

Lucy Tingwei Ko

Professional Summary

December 4, 2023

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Professional Preparation

Academic Background

Ph.D., Department of Geosciences, Jackson School of Geosciences, The University of Texas at Austin, May 2017

M.S., Department of Geology and Geological Engineering, Colorado School of Mines, December 2010

M.S., Department of Geosciences, National Taiwan University, June 2007

B.S., Department of Geosciences, National Taiwan University, June 2005

Professional Appointments

BEG STARR Barnett Core Workshop Organizer, State of Texas Advanced Oil and Gas Resource Recovery (STARR) (November 2021)

Organize a whole-day technical presentations and core workshops for the STARR partner

Session Chair, GeoGulf (August-October 2021)

Session Chair: Session 3: Unconventional Plays in An Evolving Energy Landscape, GeoGulf, 2021

Session Chair, American Association of Petroleum Geologists (AAPG) (January-September 2021)

Session Chair, Annual Convention & Exhibition of American Association of Petroleum Geologists, Siliciclastic Systems: Controls on Reservoir Quality and Rock Property Trends, 2021

Session Chair, American Association of Petroleum Geologists (AAPG) (January-September 2021)

Session Chair, Annual Convention & Exhibition of American Association of Petroleum Geologists, Unconventional Resources: Characterization of Unconventional Carbonate Reservoirs, 2021

Session Chair, American Association of Petroleum Geologists (AAPG) (January-September 2021)

Session Chair, Annual Convention & Exhibition of American Association of Petroleum Geologists, Unconventional Resources: Global Unconventional Plays, 2021

Theses

Depositional, mineralogical, and maturity controls on pore types, porosity, and pore-size distribution in mudrocks, The University of Texas at Austin, 2017, 354 p.

Characterization of gas generated by sequential hydrous pyrolysis of potential gas-prone source rocks for tight-gas reservoirs in the Rocky Mountain area, Colorado School of Mines, 2010, 203 p.

MS thesis: The effect of clay minerals on biomarker fractionation during secondary migration, National Taiwan University, 2007, 112 p.

Dissertations

Depositional, mineralogical, and maturity controls on OM pores and mineral pores in mudrocks, Jackson School of Geosciences, The University of Texas at Austin, 2017, 354 p.

Areas of Expertise

Areas of Expertise

Unconventional reservoir characterization, petrography, organic and gas geochemistry, diagenesis, biomarker, basin modeling, PVT, wireline-log interpretation/correlation, stratigraphy, sequence stratigraphy, sedimentology

Awards

Awards and Honorary Societies

Presentation Award at 2016 CAPA Petroleum and Petrochemical Technical Symposium, 2016

Best Poster Award at HGS Mudrocks Conference AGS, 2015

Presentation Award at 2014 CAPA Petroleum and Petrochemical Technical Symposium, 2014

Jackson School of Geosciences Merit Scholarship, ConocoPhillips Fellowship, 2011-2012

Service

University Committees

Committee member, Hiring and interviewing committee member for BEG Organic Geochemist Research Associate, Bureau of Economic Geology, Bureau of Economic Geology, November 7, 2022-January 1, 2023

Committee member, STARR Cisco Strawn Postdoc Search and Hiring Committee, Bureau of Economic Geology, Bureau of Economic Geology, July 19-September 1, 2022

Committee member, Hiring and interviewing committee member for BEG Third Floor Administrative Associate (2nd round), Bureau of Economic Geology, Austin, Tex., September 30-October 28, 2021

Host, Bureau Seminar Series, Bureau of Economic Geology, September 1, 2020-May 31, 2021

Committee Member, STARR (State of Texas Advanced Resource Recovery) Principal Investigator Hiring & Search Committee, Bureau of Economic Geology, September 2020-January 2021

Committee Member, Scanning Electron Microscopy Technician Hiring & Search Committee, Bureau of Economic Geology, 2019

External Committees Participation

Spackman award committee for The Society of Organic Petrography (TSOP), Spackman award committee for The Society of Organic Petrography (TSOP), The Society of Organic Petrography (TSOP), Reviewing, ranking, and providing recommendations for Spackman Award nomination, January 1, 2022-December 31, 2023

TSOP Spackman Award Committee, I was nominated as a third member of the 2022 TSOP Spackman Award Committee. Voting membership on the committee is a three-year term, with moving up to the 2nd position in 2023, and the senior position in 2024. In 2025 I will be the non-voting Chair, responsible for providing the members with the applications, adding up the scores, submitting TSOP Council the scores of the two top applicants for approval, and notifying the winners., The Society of Organic Petrography (TSOP), September 10, 2021-September 9, 2023

Review Editor, Serve in the Editorial Board of Economic Geology (specialty section of Frontiers in Earth Science), Frontiers in Earth Science, As a review editor I will play an integral role in our collaborative peer review, working with authors and editors to improve the quality of manuscripts submitted to the journal., November 3, 2022-Present

Committee Chair, Committee Chair, Tight Oil and Gas (TOG) Technical Committee, American Association of Petroleum Geologists (AAPG) Energy Mineral Division (EMD), American Association of Petroleum Geologists (AAPG), September 30, 2021-August 31, 2022

Committee Chair, Tight Oil and Gas (TOG) Technical Committee, American Association of Petroleum Geologists (AAPG) Energy Mineral Division (EMD), October 1, 2020-September 31, 2021

Committee Vice-Chair, American Association of Petroleum Geologists (AAPG) Energy Mineral Division (EMD) Tight Oil and Gas (TOG) Technical Committee, AAPG EMD, The duties of committee vice-chairs are mainly to help the committee chair conduct the work of the committee, which includes preparing an annual report for EMD, compiling summaries from contributors to the annual commodity report, updating information on the committee webpage, and otherwise providing opportunities for EMD and AAPG membership to learn about the status of tight oil and gas resources through special sessions at conferences, contributions to AAPG publications, and other outlets like webinars, field trips, and training courses., October 15, 2019-September 31, 2020

Teaching and Advising

Continuing Education Courses Taught

MSRL 2021 Core Workshop Presenter and Organizer: presented to MSRL members, presented at 2021 MSRL Core Workshop, Houston Core Research Center, December 7, 2021.

Student Committee Participation

PhD, Dissertation committee member, Charlie Yu-Chen Zheng, The University of Texas at Austin, Jackson School of Geosciences, 2021

Presentations

Invited Presentations

Depositional, Mineralogical, and Maturity Controls on OM-rich Shale/Mudrock/Mudstone Systems: presented to AAPG Student Chapter, the University of Manchester, England, Online oral presentation (UK), April 29, 2021.

Chemical and Carbon Isotopic Gas Compositions from The Wolfcamp in Permian Basin and Their Geological Significance: presented to Goldschmidt Virtual 2020, presented at Unconventional Shale Reservoirs (08o), Virtual conference meeting, June 21-26, 2020.

Facies, Depositional Environments, Chemostratigraphy, and Reservoir Quality of the Middle Devonian Marcellus Formation, Appalachian Basin, Northeastern Pennsylvania: presented to Houston Geological Society, presented at Houston Geological Society Northsiders' Luncheon, Houston, Tex., September 17, 2019.

How Depositional Environment, Diagenesis, and Thermal Maturity Affect the Evolution and Significance of Organic and Mineral Pore Systems in Unconventional Oil and Gas Reservoirs: Current Understanding and Future Research: presented at AAPG Hedberg Conference, Houston, Texas, March 4-May 6, 2019.

Presentations

Lithologic response to OAE2 across the drowned Comanche Platform, South Texas: presented to GCSSEPM Foundation, presented at 38th Annual Perkins-Rosen Research Conference, Houston, Tex., December 5-9, 2022.

Verification of Measured Porosity and Permeability using SEM Micropetrography in the Mississippian Barnett Shale, Wise and Denton Co., Texas: presented to Tight Oil Resource Assessment (TORA), presented at TORA Annual Meeting and Technical Conference, Austin, Texas, November 6-7, 2022.

Water Saturation, Porosity & Permeability, Wettability in the Mississippian Barnett Shale, Wise and Denton Co., TX: presented to BKV STARR, Austin, Tex., August 22, 2022.

Targeting the Leonardian Basinal Bone Spring Carbonates in the Southern Delaware Basin: Example from Upper 2nd Lime, Pecos Co., TX: presented to Unconventional Resources Technology Conference (URTeC), presented at 2022 Unconventional Resources Technology Conference (URTeC), Houston, Texas, June 20-22, 2022.

Comparative studies of gas geochemistry and oil migration in 3rd Bone Spring and Wolfcamp A, Delaware Basin: presented to MSRL consortium members, presented at MSRL Annual Meeting, Houston, Tex., April 11-12, 2022.

Facies and Associated Reservoir Quality of the 3rd Bone Spring Siliciclastics & Wolfcamp A and B, Pecos Co., southern Delaware Basin, west Texas: presented to MSRL consortium members, presented at MSRL Annual Meeting, Houston, Tex., April 11-12, 2022.

Facies and Associated Reservoir Quality of the Basinal Leonardian 2nd and 3rd Bone Spring Carbonates, Delaware Basin, west Texas: presented to MSRL consortium members, presented at MSRL Annual Meeting, Houston, Tex., April 11-12, 2022.

Informing drill cuttings analysis with core-based measurements - a cost effective approach to expand reservoir characterizations where core is unavailable: presented to MSRL consortium members, presented at MSRL Annual Meeting, Houston, Tex., April 11-12, 2022.

Informing drill cuttings analysis with core-based measurements - a cost effective approach to expand reservoir characterizations where core is unavailable: presented to 2022 MSRL Annual Meeting, Houston, Tex., April 11-12, 2022.

Mobile oil estimate with integrated method of geochemistry and N₂ adsorption in mudrocks of 3rd Bone Spring Sand and Wolfcamp X, Delaware Basin: presented to MSRL consortium members, presented at MSRL Annual Meeting, Houston, Tex., April 11-12, 2022.

Pore Systems and Diagenesis of the Basinal Leonardian 2nd and 3rd Bone Spring Carbonates, Delaware Basin, west Texas: presented to MSRL consortium members, presented at MSRL Annual Meeting, Houston, Tex., April 11-12, 2022.

Shale wettability: untangling the elusive property with an integrated imbibition and imaging technique: presented to MSRL consortium members, presented at MSRL Annual Meeting, Houston, Tex., April 11-12, 2022.

Possible Sources and Migration Pathway (Petroleum System) of the Pennsylvanian (Desmoinesian) Strawn Group: presented to Carr Resources, presented at STARR internal meeting, Austin, Tex., March 24, 2022.

Case Study: Reservoir Characterization of Mississippian Barnett Shale, Fort Worth Basin, Texas, United States: presented to PetroChina RIPED and Sinopec, presented at MSRL Advanced Short Course, Online oral presentation, December 15, 2021.

Characteristics of the Leonardian Second Bone Spring Sand and Third Bone Spring Lime, Reeves County, southern Delaware Basin, Texas: presented to MSRL members, presented at 2021 MSRL Core Workshop, Houston Core Research Center, December 7, 2021.

Characteristics of the Leonardian Third Bone Spring Lime, Reeves County, southern Delaware Basin, Texas: presented to MSRL members, presented at 2021 MSRL Core Workshop, Houston Core Research Center, December 7, 2021.

Chemostratigraphy and Reservoir Quality of the Lower Barnett in FS Range Cored Well

(Oil/Condensate Window), Wise Co., TX: presented to BKV Corp., presented at STARR Barnett Core Workshop, Bureau of Economic Geology, November 9, 2021.

Petroleum System of the Pennsylvanian (Desmoinesian) Strawn Group: presented to STARR partners, presented at STARR Strawn Core Workshop, Austin Core Research Center, October 26, 2021.

Integrating lithofacies and chemofacies characterizations for the Permian Basin Wolfcamp XY and Third Bone Spring Formation, Delaware Basin, Texas: presented to American Association of Petroleum Geologists (AAPG-ACE), Denver, Colorado, October 2021.

Benthic Oxygenation History of South Texas during the Austin Chalk Group Deposition: An Integrated Ichnologic, Sedimentological, and Geochemical Study: presented to AAPG, presented at International Meeting for Applied Geoscience & Energy (IMAGE), poster presentation, September 27-29, 2021.

Integrating lithofacies with geochemical and petrophysical properties of the Tithonian-Valanginian Vaca Muerta Fm., central Neuquén Basin, Argentina: presented to AAPG, presented at International Meeting for Applied Geoscience & Energy (IMAGE), Online oral presentation, September 27-29, 2021.

Organic geochemical characterization of Upper Wolfcamp and 3rd Bone Spring Formation, Delaware Basin: presented to AAPG, presented at International Meeting for Applied Geoscience & Energy (IMAGE), oral presentation, September 27-29, 2021.

Diagenesis of the Upper Cretaceous Eagle Ford Group in South Texas and Its Relationships to Rock Properties and its Pore Networks: presented at GeoConvention, Online oral presentation, September 13-15, 2021.

Chemical and Carbon Isotopic Gas Compositions from The Wolfcamp in Midland Basin and Their Significance as Geochemical Tracers for Well Completion: presented to AEC 2020, presented at Theme 5: Permian Basin Unconventional Plays In Memory of Stephen C. Ruppel II, online Zoom meeting, September 29-October 1, 2020.

Oil Recovery by Water Imbibition and Wettability in Shale: presented to MSRL members, presented at Mudrock Systems Research Laboratory Annual Meeting, Austin, TX, April 8-10, 2020.

Activities of a Professional Nature

Professional Societies

American Association of Petroleum Geologists (AAPG)

Activities of a Professional Nature

Judge for JSG Student Graduate Research Symposium (March 26, 2022)

Publications

Peer Reviewed Journal Articles

Peng, S., Shevchenko, P., and Ko, L. T., 2023, Shale wettability: untangling the elusive property with an integrated imbibition and imaging technique and a new hypothetical theory: SPE Reservoir Evaluation & Engineering, v. 26, no. SPE-212276-PA, p. 40-50, <http://doi.org/10.2118/212276-PA>.

Bhattacharya, S., Ambrose, W., Ko, L. T., and Casey, B., 2022, Integrated detection and investigation of bad borehole section in the Wolfcamp Formation in the Midland Basin using machine learning, petrophysics, and core characterization: Interpretation, v. 10, no. 3, p. C19-C27, <http://doi.org/10.1190/INT-2021-0165.1>.

Loucks, R. G., Peng, S., Hattori, K. E., Periwai, P., Lambert, J. R., Zahm, C. K., and Ko, L. T., 2022, Depositional systems, lithofacies, and reservoir characterization of the Upper Cretaceous

Austin Chalk, Brookeland and Burr Ferry fields in East Texas and western Louisiana: *GCAGS Journal*, v. 11, p. 37-57.

Davletshin, A., Ko, L. T., Milliken, K., Periwai, P., Wang, C.-C., and Song, W., 2021, Detection of framboidal pyrite size distributions using convolutional neural networks: *Marine and Petroleum Geology*, v. 132, no. 105159, 11 p., <http://doi.org/10.1016/j.marpetgeo.2021.105159>.

Loucks, R. G., Reed, R. M., Ko, L. T., Zahm, C. K., and Larson, T. E., 2021, Micropetrographic characterization of a siliciclastic-rich chalk; Upper Cretaceous Austin Chalk Group along the onshore northern Gulf of Mexico, USA: *Sedimentary Geology*, v. 412, no. 105821, 19 p., <http://doi.org/10.1016/j.sedgeo.2020.105821>.

Zhang, T., Fu, Q., Sun, X., Hackley, P. C., Ko, L. T., and Shao, D., 2021, Meter-scale lithofacies cycle and controls on variations in oil saturation, Wolfcamp A, Delaware and Midland Basins: *AAPG Bulletin*, v. 105, no. 9, p. 1821-1846, <http://doi.org/10.1306/01152120065>.

Loucks, R. G., Larson, T. E., Zheng, C. Y. C., Zahm, C. K., Ko, L. T., Sivil, J. E., Peng, S., Ruppel, S. C., and Ambrose, W. A., 2020, Geologic characterization of the type cored section for the Upper Cretaceous Austin Chalk Group in southern Texas: a combination fractured and unconventional reservoir: *AAPG Bulletin*, v. 104, no. 10, p. 2209-2245, <http://doi.org/10.1306/04222019197>.

Reed, R. M., Loucks, R. G., and Ko, L. T., 2020, Scanning electron microscope petrographic differentiation among different types of pores associated with organic matter in mudrocks: *GCAGS Journal*, v. 9, p. 17-27.

Shao, D., Zhang, T., Ko, L. T., Li, Y., Yan, J., Zhang, L., Luo, H., and Qiao, B., 2020, Experimental investigation of oil generation, retention, and expulsion within Type II kerogen-dominated marine shales: insights from gold-tube nonhydrous pyrolysis of Barnett and Woodford Shales using miniature core plugs: *International Journal of Coal Geology*, v. 217, no. 103337, 16 p., <http://doi.org/10.1016/j.coal.2019.103337>.

Shao, D., Zhang, T., Ko, L., Luo, H., and Zhang, D., 2019, Empirical plot of gas generation from oil-prone marine shales at different maturity stages and its application to assess gas preservation in organic-rich shale system: *Marine and Petroleum Geology*, v. 102, p. 258-270, <http://doi.org/10.1016/j.marpetgeo.2018.12.044>.

Ko, L., Ruppel, S. C., Loucks, R. G., Hackley, P. C., Zhang, T., and Shao, D., 2018, Pore-types and pore-network evolution in Upper Devonian-Lower Mississippian Woodford and Mississippian Barnett mudstones: insights from laboratory thermal maturation and organic petrology: *International Journal of Coal Geology*, v. 190, p. 3-28, <http://doi.org/10.1016/j.coal.2017.10.001>.

Naraghi, M. E., Javadpour, F., and Ko, L., 2018, An object-based shale permeability model: non-Darcy gas flow, sorption, and surface diffusion effects: *Transport in Porous Media*, v. 125, p. 23-39, <http://doi.org/10.1007/s11242-017-0992-z>.

Ko, L. T., Loucks, R. G., Ruppel, S. C., Zhang, T., and Peng, S., 2017, Origin and characterization of Eagle Ford pore networks in the south Texas Upper Cretaceous shelf: *AAPG Bulletin*, v. 101, no. 3, p. 387-418, <http://doi.org/10.1306/08051616035>.

Ko, L., Loucks, R. G., Milliken, K., Liang, Q., Zhang, T., Sun, X., Hackley, P. C., Ruppel, S. C., and Peng, S., 2017, Controls on pore types and pore-size distribution in the Upper Triassic Yanchang Formation, Ordos Basin, China: implications for pore-evolution models of lacustrine mudrocks: *Interpretation*, v. 5, no. 2, p. SF127-SF148, <http://doi.org/10.1190/INT-2016-0115.1>.

Ko, L., Loucks, R. G., Zhang, T., Ruppel, S. C., and Shao, D., 2016, Pore and pore network evolution of Upper Cretaceous Boquillas (Eagle Ford-equivalent) mudrocks: Results from gold tube pyrolysis experiments: *AAPG Bulletin*, v. 100, no. 11, p. 1693-1722, <http://doi.org/10.1306/04151615092>.

Milliken, K., Ko, L., Pommer, M., and Marsaglia, K. M., 2014, SEM Petrography of Eastern Mediterranean sapropels: analogue data for assessing organic matter in oil and gas shales: *Journal of Sedimentary Research*, v. 84, p. 961-974, <http://doi.org/10.2110/jsr.2014.75>.

Peer Reviewed Book Chapters

Suriamin, F., and Ko, L. T., 2022, Geological characterization of unconventional shale-gas reservoirs, in Moghanloo, R. G., *Unconventional shale gas development--lessons learned* (ch. 2): Cambridge, MA, Gulf Professional Publishing, Elsevier, p. 33-70, <http://doi.org/10.1016/B978-0-323-90185-7.00006-6>.

Conference Proceedings

Ko, L., Larson, T., Martinez, D., Roger, S., Periwai, P., and Sivil, J. E., 2022, Targeting the Leonardian Bone Spring limestone in the Southern Delaware Basin: Example from upper 2nd limestone, Pecos County, West Texas, *Unconventional Resources Technology Conference (URTeC)*, Unconventional Resources Technology Conference, 20-22 June 2022, Houston, Texas, 1215-1222 p.

Peng, S., Liu, Y., Ko, L., and Ambrose, W. A., 2019, Water/Oil Displacement by Spontaneous Imbibition through Multiscale Imaging and Implication on Wettability in Wolfcamp Shale, *Unconventional Resources Technology Conference*, Denver, Colo.

Published Reports

Moscardelli, L., Ambrose, W. A., Young, M. H., Scanlon, B. R., Flaig, P. P., Olariu, M. I., Hattori, K., Ko, L., Loucks, R. G., Radjef, E., Maraggi, L., Schuba, N., Sivil, J. E., Peng, S., Zhang, T., Sun, X., Zeng, H., Ogiesoba, O. C., Fu, Q., Reed, R. M., Rogers, H., Duncan, I. J., Dommissie, R., Jensen, J., Hessler, A., DeJarnett, B. B., and Periwai, P., 2023, *State of Texas Advanced Resource Recovery (STARR) 2020-2022 biennium report: The University of Texas at Austin, Bureau of Economic Geology* 51 p.

Ambrose, W. A., Rogers, H., Smith, D. C., Scanlon, B. R., Paine, J. G., Nicot, J.-P., Young, M. H., Loucks, R. G., Hentz, T. F., Reed, R. M., Ogiesoba, O. C., Olariu, M. I., Fu, Q., Flaig, P. P., Zhang, J., Hattori, K., Roberts, A., Zeng, H., DeJarnett, B. B., Radjef, E., Periwai, P., Peng, S., Duncan, I. J., Ren, B., Jensen, J., Male, F., Dommissie, R., Eastwood, R., Carr, D. L., Zhang, T., Ko, L., Larson, T., Lawton, T., Covault, J., Sylvester, Z., Goodman, E., Calle, A., Smye, K. G., Pelletier, I., Dunlap, D. B., Lambert, J., and Sivil, J. E., 2021, *State of Texas Advanced Resource Recovery (STARR) 2018-2020 biennium report: The University of Texas at Austin, Bureau of Economic Geology* 44 p.

Ambrose, W. A., Smith, D. C., Hentz, T. F., Loucks, R. G., Reed, R. M., Ogiesoba, O. C., Olariu, M. I., Fu, Q., Zeng, H., Hamlin, H. S., Duncan, I. J., Carr, D. L., Ko, L., Peng, S., Jensen, J., Rogers, H., Cliff, S. J., Sivil, J. E., Zhang, T., Eastwood, R., and Brooks, D. L., 2019, *State of Texas Advanced Resource Recovery (STARR) progress report: The University of Texas at Austin, Bureau of Economic Geology* 43 p.

Ambrose, W. A., Smith, D. C., Hentz, T. F., Loucks, R. G., Reed, R. M., Ogiesoba, O. C., Olariu, M. I., Fu, Q., Zeng, H., Hamlin, H. S., Duncan, I. J., Carr, D. L., Ko, L., Peng, S., Rogers, H., Cliff, S. J., Sivil, J. E., Zhang, T., Eastwood, R., and Brooks, D. L., 2018, *State of Texas Advanced Resource Recovery (STARR) interim report: Bureau of Economic Geology, The University of Texas at Austin*, 26 p.

Workshop Workbooks

Flaig, P. P., Hattori, K., Ambrose, W. A., Fu, Q., DeJarnett, B. B., Ko, L., Radjef, E., Carr, D. L., Hasiotis, S., Ogiesoba, O. C., and Moscardelli, L., 2021, *Core Workshop: Mixed Carbonate-Siliciclastic Reservoir Systems of the Strawn Group: Focus - Upper Strawn, King and Stonewall Counties, Texas: STARR*.

Published Abstracts

Davletshin, A., Ko, L., Milliken, K., Periwal, P., Wang, C.-C., and Song, W., 2022, Object detection in SEM images using CNN: Geological application on size distribution of pyrites in Mudrocks (abs.): *Microscopy and Microanalysis*, Cambridge University Press, v. 28, no. S1, p. 2964-2965.

Davletshin, A., Ko, L., Milliken, K., Periwal, P., Wang, M. C.-C., and Song, W., 2020, Object detection in SEM images using convolutional neural networks: application on pyrite framboid size-distribution in fine-grained sediments (abs.): *American Geophysical Union Fall Meeting Abstracts*, v. 2020, p. IN028-07.

Ko, L., Loucks, R. G., and Adriaens, R., 2020, Diagenesis of the Upper Cretaceous Eagle Ford Group in South Texas and its relationships to rock properties and its pore networks (abs.): *American Association of Petroleum Geologists Annual Conference and Exhibition 2020 Technical Program*.

Reed, R. M., Loucks, R. G., and Ko, T. L., 2020, Differentiation among different types of pores associated with organic matter in mudrocks using scanning electron microscope petrography (abs.): *Geological Society of America Abstracts with Programs*, v. 52, no. 6, paper no. 217-5, <http://doi.org/10.1130/abs/2020AM-352717>.

Ko, L., Larson, T., and Sivil, J. E., 2019, Facies, depositional environments, chemostratigraphy, and reservoir quality of the Middle Devonian Marcellus Formation, Appalachian Basin, northeastern Pennsylvania (abs.): *American Association of Petroleum Geologists Annual Convention and Exhibition (AAPG ACE)*, San Antonio, Texas, May 20.

Ko, L., Zhang, T., Hackley, P. C., Loucks, R. G., and Wu, C., 2019, Pore characteristics in refractory kerogen vs. solid bitumen and pore systems in the dry-gas window Marcellus Formation, Appalachian Basin, northeastern Pennsylvania (abs.): *American Association of Petroleum Geologists Annual Convention and Exhibition (AAPG ACE)*, San Antonio, Texas, May 21, 1 p.

Loucks, R. G., Reed, R. M., Ko, L. T., Birdwell, J., Paxton, S. T., Whidden, K. J., and Hackley, P., 2019, Insights into early reservoir development of the Upper Cretaceous Eagle Ford Group and Pepper Shale from observations of the USGS Gulf Coast #1 West Woodway Low-Ro research core in McLennan County, Central Texas (abs.): *GeoGulf Transactions*, v. 69, p. 551-552.