenny Nakae (Geophysics)

Undergraduate Honors Committees

- 1994 – Steve Dutton (Physics, Summa Cum Laude)
1996 – Mark James (Physics, Advisor, Magna Cum Laude.)
2001 – William Landuyt (Physics, Advisor, Magna Cum Laude)
2002 – Garrett Leahy (Physics, Advisor, Magna Cum Laude)
2004 – Nick Bunch (Physics, Magna Cum Laude), Jeremiah Goodson (Physics, Magna Cum Laude), Michelle Stempel (Physics, Magna Cum Laude), Daniel Smith (Physics, Advisor, Summa Cum Laude)
2017 – Pengqi Yin (Physics, Magna Cum Laude), Tristan Dobrian (Physics, Magna Cum Laude), Patrick Flynn (Physics, Summa Cum Laude), Ben Mobley (Physics, Summa Cum Laude), Hu Zhao (Physics, Magna Cum Laude), Andrew Seracuse (Physics, Summa Cum Laude)

Current Graduate Student Thesis Committees

- L. Feng (Physics, Advisor, working toward Ph.D. in Geophysics)
H. Wang (Physics, Advisor, working toward Ph.D. in Geophysics)
Chuanming Liu (Physics, Advisor, working toward Ph.D. in Geophysics)
Mengyu Wu (Physics, Advisor, working toward Ph.D. in Geophysics)
Shane Zhang (Physics, Advisor, working toward Ph.D. in Geophysics)
M. Bernardino (Geological Sciences, Working toward Ph.D. in Geophysics)
K. Bogolub (Geological Sciences, Working toward Ph.D. in Geophysics)
S. Plescia (Geological Sciences, Working toward Ph.D. in Geophysics)
J. Yarcce (Geological Sciences, Working toward Ph.D. in Geophysics)
A. Bellas (Physics, Working toward Ph.D. in Geophysics)
W. Mao (Physics, Working toward Ph.D. in Geophysics)
M. Yan (Physics, Working toward Ph.D. in Geophysics)

Teaching

PHYS 1000	Preparatory Physics	Teacher	Fall 1995, Spring 1997
PHYS 1110	General Physics 1	Recitation Instructor Back-Up Teacher Teacher	Fall 1990, Fall 1992 Spring 2014 Fall 2014
PHYS 1120	General Physics 2	Recitation Instructor	Fall 1994, Spring 2001
PHYS 2010	General Physics 1	Lab Instructor Teacher	Spring 1993, Fall 1993, Spring 2006 Spring 2009, Spring 2010, Spr 2011
PHYS 2020	General Physics 2	Lab Instructor Back-Up Teacher	Spring 1994 Fall 2011, Spring 2013
PHYS 2130	General Physics 3	Teacher	Fall 2001, Fall 2002
PHYS 2140	Methods in Theoretical Physics	Teacher	Spring 1991, Spring 1992, Spring 1998, Fall 2003, Spring 2004
PHYS 2170	Foundations of	Teacher	Fall 1991, Fall 1992

Modern Physics				
PHYS 3000	Science and Public Policy	Teacher		Spring 2012, Spring 2017
PHYS 3070	Energy and the Environment	Teacher		Spring 2002, Spring 2003
PHYS 3210	Analytical Mechanics	Teacher		Spring 1995, Fall 1997, Fall 1999, Spring 2000
PHYS 4610/ 4620/4630	Honors	Teacher		Spring 2004, Fall 2016
PHYS/PHIL 4450/5450	History and Philosophy of Physics	Teacher		Fall 2015
PHYS 5030	Intermediate Mathematical Physics 1	Teacher		Fall 2007, Fall 2008, Fall 2009, Fall 2010
PHYS 5040	Intermediate Mathematical Physics 2	Teacher		Spring 2007, Spring 2008
PHYS/GEOL/ APS 6610	EPP 1: Seismology	Teacher		Fall 1994, Fall 1996, Fall 2004, Fall 2006, Fall 2008, Fall 2013, Spring 2016, Fall 2018
PHYS/GEOL 7810	Seismology Seminar	Teacher		Spring 1991, Fall 1991, Fall 1993, Fall 2013