



U.S. Department of Energy

National Energy Technology Laboratory

Methane Hydrate R&D Program

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Section I: Publications Related to Methane Hydrate Fellowship Program

Papers Authored and Presentations Given by NETL Methane Hydrate Fellows

Papers Authored

Brothers, L. L., Kelley, J. T., Belknap, D. F., Koons, P. O., Barnhardt, W. A., (2011). "Pockmarks: Self-scouring seep features?" *Proc. of the 7th International Conference on Gas Hydrates (ICGH 2011). Edinburgh, Scotland, United Kingdom, July, 17-21, (2011)*. Paper 326.

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Brothers, L. L., Van Dover, C. L., German, C. R., Kaiser, C. L., Yoerger, D. R., Ruppel, C. D., Lobecker, E., Skarke, A. R., Wagner, K. S., (2013). Evidence for extensive methane venting on the southeastern U. S. Atlantic margin. *Geology* <http://dx.doi.org/10.1130/G34217.1>

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Daigle, H. and Dugan, B., (2011). "Capillary controls on methane hydrate distribution and fracturing in advective systems," *Geochemistry, Geophysics, Geosystems*, 12, Q01003, doi:10.1029/2010GC003392.

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Lapham, L., Chanton, J., Martens, C., Pohlman, J., Chapman, R., (2005). "In Situ light hydrocarbon concentrations and stable carbon isotope values in hydrate-bearing sediments of Cascadia Margin, Vancouver Island," *Second General Assembly European Geosciences Union*, April 24-29.

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Solomon, E. A., Spivack, A. J., Kastner, M., Torres, M. , Borole, D. V. , Robertson, G. , Das, H. C., (2008). Hydrogeochemical and Structural Controls on Heterogeneous Gas Hydrate Distribution in the K-G Basin Offshore SE India. Proceedings of the 6th International Conference on Gas Hydrates (ICGH 2008), Vancouver, B. C., July 6-10, (2008).

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<http://dx.doi.org/10.1016/j.dsr2.2013.02.008>

Wilson, R. M., Macelloni, L., Simonetti, A., Lapham, L., Lutken, C., Sleeper, K., D'Emidio, M., Pizzi, M., Knapp, J., and Chanton, J., (2014). Subsurface methane sources and migration pathways within a gas hydrate mound system, Gulf of Mexico, *Geochemistry, Geophysics, Geosystems*, v. 15, pp. 89-107, January, (2014).

Presentations

Brothers, L. L., Hart, P. E., Ruppel, C., (2011). Subsea permafrost mapped across the US Beaufort Sea using multichannel seismic data, *AGU Fall Meeting 2011*

Brothers, L. L., Van Dover, C. L., German, C. R., Kaiser, C. L., Yoerger, D. R., Ruppel, C. D., Lobecker, E., Skarke, A. R., Wagner, K. S., (2012). Evidence for extensive methane venting on the southeastern U. S. Atlantic margin., *AGU Fall Meeting 2012*

Brothers, L. L., Hart, P. E., and Ruppel, C., (2013). Subsea permafrost on the US Beaufort Sea Margin, *Permafrost & Gas Hydrates Workshop*, Helsinki Finland, (2013).

D'Emidio, M, M Ingrassia, CB Lutken, L Macelloni, A Simonetti, M Pizzi, LL Lapham, R Wilson, P Hsing, and C Fisher, (2012). Biogeophysical classification of seafloor seeps at a carbonate-hydrate mound, Northern Gulf of Mexico. Poster. *The Gordon Research Conference on Natural Gas Hydrate Systems*, Ventura, California. March 18th-23rd

Pohlman, J. W., Kessler, J. K., Maue, C., Ruppel, C. D., Brothers, L. L., Yvon Lewis, S. A., Sparrow, K., Bergeron, E., Worley, C., (2012). Methane fluxes to the atmosphere in an area of possibly dissociating gas hydrate in the shallow Alaskan Beaufort Sea, *Eos Trans. AGU 87(36), Ocean Sciences Meet. Supplement, Abstract OS35E 02*

Ruppel, C., Brothers, L. L., Hart, P. E., Worley, C., (2011). The distribution of subsea permafrost and shallow methane on the central U. S. Beaufort Inner Shelf from newly acquired geophysical data, *AGU Fall Meeting*

Ruppel, C., Brothers, L., Hart, P., Pohlman, J., (2012). Warming driven dissociation of gas hydrates on the continental shelf and upper continental slope of the US Beaufort Sea, *for Arctic Frontiers, Tromso, Jan 2012*.

Wilson, R. M., Lapham, L. L., and Chanton, J. P., (2012). Chemical and physical controls on hydrate stability probed with field and laboratory experiments. Presented at the *American Geophysical Union Fall Meeting*, Dec. 3-7, San Francisco, CA.

Wilson, RM, LL Lapham, B Anderson, N Garapati, and J Chanton, (2012). Laboratory experiments probe hydrate dissolution rates. Poster. The Gordon Research Conference on Natural Gas Hydrate Systems, Ventura, California. March 18th-23rd

Wilson, RM, LL Lapham, CS Martens, JP Chanton, H Mendlovitz, K Sleeper, and M Riedel, (2012). Time-series methane monitoring in gassy sediments and the benthic boundary layer. Ocean Sciences Meeting, Salt Lake City, Utah. February 20th-24th

Wilson, R. M., Lapham, L. L., and Chanton, J. P., (2013). Integrating seismic data and geochemical profiles to identify methane provenance, cycling, and migration pathways. Presented at American Chemical Society National Meeting, Apr. 8-12, New Orleans, LA.

Section II: Publications Related to the Program's Major Field Projects

With private companies, state and local governments, universities, and research institutions

Alaska North Slope Gas Hydrate Reservoir Characterization (DE-FC26-01NT41332)

BP Exploration Alaska, Inc.

Peer-Reviewed Publications

Anderson, B., Hancock, S., Wilson, S., Enger, C., Collett, T., Boswell, R., Hunter, R., (2010). "Formation pressure testing at the Mount Elbert Gas Hydrate Stratigraphic Test Well, Alaska North Slope: Operational summary, history matching, and interpretations," *Marine and Petroleum Geology, Vol. 28, Iss. 2, Thematic Set on Scientific results of the Mount Elbert Gas Hydrate Stratigraphic Test Well, Alaska North Slope*, pp. 478-492, ISSN 0264-8172, doi: 10.1016/j.marpetgeo.2010.02.012.

Anderson, B. J., Kurhiara, M., Wilson, S. J., Pooladi-Darvish, M., White, M., Mordis, G., Gaddipati, M., Masuda, Y., Collett, T. S., Hunter, R. B., Narita, H., Rose, K., Boswell, R., (2010). "Regional long-term production modeling from a single well test, Mount Elbert Gas Hydrate Stratigraphic Test Well, Alaska North Slope," *Marine and Petroleum Geology, Vol. 28, Iss. 2, Thematic Set on Scientific results of the Mount Elbert Gas Hydrate Stratigraphic Test Well, Alaska North Slope*, pp. 493-501, ISSN 0264-8172, doi: 10.1016/j.marpetgeo.2010.01.015.

Boswell, R., Collett, T. S., Hunter, R. B., and Anderson, B. J., Editors, (2010). Scientific Results of 2007 USDOE-BP-USGS "Mount Elbert Gas Hydrate Stratigraphic Test Well, Milne Point, Alaska North Slope," *Journal of Marine and Petroleum Geology Special Thematic Volume*.

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Gas Hydrate Production Trial (DE-NT0006553)

ConocoPhillips Company

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Section III: Publications Related to the Program's Efforts with Universities and Other Research Institutions

Gas Hydrate Characterization in the Gulf of Mexico (DE-NT0005668) and Mapping Permafrost and Gas Hydrate using Marine CSEM Methods (DE-FE0010144)

Scripps Institution of Oceanography, University of California – San Diego

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Assessing the Efficacy of the Aerobic Methanotropic Biofilter in Methane Hydrate Environments (DE-NT0005667)

University of California – Santa Barbara

Peer-Reviewed Publications

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**Remote Sensing and Sea-Truth Measurements of Methane Flux to the Atmosphere
(HYFLUX project) (DE-NT0005638)**

Texas A&M University - Corpus Christi

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Detection and Production of Methane Hydrates (DE-FC26-06NT42960)

Rice University

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Backus, M., Murray, P., Hardage, B., and Graebner, R., (2005). "Enhanced PS-wave images of deep-water, near-seafloor geology from 2-D 4-C OBC data in the Gulf of Mexico," *75th Annual International Meeting of the SEG*, Houston, TX, November 6-11.

Backus, M., Murray, P., Graebner, R., and Hardage, B., (2007). "OBC sensor response and calibrated reflectivity," *77th Annual Meeting of the Society of Exploration Geophysicists*, San Antonio, TX.

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Fomel, S. B., Backus, M. M., DeAngelo, Michael, Murray, Paul, and Hardage, B. A., (2003). "Multicomponent seismic data registration for subsurface characterization in the shallow Gulf of Mexico," *Offshore Technology Conference*, Houston, TX, OTC Paper No. 15117.

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Hardage, B., and P. Murray, (2006). "Detailed imaging of deepwater hydrate geology with horizontal arrays of seafloor sensors," *Proceedings of the 2006 Offshore Technology Conference*, Houston, TX, May 1-4. [OTC 17929-MS](#)

Hardage, B. A., Roberts, H. H., Sava, D. C., Murray, P. E., DeAngelo, M. V., Backus, M. M., Graebner, R. J., (2008). "Assessing Fluid-Gas Expulsion Geology And Gas Hydrate Deposits Across The Gulf of Mexico With Multicomponent And Multifrequency Seismic Data," *Proceedings of the 6th International Conference on Gas Hydrates (ICGH 2008)*, Vancouver, BC, July 6-10.

Murray, P., M. DeAngelo, B. Hardage, M. Backus, R. Graebner, and S. Fomel, (2003). "Interpreting multicomponent seismic data in the Gulf of Mexico for shallow sedimentary properties: methodology and case history," *Proceedings of the Offshore Technology Conference* Houston, TX, 2003, May 5-8. [OTC 15118-MS](#)

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Sampling and Monitoring Hydrate Mounds in the Gulf of Mexico (DE-AF26-01NT00394)

Texas A&M University – Corpus Christi

Peer-Reviewed Publications

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Leifer, I., Rehder, G. J., Solomon, E. A., Kastner, M., Asper, V. L., Joye, S. B., (2011). "Methane rising from the deep: Hydrates, bubbles, oil spills, and global warming," *American Geophysical Union Fall Meeting*, San Francisco, CA Dec. 5-9.

MacDonald, I., Kastner, M., and Leifer, I., (2005). "Estimates of natural hydrocarbon flux in the Gulf of Mexico basin from remote sensing data," *European Union of Geosciences Meeting*, Vienna, Austria, April 24-29.

MacDonald, I., Sobecky, P., Montoya, J., and Joye, S., (2003). "Research issues in the Hydrocarbon Seep System in the northern Gulf of Mexico," *American Society of Limnology and Oceanography Meeting*, Salt Lake City, UT, February 10-14.

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Investigation of 3D Structure and Physical Properties of Methane Hydrate Deposits at Blake Ridge (DE-FC26-00NT40921)

University of Wyoming

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Rock-Physics Modeling of Hydrate-Bearing Sediments (DE-FC26-05NT42663)

Stanford University

Peer-Reviewed Publications

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Investigation of Natural Gas Species Flows from Hydrate Dissociation (DE-FC26-00NT40916)

Clarkson University

Peer-Reviewed Publications

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Texas Engineering Experiment Station of Texas A&M University, University of California at Berkeley and Lawrence Berkeley National Laboratory

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Holditch, S., Patzek, T., Moridis, G., and Plumb, R., (2005). "Geomechanical Performance of Hydrate-Bearing Sediments in Offshore Environments," *U. S. DOE-NETL Semi-Annual Report, October 1, 2005 through March 31, 2006*, DE-FC26-05NT42664 CFDA Number: 81.089 (Fossil Energy Research and Development), July.

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Woods Hole Oceanographic Institute

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Evaluating the Controls on Gas Hydrate Formation and Dissociation in the Gulf of Mexico (DE-FC26-02NT41328)

Scripps Institution of Oceanography, University of California, San Diego

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In Situ Sampling and Characterization of Naturally Occurring Methane Hydrate During IODP legs 204 and 311 (DE-FC26-01NT41329)

Joint Oceanographic Institution (the National Science Foundation was the primary U. S. funder of these programs, but DOE contributed slightly more than \$2 million to further hydrate-related field analysis technologies).

Peer-Reviewed Publications

Akiba, F., Inoue, Y., Saito-Kato, M., Pohlman, J., (2009). "Data Report: diatom and foraminiferal assemblages in Pleistocene turbidite sediments from the Cascadia margin (IODP Expedition 311) northeast Pacific," In Riedel, M., Collett, T. S., Malone, M. J. and the Expedition 311 Scientists (Eds.) *Proceedings of the Integrated Ocean Drilling Program, Volume 311*. doi:10.2204/iodp.proc.311.211.2009.

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Milkov, A., Claypool, G., Lee, Y., and Sassen, R., (2005). "Gas hydrate systems at Hydrate Ridge offshore Oregon inferred from molecular and isotopic properties of hydrate-bound and void gases," *Geochim. Cosmochim. Acta, Volume 69*, pp. 1007-1026.

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Battelle Pacific Northwest Division, University of Alaska – Fairbanks

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Rock Solid Images

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Oklahoma State University

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Consortium for Ocean Leadership

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A New Approach to Understanding the Occurrence and Volume of Natural Gas Hydrate in the Northern Gulf of Mexico Using Petroleum Industry Well Logs (DE-FE0009949)

Ohio State University

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Gas Hydrate Dynamics on the Alaskan Beaufort Continental Slope: Modeling and Field Characterization (DE-FE0010180)

Southern Methodist University, Oregon State University, U. S. Geological Survey

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Hornbach, M. J., Phrampus, B. J., Ruppel, C. D., and Hart, P. E., (2012). "The role of ocean circulation on methane hydrate stability and margin evolution," *American Geophysical Union Fall Meeting*, San Francisco, CA, Dec. 3-7.

Phrampus, J. and Hornbach, M., (2012). "Recent changes to the Gulf Stream causing widespread gas hydrate destabilization," *American Geophysical Union Fall Meeting*, San Francisco, CA, Dec. 3-7.

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Application of Crunch-Flow Routines to Constrain Present and Past Carbon Fluxes at Gas-Hydrate Bearing Sites (DE-FE0010496) and Assessing the Response of Methane Hydrates to Environmental Change at the Svalbard Continental Margin (DE-FE0013531)

Oregon State University

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Hong, W. L., Torres, M. E., Kim, J.-H., Choi, J., and Bahk, J.-J., (2013). "Carbon cycling within the sulfate-methane-transition-zone in marine sediments from the Ulleung Basin," *Biogeochemistry*, pp. 1-20.

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Verification of Capillary Pressure Functions and Relative Permeability Equations for Gas Production (DE-FE0009927)

Wayne State University

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Mahabadi, N., Zheng, X., Dai, S., Seol, Y., Zapata, C. E., Yun, T.-S., and Jang, J. (2015). "Water retention curves in THF hydrate-bearing sediments – Experimental measurement and pore-scale simulation," *American Geophysical Union meeting*, San Francisco, CA, Dec. 14-18.

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Measurement and Interpretation of Seismic Velocities and Attenuations in Hydrate-Bearing Sediments (DE-FE0009963)

Colorado School of Mines, Geophysics Department

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Pohl, Mathias, Rydzy, Marisa, and Batzle, Mike, Colorado School of Mines, (2013). "Investigating the Influence of Clay Content on Ultrasonic Velocities in THF-bearing sediments" *The 2nd International Workshop on Rock Physics*, South Hampton, UK.

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THCM Coupled Model for Hydrate-Bearing Sediments: Data Analysis and Design of New Field Experiments (Marine and Permafrost Settings) (DE-FE0013889)

Texas A&M University

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Chong, S.H. and Santamarina, J.C., (2016). "Soil Compressibility Models for Wide Stress Range." *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, v. 142, n. 6.

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Controls on Methane Expulsion During Melting of Natural Gas Hydrate Systems (DE-FE0010406)

University of Texas at Austin

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Flemings, P. B., (2013). "Controls on Methane Expulsion During Melting of Natural Gas Hydrate Systems: Topic Area 2," *Quarterly Research Performance Progress Report (Period Ending 12/31/2012)*. DOE Award No.: DE-FE0010406, January 2013.

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Fate of Methane Emitted From Dissociating Marine Hydrates: Modeling, Laboratory, and Field Constraints (DE-FE0013999)

Massachusetts Institute of Technology

Peer-Reviewed Publications

Brothers, D. S., Ruppel, C., Kluesner, J. W., ten Brink, U. S., Chaytor, J. D., Hill, J. C., Andrews, B. D. and Flores, C., (2014). "Seabed fluid expulsion along upper slope and outer shelf of the U. S. Atlantic continental margin," *Geophys. Res. Lett.*, doi: 10.1002/2013GL058048.

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Brothers, D. S., Ruppel, C. D., Kluesner, J. W., Chaytor, J. D., ten Brink, U. S., and Hill, J. C., (2013). "Pervasive evidence for seabed fluid expulsion on the U. S. Atlantic continental margin," *American Geophysical Union Fall Meeting*, San Francisco, CA, Dec. 9-13.

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Hydrate Evolution in Response to Ongoing Environmental Shifts (DE-FE0013565)

University of Oregon

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Mechanisms for Methane Transport and Hydrate Accumulation in Coarse-Grained Reservoirs (DE-FE0013919)

University of Texas at Austin

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Meazell, K., Flemings, P. B., Santra, M., and the UT-GOM2-01 Scientists (2018). Sedimentology of the clastic hydrate reservoir at GC 955, Gulf of Mexico. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

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You, K., Flemings, P.B. (2016). Methane Hydrate Formation in Thick Sand Reservoirs: Long-range Gas Transport or Short-range Methane Diffusion? Presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

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Characterizing the Response of the Cascadia Margin gas Hydrate Reservoir to Bottom Water Warming Along the Upper Continental Slope (DE-FE0013998)

University of Washington

Peer-Reviewed Publications

Johnson, H. P., Miller, U. K., Salmi, M. S., and Solomon, E. A., (2015). "Analysis of bubble plume distributions to evaluate methane hydrate decomposition on the upper continental slope," *Geophys. Geochem. Geosyst.*, v. 16, pp. 3825-3839, doi:10.1002/2015GC005955.

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***Borehole Tool for the Comprehensive Characterization of Hydrate-Bearing Sediments
(DE-FE0013961)***

Georgia Institute of Technology

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Impact of Clays on the Compressibility and Permeability of Sands During Methane Extraction from Gas Hydrate (DE-FE0028966)

Louisiana State University

Peer-Reviewed Publications

Cao, S.C., Jang, J., Jung, J., Waite, W.F., Collett, T.S., Kumar, P., 2018. 2D micromodel study of clogging behavior of fine-grained particles associated with gas hydrate production in NGHP-02 gas hydrate reservoir sediments. *Journal of Marine and Petroleum Geology*. <https://doi.org/10.1016/j.marpetgeo.2018.09.010>.

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Other Publications

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A Multi-scale Experimental Investigation of Flow Properties in Coarse-grained Hydrate Reservoirs during Production (DE-FE0028967)

University of Texas at Austin

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Meyer, D.W., Flemings, P.B., DiCarlo, D., You, K., Phillips, S.C., and Kneafsey, T.J. (2018), Experimental investigation of gas flow and hydrate formation within the hydrate stability zone. *Journal of Geophysical Research- Solid Earth* <https://doi.org/10.1029/2018JB015748>

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Flemings, P.B., (2017). "A Multi-scale Experimental Investigation of Flow Properties in Coarse-grained Hydrate Reservoirs during Production," *Quarterly Research Performance Progress Report* (Period Ending 9/30/17). DOE Award No.: DE-FE0028967. October 2017.

Flemings, P.B., (2018). "A Multi-scale Experimental Investigation of Flow Properties in Coarse-grained Hydrate Reservoirs during Production," *Quarterly Research Performance Progress Report* (Period Ending 12/31/17). DOE Award No.: DE-FE0028967. January 2018.

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Flemings, P.B., (2018). "A Multi-scale Experimental Investigation of Flow Properties in Coarse-grained Hydrate Reservoirs during Production," *Quarterly Research Performance Progress Report* (Period Ending 9/30/18). DOE Award No.: DE-FE0028967. October 2018.

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Chen, X., Espinoza, N., Verma, R., and Prodanovic, M., 2017. X-Ray Micro-CT Observations of Hydrate Pore Habit and Lattice Boltzmann Simulations on Permeability Evolution in Hydrate Bearing Sediments (HBS). Presented at the 2017 AGU Fall Meeting, December 11-15, 2017, New Orleans, LA.

Chen, X., D. Nicolas Espinoza, Nicola Tisato, Peter B. Flemings (2018). X-ray Computed Micro-Tomography Study of Methane Hydrate Bearing Sand: Enhancing Contrast for Improved Segmentation, Gordon Research Conference – Natural Gas Hydrate Systems, Galveston, TX

Chen, X., D. Nicolas Espinoza, Nicola Tisato, Rahul Verma, Masa Prodanovic, Peter B. Flemings, (2018). New Insights Into Pore Habit of Gas Hydrate in Sandy Sediments: Impact on Petrophysical and Transport Properties, Gordon Research Conference – Natural Gas Hydrate Systems, Galveston, TX

Dong, T., Lin, J. F., Flemings, P. B., Polito, P. J., 2016. Pore-scale study on methane hydrate dissociation in brine using micro-Raman spectroscopy. Presented at the 2016 Extreme Physics and Chemistry workshop, Deep Carbon Observatory, Palo Alto, Calif., 10-11 Dec.

Dong, T., Lin, J.-F., Flemings, P.B., Gu, J.T., Liu, J., Polito, P.J., O'Connell, J. (2017) Pore-scale study on gas hydrate formation and dissociation under relevant reservoir conditions of the Gulf of Mexico, presented at the 2017 Extreme Physics and Chemistry workshop, Deep Carbon Observatory, November 4-5, Tempe, AZ.

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Dong, T., Lin, J.-F., Flemings, P.B., Gu, J.T., Polito, P.J., O'Connell, J. (2018), Pore-scale methane hydrate dissociation in porous media using Raman spectroscopy and optical imaging, poster presented at Gordon Research Conferences on Natural Gas Hydrate Systems, Feb. 25-March 2, 2018, Galveston, TX.

Lin, J. F., Dong, T., Flemings, P. B., Polito, P. J., 2017. Characterization of methane hydrate reservoirs in the Gulf of Mexico, presented at the Third Deep Carbon Observatory International Science Meeting, St. Andrews, Scotland, 23-25, March.

Murphy, Z., Fukuyama, D., Daigle, H., DiCarlo, D. (2018), Relative permeability of hydrate-bearing sediment, poster presented at Gordon Research Conference on Natural Gas Hydrate Systems, Feb. 25-Mar. 2, 2018, Galveston, TX.

Phillips, S.C., You, K., Flemings, P.B., Meyer, D.W., and Dong, T., 2017. Dissociation of laboratory-synthesized methane hydrate in coarse-grained sediments by slow depressurization. Poster presented at the 9th International Conference on Gas Hydrates, June 25-30, 2017, Denver, CO.

Xiongyu Chen, D. Nicolas Espinoza, Nicola Tisato, Peter B. Flemings (2018). X-ray Computed Micro-Tomography Study of Methane Hydrate Bearing Sand: Enhancing Contrast for Improved Segmentation, Gordon Research Conference – Natural Gas Hydrate Systems, Galveston, TX

Xiongyu Chen, D. Nicolas Espinoza, Nicola Tisato, Rahul Verma, Masa Prodanovic, Peter B. Flemings, (2018). New Insights Into Pore Habit of Gas Hydrate in Sandy Sediments: Impact on Petrophysical and Transport Properties, Gordon Research Conference – Natural Gas Hydrate Systems, Galveston, TX

Characterizing Ocean Acidification and Atmospheric Emission Caused by Methane Released from Gas Hydrate Systems along the US Atlantic Margin (DE-FE0028980)

University of Rochester

Peer-Reviewed Publications

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Kessler, J.D., 2017. "Characterizing Ocean Acidification and Atmospheric Emission Caused by Methane Released from Gas Hydrate Systems along the US Atlantic Margin," *Quarterly Research Performance Progress Report* (Period Ending 12/2016). DOE Award No.: DE-FE0028980. March 2017.

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Section IV: Publications Resulting from Work with the Dept. of Energy's National Labs

Additional publications produced by the National Labs in association with the Program's major field projects are included within Section II.

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Section V: Publications Resulting from Interagency Agreements

Additional publications by agencies are included under major field projects where appropriate.

Department of Defense, Office of Naval Research, Naval Research Lab

Peer-Reviewed Publications

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