

**Raymond W. Schmitt**

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Physical Oceanographer

Senior Scientist

Department of Physical Oceanography

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**Education:**

B.Sc., Carnegie–Mellon University, (Physics)

Ph.D., University of Rhode Island, (Physical Oceanography)

**Positions Held:**

Research Associate, 1977–1978, University of Rhode Island; Postdoctoral Fellow, 1978–1979; Postdoctoral Investigator, 1979–1980; Assistant Scientist, 1980–1984; Associate Scientist, 1984–1994, tenure awarded, 1988; Senior Scientist, 1994–, Woods Hole Oceanographic Institution

Visiting Scientist, October 1987–March 1988, CSIRO Marine Laboratory, Division of Oceanography, Hobart, Tasmania, Australia

Visiting Fellow, September 1997–April 1998, Department of Applied Math and Theoretical Physics, University of Cambridge, UK

**Activities:**

Convener, Meeting on Double Diffusion in Oceanography, September 26–29, 1989.

Member, NSF Polar Programs Review Panel, January 23–25, 1991.

Member, NSF review panels for Ocean Sciences (January 20–23, 1992) and Polar Programs (1991, 1993).

Member, Atlantic Climate Change Program Science Working Group, 1991–1995 Member, NSF Physical Oceanography Review Panel, January 20–23, 1992.

Member, NSF Polar Programs Review Panel, September 20, 1993.

Member, Atlantic Climate Change Program (ACCP) Science Working Group, 1992–1995 Member, Ocean Observing System Development Panel (OOSDP), 1992–1994.

Chair, Bigelow Medal Committee, Woods Hole Oceanographic Institution, 1996

Co–principal Lecturer, Summer Program in Geophysical Fluid Dynamics, Woods Hole Oceanographic Institution, 1996.

Member, CLIVAR International Science Steering Group, 1996–2000.

Member, SCOR Working Group 108 on Double-Diffusive Convection, 1996–2002.

Invited Lecturer: Geophysical and Environmental Fluid Mechanics Summer School, Dept. Applied Math and Theoretical Physics, Cambridge University, September 2002.

Guest Editor, *Journal of Marine Research*, 2004.

Member, Editorial Board, *Dynamics of Atmospheres and Oceans*, 2004–2007.

Member, Ocean Studies Board, National Academy of Sciences, 2005–2007.

Co-Chair, CLIVAR Salinity Working Group, 2005–2007.

**Award:** J. S. Guggenheim Fellowship, 1997–1998

**Research Interests:** Oceanic mixing and microstructure; double diffusive convection; relationships between small-scale mixing processes and large-scale temperature and salinity distributions; the thermohaline circulation of the ocean; the global hydrologic cycle; development of oceanographic instrumentation.

### Refereed Publications

- Schmitt, Raymond W., Jr., and David L. Evans, 1978. An estimate of the vertical mixing due to salt fingers based on observations in the North Atlantic Central Water. *Journal of Geophysical Research*, **83**(C6), 2913–2919.
- Schmitt, Raymond W., Jr., 1979. Flux measurements on salt fingers at an interface. *Journal of Marine Research*, **37**(3), 419–436.
- Schmitt, Raymond W., Jr., 1979. The growth rate of super-critical salt fingers. *Deep-Sea Research*, **26A**, 23–40.
- Schmitt, Raymond W., and Richard B. Lambert, 1979. The effects of rotation on salt fingers. *Journal of Fluid Mechanics*, **90**, part 3, 449–463.
- Schmitt, Raymond W., 1981. Form of the temperature–salinity relationship in the Central Water: Evidence for double-diffusive mixing. *Journal of Physical Oceanography*, **11**(7), 1015–1026.
- Schmitt, Raymond W., and Daniel T. Georgi, 1982. Finestructure and microstructure in the North Atlantic Current. *Journal of Marine Research*, Supplement to **40**, 659–705.
- Gargett, A. E., and R. W. Schmitt, 1982. Observations of salt fingers in the central waters of the eastern North Pacific. *Journal of Geophysical Research*, **87**(C10), 8017–8029.
- Georgi, Daniel T., and Raymond W. Schmitt, 1983. Fine and microstructure observations on a hydrographic section from the Azores to the Flemish Cap. *Journal of Physical Oceanography*, **13**(4), 632–647.
- Schmitt, Raymond W., 1983. The characteristics of salt fingers in a variety of fluid systems, including stellar interiors, liquid metals, oceans, and magmas. *Physics of Fluids*, **26**(9), 2373–2377.
- Joyce, Terrence M., Raymond W. Schmitt and Marvel C. Stalcup, 1983. Influence of the Gulf Stream upon the short-term evolution of a warm-core ring. *Australian Journal of Marine and Freshwater Research*, **34**, 515–524.
- Joyce, Terrence, Richard Backus, Karen Baker, Patricia Blackwelder, Otis Brown, Timothy Cowles, Robert Evans, Greta Fryxell, David Mountain, Donald Olson, Ronald Schlitz, Raymond Schmitt, Peter Smith, Raymond Smith and Peter Wiebe, 1984. Rapid evolution of a Gulf Stream warm-core ring. *Nature*, **308**, 837–840.
- Olson, D. B., R. W. Schmitt, M. Kennelly and T. M. Joyce, 1985. A two-layer diagnostic model of the long-term physical evolution of Warm-Core Ring 82B. *Journal of Geophysical Research*, **90**(C5), 8813–8822.
- Schmitt, Raymond W., and Donald B. Olson, 1985. Wintertime convection in warm-core rings: thermocline ventilation and the formation of mesoscale lenses. *Journal of Geophysical Research*, **90**(C5), 8823–8837.
- Schmitt, Raymond W., Rolf G. Lueck and Terrence M. Joyce, 1986. Fine- and microstructure at the edge of a warm-core ring. *Deep-Sea Research*, **33**(11/12A), 1665–1689.

- Kunze, Eric, Albert J. Williams, III., and Raymond W. Schmitt, 1987. Optical microstructure in the thermohaline staircase east of Barbados. *Deep-Sea Research*, **34**(10A), 1697–1704.
- Schmitt, R. W., H. Perkins, J. D. Boyd and M. C. Stalcup, 1987. C-SALT: An investigation of the thermohaline staircase in the western tropical North Atlantic. *Deep-Sea Research*, **34**(10A), 1655–1665.
- Toole, John M., and Raymond W. Schmitt, 1987. Small-scale structures in the northwest Atlantic subtropical front. *Nature*, **327**(6117), 47–49.
- Schmitt, Raymond W., 1987. The Caribbean Sheets and Layers Transects (C-SALT) program. *Eos, Transactions of the American Geophysical Union*, **68**(5), 57–60.
- Schmitt, R. W., 1988. Mixing in a thermohaline staircase. In: *Small-Scale Turbulence and Mixing in the Ocean*, J.C.J. Nihoul and B. M. Jamart (Editors), Elsevier Science Publishers, Amsterdam, pp. 435–452.
- Schmitt, Raymond W., John M. Toole, Richard L. Koehler, Edward C. Mellinger and Kenneth W. Doherty, 1988. The development of a fine- and microstructure profiler. *Journal of Atmospheric and Oceanic Technology*, **5**(4), 484–500.
- Schmitt, Raymond W., Phillip S. Bogden and Clive E. Dorman, 1989. Evaporation minus precipitation and density fluxes for the North Atlantic. *Journal of Physical Oceanography*, **9**(9), 1208–1221.
- Schmitt, Raymond W., 1990. On the density ratio balance in the central water. *Journal of Physical Oceanography*, **20**(6), 900–906.
- Halliwell, G. R., Jr., P. Cornillon, K. H. Brink, R. T. Pollard, D. L. Evans, L. A. Reiger, J. M. Toole and R. W. Schmitt, 1991. Descriptive oceanography during the Frontal Air–Sea Interaction Experiment: Medium–to–large-scale variability. *Journal of Geophysical Research*, **96**(C5), 8553–8567.
- Weller, R. A., D. L. Rudnick, C. C. Eriksen, K. L. Polzin, N. S. Oakey, J. M. Toole, R. W. Schmitt and R. T. Pollard, 1991. Forced ocean response during the Frontal Air–Sea Interaction Experiment. *Journal of Geophysical Research*, **96**(C5), 8611–8638.
- Wijffels, Susan E., Raymond W. Schmitt, Harry L. Bryden and Anders Stigebrandt, 1992. On the transport of fresh water by the oceans. *Journal of Physical Oceanography*, **22**(2), 155–162.
- Huang, R. X., and R. W. Schmitt, 1993. The Goldsborough–Stommel circulation of the world ocean. *Journal of Physical Oceanography*, **23**(6), 1277–1284.
- Schmitt, Raymond W., and Susan E. Wijffels, 1993. The role of the oceans in the global water cycle. *The Legacy of Hann, AGU Geophysical Monograph Series 75, IUGG*, **15**, 77–84.
- Schmitz, William J., Jr., James R. Luyten and Raymond W. Schmitt, 1993. On the Florida Current T/S envelope. *Bulletin of Marine Science of the Gulf and Caribbean*, **53**(1), 1048–1065.
- Schmitt, Raymond W., 1994. Double-diffusion in oceanography. *Annual Review of Fluid Mechanics*, **26**, 255–285.
- Schmitt, Raymond W., 1994. Triangular and asymmetric salt fingers. *Journal of Physical Oceanography*, **24**(4), 855–860.
- Toole, John M., Kurt L. Polzin and Raymond W. Schmitt, 1994. New estimates of diapycnal mixing in the abyssal ocean. *Science*, **264**, 1120–1123.

- Kunze, Eric, Raymond W. Schmitt and John M. Toole, 1995. The energy balance in a warm-core ring's near-inertial critical layer. *Journal of Physical Oceanography*, **25**(5), 942–957.
- Polzin, Kurt L., John M. Toole and Raymond W. Schmitt, 1995. Finescale parameterizations of turbulent dissipation. *Journal of Physical Oceanography*, **25**, 306–328.
- Schmitt, Raymond W., 1995. The salt finger experiments of Jevons (1857) and Rayleigh (1880). *Journal of Physical Oceanography*, **25**(1), 8–17.
- You, Yuzhu, Trevor J. McDougall and Raymond W. Schmitt, 1995. Dianeutral motion, water-mass conversion and non-linear effects on the density ratio in the Pacific thermocline. *Journal of Physical Oceanography*, **25**(5), 1891–1904.
- Schmitt, R. W., 1995. The ocean component of the global water cycle. U.S. National Report to International Union of Geodesy and Geophysics, 1991–1994, Supplement to *Reviews of Geophysics*, pp. 1395–1409.
- Nowlin, W., N. Smith, G. Needler, P. Taylor, R. Weller, R. Schmitt, L. Merlivat, A. Vezina, A. Alexiou, M. McPhaden and M. Wakatsuchi, 1996. An ocean observing system for climate. *Bulletin of the American Meteorological Society*, **77**(10), 2243–2273.
- Polzin, K. L., N. S. Oakey, J. M. Toole and R. W. Schmitt, 1996. Fine structure and microstructure characteristics across the northwest Atlantic subtropical front. *Journal of Geophysical Research*, **101**(C6), 14,111–14,121.
- Polzin, K. L., K. G. Speer, J. M. Toole and R. W. Schmitt, 1996. Intense mixing of Antarctic Bottom Water in the equatorial Atlantic. *Nature*, **380**(6569), 54–57.
- Renardy, Yuriko Yamamuro and Raymond W. Schmitt, 1996. Linear stability analysis of salt fingers with surface evaporation or warming. *Physics of Fluids*, **8**(11), 2855–2867.
- Schmitt, R. W., 1996. Why didn't Rayleigh discover salt fingers? In: *Double-Diffusive Convection*. A Brandt and H. Fernando, Editors, *AGU Geophysical Monograph*, **94**, 3–10.
- Shen, C., and R. W. Schmitt, 1996. The wavenumber spectrum of salt fingers. In: *Double-Diffusive Convection*, A. Brandt and H. Fernando, Editors, *AGU Geophysical Monograph*, **94**, 305–312.
- Montgomery, E. T., and R. W. Schmitt, 1997. Altimetric control of a free vehicle for near-bottom turbulence measurements. *Deep-Sea Research I*, **44**(6), 1077–1084.
- Polzin, K. L., J. M. Toole, J. R. Ledwell and R. W. Schmitt, 1997. Spatial variability of turbulent mixing in the abyssal ocean. *Science*, **276**, 93–96.
- Toole, John M., Raymond W. Schmitt, Kurt L. Polzin and Eric Kunze, 1997. Near-boundary mixing above the flanks of a mid-latitude seamount. *Journal of Geophysical Research*, **102**(C1), 947–959.
- Schmitt, R. W., 1998. Double-diffusive convection: Its role in ocean mixing and parameterization schemes for large-scale modeling. In: *Ocean Modeling and Parameterizations*, E. Chassignet and J. Verron, Editors, Kluwer Academic Publishers, pp. 215–234.
- Schmitt, R. W., 1998. The ocean's response to the freshwater cycle. In: *Global Energy and Water Cycles*, K. Browning and R. Gurney, Editors, Cambridge University Press, pp. 144–154.
- Zhang, Jubao, Raymond W. Schmitt and Rui Xin Huang, 1998. Sensitivity of GFDL modular ocean model to the parameterization of double-diffusive processes. *Journal of Physical Oceanography*, **28**(4), 589–605.

- Molinari, Robert L., Silvia Garzoli and Raymond W. Schmitt, 1999. Equatorial currents at 1000-m depth in the Atlantic Ocean. *Geophysical Research Letters*, **26**(3), 361–363.
- Schmitt, R. W., 1999. Spice and the demon. *Science*, **283**(5804), 498–499.
- Zhang, Jubao, Raymond W. Schmitt and Rui Xin Huang, 1999. The relative influence of diapycnal mixing and hydrologic forcing on the stability of the thermohaline circulation. *Journal of Physical Oceanography*, **29**(6), 1096–1108.
- St. Laurent, Louis, and Raymond W. Schmitt, 1999. The contribution of salt fingers to vertical mixing in the North Atlantic Tracer Release Experiment. *Journal of Physical Oceanography*, **29**(7), 1404–1424.
- Zhang, Jubao, and Raymond W. Schmitt, 2000. The impact of salt fingering on the thermohaline circulation under mixed boundary conditions. *Journal of Physical Oceanography*, **30**, (6), 1223–1231.
- Ledwell, J. L., E. T. Montgomery, K. L. Polzin, L. C. St. Laurent, R. W. Schmitt and J. M. Toole, 2000. Evidence for enhanced mixing over rough topography in the abyssal ocean. *Nature*, **403**(6766), 179–182.
- Schmitt, R. W., and E. T. Montgomery, 2000. Salinity, a missing piece in the climate puzzle. *Backscatter*, **11**(3), 10–16.
- Schmitt, R. W., and J. R. Ledwell, 2001. Dispersion and diffusion in the deep ocean. In: *Encyclopedia of Ocean Sciences*, John H. Steele, Steve A. Thorpe, and Karl K. Turekian, Editors, Academic Press, San Diego; Vol. 2, pp. 726–733.
- Schmitt, R. W., 2001. Double-diffusive convection. In: *Encyclopedia of Ocean Sciences*, John H. Steele, Steve A. Thorpe, and Karl K. Turekian, Editors, Academic Press, San Diego; Vol. 2, pp. 757–766.
- St. Laurent, Louis C., John M. Toole, and Raymond W. Schmitt, 2001. Buoyancy forcing by turbulence above rough topography in the abyssal Brazil Basin. *Journal of Physical Oceanography*, **31**, 3476–3495.
- Polzin, K. L., E. Kunze, J. M. Toole, and R. W. Schmitt, 2003. The partitioning of finescale energy into internal waves and vortices: Implications for horizontal mixing. *Journal of Physical Oceanography*, **33**, 234–248.
- Schmitt, R. W., 2003. Observational and laboratory insights into salt finger convection. *Progress in Oceanography*, **56**(3-4), 419–433.
- Holbrook, W. S. P. Parano, S. Pearse, and R. W. Schmitt, 2003. Thermohaline finestructure in an oceanographic front from seismic reflection profiling. *Science*, **301**(5634), 821–824.
- Lavery, A. C., R. W. Schmitt and T. K. Stanton, 2004. High-frequency acoustic scattering from turbulent oceanic microstructure: The importance of density fluctuations. *Journal of the Acoustical Society of America*, **114**(5), 2685–2697.
- Nash, J. D. E. Kunze, J. M. Toole, and R. W. Schmitt, 2004. Internal tide reflection and turbulent mixing on the continental slope. *Journal of Physical Oceanography*, **34**(5), 1117–1134.
- Hu, C., E. Montgomery, R. Schmitt, F. Muller-Karger, 2004. The Amazon and Orinoco River plumes in the tropical Atlantic and Caribbean Sea: Observation from space and S-PALACE floats. *Deep Sea Research*, . *Deep Sea Research*, **51** (10-11), 1151-1171.

- Nandi, Papia, W. Steven Holbrook, Scott Pearse, Pedro Páramo, Raymond W. Schmitt, 2004. Seismic reflection imaging of water mass boundaries in the Norwegian Sea. *Geophysical Research Letters*, **31**, (23), L23311, 10.1029/2004GL021325 .
- Schmitt, Raymond W., Robert C. Millard, John M. Toole and W. David Wellwood, 2005. A double-diffusive interface tank for dynamic-response studies. *Journal of Marine Research*, **63** (1) 263-289.
- McDougall, T. J. , R. W. Schmitt, G. Veronis, F. Webster, 2005. The life and work of Nick Fofonoff. *Journal of Marine Research*, **63** (1), 1-7.
- Schmitt, R. W., J. R. Ledwell, E. T. Montgomery K. L. Polzin, and J. M. Toole, 2005. Enhanced Diapycnal Mixing by Salt Fingers in the Thermocline of the Tropical Atlantic. *Science*, 308 (5722), 685-688.
- Páramo, P., W.S. Holbrook, R.W. Schmitt, and I. Fer, 2006. Enhanced Oceanic Internal Wave Energy over Small-Scale Seafloor Roughness, Submitted to *Nature*.

### Non-refereed Publications

- Georgi, D. T., R. C. Millard, Jr., and R. W. Schmitt, 1983. Conductivity microstructure measurements with a CTD. In: *Proceedings, Third Working Symposium on Oceanographic Data Systems*, Woods Hole, Massachusetts, October 2–4, 1983; C. D. Tollios, M. K. McElroy and J. Syck, editors; IEEE Computer Society and Woods Hole Oceanographic Institution, pp. 5–14.
- Converse, C. H., A. J. Williams, 3rd, P. D. Fucile and R. W. Schmitt, 1986. A free ocean vehicle to measure optical microstructure. In: *Current Practices and New Technology in Ocean Engineering – OED*, Vol. **11**; T. McGuinness and H. H. Shih, editors; The American Society of Mechanical Engineers, New York, pp. 341–345.
- Schmitt, R. W., K. L. Polzin and J. M. Toole, 1989. Shear and salt fingers. In: *Parameterization of Small-Scale Processes, Proceedings, 'Aha Huliko'a, Hawaiian Winter Workshop*, University of Hawaii at Manoa, January 17–20, 1989; Hawaii Institute of Geophysics Special Publication, Peter Müller and Diane Henderson, editors; University of Hawaii, Honolulu; pp. 127–144.
- Toole, J. M., E. T. Montgomery and R. W. Schmitt, 1991. Report of the seamount mixing cruise: R/V *New Horizon*, March, 1991. *TopoNews*, **5**, 2–7.
- Schmitt, Raymond W., 1992. Mysteries of planetary plumbing. *Oceanus*, **35**(2), 38–45.
- The Ocean Observing System Development Panel, 1993. Interim design for the ocean component of a global climate observing system. Dept. of Oceanography, Texas A& M University, College Station, Texas, 105 pp.
- Schmitt, R. W., 1993. Macelwane Citation for Eric Kunze. *Eos, Transactions, American Geophysical Union*, **74**(26), 283.
- Schmitt, R. W., 1993. The role of the ocean in the global water cycle. In: Workshop on WOCE Data Assimilation. WOCE Report No. 102/93, p. 10.
- Schmitt, R. W., E. T. Montgomery and J. M. Toole, 1995. A free-vehicle explores deep-sea mixing. *Oceanus*, **38**(1), 21–25.
- Schmitt, Raymond W., 1995. The ocean's salt fingers. *Scientific American*, **272**(5), 70–75.

- Polzin, K. L., K. G. Speer, J. M. Toole, and R. W. Schmitt, 1996. Intense mixing of Antarctic Bottom Water in the Romanche Fracture Zone. *International WOCE Newsletter*, **19**, 20–23.
- Schmitt, R. W., 1996. If rain falls on the ocean – does it make a sound? *Oceanus*, **39**(2), 4–8.
- Schmitt, R. W., and E. T. Montgomery, 1996. Oceanic constraints on the hydrologic cycle. *Proceedings of the WRCP Workshop of Air–Sea Flux Fields for Forcing Ocean Models and Validation of CCMS*. World Meteorological Organization Technical Document 762, pp. 112–117.
- Schmitt, R. W., 1997. New approaches to the salinity problem. *CLIVAR Exchanges*, **2**(1), 4–6.
- Toole, J. M., J. R. Ledwell, K. L. Polzin, R. W. Schmitt, E. T. Montgomery, L. St. Laurent, and W. B. Owens, 1997. Brazil Basin Tracer Release Experiment. *International WOCE Newsletter*, No. **28**, 25–28.
- Schmitt, R. W., J. M. Toole, K. L. Polzin and J. R. Ledwell, 1998. Large-scale patterns of turbulent vertical mixing in the Brazil Basin: implications for the Abyssal circulation. European Geophysical Society, *Annales Geophysicae*, **16**, (Suppl. II, Part II), p. C545.
- One of many contributors/editors, CLIVAR Initial Implementation Plan. WCRP report 103, March 1998.
- Polzin, Kurt, John M. Toole, and Raymond W. Schmitt, 1998. Topographic roughness begets increased oceanic mixing. *Woods Hole Oceanographic Institution 1998 Annual Report*, pp. 21–22.
- Paramo, P., W. S. Holbrook, S. Pearce and R. W. Schmitt, 2003. Fine-scale thermohaline structure revealed by seismic reflection profiling in the Gulf of California. AGU Fall meeting abstract OS41C-0821.
- Pearse, S., W. S. Holbrook, P. Paramo and R. W. Schmitt, 2003. Time-Lapse seismic-reflection images of thermohaline intrusions in an oceanographic front. AGU Fall meeting abstract OS32C-07.
- Holbrook, W. S., P. Paramo, P. Pearce and R. W. Schmitt, 2003. New tool for probing thermohaline fine structure in the ocean: seismic reflection profiling of the Labrador Current/North Atlantic Current Front. AGU Fall meeting Abstract OS41C-0820.
- Schmitt, R. W., 2003. The hydrologic cycle, ocean mixing and abrupt climate change: what do we need to measure? AGU Fall meeting abstract OS12B-06.
- Schmitt, R. W., 2003. Lavery high frequency acoustic scattering from oceanic microstructure and zooplankton. *EOS, Trans.*, AGU, **84**(52), Ocean Sci. Meet., Suppl., Abstract OS321-03.
- Holbrook, W. S., R. W. Schmitt, . Pearce and P. Paramo, 2003. Siesmic oceanography: application of seismic reflection profiling for imaging thermohaline fine structure in the ocean. *EOS, Trans.*, AGU, **84**(52), Ocean Si. Meet., Suppl., Abstract OS321-09.
- Ledwell, J., R. W. Schmitt, J. M. Toole, K. L. Polzin and E. Montgomery, 2004. Diffusivities of heat, salt and SF6 in the thermohaline staircase east of Barbados. ASLO/TOS Ocean Research Conference, SS1.03.
- Stuebe, D. A., R. W. Schmitt and J. M. Toole, 2004. A moored profiler time series from the salt finger tracer release experiment. ASLO/TOS Ocean Research Conference, SS1.03.

## Abstracts

- Schmitt, R. W., and R. B. Lambert, 1974. Collective instability of rotating salt fingers. *Eos, Transactions, American Geophysical Union*, **55**(4), 298 (abstract).

- Schmitt, R. W., and R. B. Lambert, 1975. The effects of rotation on salt fingers. *Bulletin of the American Physical Society*, **20**(11) (abstract).
- Schmitt, R. W., 1976. On the flux ratio of salt fingers. *Eos, Transactions, American Geophysical Union*, **57**(4), 261 (abstract).
- Schmitt, R. W., 1977. Recent laboratory experiments with heat–salt fingers. *Eos, Transactions, American Geophysical Union*, **58**(6), 419 (abstract).
- Schmitt, R. W., 1979. Double-diffusive oceanography: New recipes for the thermocline. *Eos, Transactions, American Geophysical Union*, **60**(18), 288 (abstract).
- Schmitt, Raymond W., 1980. A double-diffusive interpretation of the T–S relation in the Central Water. In: *Proces-Verbaux No.15*, International Association for the Physical Sciences of the Ocean, International Union of Geodesy and Geophysics XVII General Assembly, Canberra, December 1979, p. 70–71 (abstract).
- Schmitt, R. W., and D. T. Georgi, 1980. Direct observations of double-diffusive mixing on intrusions in the North Atlantic current. *Eos, Transactions, American Geophysical Union*, **61**, 1002 (abstract).
- Joyce, T. M., and R. W. Schmitt, 1982. A preliminary physical history of Warm Ring 82–B. *Eos, Transactions, American Geophysical Union*, **63**(45), 994 (abstract).
- Schmitt, R. W., 1982. Surface temperature and salinity fronts in Warm Ring 81–D. *Eos, Transactions, American Geophysical Union*, **63**(3), 51 (abstract).
- Schmitt, R. W., 1982. The relationship between microstructure and finestructure: directions for further research. *Eos, Transactions, American Geophysical Union*, **63**(45), 1002 (abstract).
- Schmitt, R. W., 1983. The role of double-diffusion in ocean mixing. In: *Programme and Abstracts, International Association for the Physical Sciences of the Ocean, International Union of Geodesy and Geophysics XVIII General Assembly*, Hamburg, Germany, August, 1983, p. 92 (abstract).
- Schmitt, R. W., and T. M. Joyce, 1983. The history of a Warm Core Ring. In: *Programme and Abstracts, International Association for the Physical Sciences of the Ocean, International Union of Geodesy and Geophysics XVIII General Assembly*, Hamburg, Germany, August, 1983, p. 34–35 (abstract).
- Schmitt, R. W., R. G. Lueck and T. M. Joyce, 1983. Fine- and microstructure observations at the edge of a Warm Core Ring. In: *Programme and Abstracts, International Association for the Physical Sciences of the Ocean, International Union of Geodesy and Geophysics XVIII General Assembly*, Hamburg, Germany, August, 1983, p. 111 (abstract).
- Olson, D. B., R. W. Schmitt, M. Kennelly and T. M. Joyce, 1983. Long term physical evolution of Warm Core Ring 82–B. *Eos, Transactions, American Geophysical Union*, **64**(52), 1073 (abstract).
- Schmitt, R. W., and D. B. Olson, 1983. Establishment of the water mass properties of the “thermostad” in Warm Ring 82B. *Eos, Transactions, American Geophysical Union*, **64**(52), 1073 (abstract).
- Bogden, Philip S., Raymond W. Schmitt and Clive E. Dorman, 1984. Surface fluxes of fresh water and density in the North Atlantic. *Eos, Transactions, American Geophysical Union*, **65**(45), 934 (abstract).
- Schmitt, R. W., and M. C. Stalcup, 1986. Characteristics of the C–SALT staircases. *Eos, Transactions, American Geophysical Union*, **67**(44), 1045 (abstract).
- Williams, A. J., E. Kunze and R. W. Schmitt, 1986. Optical microstructure during C–SALT. *Eos, Transactions, American Geophysical Union*, **67**(44), 1046 (abstract).



- Toole, J. M., and R. W. Schmitt, 1986. Fine- and microscale structures in the N.W. Atlantic subtropical front. *Eos, Transactions, American Geophysical Union*, **67**(44), 1034 (abstract).
- Toole, J., R. Schmitt, and K. Polzin, 1988. Fine- and microstructure characteristics near an upper ocean front. In: *Proceedings of Seventh Conference on Ocean-Atmosphere Interaction*, American Meteorological Society, pp. 90–92.
- Schmitt, R. W., K. L. Polzin, and J. M. Toole, 1989. Shear and salt fingers. In: *Parameterization of Small-Scale Processes*, Proceedings, 'Aha Huliko'a, Hawaiian Winter Workshop, University of Hawaii at Manoa, January 17–20, 1989; Hawaii Institute of Geophysics Special Publication, Peter Müller and Diane Henderson, editors; University of Hawaii, Honolulu; pp. 127–144.
- Toole, J., R. Schmitt and K. Polzin, 1988. Fine- and microstructure characteristics near an upper ocean front. In: *Proceedings of Seventh Conference on Ocean-Atmosphere Interaction*, American Meteorological Society, pp. 90–92.
- Polzin, K., J. M. Toole, and R. W. Schmitt, 1992. Finescale parameterizations of dissipation. *Eos, Transactions, American Geophysical Union*, **73**(14), p. 157.
- Schmitt, R. W., H. L. Bryden, and S. E. Wijffels, 1992. Constraining the hydrologic cycle with direct ocean measurements. *Proceedings of the ACCP PI Meeting, NOAA Climate and Global Change Program*, Special Report No. 7, 27–29.
- Huang, R. X., and R. W. Schmitt, 1992. On the Goldsbrough Circulation. *Proceedings of the ACCP PI Meeting, NOAA Climate and Global Change Program*, Special Report No. 7, 133–135.
- Polzin, K. L., J. M. Toole, and R. W. Schmitt, 1992. Finescale parameterizations of ocean dissipation. *Proceedings: Tenth Symposium on Turbulence and Diffusion*, September 29–October 2, American Meteorological Society, pp. 211–213.
- Kunze, E. and R. W. Schmitt, 1992. The energy balance in a warm-core ring's near-inertial wave critical layer. *Eos, Transactions, American Geophysical Union*, **73**(43), 321.
- Montgomery, E. T., R. W. Schmitt, J. M. Toole, and K. L. Polzin, 1992. Site survey results for the North Atlantic Tracer Release Experiment. *Eos, Transactions, American Geophysical Union*, **73**(43), 321.
- Toole, J. M., R. W. Schmitt, and K. L. Polzin, 1992. Deep ocean estimates of turbulent velocity and temperature dissipation *Eos, Transactions, American Geophysical Union*, **73**(43), 321.
- Polzin, K. L., J. M. Toole, and R. W. Schmitt, 1992. Application and interpretation of a Richardson number mixing model. *Eos, Transactions, American Geophysical Union*, **73**(43), 321.
- Montgomery, E. T., R. W. Schmitt, J. M. Toole, and K. L. Polzin, 1992. Site survey results for the North Atlantic Tracer Release Experiment. *Eos, Transactions, American Geophysical Union*, **73**, (43), 321.
- Schmitt, R. W., J. M. Toole, and K. L. Polzin, 1992. Velocity structure and mixing in a warm-core ring. *Eos, Transactions, American Geophysical Union*, **73**(42), 321.
- Schmitt, R. W., J. M. Toole and K. L. Polzin, 1993. Near-inertial waves and mixing in a warm-core ring. *IAPSO Proceedings*, No. 18, XX General Assembly, 328.
- Schmitt, R. W., 1993. The role of salt finger in ocean mixing. *Chapman Conference on Double-Diffusive Convection*, November 3–6, 1993. American Geophysical Union, p. 20 (abstract).

- Schmitt, R. W., K. L. Polzin and J. M. Toole, 1994. A comparison of direct turbulence measurements with tracer dispersion in the North Atlantic Tracer Release Experiment. Ocean Sciences Meeting, *Eos, Transactions, American Geophysical Union*, **75**, 130.
- Polzin, K. L., R. W. Schmitt and J. M. Toole, 1994. Internal wave dynamics in the transition region (.1–2 cpm). Ocean Sciences Meeting, *Eos, Transactions, American Geophysical Union*, **75**, 130–131.
- Toole, J. M., E. Kunze, K. L. Polzin, and R. W. Schmitt, 1994. Finestructure and microstructure observations about a subtropical-latitude seamount. Ocean Sciences Meeting, *Eos, Transactions, American Geophysical Union*, **75**, 164.
- Kunze, E., J. M. Toole and R. W. Schmitt, 1994. Diurnal trapped waves atop Fieberling Seamount. Ocean Sciences Meeting, *Eos, Transactions, American Geophysical Union*, **75**, p. 164.
- Montgomery, E. T. and R. W. Schmitt, 1994. The annual cycle of fresh water forcing over the Atlantic Ocean. Ocean Sciences Meeting, *Eos, Transactions, American Geophysical Union*, **75**, p. 172.
- Polzin, K. L., N. S. Oakey, J. M. Toole, and R. S. Schmitt, 1995. On the competition between wave/wave and wave/mean flow interactions. *IAPSO*, Honolulu.
- Polzin, K. L., E. Kunze, J. M. Toole, and R. W. Schmitt, 1995. Horizontal mixing associated with small-scale vortices. *IAPSO*, Honolulu.
- Polzin, K. L., K. G. Speer, J. M. Toole, and R. W. Schmitt, 1995. Intense mixing of Antarctic Bottom Water in the Romanche Fracture Zone. *IAPSO*, Honolulu.
- Polzin, K. L., J. M. Toole, J. R. Ledwell, and R. W. Schmitt, 1996. Spatial variability of turbulent mixing in the Abyssal Ocean. American Geophysical Union, *Eos, Transactions, American Geophysical Union*, **76**.
- St. Laurent, L., and R. W. Schmitt, 1998. The contribution of salt fingers to vertical mixing in the North Atlantic Tracer Release Experiment. Ocean Sciences Meeting, AGU.
- Zhang, J., R. W. Schmitt and R. X. Huang, 1998. The relative influence of diapycnal mixing and hydrological forcing on the stability of the thermohaline circulation. Ocean Sciences Meeting, AGU.
- Schmitt, R. W. and E. T. Montgomery, 1999. Autonomous salinity profiling in the tropical Atlantic. *Eos, Transactions, American Geophysical Union*, **80**(17), 179.
- Warren, J. D., A. Lavery, R. W. Schmitt, T. K. Stanton, 2001. Laboratory measurements of acoustic scattering from a temperature and salinity gradient. *Journal of the Acoustical Society of America*, **110**, No. 5, Pt. 2, p. 2641.
- Montgomery, E., R. W. Schmitt, C. Hu, and F. Muller-Karger, 2002. Low-salinity Amazon River plumes in the Tropical Atlantic: Comparison of in-situ float data with SeaWiFS imagery. *Eos, Transactions, American Geophysical Union*, **83**(4), Ocean Sciences Meeting, Suppl. Abstract OS21C-54, p. 98.
- Schmitt, R. W., J. R. Ledwell, J. M. Toole, and K. L. Polzin, 2002. Initial results of the Salt Finger Tracer Release Experiment. *Eos, Transactions, American Geophysical Union*, **83**(4), Ocean Sciences Meeting, Suppl. Abstract OS220-01, p. 181.
- Ledwell, J. R., J. M. Toole, R. W. Schmitt, K. Polzin, and E. Montgomery, 2002. Mixing in the Deep Brazil Basin – An Update. *Eos, Transactions, American Geophysical Union*, **83**(4), Ocean Sciences Meeting Supplement Abstract OS220-03, p. 182.

- Paramo, P , Holbrook, W S , Pearse, S , Schmitt, R W. 2003 Fine-scale thermohaline structure revealed by seismic reflection profiling in the Gulf of California. AGU Fall Meeting Abstract OS41C-0821
- Pearse, S Holbrook, W S Paramo, P Schmitt, R W 2003. Time-Lapse Seismic-Reflection Images Of Thermohaline Intrusions in an Oceanographic Front AGU Fall Meeting Abstract OS32C-07
- Holbrook, W S, Paramo, P, Pearse, S, Schmitt, R W 2003. New Tool for Probing Thermohaline Fine Structure in the Ocean: Seismic Reflection Profiling of the Labrador Current/North Atlantic Current Front. AGU Fall Meeting Abstract OS41C-0820
- Schmitt, R W, 2003. The Hydrologic Cycle, Ocean Mixing and Abrupt Climate Change: What do we need to measure? AGU Fall Meeting Abstract OS12B-06
- Lavery A. and R. W. Schmitt, 2004. High-Frequency Acoustic Scattering From Oceanic Microstructure and Zooplankton. Ocean Sciences Meeting Paper Number: OS32I-03
- Ledwell, J., R. W. Schmitt, J. M. Toole K. L. Polzin, and E. Montgomery, 2004. Diffusivities of heat, salt and SF6 in the thermohaline staircase east of Barbados. ASLO/TOS Ocean Research Conference, SS1.03.
- Stuebe, D. A., R. W. Schmitt and J. M. Toole, 2004. A moored profiler time series from the salt finger tracer release experiment. ASLO/TOS Ocean Research Conference, SS1.03.

### **Thesis and Technical Reports**

- Schmitt, Raymond, W., Jr., 1978. Time dependent and rotational effects in salt finger convection. Ph.D. Dissertation, University of Rhode Island.
- Schmitt, R. W., 1979. Ocean signatures of double-diffusion. In: 1979 Summer Study Program in Geophysical Fluid Dynamics, the Woods Hole Oceanographic Institution, Notes on Polar Oceanography. Woods Hole Oceanographic Institution Technical Report, WHOI-79-84, 1, pp. 145–147 (abstract).
- Stalcup, M. C., T. M. Joyce, R. W. Schmitt, and J. A. Dunworth, 1982. Warm-Core Ring Cruise #1, R/V Endeavor Cruise No. 74. Woods Hole Oceanographic Institution Technical Report, WHOI-82-35, 133 pp.
- Schmitt, Raymond W., 1982. Cruise report: Endeavor Cruise No. 88, 8/5/82–8/25/82. In: Warm Core Rings, an Interdisciplinary Study of Warm Core Ring Physics, Chemistry and Biology, Cruise Reports: R/V Endeavor–R/V Knorr–R/V Oceanus, August 1982; Woods Hole Oceanographic Institution, Woods Hole, Massachusetts; pp. 1–16 + 4 tables + 8 figures.
- Schmitt, Raymond W., 1984. Finger puzzles. In: 1984 Summer Study Program in Geophysical Fluid Dynamics, Woods Hole Oceanographic Institution, Dynamic Differentiation. Woods Hole Oceanographic Institution Technical Report, WHOI-84-44, pp. 91–92 (abstract).
- Schmitt, R. W., 1986. Cruise report: Endeavor Cruise No. 128, 3/18/85–4/5/85, Knorr Cruise No. 118-2, 10/28/85–11/12/85, Knorr Cruise No. 118-3, 11/16/85–12/2/85. Workshop report: C-SALT Data Workshop, 7/8–10/86. C-SALT Overview Document. All in: Caribbean – Sheets and Layers Transects Summary Document. Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, 129 pp.

- Schmitt, R. W., 1986. Cruise report: Endeavor Cruise No. 141, 2/5/86–3/11/86. In: Cruise Summaries for FASINEX Phase Two. Woods Hole Oceanographic Institution Technical Report, WHOI-86-36, pp. 141–152.
- Schmitt, R. W. and J. M. Toole, 1986. Fine- and Microstructure Profiling during FASINEX. In: Cruise Summaries for FASINEX Phase Two. Woods Hole Oceanographic Institution Technical Report, WHOI-86-36, pp. 153–160.
- Schmitt, Raymond W. and Ellyn T. Montgomery, 1991. Cruise report – Oceanus 218, March 20–April 9, 1990, Warm Ring Inertial Critical Layer Experiment (WRINCLE). Woods Hole Oceanographic Institution Technical Report, WHOI-91-33, 37 pp.
- Montgomery, Ellyn T., and Raymond W. Schmitt, 1993. Cruise report – Oceanus 250, leg 4: High resolution profiler survey for the North Atlantic Tracer Release Experiment (NATRE), March 25–April 24, 1992. Woods Hole Oceanographic Institution Technical Report, WHOI-93-39, 41 pp.